THE EFFECTS OF GIBBERELLIC ACID ON BIOMASS AND HARVESTABILITY OF VETCH HAY

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TAKE HOME MESSAGES

- The application of gibberellic acid (GA) did not improve biomass yield at hay cut timing.
- The application of GA did not influence the flowering or pod set date of vetch.
- There was no benefit of applying GA to crop height at hay cut timing despite significant height differences earlier in the season.
- Further investigation is required to determine if GA can be used as a tool to improve harvestability of vetch for hay.

BACKGROUND

Vetch is a commonly grown crop throughout North Central Victoria for hay production as it is a high protein forage for livestock. Vetch also has a beneficial role in the cropping system as a disease break as well as fixing nitrogen for subsequent crops. One well known drawback to growing vetch are the challenges at harvest due to a prostrate growth habit. Vetch grows along the ground making it difficult to cut. As a result, growers are experimenting with gibberellic acid (GA) as a tool to improve harvestability of vetch hay. Vetch like most other crops, slows in biomass production throughout the colder winter months. If growth could be boosted through these winter months, encouraging an increase in biomass, hay yields could potentially be improved.

GA is a plant hormone that promotes cell elongation and consequently increases plant growth. It is commonly used in the horticulture industry and has a role in intensive grazing systems such as dairy farming, to stimulate grass dominant pastures to help fill the winter feed gap. The use of GA in broadacre farming is uncommon and any potential benefits are poorly understood and there is minimal research in this area.

AIM

To determine how gibberellic acid (GA) influences hay yield through biomass and harvestability of vetch hay.

PADDOCK DETAILS

Location:	Pyramid Hill
Crop year rainfall (Nov-Oct):	392mm
GSR (Apr-Oct):	270mm
Soil type:	Clay Loam
Paddock history:	Barley

TRIAL DETAILS

Crop type:	Morava and Popany vetch
Treatments:	Refer to Table 1
Target plant density:	60 plants/m^2
Seeding equipment:	Knife points, press wheels, 30cm row spacing
Sowing date:	6 May 2020
Replicates:	Four
Hay cut date:	Morava – 22 September 2020
	Popany – 6 October 2020
Trial average hay yield:	4.3t/ha

TRIAL INPUTS

Fertiliser:	Granulock® Z + Flutriafol @ 60kg/ha at sowing
GA application:	Refer to Table 1

Weeds, pests and disease were controlled according to best management practice.

METHOD

A replicated field trial was sown using a complete randomised block trial design. Assessments included height measurements every two weeks after the initial GA application, crop biomass four weeks after the initial GA application and at start of flat pod formation (simulating hay cut timing), flowering assessments, grain yield and quality parameters.

Table 1. Vetch varieties and treatments.

Variety (maturity)	Product and rate	Timing (date)
Morava (late)	GALA® (100g/L Gibberellic Acid) @ 80mL/ha	Early application (31 July)
		Late application (1 September)
Popany (very late)		x 2 application (31 July, 1 September)
		Nil

RESULTS AND INTERPRETATION

Biomass

There was no significant difference between the early GA treatments in biomass four weeks after the first spray, with Morava yielding 2.2t/ha and Popany 1.9t/ha.

The application of GA did not result in any significant differences in hay yield at the flat pod stage, regardless of timing or number of applications. There was a yield difference between varieties with Popany yielding 4.8t/ha, 1t/ha more than Morava (Var $P<0.001$, LSD 0.7t/ha) (data not shown). The later maturing nature of Popany meant this variety benefited from the above average spring rainfall.

Flowering and pod set time

Flowering and more importantly pod set, are critical timings in hay production as flat pod formation is the optimal cutting time. While anecdotal evidence over the years has suggested GA delays flowering in vetch, there were no differences in flowering or podding across all treatments. Both varieties began flowering on the 14th of September. Morava reached flat pod on the 22nd of September and Popany on the 6th of October.

Crop height/harvestability

A limitation of the trial being run on a small-plot scale was harvestability could not be measured using commercial mowing and baling equipment. Alternatively, crop height (ground to the top of the vetch canopy) was used as a potential indicator of harvestability. A higher crop indicated taller, more upright plants which would suggest a crop easier to cut with a mower and in contrast a shorter crop, sprawled across the ground, would be difficult to pick up with the mower and could result in yield losses. These smaller windrows could lead to further increased losses, if they weren't able to be picked up by the baler.

Crop height was measured throughout the season to monitor the effects of GA over the season. Two weeks after the early spray application there was a significant increase in height of both varieties from applying GA ($P<0.001$, LSD=2.4cm). This was not a long-lasting result, with no differences in crop height observed between treatments six weeks after the first spray ($P=0.798$, NS) (Figures 1a, 1c). These observations were repeated following the late GA application timing (Figures 1b, 1d). At the time of hay cutting the canopy height of the early sprayed treatments was significantly lower than all other treatments. This is likely due to growing taller earlier and increasing lodging susceptibility (data not shown).

