

Windmill Grass: Biology



Windmill grass in the southern cropping region of Australia

Windmill grass (WMG) is a short-lived perennial grass species that has been problematic in the northern cropping region of Australia and is now becoming more common in the southern region. It establishes on roadsides and in summer-fallow, where over reliance on glyphosate has led to the development of resistance. An understanding of windmill grass biology will help guide management choices to enable successful long-term control. This factsheet includes findings from recent research by the Weed Science Group at the University of Adelaide.

Key Points

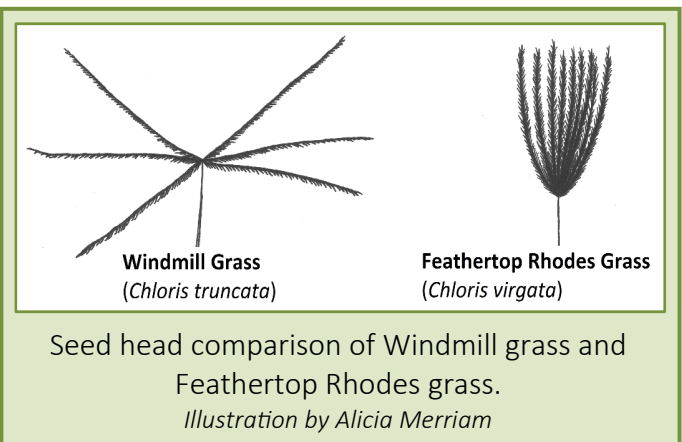
- No-till systems have favoured this species and it is becoming common in the southern region.
- Glyphosate resistance has been documented in populations from NSW, Vic and WA.
- In the southern region, seed matures on the plant throughout spring and summer. Some will then germinate immediately, but the rest will persist for several months.
- Seed has rapid germination and a low minimum temperature requirement, so plants can establish after rainfall in spring, summer and autumn.
- Seed will only germinate if exposed to light, so strategic tillage to cause seed burial is a promising management option.
- Seedbank persistence is generally around 12 months but can be extended by dry conditions.

Quick Facts

Time to maturity (irrigated)	75 days
Dormancy of fresh seed	None/Low
Optimum germination temperature	20 - 25°C
Minimum germination temperature	10°C
Effect of seed burial on germination	Prevention
Seedbank persistence	12 months

Common Names

Windmill grass	Umbrella grass
Blow-away grass	Star grass
Australian Fingergrass	



Introduction

Windmill grass (*Chloris truncata*) is an Australian native warm season grass with an annual or short-lived perennial life cycle in the southern region of Australia. It is a close relative of Feathertop Rhodes grass (*Chloris virgata*) but at mature stages they are easily distinguished by their seed heads

Favoured by the widespread adoption of minimum or zero-till cropping systems, WMG has recently been observed in cropping fields in the southern region. Management has focused on chemical control options and consequently, populations are now developing resistance to glyphosate due to high selection pressure.

Glyphosate resistance has been documented in WMG populations from fallow paddocks in New South Wales, and more recently in roadside populations from Victoria. Therefore, it is now necessary to use an Integrated Weed Management (IWM) approach to effectively control this grass.

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Young windmill grass seedlings.
Photos by Alicia Merriam



Mature windmill grass plants.
Photo by Chris Preston

Growth and development of WMG

WMG seed that was sown in an irrigated field trial in late January (2014) progressed from seedling emergence to mature seed in about 2.5 months. Plants must be controlled before reaching maturity, to prevent seed set.

Additional trials to examine the effect on plant development of different sowing dates, between October and February, had similar results. However, plants sown in autumn remained vegetative through winter and did not flower until the temperature began to rise the following spring.

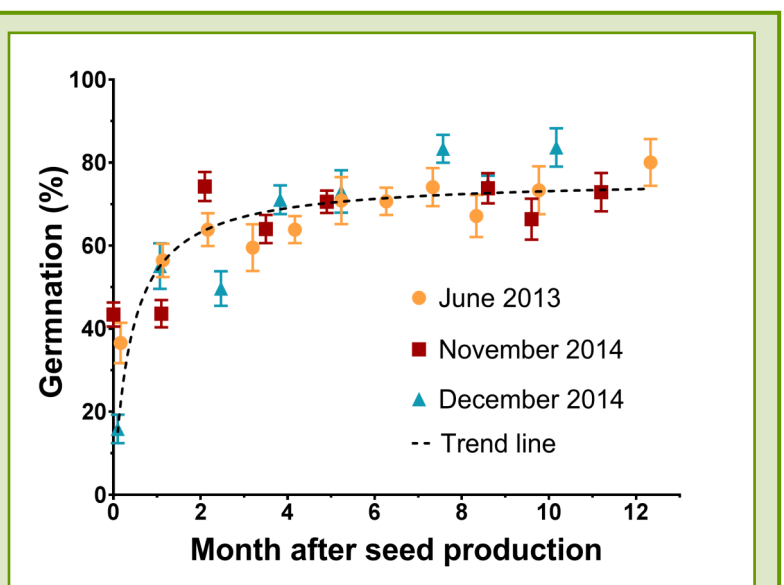
Time taken (days) to reach growth stage	
Tillering	22
Flowering	44
Mature seed	75

Seed dormancy

Seed from South Australian WMG populations reached maximum germination following 5 to 7 months of after-ripening, which was consistent with populations from NSW and WA.

Germination of up to 40% was observed in freshly produced seed from South Australian WMG populations, which was significantly higher than what has been reported for populations from NSW.

Germination of some seed immediately following maturity means this weed can take advantage of favourable conditions. However, if these plants don't survive, complete depletion of the seedbank is avoided because some seed has also remained dormant.



