Responsive Farming Using Wheat Agronomy

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RESEARCH

Location
Minnipa Ag Centre

Rainfall
Av Annual: 325 mm
Av GSR: 242 mm
2009 Total: 421 mm
2009 GSR: 333 mm

Yield
Potential: 5.2 t/ha (W)
Actual: 5 t/ha Wyalkatchem local TOS1

Paddock History
2008: Wheat
2007: Wheat

Soil Type
Sandy loam to sandy clay loam

Soil test
Presented

Diseases
Moderate Rhizoctonia

Plot size
9 x 1.48 m

Yield Limiting Factors
Nil

Water Use
Water use efficiency:
Early sowing better
Runoff potential: Nil

Resource Efficiency
Energy/fuel use: Standard
Greenhouse gas emissions (CO_2, NO_2, methane): Standard

Social/Practice
Time (hrs): Standard
Clash with other farming operations: Nil
Labour requirements: Standard

Economic
Infrastructure/operating inputs: Standard
Cost of adoption risk: Standard
Market stability risk: Standard

Key messages

- **The early to mid season varieties Wyalkatchem and Mace performed well if sown early, while Axe performed well against the other varieties if sown later, facing a shorter growing season.**
- **Matching wheat variety selection with sowing date and soil type can help to maximise returns.**

Why do the trial?

It is critical in a region of low and variable rainfall, and a time of high input costs and fluctuating commodity prices, that water use efficiency (WUE) is maximised to get the best possible yield and economic outcome for a crop. It is considered that early maturing wheat lines perform well under low rainfall situations in field trials. Trials were established to see how the commonly grown varieties with a range of maturities respond to seasonal conditions, soil type and sowing time, i.e. to evaluate how they can best fit into the farming system.

How was it done?

Paddock N1 at Minnipa Agricultural Centre was zoned using yield and EM maps to produce distinct production zones which were called poor, medium and good. The medium (sandy clay loam) and good (loamy sand) soil types were chosen for soil type comparisons.

Small plot trials were established on 3 sowing dates (4 May, 26 May and 18 June) to compare wheat lines with a range of maturity dates, Axe (early), Wyalkatchem sourced from Roseworthy, Mace and a local Wyalkatchem seed line (early to mid season), Gladius (mid season) and Correll (mid to late season). Plots received typical weed management. The two lines of Wyalkatchem were selected to compare if any yield potential was lost by using seed saved from drought years.

Soil moisture was measured at anthesis and harvest of the mid season variety Wyalkatchem at each time of sowing (TOS) treatment. Biomass of each line was sampled at their specific anthesis date, and plots were harvested and grain samples collected for yield and quality on 5-6 November, 16 November and 25 November for TOS 1, 2 and 3 respectively.

What happened?

The first rain for the growing season was late April, with 25 mm allowing TOS 1 to go ahead on 4 May. TOS 2 was sown on 26 May immediately following 30 mm of rain. TOS 3 was sown on 18 June following 60 mm rain over 6-16 June. A total of 35, 90, 100, 29 and 42 mm of rain fell in May, June, July, August and September respectively. There was no recorded temperature below 2°C from April to October.

Soil water content at anthesis and harvest for each TOS in the 0-0.4 and 0.4-1 m soil profiles for both the medium and good soil types is presented in Tables 1a and 1b.

Time of sowing 1 had more available water in the 0–1 m soil profile at anthesis in both the medium and good soil types. All TOS soil water contents were similar at harvest which meant there was more water utilised post anthesis in TOS 1 than TOS 2 and 3.

Table 1a Effect of TOS on soil water content on medium soil, N1 MAC, 2009

Sowing time	Gravimetric soil water content (mm)			
	Anthesis	Harvest	Anthesis	Harvest
Soil depth	**0 - 0.4 m**	**0 - 0.4 m**	**0.4 - 1 m**	**0.4 - 1 m**
TOS 1	31	13	43	29
TOS 2	25	14	37	33
TOS 3	23	14	33	33
LSD (P=0.05)	*4.9*	*ns*	*6.8*	*ns*

