GIBBERELLIC ACID AND GRAZING IN OATS

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Take home messages

- Current knowledge about the effects of gibberellic acid application to oats is limited.
- In 2016 gibberellic acid had no impact on biomass or feed quality of oats.
- Exceptional growing conditions and a mild winter may have reduced effects of gibberellic acid.

Background

Gibberellic acid (GA) is a naturally occurring plant hormone. Plants naturally begin to produce GA in warmer months (Wingler and Hennessy, 2016), boosting biomass production by increasing plant cell elongation and replication. GA is used on perennial pastures and horticultural crops to stimulate biomass production, flowering and fruit set, but the effects of GA in annual cereal crops is relatively unknown. When GA is applied to perennial winter pastures in the colder winter months, biomass production is stimulated, and more pasture is produced at that time – overall production is similar, but the timing of growth is shifted earlier.

Oats are a versatile crop with many applications. Common uses include milling for human and livestock consumption, export and domestic hay, grazing and feed grain. Despite these multiple uses, planting of oats has often been limited due to a lack of herbicide options for the control of grasses. However, in recent years high export hay prices have seen oats being reintroduced into many farming operations. For mixed farmer's, oats remain an essential crop for the pasture phase of the rotation due to traditional pastures (ryegrass, cocksfoot and phalaris) not suiting a Mallee rotation where crops are traditionally the focus. With feed gaps during autumn widening due to increased pressure from cropping practices (eg; plant back periods from herbicides not agreeing with oats), growers need more tools at their disposal to make early grazing decisions and grow feed quickly. GA may have the potential to help address this need.

This research was conducted to give growers a better understanding of the effects of GA on oats in terms of changes to production, plant recovery for hay and grain yields and likely economics.

Aim

To measure effect of gibberellic acid application and grazing timings on the biomass production and feed quality of oats.

Paddock details

Location: Warmur
Annual rainfall: 444mm
GSR (Apr-Oct): 371mm
Soil type: Clay loam
Paddock history: 2015 fallow

Trial details

Crop type: Wintaroo oats
Treatments: Refer to Table 1
Target plant density: 130 plants/m^2
Seeding equipment: Knife points, press wheels, 30cm row spacing
Sowing date: 21 April
Replicates: Four
Harvest date: 27 November
Trial average yield: 4.3t/ha

Trial inputs

Fertiliser: Granulock Supreme Z + Impact @ 50kg/ha at sowing
urea @ 50kg/ha on 9 July, and 60kg/ha on 29 July

Pests, weeds and disease were managed according to best management practice.

Method

A replicated field trial was sown using a randomised block design. Assessments included establishment counts, crop biomass and feed quality measurements taken at a number of timings (Table 2), lodging scores, grain quality and yield parameters.

Gibberellic acid (GA) was applied as Gala® GA @ 80mL/ha. Grazing was simulated using a whipper snipper, cutting crop to a height of 10cm on 21 July. Application timing and grazing treatments are outlined in Table 1, and the purpose of each assessment in Table 2.

Table 1. Treatment outline.

Treatment number	GA timing in relation to grazing event	Gala GA application date	Grazed 21 July
1	Nil	-	-
2	Nil	-	✔
3	Before	15 June	✔
4	After	29 July	✔
5	Before	15 June	-
6	After	29 July	-

Table 2. Timing and purpose of biomass and feed quality testing throughout the trial.

Biomass cut timing	Purpose of assessment
15 June	Measure initial biomass prior to treatment applications
27 June	Monitor biomass response 2 weeks after 15 June GA application
21 July	Monitor biomass response 4 weeks after 15 June GA application – at grazing time
16 August	Monitor dry matter recovery of all treatments following grazing
9 October	Hay yield and quality evaluation

Results and interpretation

Biomass

There were no biomass responses to GA application two or four weeks after application. Average biomass of the oat crop started at 0.5t/ha on 15 June, and increasing to 1.6t/ha on 27 June and 2.6t/ha on 21 July.

Three weeks after grazing (16 August) the only significant difference was between the grazing treatments, not the timing of GA application – with a biomass penalty due to grazing. However, there was no significant effect of using GA before or after a grazing event (Figure 1). At peak biomass at GS60 the only significance was between grazed and ungrazed plots (P=0.004).

