GRDC
GRAINS RESEARCH & DEVELOPMENT CORPORATION

HIGH RAINFALL ZONE FARMING SYSTEMS

Summary of Cereal Results

Prepared by:

FAR AUSTRALIA

Optimising High Rainfall Zone Cropping for Profit in the Western and Southern Regions (DAW1903-008RMX)

WA Cereal Research Programme – Key learnings 2020 - 2022

Background

The WA HRZ farming systems project was a GRDC multi-agency (DPIRD, FAR Australia, CSIRO) investment that aimed to reduce the gap between current and potential yield in wheat and canola in WA's HRZ. The concept of the cereal research programme for this HRZ project was to explore the productivity and profitability of cereal crops (primarily wheat) sown in mid-April (16 April) as part of an ameliorated soil farming system. The research was primarily conducted on sand plain in the Esperance region with a small site at Frankland River on forest gravel. At Esperance, the primary investigative site, an earlier sowing date allowed the research team to explore several research themes in a coastal WA HRZ region (25km from the coast) where frost risk is lower. The research themes were:

- i) The suitability of spring versus winter wheat germplasm sown mid-April (16 April sowing date in all three years).
- ii) The influence of management strategy on wheat crop productivity and profitability when sown in this mid-April sowing window.
- iii) The influence of different commercially conducted soil amelioration practices combined with a range of nutrition treatments on productivity and profitability of wheat.
- *iv)* A comparison of wheat and barley productivity with crops sown in mid-April (trials adjoining with identical sowing dates but not statistically comparable). *Note the emphasis on barley was added for completeness but was a much smaller component of the research.*
- v) A comparison of wheat sown in mid-April with wheat sown in mid-May (trials adjoining with identical inputs but not statistically comparable).

Overall research question addressed at Esperance.

Does a combination of earlier sowing superimposed on ameliorated soils allow us to exploit a "bigger soil bucket"? If it does, how will that influence our agronomy? Or does this combination do nothing but increase our costs and reduce our yields compared to more traditional sowing windows?

Locations

The research underlying the key learnings was conducted on FAR Australia's Crop Technology Centre in the Esperance Port Zone, courtesy of the Whiting family at Gibson. The smaller satellite site was conducted in the Albany Port Zone courtesy of Scott Smith in 2020 at Green Range and then courtesy of Kellie Shields at Gunwarrie near Frankland River.

The GPS locations for these paddocks are as follows:

Year	Esperance Port Zone	Albany Port Zone
2020	Shepwok Station, 277 Freebairns Rd, Gibson 6448 (GPS location of paddock -33.61989180, 121.97536300)	631 Kojaneerup West Rd, Green Range 6328 (GPS location of paddock: -34.590242, 118.345800)
2021	Lot 1427 Campbell Rd, Gibson 6448 (GPS location of paddock -33.6349430, 121.8704840)	"Gunwarrie", 411 Gunwarrie Rd, Frankland River 6396 (GPS location of paddock -34.330454, 117.240896)
2022	Lot 1427 Campbell Rd, Gibson 6448 (GPS location of paddock -33.340730, 122.0117560)	"Gunwarrie" 411 Gunwarrie Rd, Frankland River 6396 (GPS location of paddock -34.315606, 117.170169)

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2.0 The influence of management strategy on wheat crop productivity and profitability sown in this mid-April sowing window.
3.0 Combined effect of soil amelioration and nutrition on wheat productivity.
4.0 Productivity performance of wheat and barley sown mid-April with a traditional mid-May sown wheat.

Key Learnings: Albany Crop Technology Centre – Green Range & Frankland River, WA

1.0 A comparison of spring versus winter wheat germplasm under three different management levels sown in mid-late April.

Further information

More information on individual trial results from the three different seasons can be found at:
https://faraustralia.com.au/wp-content/uploads/2022/04/210316-HRZ-2020-Cereal-Results-FINAL.pdf

https://faraustralia.com.au/wp-content/uploads/2022/03/220222-HRZ-2021-Cereal-Results-FINAL-PROVISIONAL.pdf

https://faraustralia.com.au/wp-content/uploads/2023/03/HRZ-2022-Esperance-Cereal-Results_FINAL.pdf

Key Learnings: Esperance Crop Technology Centre – Gibson, WA

1.0 Spring versus winter wheat germplasm sown mid-April.

Key point summary

- Despite initial modelling to the contrary, winter wheat germplasm could not be proven to be higher yielding than the spring wheat germplasm sown in mid-April in a coastal low frost risk environment.
- The "sweet spot" for flowering in wheat in the Esperance region has been modelled as mid-September.
- Over the three years (2020 – 2022), Scepter (spring wheat) and Illabo (winter wheat) gave similar yields despite flowering 4-6 weeks apart, with the winter wheat flowering nearer the more ideal mid-September window for the Esperance Port Zone.
- However, winter wheat cultivars do extend the ability to sow early (early – mid April) on large acreages, and when combined with an early break, can offer grazing opportunities as well as grain yield.
- In addition, for regions at risk from frost, winter germplasm reduces the risks of rapid development that can occur with spring cultivars, particularly in warm autumns.
- Despite higher harvest dry matter, longer season winter cultivars such as RGT Accroc and Anapurna that have performed well in the eastern states flowered too late when sown in mid-April in the Esperance WA HRZ.
- The shorter season winter wheat Mowhawk (LPB19-14343) has been similar or better than Illabo in terms of yield and has flowered 5-10 days earlier.
- Over the three years of the project, whilst winter wheats produced more dry matter than spring wheats such as Scepter, their harvest indices tended to be lower, meaning that less biomass is partitioned into grain with the winter germplasm.
- The slightly longer season spring wheat cultivars Rockstar and Denison have been higher yielding than Scepter in this mid-April sowing window.

Grain Yields 2020 – 2022

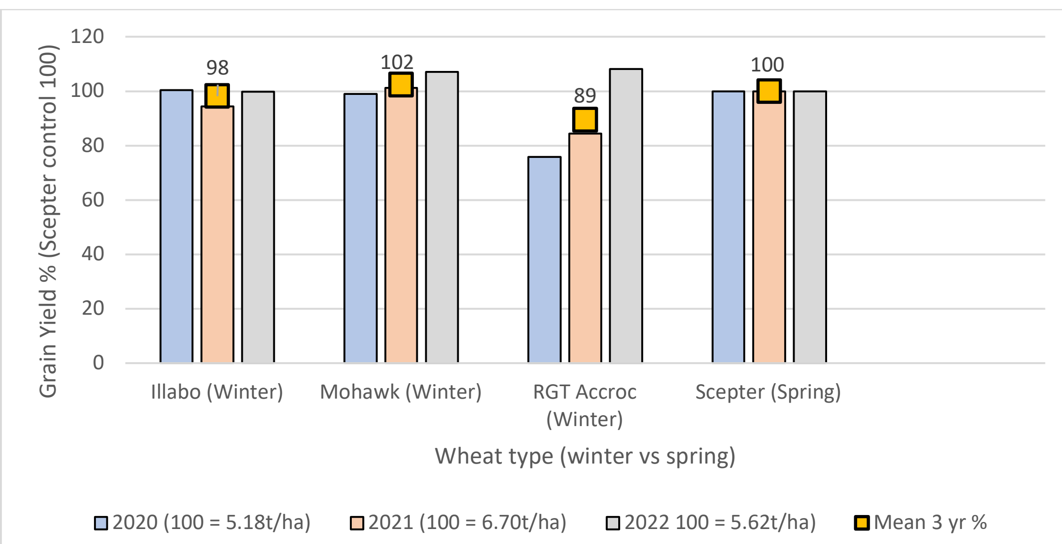


Figure 1. Winter vs. spring germplasm grain yield (%) under high input management over three seasons.

