

RiskWiSe: To Fallow or Not to Fallow? Soil Moisture Management and Cover Crop Risks and Rewards

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KEY MESSAGES

- Significant response to nitrogen when there was no legume or fallow in the rotation.
- Legume and fallow phases provided sufficient nitrogen in 2025.
- The yield benefit of fallow was not enough to justify leaving the crop out at this site in 2024.

AIM

This trial aims to explore key uncertainties in crop sequencing and nitrogen management, offering growers practical insights to support better decisions and reduce on-farm risks. It forms part of the national GRDC RiskWiSe project, which works with Australian grain growers to evaluate farm management strategies that balance risk and reward.

BACKGROUND

This trial was established in 2023 by the Liebe Group after the questions of “to fallow or not to fallow” came up during a bus tour in 2022. Growers often use fallow or break crops to improve soil health and increase production in the following seasons while also benefitting from moisture retention, weed control and nitrogen fixation. However, the risks and rewards of these practices are not often understood.

In its third year of rotation, this trial continues to evaluate the effects of various crop sequences: (i) continuous wheat, (ii) chemical fallow with stubble, (iii) legume crop, and (iv) legume cover crop incorporated as brown manure. It follows a factorial design combining crop sequence and nitrogen management strategies over four years to reflect farm practice. Three nitrogen treatments (nil, low risk, and high risk) were applied to each crop sequence strategy, with the low-risk treatment targeting yield potential for a decile 5 season finish and the high-risk treatment targeting a decile 7-8 season finish.

TRIAL DETAILS

Trial location	DW & GD McIlroy, Pithara
Plot size & replication	8.75 m x 8.1 m x 3 replications
Soil type	Loam over gravel
Sowing date	28/05/2025
Sowing rate	70 kg/ha Scepter wheat 100 kg/ha Jurien lupins
Fertiliser	Pre: 110 kg/ha MacroPro Extra with Impact (canola and legumes), 110 kg/ha MacroPro Extra with Uniform (wheat), 100 kg/ha Urea (wheat and canola)
Trial management	28/05/2025: 3 L/ha Weedmaster DST, 1 L/ha (lupins) & 1.8 L/ha (wheat) Treflan, 1 L/ha Rustler (lupins), 1 kg/ha Simazine (lupins), 3 L/ha Sprayseed (Wheat), 118 g/ha Sakura (Wheat), 200 ml/ha Voraxor (Wheat), 800mL/ha Chlorpyrifos, 100 mL/ha Bifenthrin.
Growing season rainfall	298.4 mm
Harvest date	04/12/2025

CROP SEQUENCE

Sequence Name	Crop Rotation	Phases
Continuous wheat	Wheat (1 phase)	WWW
Low risk, low return, N mining	Fallow - Wheat (3 phases)	FWW, WFW, WWF
Low risk, low return, N building	Brown Manure Lupins - Wheat (3 phases)	BMWW, WBMW, WWBM
High risk, high return	Lupins - Wheat (3 phases)	LWW, WLW, WWL
Tactical	Lupins - Canola - Wheat (1 phase)	LCW

NITROGEN TREATMENTS

Strategy	Treatment
Nil	No nitrogen was applied (other than 20 kg/ha N at sowing).
Low risk	70 units of nitrogen was applied in total (including 20 kg/ha N at sowing). Nitrogen applications are based on a decile 5 season finish (Yield Prophet prediction).
High risk	110 units of nitrogen was applied in total (including 20 kg/ha N at sowing). Nitrogen applications are based on a decile 7/8 season finish (Yield Prophet prediction).

*Lupins received 5 kg/ha N at sowing

RAINFALL

Pithara monthly rainfall (mm).

