

Nitrogen from Legumes

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Aims

The aim of the demonstration is to quantify the nitrogen supplied by a vetch brown manure crop, vetch silage, adzuki bean fallow and poultry manure for the following maize crop. This project concept arose from previous Riverine Plains Irrigation Discussion Group nitrogen discussions and aims to quantify the amount of nitrogen that could be supplied by legume crops.

Method

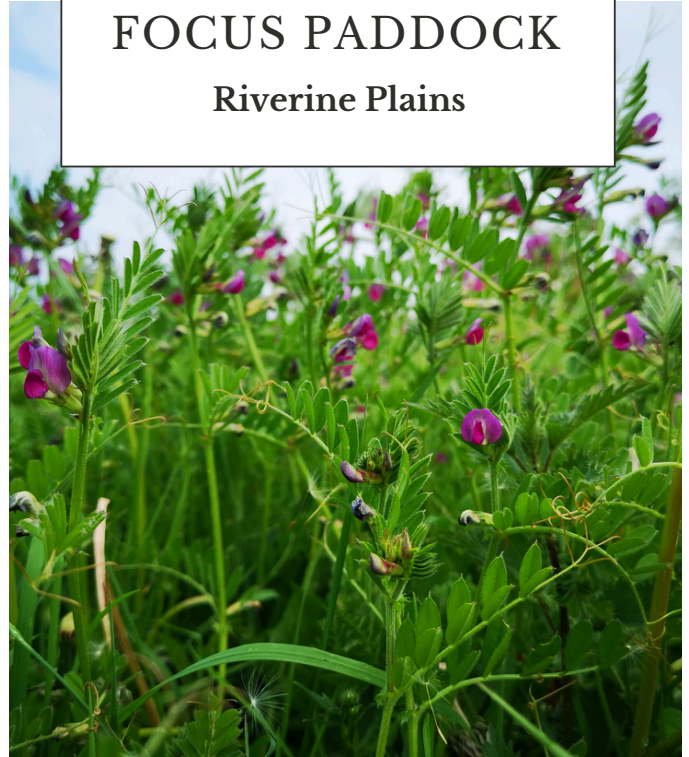
To compare the amount of nitrogen supplied by legume crops, 2 case study paddocks were chosen. The first paddock had an adzuki crop in the summer of 22/23 followed by a Pioneer P1837 Feed Grain or silage hybrid crop sown on 1 November 2023.

The second paddock was sown to a mix of 40kg/ha of Volga vetch, 7.5kg/ha of Persian clover and 7.5kg/ha of Tetila Rye on the 27th of April 2023. The cost of the seed mix was \$160/ha, the inoculant cost was \$40/ha, MAP applied at a rate of 50kg/ha was \$68/ha and the cost of sowing the paddock was \$35/ha.

The paddock was then split into two. One section of the vetch was cut for silage, which was sold standing. The other section of vetch was sprayed on the 6 September 2023 at a cost of \$51/ha and then incorporated as a brown manure using a Horsch Tiger on the 20 October 2023, before being sown to P1837 Feed Grain or Silage hybrid crop sown on 30 October 2023.

FOCUS Paddock

Riverine Plains



Focus Paddock Details

Location: Howlong NSW

Crop Type: Maize

Irrigation System: Overhead spray irrigation

The maize at all sites was pre-spread with 6t/ha of poultry manure and a received a total of 800kg/ha of urea in 2 applications of 600kg/ha and 200kg/ha.

The three sites: adzuki beans, vetch green manure and vetch silage were tested for deep nitrogen levels (0-90cm) on the 17 October 2023, prior to sowing the maize and spreading the manure. The sites were then retested on the 21 May 2024 at the exact same GPS locations after maize was harvested.

Results

The highest nitrogen levels (169kgN/ha) in October 2023 were in the Adzuki bean site, followed by the vetch green manure site (130kgN/ha), then the vetch silage (54kgN/ha) (Table 1). At all three sites most of the nitrogen was in the top 30cm.

The maize yielded 16t/ha in the adzuki bean rotation, while higher yields of 19.1t/ha were achieved in the vetch rotation. The reason for the lower yields in the adzuki bean rotation were attributed to poorer germination due to possibly overworking the paddock and underwatering a part of the paddock. The yields in the underwatered section were sub 10t/ha whereas the rest of the paddock yielded on par with the yields in the vetch rotation.

Following the harvest of the maize crop, the highest levels of nitrogen were in the vetch green manure site (313kgN/ha), followed by the Adzuki bean site (133kgN/ha) and then the vetch silage site (90 kgN/ha). There was a decrease in total Nitrogen in the Adzuki bean/Maize rotation while the total nitrogen in both vetch/maize rotations increased, indicating that the vetch residue was breaking down into available nitrogen over the summer.



Table 1 Deep Nitrogen and Maize Yield results from three different rotations.

Rotation	Depth	Oct-23	Maize Yield	May_24
		Total KgN/ha	16.0 t/ha	Total KgN/ha
Adzuki Beans 22 / Maize 23/24	0-30	79		36
	30-60	58		58
	60-90	32		40
		169		133
Vetch green manured 6/09/23 / Maize 23/24	0-30	90	19.1 t/ha	223
	30-60	14		68
	60-90	25		22
		130		313
Vetch silage 23 / Maize 23/24	0-30	25	19.1 t/ha	43
	30-60	11		29
	60-90	18		18
		54		90

Gross Margins

The vetch silage was sold standing. Once the costs of seed and sowing were considered, the gross margin was \$808/ha (Table 2). The vetch green manure income was determined based on the additional nitrogen fixed compared to the silage, in October 2023 and May 2024 (Table 3).

An additional 76kgN/ha was fixed by green manure compared to silage in October 2023, while an additional 223kgN/ha was fixed by the green manure in May 2024. Based on a urea price of \$852/t, the value of the nitrogen was \$553/ha. The costs of the green manure included, seeding and sowing vetch, spraying out the green manure and cultivation using a Horsch Tiger. After costs were considered, the gross margin of the green manure was \$99/ha.

Table 2. Vetch Silage Gross Margin

Income	6.35 t/ha	175 \$/t	\$1,111 \$/ha
Less Costs			
Sow paddock		35 \$/ha	
Seed and Inoculant		200 \$/ha	
MAP		68 \$/ha	
Gross Margin			\$808 \$/ha

Table 3. Vetch Green Manure Gross Margin

Income			
Additional nitrogen compared to silage Oct 23	76 kgN/ha	1.85 \$/kgN	\$140
Additional nitrogen compared to silage May 24	223 kgN/ha	1.85 \$/kgN	\$413
			\$553 \$/ha
Less Costs			
Sow paddock		35 \$/ha	
Seed and Inoculant		200 \$/ha	
MAP		68 \$/ha	
Spray out vetch pasture		51 \$/ha	
Cultivate Horsch Tiger		100 \$/ha	
Gross Margin			\$99 \$/ha

Discussion and Conclusion

The demonstration showed that legume crops, such as Adzuki Beans and Vetch (silage or green manure) can contribute significant amounts of nitrogen to an irrigated farming system. It also showed that green manuring vetch provided longer lasting, larger amounts of residual nitrogen compared to silaged vetch or adzuki beans, because green manuring keeps all the nitrogen in the system, rather than removing it through silage or grain.

Although the green manure can provide significant amounts of nitrogen over an extended period, it means that there is no cashflow in the winter that the crop is green manured. Whereas a crop such as Adzuki beans or Faba beans can provide some income, through sale of crop as well as some residual nitrogen.



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