At the Esperance Crop Technology Centre over the last three years (2020 – 2022), despite modelling to the contrary, there has been no advantage of winter wheat over spring wheat (Table 1).

Table 1. Grain yield of winter vs. spring germplasm (expressed as % of the Scepter control = 100).

Variety	2020	2021	2022	Mean
Illabo (Winter)	100	94	100	**98**
Rockstar (Spring)		109	120	**114**
Mohawk (Winter)	99	101	107	**102**
Denison (Spring)		104	114	**109**
RGT Accroc (Winter)	76	84	108	**89**
Scepter (Spring)	100	100	100	**100**
	100=5.18t/ha	**100=6.7 t/ha**	**100=5.62t/ha**	

When does mid-April sown wheat flower?

Previous field research work has established that the ideal flowering window for wheat in the Esperance region is around mid-September. This flowering date balances frost risk against heat stress/soil water to optimise yield over the long term. In the coastal, low frost-risk region of the current research, the flowering window to establish optimum yields has been very wide with crops planted in mid-April yielding similarly despite flowering between late July and early September (Table 2). Longer season spring wheats flowering later than Scepter appear to be more productive both in terms of final harvest dry matter and grain yield. However long season winter wheats flowering later than mid-September, whilst often being associated with higher harvest dry matter, had a poor ability to convert the dry matter to yield (Figure 2). This has been particularly prevalent with RGT Accroc at Esperance but was not the case at Frankland River (Albany Port Zone). Lower temperatures and higher rainfall in this zone allowed winter wheat, especially the longer season cultivar RGT Accroc, to perform much more strongly compared to spring wheat sown at the same time (See Albany Crop Technology Centre key learnings).

Table 2. Calendar date that the cultivar reached stem elongation (GS30) and the beginning – middle of flowering (GS61-65) in the 2020 season compared to 2022.

2020

Cultivar (type)	Date GS30	Date GS61
Scepter (Spring)	8 June	3 August
Cutlass (Spring)	8 June	15 August
Illabo (Winter)	15 June	1 September
LPB19-14343 (Winter)	15 June	2 September
RGT Accroc (Winter)	3 August	15 October

2022

Cultivar (type)	Date GS30	DAS GS30	Date GS65	DAS GS65
Illabo (Winter)	28 June	73	14 September	151
Rockstar (Spring)	10 June	55	28 July	103
LPB19-14343 (Winter)	25 June	70	3 September	140
Beaufort (Spring)	11 June	56	15 August	121
Denison (Spring)	8 June	53	11 August	117
RGT Accroc (Winter)	28 July	103	14 October	181
Scepter (Spring)	5 June	50	26 July	101

Is high harvest dry matter the route to higher yields?

The answer is both yes and no! As the figure below indicates from the Esperance data, higher harvest dry matter does not necessarily result in grain yield. It is the combination of higher harvest dry matter and higher harvest indices that result in more yield. In the HRZ trials at Esperance, if higher harvest dry matter came at the expense of late flowering past the optimum for the region, then the result was a poor harvest index and less conversion to grain yield. At Frankland River the harvest indices were lower for winter wheats than spring wheats, but the yields were similar not inferior.

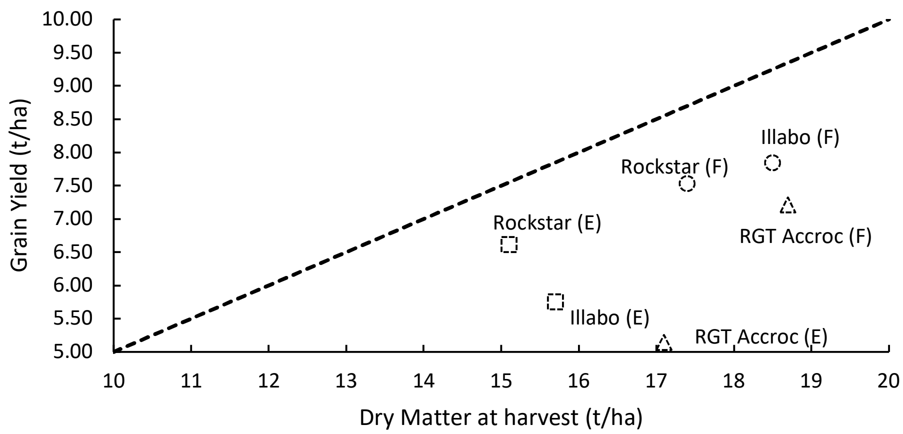


Figure 2. Relationship between dry matter and grain yield (t/ha) at 0% moisture across spring and winter wheat types at Esperance (E) and Frankland River (F), FAR Australia WA Crop Technology Centres 2021. The dotted line represents aspirational yields that are possible with a harvest index of 50%.

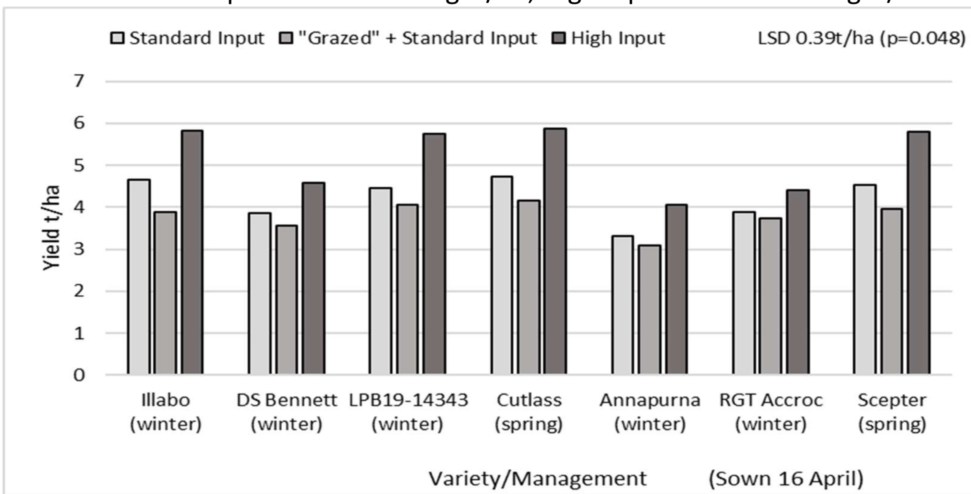
2.0 The influence of management strategy on wheat crop productivity and profitability sown in this mid-April sowing window.

