NSW GOVERNMENT Department of Primary Industries

PRIMEFACT

Alligator weed

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Introduction

Alligator weed (*Alternanthera philoxeroides*) is a potentially devastating weed that grows in water and on land, affecting both waterways and floodplain areas. It is listed as a Weed of National Significance (WoNS).

It is a native of South America and a major problem in south-eastern United States, China, New Zealand, Burma, Thailand, Indonesia and India. Alligator weed has not reached its potential distribution in Australia or within NSW, but has the ability to devastate the environment and agriculture if left unchecked.

Alligator weed has extremely vigorous growth and great tolerance of normal control measures, which makes it a major threat to wetlands, rivers and irrigation systems. It is declared a noxious weed throughout NSW and is one of the highest priority weeds for detection and management in NSW.

Distribution

Alligator weed is a native plant of the Parana River floodplains in northern Argentina and adjacent countries. It was possibly introduced into Australia in the Newcastle area via cargo from ships during the Second World War. Since its introduction alligator weed has spread to nearby seasonally flooded agricultural and grazing lands of Fullerton Cove, Williamtown and the Raymond Terrace area, and has steadily expanded to infest many creeks, lowlands and drainage channels in the lower Hunter region. It was recorded in a dam at Woomargama near Albury in 1967, and after its first recording in the Sydney basin at Duck Creek in 1969 it spread within the Parramatta catchment and throughout the Georges River catchment. In 1981 it was recorded at Camden and new infestations were then reported throughout the 1990s, with alligator weed found higher in the Hunter catchment in the Williams and Paterson Rivers in 1993; in Barren Box Swamp near Griffith in 1994; and in Byron Creek, a tributary of the Richmond River on the far north coast in 1998.

In 1995 alligator weed was observed in a backyard vegetable garden in Brisbane, grown as a substitute for the herb and vegetable Mukunawanna (*Alternanthera sessilis*), favoured by Sri Lankans. Investigations during the following years found it growing in many NSW backyards. More than 500 infestations have been found in the Sydney metropolitan area, and numerous infestations have been reported in many regional areas across NSW.

There is now an estimated total area of 3,950 ha of known alligator weed in NSW, with 2,500 ha of

Figure 1. Leaves and flowers of alligator weed. NSW DPI

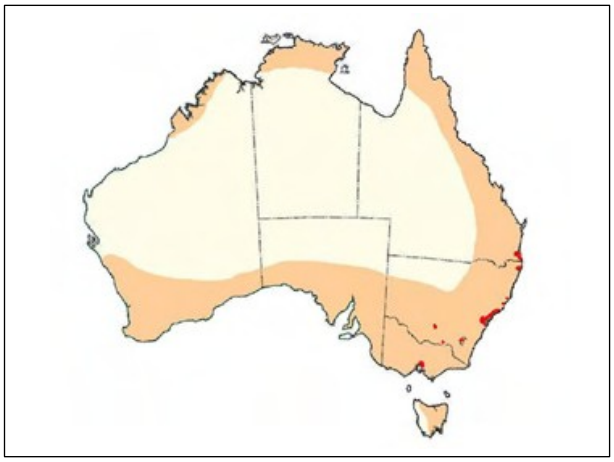

Figure 2. Current and potential distribution of alligator weed in Australia.

terrestrial infestations and 500 ha of aquatic infestations occurring in the Lower Hunter region. The current distribution is small when compared to the potential range of the weed (see Figure 2).

Habitat

Alligator weed will grow in ponded and flowing waterways, on the banks of waterways, on floodplains and poorly drained land, and less commonly in drier situations above flood level (see Figures 3 and 4). To date in Australia all infestations have occurred in temperate and subtropical climates, thriving in areas with high summer rainfall. Alligator weed will grow in a range of soils and substrates from sand to heavy clay, and can easily tolerate dry periods. Infestations have been found growing in saline conditions (flowing water with 30% of the salinity of seawater), and on beaches above the high tide zone. Frost and ice kill exposed stems and leaves, but protected stems can survive these conditions and support the next season's growth.

Figure 3. Alligator weed infestation in a water course.

