MIDSTREAM OPERATIONS - ENVIRONMENT

WEED MANAGEMENT PLAN

Scope and application

This management plan addresses the objectives and performance criteria, management measures, and monitoring, auditing, and corrective action requirements relating to weed management for the Queensland Curtis LNG Facility on Curtis Island during operations.

Management measures and reporting and auditing requirements specified, are intended to ensure compliance with the requirements of the Environmental Authority (EA) for Petroleum Facility Licence (PFL) 11 ( Permit Number EPPG00711513), and other relevant approvals, applicable under Queensland and Commonwealth legislation.

This document applies to operation of the LNG Facility following handover of the site from Bechtel to QGC. It addresses weeds within the disturbed areas of the bounds of PFL11 on Curtis Island.

Contents

1.0 Summary of Responsibilities ................................................................. 3
2.0 Structure ........................................................................................................ 4
3.0 Aspect ............................................................................................................... 4
   3.1 Mosquitos ..................................................................................................... 4
4.0 Objective ........................................................................................................... 5
5.0 Performance Criteria ....................................................................................... 6
   5.1 Legislation and Standards ........................................................................... 6
   5.2 Performance Criteria ..................................................................................... 7
6.0 Management Measures ................................................................................. 7
7.0 Monitoring and Reporting ............................................................................. 9
8.0 Auditing .......................................................................................................... 9
9.0 Corrective Action ............................................................................................. 9
   Definitions ....................................................................................................... 10
   Acronyms and Abbreviations .......................................................................... 10
Appendix A Example Weed Inspection Certificate ............................................. 11
Appendix B Fact Sheets ....................................................................................... 13

Tables

Table 1 – Summary of Responsibilities ............................................................... 3
Table 2 – Structure ............................................................................................... 4
Table 3 – Management Measures .................................................................... 8
Table 4 – Monitoring and Reporting 9
Table 5 – Corrective Actions 9
1.0 Summary of Responsibilities

The following responsibilities apply for all personnel undertaking activities covered by this document.

Table 1 – Summary of Responsibilities

<table>
<thead>
<tr>
<th>Position</th>
<th>Management Responsibilities</th>
</tr>
</thead>
</table>
| QGC Central Environment Team / QGC Central Compliance Team | ▶ Undertake audits against the QGC Environmental Management System (EMS).  
▶ Manage third party auditing of the EA and Coordinator General (CG) Conditions.  
▶ Coordinate preparation and submission of Statutory Reporting including Annual Environmental Return and Annual Monitoring Report.  
▶ Communicate non-compliance with the EA to the Administering Authority. |
| LNG Operations HSSE Manager | ▶ Oversee the evaluation of compliance with environmental legislation and regulations, permits, licences and approvals.  
▶ Ensure this Management Plan is implemented and updated.  
▶ Oversee incident investigations and implementation of corrective actions. |
| Lead Environmental Advisor (LEA) / Superintendent Environment (title TBC for Ops) | ▶ Provide input into the Environmental Site Induction provided to all site staff and visitors.  
▶ Act as primary point of contact for site personnel for weed matters and any associated environmental incidents.  
▶ Coordinate and undertake routine surveys, regular monitoring, identification and treatment of weeds.  
▶ Undertake any required reporting associated with weed surveys and provide the results to the QGC Central Environment Team/QGC Central Compliance Team.  
▶ Initiate and participate in environmental incident investigations in conjunction with and as directed by the LNG Operations HSSE Manager.  
▶ Communicate incidences and non-compliance to the QGC Central Environment Team/QGC Central Compliance Team.  
▶ Collate environmental incident reports and associated regulatory notifications for submission to the QGC Central Environment Team/QGC Central Compliance Team for review and transmission to the administering authority.  
▶ Monitor the implementation of the management measures and identify corrective actions.  
▶ Coordinate with QGC Central Environment Team/QGC Central Compliance Team, Site Management and LNG Operations HSSE Manager on weed management issues.  
▶ Communicate the need for corrective actions to the QGC Central Compliance Team/QGC Central Compliance Team, Production Manager and LNG Operations HSSE Manager.  
▶ Interact with Administering Authority as directed by the QGC Central Environment Team/QGC Central Compliance Team.  
▶ Participate in audits against the QGC EMS.  
▶ Facilitate site aspects of third party auditing of the EA and CG Conditions. |
2.0 Structure

The body of this environmental procedure follows the structure outlined below:

Table 2 – Structure

<table>
<thead>
<tr>
<th>Section</th>
<th>Heading</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.0</td>
<td>Summary of Responsibilities</td>
<td>Summary of responsibilities for all personnel undertaking activities covered by this document</td>
</tr>
<tr>
<td>2.0</td>
<td>Structure</td>
<td>This section, summarising document structure</td>
</tr>
<tr>
<td>3.0</td>
<td>Aspect</td>
<td>How aspects of the activity phases are to be managed (as it affects environmental and social values).</td>
</tr>
<tr>
<td>4.0</td>
<td>Objective</td>
<td>The Activity policy or management objective that applies to each element.</td>
</tr>
<tr>
<td>5.0</td>
<td>Performance Criteria</td>
<td>Measurable performance criteria (outcomes) for each element of each Activity phase.</td>
</tr>
<tr>
<td>6.0</td>
<td>Management Measures</td>
<td>The strategies, tasks or action program (to nominated operational design standards) that will be implemented to achieve the performance criteria.</td>
</tr>
<tr>
<td>7.0</td>
<td>Monitoring and Reporting</td>
<td>The monitoring requirements to measure actual performance (i.e. specified limits to pre-selected indicators of change). Format, timing and responsibility for reporting and auditing of monitoring results.</td>
</tr>
<tr>
<td>8.0</td>
<td>Auditing</td>
<td>The auditing requirements to demonstrate implementation of agreed environmental management strategies and compliance with agreed performance criteria.</td>
</tr>
<tr>
<td>9.0</td>
<td>Corrective Action</td>
<td>The action (options) to be implemented in case a performance requirement is not reached and the person responsible for that action (including staff authority, responsibility and management structure).</td>
</tr>
</tbody>
</table>

3.0 Aspect

3.1 Mosquitos

Baseline field surveys, which were undertaken as part of the Environmental Impact Statement (EIS), identified the presence of the following weeds within the boundary of PFL 11:

- Declared weeds as per the Weeds of National Significance as listed by Department of Sustainability, Environment, Water, Population and Communities (SEWPaC):
  - Cryptostegia grandiflora (Rubber Vine) Class 2.
  - Opuntia sp. (Prickly Pear) Class 2.
  - Lantana camara (Lantana) Class 3.
The most abundant of these was Prickly Pear, which was found to be most prevalent around the marine fringes.

- Non-declared weed as currently listed on the Alert List for Environmental Weeds collated by SEWPaC:
  - *Praxelis clematidea* (Praxelis)

Declared weeds that were not observed in the EIS field survey area, but nevertheless have preferred habitat within the study areas and will be monitored for, include:

- Giant Rat-tail Grass (*Sporobolus sp.*), a declared weed commonly found in the Gladstone area.
- Groundsel Bush (*Baccharis halimifolia*), which has the potential to occur on the site, particularly within areas of RE 12.3.3 (Blue Gum open woodland on alluvial plains), which is a preferred habitat.
- Singapore Daisy (*Sphagneticola trilobata*), a common garden plant that was observed during field studies in gardens and rocky headlands on the eastern side of Curtis Island.

The LNG Facility at Curtis Island encompasses approximately 275 ha above highest astronomical tide (HAT) with an additional indicative wet lease area (below HAT) of approximately 83 ha. Within the LNG Facility, the plant onshore construction footprint and spoil disposal areas, stormwater system, access and fire control roads, fencing and other minor works consists of approximately 176 ha of disturbed footprint.

Natural vegetation has been removed from the disturbance footprint, most of which will be covered by hardstand, with the spoil areas and boundary periphery hydro-mulched and batters stabilised with geoweb and filter rock. Weeds (as identified in the EIS) may gain a foothold in the disturbed areas and it is these areas that are managed by this Weed Management Plan.

The major source for introduction of new weeds at the LNG Facility will be vehicles and mobile. Other potential sources include packing materials that are contaminated with soil, prohibited or restricted seeds and other extraneous plant material.

The transport of weeds around the LNG Facility may be facilitated by use of vehicles and wind. It will be important for vehicles to remain on access and haul roads and for herbicidal weed control.

### 4.0 Objective

The environmental objective for weed management is:

- To prevent growth and proliferation of weeds.
- To prevent introduction of weed species as a results of operational activities.
5.0 Performance Criteria

5.1 Legislation and Standards

The performance criteria and implementation strategy has been developed in accordance with:

- *Environmental Protection Act 1994 (EP Act) (Qld).*
- *Environmental Protection Regulation 2008 (Qld).*
- Environmental Authority No. EPPG00711513.
- *Agricultural and Veterinary Chemicals Code Act 1994 (Cth).*
- *Agricultural and Veterinary Chemicals (Queensland) Code 1994.*
- *Agricultural Chemicals Distribution Control Act 1966.*

Guidelines/References include but are not limited to:

- **Strategic Plans and Management Guides:**
- **Fact Sheets:**
  - *Declared Class 2 Pest Plant – Giants Rat’s Tail Grass and other weedy Sporobolus species, Sporobolus pyramidalis, S. natalensis, S. Jacquemontii, S. fertilis and S. africanus,* Department of
5.2 Performance Criteria

The performance criteria and objectives for this management plan are as follows:

- Weeds are controlled within the LNG Facility.
- No increase in abundance or distribution of weed species as a result of operational activities.
- No introduction of weed species to Curtis Island as a result of project activities.

6.0 Management Measures

Table 3 presents management measures, monitoring and reporting requirements to be adopted during operation to meet the performance objectives and criteria for weed management.
**Table 3 – Management Measures**

<table>
<thead>
<tr>
<th>Performance Criteria</th>
<th>Management Action</th>
<th>Responsibility</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weeds are controlled within the LNG Facility.</td>
<td>Waste from ships is to be handled within the Quarantine Facilities. Waste Tracking is to be undertaken as per the <em>LNG Operations Waste Management Plan</em>.</td>
<td>Facilities Manager</td>
</tr>
<tr>
<td>No introduction of weed species as a result of project activities.</td>
<td>All vehicles, trucks, and plant to have been cleaned, including tyre treads, prior to arrival on Curtis Island.</td>
<td>Logistics Superintendent</td>
</tr>
<tr>
<td>No increase in abundance or distribution of weed species as a result of operational activities.</td>
<td>All vehicles and plant must be checked and certified as free of weeds prior to arrival on Curtis Island. Vehicle/Machinery Inspection Record is included in Appendix A.</td>
<td>Production Manager Maintenance Manager</td>
</tr>
<tr>
<td></td>
<td>Vehicels to remain on access roads and haul roads.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Avoid, minimise or mitigate any impacts on areas of native vegetation.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Inspect the hydromulch in the spoil area and geoweb and filter rock stabilised batters for weed infestation.</td>
<td>LEA</td>
</tr>
<tr>
<td></td>
<td>Coordinate management of weeds (either by spraying with herbicides as recommended in the fact sheets (Appendix B) or other appropriate measures), within the disturbed areas of the LNG Facility by Qualified Landscape Maintenance Contractors.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>LEA to be trained in the identification of weed species known to inhabit the area.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Weeds observed on site that are not included in this plan are to be inspected and identified by the LEA. Appropriate weed specific management measures are to be implemented and this management plan updated.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Packaging materials are not to consist of straw, hay, chaff or rice hulls.</td>
<td>Business Services Manager</td>
</tr>
</tbody>
</table>
7.0 Monitoring and Reporting

Monitoring and reporting is to be undertaken as specified in Table 4 below.

Table 4 – Monitoring and Reporting

<table>
<thead>
<tr>
<th>Monitoring Action</th>
<th>Reporting Action</th>
<th>Responsibility</th>
</tr>
</thead>
<tbody>
<tr>
<td>Undertake an inspection and provide a certificate, certifying that all vehicles, trucks and plant are weed free (Appendix A).</td>
<td>Maintain a register of certified vehicles and plant.</td>
<td>Logistics Superintendent</td>
</tr>
<tr>
<td>Inspect the site for weeds during routine site inspections.</td>
<td>Maintain a record of weed observations (location, type, area) and dates spraying occurred.</td>
<td>LEA</td>
</tr>
<tr>
<td>Conduct annual weed surveys of the LNG Facility to monitor location, abundance and diversity.</td>
<td>Survey report.</td>
<td></td>
</tr>
</tbody>
</table>

8.0 Auditing

QGC maintains an EMS in accordance with the international standard AS/NZS ISO 14001. The EMS must be regularly audited to ensure its continuing suitability, adequacy and effectiveness and meet QGC’s commitment to continual improvement.

Regular internal audits of the EMS are conducted, covering all activities within the scope of the QGC Asset EMS.

QGC will also ensure that a qualified third party auditor (accepted by the Administering Authority) undertakes compliance monitoring against the EA conditions within one (1) year of the completion of commissioning of the LNG Facility and every three years thereafter.

9.0 Corrective Action

Table 5 outlines corrective actions that have been identified should the weed management measures be inadequate.

Table 5 – Corrective Actions

<table>
<thead>
<tr>
<th>Corrective Action</th>
<th>Responsibility</th>
</tr>
</thead>
<tbody>
<tr>
<td>Revisit the management program should weeds be spreading and proliferating.</td>
<td>LEA</td>
</tr>
<tr>
<td>Contact supplier of goods if packaging materials consist of straw, hay, chaff or rice hulls.</td>
<td>Business Services Manager</td>
</tr>
</tbody>
</table>

Refer to Appendix A for example Certificate certifying vehicles, trucks and plant are weed free.

Auditing against relevant environmental legislation and regulations, environmental licences and permits will be undertaken.
Definitions

<table>
<thead>
<tr>
<th>Term</th>
<th>Meaning</th>
</tr>
</thead>
</table>

Acronyms and Abbreviations

<table>
<thead>
<tr>
<th>Acronym</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>DAFF</td>
<td>Department of Agriculture, Fisheries and Forestry</td>
</tr>
<tr>
<td>CG</td>
<td>Coordinator General</td>
</tr>
<tr>
<td>EA</td>
<td>Environmental Authority, and specifically the Environmental Authority for Petroleum Facility Licence PFL 11 (EPPG00711513)</td>
</tr>
<tr>
<td>EHP</td>
<td>Department of Environment and Heritage Protection, formerly Department of Environment and Resource Management (DERM)</td>
</tr>
<tr>
<td>EIS</td>
<td>Environmental Impact Statement</td>
</tr>
<tr>
<td>EMS</td>
<td>Environmental Management System</td>
</tr>
<tr>
<td>EP Act</td>
<td>Environmental Protection Act 1994 (Qld)</td>
</tr>
<tr>
<td>HAT</td>
<td>Highest Astronomical Tide</td>
</tr>
<tr>
<td>LEA</td>
<td>Lead Environmental Advisor</td>
</tr>
<tr>
<td>LNG</td>
<td>Liquefied Natural Gas</td>
</tr>
<tr>
<td>PFL</td>
<td>Petroleum Facility Licence</td>
</tr>
<tr>
<td>QGC</td>
<td>QGC – A BG Group business</td>
</tr>
<tr>
<td>QCLNG</td>
<td>Queensland Curtis LNG</td>
</tr>
<tr>
<td>SEWPaC</td>
<td>Department of Sustainability, Environment, Water, Population and Communities (Cth)</td>
</tr>
</tbody>
</table>
Appendix A Example Weed Inspection Certificate
# VEHICLE / MACHINERY HYGIENE INSPECTION REPORT

**Company Name:**

**Date:**

**Company Address:**

<table>
<thead>
<tr>
<th>Origin location:</th>
<th>Washdown Location:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Destination location:</td>
<td>GPS point for temporary washdown</td>
</tr>
</tbody>
</table>

**Make / Description of Heavy / GET / Other:**

<table>
<thead>
<tr>
<th>Model</th>
<th>Owner</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>VEHICLE</th>
<th>SEDAN / UTILITY</th>
<th>4X4 / COMMERCIAL</th>
<th>TRUCK</th>
<th>TRAILER</th>
<th>DOLL Y</th>
<th>HEAVY - SPECIFY</th>
<th>OTHER - SPECIFY</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rego or Chassis No.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

## CHECKLIST - VEHICLE / MACHINERY OR THING

<table>
<thead>
<tr>
<th>NOT YET CLEAN</th>
<th>CLEAN</th>
<th>NOT YET CLEAN</th>
<th>CLEAN</th>
<th>NOT YET CLEAN</th>
<th>CLEAN</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Interior</strong></td>
<td>Tyre Rims</td>
<td><strong>Buckets/ blades/ scoops</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Engine Bay</strong></td>
<td>Side Steps</td>
<td><strong>Machine tracks &amp; frame</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Grill</strong></td>
<td>Chassis Rails</td>
<td><strong>Hydraulic points</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Radiator</strong></td>
<td>Axle/ diffs</td>
<td><strong>Machine plates</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Wiper Recess</strong></td>
<td>Suspension</td>
<td><strong>Linkage attachment points</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Wheels &amp; Spares</strong></td>
<td>Fuel Tank Guards</td>
<td><strong>Attachments</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Wheel Arches</strong></td>
<td>Draw Bar</td>
<td><strong>Load</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Mud Flaps</strong></td>
<td>Toolboxes</td>
<td><strong>Other</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Description of Attachments / Load / Other:**

The vehicle/machinery detailed above has been inspected by a qualified Inspector and is deemed to be **CLEAN** to National Competency Standard when signed below.

**Inspection conducted at:**

**Inspector's Signature:**

**Inspector's Name:**

**Inspector's Certification No:**

**Clean Inspection Date:**

**Operator's Signature:**

**Operator's name:**

**Inspection Comments:**
Appendix B  Fact Sheets

- *Declared Class 3 Pest Plant - Singapore Daisy Sphagneticola trilobata*, Department of Agriculture, Fisheries and Forestry, 2013.
Prickly pear
Opuntia, Nopalea and Acanthocereus spp.

The introduction and spread of prickly pear into Queensland and New South Wales is one of the greatest environmental invasions of modern times.

Prickly pear was introduced into pastoral districts in the 1840s. By 1900, over 4 million hectares in Queensland and New South Wales was infested by prickly pear. By 1925, the pest had invaded over 24 million hectares. Control costs were prohibitive and the only effective herbicide at the time was hazardous. This resulted in landholders abandoning large tracts of land.

Research for biological control agents commenced in 1912, and in 1914 cochineal insects were released to control one of the minor prickly pear species. Control of this minor prickly pear species by these introduced insects occurred within a few years.

The success of the cochineal insects led to renewed efforts against other types of prickly pear in the 1920s. These efforts resulted in the control of the major pest prickly pear by the moth Cactoblastis cactorum; by the mid-1930s, prickly pear was no longer a major problem.

Several prickly pear species have since remained as minor weeds.
Prickly pear species considered pests in Queensland are:

- **Common pest pear** - *Opuntia stricta var. stricta* (= *O. inermis*)
- **Spiny pest pear** - *Opuntia stricta var. dillenii* (= *O. stricta*)
- **Tiger pear** - *Opuntia aurantiaca*
- **Drooping tree pear** - *Opuntia vulgaris* (= *O. monacantha*)
- **Velvety tree pear** - *Opuntia tomentosa*
- **Westwood pear** - *Opuntia streptacantha*
- **Devil’s rope pear** - *Opuntia imbricata*
- **Coral cactus** - *Opuntia cylindrica*
- **Snake cactus** - *Opuntia fulgida × O. imbricata*
- **Sword pear** - *Acanthocereus pentagonus*

**Description and general information**

‘Prickly pear’ is a general term used to describe some plants of the Cactaceae family. The term includes species of *Opuntia, Nopalea* and *Acanthocereus*. All of these plants originate in the Americas. The term ‘prickly pear’ also relates to the fruit, which is often spiny and pear-shaped. Plants are normally leafless succulent shrubs. Stems are divided into segments (pads or joints) that are flat and often incorrectly called leaves.

Young shoots have true leaves resembling small fleshy scales that fall off as the shoot matures.

Flowers are large, normally seen during spring and can be yellow, orange, red, pink, purple or white depending on the species. Prickly pear fruits vary between species and can be red, purple, orange, yellow or green.

