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Seed viability of feathertop Rhodes grass (*Chloris virgata* Sw.) affected by sheep rumen digestion

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Key findings

- Feathertop Rhodes grass seed viability was reduced by more than 99% after feeding through sheep.
- A low level of viable seeds (<1%) can still be detected 12 days after feeding, therefore, if sheep graze feathertop Rhodes grass, they should be quarantined for at least 8 days in order to prevent seed spread.

Keywords feathertop, Rhodes grass, digestion, sheep, weeds, resistance

Introduction

Feathertop Rhodes grass is a major weed in both cropping and non-cropping situations in Australia. This annual species is very difficult to control, and no single weed management option will provide adequate control. Currently feathertop Rhodes grass control relies heavily on a few registered herbicides, particularly those with glyphosate and acetyl-CoA carboxylase inhibitors, resulting in the rapid evolution of resistance to these key agrochemicals (Heap 2022). An integrated approach is therefore required to effectively manage this weed.

Annual weed grasses are often highly palatable to grazing ruminants (Marten and Anderson 1975). Sheep can be used to directly consume and control weeds, not only during fallow years but also during fallow periods before planting and after harvest, thereby replacing herbicide dependency. However, weeds and weed seeds present at the time consumed by sheep and from harvest are preserved in silage with the forage and it is often assumed that this renders most of these weed seeds non-viable (Kaiser et al. 2004). However, there is no reported data on feathertop Rhodes seeds survival after passing through the digestive tract of sheep. This research aimed to determine the percentage of viable seed recovered after passing through the digestive tract of sheep.

Site details

Location

Wagga Wagga Agricultural Institute, Wagga Wagga

Time of experimentation

November 2020 and March 2021

Seed population and number sheep

One feathertop Rhodes grass population MUTT 04/20 (146° 34′ 201″ E, 35° 07′ 606″ S) and 8 sheep.

Sheep feeding and faeces collection

Eight sheep were individually penned and fed a diet consisting of lucerne and oaten chaff (1:1). The sheep were fed each morning a standard diet at 800 g/day, mixed with 40 g of feathertop Rhodes grass seeds (about 135,800 seeds). After feathertop Rhodes grass seed was introduced into the diet, total faeces were collected daily from day 1 to day 12 to determine the time taken from ingestion to complete excretion of the seed. Faecal collection for each day occurred 24 hours after feeding, hence faeces for day 1 were collected before feeding on day 2 etc.

This research paper is an extract from the publication *Southern NSW Research Results 2022*, available at https://www.dpi.nsw.gov.au/agriculture/broadacre-crops/guides/publications/southern-nsw-research-results

Faeces spread on germination tray

To determine the percentages of seed viability in the faeces, each faeces sample was weighed and separated into 3 sub-samples. The first sub-sample (approximately 260 g) was used to determine seed viability in glasshouse conditions. The second sub-sample was air-dried and kept in a cool room for further testing to confirm the results. The third sub-sample was used for digestibility testing (not reported here).

To determine the percentages of seed viability in the faeces, the first sub-sample was evenly spread onto a plastic seedling tray (32 cm × 28 cm × 6 cm) that was filled with a field soil (loamy soil). The faeces were gently rubbed and lightly mixed with the surface soil. The trays were kept moist and monitored for 21 days. The trays were maintained under glasshouse conditions and irrigated as required.

The experiment was repeated in March 2021 with the second sub-sample to validate the results obtained in 2020. An additional control treatment was included in 2021 where 300 feathertop Rhodes grass seeds were spread on a seedling tray under the same glasshouse conditions used in 2020.

Germination and viability evaluation

Total emerged seedlings were counted to estimate seed viability and the speed with which feathertop Rhodes grass seed passed through the sheep gut. It is not possible to extract the seeds from the faeces through sieving or washing due to the tiny seed size (0.39 mg/100 seeds).

Experiment design and data analysis

A completely randomised design was used, with 8 replications. The significant differences among days after faeces collection were identified by Tukey's HSD (honest significant difference) at $p<0.05$.

Results

The average amount of fresh faeces from 8 sheep from day 1 to day 12 is presented in Table 1. Fresh faeces weight ranged from 695.25 g to 968 g with an average of 789 g for day 1 to day 12.

Table 1 Average fresh faeces (g) collected, number of seedlings emerged/tray and cumulative emergence (%) from day 1 to day 12.

Day after feeding	Faeces (g)	2020		2021	
		Average seedlings emerged per tray	Cumulative emergence (%)	Average seedlings emerged per tray	Cumulative emergence (%)
1	695.25 (±74.9)	8.7 (±1.3)	23.0	3.4 (±1.2)	34.6
2	671.25 (±77.3)	9.0 (±2.6)	47.0	1.7 (±0.9)	51.9
3	727.50 (±98.5)	4.3 (±1.3)	58.0	1.0 (±0.7)	62.1
4	791.87 (±95.6)	3.3 (±1.6)	67.0	0.7 (±0.7)	69.2
5	851.37 (±96.5)	5.0 (±0.9)	80.0	0.4 (±0.3)	73.2
6	757.25 (±93.2)	1.2 (±1.1)	83.0	0.4 (±0.4)	77.2
7	759.38 (±73.3)	2.0 (±0.3)	88.0	0.3 (±0.4)	80.2
8	968.13 (±69.7)	0.7 (±0.5)	90.0	0.0 (±0.0)	80.2
9	789.25 (±70.9)	2.6 (±1.4)	97.0	0.5 (±0.5)	85.3
10	858.0 (±94.8)	0.6 (±0.6)	99.0	0.5 (±0.4	90.4
11	845.63 (±66.7)	0.1 (±0.1)	99.3	0.3 (±0.1)	93.4
12	757.75 (±37.3)	0.5 (±0.3)	100	0.6 (±0.3)	100

