

Awnless barnyard grass management: double-knock application parameters

Background

Awnless barnyard grass is difficult to consistently control under commercial conditions. Multiple emergence 'flushes' together with variable control from glyphosate, when plants become moisture/heat stressed, often results in substandard weed control. When combined with multiple fallow applications of glyphosate, it was only ever a matter of time before glyphosate resistant barnyard grass developed. **There are now a number of confirmed glyphosate resistant populations in northern NSW.** A short term solution is to simply increase the rate of glyphosate however this will only increase resistance selection and hasten the demise of glyphosate as our key fallow tool.

The use of residual herbicides to reduce the selection pressure on glyphosate is being seriously considered in many areas even though it will clearly reduce crop rotation flexibility and increase cost. A 'double-knock' approach is another strategy that can be employed. A double-knock is where any two different weed management approaches (including cultivation) are used sequentially. In this project a double-knock refers to the use of glyphosate followed by a paraquat application. Double-knock approaches will be increasingly necessary in situations of developing or established glyphosate resistance but also to reduce resistance selection pressure particularly in paddocks with large barnyard grass populations.

Project aims

1. Evaluate the benefits of double-knock approaches for barnyard grass control compared to single herbicide applications
2. Evaluate the impact of varying the interval between double-knock applications
3. Validate the rate of paraquat required for effective barnyard grass control

Complete Summary

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Nuquat[®] is a registered trademark of Nufarm
Roundup[®] CT is a registered trademark of Monsanto

Results in a nutshell

Single applications v double-knock:

- *Roundup[®] CT 0.5 L/ha results varied from weak suppression to good control with apparent key factors being weed moisture stress and growth stage (as expected)*
- *Nuquat[®] 1.6 L/ha alone consistently provided ~90% control but did not exceed 95% control in any trial.*
- *All double-knock treatments provided improved control compared to Roundup CT alone and generally improved control compared to Nuquat alone.*
- *However double-knock still did **not** consistently provide 100% control in these trials*

Interval between double-knocks:

- *4-5 day delay provided most consistent control closely followed by 1 day delay*
- *10 day delay was effective at two of the sites but poorer on advanced weed growth stages and where weed moisture stress became apparent*
- *Increased Nuquat rates were required when a 10 day delay was used*

Double-knock rate:

- *Little clear dose response to Nuquat under 'good' spraying conditions but clear dose response under stressed conditions or when weeds became large*
- *Results supported a minimum of 1.6 L/ha of Nuquat (in double-knock) for consistent high levels of efficacy on barnyard grass up to ~6-8 leaves but increased rates are needed if weeds are larger or moisture stressed*

Where does double-knock fit best?:

- *Suspected or early stage glyphosate resistant populations*
- *In selected paddocks where glyphosate alone has been the key barnyard grass management tool for many years*
- *Once per season in paddock with highest barnyard grass population*
- *Timed on major barnyard grass emergence flush early in spring/summer when weed numbers likely to be highest*

Overall:

- *Will never be a standard herbicide management approach*
- *However is a useful tool for both seed bank and resistance management*
- *Consider for pre-emptive not just reactive resistance management*
- *Need to focus on small weed growth stages and ensuring good application*
- *Will require close attention to timing in paddocks with multiple soil types*

Complete Summary

Trial design

Four small plot trials were conducted in summer 2007/08 in barnyard grass populations expected to be glyphosate susceptible. Roundup CT (glyphosate 450g/L) was applied at 0.5 L/ha in all trials, at a sub-lethal below label rate, to simulate a situation where resistance to glyphosate was developing. Nuquat (paraquat 250g/L) was applied at 1.6 L/ha as a single application in comparison to Roundup CT and then as the second-knock product in all trials. All treatments were applied at a water rate of ~75 L/ha through TT (medium droplet) or AM (coarse droplet) nozzles.