Key point summary

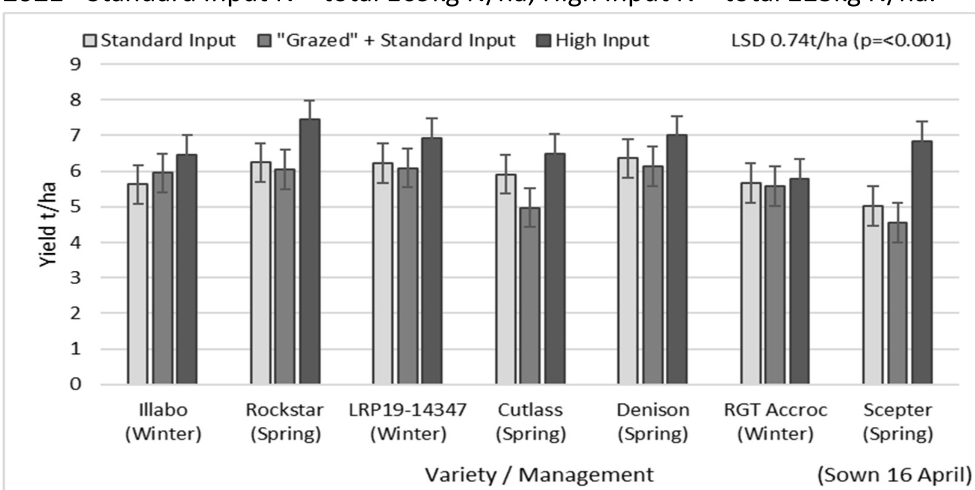
- Increased inputs, particularly nutrition have been the key to cost effective yield increases in wheat trials over the last three seasons of the project.
- An additional 45-50kg N/ha on top of a standard N dose has provided profitable increases in productivity over the last three seasons based on yield increases of 0.98, 0.84 and 0.77t/ha and associated protein lifts (mean of seven cultivars).
- The higher input approach (additional N, PGR and fungicide) has increased margins by $100 - 300/ha depending on variety and season (see results from individual seasons for more detail).
- Although high input strategies have incorporated PGR application and greater fungicide input, there has been little lodging in the trials over the three years to justify good responses from PGR, and little evidence to suggest that higher cost disease management in wheat has been a key factor of the yield gap in the WA HRZ, as it has been in the eastern states.
- The additional grain yield produced in the high input management approach was associated with higher dry matter at harvest and grain protein.
- Long season winter wheats, that have been generally lower yielding, have been less responsive to the additional N compared to shorter season winter wheats and spring wheats.

- Defoliation simulating grazing has invariably reduced grain yield but the effect on margin depends on the value of grazing to the farming system and tends to be more suited to winter germplasm.

2020 - Standard Input N – total 127kg N/ha, High Input N – total 173kg N/ha.



2021 - Standard Input N – total 169kg N/ha, High Input N – total 223kg N/ha.



2022 - Standard Input N – total 121kg N/ha, High Input N – total 167kg N/ha

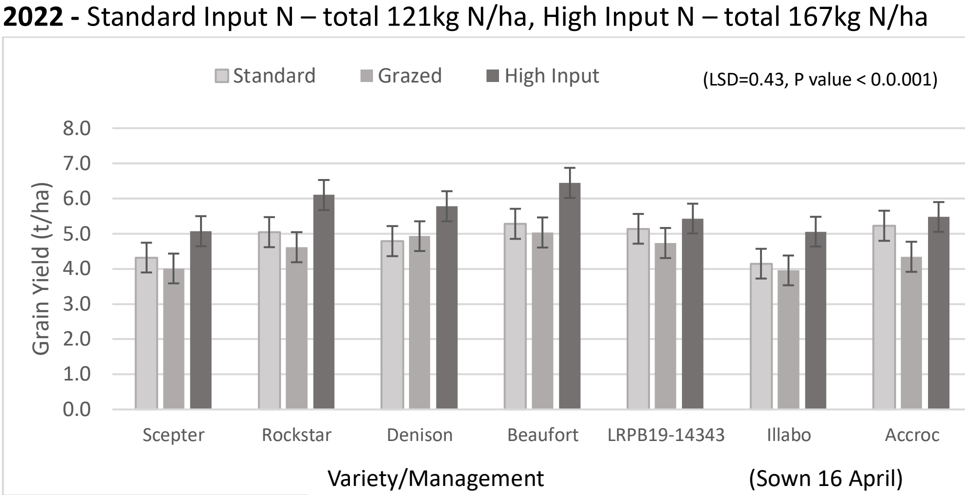


Figure 3. Influence of management approach on wheat variety performance 2020 – 2022.

Over the three seasons of the project, this trial was established on sand plain commercially deep ripped (600 – 800mm) in the autumn prior to the plots being established. Seven cultivars have been sown on the same day for the past three seasons (16th April) into good moisture and subsequently farmed under three levels of management input; i) Standard input ii) Standard with defoliation (GS30) to mimic grazing and iii) High input. Typical inputs over the three seasons are presented in Table 3.

Table 3. Details of the three management levels applied over the three project years (kg, g, ml/ha).

Plant pop'n:		**180 seeds/m² (150 plants/m² target)**		
		Standard	**Standard Grazed**	**High Input**
Grazed:		----	✓ (GS30)	----
Seed treatment:		Vibrance/ Gaucho (all managements)		
Basal Fertiliser:	16 April	100kg/ha 50% Vigour, 50% MAPZCS		
Nitrogen:				
Total N		**121 -169kg N**	**121 – 169 kg N**	**167-223 - kg N**
PGR:	GS31	----	----	Moddus Evo + Errex
Fungicide:	GS00	----	----	Systiva
	GS31-32	+	+	+
	GS39	+	+	+
	GS59/61*			+

* 2022 only

3.0 Combined effect of soil amelioration and nutrition on wheat productivity

Key point summary

- Amelioration of sandplain soils by deep ripping to 800mm increased wheat yield by approximately 0.5t/ha at a cost benefit ratio of just less than $2 return for every $1 spent in 2020 and 2021 seasons.
- In the higher yielding 2022 season, the benefit from deep ripping compared to the untreated control (deep ripped previously in 2019, three years prior) produced visual differences in crop canopy biomass and final harvest dry matter but resulted in smaller yield increases (0.18-0.22t/ha) that were not statistically significant.
- However, in the three seasons of the project (which were less limited by soil water availability), increased nutrition (N, P, K &S) applied to the unripped controls resulted in similar increases in productivity compared to deep ripping.
- The effect of increased nutrition input on lifting grain yields was less apparent with ripped and spade seeded crops where there was far greater soil disturbance as part of the establishment method, thus indicating that some of the soil amelioration may result in better access to nutrients.
- In addition, in 2022 when yields were highest of the three years, the grain yield differences amongst the soil amelioration and nutrition treatments were largely insignificant despite visual and harvest dry matter differences.

