

# Managing lantana in different situations

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Section

# Lantana control—the golden rules



Integrating various control methods will provide maximum effect, Canungra, Qld.

Don Lynch, courtesy of APTC, Kokoda Barracks



Control in stages requires follow-up over a number of years, Canungra, Qld.

Don Lynch, courtesy of APTC, Kokoda Barracks

## Lantana control—the golden rules

### 1. Control in stages

In most situations, control efforts must be carried out in stages. In extensive or dense infestations, initial control treatment can create access or promote regrowth, which is then treated with follow-up methods of control. The initial stage of treatment is often the most difficult, time-consuming and expensive. Follow-up controls tend to be more rewarding, but must be sustained over a number of years to ensure the effort of initial controls is not wasted. Revegetation of the site and continual monitoring are critical stages of a successful control strategy. Integrated weed management should also be undertaken during any follow-up work to ensure that other weeds and undesirable plants are controlled at the same time.

In smaller infestations where lantana can be completely removed from the site, follow-up treatment of regrowth from leftover stem pieces, and removal of new lantana seedlings, must still be carried out in combination with revegetation and monitoring.

***'Removing lantana is a waste of time unless cleared areas are revegetated with native trees or pasture immediately. Follow up regularly until the vegetation is well established.'*** (Landholder, Austinville, Qld)

### 2. Integrate methods

Integrated lantana control combines two or more methods targeting vulnerable aspects of the weed, different points in its life cycle or its environment in order to achieve more effective control.

In most situations, lantana can only be controlled successfully through integrated control together with sustained follow-up and revegetation. Lantana can often be managed easily if control efforts are kept up.

### Examples

The following three examples illustrate how methods can be integrated through the various stages of a control strategy. Consult sections 2 and 3 to develop an integrated approach appropriate for particular sites or properties.

#### Example 1

initial control to reduce height and density of infestations and create access (burning, dozing, slashing, trampling)  
+  
follow-up control of regrowth (foliar spraying)  
+  
revegetation/re-sowing  
+  
follow-up control of regrowth/seedlings (manual methods, spot spraying)  
+  
continual monitoring

#### Example 2

initial control to remove plants (mechanical or manual grubbing)  
+  
revegetation/re-sowing  
+  
follow-up control of regrowth/seedlings (spot spraying)  
+  
continual monitoring

#### Example 3

initial control to create access (slashing)  
+  
follow-up control (manual grubbing)  
+  
revegetation/re-sowing  
+  
follow-up control of seedlings (hand pulling)  
+  
continual monitoring

# Pastures and grazing lands



Mike Day

Scattered clumps in grazing land, Cangai, NSW.



Mike Day

Large, dense infestation, Yarraman, Qld.

## Pastures and grazing lands

### Open pastures

The choice of control methods will depend on the size of the infested area, whether the infestations are dense or scattered, and the available resources.

#### **Large, dense infestations**

Treatment with herbicides alone is not usually economically feasible. Large infestations often need initial treatments such as burning, slashing or dozing to reduce their height and density, create access, and generate regrowth, which can then be more easily and economically treated with follow-up foliar applications of herbicide.

Continual follow-up treatment of regrowth and re-establishment of pasture are essential for long-term success.

One integrated control strategy (from the NRM fact sheet for lantana) is:

- De-stock to establish a fuel load, if fire is the initial treatment.
- Carry out initial treatment: fire, dozing or slashing.
- Sow improved pastures. Exposed soil must be immediately reseeded using above-normal grass sowing rates.
- Reintroduce stock only when the pasture is well established.
- Follow up with spot spraying when vigorous regrowth has reached at least 0.5 m, and preferably 1 m.
- Repeat for all new regrowth (for at least two years).
- Monitor regularly for new seedlings and infestations.



Mick Richards

Paddock awaiting pasture establishment after dozing, Clairview, Qld.

*'We've had good success using herbicide to follow up after a hot fire, spraying the lush regrowth when it's 30 cm high. We had a 90 per cent kill rate in the first year, and 99 per cent in follow-up the next year. Some paddocks are now totally free of lantana.'*

(Landholder, Gin Gin, Qld)

Aerial spraying by helicopter may be feasible for large infestations that are inaccessible to machinery or cannot be burnt; however, ways to make it cost-effective are still being investigated.

#### **Small, dense infestations**

Small, dense infestations can be treated cost-effectively by foliar spraying of herbicides from a tractor or other vehicle. Using splatter guns to apply concentrated herbicide solutions is also appropriate for smaller areas as they minimise off-target damage to grasses and legumes.

#### **Small, scattered infestations**

Low-volume applications of herbicides, such as the cut stump method and basal bark spraying, are effective on small, scattered infestations; but access to the stems will depend on the size and density of the thicket. Mechanical grubbing can be feasible in small infestations where complete removal of stumps and roots is desirable. Mechanical grubbing of individual plants generally causes less soil disturbance than pushing, but exposed soil must still be re-sown to pasture. Also feasible are manual control methods, such as hand grubbing and hand pulling of young seedlings.

#### **Tips for initial treatments**

Trampling by stock can be useful to reduce the height and density of thickets, and create access for further control. These tracks can then be used to carry out foliar spraying, low-volume herbicide applications such as cut stump method or basal bark spraying, or manual control methods. Other initial treatments include burning, slashing and dozing.