Treatments applied

	Treatments			
	Timing 1 0 DAA1	Timing 2 1 DAA1	Timing 3 4-5 DAA1	Timing 4 10 DAA1
Single applications	Roundup CT 0.5 L/ha*			
	Nuquat 1.6 L/ha			
Double-knock applications (Roundup CT followed by Nuquat rate and timing specified)	Roundup CT 0.5 L/ha*	Nuquat 1.2 L/ha		
		Nuquat 1.6 L/ha		
		Nuquat 2.0 L/ha		
			Nuquat 1.2 L/ha	
			Nuquat 1.6 L/ha	
			Nuquat 2.0 L/ha	
				Nuquat 1.6 L/ha
				Nuquat 2.4 L/ha

DAA1 = days after application Timing 1

*Roundup CT was applied at 0.5L/ha in all trials to simulate a situation where resistance was developing

Trial locations, weed pressure and growth stages

Location	Final barnyard grass counts/m ²	Double knock interval (days)	Barnyard grass growth stages			
			Timing 1	Timing 2	Timing 3	Timing 4
Biniguy NSW	217	1, 5 or 10	2-6 leaf	2-6 leaf	4-7 leaf	6-8 leaf
Milguy NSW	438	1, 5 or 10	2-6 leaf	2-6 leaf	3-7 leaf	4-8 leaf
Pittsworth QLD	59	1, 5 or 10	Early-mid tillering	Early-mid tillering	Mid-late tillering	Late tillering-seed set
Bullarah NSW	79	1, 4 or 10	4 leaf	4 leaf	Early tillering	Mid tillering

Milguy and Pittsworth results may best represent the benefit of a double-knock approach in a situation with increasing levels of glyphosate resistance. Biniguy and Bullarah may reflect benefit in situations where barnyard grass is still glyphosate susceptible.

Assessment

1. **Barnyard grass control:** visual biomass reduction ~5, 10 and 21 days after Timing 1 with surviving weed counts taken at ~21 days after Timing 1

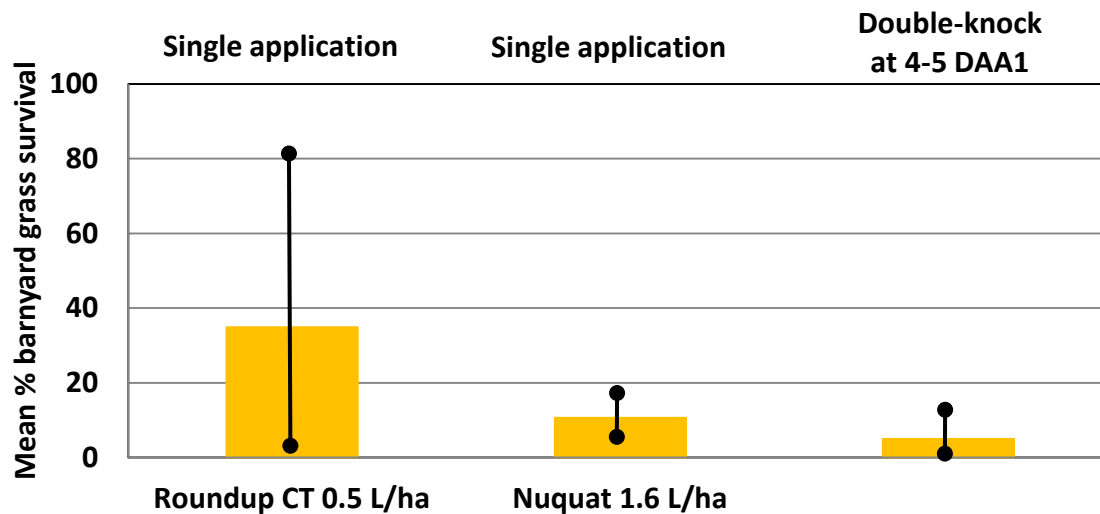
Complete Summary

Multi-trial summary

Due to the large number of treatments applied, results are presented in two groups:

- single applications (Timing 1) compared to double-knock using Roundup CT 0.5 L/ha at Timing 1 followed by Nuquat 1.6 L/ha at ~5 DAA1
- comparison of all double-knocks

Single application v double-knock



DAA1 = days after application Timing 1, fb = Roundup CT 0.5 L/ha followed by Nuquat 1.6 L/ha
Range bars show best and worst result

Key messages – single application v double-knock

- Large variability from Roundup CT 0.5 L/ha as expected
- Single application of Nuquat 1.6 L/ha was more consistent but still not generally commercially acceptable
- Double-knock provided the best control in all trials but still did **not** consistently provide complete control



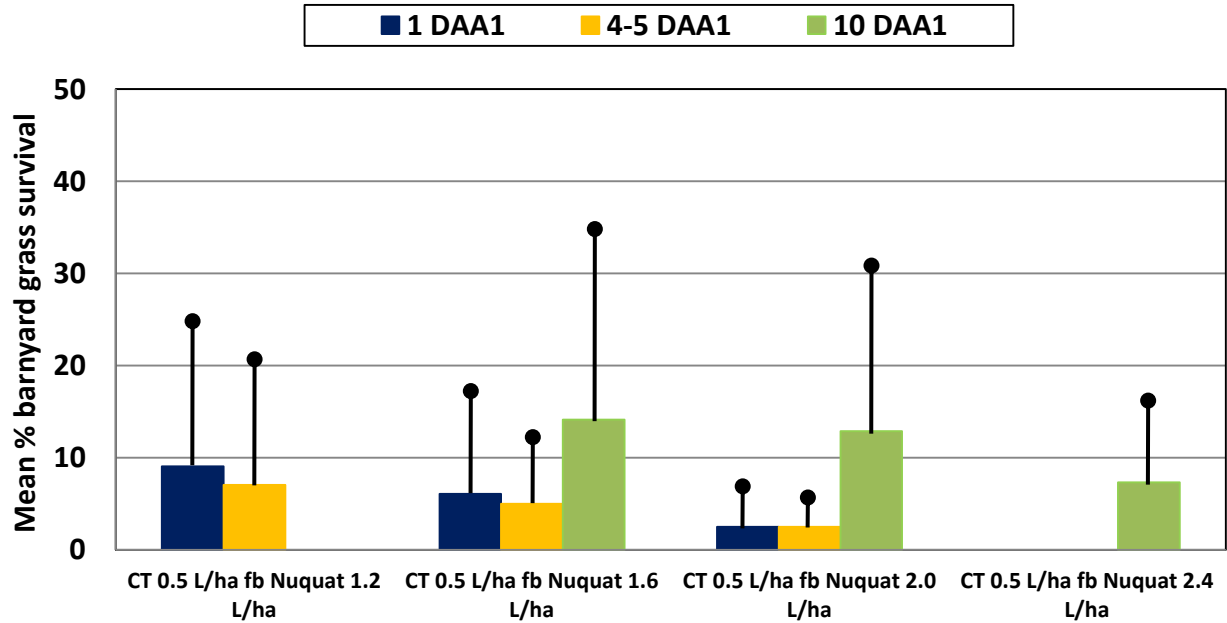
Milguy, 27 Nov 2007, Nuquat 1.6 L/ha alone 13 days after application



Milguy, Roundup CT 0.5 L/ha then Nuquat 1.6 L/ha with 5 day delay

Complete Summary

Double-knock comparisons



DAA1 = days after application Timing 1, fb = Roundup CT 0.5 L/ha followed by Nuquat. Range bars show worst result (all treatments achieved complete control in at least 1 trial)

Key messages – double-knock timing

- 4-5 day delay provided most consistent control closely followed by 1 day delay
- 10 day delay effective at some sites but poor, as expected, when used on larger or stressed weeds

