Vetch agronomy in the Victorian Mallee

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Abstract

Common vetch (*Vicia sativa*) has been incorporated into rotations in the Victorian Mallee for many years due to its versatility. Vetch can be utilised as a disease break, a grass weed break and can be sown for several end uses including grazing, hay, brown manure or harvested for seed. The impact of in-season and end use agronomic decisions in vetch on soil moisture, soil mineral nitrogen (N) and subsequent crop yields in the lower Victorian Mallee is not well understood. Two field trials were established across the Victorian Mallee focused on investigating the effect of in-season and end use decisions on the soil mineral nitrogen, soil moisture and the subsequent years crop yield. The field trial design was a randomised complete block design with four replicates. Assessments included grazing and hay biomass yield and soil mineral N and soil moisture. The first of two years of trials demonstrated differences in moisture and nitrogen soil levels following different vetch end uses but not between varieties. Based on in-season biomass cut data, Morava and Volga produced the highest amounts of biomass, 6.0 tDM/ha and 5.5 tDM/ha respectively. These findings will help growers make informed decisions around variety choice, in season management and crop end use.

Keywords

Vetch, nitrogen, soil moisture, brown manure, hay, mineralisation

Introduction

Common vetch (*Vicia sativa*) has remained a staple in the agricultural industry due to its versatility. It is understood that sowing vetch earlier will increase biomass for grazing and hay yield (GRDC 2018). There is also a trade-off between brown manure timings; the earlier the termination timing, the higher the soil moisture left behind but the lower the N fixed. In contrast, the later the termination timing, higher levels of soil mineral N are left behind, but this is quite often coupled with lower soil moisture levels (Ferrier et al. 2012). It is not well understood how the agronomic decisions made during the season affect soil moisture and soil mineral N levels following the vetch phase, and what outcome this has on yield and quality of the subsequent crop. Agronomic decisions to consider, tested as part of this research, are grazing, variety choice and therefore maturity of vetch and termination timing.

This paper discusses the effect of agronomic decisions on vetch end uses and soil moisture and soil mineral N following the end use. The outcomes of the vetch phase are analysed here, and the trials have been sown to wheat in 2024 to assess the effects on the subsequent crop.

Method

Two replicated field trials were sown at Ouyen and Kinnabulla in Victoria, Australia on 19 April and 20 April 2023 (year one). The trial sites received decile 5 and decile 7 growing season rainfall, respectively and decile 8 and decile 7 rainfall between harvest 2023 and sowing 2024, respectively. The trials were designed as complete randomised block trial design with four replicates. Three varieties were chosen for this trial with varying phenology characteristics: Morava (late maturity), Volga (early) and Studenica (very early). The in-season treatments included grazing which was carried out just prior to canopy closure during mid-July. Two termination timings were also studied. The earlier termination timing was undertaken four months after sowing for all varieties, irrespective of growth stage, whereas the late termination timing and hay cut timing was determined by variety maturity, being terminated or cut for hay when the variety reached 50 % flat pod formation. One treatment was harvested for grain. Assessments included grazing biomass yield, hay yield, feed test quality, grain yield, soil mineral N and soil moisture. Soil sampling was carried out at a site level prior to sowing in year 1 to determine a baseline understanding of the sites' soil moisture and soil mineral N. Post-harvest soil tests in year 1 and pre sowing soil tests in year 2 were carried out per plot to determine soil mineral N and plant available water (PAW) to a depth of one metre and segmented into 0–10 cm, 10–40 cm, 40–70 cm and 70–100 cm depths. The two trials were analysed separately using one-way ANOVA in Genstat 22nd edition.

Results and discussion

Termination timing of brown manure treatments

Large differences were detected in the amount of biomass produced between the early and late brown manure termination timings; an additional 4.8 tonnes of dry matter per hectare (tDM/ha) and 3.5 tDM/ha were produced at Ouyen and Kinnabulla, respectively, for the later termination timing treatments. The only difference in variety performance across both sites was that less biomass was produced in the late termination timings of Studenica at Kinnabulla compared to Volga and Morava (Figure 1).

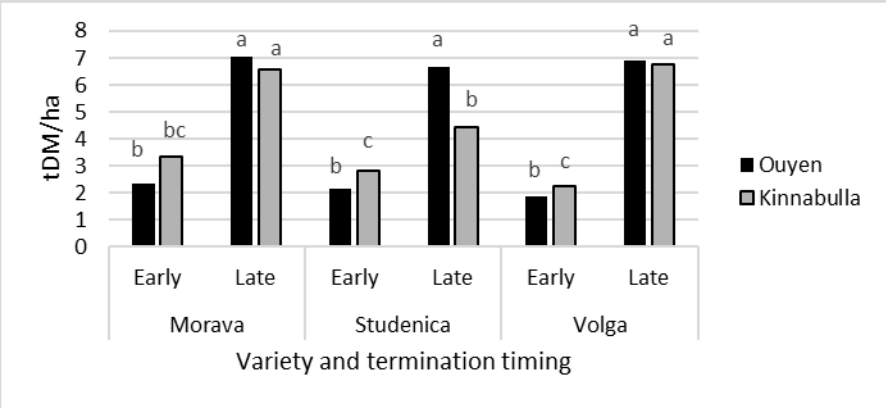

Figure 1. Biomass at termination timing (tDM/ha) of vetch varieties at Kinnabulla and Ouyen. Columns with different letters show significant difference within a site. The sites were analysed separately. Kinnabulla P<0.001, LSD 1.2 tDM/ha, CV 17.4 %; Ouyen P<0.001, LSD 1.3 tDM/ha, CV 18.7 %. LSD = Least Significant Difference (P = 0.05), CV = Coefficient of Variation. Superscript letters indicate significant differences

Hay yield

At Kinnabulla, Morava and Volga had the highest hay yields at 6.0 tDM/ha and 5.5 tDM/ha, respectively (Figure 2). At Ouyen, there were no significant hay yield differences between varieties. A large yield penalty occurred in the hay treatments that had been grazed earlier in the season at both sites (data not shown). Additionally, Volga showed the best recovery from the grazing treatment at both sites, with the lowest loss of 1 tDM/ha, when considering the combination of biomass removed at grazing and the hay cut (data not shown).