Biological control agents, if present, may suppress lantana growth and vigour, helping to create access for mechanical or manual control methods, or low-volume herbicide applications.



Lantana will establish along fence lines.

Mick Richards



Lantana understorey in native pasture woodland, Ma Ma Creek, Qld.

Mike Day

## Along fence lines

Controlling lantana along fence lines will reduce the re-infestation of paddocks, and prolong the life of the fence. Monitor fence lines regularly for new lantana seedlings. Foliar spraying is usually the most effective method of control, and, with suitable access, it can be done from a tractor or other vehicle. The cut stump method is also effective for isolated clumps.

- Protect your fence lines with firebreaks if controlling lantana with fire.
- When replacing fences, take the opportunity to grub out whole plants.

As lantana seed can be spread in bird droppings, check for new seedlings in known roosting areas such as fence lines, boundaries, gully lines and waterways, and below trees in paddocks.

*'We find that no matter what you do, every three to four years a plant will grow up alongside a fence post. You just have to be vigilant and spot spray them when they're small and still easy to control.'* (Landholder, Casino, NSW)

## Native pasture woodlands

Lantana can invade and dominate native pasture woodlands, particularly those that have been selectively cleared to increase grazing capacities. Once established, an understorey of lantana can be extremely difficult to control, as access is usually restricted and natural regeneration of pastures can be slow. Regular monitoring for new infestations is very beneficial.

Mechanical control methods may be possible where farm or cattle tracks exist. Foliar application of herbicide using a hose and hand gun from a tractor or other vehicle is the control method most commonly used in this situation. Low-volume applications of herbicide are also effective in smaller areas.

Native pastures under woodland should be managed so that they remain competitive. Stocking rates should ensure that ground cover is maintained. Where lantana has been removed, shade-tolerant pasture species can be sown rather than waiting for regeneration of the native pastures.

## Re-establishing pasture

Removing lantana will create opportunities for further weed invasion. Bare areas should be re-sown to pasture immediately and allowed to establish before restocking. Soil erosion can also result if no effort is made to regain pasture cover quickly.

- Re-sow using above-normal rates, just before rain, while the surface is still friable. Check soil fertility and apply fertiliser if necessary. Keep pastures de-stocked until they have re-established.
- If controlling with fire, ensure that vigorous improved pastures are sown after each burn, and that stock are excluded until the pasture has re-established and seeded. (To fully re-establish pastures, follow up after each burn for two to four years with spot spraying or mechanical methods).
- Consult local agronomists (Department of Primary Industries and Fisheries, Queensland, or New South Wales Department of Agriculture) for advice on pasture species suitable for local conditions.

*'We clear lantana with a stick rake and blade plough, and carry out follow-up, but we've found that stocking rates are crucial to success.'* (Landholder, Yarwin, Qld)

## Lantana poisoning in livestock

The toxic triterpene acids, lantandene A (rehmamic acid) and lantandene B, are present in lantana. Most cases of poisoning occur in stock newly introduced to infested areas, with young animals most at risk. Stock bred in infested country usually avoid lantana—unless they have no alternative fodder. Furthermore, when pasture is scarce, the smell of herbicide-treated lantana may attract stock that would not normally eat it. Red-flowered lantana is commonly believed to be more toxic than pink-flowered; in some areas, however, pink-flowered lantana is known to be highly toxic. Many landholders have observed that mature, experienced cattle browse lantana at certain times of year without obvious toxic effects. Given the lack of precise information and the highly variable physiology of lantana types, **all forms of lantana should be regarded as potentially toxic to stock.**



Mike Day

Depressed and weak with skin lesions.



Ross McKenzie, courtesy of DPI&F, Qld

Inflamed nose and tongue.



Mick Richards

Exposed flesh where photosensitive skin has died and fallen away.

**'After spring rain we can get a few showing signs of poisoning. They must consume the early lantana growth because it responds to the rain before everything else.'** (Landholder, Marlborough, Qld)

**'The cattle will nibble on lantana, so I never put them into areas that have been slashed until the regrowth has hardened off.'** (Landholder, Tungaburra, Qld)

### Signs of poisoning

- In acute cases, symptoms can appear after one feed and within 24 hours.
- Animals become increasingly photosensitive (sensitive to light).
- Early symptoms include depression, sluggishness and weakness, swaying of the head from side to side, loss of appetite, constipation (diarrhoea with strong smelling black fluid faeces in severe cases), frequent urination and dehydration.
- After one or two days, the eyes and skin around the nose and mouth become jaundiced, and the muzzle becomes dry and warm. Eyes may be inflamed and have a slight discharge.
- Finally, the muzzle becomes inflamed, moist, ulcerated and very painful (known as 'pink nose'). If the ears and eyes are un-pigmented, swelling can occur and un-pigmented skin becomes inflamed. In chronic cases, blow fly and bacterial invasion of raw and exposed flesh may occur as affected skin dies and falls away leaving raw and ulcerated surfaces.
- Death is common within one to four weeks after the first symptoms appear; and in acute cases, three to four days after eating lantana. Unless treated, cattle can die up to six weeks after becoming poisoned—even after lesions caused by photosensitivity have healed.

**Poisoning can result when a beast consumes 1 per cent or more of its body weight of fresh leaf—from about 5 to 20 kg for a 500 kg cow, depending on the toxin content of the lantana.**

### Treatment

- Act quickly. Early treatment gives a good chance of recovery; delays can cause serious kidney damage and failure.
- Move the affected animal to shade in a lantana-free area and call the vet immediately.

