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FINAL REPORT 2023

PROJECT CODE	S319
PROJECT TITLE	
Improving productivity of oats	

PROJECT DURATION						
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PROJECT REPORT:

Executive Summary

This project investigated the management of oats for maximising grain yield focusing on time of sowing and the ability of making in-season management decisions to cut for hay compared to retaining for grain yield in the event of a frost. In all three seasons, there was a small but significant increase in grain yields when crops were managed for grain rather than managed for hay at both sites. The project findings highlighted the following:

- SA growers have access to oat varieties with similar development speeds to Compass barley and Scepter wheat and are likely to flower within a similar frost risk window.
- Oat varieties sown earlier than current practice can produce biomass (hay yields) similar or better than Compass and Scepter.
- Increasing plant density and applying all nitrogen fertiliser within the first six weeks did not improve biomass in two seasons at two sites when sown into soil with high fertility. However, in a low rainfall and N responsive site, in one year (2021), a high plant density and applying all nitrogen fertiliser within the first six weeks resulted in an 0.5 t/ha increase in hay biomass compared to a lower plant density with N fertiliser delayed until GS31.
- In 2019 and 2021, oats had significantly higher grain yields (up to 1.5 t/ha in 2019 and over 4 t/ha in 2021) than Scepter (wheat) when flowering at a similar time under extreme reproductive frost conditions at Lameroo and Tarlee respectively. This suggests oats are likely to be a lower risk option in frost prone landscapes for both hay and grain.
- Through analysis of hay and grain yield data, a clear segregation occurs between the varieties bred for hay and those bred for grain. However, under some management scenarios such as earlier sowing, dual-purpose varieties can achieve both high hay and grain yields.

Project objectives

The two main objectives of this project were:

1. To provide growers with new information on how to manage oats for grain, focusing on time of sowing to maximise yields and minimise quality issues caused by environmental stress during critical periods of growth.
2. If the crop fails due to frost and the decision is made to cut for hay, how will the quality of the hay from a crop managed for grain compared to a crop that was managed for hay.

Overall Performance

The project achieved the objectives including the establishment of field trials at two locations (Lameroo/Jabuk and Tarlee) across three years with two time of sowings. A substantial amount of data has been collected and a summary of each season is provided here in the Final Report with all data available. A gross margin analysis was completed in a separate spreadsheet, however, the publication of results in a manuscript to Crop and Pasture Science was not completed.

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Difficulties encountered
The preferential grazing by Kangaroos of the Scepter wheat plots sown in the early trial at Lameroo in 2021 impacted on the wheat plots. Frost events occurred each year and impacted on field trials, however, this provided the opportunity to assess the advantages and disadvantages of the grain and hay set-up in these seasons when frost occurred, which highlighted that the dual purpose oats may be of less risk in these frost prone environments.

KEY PERFORMANCE INDICATORS (KPI)		
KPI	**Achieved**	**If not achieved, please state reason.**
Year 1: Trials sown at both locations for both times of sowing	Yes ☒ No ☐	N/A
Year 1: In season measurements and yield data complete	Yes ☒ No ☐	N/A
2019 Annual Results compiled and recommendations made including gross margin analysis	Yes ☒ No ☐	N/A
Year 2: Trials sown at both locations for both times of sowing	Yes ☒ No ☐	N/A
Year 2: In season measurements and yield data complete	Yes ☒ No ☐	N/A
2020 Annual Results compiled and recommendations made including gross margin analysis	Yes ☒ No ☐	N/A
Year 3: Trials sown at both locations for both times of sowing	Yes ☒ No ☐	N/A
Year 3: In season measurements and yield data complete	Yes ☒ No ☐	N/A
Final Report submitted to SAGIT compiling three years of trials including recommendations and gross margin analysis	Yes ☒ No ☐	N/A
Manuscript prepared for Crop and Pasture Science	Yes ☐ No ☒	This manuscript is under preparation but not completed.

TECHNICAL INFORMATION

Field trials of oat varieties and barley (Compass) and wheat (Scepter, DS Bennett) were conducted by the SARDI Waite Agronomy team across two locations including Lameroo (2019, 2020) or Jabuk (2021) in the low rainfall zone and Tarlee (2019-2021) in the high rainfall zone (Table 1). Each site involved two sowing dates of late April/early May and late May. Two agronomic management strategies were tested across the trials including (1) grain – 160 or 240 plants/m^2 LRZ and HRZ respectively with 1/3 N fertiliser at sowing and 2/3 N fertiliser at 6 weeks after sowing (WAS) (mid tillering). In 2020, the grain N treatment was shifted to 2/3 at Z31 and (2) hay – 240 or 320 plants/m^2 LRZ and HRZ respectively with 2/3 N at sowing and 1/3 at 6WAS (mid tillering). A total of 15 varieties were tested across the sites and are outlined below in Table 1.

