

Agronomic and Economic Evaluation of Vetch Hay Crops in Mixed Farming Systems in the Kwinana Port Zone

GRDC/WANTFA/Facey Group

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KEY FINDINGS

- The vetch variety RM4 demonstrated the highest crude protein and biomass among all vetch, highlighting its adaptability to drought conditions.
- While the vetch produced less biomass than the mix or oats, its significantly higher crude protein levels make it a more suitable option for grazing or hay.

BACKGROUND

Vetch crops provide multiple benefits in mixed farming systems, including nitrogen fixation, improved soil fertility, weed suppression, and drought resilience. They contribute to sustainability by reducing input costs and enhancing the productivity of subsequent cereal crops. However, quantifying their economic value within cropping enterprises is crucial for wider adoption.

Beyond cropping benefits, vetch is a valuable forage resource for livestock systems, particularly in regions needing high-quality feed. Under dryland conditions, cereal-vetch mixtures can outperform many pasture species in forage yield and are well-suited for hay or silage conservation. They also function as a break crop, aiding weed control and pasture renovation, ultimately supporting whole-farm livestock production (Piltz, et al. 2021).

This trial in the Kwinana Port Zone evaluates whether integrating vetch into a hay rotation can increase biomass production and economic returns without diminishing its rotational benefits for the following cereal crop. While vetch's role in grazing systems is recognised, its specific impact on cereal crop performance and profitability remains underexplored.

AIM

To evaluate if integrating vetch into a hay rotation can enhance biomass production and economic returns during the hay phase while maintaining the rotational benefits of vetch for the subsequent cereal crop.

TRIAL DETAILS

Property:	Brenton and Justine Tyson
Location:	Latitude 32°47'59.94"S, Longitude 117°32'4.29"E
Soil Type:	Loam
Crop Variety:	See Treatments
Sowing Date:	28/03/2024

Seeding Rate:	Volga: 40kg/ha RM4: 40kg/ha Morava: 40kg/ha Rasina: 30kg/ha RM4 (40kg) Dictator Barley (40kg): 80kg Brusher Oats: 100kg/ha
Machinery:	Seeder Type: DBS Tyne Spacing: 25 cm (10 inch)
Paddock Rotation:	Canola 2023
Inoculant:	Alosca Group F granules 10kg/ha
Fertiliser:	Date: 28 th March Product: MAP 35kg/ha, Muriate of Potash 10kg/ha
Herbicides:	<u>Pre seeding:</u> Hammer 400EC 20mL/ha Alpha Duo 250 SC 50mL/ha Chlorpyrifos 500EC 250mL/ha Uptake spraying Oil 0.5% Ammonium Sulphate Solid 1% Roundup UltraMax Herbicide (Monsnta) 1.2L/ha ACP Diuron 900 WG 0.21kg/ha
Insecticides:	<u>At seeding time</u> Titan Bifenthrin 250EC 80mL/ha
Description of Paddock:	The paddock has a slight incline towards the north and along the trail. Limed on the 13 th of March 2024 2t/ha

METHODOLOGY

The trial includes five treatments to assess the impact of different vetch varieties and cereal-vetch mixtures on biomass production and economic returns. The plots measure 12.8x100 m, arranged vertically by treatments and divided into four sections (Figure 1). The five vetch-only treatments consist of Studenica (early-flowering), Rasina (early-flowering), Volga (early-flowering), RM4 (mid-flowering), and Morava (late-flowering, 40 kg/ha). A mixed treatment combines RM4 vetch with Dictator forage barley to evaluate the benefits of multispecies cropping, while a cereal-only treatment using Brusher-oats serves as a control to compare the advantages of vetch inclusion in the rotation. Plots 7-12 failed to be seeded, resulting in a gap between the oats and the other treatments.