Note: ± = standard error

In both years, most seedling emergence (58–62%) occurred from the faeces collected during the first 3 days after seed intake (Table 1). It was observed that there was still limited seedling emergence from the 12-day faeces, being less than 1% in 2020 and 7% in 2021. On average, the total number of

emerged seedlings from day 1 to day 12 was 38.0 in 2020 and 9.8 in 2021, which is estimated at only 0.08% and 0.02% of the seeds fed in 2020 and 2021, respectively.

In comparison, 53.4% of the total control seeds germinated in the trays under the same conditions. This shows that sheep rendered more than 99.9% of feathertop Rhodes grass seeds unviable after passing through the digestive system.

Seedling emergence in 2020 was significantly (r = 0.82, p = 0.0012) correlated with seedling emergence in 2021 (Figure 1) indicating consistent results across both experiments.

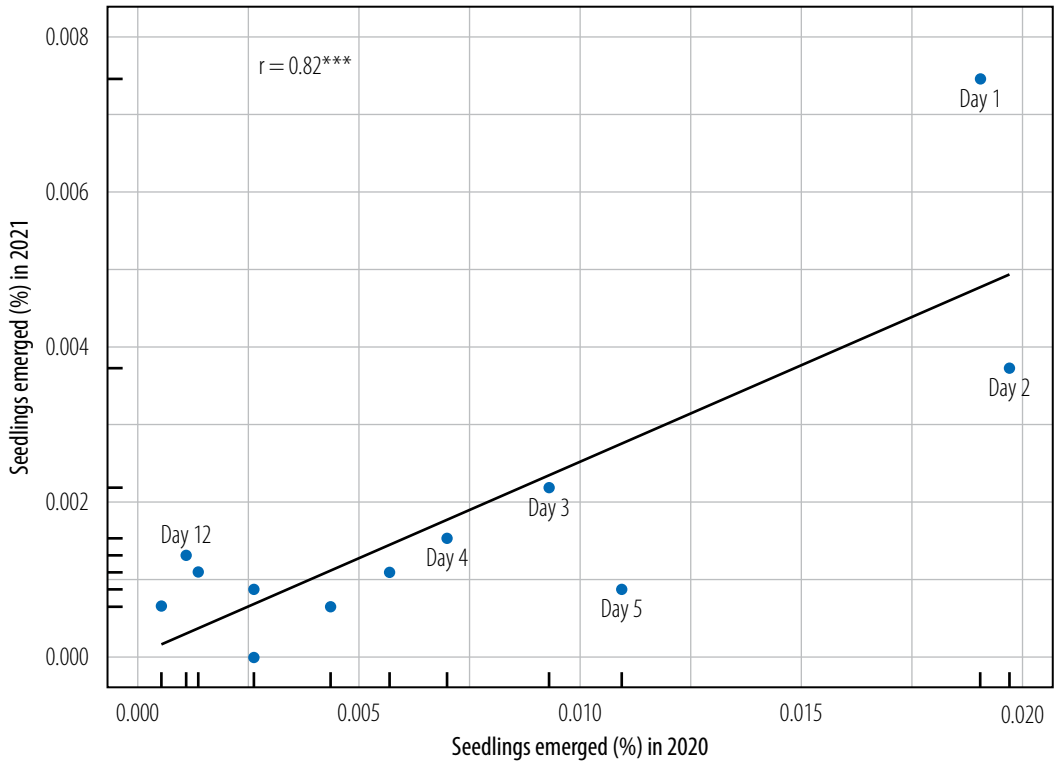

Figure 1 Correlation between seedlings emerged (%) in the sheep feeding experiment in 2020 and 2021 at different days after faeces collection.

Summary

This two-year study suggested that feathertop Rhodes grass seed viability can be reduced by feeding to sheep. In 2020, which had higher numbers of excreted viable seed, there was 80% collection during days one to 5. Seed viability percentages after ingestion ranged from 0.022% to 0.084%. Feathertop Rhodes grass seed viability was reduced by more than 99.9% after feeding through sheep, indicating the spread of feathertop Rhodes grass seeds through sheep tracts is minimal. However, a low level of germinable seeds (<10%) can still be detected 12 days after feeding.

Practical implications

Sheep grazing should only be performed before seed head emergence to reduce the risk of potential spread. If sheep are suspected of having fed on mature plants, they ideally should be quarantined for a week to allow more than 80% of seeds to be excreted.

Effective grazing before seed head emergence provides an alternative to herbicides thereby reducing selection pressure for herbicide resistance. It can also buy time for effective control. For example, advanced weeds under moisture stress are often less responsive to herbicide application. Sheep grazing the stressed plants could allow herbicide application at a later stage when spraying conditions are more ideal for maximum control efficacy.

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