MANAGING FEATHERTOP RHODES GRASS IN COTTON

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Introduction

Feathertop Rhodes grass (*Chloris virgata*) is becoming increasingly prevalent in cropping systems in the northern region. This species is already a major problem in central Queensland. This is largely due to an apparent tolerance to glyphosate, combined with minimum and no-till, glyphosate based cropping systems.

In the past feathertop Rhodes grass was considered a very minor weed. As a result, this weed appears only on the labels of clethodim (Sequence®) and butroxydim (Factor®), both which are registered for use in cotton. Recently, a minor use permit for Verdict® pre-plant to mungbeans as part of a double knock with paraquat was released. This permit is current until 31st August 2016.

Feathertop Rhodes grass is a member of the genus *Chloris*. Other *Chloris* species that are found in cotton growing regions are *Chloris truncata* (Windmill grass) and perhaps the most well known *Chloris gayana* (Rhodes grass), a common pasture species. Windmill grass is also becoming a major weed problem in grains systems in southern NSW.

Feathertop Rhodes grass is a weed which was introduced from America and has become widely established in Queensland and northern NSW, especially on road sides.

The plant

Feathertop Rhodes grass is an annual grass capable of producing over six thousand seeds per plant. It generally emerges in the warmer months of spring, summer and autumn, although in central Queensland it is able to emerge nearly year round. Trials conducted in CQ at the end of summer showed emergences throughout summer, autumn and winter (Figure 1). Being an annual, the key to managing this weed lies in the seed and seed bank.

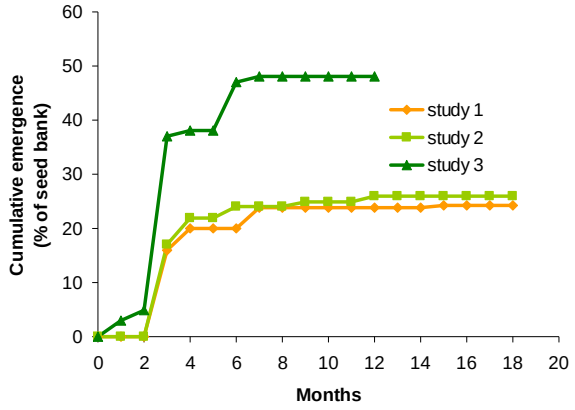

Figure 1. *Cumulative in-field emergence of feathertop Rhodes grass from seed buried in the top 2cm of soil in three separate studies. All studies started at the end of summer.*

Research has shown that seed appears to be relatively short lived regardless of burial depth in the soil. Studies in central Queensland showed that no recovered seed could be germinated after 12 months burial in the soil (Figure 2). This suggests that intensive control to stop seed set for a couple of years will have a major impact on reducing the seed bank. This is now being investigated under southern Queensland growing conditions.

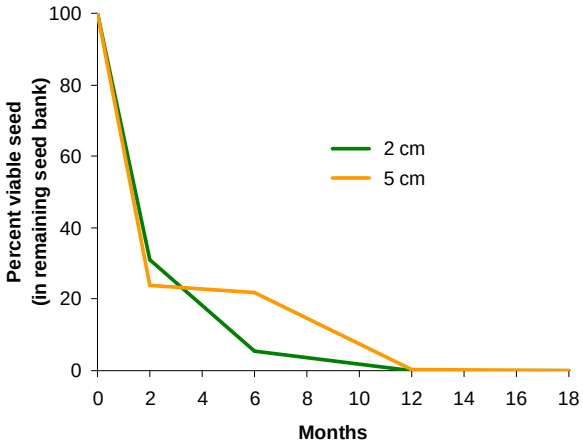

Figure 2. *Feathertop seed bank viability over time in central Queensland*

Feathertop seed responds quickly to small amounts of rainfall. An experiment conducted in controlled conditions examining the effect of rainfall amount on emergence showed that seeds germinated following 10mm of accumulated rain (Figure 3). Another experiment had feathertop emergences following as little as 5mm of rain. Some emergences occurred within two days of rainfall, which was considerably faster than other species in the experiment. The numbers emerging increased significantly with increasing rainfall with over 60-75% emergence following 30mm rain.

