Practice for Profit Trial

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Key Messages

- High and low inputs did not significantly impact production in 2017
- Crop rotation has had the greatest influence on yield and quality in 2017.
- Protein can be significantly impacted by the previous season's crop type and the current seasonal conditions.

Aim

The purpose of this trial is to investigate the interactions of crop rotation and input rates on the long term yield, quality and profitability of the farming systems of Dalwallinu region.

Background

Beginning in 2001 GRDC funded a project to investigate the benefits and economic impact of break crops and rotations over time in the Dalwallinu region. Prior to 2011 trials were conducted on different sites each year, resulting in data and information varying according to rainfall and soil type. In 2011 a long-term site on the Mills property just east of Dalwallinu was set up where the Liebe Group continue to investigate rotation practices and economic impact of input systems on overall enterprise profitability.

The following rotations and break crops are being investigated: continuous wheat, wheat on canola, wheat on fallow and wheat on field peas. High and low inputs are applied to mimic production systems seeking either maximum crop potential, taking seasonal conditions into account, or to produce a crop at the lowest possible cost, irrespective of seasonal conditions. The high cost of production puts increasing pressure on farm finances so the purpose of this trial was to see which of these alternative management strategies was more profitable in the long term.

The rotational history is shown in Table 1. High and low input treatments were not applied in 2011 but began in 2012. In 2013 the set rotation was not able to be planted due to a timing mismatch between rain and trial contractors resulting in the soil being too dry for the small trial seeding machinery to negotiate and the whole site was fallowed. Input costs associated with spray topping for fallow management has been included in the economic analysis. Low and high input wheat was planted in 2014 and 2015. 2016 saw the trial in its second rotational phase of wheat, field peas, canola and fallow. Unlike in 2011, all rotation inputs were adjusted for high and low treatments.

In 2017, the site entered its seventh consecutive season and returned to a wheat rotation. Inputs were adjusted to reflect grower standard practice for high and low input farming systems.

It is important to note that both high and low inputs of this trial are considered on a seasonal basis. The soil nutrition levels are tested annually and fertiliser rates adjusted accordingly with high input treatments reviewed midseason. Soil results are not reported here as all nutrients; Nitrogen, Potassium, Phosphorus and Sulphur, were adequate.

Trial Details

Property	Wenballa Farm, East Dalwallinu
Plot size & replication	8.8m x 12m x 3 replications
Soil type	Loamy clay
Soil pH ($CaCl_2$)	0-10cm: 5.1 10-20cm: 7.1 20-40cm: 7.5
EC (dS/m)	0-10cm: 0.112
Sowing date	10/05/2017
Seeding rate	See Table 2
Paddock rotation	See Table 1
Amelioration	11/05/2016: 500 kg/ha gypsum
Fertiliser	See Table 2:
Herbicides, Fungicides & Insecticides	10/05/2017: **High** – 400 ml/ha Flutriafol (500 g/L) in-furrow, Sakura 118 g/ha, Sprayseed 2 L/ha **Low** – 200 ml/ha Flutriafol (500 g/L) in-furrow, Trifluralin 2 L/ha, Sprayseed 2 L/ha 11/08/2017: Jaguar 1 L/ha, LVE 500 ml/ha
Growing season rainfall (April – October)	2017: 128 mm (36 mm February/March) 2016: 212mm (67 mm March)

Trial Layout

Table 1: Practice for Profit trial, rotation history.

Treatment	2011	2012	2013	2014	2015	2016	2017
1	Wheat	Wheat	Fallow	Wheat	Wheat	Wheat	Wheat
2	Wheat	Wheat	Fallow	Wheat	Wheat	Wheat	Wheat
3	Canola	Wheat	Fallow	Wheat	Wheat	Canola	Wheat
4	Canola	Wheat	Fallow	Wheat	Wheat	Canola	Wheat
5	Volunteer Pasture	Wheat	Fallow	Wheat	Wheat	Fallow	Wheat
6	Volunteer Pasture	Wheat	Fallow	Wheat	Wheat	Fallow	Wheat
7	Field Peas	Wheat	Fallow	Wheat	Wheat	Field Peas	Wheat
8	Field Peas	Wheat	Fallow	Wheat	Wheat	Field Peas	Wheat

Note: Stated input levels are for all treatment years, except rotation crops in 2011 and 2016 (Appendix B).

Table 2: 2017 Practice for Profit input rates.

