Gibberellic acid effects on head emergence in oats

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Key findings

- Applications of gibberellic acid at 40 g/ha did not promote head emergence from the boot for Mulgara or Tammar oats.
- Variety selection and seasonal conditions strongly influenced hay yield (t DM/ha) and quality at Hart in 2021.

Why do the trial?

Quality is a significant driver in the profitability of hay and optimising cutting date is a critical tool used to achieve this. Crops that have experienced a dry spring, or are sown late face environmental stresses affecting head emergence (Guidera *et al.* 2020). This can result in a longer curing time once hay has been cut, or a sharp decrease in quality by the time the head has fully emerged (Agrifutures Australia 2021).

Gibberellic acid (GA) is a plant growth regulator that promotes cell elongation. It is often utilised in intensive grazing systems to promote rapid growth in climates where growth is often slowed due to wet conditions and low temperatures (Matthew *et al.* 2009).

This trial aims to investigate the effects of gibberellic acid on oaten hay head emergence from the boot, and hay quality, for two oaten hay varieties at Hart in 2021.

How was it done?

Plot size	1.75 m x 10.0 m	**Fertiliser**	DAP (18:20) + 1% Zn + Impact @ 80 kg/ha
Seeding date	May 3, 2021		Easy N (42.5:0) 70 L/ha on June 12, 2021
Location	Hart, SA		Easy N (42.5:0) 70 L/ha on August 20, 2021
Harvest date	November 30, 2021		

The trial was a randomised complete block design with three replicates and six treatments. This trial was managed with the application of pesticides to ensure a weed, insect and disease-free canopy.

Hay varieties trialed at Hart in 2021 were a mid-maturing variety Mulgara, and Tammar, a late maturing variety. Each had a nil treatment and two GA treatments usiong ProGibb® SG at 40 g/ha, at GS31 and GS30 (growth stage) (Table 1).

Table 1. Date of application for gibberellic acid treatments at each timing for Mulgara and Tammar.

Variety	GS31 application date	GS39 application date
Mulgara	August 13	August 25
Tammar	August 25	September 8

To determine hay yield (t DM/ha), 4 x 1m rows were taken from each plot at GS71 and oven dried at 60°C for 48 hours, then weighed. Hay quality was conducted using Near Infrared (NIR) technology to observe the effect of GA on crude protein, aNDFom, NDFDom30, uNDFom240, water soluble carbohydrates and net energy of maintenance.

Plant height (cm) and head emergence (cm) assessments were conducted at GS71 prior to cutting, to measure the effects of GA on plant growth and head emergence from boot (Figure 1). Both Mulgara and Tammar were cut for commercial hay on September 22 and October 5 respectively (Table 1). Grain yield (t/ha) was also assessed.

Results and discussion

Head emergence

No differences were observed for head emergence in either Mulgara or Tammar oats when GA was applied at GS31 or GS39. The measured distance between the flag leaf ligule and head for nil treatment of Mulgara was - 5.2, compared to - 4.9 when applied at GS39. This means that at the time of cutting (GS71), 4.9 cm of the head was remaining in the boot (Table 1).

A potted experiment conducted in a growth chamber at Waite in 2020 also displayed similar trends for oat varieties Mulgara, Brusher and Williams; no response to head emergence from applications of GA was observed with similar rates across six timings, from GS13 – GS69 (Guidera *et al.* 2021).

Variety selection influenced head emergence of oats at Hart in 2021. Mulgara had significantly less head remaining in the boot when compared to Tammar, averaging -5 and -9.2, respectively. This response is likely the result of Mulgara having a shorter maturity, compared to Tammar which is a longer season variety, maturing later under dry seasonal conditions.