Some seed from southern region windmill grass populations germinated immediately after maturity, but germinations continued until reaching a plateau after about 5 months.

Adapted from Ngo 2017

Environmental effects on germination

Temperature

Studies on WMG estimated a minimum germination temperature of approximately 10°C and a maximum around 40°C. However, there were variations between populations with some continuing to germinate well at high temperatures. The optimum temperature range for germination was 20 to 25°C, which resulted in 70 to 100% of the seed germinating. The highest germination rates were observed at around 30°C, with half of the seed germinating in only 1 to 2 days.

These characteristics mean that WMG seed is not only able to germinate during the cooler months of spring and autumn, when moisture for germination and establishment is typically available, but also in summer following rain events that maintain adequate soil moisture for sufficient periods.

Light and burial depth

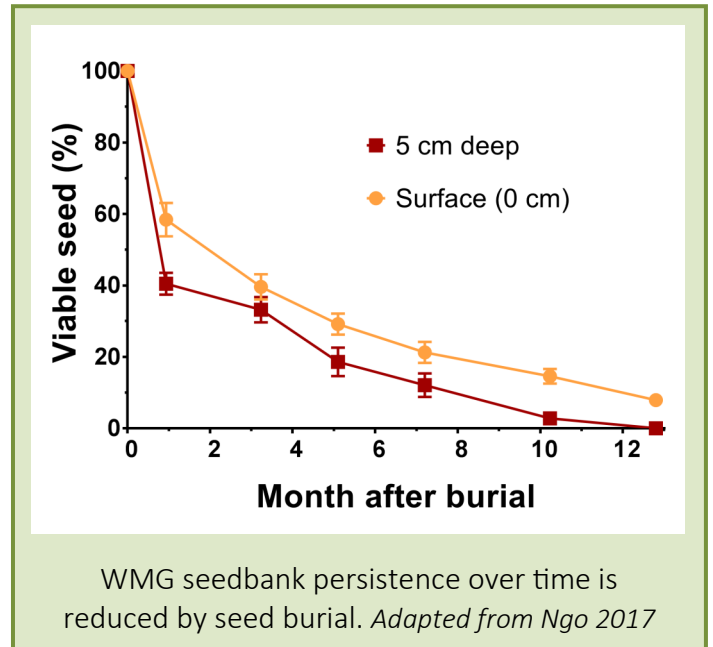
Germination of WMG requires light, which is common for species with small seeds because survival chances are higher if they germinate in open areas near the soil surface. Light/dark experiments revealed that only about 2% of seeds germinate in complete (24h) darkness, compared to 50% or more in 12h light/dark.

Burying seed also prevented germination of WMG, with none germinating from any depth from 0.5 to 5 cm. This is consistent with our finding of WMG seed requiring light for germination, as light can reach only a few millimetres into soil.

These results explain why no-till agriculture has favoured the spread of WMG. They also highlight the potential for control of this species through management practices that cause seed burial, such as strategic tillage or tined seeding systems that result in some cultivation of the soil. Using narrow crop row spacing and cover crops may also help reduce light reaching the soil surface, and so suppress germination.

Seedbank persistence

The viability of WMG seed in soil decreases over time and the seedbank almost depletes entirely after about 12 months.



In an average year, seeds on the soil surface remained viable for longer than buried seeds. Although sufficient light was available, the lack of moisture prevented germination and decay of the WMG seed.

When the study was repeated over the hot, dry spring and summer of 2015-16, buried seeds persisted for longer. This was the only instance where considerable viability was maintained beyond 12 months, and indicates a need for extended weed control following a dry season.

WMG seed normally matures on the plant during spring and summer, providing an adequate seedbank for seedling establishment throughout the year. Due to its short persistence, it is possible to eradicate the weed from a paddock after only 1 or 2 years of effective management.

Managing Windmill Grass

WMG is a complex weed to manage, and coupled with resistance to glyphosate, an IWM strategy is increasingly important. Plants must be controlled before seed set for management to be effective, which leaves a window of only about 2.5 months following emergence, except in winter. Ensuring plants are controlled prior to flowering gives the best chance to reduce the problem.

Chemical control options

Glyphosate resistant WMG has been confirmed in the southern region of Australia. If a population on your property is suspected resistant to this or any other herbicide, it should be investigated further. It would be wise to explore other management options before the problem escalates.

There are few herbicides registered for use on WMG in the southern region:

- Terbacil plus sulfometuron is registered for use on rights-of-way, around buildings, on fencelines and non-agricultural situations.
- Glyphosate is registered for use around buildings and in non-agricultural situations, in dry drains and channels and for spot spraying in pasture.
- Butroxydim is registered for lucerne (Vic only).

Product labels should be consulted to ensure the use pattern is appropriate and registration includes your location and situation.



Mature windmill grass plants on a roadside.

Photo by Chris Preston

Physical and cultural control options

WMG seed will not germinate if buried and remains viable for only around 12 months in an average year. Therefore, short-term strategic tillage of heavily infested areas is a good option to gain control of WMG. Using a tined seeding system that results in soil inversion is also likely to help.

Narrow crop row spacing and cover crops restrict light from reaching the soil surface, and so will reduce germination of WMG. It is also important to sow into clean paddocks wherever possible.

Always remember to follow IWM best practices: Rotate crops, herbicide actives and modes of action. Keeping detailed records will help you greatly with your management strategy decisions in the future.



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Further Information:

Journal article: Ngo, T.D.; Boutsalis, P.; Preston, C.; Gill, G. (2017) Plant development and seed biology of windmill grass (*Chloris truncata*) in southern Australia. *Weed Science* 65(3):395-405.

GRDC factsheet: Strategic tillage in no-till systems (2016). (www.grdc.com.au/TT-StrategicTillage)