Drenching with a slurry of 2.5 kg activated charcoal in 20 litres of electrolyte replacement solution is usually effective. A second dose 24 hours later may be required. Bentonite is a less expensive (but less effective) substitute for activated charcoal. Skin damage can be treated with antibiotics and sunscreens. Affected animals should be given intravenous fluids and encouraged to eat.

### Post-mortem signs

Signs of lantana poisoning include:

- jaundice (yellow discolouration) of tissue
- hard, dry, mucus-covered faecal masses in the large intestine
- dry, undigested plant material in the rumen (known as 'dusty ruminal contents')
- a swollen liver, with yellow to orange discolouration
- a very swollen gall bladder
- swollen and pale kidneys, which turn green on exposure to air
- ulceration of the cheeks, muzzle, nostrils, tongue and gums (in severe cases in cattle).



Ross McKenzie, courtesy of DPI&F, Qld

Post-mortem signs of lantana poisoning.

# Natural ecosystems



Andrew Clark

Infestation in eucalypt woodland, Bonville, NSW.



Ken Hanley, courtesy of CSIRO

Aerial photograph of invasion into disturbed rainforest, Gold Creek, Qld.



Rosemary Joseph, courtesy of NPWS, NSW

Lantana infestation in open clearing in rainforest, Mt Jerusalem, NSW.

## Natural ecosystems

Lantana is often introduced into natural ecosystems by birds dropping seed beneath roosting trees, and its invasion further enabled by human disturbance of soil or native vegetation. The extent of infestation will depend on the type of ecosystem (e.g. open woodland, closed rainforest), the level of disturbance and the availability of light and moisture.

### Infestations in various ecosystems

#### *Open eucalypt forests and woodlands*

Open eucalypt forests and woodlands generally have canopies between 10 and 30 m high, with widely spaced canopy trees, and grassy or shrubby understoreys. The penetration of light enables lantana to germinate and spread through the understorey, and eventually climb into the canopy. It is able to dominate open forest and woodland within 10 years of invasion. Moist gullies and areas such as tracks and trails that are regularly disturbed are highly susceptible to invasion.

#### *Bell miners and lantana*

In some eucalypt forests in New South Wales, bell miners (native bellbirds) are flourishing in areas where lantana has infested the understorey. They feed on the sugary excretions of psyllids (sap-sucking insects that live on eucalypts), but don't eat the psyllids themselves. Bell miners are very territorial and drive off other birds that do eat psyllids. It seems that the abnormally high populations of sap-sucking psyllids then contribute to eucalypt dieback. This phenomenon is not yet fully understood, and researchers are trying to establish how best to control the lantana, balance bell miner and psyllid populations, and prevent further eucalypt dieback.

Eucalypt dieback in Toonumbar National Park, NSW.



Andrew Clark

#### *Wet sclerophyll forests*

Wet sclerophyll forests generally have canopies between 30 and 100 m high, with broad-leaved, shrubby (often rainforest-like) understoreys. Lantana will usually infest the edges of the forest and areas such as tracks and access routes where disturbance allows a higher than normal penetration of light.

#### *Rainforest*

Rainforests have closed, multi-layered canopies, with dense foliage including vines, palms, ferns and epiphytes. They are highly diverse, and are found mostly in wetter areas. The closed canopies of intact rainforest prevent lantana from invading, but it will persist along forest edges, and where the canopy is broken or the vegetation structure has been disturbed.

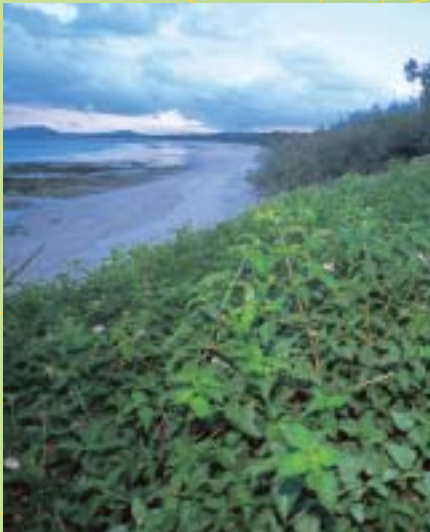
#### *Dry vine scrub*

Dry vine scrub is a relatively rare type of dry rainforest, characterised by vines, a shrubby understorey, emergent canopy trees and an absence of palms and buttressing. The penetration of light in dry vine scrub is relatively higher than in rainforest, and allows extensive thickets of lantana to dominate the understorey.



Dry lantana in Forty Mile Scrub National Park, Qld.

Colin O'Keefe, courtesy of QWPS



Mick Richards

Infestation in coastal zone, Hay Point, Qld.



Andrew Clark

Lantana and bitou bush, side by side, Norah Head, NSW.



Elissa van Oosterhout

Lantana in melaleuca swamp, Beerwah, Qld.

### Coastal areas

Coastal areas feature a range of ecosystems including mangroves, sedge lands, heath lands, as well as dune ecosystems and vegetation types dominated by melaleucas, banksias and casuarinas. Lantana will infest many of these ecosystems, and can grow in sand, as long as light, moisture and nutrients are sufficient. In the Northern Territory, lantana has recently spread along the coastal dunes and margins of monsoon vine thickets near Darwin. It is common on headlands in Queensland and New South Wales, where it is associated with other weeds, particularly bitou bush.