Table 1b Effect of TOS on soil water content on good soil, N1 MAC, 2009

Sowing time	Gravimetric soil water content (mm)			
	Anthesis	Harvest	Anthesis	Harvest
Soil depth	**0 - 0.4 m**	**0 - 0.4 m**	**0.4 - 1 m**	**0.4 - 1 m**
TOS 1	30	18	37	27
TOS 2	22	21	29	24
TOS 3	26	15	31	25
LSD (P=0.05)	*6.8*	*ns*	*6.7*	*ns*

Table 2a Wheat production on medium soil N1 MAC, 2009

TOS	Variety	Grain yield	Grain protein	Screenings	Test weight
		(t/ha)	(%)	(%)	(g/hL)
TOS only					
1		4.7	12.3	1.3	79.8
2		3.9	12.2	1.5	84.1
3		3.3	12.6	1.4	79.7
	LSD (P = 0.05)	*0.16*	*0.5*	*ns*	*1.07*
Variety only					
	Mace	4.2	11.4	1.5	81.7
	Wyalkatchem	4.2	12.1	0.9	81.8
	Axe	3.7	12.6	0.9	82.0
	Gladius	3.8	13.2	1.4	80.9
	Correll	3.7	13.2	2.6	78.7
	Wyalkatchem - local	4.2	11.8	1.0	82.0
	LSD (P = 0.05)	*0.16*	*0.25*	*0.5*	*1.06*
TOS x Variety					
1	Mace	5.0	11.3	2.3	78.7
1	Wyalkatchem	5.0	11.8	1.0	81.1
1	Axe	4.4	12.8	0.3	80.2
1	Gladius	4.5	13.3	1.5	79.8
1	Correll	4.4	13.1	2.0	78.1
1	Wyalkatchem - local	5.1	11.4	1.0	69.6
2	Mace	3.9	11.4	1.3	81.0
2	Wyalkatchem	4.1	11.9	1.0	85.0
2	Axe	3.6	12.3	1.5	84.8
2	Gladius	3.9	12.9	1.8	84.6
2	Correll	3.8	13.4	2.3	84.0
2	Wyalkatchem - local	4.1	11.7	1.0	81.8
3	Mace	3.6	11.5	1.0	73.7
3	Wyalkatchem	3.5	12.6	0.8	84.5
3	Axe	3.2	12.7	1.0	81.5
3	Gladius	3.1	13.6	1.0	79.8
3	Correll	2.9	13.1	3.5	81.3
3	Wyalkatchem - local	3.5	12.2	1.0	79.0
	LSD (P = 0.05)	*0.28*	*0.60*	*0.83*	*2.11*
LSD (P = 0.05) within TOS		*0.28*	*0.43*	*0.86*	*1.90*

Table 2b Wheat production on good soil N1 MAC, 2009

TOS	Variety	Grain yield	Grain protein	Screenings	Test weight
		(t/ha)	(%)	(%)	(g/hL)
TOS only					
1		4.6	11.6	1.5	82.0
2		3.6	11.7	1.0	82.0
3		2.9	11.4	1.4	80.0
	LSD (P = 0.05)	*0.1*	*0.2*	*0.1*	*1.4*
Variety only					
	Mace	3.8	11.1	1.3	82.6
	Wyalkatchem	3.8	11.1	0.8	82.2
	Axe	3.5	12.2	0.9	81.4
	Gladius	3.7	12.0	1.4	81.1
	Correll	3.6	12.2	2.5	79.0
	Wyalkatchem - local	3.9	11.0	0.8	82.4
	LSD (P = 0.05)	*0.2*	*0.3*	*0.3*	*0.9*
TOS x Variety					
1	Mace	4.9	11.1	1.5	83.7
1	Wyalkatchem	4.7	11.0	0.9	82.7
1	Axe	4.3	12.6	1.0	80.8
1	Gladius	4.7	12.0	1.6	81.8
1	Correll	4.4	12.3	2.7	79.7
1	Wyalkatchem - local	5.0	10.8	1.0	82.6
2	Mace	3.6	11.3	1.3	82.1
2	Wyalkatchem	3.8	11.4	0.5	83.0
2	Axe	3.3	12.3	0.7	82.3
2	Gladius	3.6	12.2	1.1	81.3
2	Correll	3.7	12.2	1.8	80.2
2	Wyalkatchem - local	3.8	11.1	0.6	83.2
3	Mace	3.1	10.9	1.2	82.1
3	Wyalkatchem	2.8	10.9	1.0	80.8
3	Axe	3.0	11.7	0.9	81.1
3	Gladius	2.8	11.9	1.5	80.0
3	Correll	2.8	12.2	3.0	77.2
3	Wyalkatchem - local	2.9	11.0	0.8	80.4
	LSD (P = 0.05)	*0.27*	*0.44*	*0.6*	*1.73*
LSD (P = 0.05) within TOS		*0.28*	*0.43*	*0.0056*	*1.48*