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
2023	6	0	25	6	21	38	23	17	4	0	26	14	180
2024	0	9	45	3	2	50	62	39	4	5	21	5	245
2025	0	7	47	21	20	39	78	90	33	17	14	3	369

RESULTS

Yield & Nitrogen 2024-2025

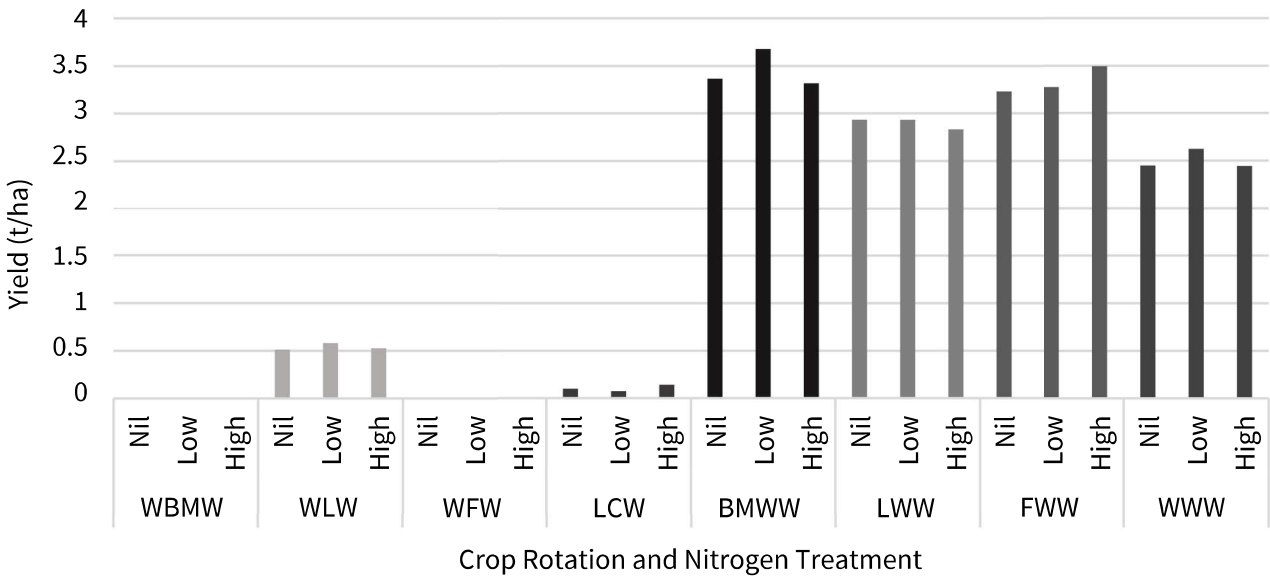


Figure 1. 2024 wheat yield (t/ha) across crop rotations and nitrogen treatments.

In 2024, the highest wheat yield was recorded in the brown manured lupin treatment, followed by the fallow treatment, lupin treatment then the continuous wheat.

