Agronomic and economic benefits of fallow in the low rainfall zone of Western Australia.

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Key words

Fallow, soil moisture, nitrogen, grain quality.

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Key messages

1. Growers considering fallow should implement a 'brown out' practice, keep paddocks weed free and maintain ground cover. This practice results in the highest amount of stored soil moisture, allows N to accumulate and be available for the following crop and provides an opportunity to control glyphosate resistant ryegrass.

2. Saving 1mm of plant available water costs $4/ha.

3. The cereal on cereal treatment recorded the highest gross margin. Despite the gross margin of the brown out practice being lower than cereal on cereal, feedback gathered from growers during the project suggests it does have a positive economic benefit to the farm system overall. Perhaps fallow is best considered a strategic investment and recorded as an asset on the grower's balance sheet.

Aims

To determine the agronomic and financial benefits of different fallow management practices in the low rainfall zone of Western Australia.

Introduction

Growers in the low rainfall zone of Western Australia (WA) are interested in fallow. However, some growers are hesitant to adopt the practice because there are knowledge gaps in what is the best fallow system to adopt, what is the impact of different fallow systems on soil moisture, soil nitrogen, grain yield and quality, and what are the economic effects of different fallow systems?

Past research (Developing farming systems for the LRZ of WA - CSA00056) reported a 0.62 t/ha grain yield increase in wheat after fallow compared to the continuous wheat rotation at Merredin. At Hyden, there was a 0.45 t/ha increase in wheat yield in the fallow-wheat-fallow-wheat rotation compared to the continuous wheat rotation.

This paper reports the results of six farm-scale trials established in the eastern WA wheatbelt between 2022 and 2023. In 2023, an additional eight fallow trial sites were established. The results from these sites have not been reported but will be available in future Research Updates papers.

Method

In 2022, six farm scale (plots 200m long x width of the grower boom spray, varying between 36m and 55m) trials were established, managed, and harvested using grower machinery. Trials were established near Kalannie (sandy loam), Gabbin (sandy loam), Bonnie Rock (sandy loam), Nungarin (clay/loam), Hines Hill (loam) and Merredin (loam).

Each trial had four treatments: 1) cereal, 2) vetch, 3) volunteer pasture, and 4) brown out. Wheat was sown at five sites, barley was sown at the Nungarin trial. The brown out treatment was kept weed-free all growing season. The volunteer pasture and vetch treatments were sprayed before seed set in late August/early September. All treatments were kept weed free over 2022/23 summer.

In 2023, the trials were managed ‘as-per-grower practice’. The trial at Kalannie was sown to canola, all remaining trials were sown to wheat.

To determine the effect of different treatments on soil moisture, all trials were sampled in October 2022 and April 2023. Each plot was sampled in 100mm increments down to 600mm. In April 2023, each plot was sampled in 100mm increments down to 300mm and analysed for nitrate and ammonia to determine soil nitrogen (N) levels.

At harvest in 2023, grain yield was taken from each plot, a sample was collected and sent for analysis to determine treatment effects on grain quality.

A gross margin analysis was completed for each trial in 2022 and 2023 to compare the economic effects of different treatments.

Statistical analysis was completed using ANOVA at p>0.10. Analysis was completed across treatments at each site.

Results

Soil Moisture

At the end of the 2022 growing season, the brown out treatment recorded the highest level of soil moisture, 24mm, 38% more than the cereal treatment. The cereal and vetch treatments recorded similar levels of soil moisture (Table 1). By April 2023, all treatments recorded similar levels of soil moisture (Table 2). Treatment differences recorded for the level of soil moisture in October did not carry over to April due to rainfall between November 2022 and April 2023. Rainfall varied between sites, ranging from 25mm at Kalannie to 128mm at Nungarin.

Table 1: Soil moisture (mm) to 600mm for each trial site in October 2022.

Trial Location	Cereal	Vetch	Volunteer Pasture	Brown Out
Kalannie	44	50	67	82
Gabbin	52	49	50	60
Bonnie Rock	45	47	50	78
Nungarin	88	84	107	114
Hines Hill	73	80	78	86
Merredin	73	86	104	99

Table 2: Soil moisture (mm) to 600mm for each trial site in April 2023.