#### Bitou bush

Another Weed of National Significance, bitou is also a serious invasive weed of coastlines in south-east Queensland and New South Wales. As painstaking removal of bitou bush can often be followed by an invasion of lantana, immediate revegetation is essential for successful control in these areas.

### Choosing control methods

To choose the most appropriate methods of control, consider the need to minimise disturbance and the ease of access to infestations, as well as the type of ecosystem, the available resources, and the level of management inherent to different land-use situations (e.g. reserve, national park, private property). For large, dense infestations, where lantana makes up the major part of the understorey and access is restricted, the only possible forms of control may be fire (if appropriate—see below), and biological control agents (see ‘Biological control’).

#### Chemical control

Chemical (i.e. herbicide) methods will not be appropriate in many cases, and where they can be used, it should be minimally and with care. Low-volume herbicide applications such as the cut, scrape and paint or cut stump methods minimise the environmental risks associated with herbicides as the chemicals are applied directly to lantana stumps. In dense infestations, foliar spraying using a hose and hand gun (if vehicular access is possible) or knapsack sprayers (if paths can be manually cleared through the lantana) may be more appropriate.

Spray drift from foliar applications of herbicides must be rigorously controlled to avoid off-target damage to native vegetation or waterways.

*‘Grants from the National Heritage Trust have allowed local landcare groups to purchase quick-spray units, hired out to landholders for \$10 a day. Most people couldn’t afford a \$10 500 spray unit, so it’s a benefit to the whole community. Landcare groups in the eastern Darling Downs now own about 10 quick-spray units.’*  
(Landholder, Crow’s Nest Shire, Qld)

*‘For two years we paid \$1250 for two bush regenerators to help with lantana control in the coastal melaleuca forest on our 100 ha property. The four of us would go into the forest for a morning once a fortnight in the cooler weather. We used the cut, scrape and paint method with 1:1 Roundup and water (and a few drops of pink dye), and removed smaller bushes by hand. Now we go in and do an hour’s weeding by hand when we are in the mood for it. It’s hard work, and most of the time it’s too hot and there are too many mosquitos and ticks. But we have reduced the lantana by about 60% overall.’*  
(Landholder, Lennox Head, NSW)

#### Mechanical control

Slashing infestations around forest edges can be appropriate if access is possible. In many cases, mechanical controls will be inappropriate because of the need to minimise disturbance.

#### Manual control

Where infestations are inaccessible, or chemical controls to be avoided, manual methods such as hand grubbing and hand cutting may be carried out. In some cases, teams of workers are able to carry out manual control over extensive areas on foot.

#### Control by fire

The type of ecosystem will determine whether control with fire is appropriate. The presence of lantana creates hotter than normal fires (whether they are bushfires or controlled burns), and an increased intensity and frequency of fires can actually



Lantana is adopted as habitat.



Allow time for natural habitat to regenerate between control efforts.

Mick Richards

Courtesy of Robin Hill

assist the spread of lantana by changing the structure of the ecosystem and the diversity of its vegetation. Higher intensity fires particularly threaten rainforests and dry vine scrubs. (See section 3 for more information on fire control, including controlled burning, and fire intensity and frequency).

Burning can be appropriate in open eucalypt forests and woodlands, as they have evolved a tolerance for, and dependence on, fire. Low-intensity fires can reduce the height and density of lantana thickets, allowing access for treating new regrowth. However, continuous high-intensity burning of open forest and woodland can damage their structure and diversity, enabling further invasion. Wet sclerophyll forests have evolved a tolerance for, and dependence on, very infrequent high-intensity fires. However, the regular use of fire to control lantana in these wetter forests is not recommended, as it can change their structure and diversity.

Rainforests are generally resistant to fire as they are too wet to burn readily, but in extreme drought conditions they are vulnerable to fire, which can be devastating. Infestations of lantana at the edges of the forest can invite repeated fires, causing damage that eventually allows further penetration of the infestation. Fire is not appropriate for controlling lantana in these ecosystems.

Fire also should not be used to control lantana in dry vine scrubs, as they have a very limited natural fire tolerance. Furthermore, the presence of lantana increases the possibility and intensity of wildfires, which can cause irreversible damage to the vegetation.

#### **Feral pigs, lantana and fire**

Lantana often invades rainforest and vine scrub after feral pig activity. Their rooting kills trees and opens the canopy, allowing more light to penetrate and lantana to proliferate. This in turn increases mid-storey fuel loads. Intense fires kill the understorey and eventually the canopy, allowing the mature fire-tolerant lantana to dominate. Ironically, pig rooting is reduced in dry rainforest that is heavily invaded by lantana—probably because lantana thickets impede access for pigs and reduce their food sources.

## **Follow-up and revegetation**

In any natural ecosystem, successful control of lantana *must* be integrated with re-establishment of native vegetation, either by natural regeneration (allowing the germination of native seeds present in the soil) and/or by active replanting of native seedlings after removing lantana. Monitor roost trees away from existing infestations and prevent the establishment of new infestations by hand pulling any seedlings. Minimise human disturbance to soil, native vegetation, water and fauna by restricting access by vehicles, humans, and livestock to permanent tracks, and fencing off revegetated and undisturbed areas.