- In conclusion, soil amelioration (ripping and spading) was reflected in better crop appearance and dry matter production but in a paddock/season with higher yield potential did not always relate to higher grain yields (as a result of lower harvest index).
- Increased nutrition in wetter seasons with less soil water stress could be shown to replicate some of the yield improvements observed with ripping and spade seeding, however, note that none of the project years were severely soil water stressed (a scenario that might have generated greater benefits from improved soil water availability due to improved penetration and depth of crop roots).

Three paddocks on the same farm were deep ripped commercially to a depth of 600mm in 2019. In the three project years that followed, a trial area was marked out and three treatments applied with large scale commercial equipment i) left untreated (deep ripped in 2019) – Tyne DBS, ii) deep ripped to 800mm – Tyne DBS and iii) deep ripped to 800mm and spade seeded. These treatments were replicated three to four times. Superimposed on these larger plots were small nutrition plots (2.0 - 2.5m x 18m) where additional nutrition treatments were evaluated: i) Standard nutrition, ii) Standard plus additional N and iii) Standard plus additional NPKS.

Table 4. Influence of soil management on grain yield (t/ha) under standard nutrition input.

	Yield						**Mean**
	2020		**2021**		**2022**		
	t/ha		t/ha		t/ha		
2019 (control) Ripped, Tyne DBS	3.94	b	3.30	d	5.72	---	**4.32**
2019 + 2020 – 22* Ripped (double ripped), Tyne DBS	4.39	a	3.77	c	5.90	---	**4.69**
2019 + 2020 – 22* Ripped (double ripped), Spade Seeder	3.64	b	4.46	a	5.94	---	**4.68**

** The second deep rip occurred in the autumn prior to sowing. In all years the land was ripped for the first time in autumn 2019. Differences in 2022 were not statistically significant. Note statistics cannot be compared between seasons.*

Results from the project in 2020 and 2021 illustrated that there was a significant yield advantage of 0.45 & 0.47t/ha respectively to deep ripping to a depth of 800mm on a sandplain soil prior to establishing wheat in the autumn, despite the land having been ripped in 2019. With ripping costed at $80/ha and grain at $310/t, soil amelioration produced an approximate return of just under $2 for each $ spent (assuming benefits were only apparent for one year). Spade seeding superimposed on deep ripping (costing approximately $140/ha) generated inconsistent results with negative results in 2020 and higher grain yields (0.69t/ha) in 2021. Where soil amelioration (deep ripping or deep ripping followed by spade seeding) was carried out in the autumn, prior to establishment, crops were generally less responsive to higher levels of nutrition input (both extra N and extra NPKS), indicating that spade seeded crops had access to greater nutrient availability without the need for the increased fertiliser input (Table 4).

Table 5. Influence of deep ripping and establishment method on 2021 season grain yields (t/ha) under nutrition strategies regimes – FAR Australia Esperance Crop Technology Centre 2021 sown 14 May Catapult

		Nutrition superimposed establishment method					
		Standard		Standard + N		Standard + NPKS	
Amelioration & Establishment method							
2019 Ripped, Tine DBS		3.30	d	3.66	cd	4.72	a
2019 + 2021 Ripped (800mm), Tine DBS		3.77	c	4.31	b	4.59	a
2019 + 2021 Ripped (800mm),Spade Seeder		4.46	a	4.62	ab	4.46	a
Rip x Nutrient interaction	P value - 0.003	LSD 0.39					

Standard N based on 164kg N/ha with 40N extra in standard + N and N: 40kg P: 5.6kg, K: 23.7kg, S: 42kg/ha in standard + NPKS.

In 2022, a more elaborate trial was put to the test; this was based on the same three different amelioration starting points, but with a wider range of nutrition treatments including organic manures and fertiliser applications with additional major elements e.g. P, K or S individually and combined, as well as additional N. The 2022 trial produced good differences in harvest dry matter as a result of amelioration and subsequent nutrition but only small changes in grain yield (non-significant in the majority of cases) (Figure 3 & 4).

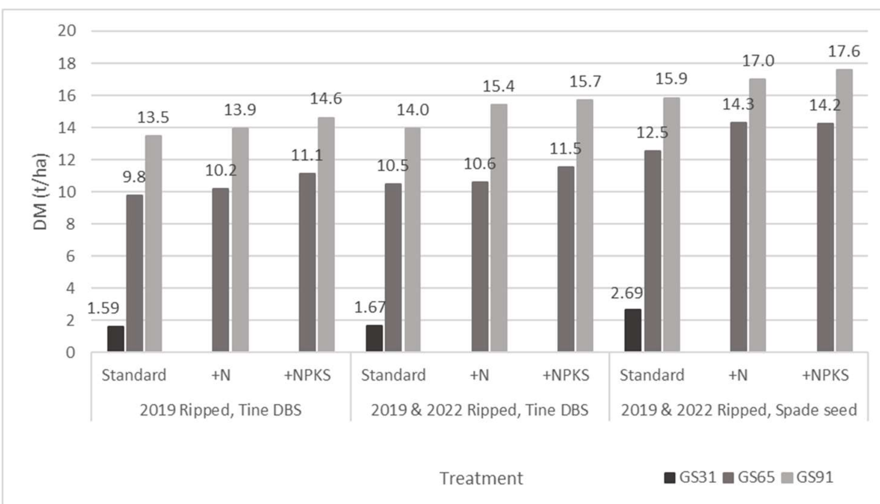


Figure 4. Influence of amelioration/seeding method and nutrition (for selected treatments of Standard, +N, and + NPKS) on Dry Matter (DM, t/ha) production at 3 key timings, being first node (GS31), mid-anthesis (GS65) and maturity (GS91). Actual values are displayed above the bars (no significant differences). DM at GS31 was only measured for Standard nutrition treatments.

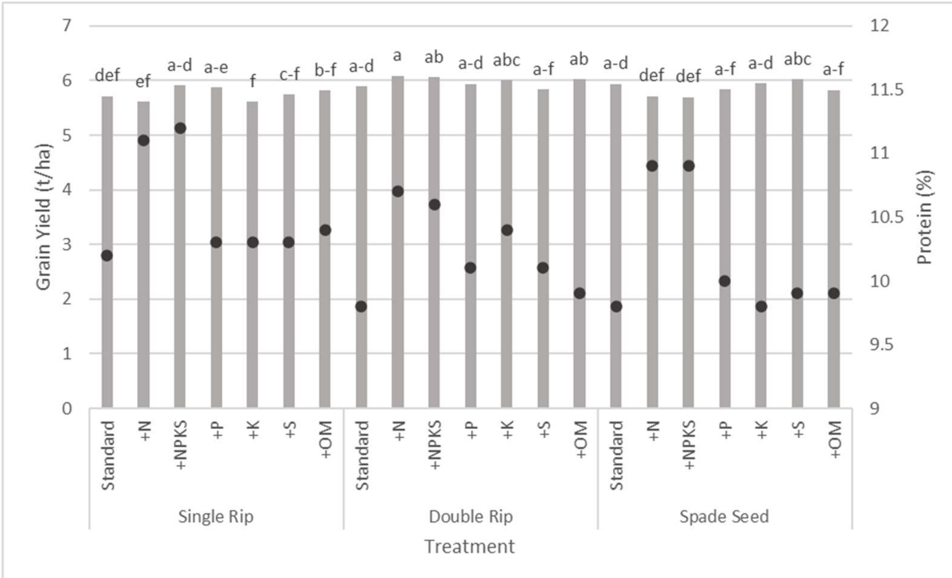


Figure 5. Influence of the interaction between amelioration/seeding method and nutrition on grain yield (t/ha) and protein (%).