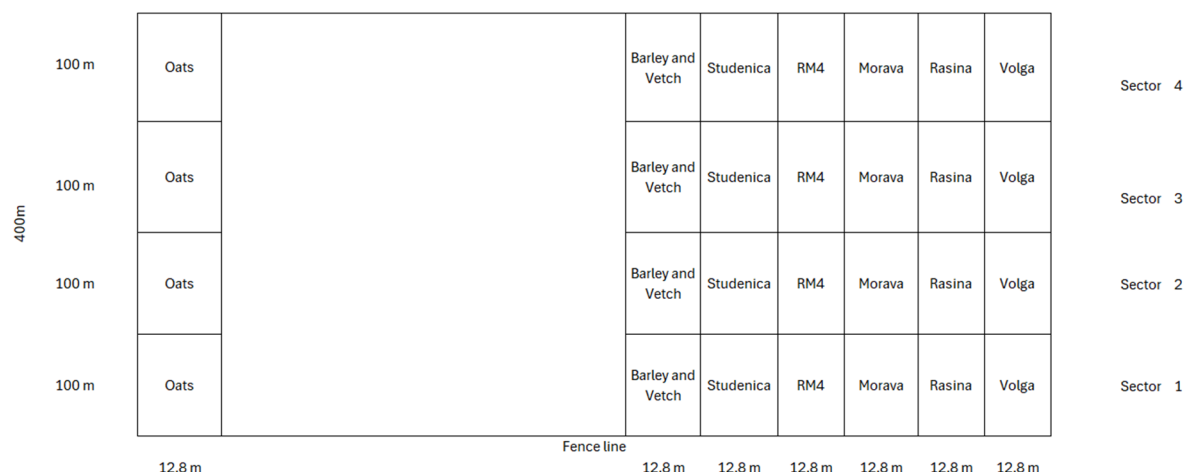


Figure 1. Trial layout, seven treatments divided by four sectors.

RESULTS AND DISCUSSION

Table 1: 2024 rainfall data from the BOM weather station West Kulin 010799 (mm).

Jan	Feb	Mar	April	May	June	July	Aug	Sept	Oct	Nov	Dec	Total
4.6	22.4	50.8	0.0	35.2	23.6	59	53.8	17.8	8.6	18.8	4.6	299.2

Total rainfall for the trial period was below the regional average, with no recorded rainfall in April (Table 1). The baseline soil testing, provided by the host farmer, was conducted after the 2023 harvest season. The results showed no signs of acidification or salinity issues (Table 2).

Table 2. Soil test results pre seeding.

Sample Depth	0-10
pH (CaCl ₂)	6.57
pH (H ₂ O)	6.77
EC (μS/cm)	0.229
Organic C	3.35
NO ₃ N (mg/kg)	8.68
NH ₄ N (mg/kg)	3.97
P (mg/kg)	31.6
PBI col P	91.6
K (mg/kg)	418
S (mg/kg)	6.46

Plant Establishment and Weed Counts

Early establishment and weed counts were conducted on June 10th. Figure 2 shows significantly higher plant numbers in oats compared to vetch and the mix (186 plants/m²). The mix outperformed all stand-alone vetch treatments, with 91 plants/m². Among the vetch varieties, RM4 had the highest early establishment, with 73 plants/m².

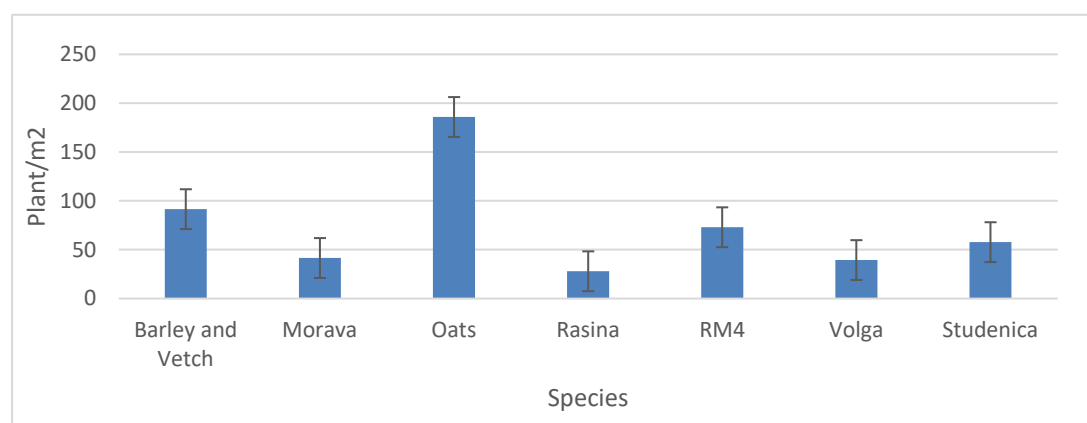


Figure 2. Plant establishment counts (plants/m²) x weeks post seeding. Error bars are the SE around the mean (.05)

The mix of barley and vetch, along with the Studenica vetch, exhibited the lowest weed concentrations, while the Rasina variety had the highest weed numbers (72 weeds/m²). RM4, Morava, and oats showed similar weed densities, ranging from 32 to 35 weeds/m². The Rasina

variety recorded the highest weed concentration and lowest establishment (28 plants/m²), followed by Volga (39 plants/m² and 59 weeds/m²). (Figure 2, Figure 3).