Figure 4. Alligator weed infestation on land. Far North Coast Weeds

Impact

Alligator weed is considered one of the world's worst weeds because it impacts on both aquatic and terrestrial environments. Overseas experience indicates that its potential impacts in Australia could be devastating.

Environmental impacts

Alligator weed disrupts the aquatic environment by blanketing the surface and impeding the penetration of light. Such blanketing can also impede gaseous exchange (sometimes leading to anaerobic conditions) which adversely affects aquatic flora and fauna. It also competes with and displaces native flora along river and creek banks and in wetlands.

Impacts on primary production

Alligator weed has eliminated small crops and turf farming from parts of the Lower Hunter. The potential costs to irrigation farming in the Murrumbidgee Irrigation Area from the Barren Box Swamp infestation have been estimated to be $250 million a year if alligator weed remained uncontrolled.

In the Sydney Basin alligator weed is currently threatening the turf industry valued at over $50 million annually. The vegetable industry in the Hawkesbury–Nepean catchment, valued at $150 million annually is also under threat, as is the extraction industry in the Hawkesbury–Nepean. This industry supplies most of Sydney's sand, gravel and soil resources. If contaminated, the movement of these resources would be severely restricted. Sugar cane and soy bean industries are also threatened in the Richmond catchment.

Alligator weed contaminates grazing pastures and competes successfully for light and space, becoming dominant in wetter sections of pastures. Dense infestations also restrict stock access to drinking water.

Figure 5. Cow with photosensitisation lesions. NSW DPI

In New Zealand and Australia, alligator weed has been associated with photosensitisation in light-pigmented cattle, resulting in cancerous lesions (see Figure 5).

Impacts on water resources and infrastructure

Alligator weed restricts access to and use of water, blocking and damaging pumps and other infrastructure. Mats of alligator weed can impede stream flow and lodge against structures promoting sedimentation which contributes to flooding and structural damage. It is currently threatening Warragamba Dam, Sydney's major water supply and storage system.

Social impacts

Tourism and recreation are affected when alligator weed limits recreational activities, reduces aesthetic values, and increases mosquito populations. Dense mats reduce the visual impact of waterways and affect the presence of other native flora and fauna. They also limit water vessel movement and access to waterways, and create a hazard for swimming and other water sports.

During 2008/2009, alligator weed cost state and local government authorities in NSW $800,000 to control. When considering other associated costs of education and awareness programs as well as planning, coordination and inspection, the total expenses would be approximately $1,300,000.

Overseas

Alligator weed is a problem in 30 countries. It is a serious weed in eight of these and a major weed in the others. In the USA floating alligator weed caused major impediments to navigation on the Mississippi River. In North Carolina aquatic infestations increased from 152 ha in 1963 to 1000 ha in 1999 along with a conservative estimate of 4000 ha of infested cropping land. It is a major weed of transplanted rice wherever it is grown in the world. In China crop production is reduced between 20 to 63%. It impacts on hydro electric power production, fishing and has seriously degraded famous scenic spots.

Description

Alligator weed is a summer growing perennial herb. It has small white papery flower heads 8–10 mm in diameter, generally appearing from November to March. The flowers grow at the end of short stalks which rise from the leaf axils (see Figure 6). Alligator weed has leaves occurring in

Figure 6. Flowers occur on short stalks. NSW DPI

opposite pairs along the stems. The leaves are shiny, spear-shaped, sessile (no stalk), entire, 2–7 cm long and 1–2 cm wide.

The plant forms dense mats of interwoven creeping and layering stems. Over water, stems grow to 60 cm high and up to 10 m long and have large, hollow internodes. Mats may extend 15 metres over the water surface and become so robust they can support the weight of a person. On land, stems are shorter and internodes are smaller and less hollow.

Alligator weed has an extensive underground root system. Roots are relatively fine and short in water but become thicker, starchy and rhizome-like in soil, able to penetrate to depths of over 50 cm. Roots and stems have been found growing more than 1 m below the surface. Root storage tissues allow for survival over long dry periods.

Key identification features

Alligator weed is generally distinguished from other plants by its combination of the following three features:

- small white papery flowers on short stalks
- leaves in opposite pairs
- hollow stems.

Life cycle

Alligator weed does not produce viable seed in Australia. Reproduction is entirely vegetative with new plants able to occur at any stem or root node. Stems break up naturally or with disturbance, creating many fragments capable of forming new plants.