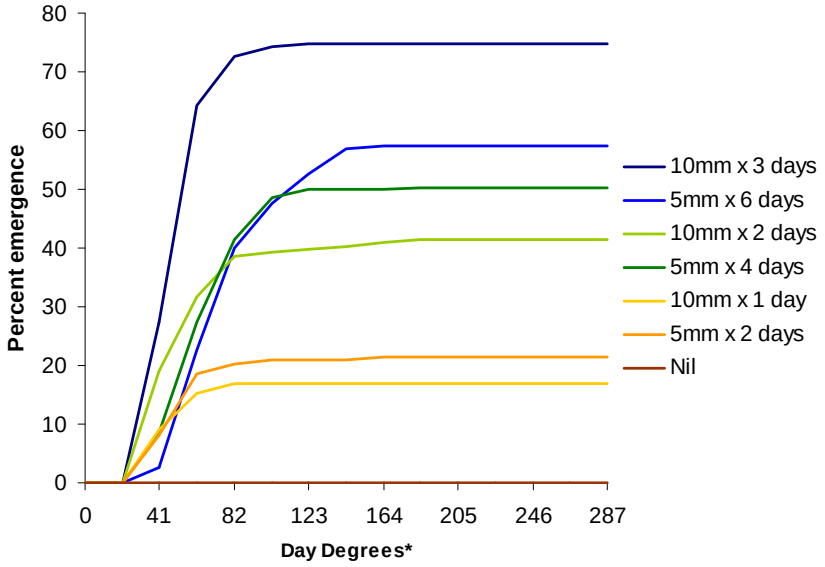

Figure 3. *Cumulative emergence of feathertop Rhodes grass in response to rainfall treatments. *Base temperatures for day degrees calculations were based on Chloris gayana (13°C).*

Strategies for managing feathertop Rhodes grass

Successful management of feathertop Rhodes grass requires a program centred on reducing replenishment of the seed bank.

A number of components will be central to any feathertop management program. These include:

- monitoring for seedling emergence,
- using a diversity of residual and post-emergent herbicides and cultivation, and
- preventing survivors from setting seed.

Peak flushes of feathertop Rhodes grass emerging in close proximity to the mother plant.

Monitoring seedling emergence

As with all species, feathertop is much easier to control when it is in the seedling stage. It is likely to emerge throughout the warmer months even with smaller rainfall events. Therefore control tactics are best aimed at reducing emergences and targeting seedlings.

Fallow paddock heavily infested with feathertop Rhodes grass. Chemical control at this growth stage can be ineffective. (Photo: R. Collins, DAFF)

Reducing emergences

Pre-emergent herbicides

Pre-emergent residual herbicides play an important role in reducing the numbers of seedlings emerging. This reduces the number exposed to post-emergent herbicides and therefore reduces the risk of resistance evolution.

Currently the only registered residual herbicide for use in cropping situation is isoxaflutole (Balance®) in fallow situations at 100 g/ha. However, when using residual herbicides for other species such as awnless barnyard grass recent trials indicate that effective levels of control can be achieved.

Data collected from a number of trials in central and southern Queensland is shown in Table 1. Feathertop can emerge late in winter crops, making it difficult to control in the following fallow after harvest. Research is investigating options for controlling these spring flushes using residual herbicides. A recent trial conducted by the Northern Grower Alliance (NGA) included a number of residual herbicides registered for use in wheat (Table 2). They conducted trials across four sites with a range of responses due to climatic variations. In a number of situations, effective control of feathertop was able to be achieved. A number of these herbicides can be used in cotton crops and rotations.

Table 1. *Residual control of feathertop Rhodes grass approximately one month after application (Source: DAFFQ 2010, NGA 2011, GSCQ 2009-10).*

Herbicide	Rates (ha)	Control (%)	
		Average	Range (n)
Flame	0.15-0.2L	80	5 – 100 (10)
Dual Gold	2L	89	75 – 98 (6)
Atrazine	1.25-2kg	65	20 – 100 (8)
Atrazine+ Dual Gold	3.2L	95	80 – 100 (10)

Table 2. *Residual control of feathertop Rhodes grass in wheat, approximately 3 months after application as incorporated by sowing or post-sowing pre-emergent (Source: NGA 2012)*