Areoles (spots with clusters of spines) are found on both the pads (joints, segments) and fruit. In addition to spines, areoles often have clusters of sharp bristles (glochids) and tufts of fibre (‘wool’). Each areole contains a growing point that can produce roots or shoots.

**Life cycle**

Prickly pear species have several features that enable them to compete and become pests.

Prickly pear species are drought resistant because of their succulent nature, their lack of leaves and their thick, tough skins. These features result in plants that use the majority of their internal tissues for water storage and their outer parts to reduce water loss and damage by grazing and browsing animals. They can remain vigorous in hot, dry conditions that cause most other plants to lose vigour or even die. Some species develop underground bulbs that enable the plant to resist fire and mechanical damage.

Prickly pear species reproduce both sexually and asexually. Birds and other animals readily eat the many-seeded fruits and deposit seeds in their droppings. The seeds have hard seed coats that allow them to survive heat and lack of water. Asexual reproduction (cloning) of prickly pear occurs when pads (joints, segments) or fruits located on the ground take root and produce shoots. Animals and floods move broken pads long distances. These pads can survive long periods of drought before weather conditions allow them to set roots.

**Habitat and distribution**

Prickly pear species considered pests in Queensland are:

- **Common pest pear** - *Opuntia stricta var. stricta* (= *O. inermis*)
- **Spiny pest pear** - *Opuntia stricta var. dillenii* (= *O. stricta*)
- **Tiger pear** - *Opuntia aurantiaca*
- **Drooping tree pear** - *Opuntia vulgaris* (= *O. monacantha*)
- **Velvety tree pear** - *Opuntia tomentosa*
- **Westwood pear** - *Opuntia streptacantha*
- **Devil’s rope pear** - *Opuntia imbricata*
- **Coral cactus** - *Opuntia cylindrica*
- **Snake cactus** - *Opuntia fulgida × O. imbricata*
- **Sword pear** - *Acanthocereus pentagonus*
While this prickly pear once formed large-scale dense infestations, it is now found as small clumps or as scattered plants. These clumps are usually broken by the action of *Cactoblastis cactorum*. It is found in eastern central Queensland, the Burnett district, the Darling Downs and south-eastern Queensland.

**Tiger pear (Opuntia aurantiaca)**

This succulent low shrub with underground tubers usually grows 30–60 cm high. The stems are divided into very spiny, slightly flattened pads that are 1–30 cm long and 1–5 cm wide. The stems are dark green to purple and red in colour. The areoles have 3–7 brown barbed spines up to 4 cm long surrounded by tufts of short, fine bristles. The pads detach easily and are transported on the skins of animals. Small and scale-like leaves are found on areoles of immature pads.

Tiger pear produces 6 cm wide yellow flowers. The rarely formed fruits are pear-shaped and about 2.5 cm long. When ripe, they are red with purple markings.

Dense tiger pear forms an impenetrable spiny groundcover and is prevalent in southern Queensland but extends into central Queensland.

**Drooping tree pear (Opuntia vulgaris)**

This erect succulent shrub with fibrous roots grows up to 5 m high but is usually 2–3 m high. The branches are divided into glossy light green pads up to 45 cm long, 15 cm wide and 1.5 cm thick. The dark grey trunk grows up to 25 cm in diameter. Drooping tree pear gets its name because the upper segments tend to droop. The areoles on the older pads have 1–5 sharp spines about 5 cm long.

Small, scale-like leaves are found on areoles of very young pads and are quickly shed as the pads grow. Drooping tree pear produces yellow flowers that are 6 cm wide and have red markings on the back. The fruit is pear-shaped and 4–7 cm long with a green skin. The flesh of the fruit is red and pulpy and contains round seeds that are yellow or pale brown. The fruits have areoles with tufts of fine, barbed bristles.

Dense thickets result when drooping tree pear is allowed to grow freely. Small scattered infestations occur in the south-east corner of Queensland and in coastal northern Queensland.

**Velvety tree pear (Opuntia tomentosa)**

This tree-like plant forms a central woody trunk over 40 cm wide and grows up to 5 m high. The stems are divided into oblong pads that are dull green and velvety to touch due to the dense covering of short fine hairs. The pads are 15–35 cm long, 8–12 cm wide and 1.5–2 cm thick.

Young plants have 2–4 white or pale yellow spines located in the areoles with one spine reaching a length of 2.5 cm. The areoles usually become spineless as the plant matures. A more spiny variety does exist and has more than 50 spines in each areole on the trunk.

The flowers are a deep orange. The fruit is egg-shaped, about 5 cm long and 3 cm wide, and dull red. The top of the fruit is saucer-shaped with circular lines that meet in the centre and give the fruit a shrivelled appearance. The fruit produces many seeds within a reddish pulp.

Velvety tree pear is found predominantly throughout the brigalow belt of Queensland and is still extending its range. It is occasionally found as dense shrubs, but more usually as small clumps of trees or as trees scattered over the landscape.

**Westwood pear or Cardona pear (Opuntia streptacantha)**

Westwood pear is a shrub-like or tree-like plant that forms clumps by branching from the base and is usually 2–4 m high. The stems are divided into almost circular dull green pads, 25–30 cm long and 15–20 cm wide. The areoles have white spines that vary in number and size when the plant matures.

Young pads have 2–5 white spines 1–2 cm long, accompanied by two hair-like spines 0.5 cm long in the lower part of the areole. Spines increase in number (up to 20) and size (5 cm long) in areoles along the trunk of the plant.

The flowers are yellow and fruits are barrel-shaped, 6 cm long and 5 cm wide with a flat top. The fruit has a purple skin and a rind that is 1 cm thick. Fruits contain red seeds buried in a dark red (carmine) pulp.

Westwood pear is found in eastern central Queensland as small clumps or as plants scattered over the landscape.

**Devil’s rope pear (Opuntia imbricata)**

This open-branching shrub grows 1.5–3 m high. The stems are divided into hairless, dull green, cylindrical pads that vary up to 37 cm in length and are 3.5–5 cm thick. The pads have a series of short raised ridges that give them a twined, rope-like appearance. The areoles are found on these ridges and produce 3–11 pale yellow or white spines, with the longest being 2.5 cm long. Papery sheaths cover these spines.

The flowers are a dull, red-purple colour and found at the ends of pads. The yellow fruit resembles a small, 5 cm wide custard apple and has a spineless areole at the top. Devil’s rope pear occurs in Queensland as a small infestation at Gladfield.
Coral cactus (*Opuntia cylindrica*)

Coral cactus grows as a branching shrub 1–1.5 m high. The stems of coral cactus are divided into green cylinder-like pads that are fist-like and obtuse at their apex. Mature coral cactus pads widen, become distorted and wavy, and resemble a piece of coral. Areoles along the pads have a number of short white spines.

Coral cactus produces small (1−2 mm wide) scarlet flowers. The fruit is yellow-green and 2−5 cm wide.

Coral cactus has been located near Mount Isa, Longreach, Wyandra, Eulo and Hungerford but its potential spread includes all of far western Queensland.

Snake cactus (*Opuntia fulgida × O. imbricata*)

This open-branching shrub grows 1–2 m high. The stems are divided into hairless, dull green, cylindrical pads that vary up to 20 cm in length and are 3.5–5 cm thick. The pads have a series of short raised ridges that give them a twined rope-like appearance. The areoles are found on the bottom of these ridges and produce 5–10 pale yellow to brown spines, with the longest being 3 cm long.

The flowers are light red to dark rose and commonly 5–7 cm wide. Snake cactus produces fruit that is yellow and 2–5 cm wide.

Snake cactus has been located near Longreach but its potential spread includes all of north-western Queensland.

Sword pear (*Acanthocereus pentagonus*)

This elongated branching shrub grows in clumps up to 4 m high. The stems are erect, up to 1.5 m long, 3–8 cm wide and divided into many joints. Sword pear stems are three-angled, four-angled or five-angled and resemble star-picket posts. The areoles are found on the edges of the joints and produce many white spines 1–4 cm long.

The flowers are white, funnel-shaped and 14–20 cm long. The flowers open at night between spring and summer. Sword pear produces bright red sphere-shaped fruits that are 5 cm in diameter. The fruit has a red pulp and black seeds.

Sword pear occurs in the Gogango area west of Rockhampton.

**Control**

**Biological control**

Investigations into biological control agents against prickly pear began in 1912. Over 150 insect species were studied throughout the world, with 52 species selected for transport to Queensland. Following intensive host specificity testing, 18 insects and one mite were released in Queensland. Nine insects and the mite remain established in Queensland. These species are:

- *Cactoblastis cactorum*, a stem-boring moth
- *Dactylopius ceylonicus*, a cochineal mealy bug
- *Dactylopius opuntiae*, a cochineal mealy bug
- *Dactylopius confusus*, a cochineal mealy bug
- *Dactylopius tomentosus*, a cochineal mealy bug
- *Dactylopius austrinus*, a cochineal mealy bug
- *Chelinidea tabulata*, a cell-sucking bug
- *Tucumania tapiacola*, a stem-boring moth
- *Archlagocheirus funestus*, a stem-boring beetle
- *Tetranychus opuntiae*, prickly pear red spider mite.

These biological control agents continue to keep several prickly pear species under control. It is important to remember not all the agents attack all species.

The most successful of these agents were the moth *Cactoblastis cactorum* and five cochineal mealy bugs—*Dactylopius ceylonicus*, *D. opuntiae*, *D. confusus*, *D. tomentosus* and *D. austrinus*. The other agents are still around but not in sufficient numbers to provide control.

*Cactoblastis cactorum* (*cactoblastis moth*)

Larvae of this moth were introduced from Argentina in 1925. Cactoblastis proved to be the most effective agent against the common and spiny pest pears, destroying massive infestations in Australia. Larvae keeps these two pest pears controlled to an acceptable level most of the time, although it is less effective in some coastal and far western areas.

The larvae collectively eat out the contents of the pads, leaving empty pad skins and piles of mushy droppings. The orange and black larvae are occasionally observed on the outsides of pads. Cactoblastis also attacks most types of prickly pear but is not effective against them.

*Dactylopius* spp. (*cochineal insects*)

All female cochineal insects are small, sessile mealy bugs that spend their adult lives permanently attached to their host plants sucking plant juices. They are covered by a fine, white, waxy secretion and when crushed yield a carmine colouring. The adult males are small, free-flying insects that do not feed.

*Dactylopius ceylonicus* (*monacantha cochineal, Argentine cochineal*)

This South American mealy bug was released in 1914 and 1915 to control drooping tree pear. It destroyed the dense infestations existing at that time. It is specific to drooping tree pear and today remains the only effective biological control agent for drooping tree pear. This insect needs to be distributed manually.
**Dactylopius opuntiae** (prickly pear cochineal)

This mealy bug was introduced from Mexico and southern United States between 1920 and 1922. It is effective against common pest pear, spiny pest pear, velvety tree pear and Westwood pear and remains the main biological control agent against velvety tree pear and Westwood pear. This insect spreads slowly in nature and can be assisted manually.

**Dactylopius confusus** (prickly pear cochineal)

This mealy bug was introduced from Florida and released in 1933 against spiny pest pear. It remains effective against spiny pest pear in central Queensland but spreads slowly. This insect can be spread manually.

**Dactylopius tomentosus** (devil’s rope pear cochineal)

This mealy bug was introduced from southern United States in 1925 and 1926. It is effective against devil’s rope pear but works slowly.

**Dactylopius austrinus** (tiger pear cochineal)

This mealy bug was introduced from Argentina in 1932. It is specific to and effective against devil’s rope pear but works slowly.

**Chelinidea tabulata** (prickly pear bug)

This plant-sucking bug was introduced from Texas in 1921. It was effective against dense common pest pear before *Cactoblastis cactorum* was but is now relatively ineffective. This insect also attacks most other prickly pears. The adult is a pale brown bug up to 20 mm long that leaves characteristic round bleached spots on the surface of the cactus.

**Tucumania tapiacola** (prickly pear moth-borer)

This moth was introduced from Argentina in 1934 against tiger pear. Its solitary larvae feed internally and eat out tiger pear pads with limited effect. It has been observed attacking common pest pear and harrisia cactus.

**Archlagocheirus funestus** (tree pear beetle)

This stem-boring beetle was introduced from Mexico in 1935. It was effective against velvety tree pear and Westwood pear but has become rare since the dense stands of these prickly pears have gone.

**Tetranychus opuntiae** (prickly pear spider mite)

This mite was introduced from southern United States and Mexico in 1922. It was effective against common pest pear but is now rare and difficult to find. It causes distinctive scar tissue formation around areoles.

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**Distributing biological control agents**

**Cactoblastis**

Cactoblastis can be spread manually by distributing eggs or larvae. Cactoblastis moths lay chains of eggs (eggsticks) on prickly pear pads from January to February and from September to November. The eggsticks are distinguished from spines by their curved appearance.

1. Collect the fragile eggsticks carefully.
2. Glue single eggsticks to small pieces of paper using a starch-based adhesive.
3. Pin the egg papers to prickly pear pads. (Eggs take up to one month to hatch.)
4. Collect pads or plants in which larvae are obviously still active.
5. At a release site place all the collected plant material in a small part of the infestation.
6. Subsequent generations of moths will disperse through the infestation.
7. Follow up the biological control with either herbicide or mechanical treatment.

**Cochineals**

Because several cochineal insects affect some prickly pears and not others, it is essential to know what prickly pear you wish to control.

1. Identify your prickly pear type.
2. Find the same prickly pear type which is being attacked by a cochineal.
3. Collect pads of the prickly pear with the insects.
4. Place affected pads against unaffected prickly pears at the release site.
5. Follow up the biological control with either herbicide or mechanical treatment.

**Tiger pear cochineal**

Tiger pear cochineal is easy to multiply quickly after collection.

1. Carefully collect a reasonable quantity of unaffected tiger pear in a container (box or bucket).
2. Place a few pieces of cochineal-affected tiger pear into the same container.
3. Cover the container with a cloth and store under cover for a few weeks.
4. Check the cactus occasionally.
5. When most of the tiger pear in the container has cochineal, it is ready to distribute.
6. At the release site place affected pads against unaffected prickly pears.
7. Follow up the biological control with either herbicide or mechanical treatment.

Note: It is best to multiply tiger pear cochineal before release.
Mechanical control

Mechanical control using machinery is difficult because prickly pear pads can easily re-establish. A hot fire is an effective control method for dense prickly pear infestations. Before burning, consult Biosecurity Queensland to see if this practice is suitable for your pasture and land management practices.

Herbicide control

Herbicide options available for the control of prickly pears in Queensland are shown in Table 1.

### Table 1 Herbicides registered for the control of prickly pears

<table>
<thead>
<tr>
<th>Pest name</th>
<th>Situation</th>
<th>Herbicide</th>
<th>Rate</th>
<th>Method</th>
</tr>
</thead>
<tbody>
<tr>
<td>Common prickly pear</td>
<td>Agricultural land—non-crop</td>
<td>Triclopyr (240 g/L) + picloram (120 g/L)</td>
<td>1 L/60 L diesel</td>
<td>Basal bark/cut stump</td>
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<tr>
<td></td>
<td></td>
<td>Triclopyr (600 g/L)</td>
<td>3 L/100 L or 0.8 L/60 L diesel</td>
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<td></td>
<td>Forests—timber production</td>
<td>Triclopyr (240 g/L) + picloram (120 g/L)</td>
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<td></td>
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<td>Triclopyr (600 g/L)</td>
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<td>Basal bark/cut stump</td>
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<td></td>
<td>3 L/100 L or 1 L/75 L diesel</td>
<td>Foliar</td>
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<tr>
<td></td>
<td>Land—commercial/industrial/public</td>
<td>Triclopyr (240 g/L) + picloram (120 g/L)</td>
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<td>Land—rights of way</td>
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<td>Pastures</td>
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</table>

Landholders and contractors should check if the property is in a hazardous area as defined in the *Agricultural Chemicals Distribution Control Act 1966* prior to spraying.

Further information

Further information is available from your local government office, or by contacting Biosecurity Queensland (call 13 25 23 or visit our website at www.biosecurity.qld.gov.au).
<table>
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<td></td>
<td>Land—around buildings</td>
<td>Amitrole (250 g/L) + ammonium thiocyanate (220 g/L)</td>
<td>1 mL/3 cm (inject) or 1 L/25 L (small plants/regrowth)</td>
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<th>Herbicide</th>
<th>Rate</th>
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<td>Land—rights of way</td>
<td>Amitrole (250 g/L) + ammonium thiocyanate (220 g/L)</td>
<td>1 mL/3 cm (inject) or 1 L/25 L (small plants/regrowth)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Triclopyr (240 g/L) + picloram (120 g/L)</td>
<td>1 L/60 L diesel</td>
<td>Basal bark/cut stump</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Triclopyr (300 g/L) + picloram (100 g/L)</td>
<td>0.5 L/100 L</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Triclopyr (600 g/L)</td>
<td>0.8 L/60 L diesel</td>
<td>Basal bark/cut stump</td>
</tr>
<tr>
<td></td>
<td>Pastures</td>
<td>Triclopyr (240 g/L) + picloram (120 g/L)</td>
<td>1 L/60 L diesel</td>
<td>Basal bark/cut stump</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Triclopyr (300 g/L) + picloram (100 g/L)</td>
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<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Triclopyr (600 g/L)</td>
<td>0.8 L/60 L diesel</td>
<td>Basal bark/cut stump</td>
</tr>
<tr>
<td></td>
<td>Land—commercial/industrial/public</td>
<td>Triclopyr (240 g/L) + picloram (120 g/L)</td>
<td>1 L/60 L diesel</td>
<td>Basal bark/cut stump</td>
</tr>
<tr>
<td></td>
<td>Land—commercial/industrial/public</td>
<td>Amitrole (250 g/L) + ammonium thiocyanate (220 g/L)</td>
<td>1 mL/3 cm (inject) or 1 L/25 L (small plants/regrowth)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Land—commercial/industrial/public</td>
<td>Triclopyr (240 g/L) + picloram (120 g/L)</td>
<td>1 L/60 L diesel</td>
<td>Basal bark/cut stump</td>
</tr>
<tr>
<td></td>
<td>Land—non-agricultural</td>
<td>Amitrole (250 g/L) + ammonium thiocyanate (220 g/L)</td>
<td>1 mL/3 cm (inject) or 1 L/25 L (small plants/regrowth)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Land—rights of way</td>
<td>Amitrole (250 g/L) + ammonium thiocyanate (220 g/L)</td>
<td>1 mL/3 cm (inject) or 1 L/25 L (small plants/regrowth)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Pastures</td>
<td>Triclopyr (240 g/L) + picloram (120 g/L)</td>
<td>1 L/60 L diesel</td>
<td>Basal bark/cut stump</td>
</tr>
<tr>
<td></td>
<td>Pastures</td>
<td>Triclopyr (240 g/L) + picloram (120 g/L)</td>
<td>1 L/60 L diesel</td>
<td>Basal bark/cut stump</td>
</tr>
<tr>
<td></td>
<td>Pastures</td>
<td>Triclopyr (240 g/L) + picloram (120 g/L)</td>
<td>1 L/60 L diesel</td>
<td>Basal bark/cut stump</td>
</tr>
<tr>
<td></td>
<td>Pastures</td>
<td>Triclopyr (240 g/L) + picloram (120 g/L)</td>
<td>1 L/60 L diesel</td>
<td>Basal bark/cut stump</td>
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<tr>
<td></td>
<td>Pastures</td>
<td>Triclopyr (240 g/L) + picloram (120 g/L)</td>
<td>1 L/60 L diesel</td>
<td>Basal bark/cut stump</td>
</tr>
<tr>
<td></td>
<td>Pastures</td>
<td>Triclopyr (240 g/L) + picloram (120 g/L)</td>
<td>1 L/60 L diesel</td>
<td>Basal bark/cut stump</td>
</tr>
<tr>
<td></td>
<td>Pastures</td>
<td>Triclopyr (240 g/L) + picloram (120 g/L)</td>
<td>1 L/60 L diesel</td>
<td>Basal bark/cut stump</td>
</tr>
<tr>
<td></td>
<td>Pastures</td>
<td>Triclopyr (240 g/L) + picloram (120 g/L)</td>
<td>1 L/60 L diesel</td>
<td>Basal bark/cut stump</td>
</tr>
<tr>
<td></td>
<td>Pastures</td>
<td>Triclopyr (240 g/L) + picloram (120 g/L)</td>
<td>1 L/60 L diesel</td>
<td>Basal bark/cut stump</td>
</tr>
<tr>
<td>Spiny pest pear</td>
<td>Agricultural land—non-crop</td>
<td>Triclopyr (240 g/L) + picloram (120 g/L)</td>
<td>1 L/60 L diesel</td>
<td>Basal bark/cut stump</td>
</tr>
<tr>
<td>Westwood pear</td>
<td>Agricultural land—non-crop</td>
<td>Triclopyr (240 g/L) + picloram (120 g/L)</td>
<td>1 L/60 L diesel</td>
<td>Basal bark/cut stump</td>
</tr>
<tr>
<td>Devil's rope pear</td>
<td>Agricultural land—non-crop</td>
<td>Triclopyr (240 g/L) + picloram (120 g/L)</td>
<td>1 L/60 L diesel</td>
<td>Basal bark/cut stump</td>
</tr>
<tr>
<td>Snake cactus</td>
<td>Agricultural land—non-crop</td>
<td>Triclopyr (240 g/L) + picloram (120 g/L)</td>
<td>1 L/60 L diesel</td>
<td>Basal bark/cut stump</td>
</tr>
</tbody>
</table>

Fact sheets are available from Department of Agriculture, Fisheries and Forestry (DAFF) service centres and our Customer Service Centre (telephone 13 25 23). Check our website at www.biosecurity.qld.gov.au to ensure you have the latest version of this fact sheet. The control methods referred to in this fact sheet 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, DAFF does not invite reliance upon it, nor accept responsibility for any loss or damage caused by actions based on it.

