FINAL TECHNICAL REPORT

GRDC Regional Cropping Solutions Network

Early seeding: a climate change adaptation method in the NE Ag Region of WA)

Project code:	DAW00253
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Abstract

How early is too early to start sowing grain crops? Three time of sowing trials were conducted at Yuna and Pindar (Geraldton port zone) in 2015. Wheat and canola varieties with different maturities were sown on April 9, April 23 and May 12. Results from this project suggest that growers faced with the right set of conditions can reduce the risk of a lack of seeding opportunities during our traditional seeding window by sowing canola or wheat early. Sowing before the normal seeding window (ie before 25th April) is not without its risks and results show similar or lower yields compared to crops sown in the ideal sowing window. Lower seeding rates of wheat did not influence yield or quality compared to normal seeding rates when sown in early April. This project tested Yield Prophet® for the sowing times trialled and found both crop development predictions and yield predictions for very early sowing times to be inaccurate. Growers provided feedback at field days about the value of early sowing. The 'pros' of early seeding were 1 risk management, 2 time and machinery efficiency, 3 grazing opportunity and 4 reduction in knockdowns used. 'Cons' were the 1 risk of a false break, 2 staggered emergence, 3 suitable varieties and 4 crop bolting.

Please note.

Confidential reports

All reports will be communicated to industry by the GRDC. Confidential material should be provided in a separate section to the final report and clearly marked confidential so it can be removed before making the rest of the report publically available. If this is not possible, a public summary should be provided along with the final report.

Executive Summary

How early is too early to start sowing grain crops? This has been a question on the minds of many in the industry following significant rainfall over recent months at the beginning of 2015. However, there was little existing Western Australian field trial data around times of sowing earlier than April 25, the traditional start to crop planting in the state. The long-term, optimal sowing date for our current suite of wheat varieties is in May.

In the Geraldton port zone in 2015, small plot trials conducted at Yuna and Pindar focussed on a range of wheat and canola varieties with different season lengths at three times of sowing (April 9, April 23 and May 12.)

Results from this project suggest that growers faced with the right set of conditions can reduce the risk of a lack of seeding opportunities during our traditional seeding window by sowing canola or wheat early. Sowing before the normal seeding window (ie before 25th April) is not without its risks and may often result in similar or lower yields compared to crops sown in the ideal sowing window. But the risk of lower yields may be worth taking on.

Growers may not see a flat response to very early sowing as an issue. Instead, the early sowing window allows them to get crop out of the ground and reduce risks of dry spells leading to a lack of future sowing opportunities.

The success of very early sowing of wheat and canola depends heavily on soil types, stored soil moisture, air temperature, rainfall zone, weeds, insects, ground cover, frost risk profile crop variety options etc. Growers need to assess the conditions they face closely in the lead into each season before embarking on very early sowing, especially when using hybrid canola seed with high seed cost. Growers need better resources to outline the risks and the conditions that will increase the chances of a successful outcome.

This project tested Yield Prophet® for the sowing times trialled and found both crop development predictions and yield predictions for very early sowing times to be inaccurate. Future research to increase the accuracy of Yield Prophet® (or other models) in predicting crop development and yield is essential to give growers a better indication of yield outcomes from very early sowing given the conditions present in the run in to each season.

This project came from growers and was embraced by growers and the industry. In 2016 we had similar conditions coming into the growing season as those present in 2015. As a result of this project and farmers experiences in 2015, growers have sown a greater proportion of their cropping program earlier than ever before. The results of these very early sown crops won't be known until harvest, but considering the dry conditions to date in May 2016 it seems likely that these crops have a good chance of being successful.

Contents

Background

How early is too early to start sowing grain crops? This has been a question on the minds of many in the industry following significant rainfall over recent months at the beginning of 2015. However, there is little existing Western Australian field trial data around times of sowing earlier than April 25, the traditional start to crop planting in the state. The long-term, optimal sowing date for our current suite of wheat varieties is in May.

In response to this year's seasonal conditions a series of trials were initiated and fast-tracked through the GRDC Cropping Solutions Networks (RCSN) initiative.

In the Geraldton port zone in 2015, small plot trials at Yuna and Pindar which focussed on a range of wheat and canola varieties with different season lengths at three times of sowing — April 9, April 23 and May 12.