Note: *For simplicity and brevity, the names of the amelioration/seeding method treatments will be shortened throughout this report to 'Single Rip' (2019 ripped, tine DBS), 'Double Rip' (2019 & 2022 ripped, tine DBS), and 'Spade Seed' (2019 & 2022 ripped, spade seeder).*

4.0 Productivity performance of wheat and barley sown mid-April compared with a traditional mid-May sown wheat

Key point summary

- Over the three project years 2020 – 2022, barley yields sown in the mid-April window in a relatively frost-free coastal environment at Esperance have been over 1t/ha higher yielding than wheat, despite the lack of adapted winter barley varieties for early sowing.
- This differential varied on what barley and wheat cultivars were chosen, but if the comparison was based on RGT Planet versus Scepter the average difference was 1.47t/ha (ranging from 1.06 -2.21t/ha).
- When comparing Planet to Rockstar instead of Scepter in 2021 and 2022, the differential fell to 0.91t/ha illustrating the better adaptation of the slightly longer season spring wheat to the mid-April sow window.
- Based on a conservative 1t/ha advantage to barley at grain prices of $250 - 400/t for barley, wheat grain prices would need to be $50 - $80/t higher to offset the yield difference.
- Higher input strategies over the three years of the project have given cost effective yield increases, particularly with the more net blotch susceptible varieties.
- To maximise the yield of barley sown in mid-April, disease management has been a key input to unlock the potential of the crop, particularly where RGT Planet was the cultivar of choice.
- Whilst higher nutrition levels cannot be discounted as being part of the success of higher input management in barley, green leaf retention and disease assessments indicate that higher fungicide input in mid-April sown barley is more important than using those same additional fungicide inputs in wheat.

- With spot form of net blotch (SFNB) in 2020 and 2021 and net form of net blotch (NFNB) in 2022, higher fungicide input based on three to four units of fungicide using all three modes of action (DMIs, QoIs and SDHIs) was noted to give superior disease control than two applications of DMI.
- The importance of disease management in the success of utilising higher inputs was further supported by observations that more disease resistant cultivars such as Laperouse only gave half the yield increase to additional fungicide, N and PGR input.
- Over the three years, the additional inputs associated with a high input programme (40-50 additional N, higher cost fungicide and PGR) was cost effective with RGT Planet but would have been more marginal with Laperouse, particularly considering the cost of additional N input.
- There was no evidence produced by the project that mid-April sowing dates were more productive than the early – mid May sowing window, however it is noteworthy that spring barley cultivars were more productive than either winter or spring wheat sown in mid-April.
- When compared in adjacent trials (not statistically comparable), spring wheat grain yields were higher as a result of sowing in early to mid-May compared to mid-April sowing using the same management inputs.
- These later sown wheat crops flowered more in line with the regional optimum of mid-September with the critical stem elongation period coinciding with longer days and higher solar radiation. The result was higher harvest dry matters and increased yields.

Which is higher yielding from a mid-April sowing, wheat or barley?

After three project years with identical mid-April sowing dates at the Esperance site, wheat and barley yields have been compared in adjacent trials (Table 6).

Table 6. Highest grain yield (t/ha) of Scepter (wheat) and Planet (barley) sown in mid-April (Yields taken from adjacent trials on the centre sown at the same time).

Crop	2020	2021	2022	Mean
	t/ha	t/ha	t/ha	
Wheat cv Scepter	**5.80**	**6.85**	**5.07**	**5.91**
Barley cv RGT Planet	**6.86**	**8.00**	**7.28**	**7.38**
GSR mm (April – October)	346	510	600	

The results illustrated that Planet barley was on average 1.47t/ha higher yielding than Scepter planted in the mid-April sowing window. Where the slightly later flowering Rockstar was substituted for Scepter in 2021 and 2022, the difference was reduced by 0.91t/ha. Overall taking account of the highest yielding cultivar, the difference has been approximately 1t/ha. Considering that yield differential and input costs were similar over the three years, the following grain price differential would be needed for wheat to equal the margin achieved with a higher yielding barley crop (Table 7).

Table 7. Grain price ($/ha) required in wheat to offset 1t/ha advantage to barley based on **6t/ha** for barley with barley grain prices between $250 - $400/t.

Crop (Grain price $/ha)				
Wheat	**$300**	**$360**	**$420**	**$480**
Barley	**$250**	**$300**	**$350**	**$400**

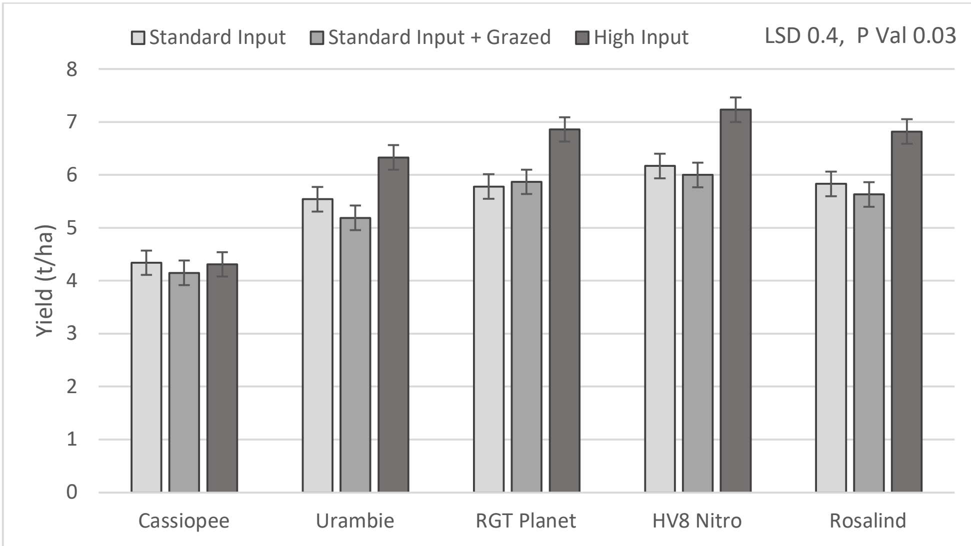
Note: *This takes no account of other considerations such as the value of straw or subsequent rotational benefits.*

How do we maximise barley yields in the HRZ?