Oat Variety Development

In 2019, the range in start of flowering date among the oat varieties tested was around 3 weeks (early sown trial) or two weeks (late sowing trial) (Table 2). Durack, the earliest maturing oat variety had a similar flowering and hay cut date (growth stage watery ripe) to barley variety Compass. A number of early-mid maturing oat varieties (Kowari, Mulgara, Bannister, Williams) had similar flowering and hay cut date to Scepter. Forester was a very slow developing variety and did not flower under all environments. All oat varieties reached anthesis within 110-140 days after sowing (Table 2). In 2020, the spread in flowering date between oat varieties excluding Vasse was just over 3 weeks when sown late April, only a slightly wider period than when sown in early May in 2019 (Table 2). Some varieties had better stability in duration from sowing to mid flowering than others resulting in a swapping of order as sowing was pushed into April. Even at the earlier sowing date in 2020, there are still oat varieties with similar flowering dates to Compass and Scepter. In 2021, hay cuts at Jabuk started on the 20th of August for Durack sown at TOS 1 and finished with Scepter, Kingbale and Vasse on the 7th of October sown at TOS 2. The hay cuts for Tarlee started later on the 6th of September for Durack and Compass sown at TOS 1 and finished with Williams, Scepter, Kingbale and Vasse sown at TOS 2. The spread in cutting date between oat varieties at both sites was similar to the window in 2020 at four weeks for the late April sown plots (Table 2). When sown in late May, at Jabuk the cutting date window reduced to three weeks whilst at Tarlee it was slightly wider at 25 days (Table 2). Collectively, based on these findings, growers have access to oat varieties with similar development speeds to Compass barley and Scepter wheat, that are likely to flower within a similar frost risk window.

Table 1: List of varieties included in trials, their maturity group and end-use purpose

Variety	Maturity	Purpose	Notes
Durack*	Very early	Milling, hay	all seasons
Kowari	Early	Milling, feed grain	all seasons
Mitika	Early	Milling, feed grain	all seasons
Yallara*	Early	Milling, feed grain, hay	all seasons
Bannister	Early-mid	Milling, (hay)	all seasons
Mulgara*	Early-mid	Feed grain, hay	2019, 2020
Williams*	Early-mid	Milling, hay	all seasons
Wintaroo*	Mid	Feed grain, hay	2019, 2020
Wombat	Mid	Milling, feed grain	2019 only; superseded variety and not suitable for hay
Kingbale	Mid	Hay	2021, 2021; Imi-tolerant
Brusher*	Early-mid	Hay	2019, 2020
Koorabup*	Mid	Hay	all seasons
Forester*	Very late	Hay	2019 only; needs longer growing season
Bilby	Early	Milling	2020, 2021; new grain variety
Vasse*	Late	Hay	2020, 2021; replaced Forester
Compass	Very early		all seasons; Barley check
Scepter	Early-mid		all seasons; Wheat check
DS Bennett	Slow Winter		2020; Winter wheat check at Tarlee

*variety also in the National Hay Agronomy project funded by AgriFutures Australia focused on export quality hay

Table 2: Date to hay cut for Lameroo and Tarlee in 2019, 2020 and 2021 for two sowing dates at each site for each oat variety tested, wheat (Scepter) and barley (Compass). Light green to dark green indicates fastest to slowest variety across all years.