A warm growing season is preferred and generally occurs between November and May, with maximum growth and reproduction from stem nodes in mid-summer. Growth generally slows or ceases during cooler months.

Spread

Alligator weed spreads naturally in water when stem or root fragments float downstream. The most significant spread between catchments in NSW has been through the commercial and recreational activities of people. Examples of these activities include:

- excavation machinery used to clean channels
- boats and trailers transported between waterbodies
- deliberate planting for ornamental use
- movement of sand dredged from infested catchments.

In terrestrial situations stem and root fragments can be spread in the movement of soil. This has occurred as a result of:

- movement of turf or hay from infested farms
- movement of fill or landscape supplies from infested areas
- accidental spread on machinery
- fragments caught in horses' hooves.

Control and management

The Alligator Weed Control Manual provides a comprehensive overview of the various chemical, physical and biological control options. See www.dpi.nsw.gov.au/agriculture/pests-weeds/weeds/profiles/alligator/alligator-weed-control-manual

Control and management options for alligator weed depend on the site and location of the infestation, its age and extent and the resources available. Any new infestation should be assessed to determine if immediate eradication is a feasible management objective (small numbers of scattered plants; infestations up to 5 m x 5 m).

If not, management should aim for suppression leading to eradication over a period of approximately 6 years (infestations with roots more than 1 m deep; areas of infestation over 10 m x 10 m), or ongoing suppression (in extensive, long established infestations).

Control methods and their application will vary depending on the management aim. While containment and prevention of spread will be necessary in all infestations, controls should be closely aligned with management aims. Table 1 provides a guide for selecting appropriate control methods for the situation.

Table 1. Guide for selecting control methods.

Management aim	Control strategy
Immediate eradication	Physical control (deep manual digging) with some initial chemical control (herbicide treatment) to kill above-ground plant growth.
Suppression leading to eradication	Chemical control (annual treatment program, see below) with herbicides over a 6 year period; possibly with initial physical control (shallow mechanical excavation to remove above-ground biomass); followed by physical control (deep manual digging) once infestation is small enough to eradicate.
Ongoing suppression	Chemical control (annual treatment program); or biological control (only in aquatic situations in cool climate areas).

Chemical control

Due to its ability to tolerate most herbicides, many have been trialled over the years for alligator weed control. It is now clear that there are important roles for specific herbicides in suppressing and depleting alligator weed and in assisting with eradication (see Figure 7).

It is currently agreed that a program based on three treatments of herbicide products containing metsulfuron-methyl per growing season is the most effective for suppression of both aquatic and terrestrial alligator weed. For application rates and concentrations in aquatic and terrestrial situations

Figure 7. Chemical control of alligator weed. Far North Coast Weeds

please refer to the current range of permits and label registrations for the use of herbicide products containing metsulfuron-methyl 600 g/kg on alligator weed in NSW. These are listed in the *Noxious and Environmental Weed Control Handbook* (available at any office of NSW DPI or at www.dpi.nsw.gov.au/weeds), or on the Australian Pesticide and Veterinary Medicines Authority website (www.apvma.gov.au).

Metsulfuron-methyl annual treatment program

1. Apply the first foliar treatment in November (early in the growing season – could be earlier in subtropical areas).
2. Apply the second foliar treatment in February.
3. Apply the third foliar treatment at the end of the growing season in May.

Carry out this annual treatment program for a number of years (6 on average) and then consider the possibility of eradication by physical removal of any remaining underground plant parts.

Note: Make the second and third treatments only if there has been sufficient regrowth (at least 5 or 6 sets of leaves on stems, 10 cm of stem length, or 30 cm crown width in prostrate growth). In dry conditions the plant may be suppressed and depleted to the point where only 2 applications are possible over the growing season. This can also occur after 2 consecutive years of treatment, as the depleted plants take longer to reach the required level of regrowth. Always maintain at least 2 sprays per growing season.

Physical control

Physical controls are vital for the eradication of small and isolated infestations and are particularly useful in removing new infestations if they can be located early enough.