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Rubber vine
*Cryptostegia grandiflora*

Rubber vine’s ability to quickly spread and colonise areas makes it a threat to many areas of northern Australia. Due to this ability, rubber vine is listed as a Weed of National Significance.

Rubber vine generally invades waterways first, where the seeds germinate in moist silt layers after rain. The plant smothers riparian vegetation and forms dense, sometimes impenetrable, thickets.

This decreases biodiversity and prevents access to both stock and native animals. It also creates habitat for feral animals. Infestations expand outward from waterways, hillsides and pastures, resulting in loss of grazing land and increased difficulty in mustering stock.

Rubber vine is poisonous to stock, though seldom eaten. Most deaths due to rubber vine occur after stock have been stressed, or when other feed is scarce.
Declaration details

Rubber vine is a declared Class 2 plant under the Land Protection (Pest and Stock Route Management) Act 2002. Declaration requires landholders to control declared pests on the land and waters under their control. A local government may serve a notice upon a landholder requiring control of declared pests.

Description and general information

Rubber vine is a vigorous climber with twining, whip-like shoots that can grow unsupported as an untidy, multi-stemmed shrub 1–2 m high, or it can scramble up to 30 m high in trees. The stems, leaves and unripe pods exude a white, milky sap when broken or cut.

Leaves are dark green and somewhat glossy, 6–10 cm long, 3–5 cm wide, and in opposite pairs.

Flowers are large and showy, with five white to light purple petals arranged in a funnel shape.

The seed pods are rigid and grow in pairs at the end of a short stalk. The pods are 10–12 cm long, 3–4 cm wide and each can contain up to 450 brown seeds. Each seed has a tuft of long, white, silky hairs, which enable easy dispersal by wind and water.

Life cycle

Rubber vine flowers at any time of year if sufficient moisture is available. Usually, June and July are the only non-flowering months. Plant stem diameter must be approximately 20 mm before flowering can occur.

Seed pod formation occurs from spring to late autumn, with peak seed production corresponding to maximum flowering. Eventually, pods dry out and split open, with pod-splitting occurring approximately 200 days after formation.

Seeds are scattered by wind, but also carried downstream by water. Approximately 95% of seed is viable, although germination requires favourable temperature and soil moisture conditions.

Habitat and distribution

Rubber vine is native to Madagascar, but is now widely distributed throughout tropical and subtropical regions of the world.

The plant was introduced to Australia as an ornamental shrub in 1875 or earlier, and was popular in north Queensland mining settlements due to its luxuriant growth even under harsh conditions. Weedy infestations were recorded around Charters Towers early this century.

Rubber vine prefers areas where annual rainfall is 400–1400 mm, and is well adapted to a monsoonal climate.

Infestations of rubber vine are now found throughout river systems of southern Cape York and the Gulf of Carpentaria, south along the coast to the Burnett River, and isolated infestations occur as far south as Gatton and as far west as the Northern Territory border.

Infestations are common throughout central Queensland, while in western Queensland there are infestations in the Mount Isa, Longreach and Aramac areas. Isolated infestations have been reported in Western Australia.

Control

Effective control of rubber vine can be achieved by a number of methods, alone or in combination depending on the situation and the severity of infestation. All areas treated must be periodically checked and any regrowth treated or the initial treatment efforts will be wasted.

Management strategies

Rubber vine seed is most commonly spread by wind and running water.

It is thus difficult to prevent seed coming onto uninfested land if there is rubber vine anywhere in the area. Your goal should be to prevent rubber vine from establishing and forming dense infestations. It is essential to regularly inspect all areas of your property, paying particular attention to creeks and gullies.

This is most important where prevailing winds are known to blow from infested areas, or where infestations occur upstream.

Any isolated plants located should be treated promptly.

All control of rubber vine will require follow-up treatments to keep your property clean. As rubber vine spreads quickly, small infestations should be controlled first to prevent them from becoming major problem areas. Dense infestations are difficult and costly to treat.

Follow-up treatment must be budgeted for within the overall control program. Techniques need to be integrated for successful rubber vine management. Consideration should be given to coordinating control over a catchment area.

Five suggested strategies for controlling rubber vine in scattered, medium, and dense infestations are outlined in Table 1 (overleaf).
Rubber vine infestations can be very effectively controlled by burning. Preparing and managing fuel load prior to burning, and following up in a timely manner after the fires, are critical to the overall success of the program.

It is recommended that you perform two successive annual burns. The first fire will open up the infestation to increase grass growth (fuel load) while killing rubber vine plants. The second fire will clean up the regrowth that occurs after the first fire.

An appropriate fire regime is an effective tool for managing rubber vine over the long term, as well as being an effective follow-up to other control methods.

For further information contact 13 25 23.

Biological control
Two biological control agents are successfully established, and their impact depends on abundance. Both agents cause abnormal defoliation, creating an 'energy sink', which appears to reduce seed production. These agents usually do not kill established rubber vine plants.

Diseases
Rubber vine rust (Maravalia cryptostegiae) is established over a wide area. Yellow spores form under the leaves and are spread mainly by the wind.

It is most active over summer, abundance being directly related to leaf wetness, which is dependent on rainfall and dew. Over summer, a generation is completed every seven days. Rust activity is reduced over the dry season.

Continued heavy infection causes defoliation, appears to reduce seed production, can kill small seedlings and causes dieback of the whip-like stems. Established plants are not killed.

Insects
Also established is the moth Euclasta whalleyi, whose larvae are leaf feeders. Observation indicates the moth prefers stressed plants, either from limited soil moisture or high levels of rust infection.

The moth’s period of activity is the dry season. A native fly parasite and a disease can reduce the localised abundance of the Euclasta larvae.

The larvae are tapered at both ends, grow up to 30 mm long, and are grey-brown with orange dots along their sides. Fine silken threads and black, bead-like droppings are often found near the larval feeding damage.

The creamy-brown moths are active at night and rest at a 45° angle from a surface, with their wings folded. The life cycle from egg to adult takes 21–28 days.

Defoliation reduces the smothering effect on other vegetation and causes an increase in leaf litter and promotes increased grass growth amongst rubber vine, increasing fuel loads required for fire management. Decreased flower and pod production should reduce the ability of rubber vine to spread.

Biological control is also important because it impacts on other control methods.

Mechanical control
Several mechanical techniques are effective in controlling rubber vine. The type of infestation will determine the technique required.

- Scattered or medium-density infestations: Where possible, repeated slashing close to ground level is recommended.
- Dense infestations: During winter, stick-raking or blade-ploughing reduces the bulk of the infestation. Pasture should be sown and windrows burned to kill residual seed. Follow-up treatment is essential. It is important to comply with the relevant state and/or local government native vegetation legislation, and it should be noted that causing even accidental death of vegetation can be a breach of this legislation.

Herbicide control
Herbicides recommended for use on rubber vine are listed in Table 2 (overleaf). Preference ratings (taking account of effectiveness and cost) are shown.

Aerial application
Three herbicides are currently registered for aerial application (refer to Table 2). Two of these are foliar herbicides and the other is a soil-applied herbicide. As a result, the necessary conditions that apply to foliar and soil applications is also applicable to the respective chemical when aerially applied.

People considering aerial application are advised to contact 13 25 23 for current advice on use of this technique.

Foliar spray
The following points should be followed carefully:

- There must be little to no rust present as it affects the health of the plant and its ability to take chemical up through its leaves.
- It is critical that plants be actively growing and NOT water-stressed, yellowing or bearing pods.
- A wetting agent should be used with foliar herbicides.
- Thoroughly spray bushes to the point of run-off, wetting every leaf.
- Avoid spraying when hot and dry (e.g. over 35 °C), or when windy—especially with Agricrop Rubber Vine Spray.
- Foliar spraying is most effective on plants less than 2 m high; large plants with a stem diameter greater than 8 cm may not be killed.

**Basal bark spray**

This method gives a high level of control although it is not as effective on multi-stemmed plants as it is difficult to spray each stem completely around the base.

Thoroughly spray around the base of the plant to a height of 20–100 cm above ground level, spraying higher on larger plants.

Optimum results are attained when the plant is actively growing.

**Cut stump treatment**

This is the most successful method of chemical control, but also the most labour intensive. The following points should be followed carefully:

- Cut the stem off as close to the ground (within 15 cm) as possible; for smaller plants use a machete or similar; larger plants may require a chainsaw.
- Make sure the cut is horizontal.
- Immediately spray or swab the cut surface.
- A cost-effective method for scattered to medium-density infestations is the use of a brush-cutter.

**Soil application**

Because of the high risk of killing non-target vegetation, including trees and pasture plants, soil-applied herbicides play a role in controlling rubber vine only in specific situations.

It is important to comply with the relevant state and/or local government native vegetation legislation, and it should be noted that causing even accidental death of vegetation can be a breach of this legislation.

The following points should be followed carefully:

- Do not use residual herbicides within a distance of two or three times the height of desirable trees.
- Do not use Graslan along waterways or land with greater than a 20° slope.
- A minimum of 50–80 mm of rainfall is required before residual herbicides are taken up by the plant.

**Further information**

Further information is available from your local government office, or by contacting Biosecurity Queensland (call 13 25 23 or visit our website at www.biosecurity.qld.gov.au).

**Figure 1 Rubber vine containment line and distribution map**
Table 1 Suggested strategies for the control of rubber vine

<table>
<thead>
<tr>
<th>Situation</th>
<th>Initial treatment</th>
<th>Follow-up</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scattered infestations</td>
<td>Basal bark/cut stump</td>
<td>Follow-up with basal bark/cut stump as necessary</td>
<td>Cut stump method preferred where possible.</td>
</tr>
<tr>
<td>Foliar spray</td>
<td></td>
<td>Follow-up basal bark/cut stump/foliar spray as necessary</td>
<td>Only foliar spray when there is nil to little rust on the leaves of the plants.</td>
</tr>
<tr>
<td>Fire</td>
<td></td>
<td>Follow-up basal bark/cut stump/foliar spray as necessary</td>
<td>For scattered infestations usually recommended only if herbicides not desired, or if have other weeds can be controlled by fire or if fire is utilised to improve pastures.</td>
</tr>
<tr>
<td>Repeated slashing</td>
<td>As above</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Medium infestations</td>
<td>Foliar spray</td>
<td>Treat regrowth, seedlings with basal bark/cut stump/foliar spray</td>
<td>Fire and follow-up with basal bark/cut stump/foliar spray as necessary.</td>
</tr>
<tr>
<td>Fire</td>
<td></td>
<td>Fire 1 year later and follow-up basal bark/cut stump/foliar spray as necessary</td>
<td>If fuel load is sufficient. CAUTION: There are some native tree species which are susceptible to fire. Check before burning.</td>
</tr>
<tr>
<td>Repeated slashing</td>
<td>As above</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dense infestations—previously cleared areas</td>
<td>Stick rake or blade plough</td>
<td>Sow pasture → basal bark/foliar spray → fire and basal bark/cut stump/foliar spray as necessary</td>
<td>First treatment clears bulk of rubber vine and kills roots; any regrowth or seedlings can then be treated; when grass growth allows fuel build up, fire used as control and individual plants later treated.</td>
</tr>
<tr>
<td>Fire</td>
<td></td>
<td>Fire 1 year later and follow-up basal bark/cut stump/foliar spray as necessary</td>
<td>If fuel load is sufficient. CAUTION: There are some native tree species which are susceptible to fire. Check before burning.</td>
</tr>
<tr>
<td>Aerial spray</td>
<td></td>
<td>Fire 1–2 years later OR follow-up with basal bark spray</td>
<td>Bulk of rubber vine killed with aerial spray; allow build up of fuel for fire or treat remaining plants with basal bark spray. Contact 13 25 23 before use of method.</td>
</tr>
<tr>
<td>Graslan</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dense infestations—along creeks and rivers</td>
<td>Basal bark/cut stump</td>
<td>Fire OR basal bark/cut stump/foliar spray</td>
<td>When bulk of rubber vine killed, allow fuel build up for fire or treat remaining plants individually.</td>
</tr>
<tr>
<td>Fire and sow pasture</td>
<td></td>
<td>Fire 1 year later and follow-up basal bark/cut stump/foliar spray as necessary</td>
<td>If there is a sufficient fuel load to carry a fire, it can open up dense infestations. CAUTION: There are some native tree species which are susceptible to fire. Check before burning.</td>
</tr>
</tbody>
</table>
### Table 2 Herbicides registered for the control of rubber vine

<table>
<thead>
<tr>
<th>Situation</th>
<th>Herbicide</th>
<th>Pref.</th>
<th>Rate</th>
<th>Optimum stage and time</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Foliar (overall) spray (ground)</td>
<td>Triclopyr + picloram (Grazon DS, Grass-up, etc.)</td>
<td>1</td>
<td>0.35–0.5 L /100 L water</td>
<td>During active growth</td>
<td>May damage pasture legumes.</td>
</tr>
<tr>
<td></td>
<td>Dicamba (200 g/L) + 2,4-D Ester 800 g/L</td>
<td>1</td>
<td>0.35–0.7 L /100 L water + 175 ml 2, 4-D Ester</td>
<td>As above</td>
<td>As above. Apply in autumn during active growth.</td>
</tr>
<tr>
<td></td>
<td>Metsulfuron methyl (e.g. Brush-off®, Brushkiller™ 600, etc.)</td>
<td>1</td>
<td>15 g/100 L water</td>
<td>As above</td>
<td>Wetting agent is critical. Complete coverage is essential. May damage pasture legumes.</td>
</tr>
<tr>
<td></td>
<td>2,4 D + picloram (Tordon 75-D)</td>
<td>2</td>
<td>1.3 L/100 L water</td>
<td>As above</td>
<td>Thoroughly wet leaves and soil around base of plant.</td>
</tr>
<tr>
<td></td>
<td>2,4-D Ester (Agricrop Rubber Vine Spray)</td>
<td>3</td>
<td>0.5 L/100 L water + activator</td>
<td>As above</td>
<td>May damage pasture legumes; less effective than other treatments, but also much cheaper.</td>
</tr>
<tr>
<td>2. Basal bark</td>
<td>2,4-D Ester (Agricrop Rubber vine spray)</td>
<td>1</td>
<td>2.5 L/100 L diesel</td>
<td>Plants actively growing</td>
<td>Thoroughly spray around base of plant.</td>
</tr>
<tr>
<td></td>
<td>Triclopyr + picloram (Access)</td>
<td>1</td>
<td>1 L/60 L diesel</td>
<td>Anytime</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Triclopyr (e.g. Garlon 600, Invader 600®, etc.)</td>
<td>1</td>
<td>1 L/60 L diesel</td>
<td>Anytime</td>
<td></td>
</tr>
<tr>
<td>3. Cut stump</td>
<td>2,4-D Ester (Agricrop Rubber Vine Spray)</td>
<td>1</td>
<td>2.5 L/100 L diesel</td>
<td>Anytime</td>
<td>Immediately swab/spray cut surface and base of stem.</td>
</tr>
<tr>
<td></td>
<td>Triclopyr + picloram (Access)</td>
<td>1</td>
<td>1 L/60 L diesel</td>
<td>As above</td>
<td>As above.</td>
</tr>
<tr>
<td></td>
<td>Triclopyr (e.g. Garlon 600, Invader 600®, etc.)</td>
<td>1</td>
<td>1 L/60 L diesel</td>
<td>Anytime</td>
<td></td>
</tr>
<tr>
<td></td>
<td>2,4 D + picloram (Tordon 75-D)</td>
<td>2</td>
<td>1.3 L/100 L water</td>
<td>As above</td>
<td>As above.</td>
</tr>
<tr>
<td></td>
<td>2,4-D Amine (500 g/L)</td>
<td>2</td>
<td>2 L/100 L water</td>
<td>As above</td>
<td>As above. Less effective than other treatments. Repeat applications may be required.</td>
</tr>
<tr>
<td>4. Soil application*</td>
<td>Hexazine* (Bobcat® SL, Velpar® L)</td>
<td>1</td>
<td>1–4 ml/spot or 6 ml/vine or bush</td>
<td>Prior to rain</td>
<td>See warning below.* Must place spots around bush. Less effective on sandy soils.</td>
</tr>
<tr>
<td>5. Aerial application</td>
<td>Tebuthiuron* (Graslan)</td>
<td>1</td>
<td>1.5 g/m2</td>
<td>As above</td>
<td>As above; application by hand or backpack spreader.</td>
</tr>
<tr>
<td></td>
<td>Triclopyr + picloram (Grazon DS, Grass-up, etc.)</td>
<td>1</td>
<td>3–5 L/ha</td>
<td>Plants actively growing</td>
<td>Before aerial application contact 13 25 23.</td>
</tr>
<tr>
<td></td>
<td>Tebuthiuron* (Graslan)</td>
<td>1</td>
<td>7.5–15 kg/ha</td>
<td>Prior to rain</td>
<td>As above.</td>
</tr>
<tr>
<td></td>
<td>2,4-D Ester (Agricrop Rubber Vine Spray)</td>
<td>3</td>
<td>0.5 L/100 L water + activator</td>
<td>Plants actively growing</td>
<td>As above.</td>
</tr>
</tbody>
</table>

* Preference rating—takes account of effectiveness and cost

# WARNING: Soil testing is highly recommended prior to application of these herbicides, as rate and efficacy are dependant on soil type.

DO NOT USE SOIL APPLIED HERBICIDES (HEXAZINONE AND GRASLAN) WITHIN A DISTANCE OF TWO TO THREE TIMES THE HEIGHT OF DESIRABLE TREES. DO NOT USE GRASLAN NEAR WATERWAYS OR LAND WITH GREATER THAN A 20° SLOPE.
Rubber vine (Cryptostegia grandiflora)

The problem

Rubber vine 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.

Rubber vine has impacts on pastoral and conservation areas of northeastern Australia. Its main impact on pastoralism is the loss of grazing country, which in 1995 was estimated to cost the Queensland beef industry $18 million. It also increases the costs of mustering and fencing.

Rubber vine threatens waterways, woodlands and rainforests throughout northeastern Australia, including significant conservation areas such as the Wet Tropics World Heritage Area and Cape York. It also severely threatens riverine vegetation, and can potentially displace the plants and animals that inhabit riverbanks, thereby affecting the water quality of streams. The whole ecological integrity of native vine thickets and riverine systems of northern Australia is under threat from rubber vine.

The weed

Rubber vine is a many stemmed shrub which can climb 30 m into tree canopies, or grow 1–3 m high when unsupported in open areas. The stems are greyish brown with a smooth bark and have two forms: a leaf-bearing branched stem and a longer unbranched ‘whip’ with fewer leaves that extends onto nearby adjacent vegetation. The plant exudes a milky sap if scratched or broken.

The leaves occur in pairs and are a glossy dark green in colour. They are oval-shaped with tapered ends (elliptical), 60–100 mm long and 30–50 mm wide. The trumpet-shaped flowers are quite large, up to 50 mm long and wide, with five light purple to white petals.