Key messages – double-knock rate

- Nuquat at 1.6 - 2.0L/ha necessary for effective control with 1 or 5 day delay
- Increased Nuquat rate was required when delay extended

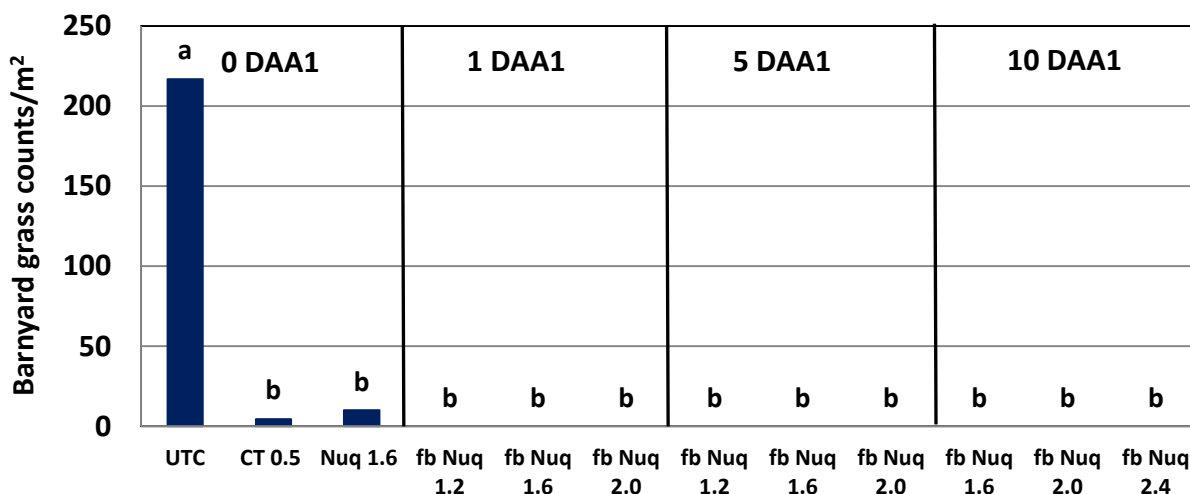
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Individual trial results 2007/08

Trial number: NGA0728
 Site: Biniguy district

		Barnyard grass stage
Timing 1:	14/11/2007	2-6 leaf
Timing 2:	15/11/2007 (1 DAA1)	2-6 leaf
Timing 3:	19/11/2007 (5 DAA1)	4-7 leaf
Timing 4:	24/11/2007 (10 DAA1)	6-8 leaf

Barnyard grass control 21 DAA1



DAA1 = days after application Timing 1, UTC = Untreated, fb = Roundup CT 0.5 L/ha followed by Treatments sharing the same letter are not significantly different

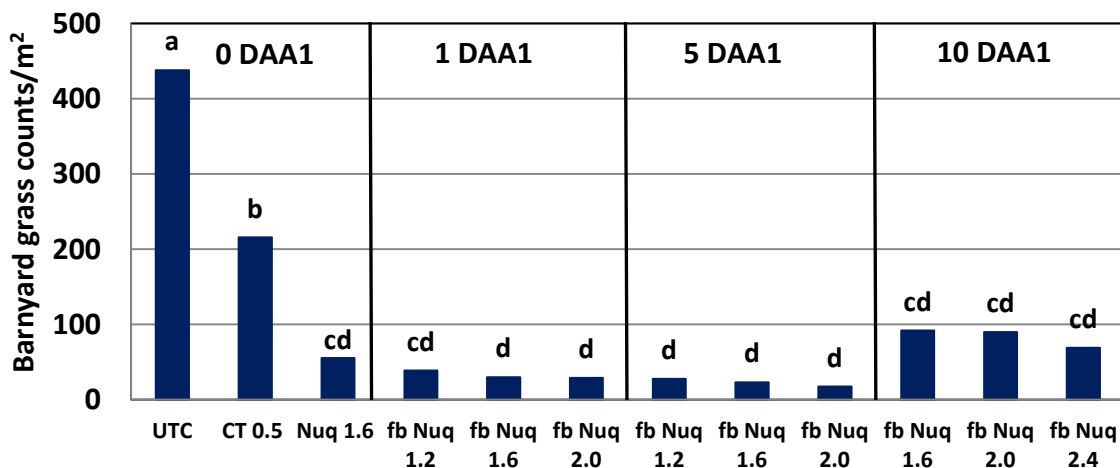
- High barnyard grass pressure
- All treatments provided >95% control with no significant difference between treatments
- No apparent Nuquat rate response or application timing difference
- Double-knock treatments trended to most effective weed control

