

June 2024

Building drought resilience of vulnerable soils in low rainfall cropping and grazing systems

CASE STUDY

Vetch and summer ground cover strategies on sandy soil





Title: Vetch and summer ground cover strategies on sandy soil

Location: Ouyen, VIC

At a Glance

- Paddock demonstrations were conducted in Ouyen in the Victorian Mallee to investigate the effect of early-applied gibberellic acid on vetch to improve in-season ground cover and the viability of summer ground covers.
- The findings of this case study show that in this Ouyen paddock, neither vetch crop nor its stubble provided a superior ground cover compared with a barley crop and stubble.
- Early application of gibberellic acid did not increase the amount of biomass produced; therefore, it did not offer increased in-season ground cover.
- Two summer ground cover demonstration patches were sown following the vetch termination; one patch was sown to a single species of mustard, and the second to a multi-species mix. The multi-species

mix provided better ground cover over the summer, however it also used more soil moisture relative to the soil moisture detected in the fallow area, particularly at depths between 30 and 100 cm.



Figure 1. Vetch crops growing on a dune in the Ouyen paddock. Photo: BCG

Paddock-scale demonstrations were established by Birchip Cropping Group (BCG) on a grower's paddock in Ouyen, Victoria. The demonstrations investigated whether early application of gibberellic acid (GA) induced increased vetch biomass for enhanced in-season ground cover, and the viability of two different summer ground covers.

This project is supported by Mallee Catchment Management Authority, through funding from the Australian Government's Future Drought Fund.

Background

The Victorian Mallee faces escalating challenges posed by increasing drought frequency and intensity¹. Amidst this climatic uncertainty, the region grapples with the intricate interplay of very high wind erosion susceptibility, placing its soils in a vulnerable position². As climatic patterns shift, the need to fortify the resilience of the Victorian Mallee against the dual threats of drought and soil degradation becomes ever more pressing. Tailoring agronomic solutions, such as the inclusion of key crops or inputs, to farms located in the high wind erosion susceptibility zones is necessary for understanding how growers in this region can protect vulnerable soils for increased drought resilience.

Vetch is a commonly grown cover and break crop in the Mallee, and its adoption into farming systems for grazing or brown manure has increased since the Millennium drought³. As a cover crop, vetch offers many benefits to the dune-swale system in the Victorian Mallee, such as increased nitrogen (N) fixation, weed suppression, and preventing the dominance of soil-borne cereal diseases. However, one of the greatest benefits ascribed to vetch is increased protection from soil erosion through its ground cover⁴. Certain factors will impact on the efficacy of vetch as a suitable cover crop in this region; it is susceptible to a number of diseases, primarily *Botrytis* which can negatively affect biomass production⁵, thus disease management is a key consideration for incorporating this crop into farming systems.

Another management tool of vetch is the application of gibberellic acid (GA), a growth regulator, which promotes cell elongation and is applied in the lead up to harvest as it generally causes the plant to become more erect and thus easier to harvest for hay, and delays flowering⁶. It is unclear, however, whether the application of GA increases plant biomass, which would be useful for increased ground cover, as well as plant height. Work carried out by Hart Field-Site Group in South Australia reported in 2021 no significant differences in biomass production between

Timok vetch that had been treated with GA and without⁷, however this work was carried out on a small-plot scale, rather than a paddock scale. Finally, vetch grown in this region is generally terminated in the third quarter of the year, leaving the soil bare from this time until the next crop is established in the following season. The efficacy of ground covers in this region for mitigating soil erosion is therefore pertinent to this case study.



Figure 2. Vetch growing in the Ouyen paddock. Photo: BCG.

This study investigated the impact that a vetch crop and stubble had on ground cover and consequently on mitigating soil erosion. Furthermore, the study assessed the impact of early-application of GA on ground cover. Early application was the target to maximise the length of time that the crop would have to respond to the treatment, as this product is generally applied close to harvest.

Finally, this study assessed the efficacy of two different ground covers over the summer 2023/2024 period. By addressing specific challenges faced by growers in this region, this project aims to define science-based approaches and innovative conservation practices that can protect vulnerable soils, mitigate drought effects, and foster sustainable land management in the Victorian Mallee.

Aims

- Assess whether early-application of gibberellic acid affects the amount and quality of vetch ground cover in-season and post-harvest.
- Investigate the advantages and disadvantages of sowing two different summer cover crops.

Method

Site establishment

The demonstration paddock is sown on a consistent rotation of cereal and legume; in 2022 the paddock was sown to barley, and in 2023 to vetch (Timok) on 3 April. Two treatment strips were studied as part of this demonstration with the dimensions of 60 m width and running the length of the paddock, approximately 930 m.

Table 1. Treatment descriptions for each strip demonstration at the Ouyen paddock.

