Northern IWM fact sheet

Windmill grass

Ecology and management

Windmill grass (*Chloris truncata* R.Br.), also known as umbrella grass or blow-away grass, is a short-lived perennial species that has recently been identified as resistant to glyphosate. This weed is becoming more dominant in southern Australian farming systems and is steadily encroaching on Queensland. To better manage this key weed, we need to understand its ecology and what management tactics are effective for its control.

Key points

- Windmill grass is native to south-eastern Australia. It is present throughout mainland Australia and is common in southern Queensland, New South Wales and Western Australia.
- This summer-dominant grass is highly tolerant to glyphosate (Group M). There are currently 11 glyphosate-resistant populations confirmed in Australia, mostly from fallows.
- Windmill grass is a prolific seed producer (up to 20 000 seeds per plant). Seedlings emerge from shallow depths (0–2 cm), which makes the grass well suited to no-till systems.
- Germination occurs throughout spring, summer and autumn; peak emergence coincides with rains in September–October. There is minor germination and establishment in winter crops.
- Maximum germination is 7 months after seed maturity, but up to 30% of seeds can germinate immediately after maturity.
- Seed persistence is short-lived (up to 18 months) and depth of seed burial has little impact on persistence. Stopping seed set for 12–18 months can greatly deplete the soil seed bank.
- Windmill grass depletes soil moisture and nutrients during the fallow phase, severely reducing yield in the following winter crops.
- Large windmill grass plants are very difficult to control with post-emergent herbicides.
- Herbicide application in water-stressed conditions provides poor control of windmill grass.
- The double-knock tactic can be effective on this weed, when applied at early stages.
- Targeted tillage can reduce the emergence of windmill grass.
- This weed persists in non-cropping areas, as panicles blow in from untreated paddocks. The weed can then spread to cropped areas, easily negating any control achieved there.

Queensland Government

Where and why is windmill grass a problem?

Recent surveys indicate that windmill grass is predominant in New South Wales and around the New South Wales – Queensland border. Modelling shows that the spread and density of this weed could increase with predicted climate changes.

Windmill grass grows mainly in summer fallows. If uncontrolled, it can deplete soil moisture and nutrients during summer, making them unavailable to the succeeding winter crop. In addition, some plants can germinate during winter, further increasing weed pressure. The result is a severe yield penalty in crops. A trial in Western Australia has shown that uncontrolled windmill grass can cause yield penalties of 300 kg/ha in wheat. No information is available on crop yield losses due to windmill grass in the northern region of Australia.

Large windmill grass plants are very difficult to control and this grass is highly tolerant to glyphosate. As at January 2016, 11 glyphosate-resistant populations have been confirmed in Australia, mostly from fallow systems. The intensive use of glyphosate for fallow weed management and conservation tillage systems have contributed to this resistance, and therefore to the rapid spread of this weed.

Ecology of windmill grass

Windmill grass is a short-lived perennial grass that grows up to 50 cm under ideal conditions. The leaves are narrow, 50–140 mm long and 1–5 mm wide (Figures 1 and 2). The seed head has 6–9 spikes with minute spikelets (Figures 3 and 4). The stems are erect and tufted, with rooting occurring at lower nodes, producing stolons.

Seed is dispersed via wind as the mature spike breaks from the plant. The spike follows the wind pattern until blocked by a fence or vegetation (Figure 5).

Figure 1 Early tillering windmill grass

Figure 2 An individual mature windmill grass plant

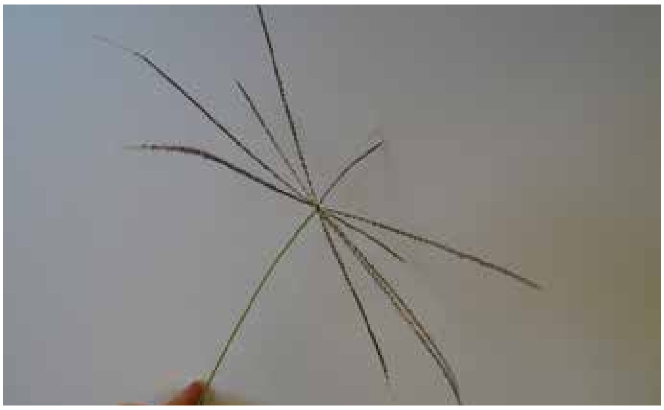

Figure 3 A characteristic windmill grass seed head

Figure 4 A windmill grass spikelet showing the small awned seeds

Figure 5 Wind dispersal of windmill grass seed heads, Parkes, New South Wales (image courtesy of Mark Congreve, Independent Consultants Australia Network)