The wheat trials were testing two seeding rates (normal and low). The wheat varieties included Yitpi, Trojan, Mace and the longer-maturing wheat, Forrest. (EGA Wedgetail, a winter wheat, was sown in buffers of the first and second sowing times.)

A canola trial focusing on triazole tolerant (TT) varieties was co-located with the wheat trial at Pindar. Varieties include Wahoo, Hyola650TT and Bonito.

Yield Prophet® is a model to predict development and yield of wheat and canola crops planted on a range of characterised soils. However has not been well calibrated for sowing times outside of normal district practice. This trial work will add to this calibration process.

Project objectives

- Compare the yield responses of wheat and canola varieties sown at three sowing dates (9 April, 23 April and 12 May)
- Validate phenology and yield predictions of the Yield Prophet (YP) tool at very early sowing times.

Methodology

Wheat trials

Two small plot trials consisting of 6 varieties x 2 seeding rates x 3 TOS were conducted at Yuna and Pindar in north eastern region of the wheat belt was conducted.

- Treatments
  - 3 time of sowing: 9th April, 23rd April, 12th May
  - 6 variety: Mace, Magenta, Yitpi, Trojan, Westonia, Forrest (EGA Wedgetail in buffers)
  - Plant density: 60, 120 plants/m^2.
- Crop phenology was monitored.
- Plant establishment, head counts, grain yield and quality were measured.
- Yield Prophet (YP) was run for the site to compare ‘actual’ vs ‘modelled’ outcomes.

Canola trials

One small plot trial consisting of Triazine Tolerant Varieties only was conducted at Pindar was conducted.

- Treatments
  - 3 time of sowing: 9th April, 23rd April, 12th May
  - 6 variety: Wahoo, Stingray, Hyola 450TT, Hyola 559TT, Hyola650TT, Bonito
- Crop phenology, establishment yield and quality were measured.
- Yield Prophet (YP) was run for the site to compare ‘actual’ vs ‘modelled’ outcomes.   See Appendix III for Yield Prophet settings.

Location

NOTE: Where field trials have been conducted please include location details: Latitude and Longitude, or nearest town, using the table below (please add additional rows as required):

	Latitude (decimal degrees)	Longitude (decimal degrees)
Trial Site #1	330107.88 E	6880416.19 N
Nearest Town	Yuna	
Trial Site #2	382946.54 E	6834681.17 N
Nearest Town	Pindar	

If the research results are applicable to a specific GRDC region/s (e.g. North/South/West) or Agro - Ecological Zone/s please indicate which in the table below:

Research	Benefiting GRDC Region (can select up to three regions)	Benefiting GRDC Agro-Ecological Zone (see link: http://www.grdc.com.au/About-Us/GRDC-Agroecological-Zones) for guidance about AE-Zone locations	
Experiment Title	Choose an item. Choose an item. Choose an item.	☐ Qld Central ☐ NSW NE/Qld SE ☐ NSW Vic Slopes ☐ Tas Grain ☐ SA Midnorth-Lower Yorke Eyre ☒ WA Northern ☐ WA Eastern ☐ WA Mallee	☐ NSW Central ☐ NSW NW/Qld SW ☐ Vic High Rainfall ☐ SA Vic Mallee ☐ SA Vic Bordertown-Wimmera ☐ WA Central ☐ WA Sandplain

Results

Table 1: Monthly rainfall (mm) recorded at Yuna and Pindar

	Jan	Feb	March	April	May	June	July	August	Sept	Oct	Summer (Ja-Mar)	GSR
Pindar												
2015	5	14	113	69	7	29	64	37	0	0	132	209
Long term average	16	21	17	22	41	50	47	35	17	9		
Yuna												
2015	1	4	75	67	52	52	59	28	7	1	80	266
Long term average)	9	16	15	22	50	62	63	40	23	15		
South Dartmoor												
2015	24	32	187	22	12	29	69	29	4	1	243	166

Note: Source BOM 2016. South Dartmoor rain guage located closer to Yuna trial site

Table 2 Significant rainfall events leading up to and during the 2015 season for Mullewa.