## **When lantana provides habitat**

In areas where lantana is providing a substitute habitat for native wildlife or stabilising soil, remove infestations in sections, and revegetate cleared areas with appropriate native species. This allows time for native vegetation to regenerate and for native animals to find new habitat.

*'We do mosaic clearing, which means we clear a pocket of lantana, revegetate and wait for those plants to become established before moving on to the next pocket. This is to cater for any creatures that may be using the lantana as habitat.'*

(Landholder, Coal Point, NSW)

*'Our approach to lantana is a deliberate, gradual phasing out—because it has been adopted as habitat for birds, frogs and reptiles. To eradicate it all at once could expose them to immediate threat from predators.'*

(Coastcare group, Ballina, NSW)



Mick Richards

Palm growing through lantana, Springbrook National Park, Qld.



Andrew Clark

Lantana providing an interim buffer, Central Tilba, NSW.

### ***Lantana threatens little penguins***

On Lion Island Nature Reserve at the entrance to Broken Bay, New South Wales, impenetrable lantana thickets prevented the burrowing and nesting activities of a colony of little penguins. The lantana is being removed in stages, and regeneration of native vegetation is allowing the penguins to recolonise the area.



Andrew Clark Inset: Mike Day

Little penguin burrows amongst lantana, Lion Island, NSW.

### **Will native seedlings grow through lantana?**

Eucalypt seedlings require more light to germinate and grow than is usually available underneath lantana thickets. Seedlings of rainforest species can grow through lantana thickets, establishing canopy that shades lantana and reduces its viability. The emergence of healthy native rainforest trees from beneath lantana thickets depends on the viability of the native seed bank, the age of the lantana thicket, and the degree of disturbance that allowed the initial establishment of lantana. In most situations, removing lantana will enable faster and more successful natural regeneration. (See 'Follow-up control and revegetation' in Section 2.)

*'You make a little ball out of a mix of clay and native seeds, allow it to dry, then throw it into the lantana thicket. Rain washes away the clay over time, depending on the size of the ball, and releases the seeds. It seems to work fine—we hope the trees will eventually shade out the lantana.'*

(Landholder, Eungella, Qld)

### **Making lantana work for us**

- In some natural ecosystems, lantana thickets are used (in the absence of other barriers) as a buffer to disturbance by humans, livestock and other weeds.
- Lantana thickets are sometimes left at the edges of rainforests as an interim buffer while infestations within the rainforest are treated.
- In the Yessabah Nature Reserve in New South Wales, lantana thickets have been left near access points to cave systems that provide habitat for microbats. Lantana here acts as a barrier to humans who might otherwise enter and disturb the colonies.

For lantana to work for us, however, it must be wisely managed. The responsible use of infestations as a management tool includes containing them, and monitoring for new, unwanted infestations.

# Watercourses



Riverbank infestation, Cattai National Park, NSW.



Creekbed infestation, Cronulla, NSW.

## Watercourses

Lantana often thrives along watercourses because of the availability of soil moisture and light. Though water is not thought to be a major dispersal agent of lantana seed, controlling these infestations is important for the health of the watercourse, and to prevent reinfestation of paddocks or bushland.

Both on grazing land and in natural ecosystems, watercourses should be buffered by healthy riparian vegetation. Lantana should be removed in stages, in order to prevent stream bank erosion, and to allow for revegetation with appropriate riparian species. This will help prevent further weed infestation, and improve the health of the watercourse. On farms, high levels of disturbance by stock or vehicles increase the likelihood of invasion and the density of infestations along watercourses. For this reason, watercourses should be fenced off and watering points for stock installed.

### **Disturbance to riparian areas**

Some mechanical controls are acceptable along watercourses, as long as disturbances to stream banks and beds are minimised, destruction of native vegetation is avoided, and the control is carried out in stages to allow revegetation with riparian species.

If stream banks are likely to be disturbed during control efforts, permission must be obtained in New South Wales from the Department of Infrastructure, Planning and Natural Resources, or in Queensland from the Department of Natural Resources, Mines and Energy. Councils may also have local laws concerning the removal of major weed infestations along stream banks. See 'Legal requirements for control' under 'Further information'.

### **Use of chemicals**

Herbicides can be used effectively; however, only certain chemicals are registered for use near water bodies. Low-volume applications of herbicide (knapsack spot spraying, basal bark spraying, and cut stump method) are effective control methods in these areas. They also allow the dead stump and roots to remain in the ground, which may assist with bank stability in the absence of other established vegetation.

- In Queensland, the Environmental Protection Agency allows the use of all chemicals registered for riparian areas, and the *Environmental Protection Act 1994* (Qld) imposes a duty of care on activities such as the control of weeds in riparian areas.
- In New South Wales, all herbicides registered for riparian areas may be used—to the standards of best practice, and providing spray drift into water bodies is avoided.

### **Tips**

- Manual control methods are appropriate along watercourses, and hand grubbing is effective for small areas of lantana infestation.
- If present, biological control agents may help to decrease the density and vigour of infestations.
- Trampling by stock along watercourses is not appropriate in any land-use situation.
- Fire, also, should not be used to control lantana along watercourses.

### **Avoid fish kills**

Large amounts of lantana leaves and stems falling into pooled water can deplete oxygen levels, causing fish kills. Avoid defoliant herbicides and methods that cut and mulch the plants.