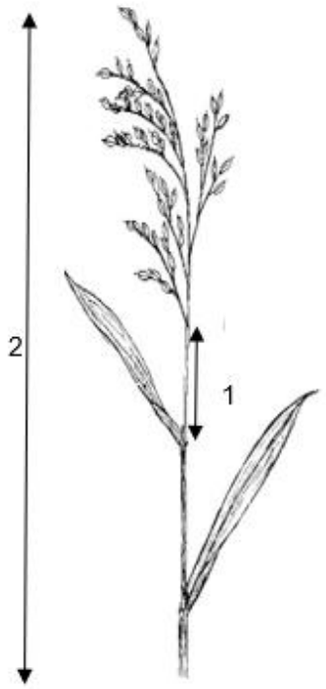

Figure 1. Head emergence and plant height measurements assessed at Hart in 2021. Head emergence (1) assessed the distance between flag leaf ligule and the base of the head (main stem). If this value was negative, the base of the head was still within the boot of the stem. Plant height (2) was measured from the soil surface to the highest point of the plant. Sourced from Guidera et.al *2020.*

Table 1. Head emergence of Mulgara and Tammar from the boot measured at GS71. Values with the same letters are not significantly different.

Variety	Treatment (+/- GA)	Head emergence (cm)	Average head emergence (cm)
Mulgara	Nil	- 5.19[a]	- 5.02[a]
	GS31	- 5.00[a]	
	GS39	- 4.85[a]	
Tammar	Nil	- 8.20[b]	- 9.17[b]
	GS31	- 9.57[b]	
	GS39	- 9.73[b]	
LSD (P≤0.05)		**2.68**	**1.55**

Plant height

Gibberellic acid had no effect on plant height, meaning that variety selection alone influenced height differences.

Label recommendations for ProGibb® SG outline that plant growth peaks seven days after the application of GA and ceases after 21 – 28 days. At Hart, it took between 28 and 40 days for oat varieties to reach the optimal hay cut timing (GS71). Applications of GA were applied at GS31 and GS39 which means that cut dates were outside of the peak response period and seasonal conditions would have influenced plant growth at this time.

Mulgara had superior plant height (69.5 cm) when compared to Tammar at 61.7 cm. Both varieties are classed as tall hay oats (Hoppo et al. 2021), meaning that differences observed were due to the shorter maturity of Mulgara, most suitable to the shorter growing season and drier conditions experienced at Hart. Similar responses were observed in the potted experiment at Waite in 2020 (Guidera *et al.* 2021).

Hay yield and cut timing

Mulgara had a greater hay yield when compared to Tammar, yielding 5.15 and 3.94 t DM/ha, respectively.

Gibberellic acid did not affect hay yield (Figure 2), however, a small difference in cut time was noted. Mulgara treated with gibberellic acid at GS39, delayed hay cutting by two days, reaching GS71 on September 24, compared to nil and GS31 treatment reaching GS71 on September 22. This effect was not observed for Tammar.

Grain yield

Mulgara achieved a higher average grain yield of 1.56 t/ha, when compared to Tammar with a yield of 1.2 t/ha. This result was likely due to the benefits of a shorter maturity under seasonal conditions at Hart.

Gibberellic acid did not negatively affect grain yield for Mulgara and Tammar oats. Similar results were also seen in a trial at Warmur, Victoria, where GA did not affect grain yield or quality of trialed oat varieties (Lemon *et. al* 2017).