Significant Rainfall Events 2015	Mullewa
31st-4th February	30mm
2nd March	87mm
14th March	63mm
26th-30th March	9mm
7th -11th April	57mm
29th April	2mm
17th – 18th May	13mm
17th – 22nd June	37mm
20th - 23rd July	43mm

Table 3 Plant development observations at Yuna and Pindar in 2015

Variety	**Sowing date 9th April 2015**	**Sowing date 23rd April 2015**	**Sowing date 11th May 2015**
On 23 June at Yuna			
Forrest(D)	Flag leaf visible	start of stem elongation	late tillering
Mace(D)	flowering	Flag leaf visible	late tillering
Magenta(D)	ear emerged	2nd node	late tillering
Trojan(D)	ear emerged	2nd node	late tillering
Westonia	flowering	Flag leaf visible	late tillering
Yitpi(D)	booting	1st node	late tillering
On 23 July at Yuna			
Forrest(D)	Awns visible	stem elongation	
Mace(D)	Grain fill	Grain fill	booting
Magenta(D)	Grain fill	Flowering	
Trojan(D)	Grain fill	Ear emerging	
Westonia	Grain fill	Grain fill	booting
Yitpi(D)	Grain fill	Booting	
On 23 June Pindar			
Forrest(D)	start of booting	start of stem elongation	mid tillering
Mace(D)	Flowering	Flag leaf visible	mid tillering
Magenta(D)	early flowering	Flag leaf visible	mid tillering
Trojan(D)	early flowering	Flag leaf visible	mid tillering
Westonia	Flowering	ear 1/2 emerged	mid tillering
Yitpi(D)	ear 3/4 emerging	2nd node	mid tillering

Table 4 Yield expectations at the 80% probability point for (12th June Yield Prophet run)

	9th April sowing	**23rd April sowing**	**12th May sowing**
Wheat, Yuna (Battens) 80% Probability (12 June run)	2.9 t/ha	3.1 t/ha	2.5 t/ha
Wheat, Pindar (Thomas 80% Probability (12 June run)	2.5 t/ha	2.5 t/ha	2.2 t/ha
Canola, Pindar (Thomas 80% Probability (12 June run)	1.8t/ha	1.6t/ha	1.4t/ha

TABLE 5: Actual Grain yield (t/ha) of canola varieties sown at three sowing times at Pindar in 2015. *NOTE: Data for Yield Prophet® predictions is for nitrogen-limiting yields.

Variety	9 April sowing		23 April sowing		12 May sowing	
	YP*	Actual	YP	Actual	YP	Actual
ATR-Bonito(D)	1.8	1.32	2	1.26	2	1.06
Pacific Seeds Hyola® 450TT	2.2	1.69	2.4	1.52	2.2	1.16
Pacific Seeds Hyola® 559TT	2.2	1.62	2.4	1.37	2.3	0.79
Pacific Seeds Hyola® 650TT	2.5	1.95	2.5	1.57	1.9	1.01
ATR-Stingray(D)	1.8	0.74	2.0	1.28	2.0	0.52
ATR-Wahoo(D)	2.2	1.2	2.4	1.23	2.2	0.83
Pvalue		<.001		NS		0.02
LSD		0.42				0.36

Table 6 Grain yield (t/ha) of wheat varieties sown at Yuna on three sowing dates and two target plant densities (TPDP) in 2015.

Variety	April 9 60 plants/m²	April 9 120 plants/m²	Ave	April 23 60 plants/m²	April 23 120 plants/m²	Ave	May 12 60 plants/m²	May 12 120 plants/m²	Ave
Forrest	4.2	4.0	*4.1*	3.9	3.8	*3.9*	3.0	3.0	*3.0*
Mace	2.3	2.3	*2.3*	3.5	3.3	*3.4*	4.6	4.7	*4.6*
Magenta	3.4	3.7	*3.5*	4.1	4.2	*4.1*	4.1	4.4	*4.2*
Trojan	2.5	2.7	*2.6*	3.9	4.1	*4.0*	3.5	4.1	*3.8*
Westonia	2.5	2.5	*2.5*	3.6	3.4	*3.5*	4.0	4.6	*4.3*
Yitpi	2.9	2.9	*2.9*	3.8	3.9	*3.8*	3.4	3.6	*3.5*
	P-value	LSD		P-value	LSD		P-value	LSD	
Variety	<.001	0.44		<.001	0.31		<.001	0.49	
TPD	NS			NS			0.04	0.28	
Var.TPD	NS			NS			NS		
Wedgetail (Buffers)			3.5			3.3			

