Improving vetch dry matter production

Declan Anderson and Rebekah Allen; Hart Field-Site Group

Key findings

- All common and woolly-pod vetch varieties had similar hay production, averaging 2.3 t DM/ha at Hart in 2021.
- Timok, RM4, and Studenica produced the highest amount of dry matter (DM) for early grazing opportunities, ranging from 0.93 – 1.13 t DM/ha.
- At Hart in 2021, small increases in dry matter production (t DM/ha) were observed when gibberellic acid (GA) was applied at 10 and 20 g/ha to Timok vetch at early grazing timings, however, vetch responses to GA across a number of seasons and trial locations has not been consistent and the management of this product cannot be recommended across low-medium rainfall environments.
- Hay yields (t DM/ha) were not influenced by the application of gibberellic acid.

Why do the trial?

Vetch is a commonly grown break crop across many regions of the Mid-North and is used as a grazing and hay option within mixed farming systems.

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 slow due to wet conditions and low temperatures (Matthew *et al.* 2009).

This trial aims to improve biomass production of vetch with relatively low cost and input strategies. Multiple agronomical techniques were tested in this trial; varietal selection, fertiliser, seeding rates, inoculation and the application of the plant growth hormone, gibberellic acid.

How was it done?

Plot size	1.75 m x 10.0 m	**Fertilizer**	DAP (18:20) + 1% Zn + Impact @ 80 kg/ha
Seeding date	April 19, 2021		
Location	Hart, SA	**GA Application Date**	Grazing: July 29, 2021 Hay: August 26, 2021

The trial was a randomised complete block design with three replicates and 15 treatments comparing vetch variety, nutrition, seeding rate and the application of gibberellic acid (GA) to increase vetch biomass. This trial was managed with the application of pesticides to ensure a weed, insect and disease-free canopy.

Common vetches *(Vicia sativa)* are the most widely grown vetch, produced within most cropping regions of South Australia. Common vetch varieties trialed at Hart in 2021 were Studenica, Timok, and Morava which are very early, mid and late maturing varieties, respectively.

The second most commonly grown vetch is woolly-pod *(Vicia villosa)*. This trial included both Capello and RM4 which have been developed for forage and hay production and are generally later maturing. Grain harvested from woolly-pod vetches should only be used for seed as it cannot be fed to livestock due to high toxin levels (Nagel et al 2021a).

Recommended seeding rates for dry matter production varied for each vetch type, with the aim of achieving 70 plants/m^2 (Nagel et al 2020). Woolly-pod vetch varieties were sown at 40 kg/ha and common vetches at 50 kg/ha. A lentil treatment sown at 120 plants/m^2 was also included to compare the biomass, hay production and hay quality to vetch.

Additional Timok treatments were included to compare standard basal phosphorus (P) inputs to high rates of basal P. This was conducted by applying DAP fertiliser at a rate of 120 kg/ha at seeding. Top-up urea was added to the standard P treatment to balance the nitrogen inputs across both treatments.

Timok was also sown at a high seeding rate to compare differences between the standard seed rate of 50 kg/ha to a high rate of 80kg/ha. An inoculation treatment was also included and was achieved by applying a group E/F peat to the vetch seed (product used NoduleN®). This was done to ensure ideal conditions for nitrogen fixation in the soil.

Applications of GA (product applied was ProGibb®) were also applied to Timok vetch plots at early branching on July 29 and budding on August 26, just prior to flowering. The rates at which GA was applied was 10 and 20 g/ha respectively.

Timok plots +/- GA were cut at three weeks post the first application to measure early biomass differences. Biomass cuts were also taken again at four weeks post first application for all plots. Hay cuts were conducted on all plots when they individually reached 50% flower (50% pod), as highlighted in Table 1.

Table 1. Maturity characteristics (Nagel et al 2020) and cut dates for all varieties sown at Hart in 2021.

Variety	Maturity	Hay Cut Date	Days to reach hay maturity
Studenica	Very early	September 10	144
Timok	Mid	September 14	148
PBA Jumbo 2	Mid	September 22	156
Morava	Late	October 5	169
RM4	Mid	October 8	172
Capello	Late	October 8	172

Results and discussion

Variety performance

Variety selection strongly influenced crop biomass production early in the growing season at Hart.

The best performing varieties for early biomass production were Timok, Studenica and woolly-pod vetch variety RM4, yielding 1.11, 0.93 and 1.13 t DM/ha respectively (Figure 1).

Common vetch varieties Timok and Studenica were suited to the conditions experienced at Hart in 2021. The later start to the season suited very early variety Studenica and mid-maturing variety Timok. The woolly-pod vetch variety RM4 also has a mid-maturity for a woolly pod, but is later than the common vetch lines.