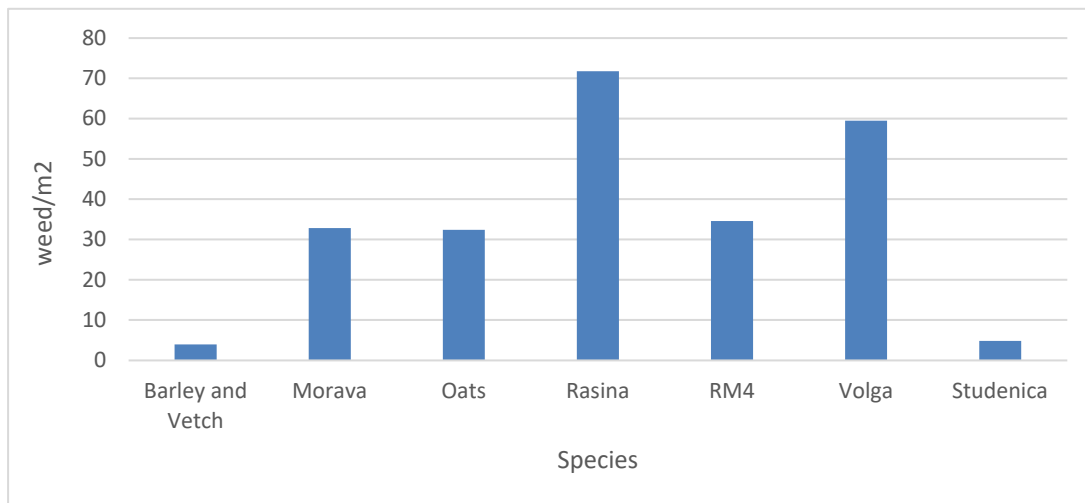


Figure 3. Effect of species mixes on total weed density (Weeds m/2). Error bars are the SE around the mean (.05)

Nodulation

Samples taken on the 1st of July showcase a range of ineffective to scarce nodulation among all plots. Varieties Volga and RM4 show the best fixation performance with 0.7 on average nodulation score, showing less than five small active nodules. The overall results show poor activity of nitrogen fixation after 8 – 13 weeks after sowing.

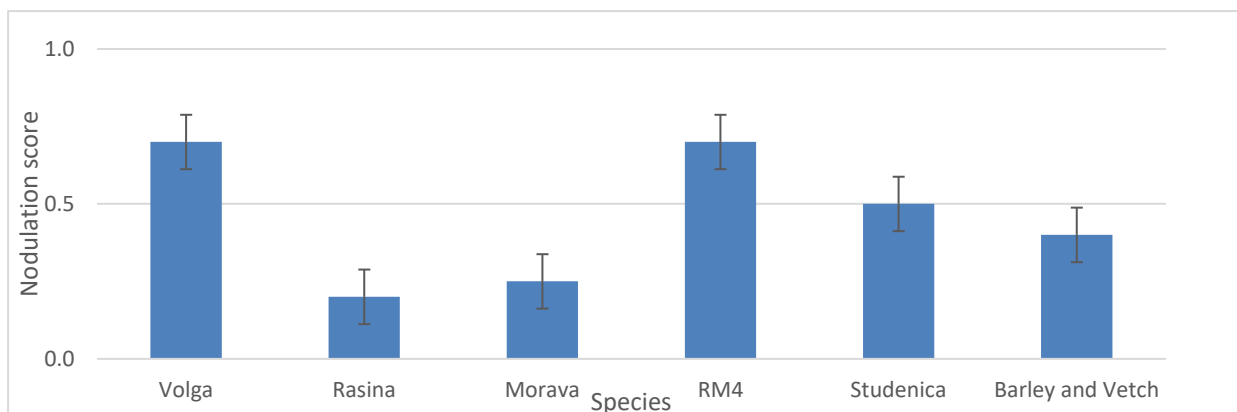


Figure 4. Effect of species mix on Nodulation score (values from 0 – 10 according to DPIRD indications).