Table 7 Dry matter (g/m²) of wheat varieties sown at Yuna on three sowing dates and two target plant densities (TPDP) in 2015

Variety	April 9 60 plants/m²	April 9 120 plants/m²	Ave	April 23 60 plants/m²	April 23 120 plants/m²	Ave	May 12 60 plants/m²	May 12 120 plants/m²	Ave
Forrest	1036	886	*961*	1016	833	*925*	886	1011	*949*
Mace	599	641	*620*	716	797	*757*	915	988	*952*
Magenta	743	671	*707*	891	830	*861*	947	1071	*1009*
Trojan	708	642	*675*	690	663	*677*	1008	990	*999*
Westonia	573	548	*561*	585	629	*607*	966	1028	*997*
Yitpi	756	583	*670*	723	673	*698*	859	953	*906*
	P-value	LSD		P-value	LSD		P-value	LSD	
Variety	<.001	105		<.001	171		0.796	171	
TPD	0.02	61		0.394	99		0.121	99	
Var.TPD	0.33	149		0.445	242		0.954	242	
CV	12%			15					

Table 8 Head number (#/m2) of wheat varieties sown at Yuna on three sowing dates and two target plant densities (TPDP) in 2015

Variety	April 9	April 9		April 23	April 2		May 12	May 12	
	60plants/ m^2	**120plant s/m^2**	**Ave**	**60plants/ m^2**	**120plant s/m^2**	**Ave**	**60plants/ m^2**	**120plant s/m^2**	**Ave**
Forrest	260	268	*264*	297	264	*281*	314	328	*321*
Mace	197	256	*227*	239	267	*253*	299	325	*312*
Magenta	265	313	*289*	278	305	*292*	302	395	*349*
Trojan	262	240	*251*	219	223	*221*	306	353	*330*
Westonia	220	283	*252*	211	248	*230*	295	369	*332*
Yitpi	253	294	*274*	258	279	*269*	317	344	*331*
	P-value	LSD		P-value	LSD		P-value	LSD	
Variety	0.032	36		0.022	45		0.643	43	
TPD	0.004	21		0.274	26		<.001	25	
Var.TPD	0.16	51		0.629	64		0.37	61	
CV%	11			15			11		

Table 9 Grain number (#/m2) of wheat varieties sown at Yuna on three sowing dates and two target plant densities (TPDP) in 2015

Variety	April 9	April 9		April 23	April 23		May 12	May 12	
	60plants/ m^2	**120plant s/m^2**	**Ave**	**60plants /m^2**	**120plant s /m^2**	**Ave**	**60plants /m^2**	**120plant s /m^2**	**Ave**
Forrest	13820	11636	*12728*	14125	12030	*13078*	13078	14158	*13618*
Mace	7314	7380	*7347*	8106	6696	*7401*	13325	13145	*13235*
Magenta	8874	8227	*8551*	9713	9190	*9452*	12319	14634	*13477*
Trojan	9090	7894	*8492*	9187	8229	*8708*	15173	14013	*14593*
Westonia	7335	7095	*7215*	7120	7744	*7432*	14484	14415	*14450*
Yitpi	8786	7253	*8020*	9768	7796	*8782*	12148	12372	*12260*
	P-value	LSD		P-value	LSD		P-value	LSD	
Variety	<.001	1492		<.001	2148		0.484	2606	
TPD	0.031	862		0.091	1240		0.617	1505	
Var.TPD	0.639	2110		0.787	3038		0.807	3686	
CV%	14			20			16		

Table 10 1000gwt (g/1000seed) of wheat varieties sown at Yuna on three sowing dates and two target plant densities (TPDP) in 2015