RM4 performed similarly to Timok for dry matter production, although it also had the same number of days to hay cut as Capello which is a late maturing woolly-pod variety. The early performance of RM4 can be explained by its early establishment characteristics (Nagel 2021b).

Variety selection did not influence total hay production at Hart this season. All varieties, including the lentil treatment, yielded similarly with an average hay yield of 2.3 t DM/ha.

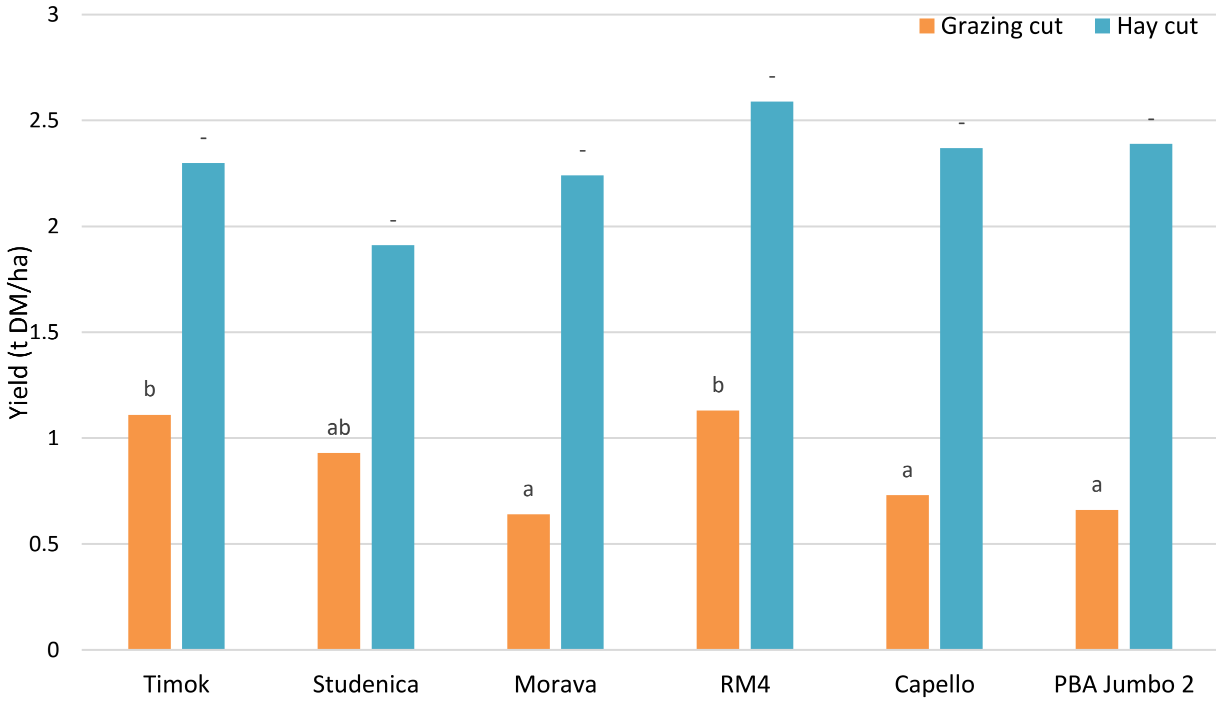

Figure 1. Biomass production of each vetch and lentil variety at grazing (four weeks after first spray), and hay cuts (when individual hay cut timings were met) at Hart in 2021. Hay yield was not significant.

Effects of gibberellic acid in vetch

At Hart in 2021, applications of gibberellic acid at 10 and 20 g/ha, applied at early branching, improved the dry matter (DM) production of Timok vetch by up to 110 kg DM/ha when cuts were taken three weeks after application (Table 2). By four weeks, no DM (t/ha) differences between treatments was observed.

There was no increase of hay yield when gibberellic acid was applied at 10 or 20 g/ha at Hart in 2021.

Results from Hart in 2020, showed vetch DM increasing by 270 kg/ha (0.27 t/ha) four weeks after GA application when applied at rates of 20 g/ha (Allen *et al* 2021).

Previous results from trials conducted in Kimba and Booleroo displayed no biomass responses to gibberellic acid when applied at vegetative and early podding stages at equivalent rates (Day & Roberts 2021). Similar results were also seen at Pyramid Hill in Victoria (Bennet 2020).

This shows that there is an inconsistent response to the application of gibberellic acid in vetch across the low and medium rainfall environments of South Australia and Victoria.

Table 2. Biomass production of gibberellic acid treatments at early grazing (three weeks after first spray), grazing (four weeks after first spray), and hay cuts (three weeks after second spray).

