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Post-emergent herbicidal options for witch grass (*Panicum capillare*) control in summer fallows

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Key findings

- It is difficult to effectively control witch grass in summer.
- No single herbicide treatment achieved 100% control.
- Glyphosate-based herbicide treatments were the best performers, achieving 86–88% control.
- The mixture of glyphosate + simazine had residual control on subsequent emergences.

Introduction

Witch grass (*Panicum capillare* L.) is an annual grass indigenous to North America. It has invaded many non-native ranges throughout the world, from subtropical to temperate areas including Asia, South America (Argentina and Chile), New Zealand, Australia, Morocco, Russia and many European countries (Clements et al. 2004). In Australia, the earliest herbarium record of witch grass was collected from the Roseworthy Agricultural College, South Australia in 1911, followed by the second earliest collection in Sydney in 1927 (AVH 2017). It is now widely distributed in NSW, VIC, SA and WA. A recent summer weed survey in the regions from the Western Plains through to the Riverina districts showed that witch grass was the second most prevalent annual summer weed, with the top-ranked weed being flaxleaf fleabane (*Conyza bonariensis* L.) (Weston et al. 2016).

The prevalence of witch grass is associated with its high seed production, tumble-weed like spreading mechanism and staggered emergence. It is a prolific seed producer, producing up to 56,400 seeds per plant in the absence of competition (Stevens 1932). Witch grass sheds seeds when mature, however, it has a unique seed-dispersing mechanism, similar to the tumbleweed. Its mature spherical inflorescence easily breaks from the plant and can be spread long distances by wind. Large piles of grass inflorescence often engulf country roads and streets, fencelines, yards, garages, sheds and houses in wet summers in southern Australia. Removing the inflorescences from the front doors, yards and garages has been a daunting task for many local residents.

Witch grass has a hard seed coat and possesses strong innate dormancy (Brecke 1974; Baskin & Baskin 1986). It is a C_4 grass (Hattersley 1984). The lower water requirement of plants with the C_4 photosynthetic pathway, along with higher optimal temperatures, makes it highly adaptable to the hot and dry summer conditions, contributing to its invasiveness.

Witch grass starts to emerge in early October in southern NSW, with major emergence occurring between October and December, followed by limited emergence throughout January and February (unpublished data). Brecke (1974) found that witch grass mostly emerged from near or on the soil surface (0–2.5 cm), with limited emergence occurring below 5 cm of burial.

Witch grass often infests summer crops in the northern hemisphere such as corn, soybeans, and sorghum, as well as in winter wheat. In southern NSW, witch grass thrives in bare areas of winter crops and grows rapidly soon after crop harvest due to the removal of crop competition. It is also a weed in degraded pastures under drought conditions (Philips 2010).

Information on its impact on crop yield is scarce. However, if left uncontrolled, it quickly grows to a thick mat, depleting soil moisture and nutrients during the summer period, which will affect the coming season for crop growth.

Witch grass can pose significant animal health issues. It has been found to accumulate nitrate and could be toxic to livestock under certain conditions (Kingsbury 1994). Hepatogenous photosensitisation was also reported in Merino sheep grazing on witch grass in Australia (Quinn et al. 2014). Care should therefore be taken when grazing on heavily infested land.

Witch grass is an alternative host to a range of pests and diseases, including cereal aphids such as *Rhopalosiphum padi* L. and *R. maidis* Fitch (Kieckhefer & Lunden 1983), western corn rootworm (*Diabrotica virgifera virgifera* LeConte) (Chege et al. 2005), *Wheat streak mosaic virus* (Christian & Willis 1993; Coutts et al. 2008), and planthoppers *Sogatodes oryzicola* Muir and *S. cubanus* Crawford, which are important vectors of the rice *Hoja blanca virus* (Thresh 1981).

There are limited effective control options for witch grass. The aim of this research was to identify effective post-emergent herbicidal options for witch grass control.