Variety	April 9	April 9		April 23	April 23		May 12	May 12	
	60plants/ m²	**120plants/m²**	**Ave**	**60plants/ m²**	**120plants/m²**	**Ave**	**60plants/ m²**	**120plants/m²**	**Ave**
Forrest	40	40	*40*	36	37	*37*	29	30	*29*
Mace	45	45	*45*	45	46	*45*	39	40	*39*
Magenta	44	45	*45*	47	47	*47*	40	38	*39*
Trojan	45	46	*45*	45	44	*45*	36	36	*36*
Westonia	42	40	*41*	45	44	*44*	37	38	*37*
Yitpi	40	39	*39*	41	40	*41*	33	33	*33*
	P-value	LSD		P-value	LSD		P-value	LSD	
Variety	<.001	2		<.001	2		<.001	2	
TPD	0.856	1		0.854	1		0.579	1	
Var.TPD	0.686	2		0.873	3		0.868	4	
CV%	3			3			6		

Table 11 Staining (%) of wheat varieties sown at Yuna on three sowing dates and two target plant densities (TPDP) in 2015

Variety	April 9	April 9		April 23	April 23		May 12	May 12	
	60plants/ m²	**120plants/m²**		**60plants/ m²**	**120plants/m²**		**60plants/ m²**	**120plants/m²**	
Forrest	2	4		0	0		0	0	
Mace	4	6		6	7		0	0	
Magenta	11	17		5	5		0	0	
Trojan	6	8		2	2		0	0	
Westonia	7	10		15	19		0	1	
Yitpi	15	21		3	2		0	0	
Wedgetail (Buffers)	0	0		0	0		0	0	

Discussion of Results

Rainfall & Conditions in 2015

The 2015 year received early rains at both sites (Table 1).

- Yuna received above average autumn rainfall followed by below average May rain. No finishing rains were received in September.
- Pindar received above average autumn rain followed by below average rain in May and June and no September rain. This lead to significant periods of moisture stress during the traditional growing season especially for the early time of sowing treatments.
- The Northern Agricultural Region had above average temperatures through winter. This caused crops to develop rapidly.

Seeding rainfall received for Mullewa (near Pindar) are detailed in Table 2 and show the seeding opportunities available to growers in the 2015 season. Although rainfall amounts may vary between Mullewa and the 2 trial sites the events still occurred at the sites (Table 2). In summary:

- Significant rainfall fell in March but was too early for a seeding opportunity.
- The seeding opportunity exploited in these trials fell on the 7-11th April.
- A rainfall event at the end of April allowed the 23rd April sown crops to emerge evenly.
- There was adequate moisture stored in the soil to germinate the 12th May TOS.

Plant Establishment

Target plant densities of the wheat trials were 60 and 120 plants /m^2 and actual plant densities averaged 63 and 105 plants/m^2 respectively at Yuna. There was no influence of plant density on the grain yield of varieties sown at Yuna in April. Bird damage at Pindar was a problem and so yield results are not reliable at this site for wheat. Canola establishment at Pindar for sowing time 1, 2 and 3 were 38, 37 and 28plants/m^2 respectively.

Plant Development

- Wheat development was rapid. Nineteen days after seeding the first tillers were visible for the April 9 sowing. The 9th April sowing time actual phenology was quicker than the Yield Prophet® prediction. Mace's development to 'first node' occurred about 35 days after seeding (Table 3). However Yield Prophet® predicted 'first node' of Mace(PBR) at 60 days after seeding. (Table 3) Yield Prophet® predicted flowering between 19 and 26 days later than the observed at Yuna and Pindar respectively.
- Yield Prophet® best predicted the development of Westonia and Forrest(PBR) for all sowing times. Yield Prophet® poorly predicted the development of Magenta(PBR) and Mace(PBR) with these varieties developing significantly quicker than predicted. On average for all varieties Yield Prophet® poorly predicted development for all sowing times. Yield Prophet® on average predicted the development to be slower than field observation.
- Yield Prophet® best predicted development for the 23rd April sowing time for the Pindar wheat site. Yield Prophet® best predicted development for the 12th May sowing time for the Yuna site. There were large variations between variety development predictions at both sites. Yield Prophet® was accurate in predicting development to the early tillering stage at both sites. This suggests the model accurately predicted emergence date. Therefore all variation in development occurred after this point.
- Yield Prophet® best predicted flowering time of canola for the April 9 sowing time at Pindar. Yield Prophet® accuracy of predicting flowering time for the different varieties varied widely. Hyola® 650TT was most accurately predicted and ATR-Wahoo(PBR) was least accurately predicted for all sowing times. Better predictions of development time are an integral part to better yield predictions.