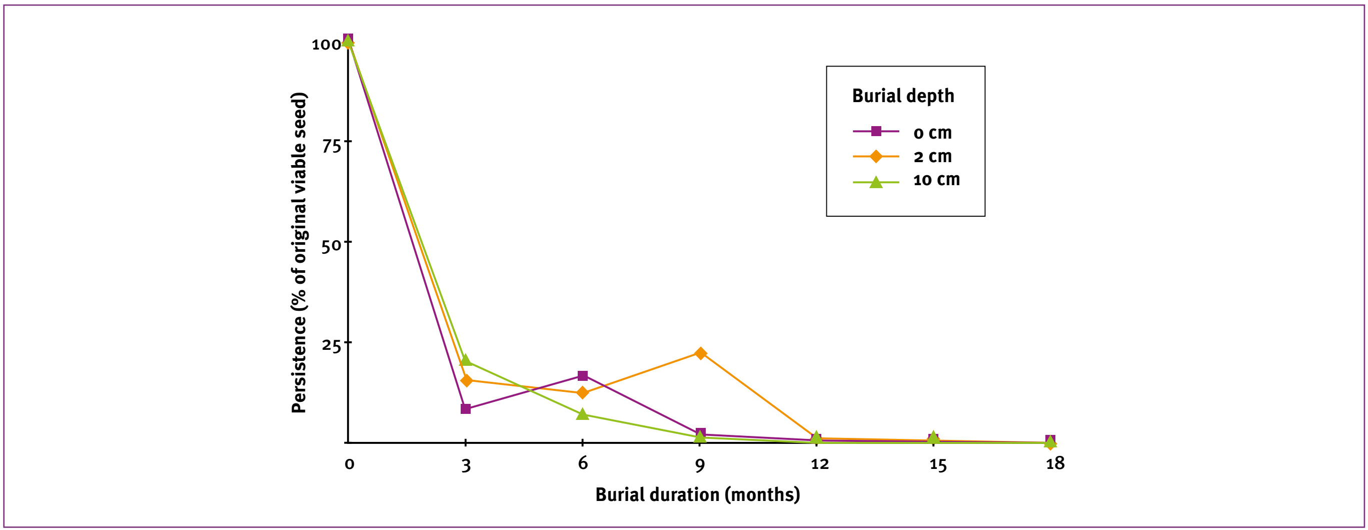

Figure 6 Persistence of viable windmill grass seed in response to different burial depths and months of burial (Least Significant Differences (LSD) for comparison of data points = 6.665)

Windmill grass emerges mainly in spring and summer, but some cohorts also emerge in winter. A study conducted in Western Australia reported that cohorts emerging in spring produced the greatest number of seed heads. Seedlings emerge from shallow burial depths (0–2 cm) and germination is inhibited by absence of light. The optimum alternating day/night temperature for germination is 30/20 °C.

A seed persistence study in southern Queensland indicated that seed viability is short, typically less than 12 months (Figure 6). In this study, a very small number of windmill grass seeds persisted to 12 months at depths of 2 cm and 10 cm, but no seeds persisted for 18 months, irrespective of burial depth.

Anecdotal evidence suggests that windmill grass may host diseases that affect many winter crops. For example, crown rot may be hosted by the weed, resulting in ineffective disease breaks between cereal crops and elevated inoculum levels at the planting of subsequent winter cereal crops. Windmill grass may also host nematodes, leading to increased populations ahead of winter crops, many of which are susceptible to this pest.

Factors affecting management

- Windmill grass will most likely be a problem in zero-till paddocks rather than in cultivated paddocks.
- Burying the seed deeper than 2 cm and leaving it deep and undisturbed for at least 18 months will generally prevent seedling germination and will significantly reduce the seed bank.
- Cultivation will remove large plants, reducing further seed set and perennial growth, which is a major factor in windmill grass management.
- There does not appear to be any seed dormancy—freshly shed seeds seem to be able to germinate immediately.
- Preventing seed from returning to the soil is very important. If seed set is stopped (and no further deposits are made into the seed bank, for example from wind-blown seed incursion), windmill grass problems should diminish quickly.
- Large seedlings are difficult to control with herbicides, so any herbicide application should target young seedlings.
- Farm hygiene in non-cropped areas is very important, as this is a potential source of new infestations in cropped paddocks (Figure 7).

Figure 7 Windmill grass growing in non-cropped areas

Management strategies

Research and industry experience have shown that successful management of windmill grass requires an integrated approach, with attention given to both fallow and in-crop phases. However, there is still a lot to be learned regarding windmill grass ecology and management options. More research is required on the weed's biology and the efficacy of various herbicide and non-chemical treatments.

Herbicide options

Only a few herbicides are currently registered for the control of windmill grass. These are listed in Table 1.