Biomass

First biomass sampling occurred on 1st July shows that oats have the highest performance (263.75 kg/ha), followed by the vetch RM4 with 169.06 kg/ha which showcased higher biomass than the mix (154.53 kg/ha) at this stage. The second sample was performed on the 11th of September given aphids were found in the trial. Besides that, biomass results followed the previous trend, being the highest oats with 7.05 t/ha, RM4 with 3.90 t/ha and the Mix with 3.73 t/ha.

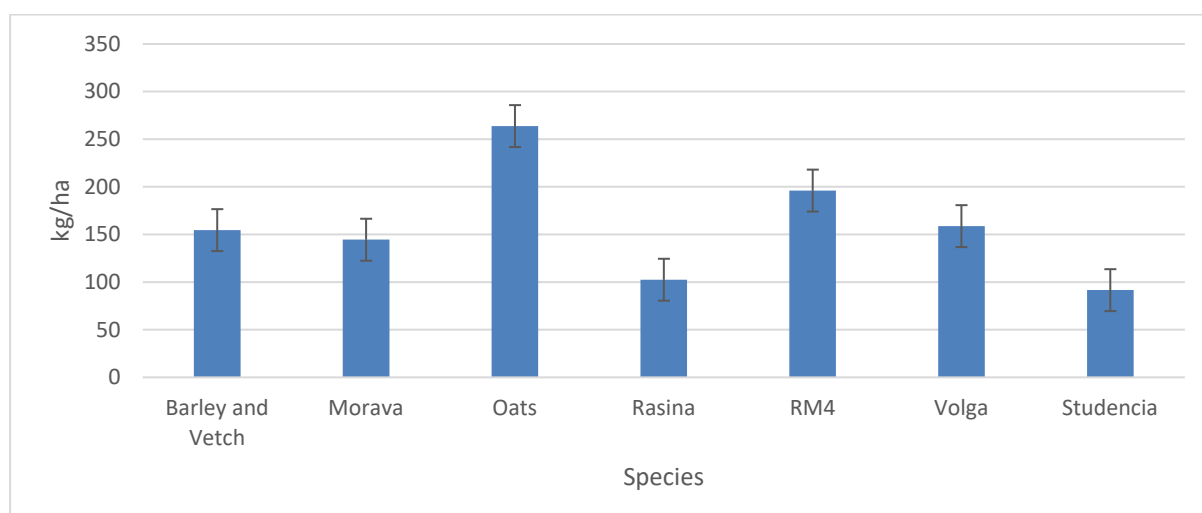


Figure 5. Mid-season biomass by species (kg/ha).