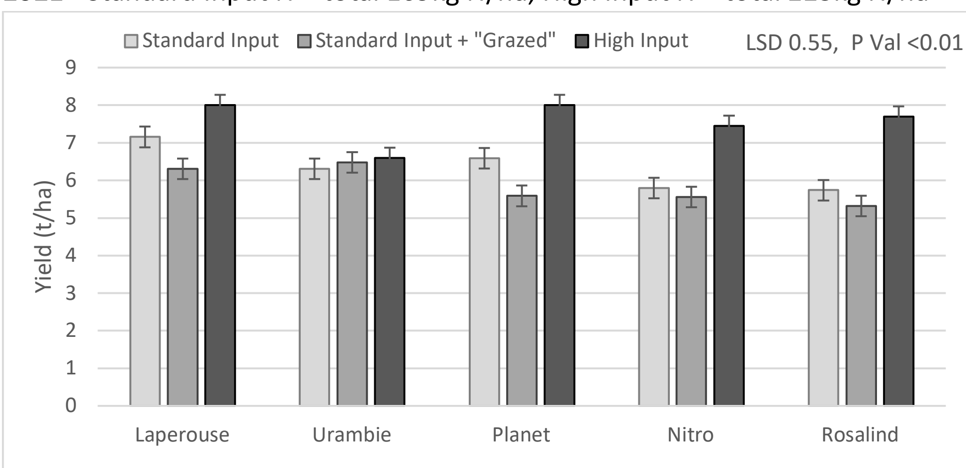
As was the case with the work conducted in wheat a range of varieties were tested with three levels of management. These management levels were i) Standard input ii) Standard input with defoliation at GS30 and iii) High input which incorporated PGR application, greater N input and a more robust fungicide package (Table 8).

Over all three seasons the results from the trials were similar with statistically significant lifts in productivity associated with the high input approach (Figure 6). The trials also revealed that there was a significant interaction between variety and management approach in all three years, meaning that the tested varieties responded differently to the management approaches tested. Although it is not possible to isolate exactly which additional input of the high input approach was responsible for the lift, ***it was clear from other trials on site and disease assessments that disease management played a much more important role in the success of lifting barley yields in comparison to wheat. With spot form of net blotch (SFNB) in 2020 and 2021 and net form of net blotch (NFNB) in 2022 higher fungicide input based on three-four units of fungicide (seed treatments and foliar sprays) using all three modes of action (DMIs, QoIs and SDHIs) was noted to give better disease control than two applications of DMI (see Table 7 for more details on specific inputs).***

2020 - Standard Input N – total 127kg N/ha, High Input N – total 173kg N/ha



2021 - Standard Input N – total 169kg N/ha, High Input N – total 223kg N/ha



2022 - Standard Input N – total 121kg N/ha, High Input N – total 167kg N/ha

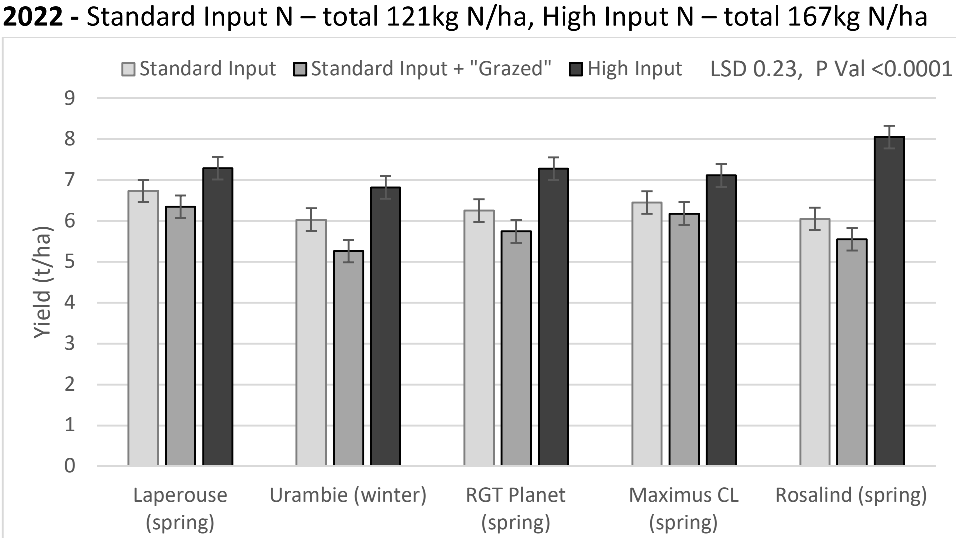


Figure 6. Influence of management approach on barley variety performance 2020 – 2022.

Table 8. Details of the typical management levels used over the three years of the project (kg, g, ml/ha).

Plant pop'n:		200 seeds/m² (150 plants/m² target) sown 16 April		
		Standard	**"Grazed" Standard**	**High Input**
Grazed:		----	✓ (GS30)	----
Seed treatment:		Vibrance/ Gaucho		
Basal Fertiliser:		71kg Summit Vigour compound and 71kg Monoammonium Phosphate (MAP)		
K in crop		**10 kg K**	**10 kg K**	**10 kg K**
Nitrogen:		**121 - 169 kg N**	**121 - 169 kg N**	**167 -223 kg N**
PGR:	GS31	----	----	200mL Moddus Evo
	GS39	----	----	200mL Moddus Evo
Fungicide:	GS00	----	----	Systiva
	GS31	150mL Prosaro	150mL Prosaro	300mL Prosaro
	GS39	500mL Opus	500mL Opus	840mL Radial

So how does the productivity of mid-April sown crops compare to more traditional May sowing windows?

The focus of the project was to look at closing the yield gap of earlier sown cereals by evaluating performance superimposed on commercially ameliorated land. Whilst it cannot be statistically compared to the mid-April sowing for the three years 2020 – 22, an adjacent trial was planted looking at mid-May sown wheat in the same ameliorated scenario (Table 9).

Table 9. Comparison of grain yield (t/ha) between three spring varieties (Scepter, Rockstar and Denison) sown either early on the 16 April (all 3 years) or between 9 -14 May grown under the same standard management input.

Variety	2020 Yield (t/ha)		2021 Yield (t/ha)		2022 Yield (t/ha)	
	April Sown	May Sown	April Sown	May Sown	April Sown	May Sown
Scepter	4.52	5.39	5.02	7.29	4.32	5.40
Rockstar	---	5.45	6.24	7.72	5.04	5.77
Denison	---	---	6.36	8.06	4.79	5.14
****Note that as these results are across two trials, they cannot be directly compared hence the lack of statistical significant values.***						

Although not statistically comparable, there have been sound trends in all three years to indicate that delaying seeding of spring wheats until the traditional early – mid May sowing period produced higher dry matter content at harvest, higher head numbers and overall higher grain yields. This later sowing date better aligned to the ideal mid-September flowering window and meant that the period of stem elongation (when grain number formation is occurring) was taking place in longer days that produced higher solar radiation than the equivalent development periods for the same varieties sown in mid-April.