Creekbank infestation, Lane Cove National Park, NSW.

# Steep and inaccessible areas



Andrew Clark

Infestations in steep country, Atherton Tablelands, Qld.

## Steep and inaccessible areas

Difficulty of access usually prevents the use of control by mechanical methods, and as a result most lantana control is labour-intensive in such areas. Teams of workers can successfully carry out manual control and low-volume applications of herbicide. Foliar spraying (knapsack spot spraying or line spraying, such as with a hand-held spray gun on a retractable hose) can be viable if access allows.

Biological control agents are also often relied on to reduce the density and vigour of infestations.

### **Other methods**

- Trampling by stock can reduce the height and density of infestations. Further treatments, such as foliar spraying using a retractable hose and hand gun or knapsack, are necessary.
- Fire can be a useful control method, depending on factors such as whether the native vegetation is fire-tolerant, and whether fire will lead to erosion.

- Aerial spraying by helicopter of medium to large infestations has been successfully trialled in extremely steep and inaccessible areas where control by fire and mechanical methods is not possible, and may prove cost-effective in the future.
- On steep roadside embankments, fire, side slashing and spraying from vehicles are possible.

### **Erosion**

Because of the risk of erosion, lantana control on steep slopes should not result in exposed soil. If plants are completely removed, the necessary labour and resources to revegetate—either with pasture or with native plants—should be available. Hand broadcasting of pasture seed may be the least labour-intensive means of revegetation. If the lantana root system is completely grubbed out soil stabilisation measures must be taken (e.g. revegetation with either pasture or native plants). In most steep areas, it is better to use control methods that leave the dead plant in the ground.



Ken Harley, courtesy of CSIRO

Lantana in steep country, Numinbah Valley, Qld.

# Orchards and crops



Lantana encroaching into macadamia nut trees, Beerwah, Qld.



Lantana near vineyard, Cessnock, NSW.



Lantana in gullies near orchards harbours vermin.

## Orchards and crops

In many countries, lantana is a serious weed of plantation crops and orchards, where the moist, disturbed soil and high light conditions between rows are favourable for infestation.

In Australia, it often grows in the less intensively maintained areas close to orchards and crops, such as along boundaries, fence lines, windbreaks, gullies and irrigation drains. Such areas should be kept free of lantana, as they provide a breeding area for rats (which are a major pest of nut crops such as macadamias) and other vermin.

If lantana has established between rows and has not been managed in conjunction with other horticultural weeds, one possible approach is:

- Completely remove individual lantana plants by grubbing them out by hand, and pulling out any seedlings. A mechanical grubber may be used only if the lantana roots are not intertwined with those of the cultivated plants.
- Spray with glyphosate at carefully calculated distances from the trunks, roots, and foliage of productive trees.

Never allow spray drift to come into contact with orchard trees. Glyphosate cannot be used where lantana has grown into the orchard crop canopy. It is most effective on young plants or regrowth. Older, more established plants should be completely grubbed out.



Lantana established between rows of macadamia nut trees.

Glyphosate (360 g/L) is the only registered active constituent for use on lantana in the following crops—almonds, avocados, bananas, citrus, cotton, grapes, guavas, kiwifruit, lychees, macadamias, mangoes, nuts, olives, papaws, peanuts, pecans, pistachios, pome fruit, soy beans, stone fruit, sugarcane, walnuts. 2,4-D amine should not be used in tree crop orchards.

## Containment and prevention

- Contain large lantana infestations near orchards and crops and prevent their spread with slashing and foliar spraying at the edges.
- Maintain a suitable ground cover between rows (e.g. sweet smother grass, pinto peanut or naturally seeded grasses), so that regular slashing can be used to prevent lantana and other woody weeds establishing.
- Check for new lantana seedlings under trees and fence lines where birds roost. If birds have access to orchard or plantation trees, new seedlings may emerge between rows. Seedlings can be slashed, but constant monitoring and hand pulling or chipping is more effective if it is possible.
- If present, biological control agents may help to reduce the density and vigour of lantana infestations in and around orchards and crops.



Lantana bordering cultivation, Yarraman, Qld.

# Commercial forestry



Mick Richards

Lantana regrowth after harvest in hoop pine plantation, Yarraman, QLD.



Mick Richards

Lantana in a hoop pine plantation, Yarraman, QLD.

## Commercial forestry

The primary aim of managing lantana in commercial forests is to prevent infestations from impeding access to trees at critical stages (such as pruning, measuring, harvesting). Lantana is rarely controlled in plantations throughout entire timber growth cycles, except when it is essential to reduce the hazard of fire.

Mechanical removal methods (i.e. pushing with small dozers between rows) and foliar spraying from vehicles or tractors are effective in all types of commercial forests. Biological control agents, if present, may be useful to reduce the density and vigour of infestations.



Mick Richards

Small dozers used to clear lantana from between rows to allow access in hoop pine plantation, Yarraman, QLD.



Elissa van Oosterhout

Lantana around the edges of an exotic pine plantation, Beerwah, QLD.

## Pine plantations

Lantana will successfully invade both hoop and exotic pine plantations in their early stages. Mature hoop pine plantations are also vulnerable to infestation as light penetrates the canopy; however, shade levels are too high under mature exotic pine plantations to allow lantana to persist. In both types of plantation, tracks, roads, firebreaks and forest edges are also prone to invasion.

