# Field testing of glyphosate-resistant awnless barnyard grass (*Echinochloa colona*) in northern NSW

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## The Problem

Awnless barnyard grass (*Echinochloa colona* (L.) Link) is a major weed of cropping in summer-dominant rainfall areas of Australia. Barnyard grass is highly competitive with crops and can have up to seven emergence events per summer and have plant populations exceeding 1000 plants m$^{-2}$.

Grain sorghum crop infested with glyphosate resistant awnless barnyard grass, January 2007.

Seed produced by glyphosate resistant awnless barnyard grass in a sorghum crop.

In northern NSW one population was confirmed resistant to atrazine (Group C) in 2004. A risk assessment analysis in 2004 found this species to be at high risk of developing glyphosate (Group M) resistance.

There are currently two separate populations of awnless barnyard grass confirmed resistant to glyphosate in northern NSW.

## The Research

Three field experiments were established near Bellata, NSW in a fallow field infested with 300–3000 predominantly glyphosate-resistant *E. colona* plants m$^{-2}$ to determine the level of glyphosate resistance and which herbicides were still effective.

**Experiment 1 — Glyphosate rate response**

Rates up to 4,500 g a.i. ha$^{-1}$ glyphosate were trialled.

Glyphosate resistant awnless barnyard grass seedling after application of 1800 g a.i. ha$^{-1}$ glyphosate.

**Experiment 2 — Pre-emergent herbicides**

Herbicides used were trifluralin (not incorporated due to rain), norflurazon, diuron, atrazine, s-metolachlor + prosulfocarb, s-metolachlor + atrazine, imazethapyr, imazapic and s-metolachlor.

**Experiment 3 — Post-emergent herbicides**

A range of knockdown and grass selective herbicides were trialled. Double knock (consecutive knockdown herbicides) were tested with single applications of knockdowns and selective grass herbicides.

## The Results

- There is **no significant improvement** in control above 1800 g a.i. ha$^{-1}$ glyphosate.
- All pre-emergent herbicides were effective on this barnyard grass population however no treatment gave 100% control.
- Water-soluble pre-emergent herbicides gave better results due to rainfall immediately after application.
- The "double-knock", two consecutive knockdown herbicides five days apart, gave 100% control.
- Single applications of bipyridil herbicides rarely gave 100% control.
- Single applications of selective post-emergent herbicides gave 100% control, however these are all from mode-of-action groups A and B (high risk for developing resistance).

Pre-emergent herbicide experiment 20 days after treatment. Foreground–metolachlor + prosulfocarb (180 + 1200 g a.i. ha$^{-1}$); mid–metolachlor + prosulfocarb (420 + 2800 g a.i. ha$^{-1}$); background–imazapic (48 g a.i. ha$^{-1}$).

Pre-emergent herbicide experiment 20 days after treatment. Foreground–metolachlor (960 g a.i. ha$^{-1}$); mid–atrazine (1800 g a.i. ha$^{-1}$); background–metolachlor (1920 g a.i. ha$^{-1}$).

## Recommendations

- **Consecutive combinations of tactics and herbicides ('double knock') are essential to obtain 100% seed-set control to drive down the weed seedbank.**
- **Use soil-active pre-emergent herbicides to reduce the selection pressure on knockdown and selective post-emergent herbicides.**
- **Use soil-active pre-emergent herbicides to reduce labour requirements and improve timeliness of weed control in the farming operation.**
- **Save selective post-emergent herbicides for in-crop weed control and don't waste them in fallows.**
- **Plan and execute a flexible rotation to prevent or manage glyphosate resistant awnless barnyard grass.**

GRDC National Panel inspects barnyard grass experiment near Bellata, NSW.

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# Tactics for the control of terrestrial alligator weed (*Alternanthera philoxeroides*)

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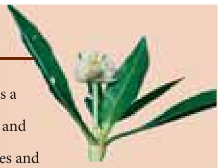
## The Problem



Alligator weed (*Alternanthera philoxeroides*) is a highly invasive weed that grows both on land and in water. Due to its ability to tolerate herbicides and spread easily by fragments, it is a serious weed of waterways, wetlands and floodplains in Australia.