Year	Lameroo				Jabuk		Tarlee					
Site	2019		2020		2021		2019		2020		2021	
Sowing Date	6-May	28-May	22-Apr	18-May	22-Apr	20-May	1-May	31-May	20-Apr	19-May	28-Apr	18-May
Variety Compass	129	125	134	133	132	125	131	123	137	122	131	122
Scepter	135	134	148	133	**frosted	140	145	132	144	127	155	147
Durack	129	125	134	122	120	119	131	119	129	119	131	122
Kowari	133	120	134	122	125	119	140	123	137	125	138	129
Mitika	133	125	134	133	132	119	140	123	137	125	138	129
Bilby	N/A~	N/A~	134	133	125	119	N/A~	N/A~	137	127	138	135
Yallara	135	125	148	133	132	125	140	132	142	125	138	135
Williams	135	125	148	133	132	131	145	132	142	127	138	147
Koorabup	147	134	148	133	125	131	149	132	144	127	138	141
Bannister	135	125	148	133	132	131	145	132	148	127	142	141
Kingbale	142	134	148	133	147	140	153	132	148	135	155	147
Vasse	N/A~	N/A~	159	141	147	140	N/A~	N/A~	149	135	161	147
Brusher	135	134	148	133	N/A~	N/A~	140	132	137	125	N/A~	N/A~
Mulgara	135	134	141	133	N/A~	N/A~	140	132	142	125	N/A~	N/A~
Wombat	142	134	N/A~	N/A~	N/A~	N/A~	145	132	N/A~	N/A~	N/A~	N/A~
Wintaroo	142	134	148	133	N/A~	N/A~	149	132	148	135	N/A~	N/A~
Forester	169	N/A~	N/A~	N/A~	N/A~	N/A~	174	N/A~	N/A~	N/A~	N/A~	N/A~
DS Bennett	N/A~	N/A~	N/A~	N/A~	N/A~	N/A~	N/A~	N/A~	176	147	N/A~	N/A~
Hay Window Opening	129	120	134	122	120	119	131	119	129	119	131	122
Hay Window Closing	169	134	159	141	147	140	174	132	149	135	161	147
Whole Window (days)	40	14	25	19	27	21	43	13	20	16	30	25

*In 2019 Forester flowered inconsistently in some parts of the plot so both sowing dates cut on the 22/10 as the later sown had stopped growing.

N/A ~Varieties not grown

** Frosted

Hay Yield Responses

In 2019, the hay biomass (cut at ground level and reported on a dry basis) at both Lameroo and Tarlee from early sowing average 7.6 t/ha and 11.6 t/ha in the early May sowing. The earliest maturing hay varieties (Bannister, Brusher, Durack and Mulgara) were the best performing varieties for hay yields at Lameroo, on par with Compass. At Tarlee, Mulgara, Kingbale and Yallara from early sowing had the highest hay yields, on par with Scepter from earlier sowing and Compass from later sowing. There was no significant effect of crop density or N management at both sites on hay yield. At both sites, hay biomass was higher from earlier sowing but management for grain or hay on its own did not have an effect on biomass. The main effects for total biomass from the hay cuts are shown in Table 3.

Table 2: Biomass (t/ha) from hay cuts at watery ripe (GS71) in 2019 at Lameroo and Tarlee. Cuts taken at ground level and reported at 0% moisture. Main effects reported only. Asterisk in variety indicate top performing varieties as determined by ANOVA (lsd.p≤0.05).

	Lameroo	Tarlee
TOS 1	7.6	11.6
TOS 2	6.3	10.0
Lsd (p≤0.05)	*0.6*	*1.1*
Grain	6.9	10.8
Hay	7.0	10.7
Lsd (p≤0.05)	*n.s (0.2)*	*n.s. (0.3)*

	Lameroo		Tarlee	
Compass	7.7	*	12.1	*
Scepter	6.4		11.5	*
Bannister	7.2	*	10.9	
Brusher	7.5	*	10.3	
Durack	7.8	*	9.3	
Forester	6.3		10.3	
Kingbale	6.6		11.3	
Koorabup	6.6		10.3	
Kowari	7.1		10.4	
Mitika	6.7		10.0	
Mulgara	7.4	*	12.2	*
Williams	6.6		10.3	
Wintaroo	7.0		10.9	
Wombat	6.2		10.1	
Yallara	7.5	*	11.5	*
Lsd (p≤0.05)	*0.6*		*0.7*	

At Tarlee there was a TOS x Variety interaction and at Lameroo there was a 3-way interaction between all main factors. At Tarlee, the highest biomass yielding treatments were all from TOS1 for oats and wheat (Mulgara 13.4, Kingbale 12.6, and Yallara 12.2, Scepter 12.5) but from TOS2 for Compass (12.3; *lsd 1.2*). At Lameroo, all the highest biomass treatments were achieved from TOS1 (Bannister, Brusher, Durack, Kowari, Mulgara and Yallara) (Figure 1).