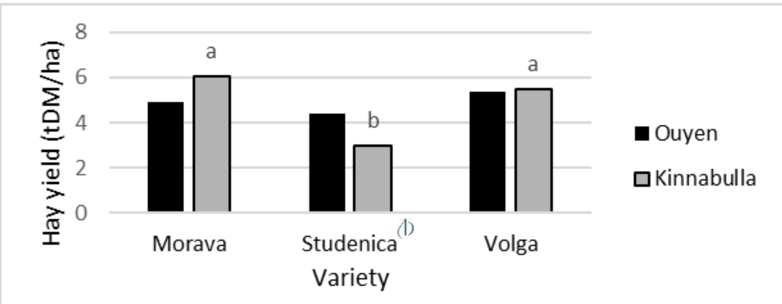

Figure 2. Hay yield (tDM/ha) of varieties at Ouyen and Kinnabulla. Columns with different letters show significant difference. The sites were analysed separately. Ouyen = NS, Kinnabulla P<0.001, LSD 1.9 tDM/ha, CV 26.7%.

Soil moisture and soil mineral N

Soil measurements taken after harvest indicated the lowest level of PAW and soil mineral N was left behind in the grain harvest treatments (Tables 1 and 2). Results for early termination timing treatments had the most soil N, which was unexpected given the large differences in biomass produced from the two termination timings (Figure 1). However, measurements taken closer to sowing showed a higher level of mineralisation in the late termination timing at Kinnabulla. The least amount of soil mineral N at Kinnabulla was provided by plots taken to grain. Differences in PAW close to sowing were insignificant due to higher-than-average rainfall between harvest and sowing (November – March) at both sites.
The higher amount of soil mineral N detected after harvest for the earlier termination timing treatments is likely owing to increased soil mineralisation (Farquharson et al. 2022). A similar amount of soil mineral N was detected in the late termination treatments and the hay treatments at the pre sowing measurement timing (Table 2). With 3–6 tDM/ha of biomass removed in the hay cut treatments, a large difference in these plots would be expected. This illustrates the time needed for fixed N to break down into available soil mineral N. When measured prior to sowing, the amount of N under the later termination timing treatment had increased however not to the predicted amount; a substantial amount of vetch stubble was still present at the time of sowing the subsequent crop in year two, and it is likely that additional time is required to realise full N mineralisation through biomass breakdown.

Table 1: The effect of end use decision on plant available water (PAW) (mm) (0-100 cm). Superscript letters within columns indicate significant differences.

End use	Kinnabulla		Ouyen	
	Post harvest	**Pre sow**	**Post harvest**	**Pre sow**
Early termination	184^{a}	210	87^{a}	113
Hay	165^{bc}	209	78^{ab}	121
Late termination	151^{c}	212	53^{cd}	118
Grain	151^{c}	193	37^{d}	109
P value LSD (P=0.05) CV%	0.001 16.01 13.7	0.206 NS	<0.001 17.96 32.7	0.234 NS

Table 2: The effect of end use decision on soil mineral N (kg N/ha) (0-100 cm).

End use	Kinnabulla		Ouyen	
	Post harvest	**Pre sow**	**Post harvest**	**Pre sow**
Early termination	87^{a}	156^{bc}	190^{a}	272
Hay	72^{b}	153^{bc}	145^{bc}	243
Late termination	65^{b}	170^{a}	135^{c}	287
Grain	46^{c}	114^{c}	104^{d}	258
P value LSD (P=0.05) CV%	<0.001 7.88 16.5	<0.001 20.43 16.9	<0.001 9.78 23.2	0.29 NS

Conclusion

In terms of biomass production during the vetch phase in year one, Morava performed well however Volga illustrated versatility; as an early-maturing line it performed similar to Morava (late-maturing) and recovered well from grazing. Studenica's performance was sub-optimal compared with the other varieties, which is reflective of it being a very early-maturing cultivar in a longer-than-average season. Variety selection had no significant effect on PAW or soil mineral N levels at the end of the season.

Delaying termination timings by 4–6 weeks significantly increased biomass left behind, and, although not reflected in the immediate post-harvest soil results, it could result in an additional ~70–95 kg N/ha being available for the subsequent crop (using an estimate of 20 kg of N being fixed for each tonne of dry matter produced (Peoples et al. 2012). Soil mineral N measured prior to sowing had not resulted in the predicted amount of N mineralised despite warm temperatures and rainfall over summer indicating ideal mineralisation conditions. Upon inspection of the trial at sowing in year two, there was still a significant amount of vetch stubble remaining on the soil surface of the late termination timing treatments and it is likely that more time is needed for biomass degradation to result in soil mineralise N. The summer rainfall following the first year of the trials at both sites was above average, and as such there was no moisture conservation benefit from terminating the vetch earlier. However, unlike water, N is something that can easily be applied in-season in the Mallee, therefore, the decision to make the trade-off between moisture and N will likely depend on a grower's appetite for risk. At the completion of year two, we will be able to determine if any additional yield from the subsequent wheat crops has been generated as a result of the year one vetch end use treatments, and if this is reflected in profitability for each treatment over the two seasons.

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