Key Learnings - Albany Crop Technology Centre – Frankland River, WA

1.0 Spring versus winter wheat germplasm sown mid-April

The activity in the Albany Port Zone has been much smaller in focus but has mirrored the Esperance work on winter versus spring germplasm with late April sowings. In 2020 this took place on a Sandplain soil at Green Range northeast of Albany with below average growing season rainfall (and then 50% falling in August causing waterlogging), and then at Frankland River on a forest gravel with above average rainfall in 2021 and slightly above average rainfall in 2022, although September rainfall was 50% down on average rainfall.

Key point summary

- Despite slightly later April sowing dates (ranging from 21st April to 1st May) winter wheat germplasm has been more consistent in the southern western WA environment than was the case at Esperance.
- Even the longer season red wheat RGT Accroc performed well in relation to Scepter, despite having a flowering date in mid-October that was later than was regarded as optimal.
- There may be several specific reasons for this in terms of overall rainfall (which was very high in 2021 compared to average) and milder spring temperatures.
- In addition, the rainfall distribution pattern in 2022 delivered a dry September which may have been more deleterious for the shorter season wheats that were at a more advanced development stage in this period.
- Over the three years 2020 – 2022 Mowhawk (winter wheat) had the edge over the more established variety Illabo (winter wheat).
- Unlike Esperance where higher harvest dry matter has not been as advantageous in winter wheat germplasm (due to lower harvest indices), lower than average maximum temperatures in October and November at Frankland River resulted in generally better yields from winter wheats, even with varieties flowering later than optimum window.
- Increased inputs, particularly nutrition have been the key to cost effective yield increases in wheat trials over the final two of the three seasons of the project.
- An additional 25 or 90kg N/ha on top of a standard N dose provided profitable increases in productivity in 2021 and 2022 based on yield increases of 0.71 and 0.66t/ha (urea at $600/t & grain price at $375/t) and associated protein lifts (mean of seven cultivars).
- RGT Accroc was the least responsive variety to higher input management, despite generally producing higher harvest dry matters, although grain proteins have been lower.
- In contrast, the spring milling wheats have shown good responses to a higher input management strategy (additional N, PGRs and greater fungicide input), which from observations of disease, lodging and crop structure is most associated with additional N fertiliser input.
- As was the case at the Esperance site, increasing fungicide input in wheat has not given rise to better crops with little evidence of disease to warrant spending more than a standard two spray strategy based on DMI chemistry.
- Defoliation simulating grazing had variable effects on grain yields and margins but was most negative in the highest yielding season, depending on the value attributed to grazing.

Grain Yields 2020 – 2022

At the Albany Crop Technology Centre, the grain yields have been more variable in comparison to Esperance, in part due to a change of site and soil type between 2020 and 2021 (Figure 7). Over the three project years the notable difference between Esperance and Frankland River has been better performance of winter germplasm relative to spring germplasm. This was not only apparent with the shorter season winter wheats Mowhawk and Illabo, but also the long season red wheat RGT Accroc, which has been much more consistent than expected over the three varying seasons.

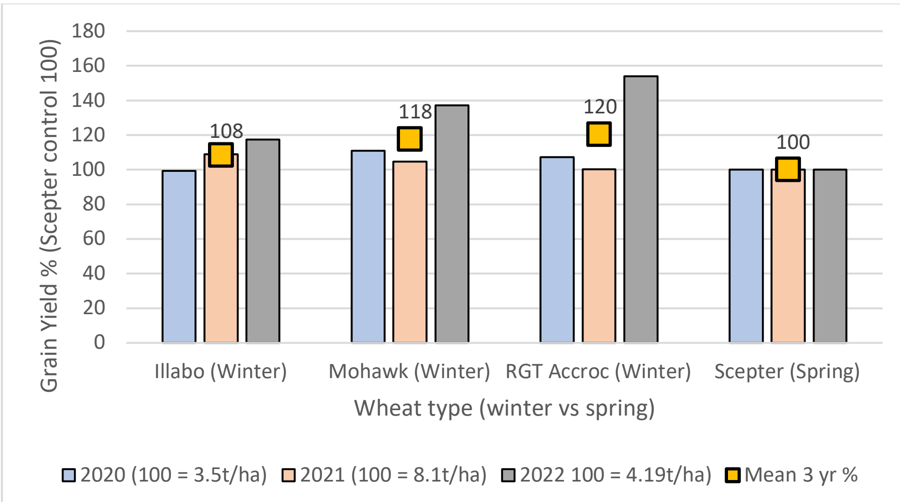


Figure 7. Winter vs. spring germplasm grain yield (%) under high input management over three seasons.

When did crops flower at the Frankland River trial?

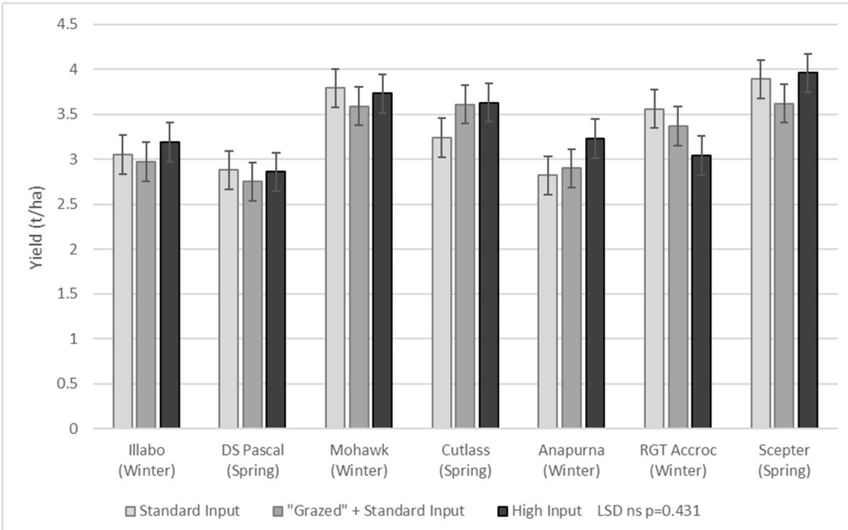
Following a 21st April sowing date in 2022, Table 10 shows the diversity in flowering dates of the winter and spring cultivars established at the Frankland River site, with almost 2 months difference between Scepter and RGT Accroc. From modelling studies, the optimum flowering period for the region is regarded as late September, slightly later than mid-September for Esperance. As might be expected, those spring wheats that flowered first had significantly lower harvest dry matters than the winter wheats. However, the surprise has been the good grain yield performance of winter wheats despite them flowering much later than the optimum period. Further assessment in future seasons is necessary to determine whether this is an artefact of two mild springs or a lift in productivity from European germplasm not previously tested in southwest WA.

Table 10. Approximate calendar date that each cultivar reached stem elongation (GS30) and the beginning of flowering (GS61) – 21 April sown.