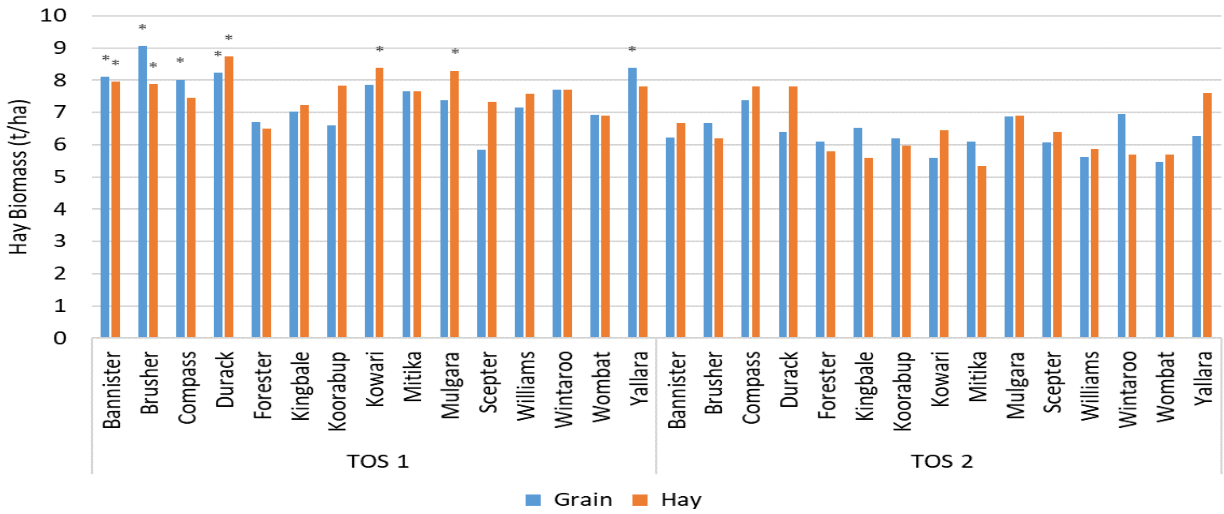

Figure 1: Interaction between TOS, Management and Variety for hay biomass at Lameroo (ANOVA p≤0.05, lsd 1.2 t/ha).

In 2020, hay yields were maximised at both sites from earlier sowing similar to 2019 (Table 4 and Table 5). The effect of crop density and N management did not affect hay yield at either site, in agreement with 2019 results. At Lameroo, only Vasse, the slowest developing oat variety could match the hay biomass of Compass (Table 4) although there was a significant TOS x Variety interaction. At Tarlee, Mulgara, Vasse, Wintaroo and Kingbale were the highest yielding oat varieties which were able to out yield Compass (Table 5).

Table 4: Hay biomass (t/ha) at watery ripe (GS71) and grain yield (t/ha) from harvest at Lameroo 2020. *Hay cuts reported at 0% moisture, grain yields reported at 11% moisture. Asterisk in variety indicate top performing varieties as determined by ANOVA (lsd.p≤0.05).*

	Hay yield		Grain yield	
TOS 1	8.2	*	3.2	
TOS 2	6.9		3.7	*
Lsd (p≤0.05)	*0.5*		*0.2*	
Grain	7.5		3.5	*
Hay	7.6		3.4	
Lsd (p≤0.05)	*n.s (0.2)*		*0.05*	

	Hay yield (t/ha)		Grain yield (t/ha)	
Compass	9.4	a	4.3	b
Scepter	7.7	defg	4.7	a
Bannister	7.7	def	4.3	b
Bilby	6.9	gh	4.0	c
Brusher	7.8	cdef	2.7	i
Durack	6.7	gh	2.9	ghi
Kingbale	7.3	efg	3.1	fgh
Koorabup	7.0	gh	2.9	hi
Kowari	6.6	hi	3.7	d
Mitika	6.0	i	3.1	fg
Mulgara	8.3	bc	3.0	fgh
Vasse	8.9	ab	3.5	e
Williams	7.2	fg	3.4	e
Wintaroo	8.1	cd	3.0	fgh
Yallara	7.9	cde	3.2	f
Lsd (p≤0.05)	*0.6*		*0.2*	

Table 5: Hay biomass (t/ha) at watery ripe (GS71) and grain yield (t/ha) from harvest at Tarlee 2020. Hay cuts reported at 0% moisture, grain yields reported at 11% moisture. Asterisk in variety indicate top performing varieties as determined by ANOVA (lsd.p≤0.05).