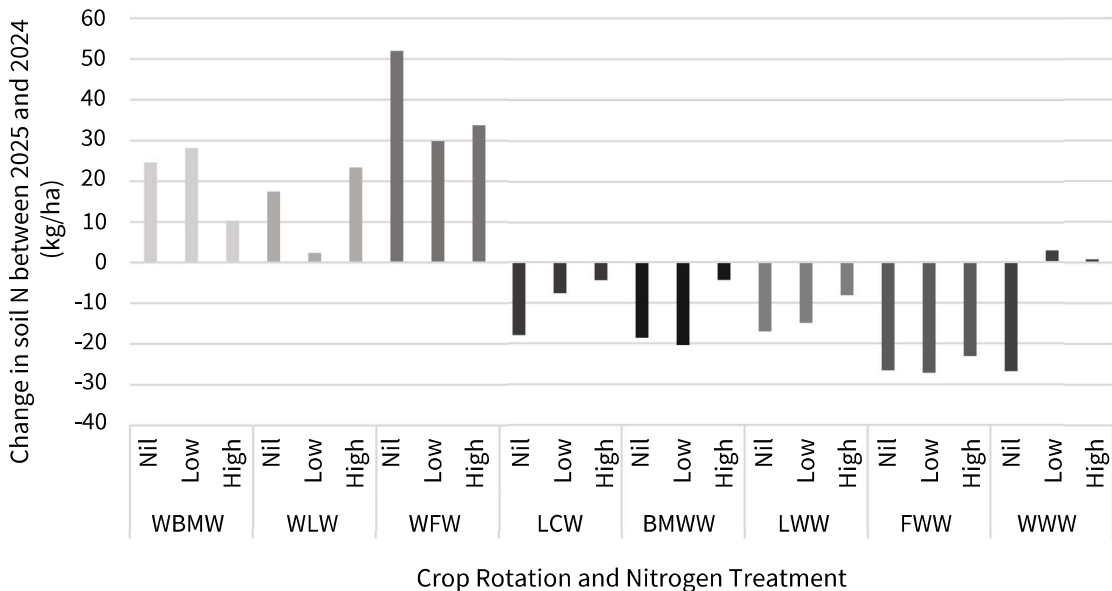


Figure 2. Change in total nitrogen (NO3 + NH4) between April 2025 and 2024 (kg/ha).

The soil nitrogen levels measured in April 2025, were significantly depleted where there was wheat grown in 2024, following a legume/fallow in 2023, the result exacerbated by Nil – Low Nitrogen additions. Higher N levels were recorded where a legume/fallow was implemented in 2024.

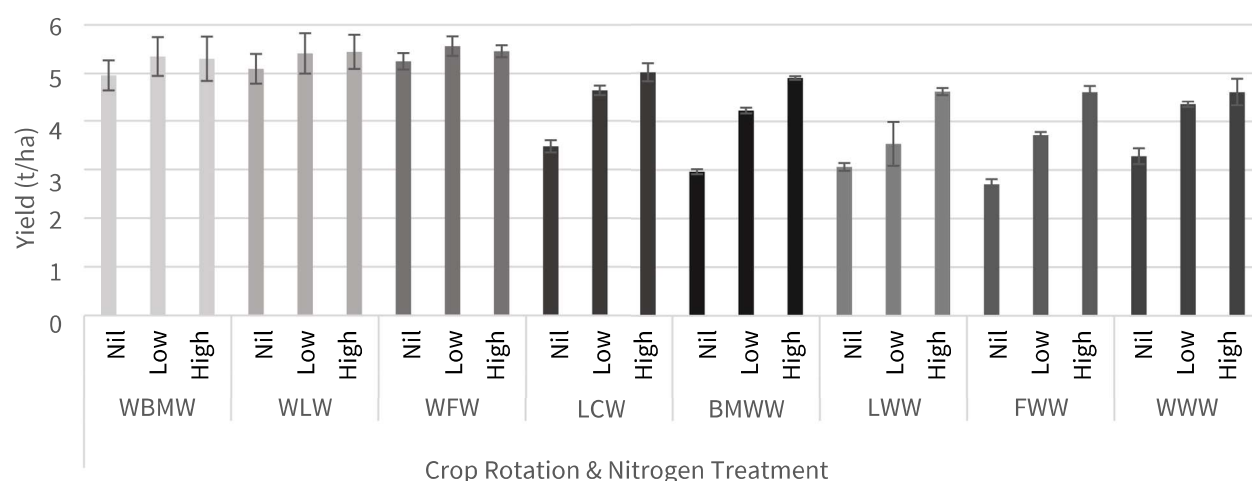


Figure 3. 2025 wheat yield (t/ha) across crop rotations and nitrogen treatments.

Grain yield in 2025 was significantly influenced by both crop rotation and nitrogen (N) strategy, with a significant Crop Rotation × N Strategy interaction ($p < 0.01$), indicating that yield responses to N varied depending on rotation history. Crop rotation had a strong effect on yield ($p < 0.001$), with wheat following fallow or legume phases generally producing higher yields than continuous cereal rotations. Nitrogen strategy also significantly affected yield ($p < 0.001$); however, the magnitude of response differed among rotations. In higher-yielding rotations (e.g. wheat following fallow or legumes), yield responses to increased N were relatively modest, whereas larger responses were observed in lower-yielding, continuous cereal rotations.