The seed pods are rigid and usually occur in opposing pairs at the end of short stalks, but are quite common as single pods and occasionally triple pods. The pods are up to 120 mm long and 40 mm wide. The brown seeds are flat with a tuft of long, white, silky hairs at one end. Roots grow to a depth of 12 m.

Key points

- Rubber vine threatens to choke the waterways, vine forests and pastures of northern Australia.
- Its westward spread must be prevented to protect environmental and economic interests in the Northern Territory and northern Western Australia.
- A containment line helps to prioritise infestations for control and to monitor progress.
- Existing control techniques (chemical, mechanical, biological and fire) should be integrated for maximum effect.
- Follow-up work needs to be ongoing, especially if seeds re-enter the site.
How it spreads

About 95% of seed produced by rubber vine is viable. It is scattered short distances from the parent plant by wind that catches the tufts on the seed ends, or longer distances by floating on floodwaters. Most seed remains viable even after the pods have floated on fresh or salt water for over a month, potentially leading to spread between catchments.

Seeds can also be potentially spread by birds, or in mud attached to vehicles, machinery and animals.

With each seed pod producing between 340 and 840 seeds, a hectare of rubber vine can produce millions of seeds every year. However, the seed is not long lived. If conditions are too dry to allow germination, most of the seed will die after one year.

Where it grows

Rubber vine typically invades new areas when seed is blown in or transported down a waterway. Seed germinates readily on riverbanks and other moist areas, and the young plants rapidly grow over and smother other plants, often completely dominating the vegetation. It then spreads aggressively from the riverbank to adjoining open woodland and/or pastures.

Currently, rubber vine is restricted to areas receiving between 400 and 1400 mm of mainly summer rain. It grows on all soil types, but is more likely to germinate on soils that retain moisture.
Rubber vine is native to southwestern Madagascar. It has become weedy in other countries throughout East Africa, South-East Asia, the United States, and Central and South America.

**Potential distribution**

Based on its climatic requirements, rubber vine has a potential distribution covering all of northern Queensland and northern Northern Territory, and most of the Kimberley and Pilbara regions of Western Australia. Parts of northeastern New South Wales could also be affected.

**What to do about it**

### Prevention of spread outside the Rubber Vine Containment Line

Prevention is the cheapest form of controlling rubber vine. The Rubber Vine Containment Line was surveyed in the early 1990s to highlight areas infested with the weed and help plan control efforts. Strategies inside the containment line are focused on managing its impact. Any infestations outside the containment line are targeted for control to prevent its spread into new areas.

Other ways to prevent the spread of rubber vine include:

- preventing its sale and planting by declaring it a weed across all states and territories
- preventing further importation
- raising public awareness of the problems.

### How to control rubber vine

Early efforts to control rubber vine have improved our understanding of control techniques and how to combine, or integrate, different methods to give the best results. There are four main methods that are used to control the weed: biological, chemical, fire and mechanical.

### A strategic plan for integrated management of rubber vine

The Queensland Department of Natural Resources and Mines and the National Rubber Vine Management Group have developed the 'Rubber Vine Management Manual - Control and Case Studies', with funding contributed by the National Weeds Program of the Natural Heritage Trust. It contains the five-step approach to planning which is summarised below.

Accurate mapping of all infestations is an ideal starting point that will provide the information required to identify infestations as priorities for control.

Control attempts should aim to kill plants before they set seed, first targeting outlying or small infestations and working towards the centre. Because wind and water are the main ways in which seed is spread, prioritise infestations that are likely to be a source of seeds (eg in upper catchments, or upwind in relation to prevailing winds). Infestations that have severe impacts on property maintenance (eg watering or mustering points) or primary production might also be high priorities for control.

Choosing appropriate control methods is a key part of the strategic plan. Aiming for maximum effect with minimum cost, it is important to first evaluate what resources (eg labour, herbicides, spray equipment, machinery) are available. Part of this evaluation will be assessing the different costs of each control method and of each of the identified priorities, and developing a financial plan for both the short and long terms.

Finally, it is important to target control efforts to suitable times of the year to take advantage of differences between seasons or any abnormal fluctuations (such as drought or flooding). For example, good rains generate pasture growth, which can be used to fuel fires.
Biology control reduces rubber vine’s vigour

Two biological control agents have become widespread in Queensland since their release in the early 1990s. The rubber vine rust Maravalia cryptostegiae forms on the underside of leaves and causes them to turn yellow and drop. The rust thrives during the wet season but is less active over the dry season. Frequent showers early in the season should result in heavy infestations of rust.

The other agent is the moth Euclasta whalleyi, whose caterpillars feed on rubber vine leaves between March and October. The moth has a black spot on each wing and characteristically rests with its wings folded at 45º to a vertical surface. The caterpillars tend to feed on the underside of new leaves, often leaving fine silken threads and black bead-like droppings.

Both agents, especially the rust, cause damage (eg reduced flowering, seed pod production and leaf cover) and occasionally the death of established plants. However, their effectiveness varies with climatic conditions.

Herbicides are effective but expensive

The strategic use of a range of registered herbicides is an effective method of controlling isolated or outlying rubber vine plants. Foliar spraying the entire plant from the ground and aerial spraying are most effective on smaller plants (less than 2 m tall, stem diameter less than 35 mm). However, note that leaves infected by the biocontrol rust will not take up herbicides. The basal bark technique, which uses spraying around the lowest bark up to a height of 500 mm (knee height), is effective on plants of stem diameter less than 35 mm at the base. For thicker rubber vine, up to 90 mm stem diameter at base, basal bark spray to 1 m high. Foliar, aerial and basal bark spraying should only be conducted when rubber vine is actively growing.

When the stem diameter at the base exceeds 90 mm, or if the stems are heavily intertwined, the cut-stump method is preferred. The stems should be cut as close to the ground as possible using a machete or chainsaw, and immediately painted with herbicide. The cut-stump method uses minimal herbicides and is effective at all times but is labour intensive and therefore best suited to scattered infestations.

Soil-applied residual herbicides are effective when applied before rain. Soil type limits their effectiveness, and there are other important considerations such as run-off and impacts on non-target trees. It is highly recommended that advice is obtained from the relevant state/territory weed management agency prior to the use of soil-applied herbicides.

Fire is relatively inexpensive and kills rubber vine

Fire is an especially valuable part of the integrated control of rubber vine because it kills surface seeds, seedlings and adult plants, yet is relatively inexpensive. If there is sufficient fuel, rubber vine can be burnt whilst green with good success. Infestations may require an initial burn to open them out, a follow-up burn to control regrowth and seedlings in the next 12 months, and another burn several
Weed control contacts

<table>
<thead>
<tr>
<th>State / Territory</th>
<th>Department</th>
<th>Phone</th>
<th>Email</th>
<th>Website</th>
</tr>
</thead>
<tbody>
<tr>
<td>NSW</td>
<td>NSW Agriculture</td>
<td>1800 680 244</td>
<td><a href="mailto:weeds@agric.nsw.gov.au">weeds@agric.nsw.gov.au</a></td>
<td><a href="http://www.agric.nsw.gov.au">www.agric.nsw.gov.au</a></td>
</tr>
<tr>
<td>NT</td>
<td>Dept of Infrastructure, Planning and Environment</td>
<td>(08) 8999 5511</td>
<td><a href="mailto:weedinfo.ipe@nt.gov.au">weedinfo.ipe@nt.gov.au</a></td>
<td><a href="http://www.nt.gov.au">www.nt.gov.au</a></td>
</tr>
<tr>
<td>Qld</td>
<td>Dept of Natural Resources and Mines</td>
<td>(07) 3896 3111</td>
<td><a href="mailto:enquiries@nrm.qld.gov.au">enquiries@nrm.qld.gov.au</a></td>
<td><a href="http://www.nrm.qld.gov.au">www.nrm.qld.gov.au</a></td>
</tr>
<tr>
<td>WA</td>
<td>Dept of Agriculture</td>
<td>(08) 9368 3333</td>
<td><a href="mailto:enquiries@agric.wa.gov.au">enquiries@agric.wa.gov.au</a></td>
<td><a href="http://www.agric.wa.gov.au">www.agric.wa.gov.au</a></td>
</tr>
<tr>
<td>Australia wide</td>
<td>Australian Pesticides and Veterinary Medicines Authority</td>
<td>(02) 6272 5852</td>
<td><a href="mailto:contact@apvma.gov.au">contact@apvma.gov.au</a></td>
<td><a href="http://www.apvma.gov.au">www.apvma.gov.au</a></td>
</tr>
</tbody>
</table>

For up-to-date information on which herbicides are registered to control rubber vine 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 river banks.

years later to continue the follow-up. In a fire research experiment west of Chillagoe in Queensland, 80% of rubber vine was killed in an initial fire (October 1997). A follow-up burn one year later resulted in a 99% kill rate.

The timing of fire is crucial to its success as fires must be hot enough to kill mature rubber vine. The fuel load should be about 1500 kg/ha, the equivalent of a relatively thin pasture. Pasture may need to be fenced off, or spelled, before burning to allow it to build to high enough levels. These costs, and the construction of fire breaks, make up the bulk of the costs associated with fire.

Fire combined with biocontrol provides cost-effective control of rubber vine

It is advisable to burn after first rains as this reduces the risk of prolonged periods of bare earth and erosion. Other factors that must be considered when using fire include its impacts on pastures and natural ecosystems, risks to stock and property, and loss of nutrients. Permits may be required to light fires – check with your local council or state or territory weed management agency.

Mechanical control helps gain access

Blade or disc ploughs and cutter bars provide reasonable control of rubber vine, but are most often used to penetrate very dense infestations to allow easier access or to open up the canopy. Slashing harms the plant but often does not kill it.
Mechanical control is not suited to core problem areas such as gullies and creeks because it can lead to erosion. Also, care must be taken not to inadvertently bury plant material (e.g., seeds, stems) that could be protected from a fire. Permits may be required to conduct mechanical control if native species will be affected. Weed control contacts (see table p. 5) will be able to provide relevant advice.

**Chemical, mechanical and biological control, fire and grazing management can be integrated together to manage rubber vine in the long term**

### Integrated management is most effective

Recent research has shown that the use of fire after biological control can be highly effective. The biocontrol rust causes leaf drop, which opens up infestations and allows grasses to grow underneath. Combined with the rubber vine leaf litter, these grasses can provide the perfect environment for fires, resulting in excellent, cost-effective control.

However, there is no single method of integrating techniques that is suitable for all infestations; control programs should be tailored to the location, size, intensity and age of each situation. Other factors that must also be considered are the effects on other vegetation and the availability of resources for control and follow-up operations. Landholders should contact their local weeds officer or lands protection officer for the most appropriate strategy.

Controlling rubber vine is hard work and requires ongoing commitment. The benefits of controlling it include: recovered pasture, increased production, reduced mustering costs and the protection of natural ecosystems, plants and animals.

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**Another weedy species of Cryptostegia**

Cryptostegia madagascariensis is closely related to rubber vine, and also occurs either in gardens or as a naturalised weed in Western Australia, the Northern Territory and Queensland. Its flowers are slightly smaller and a deeper pink colour but it is otherwise difficult to separate the two species. The risks posed by Cryptostegia madagascariensis are high, especially because it could cross-breed with rubber vine. Note that the common name ‘rubber vine’ may also be used for other unrelated nursery plants.
Protecting the Channel Country

Holmeleigh Station is a cattle property south of Prairie in the uplands of Tower Creek in northern Queensland. John and Bub Teakle run about 600 head on the 15,600 ha station, which forms part of the very upper Lake Eyre Basin.

The Teakles did not take much notice of the rubber vine when they first took over the station in 1989. The extent of the problem was revealed in 1992 when the Strategic Weed Eradication and Education Program (SWEEP) helped to map the infestation, and found that it followed Tower Creek through Holmeleigh and adjoining stations for about 9 km.

According to John Teakle, one of the main problems with rubber vine is that “the cattle get hidden in it when mustering – once they know it’s there the cattle will look for it”. Although both biocontrol agents are present, it is too dry for the rust and the moth is prone to parasitism.

In the Tower Creek area SWEEP provided an initial control effort aimed at knocking out the bulk of the rubber vine stands. The SWEEP team used foliar applied herbicides, but could not get access to some very dense infestations. Although they made some progress, upstream plants continually reinfested treated areas, and the ongoing follow-up that was required was beyond the resources of most of the landholders.

Since that initial control attempt, John Teakle has used fire to gain better access and help thin out dense infestations. “Fire is the first thing anyone should do…Burn any time you can get a fire to burn and it’s safe to burn”, he says. It is crucial that the fires are intense enough to burn up through the green rubber vine and kill it. Fire is a relatively inexpensive method of control and can help to reduce the amount of seed produced.

With funding secured through the Natural Heritage Trust, the Teakles have employed contractors to help with chemical control of rubber vine, using the cut-stump technique for plants over 30 mm diameter and basal bark spraying for anything smaller.

The Teakles are not seeking major economic gains from rubber vine control as it does not spread into their pastures. They mainly see the benefits in clearing their property and protecting the downstream Channel Country.

Legislation

Landholders throughout Western Australia, the Northern Territory and Queensland are required by law to control both species of Cryptostegia that occur on their land. Check with your local council or state/territory government agency about its requirements for rubber vine control.

Acknowledgments

Information and guide revision: Darren Moor (Qld DNRM) and members of the Rubber Vine Management Group, including Mark Bickhoff, Phil Maher (Qld DNRM), Leslee Marshall, Noel Wilson (Dept of Agriculture WA/Weeds CRC) and Tony Grice (CSIRO/Weeds CRC).

Other assistance from Rachel McFadyen (Weeds CRC), Sandy Lloyd (Dept of Agriculture WA/Weeds CRC), John and Bub Teakle (Holmeleigh Station), Michele Deveze (Qld DNRM) and John Thorp (National Weeds Management Facilitator).

Maps: Australian Weeds Committee.

Rubber vine infestation in Qld, where the total area of infestation was estimated at 700,000 ha in 1991. Its total range extends across some 35 million ha, or 20% of the state.

Photo: Joe Vitelli, Qld DNRM.
**Prevent spread outside the containment line**

All infestations outside the Rubber Vine Containment Line should be controlled to prevent further spread. Monitoring and early detection are required to target these infestations. Communication and education are critical to achieving early detection in new areas.

**Integrated management within the containment line**

Infestations within the Rubber Vine Containment Line should be managed to minimise impacts and reduce the amount of seed produced. Integrated control using a mix of fire, biological, mechanical and chemical methods is the most cost-effective long-term approach.

**The five step approach to planning**

Use the five step planning approach, as devised by the Queensland Department of Natural Resources and Mines and the National Rubber Vine Management Group:

1. Map infestations on your property.
2. Target sites that are sources of seed spread, strategically important or essential for property management.
3. Determine the availability of resources (eg herbicides, labour) and suitability of methods for different infestations (eg herbicides are too expensive for very dense or large infestations, fire is especially effective after rust infection).
4. Estimate the cost of the program and incorporate into the short- and long-term property budget.
5. Calendar control efforts for maximum results and minimum effort. For example, wait until an adequate fuel load exists before using fire.

**Ongoing follow-up**

Follow-up control must be diligent and ongoing, as rubber vine can quickly reinfest.

### Control options

<table>
<thead>
<tr>
<th>Type of infestation</th>
<th>Fire</th>
<th>Mechanical</th>
<th>Chemical</th>
<th>Biological</th>
</tr>
</thead>
<tbody>
<tr>
<td>Light (less than 1000 plants per ha)</td>
<td>Moderately hot fires using grass as a fuel will give good kill rates.</td>
<td>Slashing kills only about 50% of rubber vine. Consider other methods.</td>
<td>Foliar or basal bark spray, or use cut-stump method with registered herbicide when actively growing.</td>
<td>Two biological agents are having an impact in reducing the health and spread of rubber vine - the rubber vine rust and the rubber vine moth. An additional benefit of the rust is that it opens up the canopy to allow flammable undergrowth to grow. However, biocontrol agents will only rarely kill mature rubber vine plants on their own.</td>
</tr>
<tr>
<td>Medium (1000-2000 plants per ha)</td>
<td>Hotter fires are required to ignite and kill rubber vine in denser infestations. Either exclude stock to build up fuel, or burn after rust has defoliated rubber vine. Ideally, burn in late spring or after rain to avoid bare earth and erosion.</td>
<td>Cutter bar gives best control. Do not use on steep slopes.</td>
<td>Foliar or aerial spray, or apply registered herbicide to soil when actively growing.</td>
<td></td>
</tr>
<tr>
<td>Heavy (more than 2000 plants per ha)</td>
<td>Blade ploughing can kill most rubber vine, but is mainly used to open up infestations and allow better access. Do not use on steep slopes.</td>
<td>Aerial spray or apply registered herbicide to soil. Note it is very expensive to control large infestations with herbicides, and foliar sprayed herbicides are less effective on rubber vine infected with rust.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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Giant rat’s tail grass and other weedy *Sporobolus* species

*Sporobolus pyramidalis*, *S. natalensis*, *S. Jacquemontii*, *S. fertilis* and *S. africanus*

Weedy *Sporobolus* can out-compete desirable pasture grasses

Giant rat’s tail grass and other weedy *Sporobolus* grasses are invasive grasses that can reduce pasture productivity, out-compete desirable pasture grasses and cause significant degradation of natural areas.

These species were originally introduced as contaminants in pasture seed and have now adapted well to large areas of eastern Australia.

Five species of introduced *Sporobolus* grasses are declared Class 2 plants in Queensland:

- giant rat’s tail grass (*S. pyramidalis* and *S. natalensis*)
- American rat’s tail grass (*S. Jacquemontii*)
- giant Parramatta grass (*S. fertilis*)
- Parramatta grass (*S. africanus*).

Declaration details

Under Queensland’s *Land Protection (Pest and Stock Route Management) Act 2002*, landholders are required to control Class 2 declared pests on land and waters under their control. Local governments may serve notices to landholders requiring control of declared pests.

One seed head of giant rat’s tail grass can produce up to 85 000 seeds per year with initial seed viability of about 90%.

Description and general information

Weedy *Sporobolus* grasses are robust, tufted, perennial grasses growing up to 2 m tall. They are difficult to distinguish from other pasture grasses before maturity. However, their leaves are noticeably tougher than those of any other species.

They can also be difficult to distinguish from native *Sporobolus* grasses; however, the native grasses tend to be shorter and softer and have less dense seed heads than giant rat’s tail grass. The seeds of all species are indistinguishable in pasture seed samples using current identification techniques.

Weedy *Sporobolus* seeds are spread:

- by livestock (up to 30 000 viable seeds/beast/day) in manure and on fur and hooves
- by feral and native animals
- on vehicles and machinery (especially slashers and earthmoving equipment)
- in hay and untested pasture seed by fast-flowing water over turf.
**Giant rat's tail grass**

Giant rat’s tail grass grows to 0.6−1.7 m tall, with a seed head of up to 45 cm long and 3 cm wide. Seed head shape changes from a ‘rat’s tail’ when young to an elongated pyramid shape at maturity. Unlike Parramatta grass and giant Parramatta grass, giant rat’s tail grass does not develop ‘sooty spike’ on its seed heads.

Distribution of *S. natalensis*—Rockhampton (Queensland) to Port Macquarie (New South Wales).

Distribution of *S. pyramidalis*—Cooktown (Queensland) to Central Coast (New South Wales).

**American rat’s tail grass**

American rat’s tail grass grows to 50−75 cm tall, with a seed head of up to 25 cm long and 0.5−3 cm wide.

Distribution—Cape York (Queensland and Northern Territory) to South East Queensland.

**Giant Parramatta grass**

Giant Parramatta grass grows to 0.8−1.6 m tall, with a seed head of up to 50 cm long and 1−2 cm wide. The branches of the seed head are pressed against the axis and overlap, although lower ones generally spread at maturity.

Distribution—Mossman (Queensland) to Central Coast (New South Wales).

**Parramatta grass**

Parramatta grass grows to 0.15−1.1 m tall, with a seed head of up to 50 cm long and 1−2 cm wide. The leaves of mature plants are slender and erect, 6−18 cm long. Parramatta grass is not as invasive as giant Parramatta grass.

Distribution—Brisbane (Queensland) to Adelaide (South Australia).