	Hay yield		Grain yield	
TOS 1	10.6	*	4.3	
TOS 2	7.9		4.6	
Lsd (p≤0.05)	*0.6*		*n.s. (0.3)*	
Grain	9.2		4.5	*
Hay	9.3		4.4	
Lsd (p≤0.05)	*n.s (0.2)*		*0.09*	

	Hay yield (t/ha)		Grain yield (t/ha)	
Compass	9.7	bcd	5.2	c
Scepter	8.2	ghi	5.8	a
DS Bennett	8.9	ef	5.3	c
Bannister	9.4	cde	5.6	ab
Bilby	8.6	fg	4.6	d
Brusher	9.1	def	3.4	I
Durack	8.0	hi	3.5	hi
Kingbale	10.7	a	3.7	fgh
Koorabup	9.4	cde	4.0	ef
Kowari	8.6	fgh	4.7	d
Mitika	7.7	i	4.2	e
Mulgara	10.1	abc	3.4	hi
Vasse	10.7	a	5.3	bc
Williams	8.7	fg	5.1	c
Wintaroo	10.3	ab	3.8	fg
Yallara	9.8	bc	3.6	ghi
Lsd (p≤0.05)	*0.6*		*0.3*	

In 2021, in agreement with the previous two seasons, hay yields were maximised at both locations from earlier sowing (Table 6 and Table 7). Unlike previous seasons, Compass was not one of the highest performing varieties for hay biomass. The effect of crop density and N management did not affect hay yield at Tarlee, in agreement with the previous two seasons but at Jabuk, the higher seeding rate and more N upfront resulted in 0.5 t/ha biomass more than managing the crop for grain. At Jabuk there was also a TOS x Management interaction for hay yield. Although management did not matter when plots were sown early, from a late May sowing date, plots managed for hay yielded 0.9 t/ha more than plots managed for grain. At Jabuk, Vasse, Kingbale, Bannister and Yallara produced the most biomass along with Scepter. At Tarlee, Kingbale and Vasse produced the most biomass, more than both Compass and Scepter. This was a similar result to the 2019 season where Mulgara, Vasse, Wintaroo and Kingbale were able to yield higher than Compass.

Table 6: Hay biomass (t/ha) from hay cuts at watery ripe (GS71) and grain yield (t/ha) from harvest at Jabuk in 2021. Hay cuts taken 15cm above ground level and reported at 0% moisture, grain yields reported at 12.5% moisture. Asterisk or letters indicate significant differences as determined by ANOVA (lsd.p≤0.05).

	Hay yield		Grain yield	
TOS 1	6.2	*	4.0	
TOS 2	5.6		3.0	*
Lsd (p≤0.05)	*0.5*		*0.2*	
Grain	5.3		3.6	*
Hay	5.8	*	3.4	
Lsd (p≤0.05)	*0.4*		*0.2*	

HAY YIELD	TOS 1		TOS 2	
Grain	6.2	c	4.5	a
Hay	6.2	c	5.4	b
Lsd (p≤0.05)	*0.7 (0.6 within TOS)*			

	Hay yield		Grain yield	
Compass	5.8	abcd	4.5	d
Scepter	6.7	cde	4.2	cd
Bannister	6.2	bcde	4.1	cd
Bilby	5.2	ab	3.5	abc
Durack	5.2	ab	2.8	a
Kingbale	6.9	de	3.1	ab
Koorabup	5.4	ab	2.9	a
Kowari	5.0	ab	3.6	abcd
Mitika	4.9	a	2.8	a
Vasse	7.2	e	3.8	bcd
Williams	5.5	abc	3.9	bcd
Yallara	6.2	bcde	2.9	a
Lsd (p≤0.05)	*1.2*		*0.9*	

Table 7: Hay biomass (t/ha) from hay cuts at watery ripe (GS71) and grain yield (t/ha) from harvest at Tarlee in 2021. Hay cuts taken 15cm above ground level and reported at 0% moisture, grain yields reported at 12.5% moisture. Main effects reported only. Asterisk in variety indicate top performing varieties as determined by ANOVA (lsd.p≤0.05).