Yield Prophet- yield and nitrogen

Wheat Yield Prophet® outputs on the 12 June 2015 indicated significant yield potential in the 2015 growing season even considering the dry June (Table 4). At Pindar, the 9th April was predicted the highest or equal highest yielding sowing time for wheat. For canola at this site the Yield Prophet® suggests the 9th April is the highest yielding TOS. See the 80% probability point of yield for the 3

TOS's in (Table 5). Note: this site has not been characterised and the Yield Prophet® settings are outlined in Appendix I.) At Yuna, the 23rd April sowing time was the highest yielding wheat sowing time according to Yield Prophet® at the 80% probability point (Table 4).

Yield Prophet® modelling for canola was carried out in conjunction with the in-field trials at Pindar to test its accuracy for the range of sowing opportunities trialled. This project did not test nitrogen (N) responsiveness, but Yield Prophet® suggested all sowing times were responsive to N above what was applied to the plots. Yield Prophet® generally predicted yield trend for the different sowing times, but absolute yield was predicted poorly. It over-estimated predicted yield compared to actual yield. Better predictions of yield by Yield Prophet® are essential so growers can make informed decisions about optimum sowing times for canola.

At Yuna Yield Prophet® suggested there was enough nitrogen available to the crop for 2 t/ha of yield. Above this yield there is responsiveness to nitrogen which varies depending on time of sowing. At Pindar there was little chance of getting Nitrogen response for any time of sowing.

Canola Grain Yield at Pindar

- All varieties apart from Stingray were able to yield the same or higher from the 9th April sowing opportunity. (Table 5)
- As expected the shorter seasoned varieties were not able to capitalise on the 9th April sowing as the longer season varieties. Grain yield declined with delayed sowing for longer season canola varieties.
- Growers may not see a flat yield response for early sowings as an issue. Instead, the early sowing window allows them to get crop out of the ground and reduces the risk of dry spells leading to a lack of future sowing opportunities. However pests (eg Diamondback moth) and diseases (such as Sclerotinia), depending on rainfall zone and soil type, need to be factored into decisions about very early sowing windows.
- The success of very early sowing depends heavily on soil type, soil moisture and temperature. Growers need to assess the conditions they face in the lead into each season closely before embarking on very early sowing, especially when using hybrid seed with high seed costs.

Wheat Grain Yield

At Yuna:

- Forrest⦹ was the highest yielding variety for the 9 April sowing date (Table 6). Shorter season varieties were not able to capture the yield benefits of this time of sowing. Plant densities of 60 and 120 plants/m^2 did not influence the grain yield or quality of wheat when sown on the 9th and 23rd April.
- Magenta⦹ was the highest ranked variety when sown on 23 April, however other long-mid maturing varieties also compared favourably.
- Mace⦹, the most widely grown variety in the state, maximised yield at the 12 May sowing time. It out yielded all other varieties at this sowing date.
- There was no influence of sowing time and plant density on the screenings which were below 5% for all varieties at all sowing times.

At Pindar, there was significant bird damage at this site and the yield and quality data will not reflect the true response of the varieties.

- Biomass was measured at maturity. With early April sowing, the biomass of Forrest⦹ was significantly higher than other wheat varieties. This difference was not evident at the May sowing time (Appendix 7)
- Head numbers of Mace⦹ were significantly lower at the first sowing time compared to the other wheat varieties. An increase in plant density resulted in higher head numbers at both the early April and May sowings however this did not influence grain yield. (Appendix 8).
- Grain number of Forrest⦹ wheat was significantly higher than the other wheats at the early April sowing time however this difference was not evident at the May sowing time (Appendix 9). At the

mid-April and May sowing times, the grain size of Forrest was significantly lower than the other wheat varieties (Appendix 10).

- A risk factor with sowing too early is staining. Observed data (not analysed) provides evidence of the varietal differences and influence of sowing time (Appendix11)

Conclusion

Results from this project suggest that growers faced with the right set of conditions can reduce the risk of a lack of seeding opportunities during our traditional seeding window by sowing canola or wheat early. Sowing before the normal seeding window (ie before 25th April) is not without its risks and may often result in similar or lower yields compared to crops sown in the ideal sowing window. But the risk of lower yields may be worth taking on.