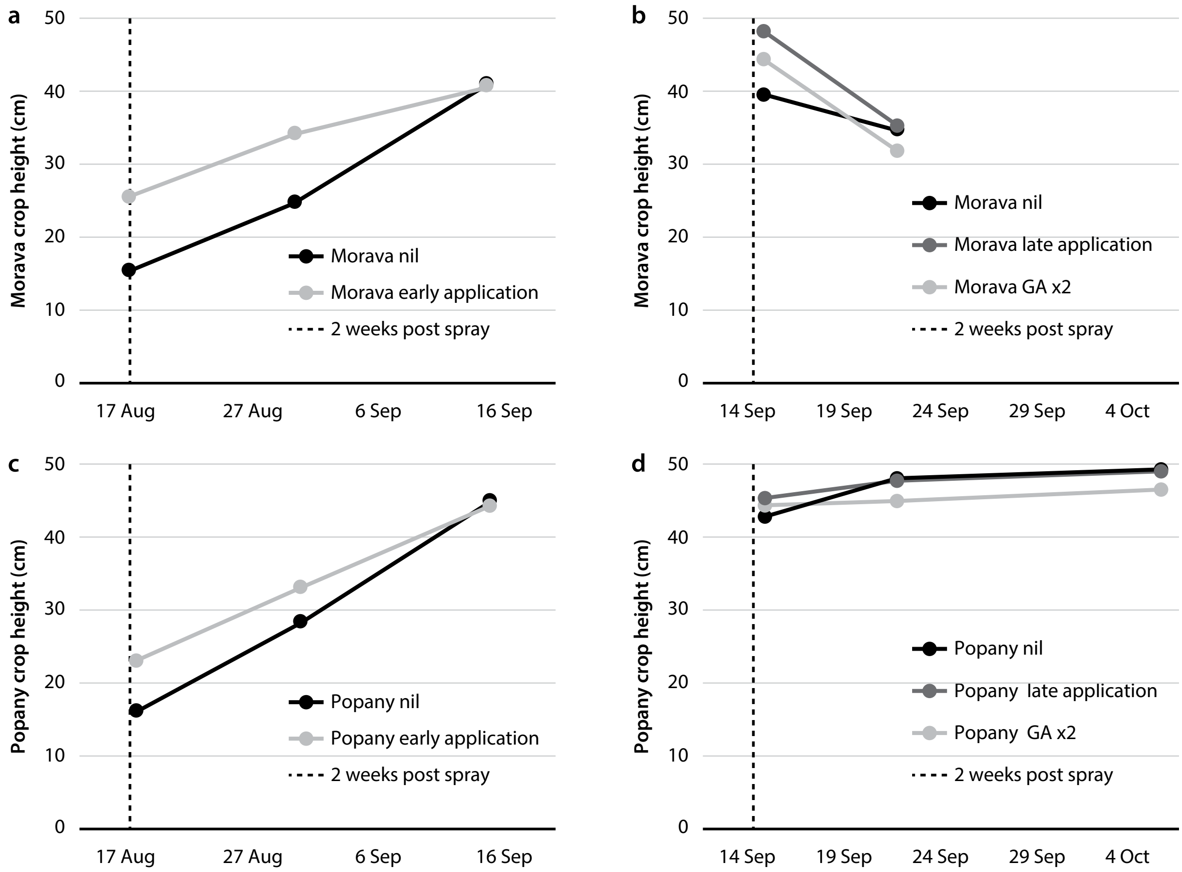

Figure 1. Crop height (cm) of vetch varieties after different application timings of GA. a. Morava early and Nil, b. Morava late, x2 timings and Nil, c. Popany early and Nil, d. Popany late, x2 timings and Nil.

GA has a role in intensive grazing systems to increase feed of grass dominant pastures over winter when growth slows but it is suggested optimum results are seen around the three-week mark (Vicchem, 2019). Although a different crop type, this supports the observation that an earlier spray increased growth through height but became essentially ineffective at hay cut timing. Further investigation may determine whether a vetch crop could be grazed early and sprayed with GA to promote growth before being locked up and cut for hay.

COMMERCIAL PRACTICE AND ON-FARM PROFITABILITY

The use of GA in broadacre cropping systems has been experimented with for many years with varied anecdotal evidence. However, with minimum solid research in this space it has been difficult to ascertain if GA has a fit in the cropping system.

In the 2020 season at Pyramid Hill, the use of GA did not offer benefits to hay yield as it did not improve biomass or harvestability of the crop. The use of GA would have decreased paddock profitability in this season. Similarly, in the 2016 season, a contrasting season where above average rainfall was achieved GA again did not benefit hay or grain yield (Angel 2017).

Whilst GA has offered no improvements to yield or harvestability in this trial, further investigation may be warranted with the focus on alternative spray timings to those in this study and in different seasonal conditions.

Research areas not considered in this trial that may be worth further investigation include the impact of GA on N fixation. From the work undertaken by BCG it is unlikely differences would be noted as peak biomass, a key driver to N fixation, was not influenced by GA application. Another consideration, particularly from early GA applications is whether an increased disease risk is posed from the additional short-term growth. This was not a noted effect in this trial and would need further investigation.

A final consideration around the use of GA is its return on investment (ROI). Applying GA is not an expensive input (Table 2). GALA® has good compatibility with many chemicals and can be tank mixed, further decreasing the cost of application. Nevertheless, if no ROI is achieved as was observed in this trial, it would be advantageous to keep the costs as profit or put these resources toward a more valuable input given seasonal conditions i.e. fungicide or starter fertiliser.

Table 2. Cost of applying GA. Based on $8/ha for product and $8/ha for spray costs.

Treatment	Cost ($/ha)
Early or late application	16
x 2 application	32
Nil	0

REFERENCES

Angel K., 2017, *2017 BCG Season Research Results*, 'Making every dollar count: seed coating, foliar zinc and gibberellic acid in lentils and vetch' pp 162-166. <http://www.bcg.org.au/>

Vicchem, 2019, *GALA growth regulator label*, 'Vicchem GALA growth regulator product description' Accessed 21 January 2021, <http://www.vicchem.com/prods/label/GALALabel.pdf>.

ACKNOWLEDGEMENTS

This research was funded by the GRDC and Agriculture Victoria as part of the 'Understanding the implications of new traits on the adoption, crop physiology and management of pulses in the southern region' project (DAV00150).