Table 1 Registered herbicide treatments for windmill grass

Herbicide	Uses	Comments
Butroxydim (e.g. Factor®)	In-crop in cotton, mung bean, navy bean, soybean, peanuts and sunflowers—80–180 g/ha	Resistance risk to this mode of action (Group A) is high—be sure to rotate with other modes of action
Chlorthal-dimethyl (e.g. Dacthal® 900)	Pre-emergent in cotton, soybean and mung bean—5–12.5 kg/ha	Incorporation by rain/irrigation is required for optimal efficacy
Glyphosate potassium salt 500 g/L (e.g. Touchdown® HiTech and Sabakem® Glyphosate K-Tech 500SL)	In fallows at 470–1330 mL/ha	Efficacy quite variable and frequently very poor
Glyphosate trimesium 600 g/L (e.g. Touchdown® Broadacre)	In fallows at 800–1200 mL/ha	Efficacy quite variable and frequently very poor
Quizalofop-p-ethyl 200 g/L followed by paraquat 250 g/L within 7 days	Quizalofop-p-ethyl at 250–500 mL/ha and paraquat at 1.6 L/ha	APVMA minor use permit (PER13460) valid only in New South Wales expires 31 March 2017

In a pot trial in southern Queensland, treatment with glyphosate alone (day zero with no SPRAY.SEED® applied) greatly reduced the biomass of glyphosate-susceptible windmill grass (see Figure 8). The double knock of glyphosate followed by SPRAY.SEED® on the glyphosate-resistant population did not achieve 100% biomass reduction. In contrast, the biomass of the glyphosate-susceptible windmill grass was greatly reduced by the double knock. Treatment with a Group A herbicide alone (day zero with no SPRAY.SEED® applied) greatly reduced biomass for both populations. The double-knock treatment with the Group A herbicide was very effective in reducing biomass, with optimal timing between knocks of 1–4 days. A delay of 7–21 days resulted in a slightly greater biomass of both resistant and susceptible plants. Surviving plants can set seed, so it is important to aim for 100% control by targeting young seedlings.

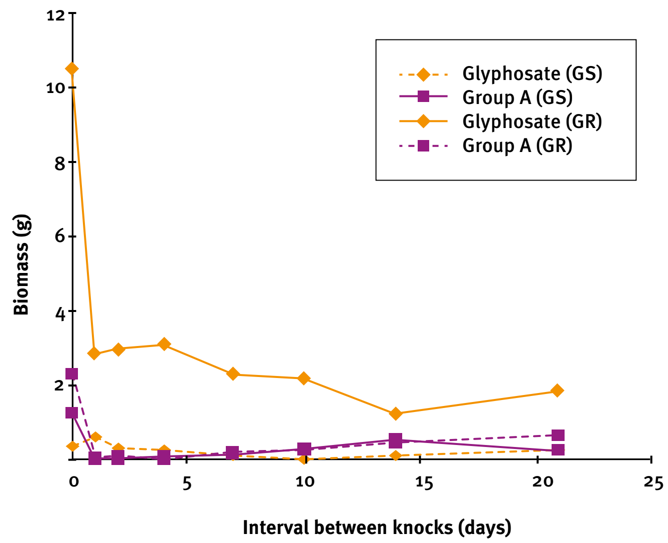

Figure 8 Biomass of glyphosate-susceptible (GS) and glyphosate-resistant (GR) windmill grass treated with a double knock of either glyphosate or a Group A herbicide followed by SPRAY.SEED® applied at different intervals after the first knock (LSD for comparison of data points = 0.867)

Grain Orana Alliance established a trial to investigate the effect of delayed herbicide application on the control of windmill grass. Glyphosate at 900 g and 1800 g of active ingredient per hectare and quizalofop (Group A) at 90 g of active ingredient per hectare were applied at four different timings after rain, and each of these treatments was followed by a double knock at 7 days after the initial treatment. Weed control was reduced sharply between 11 and 18 days post-rainfall, regardless of the herbicide. The study suggests that windmill grass control depends upon moisture availability during and after spraying.

Non-chemical options

Non-chemical options for the treatment of windmill grass include tillage and crop competition.

Targeted tillage treatments with different levels of soil disturbance and inversion were explored in four experiments on the Darling Downs. Zero tillage and tillage using harrows, chisel ploughs, offset discs and one-way discs were investigated. All the experiments clearly showed that all forms of tillage reduced the emergence of windmill grass. However, the results were not consistent across seasons, and were most likely affected by interacting factors such as rainfall, temperature and soil disturbance.

Crop competition studies in Western Australia compared windmill grass density in narrow row spacing (18 cm) with its density in standard row spacing (36 cm) in a wheat crop. The studies did not show significant reductions in the windmill grass density due to competition. The effect of crop competition on windmill grass is yet to be investigated in the northern region.

Useful references

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CS5174 04/16