Treatment/strip	Description
No treatment	Strip untreated with GA
GA treatment	Application 14 June 2023 (early)

Assessments

Three biomass cuts were taken from both strips, from the swale, mid-slope, and dune systems. Each biomass cut consisted of total above ground biomass and was dried at 70 °C for 3 days, and then weighed.

Whole-paddock total vegetation cover assessments were carried out by MODIS monthly fractional cover average (500m spatial resolution) satellite imagery, and bare ground assessments were carried out by Landsat seasonal fractional cover medoid (30m spatial resolution) satellite imagery, both accessed through the Digital Twin Victoria platform (version 2023-10-3-0.3.9-8.3.6-8f9b519).

Sowing summer ground cover crops

Two patches of ground cover crops were sown on 14 November 2023. The first patch (Figure 3) was sown to a single crop, Falkor white mustard (AGF Seeds) at a rate of 4 kg/ha. This crop was chosen for its ground cover benefits as well as its biofumigation benefits, as it was determined that *Botrytis* was detected in the vetch crop during biomass sampling in July 2023. This patch was sown to a width of 72 m and 72 m length, approximately half a hectare (ha).

The second patch was sown to a mixed cover crop, 'Farmour WarmCover Mix' (AGF Seeds) at a rate of 20 kg/ha. The mix contains 20% millet, 10% sorghum, 5% teff grass, 13% buckwheat, 13% tillage radish, 3% leafy turnip, 3% forage rape, 13% sunflower, 3% phacelia, 13% freyr sunn hemp, 8% linseed flax. This cover was chosen as it provides quick cover and a high level of erosion protection and is suitable for grazing and manuring. This patch was sown to a width of 63 m and 72 m length. Prior to sowing, each patch was soil sampled to understand the availability of soil nutrition and moisture following the vetch crop that was terminated in early September 2023.



Figure 3. Drone photo of Falkor White Mustard patch (Cover 1) at sowing. Photo: BCG.

Results/findings

Vetch vs barley ground cover

Satellite imagery (Figures 4-5) shows that in this Ouyen paddock, neither vetch crop nor its stubble provided a superior ground cover compared with a barley crop and stubble. As shown by satellite imagery and biomass weight data (Figures 4-6), the dunes included

in this study were particularly vulnerable to soil erosion due to lower cover crop availability. These findings illustrate the challenges associated with incorporating leguminous crop into Mallee cropping systems without compromising soil cover.

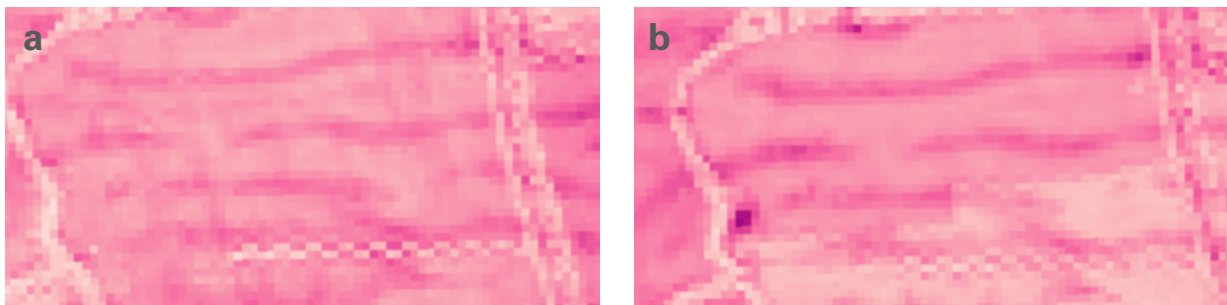


Figure 4. Digital Twin Victoria satellite imagery, bare ground percentage, image taken 13 February 2023 (a) and 27 October 2023 (b). The ground cover provided by barley stubble in the demonstration paddock prior to sowing to vetch in April 2023. Pixel colour represents percentage of pixel that is bare soil; lighter colour indicates a lower percentage, and darker colour indicates a higher percentage of bare soil.