Growers may not see a flat response to very early sowing as an issue. Instead, the early sowing window allows them to get crop out of the ground and reduce risks of dry spells leading to a lack of future sowing opportunities.

The success of very early sowing of wheat and canola depends heavily on soil types, stored soil moisture, air temperature, rainfall zone, weeds, insects, ground cover, frost risk profile crop variety options etc. Growers need to assess the conditions they face closely in the lead into each season before embarking on very early sowing, especially when using hybrid canola seed with high seed cost. Growers need better resources to outline the risks and the conditions that will increase the chances of a successful outcome.

More very early sowing trial work is needed to populate the yield response curve of very early sowing for the various cropping regions. A more targeted and efficient approach would be to ground truth the current models such as yield prophet to better estimate likely yield outcomes for very early sowing times. This project tested Yield Prophet® for the sowing times trialled and found both crop development predictions and yield predictions for very early sowing times to be inaccurate. Future research to increase the accuracy of Yield Prophet® (or other models) in predicting crop development and yield is essential to give growers a better indication of yield outcomes from very early sowing given the conditions present in the run in to each season.

This project came from growers and was embraced by growers and the industry. In 2016 we had similar conditions coming into the growing season as those present in 2015. As a result of this project and farmers experiences in 2015, growers have sown a greater proportion of their cropping program earlier than ever before. The results of these very early sown crops won't be known until harvest, but considering the dry conditions to date in May 2016 it seems likely that these crops have a good chance of being successful.

Implications

This research project provided a platform for discussion at a regional and state level in Western Australia on the value of early sowing in the low rainfall. Growers provided feedback about the value of early sowing to the farming system at field days at Yuna and Pindar. They have been summarised below.

The pros of early seeding (a grower's perspective):

- Risk Management:-The lack of opportunities to sow crops in our traditional sowing in recent years is forcing growers to chase other sowing outside of the normal sowing window. Even if these are not as high yielding they do hedge against the risk.
- Time and Machinery Efficiency: - Larger sowing programs results in growers commencing sowing earlier to increase the proportion of crops emerging in the optimum window. Dry sowing and early sowing are two methods growers have to achieve this. This will also allow growers to gain better efficiencies from seeding equipment.
- The opportunity to graze early sown crops to both provide grazing value and delay the maturity of early sown crops.
- Risk Management: Growers don't know how the season will unfold. A tight finish will have less influence on early emerging crops.
- Reduction of knockdowns used. Seeding a paddock will dry the profile both by the cultivation effect of seeding as well as the crop roots drying the profile. This will results in the germination of less weeds. Sowing a crop can results in less knockdowns but may increase in-crop herbicide selection pressure. Crops sown early will often get a significant head start on weeds and therefore out-compete them compared to later seeded crops.

The cons of early seeding (a growers perspective)

- False break – early sown crops have to often survive through significant dry and hot periods. Without enough stored moisture crops may not survive to the true break of the season. Growers should therefore account for this by only sowing a proportion of the crop in the "very early" window.
- Staggered emergence: - This may results on some soil types. Generally the use of the appropriate herbicide post emergent can allow for a level of staggered emergence.
- Suitable varieties: - Our current varieties don't gain full advantage of very early sowing opportunities as seen by this yield data. Better varieties suited to this sowing window are required.
- The crop bolts: This can cause an increased risk of frost or reduced yields due to inadequate dry matter formation.
- Disease and frost risk: In some areas frost risk may well be a random event and therefore early sowing may afford no further increase in frost risk. However the probability of frost risk is greater during the winter months and very early seeding can place crops at risk in areas that are traditionally not influenced by frost. Growers need to collect frost incidence data for their location and be wary of this risk.
- Birds and falling number: - Bird damage can be significant where there are not many early sown crops.

The experience and feedback of growers who sowed wheat early in 2015:

Yuna grower 1 - Early sown Magenta. Sown on 19th April. It was on poorer performing country and yielded just over 2t with no difference in quality to other Magenta. "Probably the most significant issue was we only seeded at 30kg, which was well and truly enough, large areas did not have to be sprayed post em , due to early competition and frost impact the early sown crop was lower yielding than paddocks nearby that were sown a bit later. It was more advanced in grain fill when the frost occurred and was therefore slightly more affected by frost". In conclusion, given the opportunity we would definitely do it again or even a week earlier, as it allows us to spread some risk".