Treatment	2017 Rotation	Variety	Input	Sowing rate (kg/ha)	Agstar Extra (kg/ha)	Urea (kg/ha)	Flexi-N 6 WAS (L/ha)
1	Wheat low	Mace	Low	40	50	45	0
2	Wheat high	Mace	High	80	70	45	0
3	Wheat low	Mace	Low	40	50	45	0
4	Wheat high	Mace	High	80	70	45	0
5	Wheat low	Mace	Low	40	50	45	0
6	Wheat high	Mace	High	80	70	45	0
7	Wheat low	Mace	Low	40	50	45	0
8	Wheat high	Mace	High	80	70	45	0

No post emergent Flexi N was applied in 2017 due to seasonal conditions and soil sample results indicating adequate N supply.

Results and Discussion

Seeding began at the site on May 10th in 2017 but there was no crop emergence until the beginning of July. The 2017 season was late to break, with 11mm rain received on July 2nd, and only 128 mm of Growing Season Rainfall (GSR). All plots were sown to Mace wheat. Due to the unfavourable seasonal conditions no post emergent fungicides, insecticides or nitrogen were applied.

Table 3 summarises the average soil pH and organic carbon (OC%) collected prior to seeding from 2012 to 2017. Due to the nature of continuous cropping, in most treatments, there has been a noticeable decline of 1.5 units in soil pH in the top 0-10 cm of the profile but organic carbon has improved by 0.26% over the lifetime of the trial, likely to be due to the retention of stubbles post-harvest since the beginning of the trial in 2011.

Table 3: Average organic carbon (OC) and pH ($CaCl_2$) across high and low input treatments taken from 2012-2017.

Year	Depth (cm)	Average pH ($CaCl_2$)	Average OC (%)
March 2012	0-10	6.6	0.66
	10-20	7.3	0.60
	20-30	8.0	0.42
July 2013	0-10	5.3	0.89
	10-20	7.1	0.48
	20-30	7.9	0.33
March 2014	0-10	5.7	0.89
	10-20	7.1	0.56
	20-30	7.5	0.51
November 2015	0-10	5.7	0.80
	10-20	6.9	0.52
	20-30	7.4	0.42
April 2016	0-10	5.4	0.83
March 2017	0-10	5.1	0.92

Note: 2013 was a chemical fallow across all plots.

A factorial analysis of variance was conducted on the 2017 wheat yield and quality data with four 'previous crop' types as one factor by two levels of 'input' (High and Low) as a second. In each case the interaction between 'previous crop' and 'input' was not significant, so the two main effects can be presented separately (Tables 5 and 6).

Wheat after canola was significantly lower yielding than after wheat, fallow, or field peas. This impact on yield is due to the effect of the previous crop herbicide management system. In this case, the previous canola crop was TT canola and early wheat establishment showed evidence of residual atrazine damage.

There was a close to significant increase in yield in wheat grown after chemical fallow compared to wheat after wheat (p=0.056). This is likely to be in part due to the soil moisture storage under fallow in 2016 becoming available to the 2017 wheat crop.

Table 5: Impact of previous crop on 2017 wheat yield and grain quality.

Previous Crop/stubble	2017 Wheat Yield	Protein (%)	Hectolitre (g/hL)	Screenings (%)	Grade
Wheat	1.55[b]	9.57[a]	81.84[a]	2.96[b]	ASW1
Canola	0.82[a]	12.07[c]	82.33[a]	3.25[b]	H2
Chemical Fallow	1.87[b]	11.10[b]	82.33[a]	1.95[a]	APW1
Field Peas	1.40[b]	11.27[b]	82.12[a]	2.62[ab]	APW1
LSD (P=0.05)	*0.48*	*0.743*	*1.231*	*0.813*	
CV (%)	*27.4*	*5.5*	*1.2*	*24.4*	
P value	*0.003*	*<0.001*	*0.802*	0.023	

Means followed by a different letter are significantly different.

There were highly significant differences in grain protein between previous crop types: wheat following canola had 12.07% protein, whilst the continuous wheat only achieved 9.57%. Wheat grain protein after fallow or field peas was also much higher than in continuous wheat.