### Using fire

- Hoop pine plantations are extremely fire-sensitive, so total protection is necessary. This can be achieved by burning firebreaks around the plantation, keeping the rows wide enough for control by slashing and spraying, and/or maintaining rainforest buffer zones.
- In Queensland, controlled burns may be carried out in exotic pine plantations from when the trees are 10 years old. They are often burnt at low intensities on a 5 to 10 year cycle, depending on fuel loads.



Mick Richards

Lantana in a plantation at an early stage of establishment.



Andrew Clark

Lantana on edges of commercial forestry, Kempsey, NSW.



Hellen Haapakowski

Lantana in commercial forestry, Coffs Harbour, NSW.

## Hardwood plantations

Lantana can be a serious weed in commercial hardwood plantations. The plantations' open canopies permit lantana to establish and persist as a prolific understorey monoculture, which affects re-establishment after harvesting, and increases the costs of road and firebreak maintenance. In the early stages of plantation establishment, lantana can out-compete saplings and seedlings. In later stages, it restricts access, increases the risks of intense fire damage, and reduces the health and growth of the trees.

### Using fire

- Research is now being carried out into under-tree hazard-reduction burning. While such fires are unlikely to be intense enough to kill lantana, they should effectively reduce the density and vigour of infestations and allow follow-up with other control treatments.

## Cabinet timber plantations

Rainforest species are often grown in cabinet timber plantations. Depending on the design of the plantation and the availability of light, lantana can invade the understorey or the edges. The investment value of privately owned cabinet timber plantations may justify intensified control efforts.

### Using fire

- Most cabinet timber species do not tolerate fire, and it should not be used as a control technique in these plantations.

## Native forestry

Lantana in native forestry inhibits the natural regeneration of trees and increases the risk of fire damage. Native forests used for recreation or grazing will have higher levels of disturbance, which will in turn increase the likelihood of lantana infestation.

### Using fire

- In dry sclerophyll hardwood forestry in Queensland, lantana infestations are controlled with low-intensity fires on a three-to-five year cycle, followed up wherever possible with foliar spraying of regrowth.



Mick Richards

Infestation in native forestry, Bangalow, NSW.

# Disused or vacant land



Elissa van Oosterhout

Lantana growing on public land, Landsborough, Qld.



Elissa van Oosterhout

Lantana growing on a vacant block, Landsborough, Qld.

## Disused or vacant land

### Public land

Lantana on state lands that is affecting an environmentally significant area should be controlled.

Control of lantana is particularly difficult in areas that are not actively managed, because of the frequent lack of follow-up and revegetation. Minimising disturbances to soil and vegetation is important to prevent worsening of the weed problem. Slashing has the advantage of causing little soil disturbance, and can effectively keep infestations at a minimum. Mechanical controls may also be appropriate, as long as access is adequate. Disturbed soil should be sown with pasture seed, or revegetated with appropriate native plants. Follow-up treatments will be necessary to reduce re-infestation.

Burning can be a part of responsible lantana management on public lands, even in the absence of other initial control. Follow-up controls are necessary. Refer to 'Fire control' in section 2 for more information.

### Private land

Disused or vacant private land (particularly land awaiting development and farmland that has been subdivided into rural residential acreage) is often unmanaged, and is conducive to the establishment of lantana.

Absentee owners can incorporate lantana management into their obligation to control declared weeds. Slashing by contractors once or twice a year will generally be sufficient to maintain lantana infestations at a manageable level. For a higher level of control, spray contractors can treat lantana with herbicide.

### Fire control

Many landholders don't have the equipment or experience necessary to undertake fire control. In some areas, rural fire brigades will carry out burning on private property on request. Always obtain a permit from the rural fire brigade before carrying out any kind of fire control (see 'Fire control' in section 2).

### Biological control

Biological control agents (biocontrols) can reduce the density and vigour of infestations on disused private land; however, not all biocontrols are established in all regions.

Unfortunately, some landholders believe that the presence of biocontrols on their land can excuse them from any further management or control of lantana. However, other control methods are necessary, as biocontrols alone cannot effectively suppress infestations.

### Other methods

- Goats have been reported to graze lantana; however, this is not recommended as long-term consumption is fatal.
- Manual control methods (i.e. hand grubbing and hand chopping) and low-volume applications of herbicides (i.e. spot spraying from backpacks, basal bark spraying, and the cut stump method) are effective methods of control, although labour can be expensive.

### Revegetation

Unfortunately, active revegetation is unlikely if landholders are absent. Where landholders are willing and able to revegetate their land, they can plant native species and carry out follow-up control of lantana seedlings and regrowth. On acreage blocks that were formerly pasture, following up control by sowing suitable pasture seed is important. Many acreage dwellers are unaware that they need to assist their grass cover by actively sowing pasture seed and fertilising.

# Utility easements, roadways and railways



Lantana in powerline easement, Bellingen, NSW.

Andrew Clark



Lantana in railway corridor, Mackay, Qld.

Mick Richards



Lantana on roadside, Mt Nebo Road, Qld.

Mike Day



Lantana in railway corridor, Beerwah, Qld.