**Potential damage**

Weedy *Sporobolus* grasses:

- have low palatability when mature
- are difficult to control
- can quickly dominate a pasture, especially following overgrazing or soil disturbance
- can affect cattle health and productivity (including finishing times, weaning percentages and weights)
- can set seed throughout frost-free periods (with a significant proportion of seed remaining viable for up to 10 years)
- can become a serious fire hazard in spring months.

**Habitat and distribution**

Giant rat’s tail grass has adapted to a wide range of soils and conditions.

Ecolimatic modelling suggests giant rat’s tail grass is suited to conditions present in 30% of Australia (223 million ha) and 60% of Queensland (108 million ha), including areas receiving as little as 500 mm average annual rainfall.

**Control**

**Prevention**

Maintain vigorous, dense pastures and use higher grass seed sowing rates to reduce the chance of invasion and to increase competition against weedy *Sporobolus* seed establishment. Do not expect heavy grazing to control weedy *Sporobolus* grasses—research indicates that grazing may actually favour its spread.

When moving stock from infested areas into clean areas, spell the stock in yards for at least five days. Similarly, spell stock purchased from known or suspected infested areas before releasing them into larger paddocks. Alternatively, quarantine new stock in a densely pastured, well-monitored holding paddock. Move stock when there is no dew or rain, to decrease the amount of seed sticking to their coats (see Table 1).

Establish weed-free buffer strips along boundary or perimeter fences, drainage lines and roadsides to restrict the spread of weedy *Sporobolus* grasses. Always clean machinery thoroughly after working in infested areas. Follow integrated control strategies using herbicides and other control methods, combined with good property hygiene.

Consider the attributes of replacement pasture grasses when deciding what to sow. If possible, choose grasses that are:

- well adapted to local environmental conditions and soil types
- stoloniferous or rhizomatous in growth habit
- resistant to heavy grazing
- palatable and productive
- competitive all year (i.e. do not open up in late winter/spring)
- not inclined to decline as soil fertility decreases
- fast to establish.

If a sown pasture species does not contain most of these attributes, it is unlikely to be successful as part of a weedy *Sporobolus* grass control program.

Some pasture species, while providing strong competition once established, are weak competitors with weedy *Sporobolus* grasses in their early stages of establishment (e.g. Koronivia grass and Bisset creeping blue grass). These grasses are most successful against weedy *Sporobolus* when sown with other grasses that are vigorous when young and provide early competition against weedy *Sporobolus* grasses (e.g. Rhodes grass). See *Weedy Sporobolus grasses: best practice manual* (Queensland Department of Primary Industries, revised edition 2007) for further information about pasture species that can be used in particular situations.

Suppliers must not supply anything containing reproductive material of a plant that is a Class 1 or Class 2 pest under the Land Protection (Pest and Stock Route Management) Regulation 2003.
Management strategies

Always commence control programs in areas of light infestation, and work towards the denser infestations.

If, after considering the management options set out below, you choose to use a herbicide option, ensure you apply all herbicides strictly according to the directions on the label and the directions of any Australian Pesticides and Veterinary Medicines Authority (APVMA) permit. You must read APVMA permit 9792 if you wish to prepare or use products for the control of *Sporobolus* weeds in situations other than those specified on the product label.

Some herbicides permitted or registered for giant rat’s tail grass control have withholding periods and significant ongoing management requirements in grazing and dairy farming. If you have or may have dairy or beef cattle on your property at any stage in the future, carefully consider these requirements when choosing herbicides for use on your property.

Some details of management options are provided below.

**Scattered plants and light infestations**

Choose one of the following options:

(a) Spot spray with glyphosate.

(b) Spot spray with flupropanate.

(c) Use glyphosate through a pressurised wick wiper.

(d) Hand chip, bag and remove stools from the paddock and burn them.

**Dense infestations on arable land**

(a) Cropping option

**First summer**

1. Boom spray with glyphosate as per label or permit directions and burn prior to ploughing.

2. Spot spray or hand chip fence lines, headlands, drainage lines, shelter belts etc. for weedy *Sporobolus* grasses missed in cultivation. Plant a long-season forage sorghum variety using a recommended pre-emergent herbicide.

3. Spot spray or hand chip any surviving weedy *Sporobolus* grasses to prevent reseeding.

**Second summer**

1. Boom spray with glyphosate to control crop regrowth and any weedy *Sporobolus* seedlings.

2. Plant paddocks with improved pastures using minimum tillage techniques to restrict bringing buried seed to the surface. Use a direct drill planter or surface broadcasting and rolling techniques. Plant fast-growing pasture grasses at triple the standard sowing rates to compete with weedy *Sporobolus* seedlings.

3. Fertilise the pasture for fast pasture establishment.

4. Spot spray or hand chip weedy *Sporobolus* seedlings.

(b) Pressurised wick wiper option

To be effective, this option requires three treatments over an 18-month period.

**First treatment (midsummer)**

1. Make sure there is a 30 cm height difference between weedy *Sporobolus* and other pasture plants by selective grazing of the ‘good’ pasture.

2. Wick wipe weedy *Sporobolus* grass using glyphosate as per label or permit directions.

3. Graze using increased stocking rates after wick wiping.

**Second treatment (late summer or autumn)**

Wick wipe weedy *Sporobolus* grass using glyphosate as per label or permit directions.

**Third treatment (next summer)**

Wick wipe weedy *Sporobolus* grass using glyphosate as per label or permit directions.

**Dense infestations on non-arable land**

Choose one of the following options:

(a) In summer, apply glyphosate through a pressurised wick wiper (if terrain and timber allow).

(b) In summer, boom or blanket spray with glyphosate in split applications as per label or permit directions (see Table 2) and replant the pasture using fast-growing pasture grasses at double the standard sowing rates.

(c) In winter or spring, boom or blanket spray with flupropanate as per label or permit directions.
Further information

Further information is available from your local government office, or by contacting Biosecurity Queensland (call 13 25 23 or visit our website at www.biosecurity.qld.gov.au).

Also refer to Weedy Sporobolus grasses: best practice manual (Queensland Department of Primary Industries, revised edition 2007).

Table 1. Best practices for management of weedy *Sporobolus* infested paddocks

<table>
<thead>
<tr>
<th>Dos</th>
<th>Don’ts</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Cattle</strong></td>
<td></td>
</tr>
<tr>
<td>• Manage the grazing and stocking rate to maintain good ground cover of pasture.</td>
<td>• Don’t overgraze, as this will create bare patches that allow weedy <em>Sporobolus</em> grass seedlings to emerge.</td>
</tr>
<tr>
<td>• Muster only in the afternoon when plants and seeds are dry.</td>
<td>• Don’t muster on wet days or when the soil is muddy.</td>
</tr>
<tr>
<td>• Restrict cattle to a small paddock or a laneway (on hay) for five days after grazing the weedy <em>Sporobolus</em> paddock.</td>
<td>• Don’t deliberately overstock paddocks infested with weedy <em>Sporobolus</em>.</td>
</tr>
<tr>
<td>• Muster on foot or on horseback to prevent seed contamination of machinery.</td>
<td>• Avoid creating bare ground from trampling around mineral licks etc.</td>
</tr>
<tr>
<td><strong>Machinery</strong></td>
<td></td>
</tr>
<tr>
<td>• Provide a specific hose-down tarmac to clean contaminated machinery.</td>
<td>• Don’t slash infested paddocks unless they are part of a wick wiping program.</td>
</tr>
<tr>
<td>• Keep roadways, laneways, stock routes and machinery corridors free of weedy <em>Sporobolus</em>.</td>
<td>• Don’t drive vehicles through infested paddocks.</td>
</tr>
<tr>
<td><strong>General hygiene</strong></td>
<td></td>
</tr>
<tr>
<td>• Enclose specimens for identification in tied fertiliser bags.</td>
<td>• Don’t drive around the farm with a suspected weedy <em>Sporobolus</em> specimen in the cabin or in the back of the ute.</td>
</tr>
<tr>
<td><strong>Pasture management</strong></td>
<td></td>
</tr>
<tr>
<td>• Maintain pasture vigour with a maintenance fertiliser program.</td>
<td>• Don’t allow soil fertility run-down, as this favours weedy <em>Sporobolus</em> establishment.</td>
</tr>
<tr>
<td>• Use band seeding if possible, as this is the ‘safest’ method to plant legumes into an infested pasture.</td>
<td>• Don’t renovate an infested pasture.</td>
</tr>
<tr>
<td>• Plant the recommended competitive pasture grasses.</td>
<td>• Don’t burn the pasture unless it is part of a wick wiping, pre-cropping pasture replacement strategy.</td>
</tr>
<tr>
<td><strong>Hay and pasture seed</strong></td>
<td></td>
</tr>
<tr>
<td>• Determine the origin of hay and ask for a weed hygiene declaration.</td>
<td>• Don’t knowingly purchase hay contaminated with weedy <em>Sporobolus</em>.</td>
</tr>
<tr>
<td>• Feed hay in a yard, feedlot or small holding paddock.</td>
<td>• Don’t buy seed without knowing its origin.</td>
</tr>
<tr>
<td>• Only purchase seed from a reputable seed merchant.</td>
<td>• Don’t buy seed unless it has a weed hygiene declaration.</td>
</tr>
<tr>
<td><strong>Control strategies</strong></td>
<td></td>
</tr>
<tr>
<td>• Choose the best control strategy based on the paddock situation and the weedy <em>Sporobolus</em> population before starting the job.</td>
<td>• Don’t spot spray with glyphosate using a high-pressure gun from the cabin of the ute.</td>
</tr>
<tr>
<td>• If dairy or beef cattle will be in the paddock at any time in the future, carefully consider the exclusion and withholding requirements of the herbicides and their long-term implications before commencing treatments.</td>
<td>• Don’t wave the spray gun around—if the weedy <em>Sporobolus</em> is dense, you should not be spot spraying.</td>
</tr>
<tr>
<td>• If spot spraying with glyphosate, operate close enough to step on the plant and spray downwards.</td>
<td>• Don’t overspray with glyphosate past the point of spray run-off.</td>
</tr>
<tr>
<td>• Use low-pressure spraying equipment to reduce the risk of overspraying.</td>
<td></td>
</tr>
<tr>
<td>• Always spot spray the single ‘scout’ plants around the perimeter of the infestation first, then work inwards.</td>
<td></td>
</tr>
</tbody>
</table>
The herbicides in Table 2 are permitted under PER9792, which expires on 30 November 2015. You must read the permit if you wish to prepare or use products for the control of *Sporobolus* weeds in situations other than those specified on the product label. The permit is available on the APVMA website, www.apvma.gov.au

**Table 2. Herbicides permitted for the control of *Sporobolus* weeds**

<table>
<thead>
<tr>
<th>Situation</th>
<th>Application method</th>
<th>Herbicide</th>
<th>Rate</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pasture, grazed woodlands and agricultural situations prior to sowing;</td>
<td>Boom spraying</td>
<td>Glyphosate (360 g/L)</td>
<td>6 L/ha</td>
<td></td>
</tr>
<tr>
<td>tree and vine crops; lucerne; agricultural non-crop situations</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wasteland; forest and conservation areas; margins of aquatic areas;</td>
<td>Boom spraying</td>
<td>Glyphosate (360 g/L)</td>
<td>3 L/ha + 3 L/ha</td>
<td>Follow up the first treatment with a later knockdown treatment such as</td>
</tr>
<tr>
<td>roadsides and easements; rights of way; commercial and industrial areas;</td>
<td>Double knockdown</td>
<td></td>
<td></td>
<td>herbicide or tillage.</td>
</tr>
<tr>
<td>turf; playing fields; golf courses; public service areas; areas</td>
<td>split application</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>surrounding agricultural buildings</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pasture, grazed woodlands and agricultural situations prior to sowing;</td>
<td>Spot spraying</td>
<td>Glyphosate (360 g/L)</td>
<td>1 L per 100 L water</td>
<td></td>
</tr>
<tr>
<td>tree and vine crops; lucerne; agricultural non-crop situations</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wasteland; forest and conservation areas; margins of aquatic areas;</td>
<td>Double knockdown</td>
<td>Glyphosate (360 g/L)</td>
<td>1 L + 1 L per 100 L water</td>
<td>Follow up the first treatment with a later knockdown treatment such as</td>
</tr>
<tr>
<td>roadsides and easements; rights of way; domestic, commercial and</td>
<td>split application</td>
<td></td>
<td></td>
<td>herbicide or tillage.</td>
</tr>
<tr>
<td>industrial areas; turf; playing fields; golf courses; public service</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>areas; areas surrounding agricultural buildings</td>
<td>Wick wiping</td>
<td>Glyphosate (360 g/L)</td>
<td>3.3 L per 10 L water</td>
<td></td>
</tr>
<tr>
<td>Pasture; grazed woodlands;</td>
<td>Boom spraying</td>
<td>Flupropanate (745 g/L)</td>
<td>1.5–2 L/ha</td>
<td>Do not use in channels, drains or watercourses.</td>
</tr>
<tr>
<td>agricultural non-crop situations</td>
<td></td>
<td></td>
<td></td>
<td>Do not reseed treated areas until at least 100 mm of leaching rain has</td>
</tr>
<tr>
<td>Wasteland; forest and conservation areas; roadsides and easements;</td>
<td></td>
<td></td>
<td></td>
<td>fallen.</td>
</tr>
<tr>
<td>rights of way; commercial and industrial areas</td>
<td></td>
<td></td>
<td></td>
<td>Do not spray near desirable susceptible trees.</td>
</tr>
<tr>
<td>Suppression of seedlings in</td>
<td></td>
<td></td>
<td></td>
<td>Do not apply above 3 L/ha to steeply sloping sites.</td>
</tr>
<tr>
<td>improved pasture</td>
<td></td>
<td></td>
<td></td>
<td>Allow 3–12 months for control, depending on weather conditions and</td>
</tr>
<tr>
<td>Pasture; grazed woodlands;</td>
<td>Spot spraying</td>
<td>Flupropanate (745 g/L)</td>
<td>200 mL per 100 L water</td>
<td>High rates will kill native grasses.</td>
</tr>
<tr>
<td>agricultural non-crop situations</td>
<td></td>
<td></td>
<td></td>
<td>Apply once per year.</td>
</tr>
<tr>
<td>Wasteland; forest and conservation areas; roadsides and easements;</td>
<td>Wick wiping</td>
<td>Flupropanate (745 g/L)</td>
<td>500 mL per 10 L water</td>
<td>Monitor treated areas regularly for any regrowth.</td>
</tr>
<tr>
<td>rights of way; commercial and industrial areas; golf courses; public</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>service areas; areas surrounding agricultural buildings</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

1 Read APVMA permit PER9792 for rates for products containing glyphosate at 450 g/L or 540 g/L.
Withholding periods

Glyphosate
Not required when used as directed.

Flupropanate

- **Broadacre**: Do not graze or cut for stock feed for at least 4 months after application.
- **Spot spray**: Do not graze or cut for stock feed for at least 14 days after application.
- Do not allow stock to graze in treated areas for at least 14 days prior to slaughter.
- Do not allow lactating cows or goats to graze in treated areas.

Records

If you graze cattle on more than 2000 ha in the Wet Tropics, Burdekin Dry Tropics or Mackay Whitsunday catchments, you must keep records on the use of flupropanate. See the Reef Wise Farming website, www.reefwise.farming.qld.gov.au

Vendor declarations

If any stock from a flupropanate-treated area are sold, the seller must ensure that details relating to the grazing of stock on the treated land are disclosed in accordance with the obligations outlined on the national vendor declaration relating to that type of livestock. See the Meat & Livestock Australia website, www.mla.com.au, for further details on national vendor declarations.
Groundsel bush
*Baccharis halimifolia*

Groundsel bush rapidly colonises disturbed areas, especially overgrazed pastures. It competes with pasture species for water and nutrients. Groundsel bush spreads rapidly from windborne seed, making clearing groundsel bush from paddocks a very time-consuming and expensive task.

In native *Melaleuca* wetlands, groundsel bush can form a dense understorey, suppressing growth of native sedges and interfering with the natural ecosystem.

Groundsel bush can become abundant in the vegetation along watercourses and in coastal woodlands and forest areas if not controlled.

The wind-dispersed seed can be a nuisance in urban areas where it sticks to insect screens and germinates in home gardens. Urban problems include potential allergies caused by airborne pollen and seed ‘fluff’.

**Declaration details**

Groundsel bush is a declared Class 2 pest plant 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 and 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. A local government may serve a notice upon a landholder requiring control of declared pests.
Description and general information

Groundsel bush is a densely branched shrub usually no more than 3 m high. Stems are green, maturing to brown and woody. Bark of mature plants is deeply fissured. Leaves are dull green, alternate, wedge shaped, 2.5–5 cm long and 1–2.5 cm wide, with a few lobes in the upper part. It has a deep branching taproot with numerous fibrous laterals in the upper soil.

Male and female flowers are borne on separate plants. Male flowers are pale yellow and open around mid to late March, slightly earlier than the female flowers. Female flowers are white and inconspicuous at the end of branches until seeds are fully developed. Then the plant has a fluffy appearance, with tufts of white hair (around late March to early April) that begin to blow the fluffy seeds in the breeze from mid to late April.

Habitat and distribution

Groundsel bush is a native of Florida (United States) and coastal areas adjacent to the eastern side of the Gulf of Mexico.

It was introduced into the Brisbane region as an ornamental plant in 1900 and has spread along the coastal areas of south-east Queensland (north to Miriam Vale) and down the New South Wales coast. Scattered plants have occurred as far west as the Chinchilla region.

Groundsel bush is a rapid coloniser of cleared, unused land and is particularly suited to moist gullies, salt marsh areas and wetlands. It also does well on high, cleared slopes.

Most germination occurs in the autumn/winter period. Plants normally do not flower in the first year of growth. Plants that are 2m tall can produce from 500 000 to a million seeds.

Seeds from mature plants drift in the breeze like thistle seeds, most falling within a few metres of the parent bush. Wind updrafts can carry seeds many kilometres. Seeds germinate readily with rainfall; however, if they become buried they can remain dormant for several years.

Seeds are readily transported by wind, running water, vehicles and machinery. Soil disturbance in infested areas usually leads to substantial germination. Further infestation occurs unless the ground is sown to pasture or other competitive ground cover.

Prevention

The spread of groundsel bush threatens the sustainability of agriculture and other land uses. Groundsel bush can replace plants and destroy habitat for native wildlife.

The best form of weed control is prevention. Always treat weed infestations when small—do not allow weeds to establish. Weed control is not cheap, but it is cheaper to do it now rather than next year, or the year after. Proper management planning ensures you get value for each dollar spent.

Control

Look at your weed problem carefully. Can you realistically eradicate it? Or should you contain the weed to stop new infestations developing while you reduce existing ones? What are you required to do by legislation? How does weed control fit into your property management? What can you do to restore areas and prevent re-establishment?

The best approach is usually to combine different methods. Control may include chemical, mechanical, fire and biological methods combined with land management changes. The control methods you choose should suit your particular situation.

Management strategies

In grazing situations, good pasture management will greatly reduce groundsel bush invasions. Slashing, timely use of fertiliser and management of stocking rates can assist in control by maintaining a healthy pasture. Good pastures provide competition to limit re-invasion of groundsel bushes. Consult pasture agronomists on the best options for your property.

For tall, dense infestations, burning can reduce the amount of above-ground material (and even kill the odd plant) making it a lot easier to spray regrowth. Annual burning does not reduce existing plant numbers, but allows grasses to establish more quickly and out-compete groundsel bush seedlings.

Regular slashing over a period of several years will result in a decreased level of infestation. In non-grazing situations, reforestation will eventually assist in control of groundsel bush. However, it is important to ensure that seed production is prevented while trees are establishing.
Biological control

Since the biological control program began for groundsel bush in 1967, over 35 different insects have been tested but only six have become permanently established in the field:

1. Stem borer (*Megacyllene mellyi*)—This beetle is restricted to areas adjacent to salt marshes where the sap flow in the host plant is lower. Newly hatched larvae are drowned by the heavier sap flow in plants growing in non-saline soils. Dense populations of this insect can reduce groundsel bush infestations in suitable habitats.

2. Plume moth (*Oidaematophorus balanotes*)—This insect is present in all areas. Damage is caused by larvae tunnelling in the stems and varies from severe dieback to death of individual branches. Populations of the moth appear to be restricted by ant predation on the eggs and young larvae. This in turn restricts plant damage.