	Hay yield		Grain yield	
TOS 1	10.4	*	5.2	
TOS 2	10.0		5.2	
Lsd (p≤0.05)	*0.3*		*n.s. (0.3)*	
Grain	9.6		5.4	*
Hay	10.3		4.9	
Lsd (p≤0.05)	*n.s (0.8)*		*0.2*	

	Hay yield		Grain yield	
Compass	9.0	ab	4.2	b
Scepter	9.6	abc	0.9	a
Bannister	10.6	cd	7.1	f
Bilby	8.7	a	6.2	e
Durack	9.3	ab	4.8	b
Kingbale	13.2	f	5.5	d
Koorabup	10.2	bcd	4.9	c
Kowari	9.2	ab	5.5	d
Mitika	9.0	ab	5.3	cd
Vasse	12.5	ef	6.1	e
Williams	10.2	bcd	6.7	f
Yallara	11.3	de	5.1	cd
Lsd (p≤0.05)	*1.3*		*0.5*	

Collectively, based on the data across the three years and two sites, the oat varieties sown earlier than current practice had high biomass (hay yields) similar to Compass and Scepter. Increasing plant density and shifting a greater proportion of nitrogen upfront did not increase hay biomass in most varieties. This suggests sowing date and variety choice are the biggest management levers to optimise hay yields and growers may be able to plant crops with more conservative strategies for hay than previously recommended.

Grain Yield Responses

In 2019, the Lameroo site was affected by severe frosts. There was a time of sowing by variety interaction for grain yield (Table 7) with oat varieties yielding (up to 1.5 t/ha) better from earlier sowing in the frost events but both Compass and Scepter yielded better from later sowing. Neither Scepter nor any oat variety was able to match the yield of Compass from late May sowing (3.8 t/ha). Despite the frost, highest grain yields for oats were from early May sowing (Bannister, Kowari and Williams 3.1 t/ha and Wombat 2.9 t/ha l.s.d. 0.4), were all either milling or dual purpose varieties and matched Scepter from late May sowing (2.9 t/ha). At Tarlee, despite the shattering in early maturing lines, grain yield was higher from earlier sowing (4.0 compared to 3.2 t/ha for all varieties and management) (Table 7). The only oat variety to yield the same as Compass (6.4 t/ha) and Scepter (6.1 t/ha) was Bannister (5.9 t/ha), all from sowing in early May (Table 7).

Table 7: Grain yield (t/ha) from Lameroo and Tarlee reporting interaction of TOS x Variety in 2019. Within locations, the highest yielding treatments are indicated at Lameroo with an 'a' followed by the second highest with a 'b'. At Tarlee the highest yielding treatments are indicated with an asterisk.

	Lameroo		**Tarlee**	
	TOS 1	**TOS 2**	**TOS 1**	**TOS 2**
Compass	2.6	3.8 a	6.4*	5.6
Scepter	1.4	2.9 b	6.1*	5.3
Bannister	3.1 b	2.7	5.9*	3.5
Brusher	1.9	2.1	2.7	2.1
Durack	2.2	2.1	3.3	3.8
Forester	N/A	N/A	0.5	0.2
Kingbale	1.5	2.0	3.8	2.5
Koorabup	1.7	2.1	3.2	2.6
Kowari	3.1 b	2.6	5.0	3.7
Mitika	2.4	2.4	3.8	3.6
Mulgara	2.2	2.2	3.1	2.2
Williams	3.1 b	2.5	4.7	3.5
Wintaroo	1.9	1.9	3.5	2.5
Wombat	2.9 b	2.5	5.4	3.5
Yallara	2.4	2.3	3.2	2.7
Lsd ($p \leq 0.05$)	*0.4*		*0.6*	

N/A Forester was not ready to harvest when all other varieties were harvested.

In 2020, due to the late rain, later sown crops at Lameroo had higher grain yields than early sown crops (Figure 2). At Tarlee, TOS did not impact grain yields (Table 5). Unlike hay yields, there was a small but significant increase in grain yields when crops were managed for grain rather than managed for hay at both sites. Scepter at both sites had the highest grain yields (Table 4 and Table 5) showing the upside of growing a wheat to capitalise on the Spring rain. Likewise, when Compass was sown later (in May, its optimal sowing window), it was one of the highest yielding varieties at both Lameroo and Tarlee (Figure 2b and 2d). Bannister was the highest potential milling oat at both sites but performed better from late sowing at Lameroo (Figure 2b) whilst it was able to maintain its grain yield across sowing dates at Tarlee (Figure 2d).

