Can gibberellic acid improve oat head emergence?

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Key findings

- Gibberellic acid had either a nil or negative effect on oat head emergence from the boot.
- There were crop differences between varieties trialed including head emergence, dry weight and plant height. Brusher was in all cases a high-performing variety for the parameters measured.

Why do the trial?

Export hay has become a large part of farming systems in the medium to high rainfall zones. It can benefit farm business risk management and is an option for controlling herbicide resistant weeds (GRDC 2017). Oats are a common hay option with a multitude of rotational benefits including some cereal disease resistance, suitability to early sowing and ease of establishment, reliability as a break crop where broadleaves are unsuitable and versatility in their end-use (GRDC 2017).

In lower rainfall areas or late sown oat crops, particularly in seasons with a dry spring, poor head emergence from the boot has been observed. This places growers in a difficult situation because crops cut with heads in the boot require a longer curing time, extending the amount of time the hay is exposed to the elements. However, waiting for the head to emerge can also lead to a decline in hay quality as the crop advances beyond the recommended watery- ripe (GS71) growth stage. Previous research (DPIRD 2020) has shown there is a sharp decrease in hay quality as the crop moves into grain fill.

Gibberellic acid (GA), is a plant hormone known for its effect on plant growth, causing stem elongation and leaf expansion. Gibberellic acid is commonly used in horticulture and on pastures to stimulate out of season growth, or to accelerate early growth, stem elongation and to promote flowering (Matthew *et al.* 2009).

The aim of the trial was to investigate the potential for GA to promote head emergence from the boot in oats to benefit growers in the Southern region.

How was it done?

A glasshouse trial was set up at the Waite Campus, Urrbrae in June, 2020 to assess the effect of different timing of GA application on plant height, dry weight and head emergence (Figure 1). The trial was a randomised complete block design with four replicates of seven GA treatments applied to three oat varieties, Williams, Brusher and Mulgara.

Four seeds of the same variety were sown in each pot on June 15 and watered to saturation every few days or more frequently if necessary. The average daily maximum temperature in the glasshouse was 34°C, the average daily minimum temperature was 11°C. All varieties had emerged by June 26 and were hand thinned to one plant per pot on July 6 at the 2.5 leaf growth-stage.

Figure 1. Setup of the GA oat glasshouse trial.

ProGibb was applied to plants by spraying onto the leaves from each side of the plant and above at six growth stage timings (Table 1). The rate was 1.73 mg /pot, diluted from the target rate of 40 g / 100 L, therefore 692 µg GA per application (400 g/kg active ingredient).

Plants were harvested at ground level on October 8 at early-mid dough (GS83-85). Prior to harvest tiller numbers were counted and measurements were taken prior to and after harvest including:

1. Distance between flag leaf (FL) ligule and soil surface (Figure 2).
2. Distance between FL ligule and base of the head (Figure 2).
3. Plant height from the soil surface to the top of the tallest leaf (Figure 2).

Once the samples had air-dried, the distance between the FL ligule and head was measured for each tiller and the total biomass was determined.

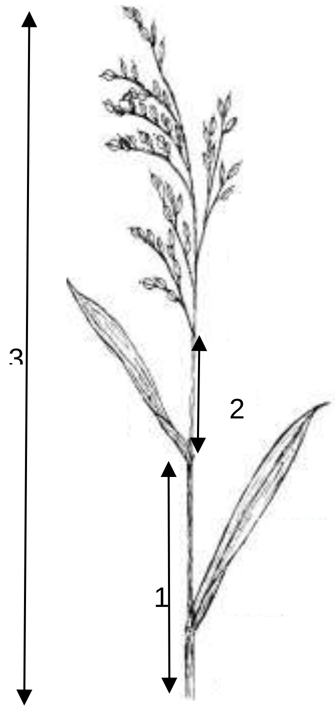

Figure 2. Measurements taken on oat plants prior to and after harvest.

Table 1. Targeted growth stages for GA applications.*

Treatment (application timing)	Growth stage	GS score
Control	-	-
T1	Three leaf, early tillering	13
T2	Main stem + four tillers	24
T3	Stem elongation	30-32
T4	Flag leaf emergence	37
T5	Ear emergence	51-59
T6	Anthesis	61-69

**Due to the warm and well-watered glasshouse conditions, plants advanced rapidly through growth stages and plants within the same treatments were at different growth stages. Therefore, to account for the variability in growth stages, a range of GS scores have been presented.*

Results and discussion

Distance between FL ligule and head (main stem)

Variety affected the distance between the FL ligule and head, with Brusher having a greater distance on average than Mulgara and Williams (Table 2). As described in the GRDC Oat Variety Sowing Guide, Brusher was generally a taller variety and this was observed during the experiment. However, there were no differences in this measurement between GA treatments. This indicates GA did not result in extension of the head from the boot in any of the varieties trialed.

Distance between ligule and panicle (tillers)

Gibberellic acid applications had a negative effect on the average distance between the ligule and head on plant tillers. The difference was just significant ($P \leq 0.04$). Applying GA at ear emergence resulted in a shorter distance between the ligule and head. All other treatments were not different to the control (Table 2). Therefore, there was no benefit from applying GA to oats in this trial.

Average plant height

Brusher and Mulgara were taller than Williams when accounting for the height from the soil surface to the top of the flag leaf (Table 2). There was no effect of GA on overall average plant height in any of the oat varieties trialed.

Dry weight

Brusher and Mulgara had greater dry weights compared to Williams (Table 2). This is unsurprising given that these two varieties were also taller than Williams, contributing to greater biomass and bulk. Gibberellic acid applications did not affect dry weight compared to the control.

Table 2. Gibberellic acid treatment and variety effects on various plant growth measures. Values highlighted blue in the same column are not significantly different to each other.

Application timing	Average dry weight (g)	Average plant height (cm)	MS distance between FL ligule and base of head (cm)	Distance between ligule and base of head on tillers (cm)
Gibberellic acid applications				
Control	60.9	120.2	34.0	8.8[bcd]
T1	62.3	121.3	33.5	10.1[cd]
T2	64.1	118.9	32.1	6.6[ab]
T3	61.5	121.6	32.9	10.9[d]
T4	65.5	116.3	31.0	7.5[abc]
T5	63.4	118.6	32.3	5.9[a]
T6	65.3	113.9	31.3	6.4[ab]
LSD (P≤0.05)	ns	ns	ns	2.9
Variety				
Brusher	67.2[b]	128.1[b]	36.0[b]	10.1[b]
Mulgara	65.9[b]	126.9[b]	30.6[a]	6.9[a]
Williams	56.6[a]	101.7[a]	31.3[a]	7.3[a]
LSD (P≤0.05)	4.1	8.0	4.2	1.8

Conclusion

Gibberellic acid had a nil or negative effect on oat head emergence from the boot. Dry weight, plant height, distance between the FL and base of the head on the main stem were not affected by GA applications. The average distance between the ligule and base of the head on tillers was negatively affected by GA or, in most cases, was the same as the control. However, it is worth noting that the trial was performed in a controlled environment and plants were not at any stage under stress as may be seen in the field where heat, frost and moisture stress are incurred. Further investigation is required to ascertain whether there is any effect of GA on head emergence in oats.

References

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