Figure 8. Physical removal of alligator weed. Far North Coast Weeds

For alligator weed, physical control involves either deep manual digging or shallow mechanical excavation. Deep manual digging can be done in terrestrial and shallow aquatic situations and requires an infested area to be hand dug in order to find and remove all the roots associated with each individual stem arising from the ground. While time-consuming, local weed authorities have shown this technique to be successful for eradication of small or new infestations (see Figure 8).

Shallow mechanical removal can be used to remove large amounts of above-ground plant material and small amounts of below-ground root material. Excavations should only be made to a depth of 20 cm due to the sheer volume of contaminated soil to be disposed of. An excavated site is then inspected regularly for signs of regrowth, which are then either treated with herbicide or removed by deep manual digging, depending on the management aim. Shallow mechanical removal is generally not appropriate in aquatic situations and the risks of spreading fragments are high.

Disposal

With any physical removal method there are issues with disposing of the removed plant material. Removed material must be treated and disposed of securely.

Do not dispose of alligator weed in green waste or composting facilities.

Plant material can be dried and incinerated, boiled or microwaved. Large volumes of contaminated soil are difficult to process, and if possible need to be spread on an impenetrable surface and dried prior to burial (preferably sealed in containers) at a secure disposal site that can be monitored for any signs of regrowth.

Councils and landowners require a permit from NSW DPI to remove and transport alligator weed.

Machinery hygiene

Accidental spread on machinery can introduce the plant to new areas with disastrous consequences. Any machinery working in an infested area should be thoroughly cleaned before it is moved to a new site. Cleaning should include removal of all mud and vegetation, followed by complete and thorough inspection of the machine.

Once alligator weed is established on land it cannot be controlled by cultivation or slashing. Any cultivation or slashing of infested land will only spread the infestation further.

Biological control

The flea beetle (*Agasicles hygrophila*) was first introduced to Australia in 1976. It provides good control in aquatic environments in the Sydney region, successfully reducing the area of floating mats in the Georges River and in parts of the Hawkesbury Nepean system. However, this insect is limited to warm temperate and subtropical areas and the predicted range for alligator weed in Australia far exceeds the predicted range for the flea beetle.

One criticism of the flea beetle is the tendency for alligator weed to fragment when under attack, causing downstream spread. Plant fragments should be contained if downstream spread is an issue in areas where the flea beetles are active.

A moth (*Arcola malloi*) contributes to control in aquatic habitats and is established but, like the flea beetle, has no impact on terrestrial alligator weed.

The role of these agents is therefore limited to ongoing suppression of extensive aquatic infestations. Biological control is not appropriate for eradication strategies. Further biological control programs are being explored.

Legislation

Alligator weed is declared a Class 2 or 3 noxious weed throughout NSW (see Figure 9). Under the NSW Noxious Weeds Act 1993, the presence of a Class 2 weed must be notified to the Local Control Authority and the weed must be fully and continuously suppressed and destroyed. In areas where there are dense infestations of alligator weed regional management plans outline the appropriate actions to be undertaken. For new incursions of alligator weed, initial treatments may be undertaken by the Local Control Authority. Follow up works will then be the responsibility of the owner or occupier of the land, who must take effective measures towards eradication. Failure to do so could result in legal action and a fine.

Figure 9. Declarations for alligator weed in NSW.

Acknowledgments

Technical reviewers: Melissa Freeman, Peter Gorham, Mark Scott and Birgitte Verbeek.

Production coordinated by Elissa van Oosterhout.

Design and typesetting by Barry Jensen.

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The information for this Primefact was taken from the following sources.

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Alligator Weed – Don't let it drag you under! An early detection guide for farmers (2008), Brochure, NSW DPI, Orange.

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Noxious and Environmental Weed Control Handbook 4th Edition (2009), NSW DPI, Orange.

The above NSW DPI publications can be found at www.dpi.nsw.gov.au/weeds

Printed copies can be arranged by contacting the NSW DPI Bookshop, Orange Agricultural Institute, Forest Rd, Orange 2800 on 1800 028 374.

ISSN 1832-6668

Published by the Department of Primary Industries, a part of the Department of Trade and Investment, Regional Infrastructure and Services.

Primefact 671 (replaces Agfact P7.6.46)
PUB12/88
First published November 2009


NSW
GOVERNMENT
Department of
Primary Industries