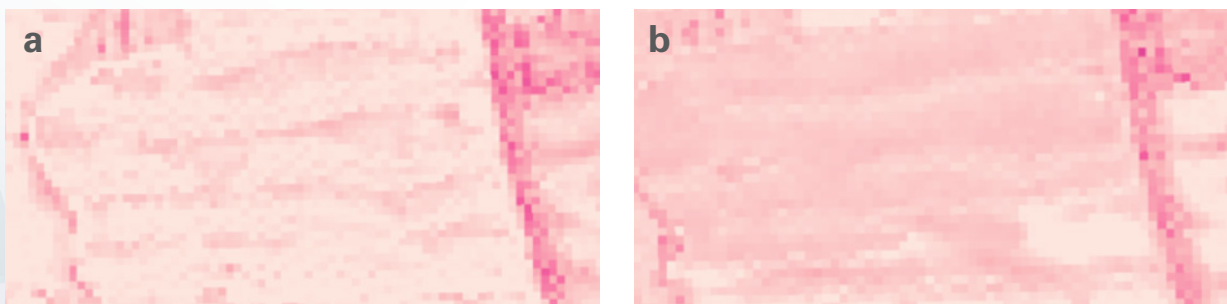


Figure 5. Digital Twin Victoria satellite imagery, bare ground percentage, image taken 21 August 2022 (a) and 24 August 2023 (b). The ground cover provided by barley and vetch, respectively, in the demonstration paddock during the respective cropping season. Pixel colour represents percentage of pixel that is bare soil; lighter colour indicates a lower percentage, and darker colour indicates a higher percentage of bare soil.

Effect of GA on biomass

Satellite imagery confirmed that the GA was active on the strip of vetch that it was applied to (Figure 6), however biomass assessments showed no increase in biomass, and suggests a negative impact on vetch growing on the mid-slope system in the paddock (Figure 7).

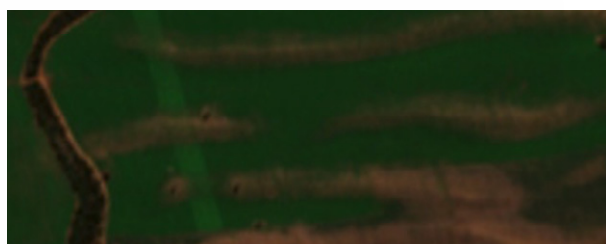


Figure 6. Sentinel-2 satellite imagery, 7 July 2023. The light green strip depicts the strip of gibberellic acid that was applied on 14 June 2023. This effect is characteristic as the acid causes cell elongation in the plant, effectively diluting the plant chlorophylls.

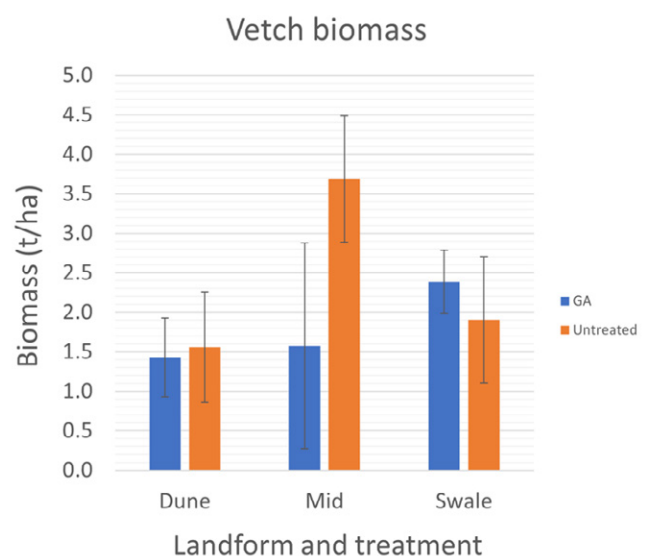


Figure 7. Vetch biomass for each treatment strip by landform. Error bars represent the standard error across all data points for landform in each strip.

Summer ground cover patches – establishment

Cover 1, the Falkor white mustard, did not establish well and this patch was inundated with weeds (Figure 8). Cover 2, the Farmour WarmCover Mix, established successfully (Figure 9). This illustrates one of the risks of utilising cover crops in the Mallee; and supports concerns about the suitability of certain cover crops.



Figure 8. Weeds growing in the Cover 1 ground cover patch.

Summer ground cover patches – soil moisture

Starting soil moisture (Figure 10) was variable across both patches, as was soil moisture at termination. However, at termination, the data show that there was less soil moisture underneath the mixed cover crop compared with both the weedy Cover 1 and the paddock fallow.



Figure 9. Cover 2 ground cover patch established successfully.

Cover patch soil moisture

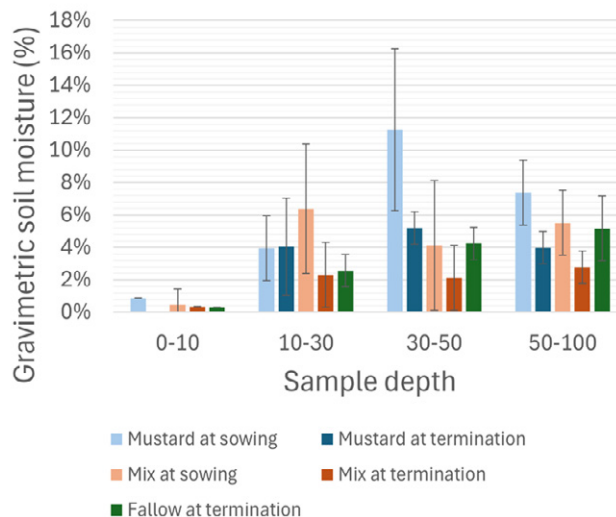


Figure 10. Soil moisture data for both cover patches at sowing and termination. Reference data from a fallow area of the paddock was also collected when the patch was terminated. Data represents the mean for three replicates. Error bars represent the standard error across all data points for sample area and depth.