Complete Summary

Trial number: NGA0729
Site: Milguy district

		Barnyard grass stage
Timing 1:	14/11/2007	2-6 leaf
Timing 2:	15/11/2007 (1 DAA1)	2-6 leaf
Timing 3:	19/11/2007 (5 DAA1)	3-7 leaf
Timing 4:	24/11/2007 (10 DAA1)	4-8 leaf

Barnyard grass control 21 DAA1



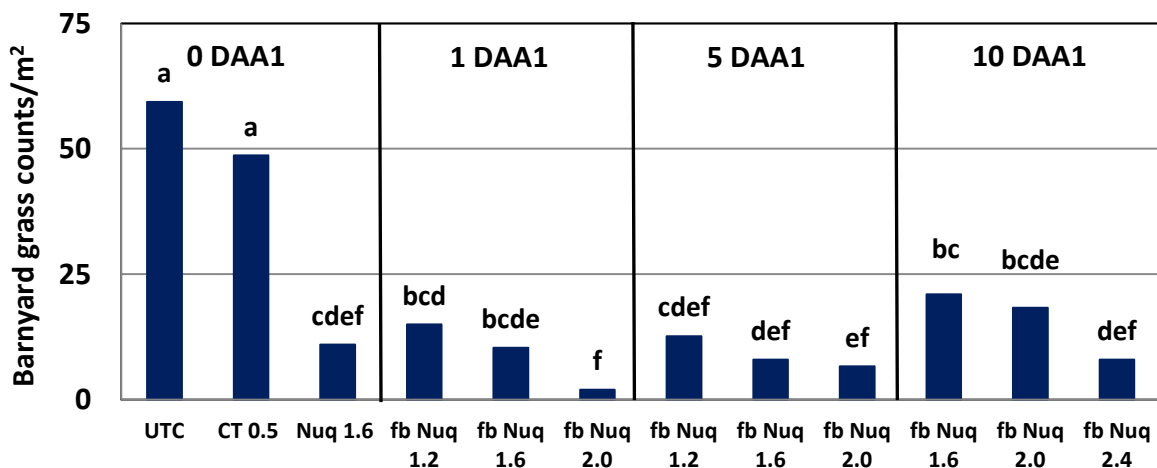
DAA1 = days after application Timing 1, UTC = Untreated, fb = Roundup CT 0.5 L/ha followed by
Treatments sharing the same letter are not significantly different

- Extreme barnyard grass pressure in heavy new season wheat stubble
- Only double-knock treatments at 1 or 5 DAA1 provided >90% control with no significant difference between treatments at these timings
- Small dose response to Nuquat at each application timing
- Double-knock at 5 days trended to best control with poor results at 10 days
- Sprayed on identical days as Biniguy site (NGA0728) and on smaller weed growth stages. Reduced control most likely due to increased weed moisture stress and possibly poorer coverage in thick stubble

Complete Summary

Trial number:	NGA0730	
Site:	Pittsworth district	
		Barnyard grass stage
Timing 1:	17/1/2008	Early – mid tillering
Timing 2:	18/1/2008 (1 DAA1)	Early – mid tillering
Timing 3:	22/1/2008 (5 DAA1)	Mid – late tillering
Timing 4:	27/1/2008 (10 DAA1)	Late tillering – seed set