Protein

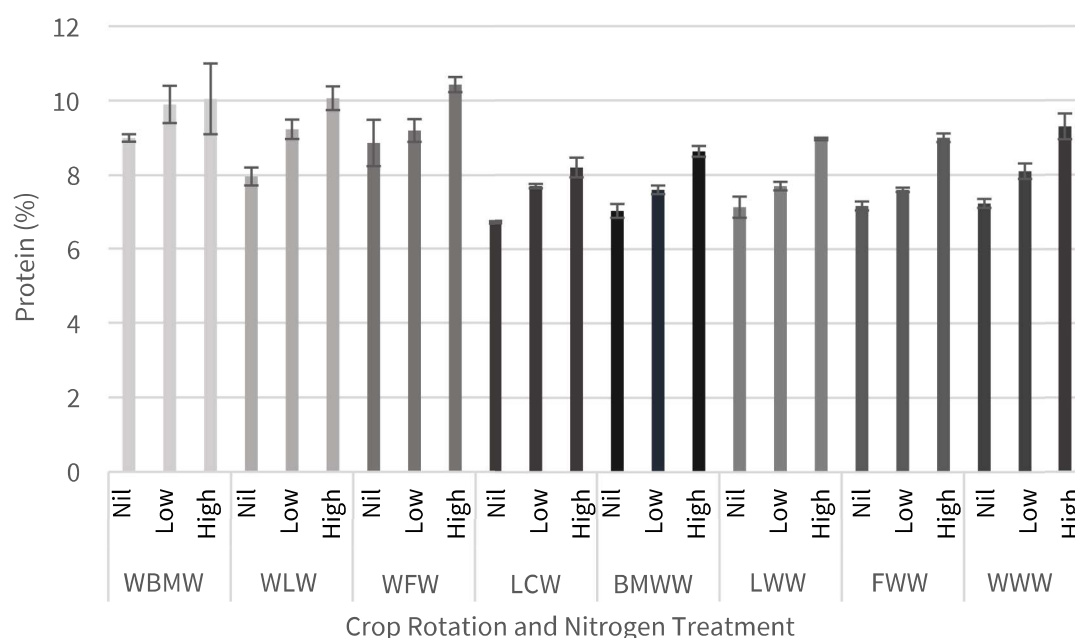


Figure 4. 2025 wheat protein (%) following various rotations with three nitrogen treatments.

Crop rotation and N strategy both had a strong effect on protein ($p < 0.001$), with higher N resulting in increased protein concentration across all rotations. Rotations including fallow or legumes in 2024 also achieved higher protein compared with continuous wheat.