3. Gall-fly (*Rhopalomyia californica*)—The larvae of this mosquito-like fly feed within development shoots and buds. Initially this insect caused heavy damage when it was released. However, soon after its release it was attacked by a small native wasp that drastically reduced gall numbers. Galls can always be found in low numbers, but occasionally higher numbers are found in patches. Overall damage to the plant is minimal.

4. Groundsel bush leaf beetle (*Trirhabda baccharidis*)—This beetle is restricted to similar habitats to the stem borer, where the larvae can form suitable cocoons and pupate in the soil. Plants will be totally defoliated in autumn, but can recover and are in full leaf next spring. In some years larvae severely damage the buds and flowers.

5. Leaf skeletoniser (*Aristotelia ivae*)—The larvae of this moth eat the soft leaf tissue leaving the skeletal woody veins. Though widespread, populations do not become large enough to cause significant damage. It is most commonly found in the spring on new leaves.

6. Leaf miner (*Buccalatrix iveila*)—The larvae of this small moth mine in the leaf blades and later skeletonise the leaves in a manner similar to *Aristotelia*. This insect is widespread within the range of groundsel bush and causes minor damage.

Research has seen a move away from insect biocontrol to plant disease biological control agents. Two diseases have been studied in Florida. Experimental field releases of the rust fungus *Puccinia evadens* from Florida commenced in 1998 and this pathogen is now established at several sites.

Groundsel bush rust (*Puccinia evadens*) acts as both a leaf and stem parasite, causing defoliation during summer and winter and stem dieback over summer. The infection process requires a moisture film on the leaf or stem surface. The dry spores are spread by wind.

The presence of these biocontrol agents does not relieve landholders from their responsibility under Queensland legislation to control declared plants.

Mechanical control

Hand-pull small plants. Dig larger plants out or cut them off more than 10 cm below ground level.

As groundsel bush is a perennial woody plant with underground growing buds, slashing or burning will rarely kill plants and such action will generally result in regrowth occurring. Therefore the regrowth will need to be promptly controlled.

Herbicide control

Before using any herbicide, always read the label carefully. All herbicides must be applied strictly in accordance with the directions on the label.

Table 1 details the herbicides registered for groundsel bush control.

Further information

Further information is available from your local government office, or by contacting Biosecurity Queensland (call 13 25 23 or visit our website at www.biosecurity.qld.gov.au).
Table 1 Herbicides registered for the control of groundsel bush

<table>
<thead>
<tr>
<th>Situation</th>
<th>Herbicide</th>
<th>Rate</th>
<th>Comments¹⁻²⁻³</th>
<th>Notes</th>
</tr>
</thead>
</table>
| Pastures; non-agricultural, commercial, industrial land; rights of way | 2,4-D amine 500 g/L | 3.6–5.5 L/ha 0.4 L/100 L 300 mL/15 L 1.2 L/15 L | Air—higher rate for bushes High volume foliar spray Cut stump Misting | Pasture legumes are susceptible to these herbicides.
| | | | | ² | Cut stump treatments—cut as close to ground as possible and apply mixture immediately (within 15 seconds).
| | | | | ³ | Basal bark treatments—paint/spray 25 cm band around base of each stem.
| Pastures; non-agricultural land | 2,4-D acid | 10 L/ha 33 mL/1 L kero or turps 100 mL/10 L 1 L/10 L 0.37 L/ha 1 L/40 L diesel | Helicopter spraying Basal bark or cut stump Knapsack foliar spray Sprinkler spray—1 L/100 m² | Glyphosate will kill pasture species.
| Commercial, industrial land; pastures; rights of way | 2,4-D sodium (e.g. Tornado DF) | 0.275 kg/100 L | Spot spray | ⁵ Cannot be used in hazardous areas without a DAFF permit.
| Irrigation channels/banks; non-agricultural, commercial, industrial land; home gardens; pastures; rights of way; forests | Glyphosate⁴—IPA 360 g/L | 0.7–1 L/100 L 100–150 mL/15 L 1:9 (2 x 2 mL dose per 0.5 m bush height) | Handgun—high rate in winter Knapsack foliar spray Splatter gun foliage |
| Commercial, industrial land; pastures; rights of way | Picloram + 2,4-D 75 g + 300 g (e.g. Tordon 75-D⁰) | 0.65 L/100 L | Spot spray foliage |
| Commercial, industrial land; pastures; rights of way; forests | Picloram + triclopyr (premix) (e.g. Grazon DS® ⁵) Access | 0.25–0.35 L/100 L 2.5 L/100 L 30 mL/15 L 1 L/60 L diesel | Handgun foliage Misting foliage Knapsack foliage Basal bark or cut stump |
| Recreational, commercial, industrial land; pastures; rights of way; forests | Triclopyr 600 g/L (e.g. Garlon 600⁶) Home garden packs (e.g. Defender Chemspray, Garden King) | 0.16–0.32 L/100 L  water 1 L/120 L diesel 25–50 mL/15 L 50 g/L 120 g/L 0.1–0.2 L/5 L water 0.1 L/0.5 L kerosene | Overall spray foliage Basal bark or cut stump Knapsack foliage Overall spray foliage Basal bark or cut stump Knapsack foliage Basal bark or cut stump |
| Grass pasture | Dicamba + MCPA (premix) (e.g. Banvel M⁶) | 2.8–4 L/ha 0.19–0.27 L/100 L 60 mL/15 L | Knapsack foliage |
| Pastures; forests; rights-of-way | Clopyralid (e.g. Lontrel⁹) | 0.33–0.5 L/100 L | Handgun foliage |
| Pastures | Tebuthiuron 200 g/kg (e.g. Graslan⁹) | 1 gm/m² | Hand application (restrictions on use apply) |

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

Notes:

¹ Pasture legumes are susceptible to these herbicides.
² Cut stump treatments—cut as close to ground as possible and apply mixture immediately (within 15 seconds).
³ Basal bark treatments—paint/spray 25 cm band around base of each stem.
⁴ Glyphosate will kill pasture species.
⁵ Cannot be used in hazardous areas without a DAFF permit.
Singapore daisy
*Sphagneticola trilobata*

Singapore daisy spreads rapidly and smothers seedling, ferns and shrubs and will out-compete them for survival. Singapore daisy is invading all different environmental areas, even living in sand. Singapore daisy is difficult to control.

Declaration details

Singapore daisy is a declared Class 3 plant under the *Land Protection (Pest and Stock Route Management) Act 2002*. The Act prohibits the supply or sale of Class 3 plants and may require their removal from within, or adjacent to, environmentally significant areas.
Description and general information

Singapore daisy is a vigorous ground cover with lush glossy green leaves. The leaves are usually 3 lobed and in pairs up the stem. Singapore daisy produces yellow to orange-yellow daisy flowers about 2 cm across all year round. The flowers are held above the leaves on short stalks. Singapore daisy is a garden escapee and native of tropical America.

Control

Singapore daisy produces variable amounts of seeds but is mainly spread by cuttings via slashing and pruning. Revegetation of the cleared area should be pre planned to ensure that other weeds do not gain a foothold in the disturbed area, include mulching to keep weeds down.

Further information

Further information is available from your local government office, or by contacting Biosecurity Queensland (call 13 25 23 or visit our website at www.biosecurity.qld.gov.au).

Table 1. Herbicides registered for the control of Singapore daisy

<table>
<thead>
<tr>
<th>Method</th>
<th>Herbicide</th>
<th>Rate</th>
<th>Registration status</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Foliar spray</td>
<td>metsulfuron-methyl (600 g/L)</td>
<td>10 g per 100 L water plus wetting agent</td>
<td>10 g per 100 L water plus wetting agent</td>
<td>Spray thoroughly to wet all foliage, but not to cause run-off. Minimise contact with desirable species.</td>
</tr>
</tbody>
</table>

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

This fact sheet is developed with funding support from the Land Protection Fund.

Fact sheets are available from Department of Agriculture, Fisheries and Forestry (DAFF) service centres and our Customer Service Centre (telephone 13 25 23). Check our website at www.biosecurity.qld.gov.au to ensure you have the latest version of this fact sheet. The control methods referred to in this fact sheet 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, DAFF does not invite reliance upon it, nor accept responsibility for any loss or damage caused by actions based on it.

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Lantana

*Lantana camara*

Currently, lantana covers more than 5 million ha of the east coast from southern New South Wales to Far North Queensland. Small infestations of lantana have also been found in central west Queensland, the Northern Territory, Western Australia, South Australia and Victoria. Efforts are under way to control these.

Lantana is mainly spread by people (as ornamental plants) and fruit-eating birds. It forms dense thickets that smother and kill native vegetation and are impenetrable to animals, people and vehicles.

Research indicates more than 1400 native species are negatively affected by lantana invasion, including many endangered and threatened species. As lantana is a woody shrub that has thin, combustible canes, its presence can also create hotter bushfires.

**Declaration details**

All lantana species are declared Class 3 plants under the *Land Protection (Pest and Stock Route Management) Act 2002*. Lantana species cannot be sold or distributed and landholders may be required to control these plants if they pose a threat to an environmentally significant area.

**Description and general information**

Lantana is a heavily branched shrub that can grow in compact clumps, dense thickets or as a climbing vine.

The stems are square in cross section, with small, recurved prickles. Most leaves are about 6 cm long and are covered in fine hairs. They are bright green above, paler beneath and have round-toothed edges. Leaves grow opposite one another along the stem. When crushed the leaves produce a distinctive odour.

Flowers appear throughout most of the year in clustered, compact heads about 2.5 cm in diameter. Flower colours vary from pale cream to yellow, white, pink, orange and red. Lantana produces round, berry-like fruit that turn from glossy green to purplish-black when ripe.

For rural producers, lantana poses problems of stock poisoning and invasion of desirable pasture. An economic impact assessment indicated lantana costs the Queensland grazing sector in excess of $70 million (2005–06 values) per year. It is now illegal to sell or distribute any variety of lantana in Queensland. However, garden plantings are still common in many areas and have the potential to cause problems of their own.
Despite being sold and marketed as ‘sterile’ plants, research indicates some ornamental lantana varieties have the ability to set seed and can spread vegetatively. They also produce some viable pollen and have the potential to cross-pollinate with wild forms, creating new varieties that could naturalise in the environment.

If the number of naturalised varieties increases due to genetic drift from ornamental varieties it will make finding effective biological control agents even more difficult, and potentially extend the climatic tolerances and range of the weed’s spread.

Habitat and distribution

Lantana is native to the tropical and subtropical regions of Central and South America. It is found throughout most coastal and subcoastal areas of eastern Australia, from Far North Queensland to southern New South Wales. It grows in a wide variety of habitats, from exposed dry hillsides to wet, heavily shaded gullies.

Toxicity

Many lantana varieties are poisonous to stock. It is difficult to tell which varieties are toxic so it is better to treat all forms as potentially poisonous. The toxins in lantana include the triterpene acids, lantadene A (rehmannic acid), lantadene B, and their reduced forms.

Most cases of lantana poisoning occur when new stock are introduced into lantana-infested areas. Stock bred on lantana-infested country avoid lantana unless forced to eat it due to lack of other fodder. Young animals introduced to lantana areas are most at risk.

Symptoms of lantana poisoning depend on the quantity and type of lantana consumed and, under some circumstances, the intensity of light to which the animals are exposed.

Early symptoms of depression are noticeable, with head swaying, loss of appetite, constipation and frequent urination. After a day or two the eyes and the skin of the nose and mouth start yellowing with jaundice, and the muzzle becomes dry and warm. The eyes may become inflamed and have a slight discharge. The animal also becomes increasingly sensitive to light. Finally, the muzzle becomes inflamed, moist and very painful (‘pink nose’). Areas of skin may peel and slough off. Death commonly occurs 1–4 weeks after symptoms occur. Death from acute poisoning can occur 3–4 days after eating the plant.

If animals show any of the early symptoms, they should be moved to lantana-free areas, kept in the shade and monitored. Veterinary treatment should be sought immediately. Some remedies may include intravenous fluids, treating skin damage with antibiotics, or drenching with an activated charcoal slurry.

Care should be taken when introducing new or young animals into a paddock if lantana is present. Ensure they have enough fodder to stop them eating lantana in quantities sufficient to result in poisoning. During drought, animals should not be placed in lantana-infested areas without alternative food.

Control

Using a mix (integration) of control methods gives the best results. Size, density and geographic location of infestations are important considerations for choosing which control methods to use. A general principle is to commence control programs in areas of light infestations and work towards the denser infestations.

For large lantana infestations, treatment with herbicides by foliar spraying is usually not economically feasible. However, fire, dozing/stick raking, slashing/cutting, aerial helicopter spraying can reduce dense infestations, making follow-up spot treatments with chemicals more economically viable.

Lantana seed banks remain viable for at least four years, so follow-up control to kill seedlings before they mature is vital to ensure initial management efforts to control the parent bush are not wasted.

Appropriate fire regimes may become part of a management program to ensure lantana invasiveness is reduced and pasture is maintained.

Removal of lantana within areas of remnant vegetation may require a permit under the Vegetation Management Act 1999. Further information should be sought from the Department of Environment and Resource Management before works commence.

Mechanical control

Stick raking or ploughing can be effective in removing standing plants. However, regrowth from stumps and/or increased seedling germination in disturbed soil is common and the site will require follow-up treatment.

Grubbing of small infestations—for example, along fence lines—can be a useful and effective method of removing plants, though this is time consuming.

Repeated slashing can also reduce the vigour of lantana, exhausting its stored resources and reducing its likelihood of re-shooting.

Some locations—for example, very steep inclines or gullies—are not suitable for mechanical control options because of the danger of overturning machinery and soil erosion.
Fire
Regular burning will reduce the capacity of plants to survive; however, initial kill rates are variable.

The effectiveness of this method will depend on the suitability of available fuel loads, fire intensity, temperature, relative humidity, soil moisture and season. Pasture re-establishment can then provide competition to inhibit lantana seed germination.

Fire is not recommended in non–fire tolerant vegetated areas such as rainforest, or wooded or plantation areas.

A typical control program for fire may include:

- exclude stock to establish a pasture fuel load
- burning (may require a permit)
- sow improved pastures—consult your local Biosecurity Queensland officer for advice
- continue to exclude stock until pasture has established and seeded
- burn again in summer before rain and spot spray lantana regrowth when > 0.5 m high and when it is actively growing (see Table 1).

Herbicide control
Herbicide recommendations for lantana are shown in Table 1. Users of herbicides have a legal obligation to read herbicide labels and use only the registered rates. Always use herbicides responsibly; adhere to legislation and safety requirements.

Variation in results can be a result of inconsistent application methods, mix rates or seasonal variation. Red-flowered and pink-edged red-flowered lantana are often considered the most difficult to control because their leaves are often smaller and tougher. However, herbicides can kill these varieties if you carefully follow application procedures.

For single-stemmed lantana, basal bark spraying and cut stump methods also give good results at any time of year (but best when the plant is actively growing). On multi-stemmed varieties, you will obtain best results by carefully applying herbicide to each stem.

When treating actively growing plants less than 2 m high, overall spraying of foliage to the point of run-off is recommended. Splatter gun techniques are also effective and particularly useful in hard-to-access areas. This is best done in autumn—when sap flows draw the poison down into the root stock, but before night temperatures get too cold.

Remove grazing animals from spray areas during and soon after treatment. Stress can cause increased sugar levels in the leaves of lantana plants, making them more palatable.

Landholders and contractors should check if the property is situated in a hazardous area. This prevents the use of some chemicals, as defined in the Agricultural Chemicals Distribution Control Act 1966.

Biological control
Since 1914, 31 biological control agents have been introduced into Australia in an attempt to control lantana. Seventeen have established, of which several insect species cause seasonal damage, reducing the vigour and competitiveness of lantana in some areas.

Biosecurity Queensland research programs continue to investigate agents suitable for release in Australia, and test the viability of these agents in an effort to identify more effective biological control agents.

It is important to remember that biological control alone should not be relied upon for managing lantana infestations. Consideration should be given to other available control techniques.

The four most important biological control agents are:

- **sap-sucking bug** (Teleonemia scrupulosa)
  Found in dry areas from Cooktown to Wollongong, this small, mottled, bug feeds on the underside of leaves, growing tips and flower buds, causing the leaves to drop early and stopping the plant from flowering.

- **leaf-mining beetle** (Uroplata girardi)
  Found in most lantana infestations from Cape Tribulation to Sydney as well as around Darwin, except in very dry or high altitude areas. The adult beetles are dark brown. They shelter in curled leaves and feed on the upper leaf surfaces. Larvae feed in leaves causing blotches to spread across the leaf. This beetle reduces plant vigour and can suppress flowering.

- **leaf-mining beetle** (Octotoma scabripennis)
  Found in most lantana infestations from Atherton to Wollongong. Adults of this species feed on the upper leaf surface, while larvae feed and mine the centre of the leaf and cause blotches. This activity reduces plant vigour and can suppress flowering.

- **seed-feeding fly** (Ophiomyia lantanae)
  Found from Cape Tribulation to Eden in New South Wales and also around Darwin and Perth. *Ophiomyia* is a small black fly that feeds on flowers and lays eggs on the green fruits. The maggots of the fly eat the seed and make the fruit unattractive to birds, reducing seed spread.

Other agents such as *Aconophora compressa* (a stem-sucking bug) and *Leptobyrsa decorata* (a sap-sucking bug) have caused some damage in specific geographic areas.

**Note:** Landholders are advised not to consume their time collecting established insects for distribution. Due to their own ability to disperse, these insects will be periodically/seasonally present in areas that are climatically suitable for them.

Further information
Further information is available from your local government office, or by contacting Biosecurity Queensland (call 13 25 23 or visit our website at [www.biosecurity.qld.gov.au](http://www.biosecurity.qld.gov.au)).
Table 1. Herbicides for control of lantana

<table>
<thead>
<tr>
<th>Method of application: active ingredient (trade name)(^a)</th>
<th>Rate</th>
<th>Optimum time(^b)</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Foliar (overall) spray</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fluroxypyr (Starane(^\circ) 200)</td>
<td>0.5 L to 1 L/100 L water</td>
<td>December to April</td>
<td>Thorough wetting of plants is required, higher rate should be used for larger plants</td>
</tr>
<tr>
<td>Glyphosate (Roundup(^\circ) 360, Glyphosate 360(^\circ))</td>
<td>1 L/100 L water</td>
<td>October to April</td>
<td>Wet plant thoroughly. Glyphosate affects any green plant it comes into contact with. Glyphosate is available in a range of strengths</td>
</tr>
<tr>
<td>Picloram + 2,4-D (Tordon(^\circ) 75-D)</td>
<td>0.65 L/100 L water</td>
<td>February to April</td>
<td>Wet plant thoroughly. Legumes are affected if sprayed</td>
</tr>
<tr>
<td>Dichlorprop (Lantana(^\circ) 600)</td>
<td>0.5 L/100 L water</td>
<td>December to April</td>
<td>Must thoroughly wet all leaves. Please refer to product label for situation details</td>
</tr>
<tr>
<td>Picloram + triclopyr + aminopyralid (Grazon Extra(^\circ))</td>
<td>0.35 L to 0.5 L/100 L water</td>
<td>February to April</td>
<td>Wet plant thoroughly. Use the higher rate on larger plants. Legumes may be affected if sprayed</td>
</tr>
<tr>
<td>2,4-D amine (Amicide(^\circ) 625)</td>
<td>0.32 L/100 L water</td>
<td>March to May</td>
<td>Red-flowered lantanas are more resistant to 2,4-D. Will kill young legumes</td>
</tr>
<tr>
<td>Metsulfuron methyl, (Brush-off(^\circ), Brushkiller(^\circ) 600, Lynx(^\circ) 600)</td>
<td>10 g/100 L water(^a)</td>
<td>March to May</td>
<td>Results variable. Not found effective in tropics. Follow-up sprays are necessary</td>
</tr>
<tr>
<td>Metsulfuron methyl + glyphosate (Cutout(^\circ))</td>
<td>95 g/100 L water</td>
<td>March to May</td>
<td>Apply to bushes up to 2 m tall. Spray to thoroughly wet all foliage and stems. Spray to penetrate throughout the bush</td>
</tr>
<tr>
<td>Metsulfuron methyl + glyphosate (Trounce(^\circ))</td>
<td>173 g/100 L water</td>
<td>March to May</td>
<td>Apply when actively growing. Do not apply during periods of stress</td>
</tr>
<tr>
<td>Aminopyralid + fluroxypyr (Hotshot(^\circ))</td>
<td>0.5 L to 0.7 L/100 L water</td>
<td>October to April</td>
<td>Spray all foliage, including stems, to the point of run-off</td>
</tr>
<tr>
<td>(i) Basal bark</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(ii) Cut stump</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Triclopyr (Garlon 600(^\circ))</td>
<td>1 L/60 L diesel</td>
<td>Any time. Best results when actively growing</td>
<td>(i) Apply to lower 40 cm of every stem. Must ensure complete coverage around stem (ii) Cut close to ground level. Immediately apply herbicide</td>
</tr>
<tr>
<td>2,4-D ester (AF Rubber Vine Spray(^\circ))</td>
<td>2.5 L/100 L diesel</td>
<td>Any time. Best results when actively growing</td>
<td>As above</td>
</tr>
<tr>
<td>Picloram + Triclopyr (Access(^\circ))</td>
<td>1 L/60 L diesel</td>
<td>Any time. Best results when actively growing</td>
<td>As above</td>
</tr>
<tr>
<td>Picloram (Vigilant(^\circ) Herbicide Gel)</td>
<td>3 mm to 5 mm gel</td>
<td>Any time. Best results when actively growing</td>
<td>(ii) If diameter of stump is &gt; 20 mm, use a minimum of 5 mm gel thickness</td>
</tr>
<tr>
<td>Glyphosate (Roundup(^\circ), Weedmaster Duo(^\circ))</td>
<td>Neat</td>
<td>Any time. Best results when actively growing</td>
<td>Off-label permit</td>
</tr>
<tr>
<td>Splatter gun</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Glyphosate (Roundup(^\circ) 360)</td>
<td>1:9 glyphosate + water</td>
<td>October to April</td>
<td>2 x 2 ml dose per 0.5 m height of lantana</td>
</tr>
<tr>
<td>Metsulfuron methyl (Brushkiller(^\circ) 600, Lynx(^\circ) 600)</td>
<td>2 g/L water</td>
<td>March to May</td>
<td>As above</td>
</tr>
<tr>
<td>Aerial</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Picloram + triclopyr + 2,4-D (Grazon(^\circ) DS + 2,4-D amine 625 g/L)</td>
<td>1.5 L + 6 L/ha or 10 L/ha (Grazon(^\circ))</td>
<td>When plant actively growing</td>
<td>Helicopter only. Minimum of 200 L water per hectare. Follow-up re-spray will be required. Do not burn within six months of treatment</td>
</tr>
<tr>
<td>Dichlorprop (Lantana(^\circ) 600)</td>
<td>6 L to 8 L/ha</td>
<td>When plant actively growing</td>
<td>As above</td>
</tr>
</tbody>
</table>

\(^a\) Only some common trade names provided.  
\(^b\) Optimum times are only a guide. Lantana must be actively growing for the herbicide to work.  
\(^\circ\) = Registered trade name.  
Labels often recommend the additional use of a wetting agent or surfactant within the mix. Herbicides types vary in their selectivity against other species and soil residual.