Terrestrial alligator weed has an extensive root system in with over 70% of the plants' biomass underground. This enables the plant to survive long dry periods and sporadic applications of herbicide.

## The Experiments

### Experiment 1 Effectiveness of different Group B (ALS inhibitor) herbicides

Eleven Group B herbicides were tested for post-emergent control of terrestrial alligator weed.

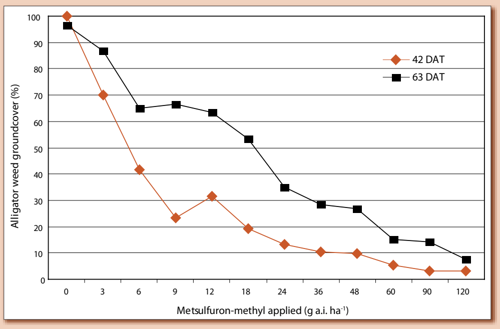
Metsulfuron-methyl and imazapyr were the most effective herbicides.

Two effective options: imazapyr (left) and metsulfuron-methyl (right)

### Experiment 2 Finding the optimum rate of metsulfuron-methyl

Rates from 0 to 120 g a.i. $ha^{-1}$ were tested.

There were no significant differences between 24 and 48 g a.i. $ha^{-1}$ (the latter being the registered rate), although marginal decreases in alligator weed groundcover continued up to 120 g a.i. $ha^{-1}$. Rates greater than 60 g a.i. $ha^{-1}$ significantly damaged pasture grasses.




Effect of metsulfuron-methyl application rate on alligator weed groundcover 42 and 63 days after treatment (DAT).

### Experiment 3 Finding the best adjuvant for metsulfuron-methyl

Thirteen adjuvants including non-ionic and cationic wetters and a range of crop oils were tested with a sub-lethal rate of metsulfuron-methyl (12 g a.i. $ha^{-1}$). Alligator weed groundcover was assessed 77 days after treatment.

Addition of adjuvants to metsulfuron-methyl improved control significantly. There was little difference in control between adjuvants.

### Experiment 4 Effect of pasture height on alligator weed growth and effectiveness of metsulfuron-methyl

The kikuyu pasture was slashed to a range of heights from 10 cm to 60 cm and the alligator weed density was assessed 21 days after slashing. Metsulfuron-methyl was applied at 24 g a.i. $ha^{-1}$ over all plots. An assessment was made 45 days after application to determine the final control of alligator weed.

Low pasture height promotes alligator weed growth and density, enabling better herbicide foliar contact and improved efficacy.

### Experiment 5 Effect of repeated applications of metsulfuron-methyl over consecutive years

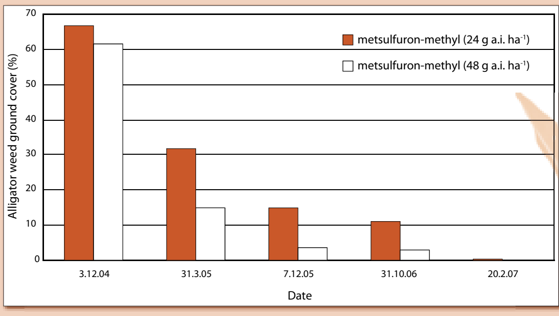
Treatments were applied during the growing season:

- Season 1 3 December 2004, 31 March 2005 and 9 June 2005
- Season 2 7 December 2005 and 28 March 2006
- Season 3 6 December 2006 and 20 February 2007

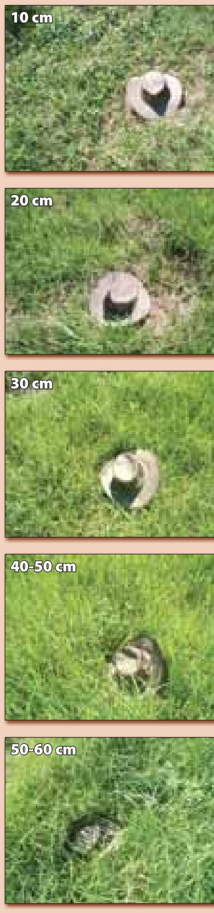
Two rates of metsulfuron-methyl were applied each time, 24 and 48 g a.i. $ha^{-1}$, with a non-ionic surfactant at 0.1% v/v. The site was continuously grazed, leaving less competition for actively growing alligator weed.