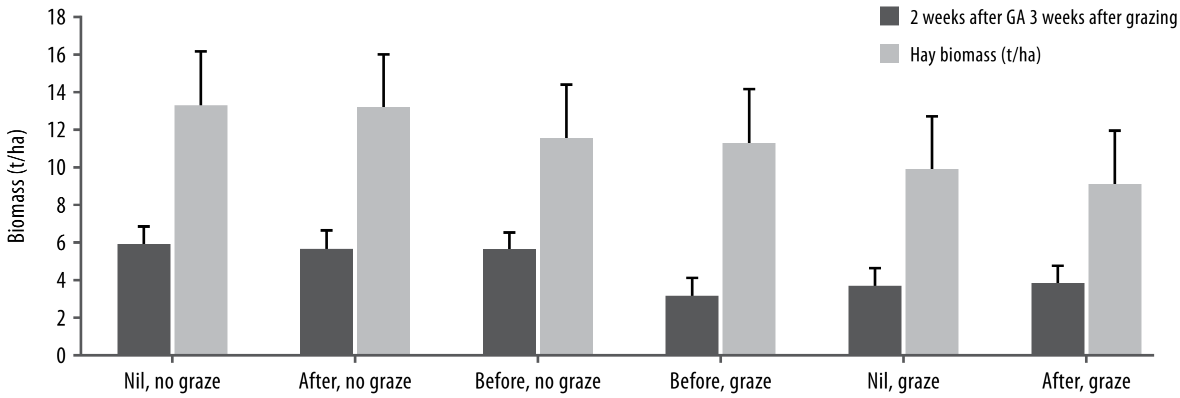

Figure 1. Biomass production three weeks after grazing and peak hay biomass at GS60. Stats: 16 August biomass GA timing NS (P=0.42) LSD=0.71; Grazing P<0.001, LSD=0.58; GA timing x grazing NS (P=0.70), LSD=1.00, CV%=14.4; Hay biomass GA timing NS (P=0.89), LSD=2.0; Grazing P=0.004, LSD=1.65; GA timing x grazing NS (P=0.13), LSD=2.9, CV%=16.6. Note: error bars denote the LSD of the GA timing x grazing interaction.

Feed/hay quality

Feed quality testing was carried out using a number of quality parameters including:

- crude protein (CP) that describes protein and non-protein nitrogen content
- neutral detergent fibre (NDF) describing hemicellulose, cellulose and lignin within a plant that contribute to 'roughage'
- digestibility percentage of a plant, representing what part of the plant can be digested
- metabolisable energy (ME) that describes the energy provided through the feed that can be used for maintenance, reproduction and growth
- water soluble carbohydrates (WSC) that are sugars available to the livestock and bacteria found within the rumen.

While there is natural variation in oat tissue quality across a growing season, there were no significant differences found for any feed quality parameters between treatments at any one time suggesting GA and or grazing had no effect (Figure 2).