Despite using more soil moisture relative to the fallow area, the mixed species cover crop provided better ground cover, as depicted in Figures 11 and 12.



Figure 11. Digital Twin Victoria satellite imagery. Image taken on 31 January 2024, and shows the percentage of each pixel where green vegetation is detected. Darker green is correlated with denser green vegetation. The image shows Cover 2, the mixed species cover, with a higher level of green vegetation.

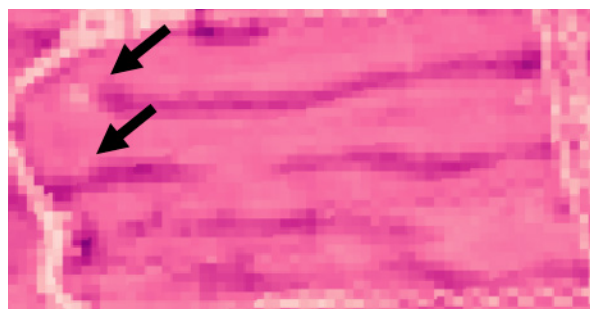


Figure 12. Digital Twin Victoria satellite imagery, bare ground percentage, image taken 31 January 2024. Pixel colour represents percentage of pixel that is bare soil; lighter colour indicates a lower percentage, and darker colour indicates a higher percentage of bare soil. The image shows Cover 2, the mixed species cover, with a lower level of bare ground.

Implications

The findings from these demonstrations illustrate the challenges associated with incorporating leguminous crop into Mallee cropping systems without compromising soil cover. The challenge remains how to capitalise on the use of a leguminous crop without compromising soil stability. Data collected in this project suggest that the early application of gibberellic acid, usually used as an aid for harvest, is not effective in increasing crop biomass and is not suitable as a tool to increase ground cover for soil protection. To be certain of this effect, this work should be replicated in larger and longer-term field trials.

Growing ground cover crops in the Mallee can be a polarising topic given concerns around conserving available soil moisture

and economic impact of the opportunity cost. The findings from two summer cover crop demonstrations illustrate that choice of ground cover in the Mallee is important, as poor establishment may lead to a higher weed burden. This demonstration illustrates the impact that uncontrolled summer weeds can have on soil moisture in the Mallee.

Furthermore, a successfully established cover crop, such as that found for the mixed species patch, may provide better ground cover over the summer, but it may also use precious soil moisture ahead of the next crop. It is important for growers to assess the economic impact of implementing strategies to mitigate soil erosion in the Mallee.

References

1. Ma, X., et al., *Abrupt shifts in phenology and vegetation productivity under climate extremes*. Journal of Geophysical Research: Biogeosciences, 2015. 120(10): p. 2036-2052.
2. Webb, N.P., et al., *AUSLEM (AUStralian Land Erodibility Model): A tool for identifying wind erosion hazard in Australia*. Geomorphology, 2006. 78(3): p. 179-200.
3. Kirkegaard, J.A., et al., *Improving water productivity in the Australian Grains industry—a nationally coordinated approach*. Crop and Pasture Science, 2014. 65(7): p. 583-601.
4. MacLaren, C., et al., *Cover Crop Biomass Production Is More Important than Diversity for Weed Suppression*. Crop Science, 2019. 59(2): p. 733-748.
5. Nagel, S., G. Kirby, and A. Kennedy. *Vetch agronomy and management*. 2021 [cited 2023 21 November,]; Available from: <https://grdc.com.au/resources-and-publications/grdc-update-papers/tab-content/grdc-update-papers/2021/02/vetch-agronomy-and-management>.
6. Matthew, C., W.A. Hofmann, and M.A. Osborne, *Pasture response to gibberellins: A review and recommendations*. New Zealand Journal of Agricultural Research, 2009. 52(2): p. 213-225.
7. Anderson, D. and R. Allen, *Improving vetch dry matter production*. Hart Trial Results, 2021: p. 52-58.

This publication may be of assistance to you but the Mallee Catchment Management Authority and the author do not guarantee that the publication is without flaw of any kind or is wholly appropriate for your particular purpose and therefore disclaims all liability for any error, loss or other consequence that may arise from you relying on any information in this publication.

This project is supported by the Mallee Catchment Management Authority, through funding from the Australian Government's Future Drought Fund.