"Double knock" as a tactic for problematic weeds

Jeff Werth[1,2], Michael Widderick[2], Vikki Osten[3], David Thornby[2] and Steve Walker[1,2]

Cotton Catchment Communities CRC[1]
DPI&F Leslie Research Centre, Toowoomba QLD[2]
DPI&F Emerald QLD[3]

The Problem

Weed management in broadacre cropping systems relies heavily on glyphosate. This is true regardless of tillage or irrigation practices used. This widespread use of glyphosate, particularly in fallows and now in glyphosate tolerant crops has increased the risk of glyphosate resistance evolution and resulted in a shift towards weed species that are favoured by its use, in particular fleabane (*Conyza bonariensis*) (Walker and Robinson 2008).

In terms of glyphosate resistance risk, two weeds that have come under the microscope are barnyard grass (*Echinochloa colona*) and sweet summer grass (*Brachiaria eruciformis*). Both species are small seeded and produce many seeds. As a result they often emerge in large numbers and are can be exposed to glyphosate a number of times throughout spring and summer. These characteristics make them ideal candidates for resistance selection.

Fleabane is one of the most persistent and difficult to control weeds in northern no-till fallows, with individual plants capable of producing over 100,000 seeds. Fleabane is tolerant to glyphosate, and although a number of post-emergent herbicide mixes with glyphosate have been developed for its control, few of these are able to deliver consistently effective control of this species. This often results in fleabane continuing to be a problem in subsequent crops.

Double knock

Stopping seed-set on weeds that have survived a treatment of glyphosate is an important part of an IWM approach to preventing the development of glyphosate resistance. The double knock method of seed-set prevention to avoid or significantly delay the evolution of glyphosate resistant ryegrass has been used successfully in southern Australia. The double knock tactic involves the use of sequential knockdown herbicide applications from different herbicide mode of action groups. This method has been developed so that survivors of the first herbicide application are controlled by the second, thereby preventing seed production. From a resistance management perspective, it is critical that the rates of the individual products used are sufficient to kill a high proportion of susceptible weeds if used alone. The double knock tactic has been trialled also for its effectiveness in managing fleabane.

Effective use of the double knock tactic

The tables below illustrate the effectiveness of the double knock tactic. In the case of fleabane, it is easy to see the benefits of this tactic over using glyphosate alone. For the other species it is less obvious. However, remembering that one of the keys to stopping resistance is seed-set prevention, the picture becomes clearer. A small number of survivors in a field can still produce a large number of seeds, particularly with the weeds mentioned in this paper. It is therefore important to

achieve 100% control. If there are resistant plants that survive the first herbicide application but that are prevented from setting seed by the second herbicide application (from a different herbicide mode of action), the risk resistance evolving is reduced.

Timing of the second knock is also an important factor. When the period between applications stretches beyond 14 days the levels of control achieved declines. It is also important that the herbicides are applied to the same weed cohort, otherwise they are just two separate applications and the combined effect is not achieved.

Using robust rates and ensuring good coverage, particularly with paraquat and SpraySeed, is important to get maximum effectiveness from these chemicals. Herbicides applied at sub-optimal rates or in adverse conditions end up being costly in the long-term.

Table 1. Efficacy of different double knock tactics on fleabane

First knock	Second knock	Days between treatments	Control (%)
Glyphosate 450 2 L/ha	-	0	54
Glyphosate 450 2 L/ha	SpraySeed 1.6 L/ha	7	95
Glyphosate 450 2 L/ha	SpraySeed 2.4 L/ha	7	97
Glyphosate 450 2 L/ha + 2,4-D 300 ipa 1.5 L/ha	SpraySeed 1.6 L/ha	7	99
Glyphosate 450 2 L/ha + 2,4-D 300 ipa 1.5 L/ha	SpraySeed 2.4 L/ha	7	99
Glyphosate 450 2 L/ha + 2,4-D 300 ipa 3 L/ha	SpraySeed 2.4 L/ha	7	100

Table 2. Efficacy of different double knock tactics on glyphosate susceptible barnyard grass

First knock	Second knock	Days between treatments	Control (%)
glyphosate 450 0.8 L/ha	-	-	98
glyphosate 450 1.6 L/ha	-	-	100
paraquat 250 1.2 L/ha	-	-	97
paraquat 250 2.0 L/ha	-	-	99
glyphosate 450 0.8 L/ha	paraquat 250 1.2 L/ha	7	100
glyphosate 450 1.6 L/ha	paraquat 250 2.0 L/ha	7	100
Glyphosate 450 2 L/ha	SpraySeed 2.4 L/ha	7	100

Table 3. Efficacy of different double knock tactics on glyphosate resistant barnyard grass (courtesy A. Storrie, NSW DPI)

First knock	Second knock	Days between treatments	Control (%)
glyphosate 450 1.5 L/ha	-	-	90
glyphosate 450 2.0 L/ha	-	-	95
paraquat 250 1.6 L/ha	-	-	99
paraquat 250 2.4 L/ha	-	-	99.8
SpraySeed 2.4 L/ha	-	-	97.9
glyphosate 450 1.5 L/ha	paraquat 250 2.4 L/ha	7	100
glyphosate 450 2.0 L/ha	paraquat 250 2.4 L/ha	7	100
glyphosate 450 2 L/ha	SpraySeed 2.4 L/ha	7	100

Table 4. Efficacy of different double knock tactics on sweet summer grass

First knock	Second knock	Days between treatments	Control (%)
glyphosate 450 0.5 L/ha	-	-	99.3
glyphosate 450 1.0 L/ha	-	-	97.7
paraquat 250 1.5 L/ha	-	-	98
paraquat 250 2.0 L/ha	-	-	98.7
glyphosate 450 1.0 L/ha	paraquat 250 1.0 L/ha	11	100
glyphosate 450 1.0 L/ha	paraquat 250 1.5 L/ha	11	100
Glyphosate 450 1.0 L/ha	paraquat 250 2.0 L/ha	11	100

Conclusions

The double knock tactic, used as part of an integrated weed management strategy, will reduce the reliance on glyphosate as the only form of weed control and help prevent or significantly delay glyphosate resistance development and aid in the management of problematic weeds.

References:

Walker, S and Robinson, G. (2008). Flaxleaf fleabane – the next glyphosate resistant weed? In R. D. van Klinken, V. A. Osten, F. D. Panetta and J. C. Scanlan (eds) 16th Australian Weeds Conference Proceedings. Weed Society of Queensland, Cairns, Australia, pp. 74-76.

Walker, S., Widderick, M., Thornby, D., Werth, J. and Osten V. (2007) Management of barnyard and liverseed grasses. Available online at: http://www.dpi.qld.gov.au/cps/rde/xbcr/dpi/Managing-barnyard-and-liverseed-grasses.pdf

Widderick, M., Thornby, D., Werth, J., Osten, V., Storrie, A. and Cook T. (2008). Double knock is effective on a broad range of weeds. The Northern Herbicide Resistance Reporter, May 2008.