Trial Location	Cereal	Vetch	Volunteer Pasture	Brown Out
Kalannie	45	45	44	66
Gabbin	51	56	50	53
Bonnie Rock	56	64	64	47
Nungarin	91	103	116	110
Hines Hill	76	86	90	81
Merredin	104	104	69	88

Nitrogen (N)

The vetch and brown out treatments had similar levels of N in the soil, 14 and 15 kg N/ha, respectively. There was a slight increase in N in the volunteer pasture treatment compared to the cereal treatment, 5 kg N/ha (Table 3).

Table 3: Soil nitrogen (kg N/ha) to 300mm for each trial site in April 2023.

Trial Location	Cereal	Vetch	Volunteer Pasture	Brown Out
Kalannie	15	17	18	24
Gabbin	29	37	40	36
Bonnie Rock	31	62	33	64
Nungarin	12	25	21	36
Hines Hill	16	30	11	25
Merredin	14	31	26	23

Grain Yield and Quality

The brown out and volunteer pasture treatments resulted in a grain yield increase of 0.43 t/ha and 0.47 t/ha, respectively, compared to the cereal on cereal treatment. This result is consistent with grower observations gathered during the project that yield increases in cereals following fallow are about 0.5 t/ha. The yield increase in cereal following vetch was 0.33 t/ha.

All fallow practices increased grain protein, this ranged from 1.18% in cereals grown after vetch to 0.45% in cereals grown after volunteer pasture.

Table 4: Grain yield (t/ha) for the cereal treatment in 2022 and all treatments in 2023.

Trial Location	Cereal 2022	Cereal 2022[e] Crop 2023[f]	Vetch 2022 Crop 2023[f]	Volunteer Pasture 2022 Crop 2023[f]	Brown Out 2022 Crop 2023[f]	LSD
Kalannie	2.49	0.17^{d}	0.47^{b}	0.32^{c}	0.70^{a}	0.15
Bonnie Rock	2.94	1.05^{b}	1.45^{a}	1.51^{a}	1.41^{a}	0.18
Nungarin	0.66	1.19^{b}	1.45^{a}	1.38^{ab}	1.57^{a}	0.20
Hines Hill	2.61	1.50^{b}	1.99^{a}	2.11^{a}	2.20^{a}	0.31
Merredin	1.72	1.02^{c}	1.19^{bc}	1.48^{a}	1.44^{a}	0.25

[e]Trial at Nungarin was sown to barley in 2023. [f]The trial at Kalannie was sown to canola in 2023 all others were wheat. All other sites were planted with wheat. Grain yield results from the Gabbin site were not available in time to be included in this report. Grain yield followed by the same letter is not statistically significant p=<0.1.

Table 5: Grain protein (%) in wheat sown in 2023 following the 2022 treatments.

Trial Location	Cereal	Vetch	Volunteer Pasture	Brown Out	LSD
Gabbin	10.10[c]	11.10[ab]	10.90[bc]	11.80[a]	0.80
Bonnie Rock	11.20[c]	13.70[a]	11.90[bc]	12.20[b]	0.95
Nungarin	9.67[c]	13.20[a]	10.97[b]	12.03[b]	1.10
Hines Hill	10.30[b]	9.60[c]	11.20[a]	10.10[bc]	0.50
Merredin	11.00[c]	12.9[a]	10.40[c]	11.40[b]	0.70

Oil content for the canola at Kalannie was lost due to a sampling error. Grain protein followed by the same letter is not statistically significant p=<0.1.

Economics

The cereal on cereal treatment was the most profitable ($402/ha) over the two years of the project. This was followed by cereal after brown out ($207/ha), cereal after volunteer pasture ($160/ha) and cereal after vetch ($33/ha) (Table 5).

Table 5: Gross margin ($/ha) analysis for each treatment.

Treatment	2022	2023	Combined
Cereal 2022 Cereal 2023[a]	318	84	402
Vetch 2022 Cereal 2023	-211	244	33
Volunteer Pasture 2022 Cereal 2023	-71	232	160
Brown out 2022 Cereal 2023	-97	304	207

[a]Kalannie trial site was sown to canola in 2023 and has not been included in this analysis.

Conclusion

Based on the gross margin analysis, the most profitable practice for growers in the low rainfall zone is to grow cereal on cereal. However, this rotation is unlikely to be sustainable over the long term.

The brown out practice is the best option for growers looking to adopt fallow. This practice retains the most soil moisture, allows N to accumulate and be available for the following crop and provides an opportunity to control glyphosate resistant ryegrass.

This project has been extended until 2027, and all sites will continue to be monitored. More information on the agronomic and economic benefits of fallow will become available over the coming years.

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