Treatment	**Grazing 3 weeks after GA application (t DM/ha)**	**Grazing 4 weeks after GA application (t DM/ha)**	**Hay cut (t DM/ha)**
Timok	0.58[a]	1.11	2.30
Timok + 10 g/ha GA	0.67[b]	1.12	2.55
Timok + 20 g/ha GA	0.69[b]	0.93	2.72
LSD (P≤0.05)	**0.056**	**NS**	**NS**

Although no DM differences were observed, a height response was noted four weeks after gibberellic acid was applied. Increases in height by 6.5 and 7.9 cm were observed for applications of GA applied at 10 and 20 g/ha, respectively. No height response was observed later at the hay cut timing.

At Booleroo and Kimba, an increase in plant height was observed at the late vegetative stage, while gibberellic acid applications at early podding decreased plant height (Day & Roberts 2021). The same response was also seen at Pyramid Hill (Bennett 2020).

Similarly to Hart in 2020, colour differences in vetch treatments were noted for plots with applications of gibberellic acid (Figure 2).

Figure 2. Comparison between 20 g/ha of GA applied before hay cutting (left) and standalone Timok (right) at Hart in 2021. Photo taken on September 6, 2021.

Table 3. Plant height for +/- gibberellic acid treatments at grazing (four weeks after first spray), and hay cuts (three weeks after second spray).

	Plant height (cm)	
Treatment	**Grazing**	**Hay**
Timok	27.2[a]	50.1
Timok + 10 g/ha GA	33.7[b]	59.0
Timok + 20 g/ha GA	35.1[b]	63.8
LSD (P≤0.05)	**4.9**	**NS**

Feed quality

Varieties

Feed quality for all vetch varieties at grazing was similar across multiple testing characteristics, including crude protein (%), water soluble carbohydrates (WSC %) and net energy (MJ/kg) of 26.9%, 9.0 % and 5.85 MJ/kg, respectively.

The only differences observed were neutral detergent fibre (NDF) levels. Timok, Morava, Capello and RM4 had the lowest level of NDF (aNDFom). Lower levels of aNDFom can result in increased dry matter intake due to the feed having higher levels of easily digestible plant matter.

Capello and RM4 were also observed to have the highest levels of NDFDom30 and lowest uNDFom240, meaning these varieties provided the greatest grazing value to livestock through increased digestibility and improved dry matter intake.

Grazing

Grazing feed quality was negatively affected by applications of both 10 and 20 g/ha of GA. The application of 20 g/ha produced decreased crude protein levels (%) in vetch DM after three weeks. After four weeks, applications of both 10 and 20 g/ha of GA resulted in a decrease in crude protein (%) and an increase the neutral detergent fibre content in the dry matter.

Table 4. Comparison of feed test results for varieties trialed at Hart in 2021. Shaded values show the highest performing varieties for each feed test characteristic.

	Variety	**Crude protein (CP) (%)**	**aNDFom (%)**	**NDFDom30 (%)**	**uNDFom240 (%)**	**WSC (%)**	**Net energy of maintenance (MJ/kg)**
Grazing cut	Timok	27.97	21.5^{ab}	46.49^{ab}	9.5^{b}	8.23	5.96
	Studenica	24.33	27.97^{c}	23.32^{b}	10.67^{b}	10.57	5.66
	Morava	28.1	21.33^{ab}	39.42^{a}	10.5^{b}	8.57	5.96
	Capello	28.33	19.83^{ab}	76.39^{c}	1.3^{a}	9.47	5.67
	RM4	26.7	16^{a}	79.25^{c}	6^{ab}	8.57	5.77
	PBA Jumbo 2	25.8	25.97^{bc}	53.32^{b}	9.7^{b}	8.93	5.99
	LSD (P≤0.05)	**NS**	**6.231**	**10.05**	**6.31**	**NS**	**NS**
Hay Cut	Timok	19.7^{bc}	30.93^{bc}	37.53^{bc}	17.27^{ab}	12.43^{b}	5.69^{bc}
	Studenica	19.53^{bc}	29.33^{ab}	28.1^{ab}	18.27^{b}	14.87^{c}	5.79^{c}
	Morava	20^{c}	32.23^{bc}	22.9^{a}	22.7^{c}	12.03^{ab}	5.27^{a}
	Capello	18.23^{b}	34.03^{c}	44.23^{c}	16.17^{a}	10.6^{a}	5.36^{ab}
	RM4	19.6^{bc}	34.77^{c}	44.57^{c}	16.47^{a}	10.9^{ab}	5.47^{abc}
	PBA Jumbo 2	15.63^{a}	26.6^{a}	27.53^{ab}	16.97^{ab}	18.9^{d}	6.28^{d}
	LSD (P≤0.05)	**1.659**	**4.156**	**10.81**	**1.498**	**1.715**	**0.402**

Lentil as a grazing and hay option

PBA Jumbo2 was trialed to assess its potential as a grazing and hay option. PBA Jumbo2 lentils produced poor biomass and average quality feed when compared to vetch, however, when cut for hay at the optimal timing (50% pod), PBA Jumbo 2 produced similar levels of biomass compared to vetch, as well as having improved feed characteristics. It should be noted that the lentil treatment was sown at almost double the seeding rate of the vetch.