When comparing the 6 lines over the 3 TOS and using the local Wyalkatchem seed line as the control:

- Mace produced comparable yields but lower grain protein content except at TOS 3 medium soil. Screening % similar or lower but generally below 2%, similar or higher test weight and similar 1000 grain weight.
- Wyalkatchem produced a lower grain yield at TOS 3 on the good soil.
- Axe produced lower grain yields in both soil types at TOS 1 and 2 but higher protein contents at all 3 TOS.
- Gladius produced lower grain yields at TOS 1 in both soil types but higher protein contents at all 3 TOS.
- Correll produced lower grain yields at all 3 TOS in the medium soil type and at TOS 1 in the good soil type. It produced higher grain protein contents at all 3 TOS.

Table 3 Quality, yield and gross income data for wheat varieties sown with different sowing time and sowing rates, on medium and good soil, N1 MAC, 2009

Variety		Medium soil		Good Soil	
	TOS	Grade	Gross Income[1] ($/ha)	Grade	Gross Income[1] ($/ha)
Axe	1	H1	1022	H2	950
Correll		H1	1026	H2	978
Gladius		H1	1050	H2	1048
Wyalkatchem		APW1	1051	APW1	984
Wyalkatchem - local		APW1	1075	APW1	1053
Mace		APW1	1052	APW1	1029
Axe	2	H1	824	H2	713
Correll		H1	877	H2	811
Gladius		H1	901	H2	787
Wyalkatchem		APW1	850	APW1	783
Wyalkatchem - local		APW1	852	APW1	785
Mace		APW1	806	APW1	734
Axe	3	H2	689	H2	642
Correll		H1	653	H2	598
Gladius		H1	705	H2	597
Wyalkatchem		APW1	716	APW1	559
Wyalkatchem - local		APW1	695	APW1	584
Mace		APW1	739	APW1	627

[1] Gross Income is yield x price (with quality adjustments) less seed costs delivered to cash pool on 2 December 2009, Port Lincoln. Grades were adjusted for each variety according to screenings and test weight. $350/t used for seed value.

TOS 1 produced a higher average grain yield than TOS 2 which produced a higher average grain yield than TOS 3 in both the medium and good soil types (Table 2a & 2b). Mace and Wyalkatchem produced higher grain yields and lower protein contents than Axe, Gladius and Correll on the medium soil type when the averages of the 3 time of sowings were calculated. Mace and Wyalkatchem produced higher grain yields and lower protein contents than Axe and Correll on the good soil type.

Tables 2a and 2b present the comparative crop production results from the 3 time of sowings and the six wheat lines.

What does this mean?

These trials demonstrate the importance of early sowing, even in an above average year as experienced at MAC in 2009. The results showed the benefits in 2009 of more available water at the TOS 1 anthesis with a much higher grain yield achieved. The medium soil also had a higher average yield for all sowing dates due to the higher water holding capacity of loamy soils compared to sandy soils.

The results from the above average rainfall season of 2009 do not differ from the outcomes from trials conducted in 2008 (EPFS 2008, p 89-91), which was a season of considerable moisture deficit. The 2009 trials continued to demonstrate the benefit of early sowing. On both soil types the early to mid season varieties (Wyalkatchem and Mace) were best in the early sowing treatment, while a shorter season variety (Axe) improved with a later sowing date.

These results continue to show that matching variety selection with sowing date can help to maximise profits.

Acknowledgements

We thank GRDC for funding this work, Amanda Cook, Brenton Spriggs, Cilla King, Kay Brace and Trent Brace for their help during the year with sampling and harvesting the trial. Thanks to Alison Frischke for setting up the trial.