Evaluating the fit of Long Season Oat Varieties as Alternative Hay Varieties in South-West Western Australia 2016

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Introduction:

This is the second year of trials evaluating different maturity oat varieties. The driver for investigating new variety options is due to the severe impact from rainfall post cutting which has been experienced over previous growing seasons. Growers have adopted shorter season varieties and sown them earlier to achieve higher yields and avoid the end of season drought risk. This has resulted in the hay crop being cut earlier each season. Earlier cutting slows drying time and also means the hay is on the ground at a time when the probability of rain is higher.

The trial also gives a good opportunity to evaluate the performance of Hay specific varieties against the commonly grown hay variety Carrolup as well as varieties such as Williams and Bannister which are used as dual purpose varieties.

Trial Aims

This trial seeks to evaluate how yield, quality and economics of long season varieties compare to the traditional shorter season hay varieties (Carrolup, Brusher) with both early and later sowing. This information will provide options to growers so that they can use variety selection to better manage risk.

Methods

The trial was located 18km NE of Cuballing in the medium rainfall zone. The trial was designed using a near neighbour control configuration with plots measuring 11m in width and 200m in length. The paddock was sown to Brusher oats which were consequently selected as the control variety. Larger 5ha block of the varieties were sown to the north of the trial site to assess performance in hay plants. Nine varieties were included in both times of sowing which included Brusher, Tungoo, Genie, Bannister, Durack (formally WAO2Q302-9), Carrolup, Williams, Forester and Aladdin. The second time of sowing included two additional varieties in Mulgara and Kojonup.

The first time of sowing occurred on the 27th of April and the second on the 17th of May. Sowing rates were determined using 1000 grain weights and commercial rates of fertiliser were applied (table 1). The trial was sown using a DBS bar on 10inch spacings. Industry standard herbicides were applied to control weeds and fungicides were applied to reduce septoria and potential rust infections.

Varieties were cut at flowering which was determined using industry practice for maximum quality. Grab samples were taken at the time of cutting and core samples taken at the time of baling to assess quality. Visual observations and plant counts were made in season and bales were weighed on scales post baling to determine crop yield.

Table 1: Fertiliser applied to the trial throughout the season.

Products	kg/ha	N	P	K	S
Vigour (Sowing)	80	8.00	9.60	9.60	4.00
Urea (Sowing)	50	23.00	0.00	0.00	0.00
NK31 (Post emergence)	135	49.68	0.00	13.37	0.00
Total		80.68	9.60	22.97	4.00

Results

Seasonal Conditions

Cuballing east is located in the medium rainfall zone of Western Australia and experience slightly below average rainfall in the 2016 season. For the growing season from April to October the nearest weather station at Cuballing measured 289.6mm compared to the long term average for the station of 333.3mm (figure 1). The season started strong with good rainfall in March and April which allowed for good establishment. Mid-season rainfall levels were lower but promising falls late in the season allowed for a soft finish and attempts to chase extra yield. Temperature data wasn't available from the Cuballing weather station so data was collected from the Narrogin weather station. Temperatures were milder throughout the growing season compared to the long term average, this contributed to the soft finish.

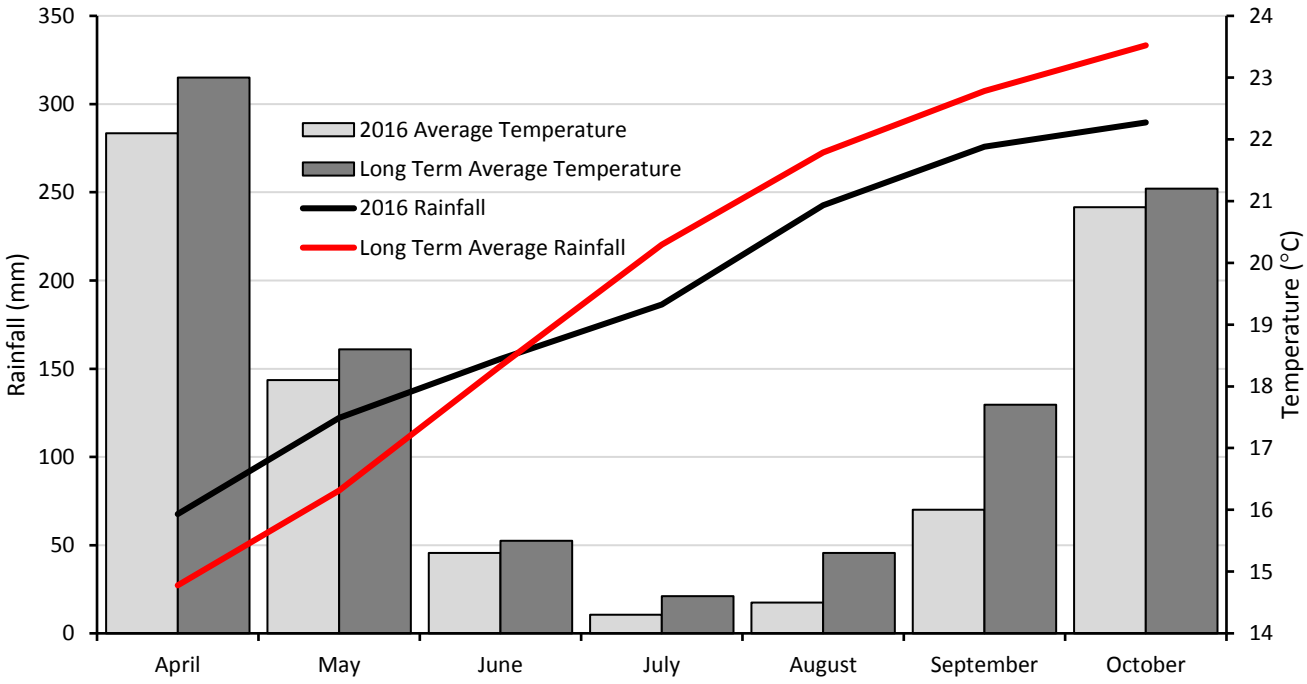

Figure 1: Cuballing cumulative growing season rainfall and Narrogin monthly average temperatures of the 2016 season vs the long term average.