Fact sheets are available from the Department of Employment, Economic Development and Innovation (DEEDI) service centres and our Customer Service Centre (telephone 13 25 23). Check our website at [www.biosecurity.qld.gov.au](http://www.biosecurity.qld.gov.au) to ensure you have the latest version of this fact sheet. The control methods referred to in this fact sheet 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, DEEDI does not invite reliance upon it, nor accept responsibility for any loss or damage caused by actions based on it.


4 Lantana Lantana camara
Lantana (Lantana camara)

The problem

Lantana 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.

Lantana forms dense, impenetrable thickets that take over native bushland and pastures on the east coast of Australia. It competes for resources with, and reduces the productivity of, pastures and forestry plantations. It adds fuel to fires, and is toxic to stock.

Lantana is a serious threat to biodiversity in several World Heritage-listed areas including the Wet Tropics of northern Queensland, Fraser Island and the Greater Blue Mountains. Numerous plant and animal species of conservation significance are threatened. It is listed as the most significant environmental weed by the South-East Queensland Environmental Weeds Management Group.

It is a problem in gardens because it can cross-pollinate with weedy varieties to create new, more resilient forms.

The weed

There are two main forms of lantana in Australia: a cultivated form planted in gardens and a weedy variety found in bushland and pastures. The cultivated form of lantana is non-thorny, produces few seeds and is compact in shape. The weedy form is a prolific seeder with straggly, thorny stems. Both forms include many varieties, which differ from each other in shape, flower colour, prickliness, response to enemies and toxicity.

Weedy lantana is a much branched, thicket-forming shrub, 2-4 m tall. The woody stems are square in cross-section and hairy when young but become cylindrical and up to 150 mm thick with age. The ovate (ie tear-shaped) leaves (20–100 mm long) occur in opposing pairs along the stem. The leaves are rough and finely hairy and emit a pungent odour when crushed. Each flower head is made up of 20–40 flowers, ranging in colour from white, cream or yellow to orange, pink, purple and red. The fruit has many berries, which ripen from green to shiny purple-black and contain a single pale seed. Lantana has a short taproot and a mat of many shallow side roots.

Key points

• Lantana is a thicket-forming shrub that has spread from gardens into pastures, woodlands and rainforests on the east coast.
• It typically invades disturbed land and river margins, extending its range in response to rainfall.
• It threatens agriculture and pastoral production, forestry and biodiversity of conservation areas, and may be toxic to stock.
• The highest priority for lantana control is preventing its spread into northern Australia and west of the Great Dividing Range.
• Integrated control should combine fire, mechanical, chemical and biological methods, and revegetation.
How it spreads

Lantana spreads in two ways. Layering is a form of vegetative reproduction where stems send roots into the soil, allowing it to quickly form very dense stands and spread short distances. Also, birds and other animals such as foxes consume and pass the seed in their droppings, potentially spreading it over quite large distances. The germination rate of fresh seed is generally low, but improves after being digested.

Germination most frequently occurs following the first summer storms, but may occur at any time of the year when sufficient moisture is present. Initial seedling growth is slow until the roots become established, after which close stems intertwine and begin to form thickets. Flowering does not usually commence until early in the following summer and then continues until March or April.

Lantana can resprout from the base if the shoot dies, extending the life of individual plants.

Where it grows

Lantana can grow in high-rainfall areas with tropical, subtropical and temperate climates. It does not tolerate salty or dry soils, waterlogging or low temperatures (<5°C). It thrives on rich, organic soils but also grows on well-drained clay and basalt soils. Sandy soils tend to dry out too rapidly for lantana unless soil moisture is continually replenished. It has been reported at altitudes up to 1000 m in Queensland.

Lantana invades disturbed sites, especially open sunny areas, such as roadsides, cultivated pastures and fencelines. From there it can invade the edges of forests, but it does not fare as well under a heavy canopy as it is not very shade tolerant. Therefore, it is not a problem in intact tropical rainforest but can quickly spread there if the canopy opens out.

Lantana occurs naturally in Mexico, the Caribbean and tropical and subtropical Central and South America. It is considered a weed in nearly 50 countries.
Another weedy species of lantana

Another species of lantana is a popular ornamental that is considered a weed when present in natural ecosystems. Creeping lantana (Lantana montevidensis) occurs in coastal and subcoastal Queensland and as far south as Sydney. It is fairly similar to Lantana camara but does not have thorns, has mainly pink or purple flowers and trails along the ground, only growing to a height of half a metre. It is also toxic and readily displaces native vegetation.

Potential distribution

Lantana may be able to spread west of the Great Dividing Range, and could expand its range throughout southern Victoria, South Australia and southwestern Western Australia.

What to do about it

Lantana is extremely widespread and abundant. Because it is so well established on the east coast, and prevention of spread is the most cost-effective weed management tool, the highest priority for lantana management is to prevent its spread into uninfested areas. This will require three main actions.

1. Restricting further importation of lantana into Australia. Any new varieties brought in could escape cultivation and naturalise, or could cross-breed with naturalised varieties, leading to harder new varieties more resistant to control.
2. Restricting the sale and use of lantana in gardens as these are potential sources of new infestation and new varieties. There are native and less weedy exotic ornamental alternative species.
3. Strategically controlling infestations that threaten areas where lantana is not yet a weed. Control methods are outlined below.

Integrated management

An integrated approach that uses a variety of control methods gives best results when dealing with lantana. A range of methods including herbicides, mechanical removal, fire, biological control and revegetation should be used. Best results are obtained by working from areas of light infestation towards heavier infestation, and long-term follow-up control is required after initial attempts. Minimise both disturbance to land and excessive use of fire to retain vigorous native vegetation and reduce the opportunity for lantana to become established.

Herbicide control – effective but expensive

There are many herbicides registered for lantana control and three main application techniques. Spraying the entire plant (foliar spraying) usually kills plants that are less than 2 m high. Herbicides applied to the lower bark of the stems (the basal bark technique) or immediately painted onto a freshly cut stump (the cut-stump technique) are useful for larger plants. Both of these techniques are time consuming because they require treatment of each stem, which can be difficult to access in large stands of lantana. High costs make herbicide control uneconomical for large infestations, except when there are no other options (eg on steep slopes, where helicopter spraying may be required).

For best results, integrate fire, mechanical, chemical and biological control and revegetation

Herbicides, especially those that are foliar applied, are most effective when plants are actively growing. With lantana, best results are obtained six weeks after good rains (at least 35 mm) when minimum temperatures exceed 15ºC. In Queensland the spraying season generally lasts from early summer to autumn, but earlier control will potentially allow follow-up in the same growing season.
Mechanical and physical control – suitable for small infestations

Lantana can be removed mechanically or physically in several ways, including stickraking, bulldozing, ploughing and grubbing. These techniques are mainly suited to medium-sized infestations and require extensive follow-up, as they invariably lead to regrowth if the rootstock is not removed, or seedling germination when heavy machinery disturbs the soil. Any soil disturbance should be avoided on steep inclines or in gullies. A permit may be required if native plants are to be affected by mechanical control – check with your local council or state/territory weed management agency. Note that herbicides vary in their effectiveness on different lantana varieties. The red flowered varieties are normally the least susceptible to herbicides while the pink forms are the easiest controlled. Consult your local council or state/territory weed management agency about which herbicides and applications are most suitable for your infestation of lantana. State and territory 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.
Lantana – Lantana camara

Of the 16 species that have established, four insects have had a major impact on lantana. They are:

• a sap-sucking bug (Teleonemia scrupulosa) (Sydney to northern Queensland).
• a leaf-mining beetle (Uroplata girardi) (northern Queensland to Sydney).
• a leaf-mining beetle (Octotoma scabripennis) (Sydney to Rockhampton).
• a seed-feeding fly (Ophiomyia lantanae) (northern Queensland to Sydney).

The biological control agents vary in their effectiveness against the many different types of lantana. For example, lantana can drop its leaves when stressed, depriving some agents of their food.

Revegetation – useful in pastures and forests

Revegetation of a treated site is a key component of a lantana management program. Revegetation helps to reduce erosion, adds fuel for future burning in pastures and is vital in limiting the re-establishment of lantana and other weeds. Sowing an improved pasture that outcompetes and smothers lantana seedlings is assisted by withholding light grazing for the first six months, and only allowing light grazing for the next 12–18 months. In forested areas either planting trees or encouraging naturally occurring seedlings will help to shade out lantana in the longer term. Check with your local council or state/territory weed management agency about appropriate species for revegetating pastures or forests in your area.

Follow-up

Follow-up control after an initial effort may include any or all of the above methods. Established pastures can be burnt to control significant lantana regrowth, and any small patches can be spot sprayed with a registered herbicide or grubbed out. In forested areas herbicides are recommended to control regrowth, typically requiring three follow-up sprays after the initial control effort.

Legislation

Landholders are required to reduce lantana infestations throughout some regions of Queensland, New South Wales and the Northern Territory. The sale of lantana in Queensland was banned in late 2003. Lantana importation is prohibited in Western Australia. Check with your local council or state/territory weed management agency for relevant details.

Acknowledgments

Information and guide revision: Michael Day (Qld DNRM/Weeds CRC), Tony Grice (CSIRO/Weeds CRC), Richard Carter (NSW Dept of Agriculture/Weeds CRC), Andrew Clarke (Qld DNRM), Georgina Eldershaw (NSW NPWS), Jim Sloane (Sutherland Shire Environment Centre) and John Thorp (National Weeds Management Facilitator).

Maps: Australian Weeds Committee.

Lantana control at Towra Point, Botany Bay, New South Wales

Towra Point Nature Reserve in Botany Bay contains habitats of high conservation status, including wetlands of international importance and open woodlands that are unique in the Sydney region. A coastal rainforest in the region was recently listed as an endangered ecological community under the New South Wales Threatened Species Conservation Act 1995. It includes the magenta brush cherry (Syzygium paniculatum), a vulnerable tree species.

By the 1990s, lantana made up almost 75% of the vegetation cover in some parts of the reserve and was limiting the regeneration of native species, particularly around a freshwater wetland called Weedy Pond. The Friends of Towra, a volunteer group, commenced weed control in the Weedy Pond rainforest in 1996. In 1998 the Sutherland Shire Environment Centre, working in conjunction with the National Parks and Wildlife Service, gained Coastcare funding to supplement the volunteer program.

Beginning in March 1998, weed control focused on a corridor connecting the rainforest and a casuarina/banksia forest, following up on previous control and initiating new efforts. Lantana was controlled by a combination of cut-stump herbicide application and manual removal of smaller plants. Other weeds were also controlled when they were encountered.

Work was undertaken about every two months throughout 1998 by volunteers and members of local community groups. Follow-up hand weeding and spot spraying, and further control of primary lantana infestations, were also undertaken throughout 1999. This work involved international backpackers, unemployed people from Green Corps 2000, students and personnel from private enterprise, all of whom volunteered their time. The total area cleared of lantana and other weeds was approximately 75 m wide and 100 m long.

In May 2000 the cleared areas were planted with native vegetation by local Cub Scouts and Venturers and members of the Friends of Towra. Approximately 200 banksias were planted. The training of volunteers and community groups on such issues as weed control techniques, bush regeneration and plant identification was another significant outcome.

At each quarterly follow-up visit to the site, approximately 24 man-hours are required to keep on top of any reshooting and newly germinated lantana, and encourage regeneration of native species. It is expected that lantana will become disadvantaged as canopy cover and shade increases, and less work will be required in the future.
How to control lantana

Minimise spread and future impacts

Although lantana is widespread on the east coast of Australia, it is still absent from parts of its potential range. These areas should be protected by:

- preventing the importation of further varieties and species of lantana
- stopping more planting of lantana in gardens
- strategically controlling infestations which threaten uninfested areas.

A control program for dense infestations in pastures

The Queensland Department of Natural Resources and Mines has produced a pest series fact sheet on lantana (PP#34). They advise that herbicides are too expensive to treat large lantana infestations. A combination of fire and mechanical control makes spot treatment of small patches with herbicides more cost-effective. The following suggested control program for dense infestations in pastures is based on the fact sheet:

1. Exclude stock to allow a fuel load to build up.
2. Bulldoze, stickrake or plough the infestation to add to the fuel load.
3. Burn the infestation after obtaining a permit. Summer burns are more effective than winter burns.
4. Sow an improved pasture. Seek advice of local council or state/territory government agencies for selection of non-weedy pasture species.
5. Continue stock exclusion until pasture has established and set seed.
6. Burn the infestation again after obtaining a permit.

7. Spot spray or grub out any regrowth or seedlings. Spraying is most effective between summer and autumn.
8. Follow-up burning, spraying and/or grubbing will be required for several years.

Quick reference guide

Lantana can escape from garden plantings into surrounding bushland.

Photo: Tim Schultz

<table>
<thead>
<tr>
<th>Type of infestation</th>
<th>Physical</th>
<th>Mechanical</th>
<th>Chemical</th>
<th>Fire</th>
<th>Biological</th>
</tr>
</thead>
<tbody>
<tr>
<td>Small (few plants, small area)</td>
<td>Hand grubbing only suitable for seedlings. Wear gloves for protection from thorns.</td>
<td>Not suitable.</td>
<td>Spot spray plants less than 2 m in height between summer and autumn with a registered herbicide.</td>
<td>Not suitable.</td>
<td>There are four useful biological control agents. They are already distributed throughout their potential range.</td>
</tr>
<tr>
<td>Medium (medium density, medium total area)</td>
<td>Bulldoze, plough, stickrake or slash infestations. Soil disturbance will lead to mass seed germination, so follow up with further controls. Do not use mechanical control in areas susceptible to erosion. A permit may be required.</td>
<td>Spraying is uneconomical for medium or large infestations. Helicopter spraying is used when there is no access for mechanical control, eg very steep slopes.</td>
<td>Under permit, burn in summer with good fuel load of grass and/or mechanically cleared lantana. Also use as follow-up. Do not burn in rainforests.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Large (many plants, many ha)</td>
<td></td>
<td>Mechanical</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Native to South America, Praxelis spreads rapidly along roadsides, and invades pastures and native vegetation where it can form dense monospecific stands that exclude other vegetation. Praxelis spreads by seed.

Declaration details

Praxelis is a not declared plant under the Land Protection (Pest and Stock Route Management) Act 2002; however, plants that are not declared under state legislation may have control requirements imposed by local governments.

Description and general information

Praxelis is an annual to short-lived perennial herb, usually 40–80 cm tall, but can grow to 1 m. It has brittle hairy stems.

Leaves are opposite, roundly triangular with an acute apex, hairy and toothed along the edges, and have an unpleasant smell when crushed.

Flowers are lilac-blue and form in clusters at the ends of stems. Each plant produces hundreds of small black seeds.

Control

Manual control
Hand pulling of small areas of praxelis is not recommended. Mature seed can drop off and increase the area of infestation.

Herbicide control
There is no herbicide currently registered for control of praxelis in Queensland; however, an off-label use permit (Permit No. 11463) allows the use of various herbicides for the control of environmental weeds in non-agricultural areas, bushland, forests, wetlands, and coastal and adjacent areas.

See Table 1 for treatment options allowed by the permit.

It is important to note that specific research on the use of herbicides to control praxelis has not been undertaken to date. Therefore, the treatment options outlined in Table 1 are suggestions only, based on registered controls for similar weeds in non-agricultural areas and the specifications of PER11463. As such, their effectiveness cannot be guaranteed.
Prior to using the chemicals listed under PER11463 you must read or have read to you and understand the conditions of the permit. To obtain a copy of this permit contact your local council weed inspector or visit www.apvma.gov.au.

It is a requirement of the permit that all persons using products covered by this off-label permit comply with the details and conditions listed in the permit. Permit number PER11463 expires on 30 June 2014. While the permit may be extended beyond this date, there is no guarantee that it will, so contact your local council weed inspector for the latest information after the expiry date.

Follow up

Monitor treated areas regularly for any new seedlings or regrowth.

Further information

Further information is available from your local government office, or by contacting Biosecurity Queensland (call 13 25 23 or visit our website at www.biosecurity.qld.gov.au).

Table 1. Herbicides registered for the control of praxelis

<table>
<thead>
<tr>
<th>Method</th>
<th>Herbicide</th>
<th>Rate</th>
<th>Registration status</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spot spray</td>
<td>2,4-D (300 g/L) + picloram (75 g/L)</td>
<td>1 L per 100 L water plus wetting agent</td>
<td>APVMA permit PER11463 Permit expires 30/06/2014</td>
<td>Read permit carefully prior to use</td>
</tr>
<tr>
<td>Spot spray</td>
<td>Fluroxypyr (200 g/L)</td>
<td>500 ml to 1 L per 100 L water</td>
<td>APVMA permit PER11463 Permit expires 30/06/2014</td>
<td>Read permit carefully prior to use</td>
</tr>
<tr>
<td>Spot spray</td>
<td>Metsulfuron-methyl (600 g/kg)</td>
<td>10 g per 100 L water plus wetting agent</td>
<td>APVMA permit PER11463 Permit expires 30/06/2014</td>
<td>Read permit carefully prior to use</td>
</tr>
<tr>
<td>Spot spray</td>
<td>Glyphosate (360 g/L)</td>
<td>1 L per 100 L water</td>
<td>APVMA permit PER11463 Permit expires 30/06/2014</td>
<td>Read permit carefully prior to use</td>
</tr>
</tbody>
</table>

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

Source: Infopest 2009 + PER11463

Fact sheets are available from Department of Employment, Economic Development and Innovation (DEEDI) service centres and our Customer Service Centre (telephone 13 25 23). Check our website at www.biosecurity.qld.gov.au to ensure you have the latest version of this fact sheet. The control methods referred to in this fact sheet 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, DEEDI does not invite reliance upon it, nor accept responsibility for any loss or damage caused by actions based on it.