Materials and methods

A field experiment was established in southern NSW in canola stubble that had a high level of witch grass, with an initial plant density of 500 plants per square metre, determined by randomly counting five quadrats (0.5 × 0.5 m) from each replicate across the field site. Herbicide treatments were applied using a 2 m hand-operated boom fitted with Teejet 11002 nozzles, delivering 100 L/ha spray volume at 2 bar pressure. Herbicides were applied on 17 December 2016 following 55 mm of rain which fell on 15 December 2016. A total of 16 treatments were compared, including the untreated control. A randomised complete block design was used with four replicates. The plot size was 2 × 9 m.

Herbicide efficacy was monitored 31 days post herbicide application on 17 January 2017. Plant numbers were recorded from two random quadrats (0.5 × 0.5 m) each plot. Visual control rating was also undertaken in comparison with the untreated control plots.

Results

Only four glyphosate-based herbicide treatments achieved more than 85% control on witch grass based on the visual rating results (Table 1). These treatments also had less than 25 witch grass plants per square metre after one month of herbicide application. The four treatments included glyphosate, glyphosate + haloxyfop, glyphosate + simazine and glyphosate + metolachlor. Adding haloxyfop, metolachlor or simazine did not significantly improve control. However, adding simazine did have a residual impact on new plant emergence (Figure 1).

Table 1. Post-emergent herbicide control efficacy on witch grass (December 2016).

Treatment ID	Group	Active ingredient (concentration)	Rate (mL or g/ha)	Adjuvant, application rate	Weed count* (plants/m^2)	Visual rating* (%)
Verdict™ 520	A	Haloxyfop (520 g/L)	400 mL	Uptake™, 0.5 L/100 L	72	84
Wildcat® 110 EC	A	Fenoxaprop (110 g/L)	900 mL	BS 1000, 0.25 L/100 L	128	54
Targa®	A	Quizalofop-p-ethyl (99.5 g/L)	750 mL	BS1000, 0.2 L/100 L	154	33
Factor* WG	A	Butroxydim (250 g/kg)	180 g	Supercharge®, 1 L/100 L	112	59
Status®	A	Clethodim (240 g/L)	400 mL	Supercharge®, 1 L/100 L	124	68
Verdict™ 520 + Nuquat®250	A + L	Haloxyfop (520 g/L) + paraquat (250 g/L)	150 mL + 1600 mL		162	23
Verdict™ 520 + Weedmaster® Argo	A + M	Haloxyfop (520 g/L) + glyphosate (540 g/L)	150 mL + 1000 mL		13	88
Nuquat® 250	L	Paraquat (250 g/L)	1600 mL		140	20
Weedmaster® Argo	M	Glyphosate (540 g/L)	1000 mL		24	88
Basta®	N	Glufosinate (200 g/L)	5000 mL		109	71
Balance® 750 WG	H	Isoxaflutole (750 g/kg)	50 g		163	15
Dual Gold®	K	S-metolachlor (960 g/L)	1500 mL		169	16
Balance® 750 WG + Nuquat®250	H + L	Isoxaflutole (750 g/L) + paraquat (250 g/L)	50 g + 1600 mL		110	31
Weedmaster® Argo + Simazine WDG	M + C	Glyphosate (540 g/L) + simizine (900 g/kg)	1000 mL + 2000 g		18	86
Weedmaster® Argo + Dual Gold®	M + K	Glyphosate (540 g/L) + S-metolachlor (960 g/L)	1000 mL +1500 mL		16	88
Control					185	0
				l.s.d (P = 0.05)	46.8	31.5

* Herbicides were applied 17 December 2016 two days after 55 mm of rain.

** Weed count and visual rating were conducted on 17 January 2017.

Among the Group A herbicides (fops and dims), haloxyfop was the most effective, achieving 84% control on witch grass (Figure 1). All other Group A herbicides had limited effects (23–68%), including a lower rate of haloxyfop mixed with paraquat. Paraquat and glufosinate alone were also ineffective, controlling only 20% and 71% of witch grass, respectively.

Summary

Effective post-emergent herbicidal control of witch grass has been limited. No herbicide treatments achieved complete control, even the herbicide treatments that were applied to stress-free weeds after a significant rainfall event.

Glyphosate-based herbicide treatments achieved the best results. The glyphosate + simazine mixture achieved acceptable residual control on subsequent emergences.