Herbicide (MOA)	Rate	Control (%) at wheat harvest			
	(mL or g/ha)	Site 1	Site 2	Site 3	Site 4
Incorporated by sowing					
Sakura (K)	118	100	99	46	57
Sakura + Glean (K+B)	118+20	100	100	86	53
Logran (B)	35	89	13	0	34
Boxer Gold (J+K)	2500	95	96	0	48
Avadex Xtra (J)	1600	100	62	0	0
Treflan (D)	2000	97	98	97	58
Stomp 440 (D)	2500	100	74	99	5
Post-plant pre-emergent					
Glean (B)	20	100	0	20	38
Balance (H)	100	100	100	8	63
Balance + Simazine 900 (H+C)	100+883	100	100	0	83
Simazine 900 (C)	2200	0	0	0	0
Terbyne (C)	1400	79	0	18	14
Balance + Terbyne (H+C)	100+1000	100	100	42	0

Tillage

Feathertop Rhodes grass seed is small and therefore unable to emerge successfully when buried. This makes tillage an important option for reducing seedling emergence. A recent trial by DAFFQ demonstrated the effect of tillage on feathertop emergence (Figure 4).

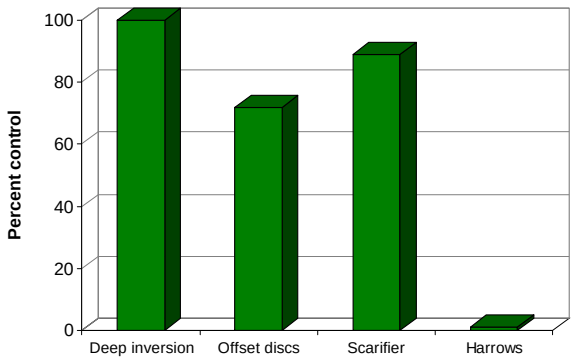

Figure 4. *Impact of different tillage types, some with residual herbicides included, on the control of feathertop Rhodes grass 9 months after application (and after > 200 mm total rain received during the period).*

Tillage operations that bury the seed prevented almost all emergences. Seed burial below 5 cm will place the seed too deep for germination. Lighter tillage operations such as harrows and Kelly chains will do little to minimise emergences, however they can be used to stimulate emergences to facilitate peak flushes, to which control tactics such as the double knock can be applied. This practice can be very effective at driving down the seed bank.

Post-emergent options

As mentioned earlier there are some group A herbicides that are registered for use in cotton. These are clethodim (Sequence®) and butroxydim (Factor®). Haloxyfop (Verdict®) is registered for use in cotton, but not specifically on feathertop Rhodes grass. Haloxyfop has recently been registered for pre-plant use in mungbeans in conjunction with a double knock with paraquat. Also there is a permit for using these products in fallow with a weed detector.

Tables 3 and 4 show results of post-emergent herbicides on feathertop control. As can be seen from Table 3, it is not controlled well by glyphosate alone.

It is also important to note the decline in control as feathertop age and size increase. For example, in Table 3, Verdict was able to provide consistent control of feathertop on seedlings, as plants reached mid-tillering and maturity, both the efficacy and consistency of control across sites declined dramatically. Control of mid-tillering plants was affected by rate and conditions at spraying. It is also important to note the heavy reliance on group A herbicides: this group of herbicides has a high risk for resistance.

Table 3. *Control of feathertop Rhodes grass when treated at seedling, mid-tillering and mature stages (Source: GSCQ 2011-12)*

Herbicide (MOA)	Control (%)						
	Seedling		*Mid-tillering*			*Mature*	
Rate (ha)	Site A	Site B	Site C	Site D	Site E	Site F	Site G
Roundup Powermax 1L (M)	48	28	30	69	9	0	6
Roundup Powermax 2L (M)	74	60	59	94	5	0	4
Roundup Powermax 4L (M)	86	88	96	99	13	5	6
Verdict 150mL (A)	91	92	98	44	36	48	23
Verdict 300mL (A)	100	99	100	44	60	49	45
Verdict 400mL (A)	100	99	100	70	68	96	78
DAT	*38*	*21*	*38*	*22*	*35*	*49*	*35*

Table 4. *Control of seedling and mature feathertop Rhodes grass with different Group A products at three field sites (Source: NGA 2010)*

Herbicide (MOA)	Seedling control (%)		Mature plant control (%)
Rate (ha)	Site A	Site B	Site C
Verdict 150mL + Uptake (A)	100	81	
Verdict 300mL+ Uptake (A)	100	99	
Verdict 500mL+ Uptake (A)			34
Glyphosate CT 2L + Liase / LI700 (M)	60	0	45
Glyphosate CT 4L + Liase / LI700 (M)	71	60	80

Double knock strategies

Using the double knock tactic is one way to minimise the risk of resistance development, and provide improved control of seedlings and older plants. Table 5 shows a trial conducted by NGA on the effect of applying paraquat in a double knock at different intervals to seedling feathertop. In these trials timing of the second knock largely didn't affect the level of control achieved. However, it is important to note the reduced control when glyphosate was applied as the first knock. The tolerance of feathertop to glyphosate was illustrated when a double knock was not applied; this indicates that when paraquat was applied it was providing most of the control. If this practice was to continue over several generations/seasons, the risk of paraquat resistance would become high.

