RISING THREATS FROM ARUNDO DONAX: AUSTRALIAN CONTRIBUTION TO A SUCCESSFUL US PROJECT

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- AN OPPORTUNITY FOR ‘PRE-EMPTIVE’ BIOLOGICAL CONTROL OF ARUNDO IN AUSTRALIA

Arundo donax edging an irrigation Canal, Weslaco Texas
ARUNDO DONAX IN ITS NATIVE MEDITERRANEAN RANGE

Spain: open wetland plants or riparian clumps on waterways & embankments
ARUNDO DONAX: AN INVASIVE PERENNIAL GRASS IN USA

- Common names: Giant Reed, Carrizo Cane
- Scientific name: *Arundo donax* (L.) Asch. & Graebn.
- Origin: Mediterranean Region (Spain, France, Italy etc.)
- Riparian invader spread vegetatively via rhizomes
- Invasive in USA, Mexico, South Africa, South Pacific Islands & Australia (e.g. Clarence River, NSW; Brisbane River, Qld)
IMPACTS OF ARUNDO IN USA

- Increased water loss from evaporation (2000 l. / sq. m.)
- Blocks right-aways and drains
- Highly flammable: increases fuel loads & intensities of wildfires
- Displaces riparian biodiversity: a major threatening process in National Parks
- Increased waterways maintenance costs

Dead leaves following leafminer attack
WEED STATUS IN AUSTRALIA - DECLARED WEED IN NEW SOUTH WALES (NOXIOUS WEEDS ACT 1993)

• Produces dense impenetrable riparian thickets

• Displaces indigenous vegetation

• Causes embankment collapse, erosion

• Formed damaging floating islands during 2012 flood in Brisbane River

YARRAMAN, UPPER BRISBANE RIVER
Sue Riley
DISTRIBUTION* OF ARUNDO DONAX IN AUSTRALIA

ARUNDO ON THE CLARENCE RIVER
NEW SOUTH WALES
TYNDALE, CLARENCE RIVER
NEW SOUTH WALES
SHARK CREEK, CLARENCE RIVER NEW SOUTH WALES
TYNDALE, CLARENCE RIVER
NEW SOUTH WALES
PREDICTED* DISTRIBUTION OF ARUNDO DONAX IN AUSTRALIA


Green: unsuitable regions
Yellow / orange: marginally suitable
Red: highly suitable

Invasive potential in Australia
SOME USES (Australia *)

- Ornamental for gardens including: *variegata*, *versicolor*, *macrophylla*
- Waste water treatment
- Windbreaks, mostly for crops with high water-tables
- Woodwind instruments
- Biofuel – *see next slide*

DETRIMENTAL EFFECTS

- Develops dense mono-stands & impenetrable riparian thickets
- Invades sugar cane farms
- Displaces indigenous ecosystems & threatens biodiversity
- Causes embankments to collapse
- Forms massive floating islands broken free after flooding
- Alternative host for beet virus, sugar cane mosaic virus, maze dwarf mosaic virus (in USA)
Giant reed, a fuel for super hot, giant fires

Proposals to plant giant reed (Arundo donax) as a biofuel in Australia combine two of ISC’s major concerns in recent years – hot-burning invasive grasses and weedy biofuels.

Gamba grass (Andropogon gayanus) and other large invasive grasses produce very hot fires when they burn, often killing shrubs and trees, and facilitating further invasion of the grasses via a fire-driven cycle of invasion. In recent reports about climate change and fire (see Bradstock 2010 and Williams et al. 2009), the potential of these grasses to increase fire risk has received much emphasis.

Weedy biofuels have the potential to invade vast areas because enormous plantings will be needed to make any dent in greenhouse gas emissions. The two crops concerning us most have been giant reed and jatropha (Jatropha curcas) (see ISC’s report on weedy biofuels by Low and Booth 2007).

Giant reed is a much larger grass than gamba grass, and we have been aware of it fuelling very large fires in California, a problem that has now been properly documented. In a recent article in Biological Invasions, Gretchen Coffman and two colleagues at the University of California assessed its success following fire.

After a 2003 wildfire burned through riparian woodlands along the Santa Clara River, Coffman and colleagues found that recovering giant reed grew 3-4 times faster than native woody plants, reaching 2.5 metres height within three months of the fire.

‘One year post-fire, A. donax density was nearly 20 times higher and productivity was 14-24 times higher than for native woody species,’ they reported.

Giant reed resprouted much faster than native plants, making good use of the nutrients released by ash. A year after the fire it made up 99% of the post-fire vegetation.

Giant reed is valued as a biofuel because it grows so fast – as much as 10cm in a day – which also explains its success as a weed. The finding that it is a fire-exploiting grass provides another reason not to grow it.

In 2009 the South Australian government ended trials of giant reed after a series of complaints from ISC (see Feral Herald 24), but interest has emerged from other quarters.

In January 2010, Norwegian company ENENnergy was reported on ABC News to be proposing to plant more than 300,000 hectares of giant reed in northern Australia. The company’s website lists three field development projects underway or in planning in Australia.

Australia has the most flammable vegetation in the world, and the most to fear from an increased fire risk under climate change. But climate change has become a justification to grow a flammable grass, when it should be an additional reason to ban it. Giant reed is on the IUCN list of ‘100 of the World’s Worst Invasive Alien Species’.