Screenings

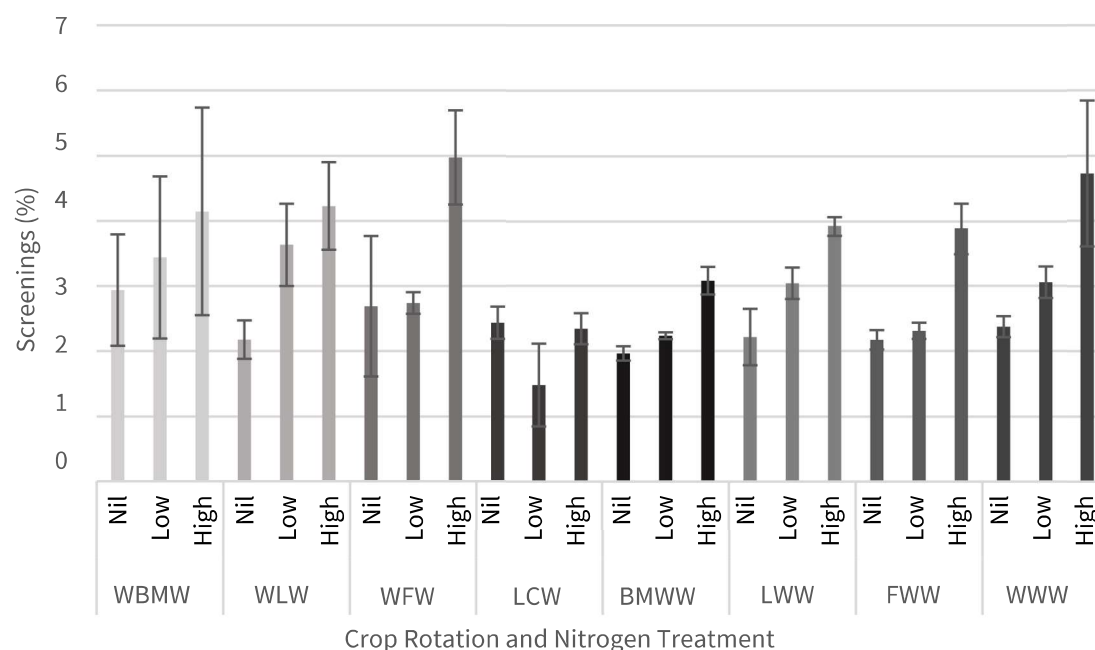


Figure 5. 2025 wheat screenings (%) following various rotations with three nitrogen treatments.

Screenings were significantly affected by crop rotation ($p = 0.019$) and N strategy ($p < 0.001$), with higher N generally leading to higher screenings. Fallow and Legume rotations in 2024 tended to produce higher screenings. All rotations fell under the 5% quality standard on average.

COMMENTS

In 2025, the wheat yields generally reflected the nitrogen status of the soil, which is likely due to the crop rotation history of the trial (Figure 3). Continuous wheat (WWW) produced the lowest yields overall, with the nil nitrogen treatment yielding 3.3 t/ha and rising to 4.6 t/ha in the high nitrogen treatment. These results align with the low residual nitrogen measured in the continuous wheat treatments. Nitrate levels were between 16 and 26 kg/ha, and the ammonium was between 3 and 6 kg/ha, indicating a nitrogen depletion, which is seen in Figure 2.

Wheat grown after fallow, legumes or brown manure had noticeably higher yield, which was largely due to the increased soil nitrogen from those phases. Wheat in 2023, followed by a legume or fallow in 2024, increased the soil nitrogen reserves, which was reflected in the total nitrogen differences between seasons (Figure 2). In 2025, the wheat–fallow–wheat (WFW) treatment performed the best, with an average of 5.3 t/ha in the nil nitrogen treatment. Wheat–brown manure–wheat (WBMW) and wheat–legume–wheat (WLW) also yielded strongly, with an average of 5.0–5.1 t/ha in the nil nitrogen treatment, and only small increases to 5.3–5.4 t/ha in the low or high nitrogen treatments.

In contrast, rotations that had a legume or fallow in 2023, followed by wheat or canola in 2024, appeared to have mined soil nitrogen due to higher crop demand in 2024 (Figure 1). This was also reflected in the second wheat crop, where soil nitrogen levels were lower, and yield responses to applied nitrogen were stronger (Figures 2 and 3). Other rotations such as legume–canola–wheat (LCW) and brown manure–wheat–wheat (BMWW) had more moderate results, with yields rising from 3.0–3.5 t/ha in the nil nitrogen treatment to nearly 5.0 t/ha in the high nitrogen treatment (Figure 3).

Fallow phases increased nitrogen availability by promoting organic matter decomposition and nitrogen mineralisation through higher stored soil moisture. This increase in soil moisture and nitrogen has been a primary driver of yield increases in this trial. However, the yield increases observed in this trial in 2025 would not have been enough to compensate for the loss of crop in 2024. However, the fallow phase would have been justified in the poor 2023 season, with a larger response in 2024 yields compared to continuous wheat. It is important to note that

whilst the fallow phase supports higher yields in the year immediately following the fallow, it does deplete the soil of more N than the other rotations in the second year (Figure 2), thus requiring a higher level of N input in that season.

Grain quality patterns reflected the same rotation and nitrogen effects seen in yield. Protein increased from nil to high nitrogen in nearly all rotations, with the highest values occurring where soil nitrogen was strongest, such as WFW, WBMW and WLW. Continuous wheat recorded the lowest protein levels. Screenings generally increased with greater nitrogen availability, suggesting that stronger crop growth may have led to more variation in grain size. Overall, these quality results highlight that rotations which build soil nitrogen not only improve yield potential but also influence grain quality in the following wheat crop.

Further economic analysis is still required to be completed as part of this project to assess the profitability of each of the different strategies.

ACKNOWLEDGMENTS

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