Elissa van Oosterhout

## Utility easements, roadways and railways

### Who's responsible?

#### Utility easements

Utility providers are usually responsible for preventing the introduction and minimising the spread of declared weeds along utility easements; however, the management and control of declared weeds on freehold land under easement is the responsibility of landholders. Utility providers usually draw up management plans for particular areas, which include prioritisation of control activities. New outbreaks of weeds on an easement in a weed-free area are likely to be controlled by the utility provider.

#### Roadways

Some roads are owned and maintained by local councils; others by the state government. Lantana control on roadsides is often required for compliance with road safety standards, but increasingly for the sake of the local flora and fauna. Many landholders gain the necessary permission from their council to contribute to controlling lantana on council roadsides bordering their properties as it helps to reduce their own lantana problems, including the risk of re-infestation.

#### Railways

Railway corridors are usually owned by state governments and leased by private operators or government-owned corporations. The lessees are responsible for weed control in the corridors.

### Common control practices

- Foliar application of herbicide using a hand gun and hose from a vehicle is probably the most usual form of control along roadsides.
- Slashing can reduce the height and density of infestations; regular slashing will help to keep infestations at a minimum. Bank slashers or side slashers are most practical. Follow-up is usually with foliar applications of herbicide.
- Removing lantana by mechanical methods is appropriate, as long as access is adequate, and disturbed soil is re-sown with pasture seed or revegetated with native plants.
- Biological control agents, if present, can reduce the density and vigour of infestations.
- Fire is sometimes used to manage lantana along roads and railways, and some easements (except overhead powerline easements, as it may damage infrastructure).
- In all cases, follow-up treatment of regrowth is necessary for long-term control.



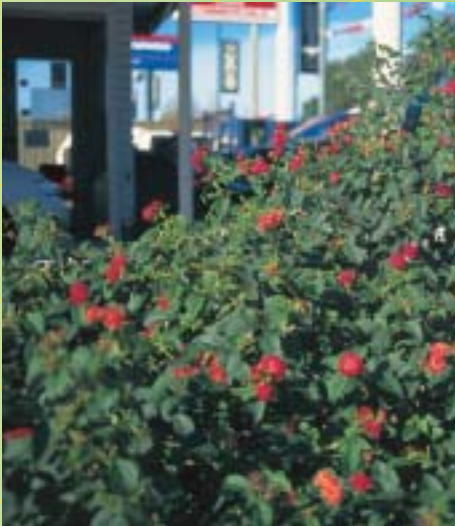
Lantana in powerline easement.

Mick Richards

#### Department of Main Roads

In Queensland, the Department of Main Roads (DMR) is responsible for the extensive reserve areas associated with the state-controlled road network. Under DMR's Road Corridor Environmental Assessment program, pest plants within the road reserve are identified and managed in accordance with local and regional weed management priorities. Funding for the control of weeds around the construction of new roads is allocated with the help of field surveys of the location and extent of infestations.

# Gardens and landscaping



Graham Harding, courtesy of Eurobodalla Shire Council

Public planting of red-flowered ornamental lantana, Moruya, NSW.



Mick Richards

Public planting of white-flowered ornamental lantana, Brisbane, QLD.



Graham Harding, courtesy of Eurobodalla Shire Council

Public planting of orange-flowered ornamental lantana, Moruya, NSW.

## Gardens and landscaping

Ornamental varieties of *Lantana camara* have been developed by the nursery industry, and valued by gardeners and landscapers for being hardy and colourful, and requiring little maintenance. Ornamental lantana is used extensively in public plantings (e.g. parks, roundabouts, and footpaths) and in home gardens in all states and territories of Australia.

Nurseries in some states still stock ornamental lantana plants. However, *L. camara* has now been declared in a number of states with its status under review elsewhere, and is restricted from sale in Queensland, Tasmania, South Australia and the Northern Territory.

### **Ornamental *Lantana camara***

Ornamental lantana is often said to be safe to plant in gardens because it is sterile. However, studies have shown that five per cent of pollen from supposedly sterile ornamental lantana is viable (Neal 1999), and also that pollen from weedy lantana can pollinate these supposedly sterile varieties, causing them to produce fertile seed.

### **Ornamental *Lantana montevidensis***

Ornamental varieties of *L. montevidensis* (creeping lantana) have also been developed for sale in nurseries. In some cases, it is the weedy purple-flowered form capable of producing fertile pollen and seed that is grown in gardens as an ornamental. The ornamental forms of creeping lantana are sterile, flowering profusely without setting seed. However, the pollen from weedy forms can pollinate ornamental forms resulting in viable seed, which adds to the genetic base of weedy creeping lantana.

Allowing the sale and use of any ornamental lantana therefore adds to the genetic diversity of the lantana species complex, and potentially enhances the ability of weedy lantana to spread by adapting to new environments and resisting control by herbicides and biological control agents.

## Removing lantana

- Remove all lantana by hand from private gardens and public plantings in all states.
- Kill removed plants and stems by placing in a black plastic bag in the sun for seven days, then take them to a rubbish dump.
- Follow up. Check for lantana seedlings in and around gardens and other areas previously planted with lantana.
- Replant with local native species or non-invasive exotic species. Many non-invasive plants are comparably hardy and colourful, and require little maintenance. Contact your local landcare group, council, or bushland friendly nursery for suggestions.



Andrew Clark

Chelsea Gem variety of ornamental lantana.

**ALL LANTANA PLANTS ARE WEEDS**