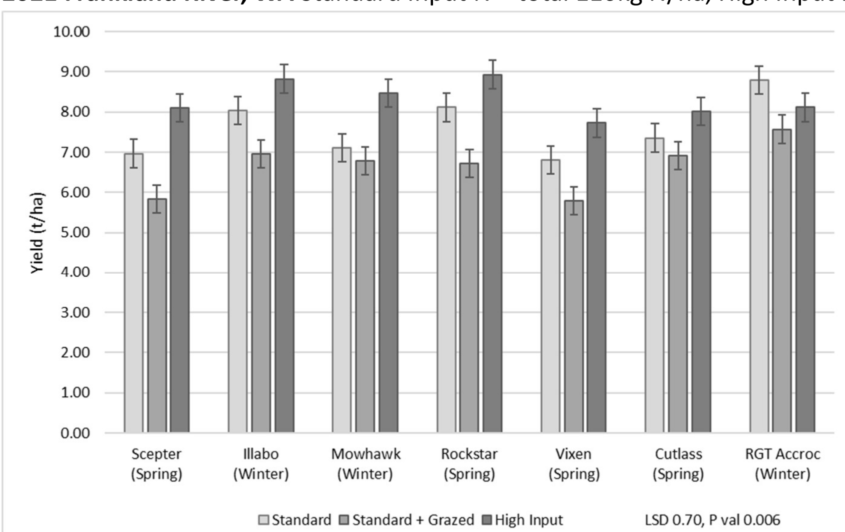
Cultivar (type)	Date GS30	Date GS61
Illabo (Winter)	1 July	26 September
Rockstar (Spring)	16 June	30 August
Mowhak (Winter)	1 July	12 September
Kinsei (Spring)	16 June	30 August
RGT Accroc (Winter)	16 June	14 October
Scepter (Spring)	2 Aug	19 August
Denison (Spring)	16 June	9 September

As figure 8 indicates, the differential between spring and winter germplasm performance could be reduced by introducing spring wheat cultivars such as Rockstar and Denison that were higher yielding than Scepter. However, the generally cooler environment of Frankland River compared to Esperance has favoured the winter wheat germplasm.

2020 Green Range, WA - Standard Input N – total 86.5kg N/ha, High Input N – total 136.5kg N/ha



2021 Frankland River, WA Standard Input N – total 116kg N/ha, High Input N – total 209kg N/ha



2022 Frankland River, WA Standard Input N – total 100kg N/ha, High Input N – total 125kg N/ha

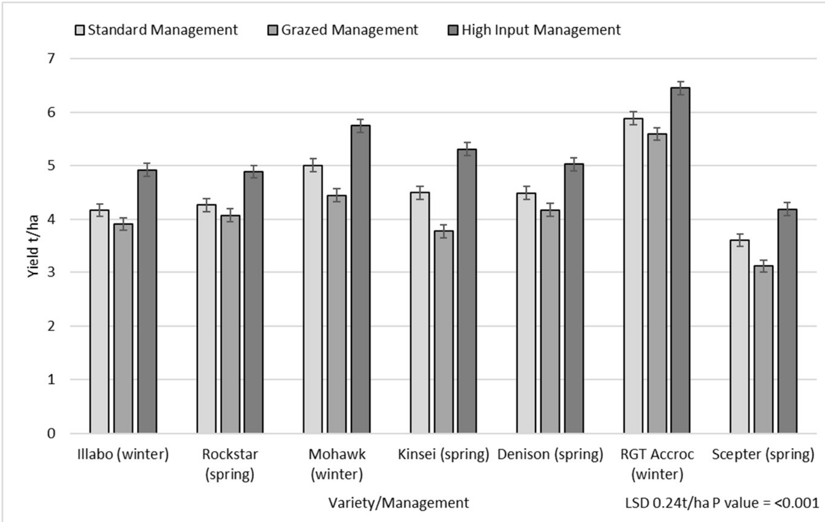


Figure 8. Influence of management approach on wheat variety performance 2020 – 2022 Frankland River, WA.

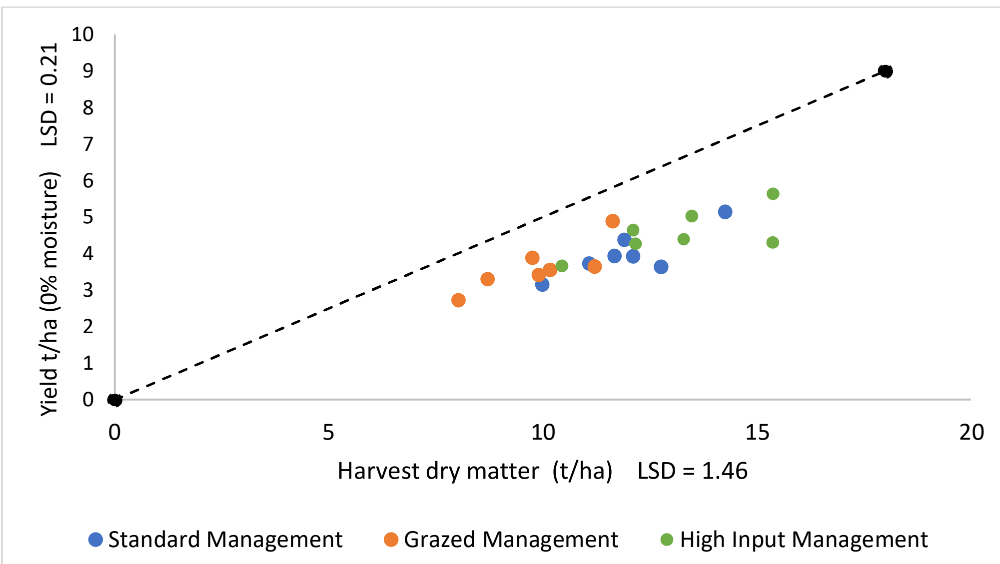


Figure 9. Influence of management approach on wheat harvest dry matter and grain yield (recorded at 0% grain moisture) under three management approaches - Frankland River, WA 2022

Further reading – Please refer to the Cereal Results documents for *Optimising high rainfall zone cropping for profit in the Western and Southern Regions (DAW1903-008RMX)*

This key learning document features a small sample of the information collected in the project over the last three years. If you would like to follow up on any of the results, background details or assessments please refer to the individual results documents issued for 2020, 2021 and 2022 which have the following links.

https://faraustralia.com.au/wp-content/uploads/2022/04/210316-HRZ-2020-Cereal-Results-FINAL.pdf

https://faraustralia.com.au/wp-content/uploads/2022/03/220222-HRZ-2021-Cereal-Results-FINAL-PROVISIONAL.pdf

https://faraustralia.com.au/wp-content/uploads/2023/03/HRZ-2022-Esperance-Cereal-Results_FINAL.pdf

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Finally we would like to thank Nicky Tesoriero of Ceres Agronomy who assisted with the research leading to the 2022 results and reviewed the final results summary.

Six annual field days and a number of informal field walks were delivered across the Esperance and Albany Port zones over the course of the project. Whilst these were largely affected by COVID in the first two years, the turnout was still extremely pleasing with c.700 growers, advisers and researchers in attendance.

SOWING THE SEED FOR A BRIGHTER FUTURE

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