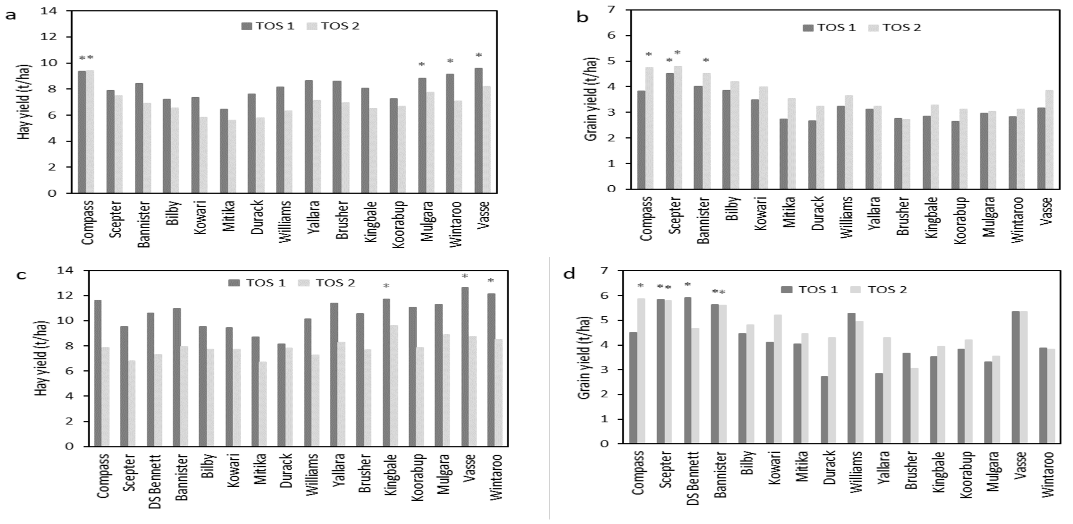

Figure 2: Interaction between Variety and TOS in 2020 on (a) hay yield at Lameroo, (b) grain yield at Lameroo, (c) hay yield at Tarlee, (d) grain yield at Tarlee. Asterisk indicate the top performing treatments within each graph.

In 2021, grain yields were higher from the late April sowing at Jabuk (Table 6) but at Tarlee the TOS did not impact grain yields for the second season in a row (Table 7). Scepter, which was frosted at Tarlee in 2021, had the lowest grain yield but at Jabuk where it did not experience frost during flowering, it had the highest grain yield along with Compass, Bannister, Kowari, Vasse and Williams. Bannister and Williams were also the highest performing varieties for grain yield. In all three, there was a small but significant increase in grain yields when crops were managed for grain rather than managed for hay at both sites. However, unlike the previous two seasons of trials, there was no interaction between TOS and Variety for grain yield at either site (Table 6 and Table 7).

CONCLUSIONS REACHED &/OR DISCOVERIES MADE

The key conclusions for this project are outlined below:

1. SA growers have access to oat varieties with similar development speeds to Compass barley and Scepter wheat and are likely to flower within a similar frost risk window.

2. Oat varieties sown earlier than current practice can produce biomass (hay yields) similar or better than Compass and Scepter.

3. Increasing plant density and applying all nitrogen fertiliser within the first six weeks did not improve biomass in two seasons at two sites when sown into soil with high fertility. However, in a low rainfall and N responsive site, in one year (2021), a high plant density and applying all nitrogen fertiliser within the first six weeks resulted in an 0.5 t/ha increase in hay biomass compared to a lower plant density with N fertiliser delayed until GS31.

4. In all three seasons, our results suggest sowing date and variety choice are the biggest management levers to optimise hay yields.

5. The high winds of 2019 highlighted the susceptibility of oats to shattering and greater grain yield losses relative to wheat and barley from earlier planting, however there are useful genetic differences growers can exploit if considering early sowing oats. This observation was supported in 2020 at both Lameroo and Tarlee and shows the better adaptation of milling varieties to shattering tolerance compared to varieties bred specifically for hay.

6. In 2019 and 2021, oats had significantly higher grain yields (up to 1.5 t/ha in 2019 and over 4 t/ha in 2021) than Scepter (wheat) when flowering at a similar time under extreme reproductive frost conditions at Lameroo and Tarlee respectively. This suggests oats are likely to be a lower risk option in frost prone landscapes for both hay and grain.

7. Through analysis of hay and grain yield data, a clear segregation occurs between the varieties bred for hay and those bred for grain. However, under some management scenarios such as earlier sowing, dual-purpose varieties can achieve both high hay and grain yields.