References


US: FLOATING MASSES CAUSE DAMAGE TO INFRASTRUCTURES
WETLANDS

- Floating island biomasses collapse into rivers & damage bridges
- Promotes streambank erosion
- Provides habitats for cattle tick & cattle fever
- Impedes law enforcement on the USA / Mexico border

South of Eagle Pass USA
FLOOD PLAINS

Maverick Irrigation Diversion, Eagle Pass, USA
MEDITERRANEAN BIOLOGICAL CONTROL AGENTS OF *ARUNDO DONAX* EVALUATED FOR IMPORTATION INTO THE USA

- Gall-forming wasp (*Tetramesa romana*)
- Diaspid scale insect (*Rhizaspidiotus donacis*)
- Leaf-sheath miner dipteran (*Lasioptera donacus*) + symbiotic fungus

* Exploration by USDA for agents for *Arundo* began in the indigenous range in the wetlands of France and Spain.
PROMISING EUROPEAN AGENTS

Arundo wasp

*Tetramesa romana* (Eurytomidae)
larvae feed in stems & side shoots forming galls

Released April 29, 2009

MAJOR WIDESPREAD IMPACTS

Arundo scale

*Rhizaspidiotus donacis* (Diaspididae)
Females feed on rhizomes and side shoots, males on leaves

Released Dec. 17, 2010

EARLY LOCAL IMPACT

Arundo leafminer

*Lasioptera donacis* (Ceccidomyidae)
Larvae are leaf sheath miners - cause defoliation

Not yet released
OVERCOMING PROBLEMS WITH CULTURES AND HOST RANGE TESTING

- **Gall-forming wasp**: failed to reproduce in white cages
- **Diaspid scale**: healthy scales difficult to separate from parasitised scales or those with predatory mites
- **Leaf-sheath dipteran**: difficult to culture on plants; identification needed for its symbiotic fungus
IN AUSTRALIA - SINGLE COCCIDS & DIASPIDIS REMOVED FROM PLANTS REPRODUCED IN GELATINE CAPSULES

Ceroplastes destructor

Ceroplastes rubens

Single gravid scales are transferred to capsules

↑ Cap removed when crawlers emerge

Gelatine capsule + scale pinned to test plant.
IN US - INDIVIDUAL ARUNUDO SCALES REPRODUCED IN GELATIN CAPSULES

Capsules
• enable separation of predators (esp. mites) & parasitised scales from crawlers
• Provide newly-hatched crawlers for infesting test plants
• Can be pinned to plant tissues with scales producing crawlers inside for host acceptance/ host range tests
• Enabled estimates of crawlers per scale & per test
Capsules used in quarantine lab. studies of biology and no-choice host range tests

P. Moran, USDA
DAMAGE TO ARUNDO BY SCALE

In native range: Ceret, France

In quarantine: Texas

After release: Del Rio, Texas

Scales cause distortion & death of nodes and shoots
IN AUSTRALIA - BLACK CAGES HELPED OVERCOME REARING PROBLEMS

White or coloured cages can disrupt:

- Mating & finding mating sites
- Host recognition in parasitic insects
- Plant host recognition in phytophagous insects
- Habitat-substrate searching behaviour

Black used to overcome above problems:

- Gall-forming & scale parasitoids (Hymenoptera)
- Pentatominid parasitoids (Diptera)
- Stem boring moths (Ceccidae)
The *Tetramesa* wasp in greenhouses with *Arundo*. Black cages promoted mating and oviposition.
THIRD AGENT: LEAF-SHEATH MINING DIPTERAN (LASIOPTERA DONACUS)

Damage to potted Arundo plant

Larva in sheath
SUMMARY

A diaspid scale & a gall-forming wasp from Europe are showing promise as agents for *Arundo donax* in the US.

An opportunity for ‘pre-emptive’ biological control of *Arundo donax* in Australia.

- US are investigating prospects for biological control of several African grasses – some invasive in Australia.

- Should a range of invasive grasses be targeted for biological control projects? (current Victorian program on Chilean Needle Grass).

- Should conflicts of interest (e.g. values as pastures) be carefully assessed to identify benefits of biological control of many other invasive in Australia?
OTHER INVASIVE & FLAMMABLE GRASSES - SUITABLE TARGETS FOR BIOCONTROL IN AUSTRALIA

Flammability

- Gamba grass (*Adropogon gayanus*)
  Flammability: ++++
  Indigenous understory displaced – northern rangelands; NT and N. Qld

- Buffel grass (*Cenchrus ciliaris*)
  Flammability: +++
  Indigenous grasses displaced – inland rangelands; NSW, Qld, NT & WA

- Love grass (*Eragrostis curvula*)
  Flammability: ++
  Pastures displaced – central-southern rangelands; Vic, NSW, Qld

- Panic, Guinea grass (*Panicum maximum*)
  Flammability: +++
  Indigenous understory displaced – east coast grasslands & woodlands; Qld, NT

- Signal grass (*Brachiaria decumbens*)
  Flammability: ++
  Understory displaced – east coast slopes & hilltops; coastal N. NSW & S. Qld

- Molasses grass (*Melinis minutiflora*)
  Flammability: ++++
  Understory displaced - east coast slopes, woodlands; N. NSW & S. Qld