There were also significant differences in screenings between previous crops. Screenings were significantly lower in wheat following chemical fallow than after other crops. This is likely due to the crop having access to more subsoil moisture during grain filling under the fallow, compared to those plots after wheat or canola, which had significantly higher screenings (most of which was small and pinched grain). Reduced screenings levels after fallow were also observed at Wongan Hills in 2010, where an increase in crop production and low screenings (5.8% compared to 7.4% after wheat) after fallow was attributed to stored soil moisture, reduced weed burden and increased soil mineralised N (French 2012).

Table 6: Impact of High and Low inputs on 2017 wheat yield and grain quality

Treatment	2017 Wheat Yield	Protein (%)	Hectolitre (g/hL)	Screenings (%)	Grade
High	1.53[a]	11.07[a]	82.08[a]	2.59[a]	APW1
Low	1.28[a]	10.93[a]	82.22[a]	2.80[a]	APW1
LSD (P=0.05)	*0.34*	*0.525*	*0.871*	*0.575*	
P value	*0.138*	*0.595*	*0.732*	*0.441*	

There were no significant yield or quality differences between high and low inputs (Table 6). This indicates that low input levels did not significantly compromise production in 2017, but also that there was no significant response to increased inputs. The effect on yield was the closest to being significant with 'High' having 0.25 t/ha higher yield (p=0.14).

Analysis of harvested seed in 2017 for nitrogen, potassium, phosphorus, copper, zinc and manganese showed no significant differences between treatments for any nutrient. All nutrients were considered adequate.

Economic Analysis

Table 7: Economic Analysis as Operating Profit ($/ha) over 7 year lifetime of the trial

	Treatment	Average Income	*Average Full Costs	Operating Profit	Full Cost as % Income	Profit Margin	Extra Investment	Return on the Extra Investment	*Simple Low Risk* Comparison to Wheat Low	*Lowest Cost* Comparison to Pasture Low	*Highest Cost* Comparison to Wheat High
1	Wheat low	500	424	76	85%	15%			0	154	21
2	Wheat high	526	471	56	89%	11%	47	-44%	-21	133	0
3	Canola low	439	394	45	90%	10%			-31	123	-11
4	Canola high	513	438	75	85%	15%	44	67%	-2	152	19
5	Chemical fallow low	263	340	-77	129%	-29%			-154	0	-133
6	Chemical fallow high	258	372	-114	144%	-44%	32	-115%	-190	-37	-170
7	Field Peas low	351	381	-30	109%	-9%			-107	47	-86
8	Field Peas high	393	437	-44	111%	-11%	56	-26%	-121	33	-100

*Costs only include seed, fertiliser, chemical and CBH costs
Other costs include fixed costs at $117/ha and Operation costs at $200/ha as per the 2017 Farmanco Profit Series for low to medium rainfall zone.

After investigating the effects of crop rotation and input levels for the past six seasons, the economic analysis as depicted in table 7 begins to show how the system affects operating profit over time.

A low input system may perform well over a number of years, as noticed under the continuous Wheat Low system which returned $76/ha as operating profit at a 15% margin over the past seven seasons, however analysis does not recognise the potential risk that this low input system is placing on the long term management and profitability. Where fewer inputs are applied, growers increase the risk of exposing their crop and the future farming system to greater weed pressure, disease and lower yields.

While there was a significant improvement in wheat yield in treatments 6 and 5 compared to other treatments in 2017, resulting in the highest Gross Margins (Appendix A) at $348.44/ha and $301.96/ha respectively, the lack of income from both 2013 and 2016 has impacted negatively on the long term profit margin (Table 7). Although the high input fallow treatment had higher gross margin in 2017 its average income over the 7 years of the trial was less than the low input fallow (Table 7) so there is a negative return on the extra $32/ha investment made on fertiliser and chemical over the lifetime of the trial.

Comments

All treatments performed well in 2017, despite the low GSR of only 128mm. At present, after seven years of consecutive analysis of yield and economic return at this site, the continuous wheat rotation remains the most consistent in its financial returns.

As noted in the economic analysis, the level of risk a grower can sustain when adopting a low input farming system may become evident in future years of this trial. Careful observation and measurement of weed and disease pressure will further support the initial objective of the High versus Low input analysis, to determine if and when a particular system may show signs of 'breaking'.

It was evident during crop establishment, that the site showed considerable variability. The nature of this variability suggests that some plots are influenced by shallow rock which, during dry seasons such as that experienced in 2017, many plots were negatively affected.

The Liebe Group aim to continue the Practice for Profit trial in 2018, where a second wheat phase will be adopted.

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References

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