Further studies should evaluate double-knock options and other post-emergent mixtures. In addition, soil-applied residual herbicides should be further explored in future studies, as witch grass has multiple emergences during the growing season.

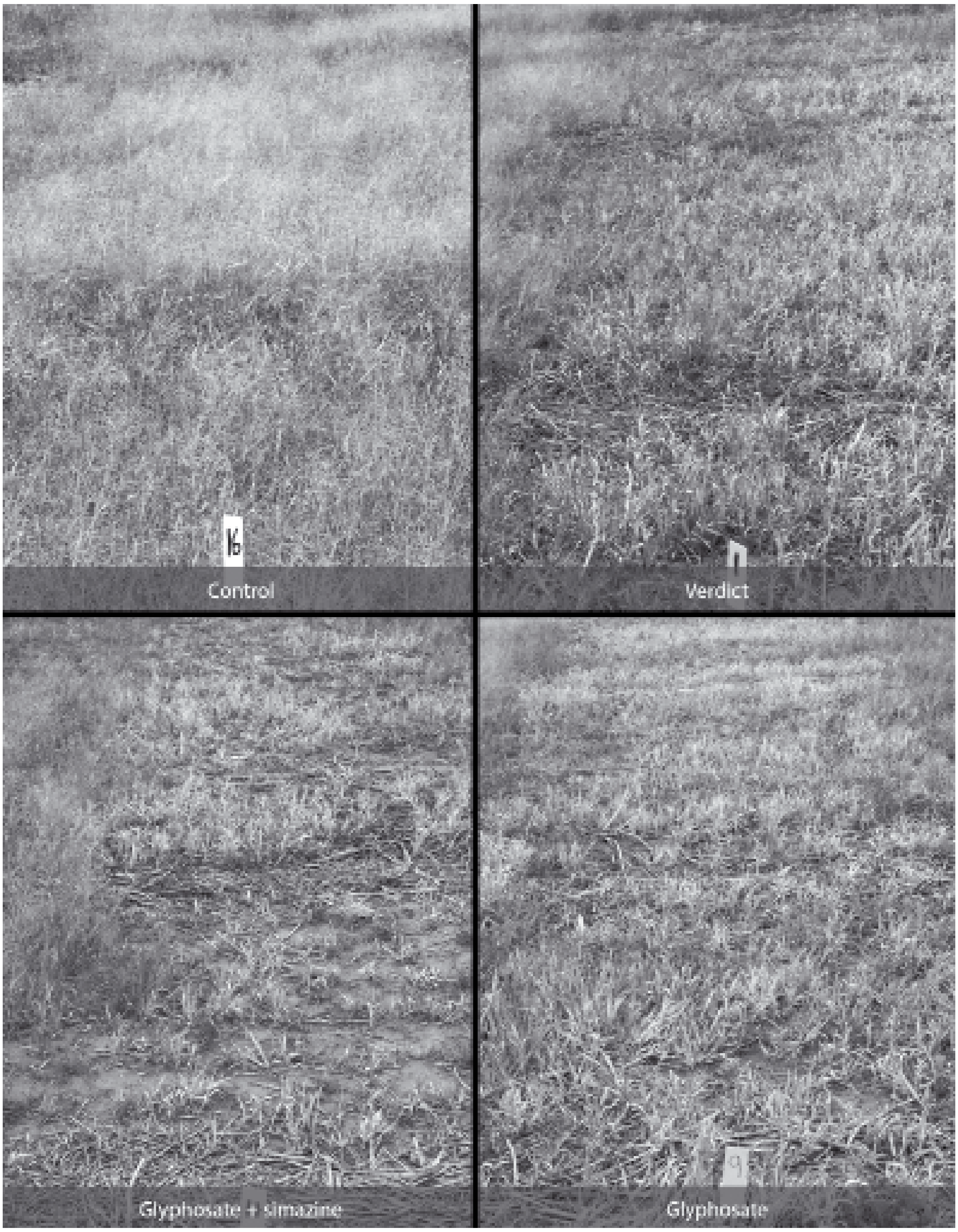

Figure 1. Impact of selected herbicide treatments on witch grass.

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