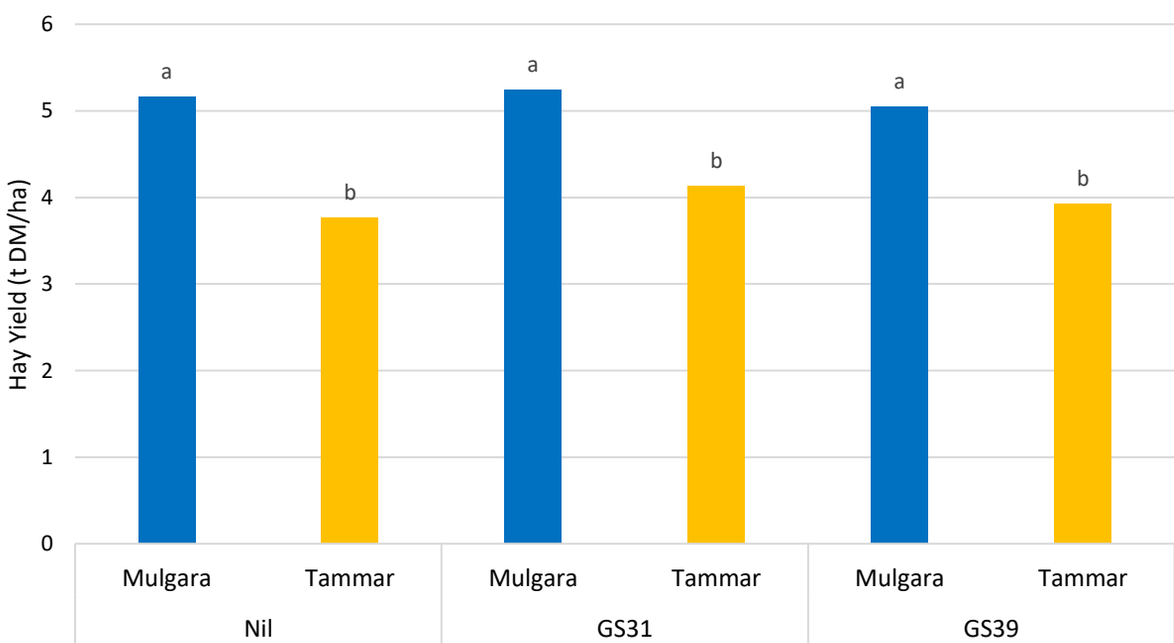

Figure 2. Hay yield (t DM/ha) of Mulgara and Tammar oats +/- gibberellic acid.

Hay quality

At Hart in 2021, the application of GA at GS31 and GS39 did not affect hay quality (Table 2).

A trial in Warmur, Victoria also tested the hay quality of GA treated oats at similar rates. No differences were observed for hay quality characteristics when compared to the nil treatment (Lemon *et. al* 2017).

In comparison to Tammar, Mulgara had increased levels of water-soluble carbohydrates (WSC) and lower levels of aNDFom and uNDFom240 (Table 3), showing improved palatability of the hay, while also assisting protein synthesis (AEXCO 2016b).

Table 2. Feed test results for hay samples from application timing of gibberellic acid within the trial at Hart in 2021.

Feed Test Parameter	Minimum export standards	Nil	GS31	GS39	LSD (P≤0.05)
Crude protein (%)	4 – 10%	13.5	12.6	12.7	**NS**
aNDFom (%)	< 57%	47.0	46.6	48.0	**NS**
NDFDom30 (%)	-	58.5	54.5	54.4	**NS**
uNDFom240 (%)	-	14.4	15.8	16.1	**NS**
Water soluble carbohydrates (%)	> 18%	17.0	18.0	18.0	**NS**
Net energy of maintenance (MJ/kg)	-	6.1	6.1	6.2	**NS**

Minimum standards for export hay quality requirements were sourced from AEXCO, 2016a.
Other quality parameters not shown.
aNDFom = neutral detergent fibre free form ash
NDFDom30 = measure of the percentage of neutral detergent fibre (NDF) that has been digested after 30 hours
uNDFom240 = percentage of dry matter that will go undigested in an animal

Table 3. Feed test results for Mulgara and Tammar at Hart in 2021. Shaded values indicate the best performing variety for each feed quality characteristic.

Feed Test Parameter	Minimum export standards	Mulgara	Tammar	LSD (P≤0.05)
Crude protein (%)	4-10%	12.1	13.5	**0.528**
aNDFom (%)	< 57%	44.24	50.08	**2.456**
NDFDom30 (%)	-	56.6	55.1	**NS**
uNDFom240 (%)	-	14.09	16.76	**1.692**
Water soluble carbohydrates (%)	> 18%	20.88	14.49	**2.459**
Net energy of maintenance (MJ/kg)	-	6.25	5.98	**NS**

Minimum standards for export hay quality requirements were sourced from AEXCO, 2016a. Other quality parameters not shown.

Acknowledgements

The Hart Field-Site Group would like to acknowledge the generous support of our sponsors who provide funding that allows us to conduct this trial. Proceeds from Hart's ongoing commercial crop also support Hart's research and extension program.

We would like to thank SARDI Waite Agronomy team for providing seed to conduct this trial.

We would also like to kindly acknowledge Balco for conducting the feed test analysis.

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