Barnyard grass control 20 DAA1



DAA1 = days after application Timing 1, UTC = Untreated, fb = Roundup CT 0.5 L/ha followed by
Treatments sharing the same letter are not significantly different

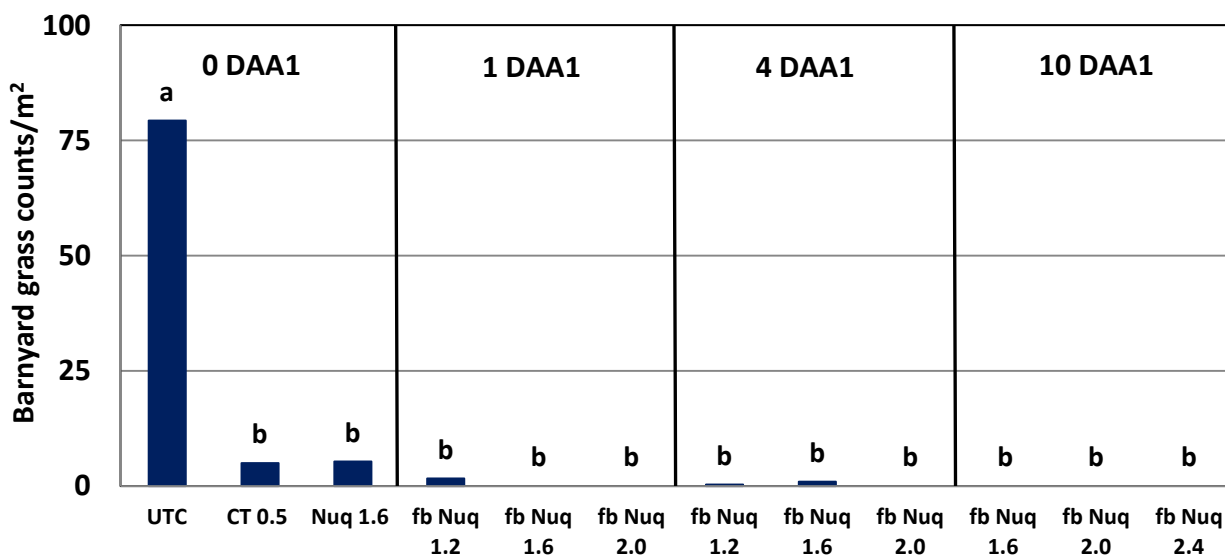
- Moderate barnyard grass pressure but at advanced weed growth stages
- Only one treatment provided >90% control (double-knock Nuquat 2.0 L/ha at 1 DAA1)
- Clear dose response trend to Nuquat at all application timings. Needed a minimum of 2.0 L/ha Nuquat 2.0 at 1 and 5 day delay.
- Double-knock at 1 and 5 days trended to best control with poor results at 10 days
- Complete control of low levels of stink grass (*Eragrostis cilianensis*) with Nuquat at 1.6 L/ha or more alone or in a double-knock

Complete Summary

Trial number: NGA0731
Site: Bullarah district

		Barnyard grass stage
Timing 1:	17/12/2007	4 leaf
Timing 2:	18/12/2007 (1 DAA1)	4 leaf
Timing 3:	21/12/2007 (4 DAA1)	Early tillering
Timing 4:	27/12/2007 (10 DAA1)	Mid tillering

Barnyard grass control 21 DAA1



DAA1 = days after application Timing 1, UTC = Untreated, fb = Roundup CT 0.5 L/ha followed by
Treatments sharing the same letter are not significantly different

- Moderate barnyard grass pressure
- All double-knock treatments provided >95% control and trended to improve control compared to single applications
- Little dose response to Nuquat at any application timing but with 2.0 L/ha needed to provide complete weed control
- No clear difference between any double-knock timing in this trial