INTELLECTUAL PROPERTY

There is no intellectual property suitable for commercialisation from this project.

APPLICATION / COMMUNICATION OF RESULTS

Main findings

This project completed time of sowing trials of oat varieties (grain, hay and dual purpose) compared to wheat (Scepter) and barley (Compass) across three growing seasons at two sites (high and low rainfall). The main findings in dot point form are highlighted in the key conclusions above with a concise summary of:

- Sowing oat varieties early (April) can generate higher hay yields than current standard practice (May).
- Dual-purpose oat varieties are most useful if wanting to make in season decisions based on environmental conditions to switch from grain yield to hay or vice versa and achieve high yields and quality.

Statement of potential industry impact

This project highlights the feasibility of an in growing season switch between the choice of generating grain to hay and vice versa. It indicates that it is possible to choose a dual-purpose oat variety and to have an early sowing date to facilitate the highest hay yields and grain yields. Responses to altering nitrogen fertiliser amounts were variable with no clear advantage to applying more fertiliser unless in an N responsive site. In two years, results also indicated that the oats may be a lower risk option in frost prone environments for both hay and grain yield compared to wheat (Scepter). This project has the potential to give growers more confidence to grow oats (particularly dual-purpose oat varieties) for grain yield knowing they are able to make an in-season switch to oaten hay production or retain to grain yield depending on the season rainfall and frost events. This will have significant impact on the oat industry in SA with key findings supporting the concept that early sowing of oat varieties can increase hay yields similar to (and sometimes better than) both barley (Compass) and wheat (Scepter).

Publications and extension activities

- Mallee Sustainable Farming (MSF) Mallee Crop Walk Field Day at Jabuk site on 16 September 2021 presented by Brendan Kupke from SARDI to around 30 growers, researchers, exporters and agronomists in attendance.
- Mid North High Rainfall Zone (MN HRZ) Field Day on 24 September 2021 presented by Rhiannon Schilling from SARDI to around 30 growers and agronomists in attendance
- Hart Variety Talk 2021 presented by Rhiannon Schilling; 30 growers, researchers and agronomists in repeat sessions.
- Bendigo GRDC Updates by Courtney Peirce – 25th February 2021; around 40 growers, researchers and agronomists across two speaking slots.
- The 2020 results were distributed in the Hart Field Site 2020 Trial Results Book, MSF 2020 Annual Compendium and Eyre Peninsula Farming Systems 2020 Summary.
- Mid North High Rainfall Zone (MN HRZ) 2020 results update on 26 March 2021 by Courtney Peirce from SARDI to 30-40 growers and agronomists in attendance.
- Peirce C & Porker K. (2019 and 2020), Improving the dual-purpose productivity of oats, Mallee Sustainable Farming annual compendium.

- Peirce C & Porker K. (2021), Improving the productivity of oats for grain and hay, Eyre Peninsula Farming Systems Summary 2021.

Suggested path to market

The findings of this project have been extended directly to growers and agronomists throughout SA via a variety of crop walks, articles and summary books over the last three years. Growers and agronomists in both the Mid North and Murray Mallee regions have readily attended events and have been engaged in extension of trial outcomes. However, barriers to adoption include unreliable long term rainfall forecasts making the decisions around late in season nitrogen fertiliser management and the switch from oaten grain production to oaten hay production in season a difficult one to manage. The occurrence of frost events within the season is the most likely opportunity for growers, particularly in the lower rainfall region of the Mallee, and the choice of growing a dual-purpose variety is the clear path to market for growers who are looking to switch in season from hay to grain or grain to hay.

POSSIBLE FUTURE WORK

This SAGIT funded project successfully completed three years of trials which involved two field sites and multiple times of sowing to assess the impact of establishing agronomic management of the oaten crops. The findings are sufficient to address the aims of this project and no subsequent following on work is envisaged for this component. Early sowing date was found to be an important factor needed to evaluate the potential of new oat varieties (hay and yield) and should be considered when evaluating the performance of new oat varieties in the future.

AgriFutures Australia have recently funded a large-scale investment into export oaten hay agronomy in SA and Vic in collaboration with SARDI (lead), Birchip Cropping Group (BCG) and Hart Field Site group working with all oaten hay exporters, growers and Intergrain. This will focus on increasing export oaten hay biomass while maintaining quality and the management of hay rows to reduce the time from cutting to baling. The GRDC also recently announced a tender for an investment into oats focused on grain quality.