© The State of Queensland, Department of Employment, Economic Development and Innovation, 2011
Praxelis (Praxelis clematidea)

The problem

Praxelis is on the Alert List for Environmental Weeds, a list of 28 non-native plants that threaten biodiversity and cause other environmental damage. Although only in the early stages of establishment, these weeds have the potential to seriously degrade Australia’s ecosystems.

Praxelis was first recorded in Tully and Innisfail, Queensland, in 1993 but was probably present there for about 20 years before being positively identified. It is spreading extremely quickly and effectively throughout northern and eastern Queensland – an isolated infestation recently found in Gympie is some 1200 km by road south of the nearest infestation in Townsville.

An invader of both disturbed and relatively undisturbed ecosystems, praxelis could threaten, and significantly increase the costs of managing, such crops as bananas, other fruits and sugar cane. It could infest pastoral grasslands and conservation areas, particularly open eucalypt woodlands. Praxelis is easily mistaken for two species of Ageratum, less serious weeds found in similar regions.

There is some evidence that it may be poisonous to stock and humans if ingested.

The weed

Praxelis is an annual or short-lived perennial herb growing 0.2-1.0 m tall.

Its leaves are arranged in opposite pairs along the brittle cylindrical stems, which are covered in short soft hairs. The leaves are tear-shaped or ‘ovate’ to diamond-shaped or ‘rhomboid’, with a conspicuously toothed margin containing between five and eight teeth. When crushed, they emit a pungent odour similar to cat’s urine.

The flowers, which are clusters of numerous (30-50) lilac or bluish coloured ‘florets’, are 7-10 mm long and occur in groups at the ends of stems. The florets are set into a highly conical (ie cone-shaped) receptacle – this is a key distinguishing feature of this species.

The seeds are black and about 2.5-3.0 mm long. They bear a pale tuft of finely barbed bristles, 3-4 mm long.

Key points

- Prevention is the most cost-effective form of weed control. Keep uninfested areas free of praxelis.
- Praxelis spreads into new areas very quickly. Seed dispersal is aided by machinery and vehicles.
- Disturbed areas such as roadsides, fencelines, railway lines, run-down pastures and plantations are all at risk from infestation.
- Contact your state or territory weed management agency or local council if you find praxelis, especially any infestations outside its known distribution. Any new information on its presence is extremely important.
- Do not attempt control on your own.

Praxelis can invade both disturbed and undisturbed ecosystems including grasslands, woodlands and conservation areas.
Photo: Queensland Herbarium
How it spreads

Praxelis mainly spreads by seeds. It can produce large numbers of seeds in as little as three or four months after germinating. The seeds possess a ‘pappus’, a tuft of barbed bristles that can help them spread by wind or water, or by attaching themselves to animal fur and feathers, clothing or machinery. Long distance dispersal is mainly attributed to seed attached to vehicles or carried as accidental contaminants of building supplies and landscaping materials. Praxelis is also capable of vegetative growth, in which roots and new plantlets form along branches in contact with the soil.

Praxelis is thought to have first entered Australia in a batch of contaminated seed from Brazil between 1965 and 1975. It is believed to have been part of the same seed batch that also included Siam weed, Chromolaena odorata – a closely related species also on the Alert List for Environmental Weeds – because the two species were first found growing in very close association in the Tully region.

Although it was recognised by landholders in the area as a weed, it was not formally identified as praxelis until 1993 during the initial investigations into the Siam weed infestation (for more information on Siam weed, see the companion guide in this series).

Infestations have been recorded along the coast of northern Queensland from Townsville to Cairns, and on the Atherton Tablelands at Kuranda, Mareeba, Herberton and Malanda. Other scattered infestations exist in remote parts of Cape York Peninsula and the Torres Strait islands, originating from seeds in building and landscaping materials brought in from infested regions. In 2002 an infestation was discovered just north of Gympie, some 1200 km by road from Townsville and only 160 km north of Brisbane.

Where it grows

A native of South America (southern Brazil, Venezuela, Bolivia, northern Argentina), praxelis invades a range of habitats. It is particularly suited to disturbed areas such as roadsides, railway lines and fencelines, and rapidly colonises bare earth following fire. Able to survive on a range of soil types, it invades crops, grasslands and, particularly, over-grazed pastures. It can become the dominant herbaceous plant in open eucalypt woodlands, and grows vigorously along riverbanks. It tolerates partial shade to full sun but does not cope well under heavy shade.

Praxelis is well established in areas that have more than 900 mm annual rainfall and is expected to survive in areas with annual rainfall in the range 500–700 mm. In these drier areas praxelis behaves more like an annual, setting seed and dying off until the next rainy season, when germination takes place. It will probably only exist in cultivated areas or along waterways in areas where annual rainfall is less than 500 mm.

Why we need to be ‘alert’ to praxelis

Praxelis is capable of quickly spreading large distances. Because it was not positively identified early, and is extremely similar to two less serious weeds (Ageratum species), it has been allowed to spread virtually unimpeded during its first 20 years in Australia. In that time it could easily have spread into new areas where it may not yet have been identified, as shown by the discovery of an infestation in Gympie in 2002.

Praxelis leaves are tear-shaped or ‘ovate’ to diamond-shaped or ‘rhomboid’, with a conspicuous toothed margin containing between five and eight teeth.

Photo: John Swarbrick
Praxelis is also showing its weedy potential in Hong Kong and mainland China, where it appears set to become a significant weed of dryland agriculture. It can survive some exposure to frost and in China it grows above the frost line as an annual.

**What to do about it**

**Prevention is better than the cure**

As with all weed management, prevention is better and more cost-effective than control. The annual cost of weeds to agriculture in Australia, in terms of decreased productivity and management costs, is conservatively estimated at $4 billion. Environmental impacts are also significant and lead to a loss of biodiversity. To limit escalation of these impacts, it is vital to prevent further introduction of new weed species, such as praxelis, into uninfested natural ecosystems.

Early detection and eradication are also important to prevent infestations of praxelis. Small infestations can be easily eradicated if they are detected early but an ongoing commitment is needed to ensure new infestations do not establish.

**Quarantine to prevent further introductions**

Quarantine laws require that before the Australian Quarantine and Inspection Service (AQIS) could consider applications to import praxelis, a comprehensive weed risk assessment would need to be conducted by Plant Biosecurity Australia. Considering its potential impacts on agriculture and the environment, it is unlikely that permission to import this plant would be granted.

Do not buy seeds via the internet or from mail order catalogues unless you check with quarantine first and can be sure that they are free of weeds like praxelis. Call 1800 803 006 or see the Australian Quarantine and Inspection Service (AQIS) import conditions database [www.aqis.gov.au/icon](http://www.aqis.gov.au/icon). Also, take care when travelling overseas that you do not choose souvenirs made from or containing seeds, or bring back seeds attached to hiking or camping equipment. Report any breaches of quarantine you see to AQIS.

**Raising community awareness**

Because there is a high probability that praxelis exists outside known infestations, it is extremely important that the general public be made aware of the potential impacts of praxelis and how to identify it and distinguish it from similar weeds (see box on p.5). Assistance from landholders, natural resource managers and interested community groups will be vital in compiling up-to-date maps of known infestations, alerting authorities to new infestations and helping to prevent the spread of praxelis.

**The Alert List for Environmental Weeds**

The Federal Government’s Alert List for Environmental Weeds was declared in 2001. It consists of 28 weed species that currently have limited distributions but potentially could cause significant damage. The following weed species are therefore targeted for eradication:

<table>
<thead>
<tr>
<th>Scientific name</th>
<th>Common name</th>
<th>Scientific name</th>
<th>Common name</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acacia catechu var. sunda</td>
<td>cutch tree</td>
<td>Koelreuteria elegans ssp. formosana</td>
<td>Chinese rain tree</td>
</tr>
<tr>
<td>Acacia karroo</td>
<td>Karroo thorn</td>
<td>Lachenalia reflexa</td>
<td>yellow soldier</td>
</tr>
<tr>
<td>Asystasia gangetica ssp. micrantha</td>
<td>Chinese violet</td>
<td>Lagarosiphon major</td>
<td>lagerosiphon</td>
</tr>
<tr>
<td>Barleria prionitis</td>
<td>barleria</td>
<td>Nassella charruana</td>
<td>lobed needle grass</td>
</tr>
<tr>
<td>Bassia scoparia</td>
<td>kochia</td>
<td>Nassella hyalina</td>
<td>cane needle grass</td>
</tr>
<tr>
<td>Calluna vulgaris</td>
<td>heather</td>
<td>Pelargonium alchemilloides</td>
<td>garden geranium</td>
</tr>
<tr>
<td>Chromolaena odorata</td>
<td>Siam weed</td>
<td>Pereskia aculeata</td>
<td>leaf cactus</td>
</tr>
<tr>
<td>Cyoglossum creticum</td>
<td>blue hound’s tongue</td>
<td>Piptochaetium montevidense</td>
<td>Uruguayan rice grass</td>
</tr>
<tr>
<td>Cyperus teneristolon</td>
<td>cyperus</td>
<td>Praxelis clematidea</td>
<td>praxelis</td>
</tr>
<tr>
<td>Cytisus multiflorus</td>
<td>white Spanish broom</td>
<td>Retama raetam</td>
<td>white weeping broom</td>
</tr>
<tr>
<td>Ditrichia viscosa</td>
<td>false yellowhead</td>
<td>Senecio glastifolius</td>
<td>holly leaved senecio</td>
</tr>
<tr>
<td>Equisetum spp.</td>
<td>horsetail species</td>
<td>Thunbergia laurifolia</td>
<td>laurel clock vine</td>
</tr>
<tr>
<td>Gymnocoronis spilanthoides</td>
<td>Senegal tea plant</td>
<td>Tipuana tipu</td>
<td>rosewood</td>
</tr>
<tr>
<td>Hieracium aurantiacum</td>
<td>orange hawkweed</td>
<td>Trianoptiles solitaria</td>
<td>subterranean Cape sedge</td>
</tr>
</tbody>
</table>

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**Endnotes:**

Weed Management Guide • Praxelis – Praxelis clematidea
Weed control contacts

<table>
<thead>
<tr>
<th>State / Territory</th>
<th>Department</th>
<th>Phone</th>
<th>Email</th>
<th>Website</th>
</tr>
</thead>
<tbody>
<tr>
<td>ACT</td>
<td>Environment ACT</td>
<td>(02) 6207 9777</td>
<td><a href="mailto:EnvironmentACT@act.gov.au">EnvironmentACT@act.gov.au</a></td>
<td><a href="http://www.environment.act.gov.au">www.environment.act.gov.au</a></td>
</tr>
<tr>
<td>NSW</td>
<td>NSW Agriculture</td>
<td>1800 680 244</td>
<td><a href="mailto:weeds@agric.nsw.gov.au">weeds@agric.nsw.gov.au</a></td>
<td><a href="http://www.agric.nsw.gov.au">www.agric.nsw.gov.au</a></td>
</tr>
<tr>
<td>NT</td>
<td>Dept of Infrastructure, Planning and Environment</td>
<td>(08) 8999 5511</td>
<td><a href="mailto:weedinfo.ipe@nt.gov.au">weedinfo.ipe@nt.gov.au</a></td>
<td><a href="http://www.nt.gov.au">www.nt.gov.au</a></td>
</tr>
<tr>
<td>Qld</td>
<td>Dept of Natural Resources and Mines</td>
<td>(07) 3896 3111</td>
<td><a href="mailto:enquiries@nrm.qld.gov.au">enquiries@nrm.qld.gov.au</a></td>
<td><a href="http://www.nrm.qld.gov.au">www.nrm.qld.gov.au</a></td>
</tr>
<tr>
<td>SA</td>
<td>Dept of Water, Land and Biodiversity Conservation</td>
<td>(08) 8303 9500</td>
<td><a href="mailto:apc@saugov.sa.gov.au">apc@saugov.sa.gov.au</a></td>
<td><a href="http://www.dwlbcsa.gov.au">www.dwlbcsa.gov.au</a></td>
</tr>
<tr>
<td>Vic</td>
<td>Dept of Primary Industries/Dept of Sustainability and Environment</td>
<td>136 186</td>
<td><a href="mailto:customer.service@dpi.vic.gov.au">customer.service@dpi.vic.gov.au</a></td>
<td><a href="http://www.dpi.vic.gov.au">www.dpi.vic.gov.au</a></td>
</tr>
<tr>
<td>WA</td>
<td>Dept of Agriculture</td>
<td>(08) 9368 3333</td>
<td><a href="mailto:enquiries@agric.wa.gov.au">enquiries@agric.wa.gov.au</a></td>
<td><a href="http://www.agric.wa.gov.au">www.agric.wa.gov.au</a></td>
</tr>
</tbody>
</table>

The above contacts can offer advice on weed control in your state or territory. If 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.

New infestations of praxelis

Because there are relatively few praxelis infestations, and it can potentially be eradicated before it becomes established, any new outbreaks should be reported immediately to your state or territory weed management agency or local council. Do not try to control praxelis without expert assistance. Control effort that is poorly performed or not followed up can actually help spread the weed and worsen the problem.

Legislation

There is no legislation to control praxelis but, as part of the Alert List for Environmental Weeds, it is marked for eradication and should not be imported into Australia or further spread.

Acknowledgments

Information and guide revision: Barbara Waterhouse (AQIS/Weeds CRC), Rachel McFadyen (Weeds CRC), Ailsa Holland (Queensland Herbarium) and John Thorp (National Weeds Management Facilitator).

Map: Base data used in the compilation of distribution map provided by Australian herbaria via Australia’s Virtual Herbarium.

The blue flowers of praxelis are made up of 30–50 florets set into a cone-shaped receptacle. Photo: C.G. Wilson
Praxelis is very similar to two related weed species, Ageratum conyzoides and Ageratum houstonianum, which are also found in northern Australia. These species are commonly known as ‘blue top’ and ‘billy goat weed’, and are often mistaken for each other. Both are found as environmental weeds, especially on roadsides and disturbed areas. A. houstonianum has also been used as an ornamental plant and has escaped from gardens.

Local authorities and landholders in northern Queensland initially believed that the weed now known to be praxelis was either a herbicide-resistant or hybrid form of A. conyzoides because it was much harder to kill with herbicides than previous experience with A. conyzoides. Collection of specimens and verification from several herbaria revealed that it was, in fact, a different plant altogether, Praxelis clematidea.

The differences between praxelis and A. conyzoides are subtle, even to the trained eye. Both have blue flowers, although those on A. conyzoides are often a less intense blue and may also be white or pale lilac. Both are covered with hairs, although the hairs on praxelis are longer and more conspicuous. The main difference is that praxelis has a conical receptacle for its ‘florets’, the dense cluster of small flowers that make up the flower head, whereas A. conyzoides has a flat or slightly dome-shaped receptacle. Also, the ring of ‘bracts’, modified leaves that surround and support the flower head, is deciduous and drops off praxelis flowers, whereas in A. conyzoides the bracts are persistent. The leaves of praxelis have a more pungent odour when crushed, and are more triangular and more sharply toothed than those of A. conyzoides, which are more rounded near the tip and have smooth teeth along the edges. Finally, the ‘pappus’ on praxelis seeds consists of many more bristles (15–40) than A. conyzoides, which has only about 5 bristles.

The flower colour and size of A. houstonianum is usually much closer to that of praxelis than A. conyzoides, especially in those parts of northern Queensland where the three species occur together (eg Atherton Tablelands).

**Differences between Praxelis clematidea and Ageratum conyzoides**

<table>
<thead>
<tr>
<th>Feature</th>
<th>Praxelis clematidea</th>
<th>Ageratum conyzoides</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Habitat</strong></td>
<td>Roadside, crops, pastures and undisturbed bushland</td>
<td>Mainly disturbed sites such as roadsides</td>
</tr>
<tr>
<td><strong>Flower</strong></td>
<td>Intense blue</td>
<td>Pale blue, also white or pale lilac</td>
</tr>
<tr>
<td><strong>Flower receptacle</strong></td>
<td>Conical, with pointed apex</td>
<td>Flat or slightly dome-shaped</td>
</tr>
<tr>
<td><strong>Bracts</strong></td>
<td>Deciduous</td>
<td>Persistent</td>
</tr>
<tr>
<td><strong>Hairiness</strong></td>
<td>Stems covered in short hairs</td>
<td>Hairs on stems are shorter and less conspicuous</td>
</tr>
<tr>
<td><strong>Leaf odour when crushed</strong></td>
<td>Pungent, similar to tom-cat spray</td>
<td>Less pungent</td>
</tr>
<tr>
<td><strong>Leaf</strong></td>
<td>Tear-shaped to triangular, sharp serrated edges</td>
<td>More rounded, especially at the tip, smooth serrations</td>
</tr>
<tr>
<td><strong>Pappus</strong></td>
<td>15–40 bristles</td>
<td>5 bristles</td>
</tr>
</tbody>
</table>
Identification

You will first need to confirm its identity. Contact your state or territory weed management agency for help in identifying the plant. You will need to take note of the characteristics of the plant in order to accurately describe it. Some important features of praxelis are:

- stems covered in soft downy hairs
- blue flowers made up of 30-50 florets set into a cone-shaped receptacle
- small black seeds, with a tuft of 15-40 bristles on one end.

Note that praxelis is very similar to the common but less serious weeds of northern Queensland roadsides, Ageratum conyzoides and A. houstonianum. For more information, see the box on p.5.

Reporting occurrences

Once identified, new occurrences of praxelis should be reported to the relevant state or territory weed management agency or local council, who will offer advice and assistance on its control. Because praxelis spreads so easily and poses such a serious threat, its control should be undertaken with the appropriate expertise and adequate resources.

Follow-up work will be required

Once the initial infestation is controlled, follow-up monitoring and control will be required to ensure that reinfestation does not occur.

Collecting specimens

State or territory herbaria can also identify plants from good specimens. These organisations can provide advice on how to collect and preserve specimens.

<table>
<thead>
<tr>
<th>State/Territory</th>
<th>Postal Address</th>
<th>Phone</th>
<th>Web</th>
</tr>
</thead>
<tbody>
<tr>
<td>Australian National Herbarium</td>
<td>GPO Box 1600 Canberra, ACT, 2601</td>
<td>(02) 6246 5108</td>
<td><a href="http://www.anbg.gov.au/cpbr/herbarium/index.html">www.anbg.gov.au/cpbr/herbarium/index.html</a></td>
</tr>
<tr>
<td>National Herbarium of New South Wales</td>
<td>Mrs Macquaries Rd Sydney, NSW, 2000</td>
<td>(02) 9231 8111</td>
<td><a href="http://www.rbg.sydney.nsw.gov.au">www.rbg.sydney.nsw.gov.au</a></td>
</tr>
<tr>
<td>Northern Territory Herbarium</td>
<td>South Yarra, Vic, 3141</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Queensland Herbarium</td>
<td>PO Box 496 Palmerston, NT, 0831</td>
<td>(08) 8999 4516</td>
<td><a href="http://www.nt.gov.au/ipe/pwcnt/">http://www.nt.gov.au/ipe/pwcnt/</a></td>
</tr>
<tr>
<td>South Australian Plant Biodiversity Centre</td>
<td>PO Box 2732 Kent Town, SA, 5071</td>
<td>(08) 8222 9311</td>
<td><a href="http://www.flora.sa.gov.au/index.html">www.flora.sa.gov.au/index.html</a></td>
</tr>
<tr>
<td>Tasmanian Herbarium</td>
<td>Private Bag 4 Hobart, Tas, 7000</td>
<td>(03) 6226 2635</td>
<td><a href="http://www.tmag.tas.gov.au/Herbarium/Herbarium2.htm">www.tmag.tas.gov.au/Herbarium/Herbarium2.htm</a></td>
</tr>
<tr>
<td>Western Australian Herbarium</td>
<td>Locked Bag 104 Bentley DC, WA, 6893</td>
<td>(08) 9334 0500</td>
<td><a href="http://science.calm.wa.gov.au/herbarium/">http://science.calm.wa.gov.au/herbarium/</a></td>
</tr>
</tbody>
</table>

Collecting specimens

State or territory herbaria can also identify plants from good specimens. These organisations can provide advice on how to collect and preserve specimens.