PBA Jumbo 2 had low neutral detergent fibre levels (aNDFom), low uNDFom240 levels, high water-soluble carbohydrates and higher net energy than most vetch varieties (Table 4). While PBA Jumbo2 was cut for hay at an optimum timing, there is a potential for lentils to be cut later; after significant frost damage in some environments. This means quality would likely be decreased when compared to results observed in 2021 (Hawthorne 2007), however, pulses do not lose hay quality as quickly as cereals after frost events.

Table 5. Feed test results for Timok vetch +/- gibberellic acid treatments at Hart in 2021. Shaded values show the highest performing treatment for each feed test characteristic.

	Variety quality @ grazing	Crude protein (CP) (%)	aNDFom (%)	NDFDom 30 (%)	uNDFom240 (%)	WSC (%)	Net energy of maintenance (MJ/kg)
Grazing cut (3 weeks post application)	Nil	29.1^{bc}	20.9^{a}	32.3	11.6	7.33	5.79
	10 g/ha	29.23^{bc}	21.67^{a}	28.6	13.4	5.7	5.75
	20 g/ha	28.53^{b}	22.77^{a}	30.9	13.83	6.17	5.7
Grazing cut (4 weeks post application)	Nil	27.97^{b}	21.5^{a}	46.3	9.5	8.23	5.97
	10 g/ha	26^{a}	25.7^{b}	42.1	12.33	8.53	5.66
	20 g/ha	25.93^{a}	25.73^{b}	43.1	12.57	9.13	5.86
LSD (P≤0.05)		**0.759**	**1.911**	**NS**	**NS**	**NS**	**NS**
Hay cut	Nil	19.7	30.93	37.5	17.27	12.43	5.69
	10 g/ha	19.23	32.3	33.3	18.7	11.2	5.61
	20 g/ha	19.73	34.3	38.2	19.03	12.23	5.43
LSD (P≤0.05)		**NS**	**NS**	**NS**	**NS**	**NS**	**NS**

Common management techniques

Increasing the seeding rates of vetch was trialed as a technique to increase biomass, however, no significant increase in dry matter production was observed.

Increasing seed rate is not a recommended management practice for vetch or lentil due to the increased likelihood of disease infection (Day & Roberts 2021).

The inoculation of Timok vetch seed was conducted to see if the addition of rhizobia to the soil could increase crop biomass. No response was expected as a PREDICTA® rNod test was completed across the trial area, indicating an adequate background level of rhizobia for successful inoculation. There was no response in plant biomass or root nodulation between treatments.

Applying higher levels of phosphorus (P) fertiliser has seen some positive responses in vetch trials (Dzoma et al 2019). Although no response was seen at Hart in 2021 when a base rate of 16 kg P/ha was compared to a higher rate of 24 kg P/ha (applied at seeding). This is likely a response to adequate background levels of P the Hart field site.

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 the SARDI/GRDC National Vetch Breeding Program for providing seed to conduct this trial, Ross Ballard from SARDI Plant & Soil Health for conducting Rhizobia testing and Balco for conducting the feed test analysis.

References

Allen R, Noack S and Guidera B 2021, 'Increasing vetch dry matter production through the application of gibberellic acid', *2020 Hart Trial Results*

Bennet B 2020, 'Gibberellic acid in vetch', *Birchip Cropping Group*

Day S & Roberts P 2021,'Alternative end use for lentil and novel management strategies for vetch', *Upper North Farming Systems Annual Research and Extension Compendium – 2020 Results*

Dzoma B, Wilhelm N, Telfer P & Zeppel K 2019, 'Effect or rate and placement of phosphorus on vetch performance', *Agronomy Australia Conference, 25-29 August 2019, Wagga Wagga*

Hawthorne W 2007, 'Managing pulses to minimize frost damage', *Australian Pulse Bulletin*

Matthew, C, Hofmann, W.A & Osborne, M.A 2009,'Pasture response to gibberellins: A review and recommendations, *New Zealand Journal of Agricultural Research*, Vol. 52, Issue 2, pp. 213-225

Nagel S, Kennedy A & Kirby G 2020, 'Vetch', *2021 South Australian Crop Sowing Guide*

Nagel S, Kirby G & Kennedy A 2021a, 'Vetch agronomy and management', *GRDC Research Update Adelaide, South Australia*

Nagel S 2021b, 'O – Vetch Varieties', *2021 Hart Field Day Guide*

Photo. Timok ready for hay cutting (September 14); vetch biomass trial at Hart.