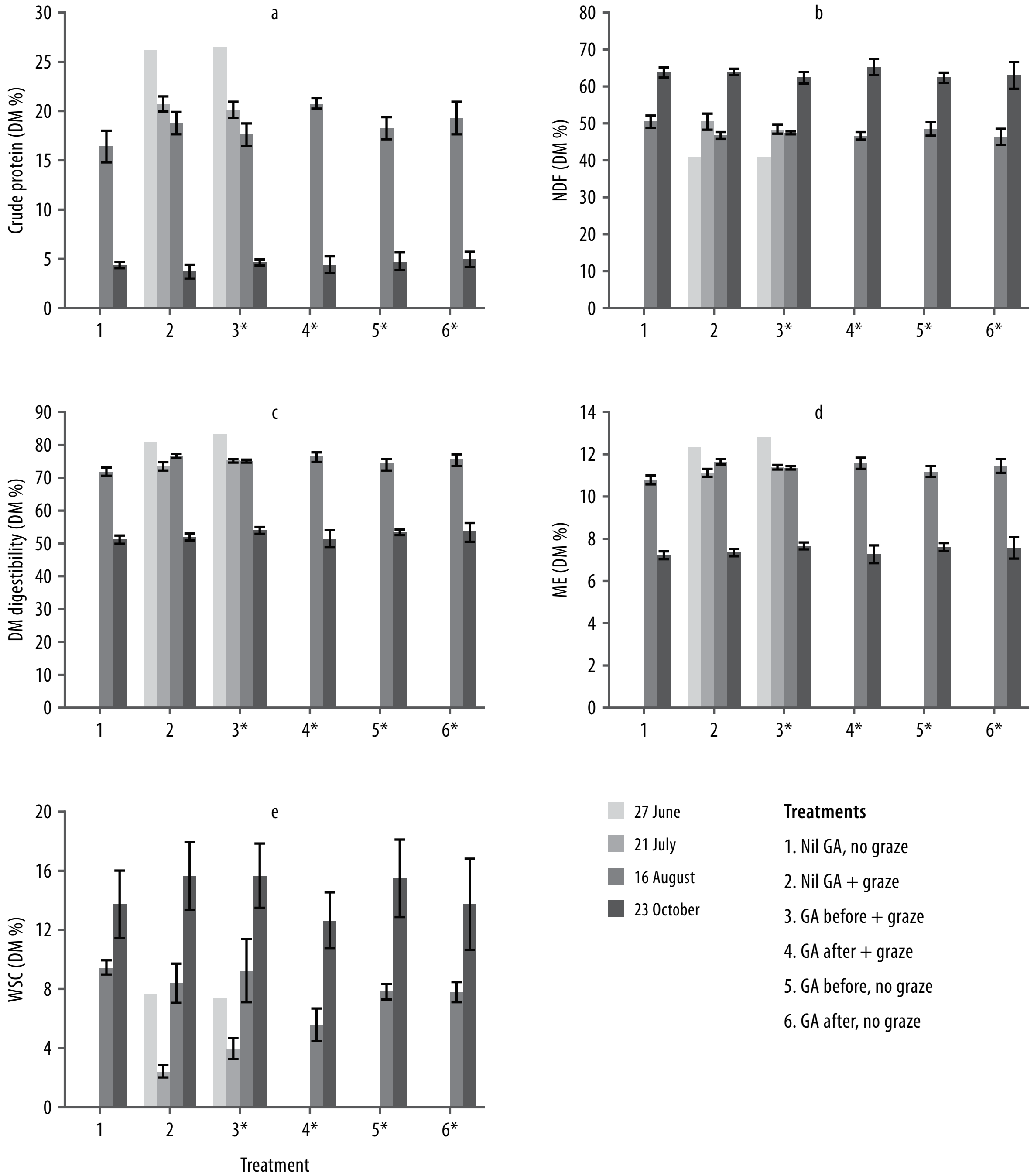

Figure 2. Feed quality results of samples taken at different times throughout the trial. a) CP (%Dry matter (DM)), b) NDF (%DM), c) DMD (%DM), d) ME (%DM) and d) WSC (%DM) measurements by treatment (*treatments with GA applied). Error bars are standard error of the mean of each treatment. In all cases treatment differences were NS (P=0.135-0.910, CV=1.5-34.2).

The feed quality results at the time of the final cut are indicating hay was of poor quality across all treatments. This may be because of delayed cutting due to logistical difficulties, giving higher NDF%, lower DMD% and CP% than could have been achieved. Therefore, in a wet year such as 2016 there would have been no financial return from the application of GA in terms of hay quality.

Grain yield and quality

Wintaroo is a hay/grazing/feed oat variety. There were no significant grazing or GA timing treatment effects on grain yield. The trial average grain yield was 4.3t/ha.

There was also no significant effect of GA timing on grain quality.

Table 3. Grain yield and quality parameters.

Treatment number	Grazing tmt/ GA timing	Yield (t/ha)	Protein (%)	Screenings (%)	Test weight (kg/hL)
1	No graze Nil	3.5	12.4	6.9	49.2
2	Graze Nil	4.8	12.2	5.1	51.8
3	Graze GA Before	4.6	12.1	4.4	51.3
4	Graze GA After	4.4	11.9	5.4	51.1
5	No graze GA before	3.9	12.0	5.3	50.5
6	No graze GA after	4.2	12.3	5.1	50.1
	Sig. diff.				
	Grazing trt	NS (P=0.14)	NS (P=0.14)	NS (P=0.14)	NS (P=0.19)
	GA timing	NS (P=0.83)	NS (P=0.28)	NS (P=0.22)	NS (P=0.35)
	GA timing x Grazing	NS (P=0.10)	NS (P=0.37)	NS (P=0.26)	NS (P=0.30)
	LSD (P=0.05)				
	Grazing trt	0.31	0.29	1.16	8.66
	GA timing	0.38	0.35	1.43	10.6
	GA timing x Grazing	0.53	0.50	2.02	15.0
	CV%	8.5	2.7	24.8	20.5

*Note: this trial experienced severe lodging before harvest. Lodging scores were taken (the per cent of plot which had laid down/bent over due to rain, wind or its own weight) which ranged from 30 per cent to 90 per cent. There were no correlations between treatments and lodging.

The 2016 season was excellent for biomass production. As the trial site was sown on a fallow with 56kg N/ha available to 70cm – it is possible that the good season and additional urea applications applied to the trial received may have over-shadowed the GA effects.

Plants produce their own GA continuously throughout their entire life, initially produced to induce seed germination then produced in the apical meristems as the plant grows. As 2016 was a very wet and mild year with high minimum temperatures during the growing season, it can be hypothesised that the crops produced enough of their own GA, so that any additional GA application was not effective. Potentially in a more 'average' year the effects of a GA application may be realised.

Commercial practice

A number of growers are exploring the use of growth regulators on annual crops.

The results of this trial suggest that in seasons like 2016, GA applications produce no benefit to biomass, feed quality, grain yield or grain quality in oats. This may have been due to the exceptional seasonal conditions and very mild temperatures, or the growth habit of oats. Oats store more carbohydrates in their upper stems and leaves, while perennials store more in their roots, which gives them the ability to respond to GA application early in the season.

Further research is warranted to increase the understanding of when GA may be effective in an annual cereal plant.

Grazing oats without the addition of GA in 2016 provided good quality feed for livestock in the cooler months. Results show that this had no significant impact on grain yield or quality however, if the end goal of production were hay, this would have had a significant negative impact on the final hay yield.

On-farm profitability

Cost of product: $9 @ 80mL/ha

Cost of application: $8/ha

Total application cost: $17/ha

In 2016, a single application of Gala GA had no production benefits, resulting in a loss of $17 per hectare. The application cost of GA could be reduced as Gala has tank compatibility with a number of other chemicals.

The cost benefit of grazing compared to hay production is more difficult to calculate with fluctuation in prices of both hay and livestock. Providing high quality feed to graze during a feed gap can play an important role in maintaining good livestock condition for breeding, growth and ability to carry lambs. However, this research suggests that grazing can cause a significant impact on the final hay yield and dependant on prices may not be the best financial decision.

References

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