When plants pass seedling stage, the double knock is the best herbicidal option for control. A glasshouse experiment on plants that were mid-late tillering (Table 6) showed that applications of Verdict followed by Sprayseed® provided good control of older feathertop plants The effect of timing slightly differed between the two experiments however the results suggest that a window of 1-4 days between applications is effective. Once again, glyphosate proved to be a poor partner for providing effective control.

Table 5. *Control of feathertop Rhodes grass with double-knock tactics (DK) when the second knock of Paraquat at 2L/ha is applied at different intervals at two field sites (Source: NGA 2012)*

First knock	Seedling control (%)				
			Site A		
Rate (ha)	-DK	+DK 3 days	+DK 7 days	+DK 16 days	+DK 19 days
Verdict 150mL	95	100	99	96	99
Glyphosate CT 4L	70	74	68	69	79
			Site B		
Rate (ha)	-DK	+DK 4 days	+DK 7 days	+DK 14 days	+DK 21 days
Verdict 150mL	93	100	100	100	100
Glyphosate CT 4L	31	26	76	100	52

Table 6. *Efficacy of the double knock later-tillering plants in pots, when the second knock of Sprayseed at 1.2L/ha followed glyphosate or Verdict (at sub-lethal rates) at seven intervals (Source: QDAFF 2011-2013)*

First knock	Weed biomass (g/pot)							
Rate (ha)	Interval between knocks (days)							
	-DK	1	2	4	7	10	14	21
				Pot experiment 1				
Glyphosate CT 400mL	6.8	8.9	6.3	2.7	0.3	4.9	4.5	7.7
Verdict 40mL	1.7	0	0	0	0	0	0	0.72
				Pot experiment 2				
Glyphosate CT 400mL	16.7	21.1	13.4	13.1	6.1	7.7	4.4	9.1
Verdict 40mL	4.3	0	0	0	1.4	2.2	1.7	2.8

Combining DK + residual

Adding a residual herbicide to paraquat when applying a double knock can be an effective way to get control of existing plants, and minimise further emergences. This is shown in Figure 5 where residual herbicides were added to paraquat. In this trial a combination of Dual Gold® had the greatest reduction in feathertop emergences. None of the residual herbicides appeared to be antagonistic when mixed with paraquat.

Double-knock (Group M herbicide followed 11 days later by Group L mixed with a Group B residual herbicide) in fallow on feathertop Rhodes grass (right) compared with untreated (left).

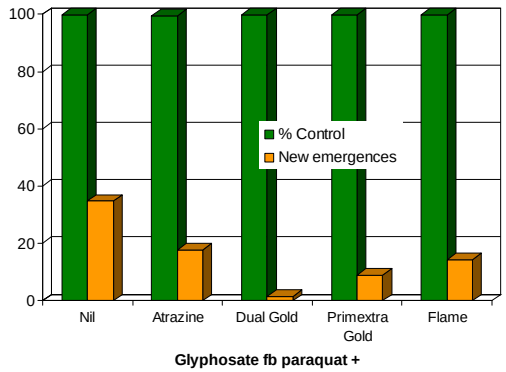

Figure 5. *Effect on initial control and reduction in emergences in the next flush (plants/m²) from adding a residual herbicide to paraquat (Source: QDAFF)*

Summary

Feathertop Rhodes grass is poorly controlled by glyphosate and as a result is increasing in prevalence in cotton growing regions.

It is a small-seeded annual species, so the key to management lies in managing the seed bank and preventing new seed from entering the soil.

This can best be achieved by:

- Utilising tillage and pre-emergent herbicides to reduce numbers of seedlings emerging
- Monitoring emergences and controlling seedlings when they are small
- Using robust herbicides and rates and the double knock tactic to control plants and prevent seed set

Feathertop Rhodes grass seeds have a relatively short life compared to other species, so intensive management for up to two years can have a major impact on driving down the seed bank.