Alligator weed infestation after three years was < 1% of the original infestation for both metsulfuron-methyl rates. Surviving plants had significantly reduced vigour.

Almost 100% pasture groundcover by grasses after two years of repeated metsulfuron-methyl applications (notice untreated buffer area)




Alligator weed groundcover reduction over three years of metsulfuron-methyl applications at two rates.




The effect of height of slashing on kikuyu and alligator weed growth.

## Recommendations

- **Control terrestrial alligator weed infestations with repeated applications of metsulfuron-methyl for 3 years.**
- **Use a recommended adjuvant with metsulfuron-methyl.**
- **Manipulate pasture height by grazing or slashing to improve herbicide effectiveness and competition with alligator weed**

### Further information

*Suppression of alligator weed in pastures.* Primefact 726, NSW Department of Primary Industries.

*Alligator weed control manual.* Weeds of National Significance. NSW DPI.


Acknowledgements

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# Herbicide tolerance of pasture legumes and herbs

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Untreated control plots, 25 days after early post-emergent treatments were applied.

Flumetsulam and bromoxynil + diflufenican, 25 days after being applied early post-emergent.

MCPA + diflufenican, 25 days after being applied early post-emergent.

## Project summary

A range of legume and herb species were assessed in 2004 and 2005 at Wagga Wagga, southern New South Wales for the feasibility of using herbicides to manage weeds to facilitate successful pasture establishment in late autumn.

Thirty six herbicide combinations were tested on 10 annual legumes, one perennial legume and two perennial herbs (Figure 1). The herbicides were applied at one of four pasture growth stages–incorporate by sowing (IBS), post-sowing pre-emergent (PSPE), early post-emergent (EPE) or late post-emergent (LPE or full canopy).

Herbicide damage was assessed by measuring biomass in late spring. A reduction in yield of 30% was in all cases statistically significant, but is considered an 'acceptable' level of damage off-setting the cost of establishment and reduction in future weed problems and any subsequent control costs.

Harvesting forage crops to assess biomass in late spring.

## Results: all species

The results for rose clover are presented in this poster. The complete set of results for all species assessed is available from the authors on CD and includes biomass data and graphs, and photos of herbicide injury symptoms soon after treatment and at the time of harvest.

Herbicide injury in rose clover two weeks after EPE application of Igran® (terbutryn 500 g/L).

## Results: rose clover

More than half the herbicide combinations tested resulted in unacceptable damage to rose clover (*Trifolium hirtum* cv Hykon) (Figure 2).

The IBS treatments were safe but those applied PSPE all caused unacceptable damage.

Level of damage observed in a number of early post-emergent treatments varied significantly between years (eg Igran®, Igran® and MCPA amine mix, and Broadstrike® and MCPA mix).

Rose clover treated with Igran® (terbutryn 500 g/L) EPE. Growth at harvest was 99% of the untreated control in 2004 (left), and only 37% of the control in 2005 (right).

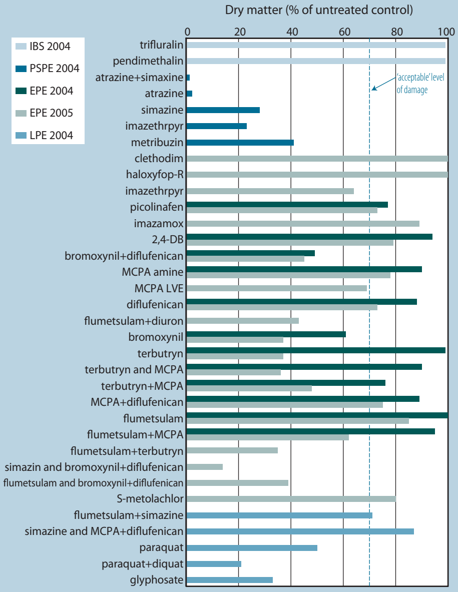



**Figure 2. Rose clover dry matter at harvest following treatment with various herbicide combinations.**

### Annual legumes

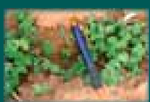
Arrowleaf clover, Cefalu
*Trifolium vesiculosum*