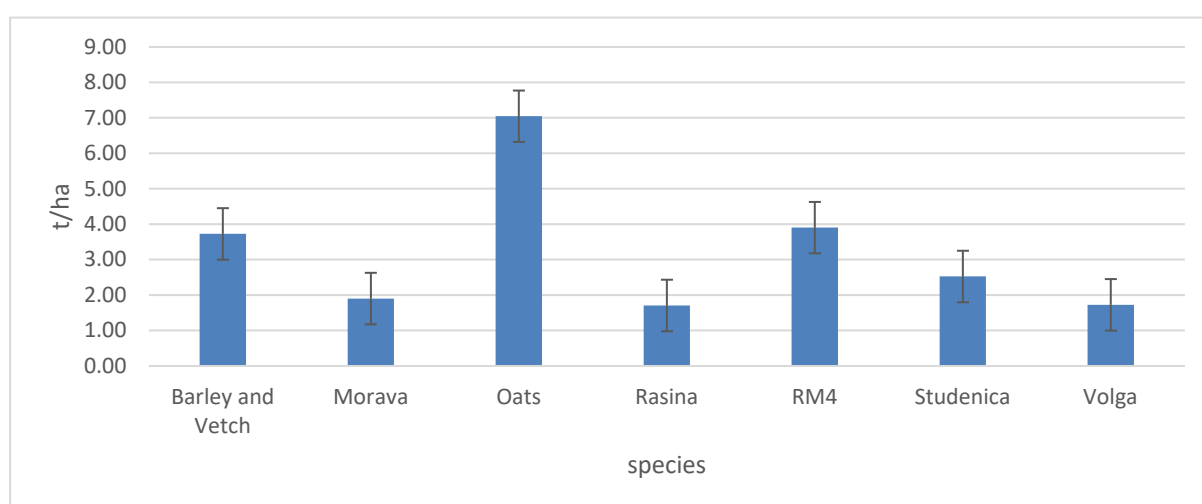


Figure 6. Close to peak biomass by species (t/ha).

Forage Analysis

The sampling was performed at the same time of the last biomass cut on the 11th of September. Figure 7 indicates that RM4 have the highest metabolizable energy (12.46%) and crude protein (40%) content above all treatments. All the vetch varieties had high percentages of crude protein in dry matter the trial in comparison to the oats (8.3) and mix (19.3).

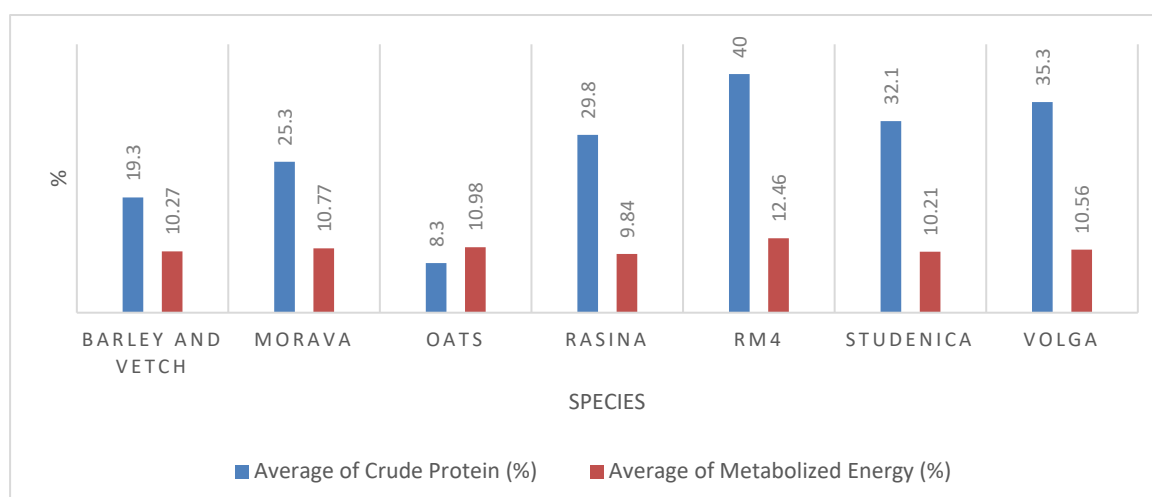


Figure 7. Effect of crude protein and metabolisable energy by species (%).

CONCLUSION

The soil analysis revealed no issues with acidification or salinity, indicating a suitable environment for vetch establishment. However, April's below-average rainfall and dry conditions may have impacted early plant development. Despite these challenges, oats exhibited the highest early-stage plant density, and biomass throughout the season, though with lower crude protein content. The lower nodulation activity of vetch indicates potential low nitrogen fixation for further rotations.

Among vetch varieties, RM4 demonstrated the strongest early establishment, exceeding the species' average plant density of 50–60 plants/m² (GRDC, 2017). It also achieved the highest biomass and crude protein levels. In contrast, Rasina had the highest weed concentrations, lowest establishment, and the lowest crude protein content. RM4's better performance may be attributed to its adaptation to low rainfall, drought tolerance, and strong early establishment.

Aphid infestations between August and September may have influenced plant growth and biomass accumulation in some vetch varieties. Despite this, vetch exhibited significantly higher protein content than both the mix and oats. These findings highlight the potential of vetch, particularly RM4, to enhance forage quality and biomass production in hay rotations. However, challenges such as weed pressure, nodulation performance, and pest susceptibility require further investigation to optimise economic returns and sustain the rotational benefits for subsequent cereal crops.

ACKNOWLEDGEMENTS

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