Yuna grower 2 "We didn't sow really early. The 29th April was when we started seeding last year. We try to keep Magenta on our sandier soils so seeding these really early is a little risky. However I am not against going earlier with Magenta on loams if condition are right, just not a big percentage of program”.

Morawa – Grower 3 – Mace seeded April 20: Crop seeded on significant summer rainfall similar to trials. Yielded 3t/ha which was the highest yielding paddock on the farm. The crop developed very quickly but still possessed good head numbers. Later sown crops ran into drying seeding conditions which meant they didn’t emerge until follow up rain fell towards the end of May. Later emerging crops also failed to fill well due to the lack of September rainfall. No frost was found in the crop. Keen to sow crops at least this early in the future.

Recommendations

This project compare the yield responses of wheat and canola varieties sown at three sowing dates (9 April, 23 April and 12 May). The key messages from this research back up the findings from other research projects (eg DAW00249: Tactical Wheat Agronomy for the West)

- Highest wheat grain yields are not always achieved at the earliest sowing opportunity.
- Current commercial wheat varieties have good adaption for yield in WA but are more exposed to the risk of frost and other grain quality issues (staining and sprouting) when sown early.

However growers may not see a flat or reduced yield response to very early sowing as an issue. Instead, the early sowing window allows them to get crop out of the ground and reduce risks of dry spells leading to a lack of future sowing opportunities.

This project tested Yield Prophet® for the sowing times trialled and found both crop development predictions and yield predictions for very early sowing times to be inaccurate. Future research to increase the accuracy of Yield Prophet® (or other models) in predicting crop development and yield is essential to give growers a better indication of yield outcomes from very early sowing given the conditions present in the run in to each season.

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Appendix

Appendix I Yield Prophet Settings

Predictions were based on the following:

- Sowing date
- Variety, using appropriately characterised soil and either the Pindar or Yuna weather station.
- The soils types where the trials were located were not characterised for YP due to budget constraints. Instead best estimate soils were chosen from characterised soils in the region. YP results may lose some accuracy by not using characterised soils however they should be accurate enough for broad comparison with trial yields.
- Yield Prophet (YP) utilises the rainfall data from Yuna, however the rainfall pattern is better represented by the South Dartmoor rainfall data. Temperature data is not available at South Dartmoor.

Table I Details used to calculate Yield Prophet (YP) prediction at Yuna and Pindar

	Yuna Wheat	**Pindar Wheat**	**Pindar Canola**
Location	Battens, Yuna	Thomas's, Pindar	Thomas's Pindar
Soil Type	Deep Red Loam	Loamy Clay	Loamy Clay
Yield Prophet Soil Type	Deep Red Duplex (Yuna No831)	Clay (Mingenew No71)	Clay (Mingenew No71)
Stubble Type	Wheat	Fallow	Fallow
Stubble Amount	1000kg/ha	0 kg/ha	0 kg/ha
Tillage operations	1	1	1
YP Silo station used	Yuna	Pindar	Pindar
Temperature records Used	SILO	SILO	SILO
Maximum rooting depth	150cm	70cm	70cm
Stubble Type	Wheat	None	None
Time of Sowing	9th April, 23rd April, 12th May	9th April, 23rd April, 12th May	9th April, 23rd April, 12th May
Varieties	Forrest, Magenta, Mace, Yitpi, Westonia, Trojan	Forrest, Magenta, Mace, Yitpi, Westonia, Trojan	Bonito, Hyola 450TT, Hyola 559TT, Hyola 650TT, Stingray, and Wahoo
Emergence Date	YP Predicted	YP Predicted	YP Predicted
Sowing Density	80 Plants/m2	80 Plants/m2	25 Plants/m2
Nitrogen Applied	36 kg/ha N	11 kg/ha N	11 kg/ha N

Glossary and Acronyms

Below is a sample Abbreviations and Acronyms list. Be sure to include on this page all abbreviations and acronyms that appear in the report

DAFWA	Department of Agriculture and Food, Western Australia
YP	Yield Prophet®