Balansa clover, Frontier
*Trifolium michelianum*

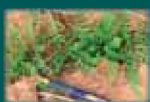
Berseem clover, Elite II
*Trifolium alexandrinum*

Gland clover, Prima
*Trifolium glanduliferum*

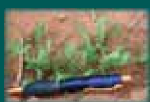
Persian clover, Laser
*Trifolium resupinatum*



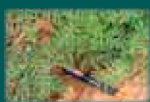
Rose clover, Hykon
*Trifolium hirtum*



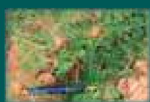
Biserrula, Casbah
*Biserrula pelecinus*



French serradella, Erica
*Ornithopus sativu*



Purple vetch, Popany
*Vicia benghalensis*



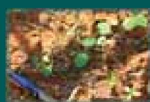
Wooly pod vetch, Capello
*Vicia villosa*

### Perennial herbs

Chicory, Puna
*Chicorium intybus*

Plaintain, Tonic
*Plantago lanceolata*

### Biennial legume



Sulla, Aokau
*Hedysarum coronarium*

**Figure 1. Pasture legumes and herbs (common name, cultivar, latin name) assessed for safe use of herbicide.**

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# What does your garden grow?
## Educating the home gardener

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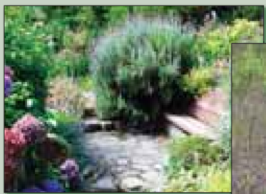
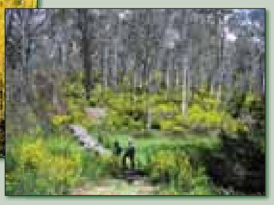
## The Problem

Lack of recognition and knowledge within the general community about the adverse impact many common garden plants have on our unique Australian environment.




Topped lavender (above), broom (below) and many other garden plants have escaped and are now invading native bushland.

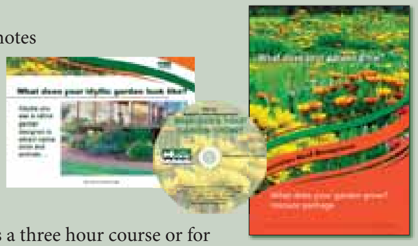
## The Resource

The training resource has been developed to:

- Define what weeds are and highlight the impact weeds have on the environment
- Give home gardeners practical information on how to manage weeds in their gardens
- Provide home gardeners with information that will help them identify potential environmentally weedy plants in there gardens
- Provide knowledge on how each home gardener can make a difference!

Trainers can freely use the ***What does your garden grow?*** training resource which includes:

- Over 150 quality slides with explanatory notes
- A Participant's Workbook
- Managing Garden Weeds FactSheets
- A Trainer's Guide



The resource has the flexibility to be used as a three hour course or for shorter information sessions. It also has the ability to be adapted to suit various regions and target audiences across Australia.

## The Initiative

The CRC for Australian Weed Management has developed a generic training resource ***What does your garden grow?*** targeting home gardeners.

Train-the-trainer courses are being conducted across Australia to facilitate uptake of the resource by various extension and training providers e.g. Community Colleges, Institutes of TAFE and local councils.



## Outcomes

Over 250 Trainers across Australia have completed the train-the-trainer workshop and are now delivering all or components of the ***What Does Your Garden Grow?*** resource.

Trainers now include weeds officers, horticulturists, agronomists and personnel from:

- Community Colleges and Institutes of TAFE
- The Nursery Industry
- Local Councils
- Landcare, Bushcare, Greening Australia and NRM regional organisations or groups
- Numerous government organisations e.g. Primary Industries, Environment and Natural Resources, National Parks and Wildlife

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CRC Weed management

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