Hay Yield

The later time of sowing on the 17th of May (TOS2) consistently returned a higher yield for each variety compared to the earlier sowing (24th April (TOS1)). The average yield of TOS2 was 18.5% more than the average of TOS1.

Brusher was the highest yielding variety in TOS2 averaging 8% higher than the average of TOS2. Though Brusher was the highest yielding variety, Bannister and Mulgara also yielded more than the TOS2 average (7.64t/ha). No TOS1 variety yielded higher than the average yield of TOS2.

Last season the trend was toward long season oat varieties (Forester, Genie and Aladdin) returning higher yields from the later plantings than the early plantings, this was not the case in 2016. Genie and Forester were the highest yielding varieties in TOS1 yielding 7.5% and 4.5% more than the TOS1 average (6.44t/ha). respectively. Brusher, Bannister, Mulgara, and Tungoo also yielded above the TOS1 average.

Williams and Carrolup which are the commonly grown varieties returned very similar yields under both times of sowing. Both Williams and Carrolup however yielded lower than the site averages of both times of sowing.

There were multiple frost events throughout the season and these may have had a greater impact on the early sown (TOS1) crops which were at more critical development stage at the times of these events.

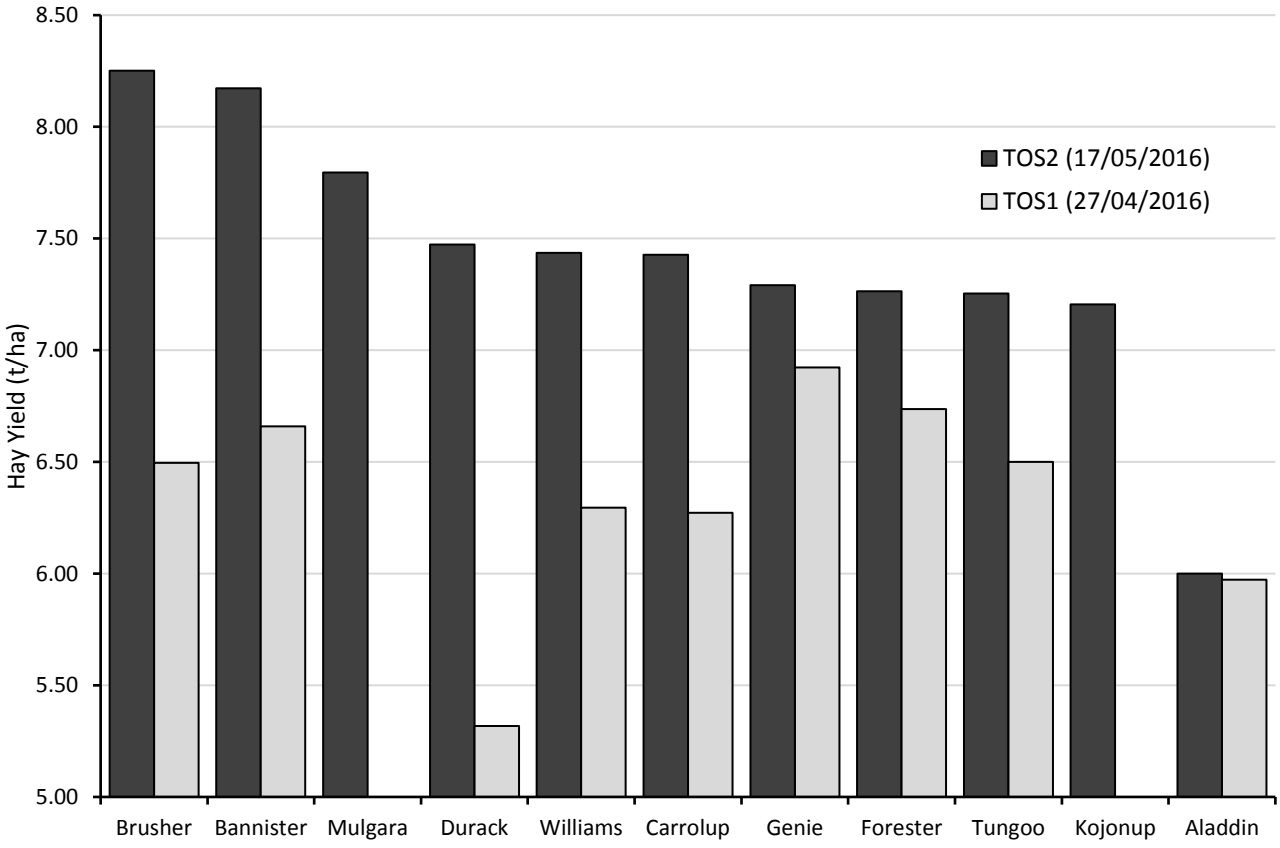

Figure 2: Hay Yield by variety at two times of sowing (note Mulgara and Kojonup only had one time of sowing)

Hay Quality of Time of Sowing One

Hay quality was determined using Gilmac's grading system based upon feed test data and visuals (appendix table 2). Time of sowing one showed the greatest variation in quality (figure 3). Dates of cutting and baling were used to determine how much rainfall fell on each of the varieties after it was cut (appendix table 4).

Time of sowing one experienced more rainfall events than time of sowing two post cutting. The short season varieties had the greatest amount of rain fall on them. Durack the shortest variety endured 34.4mm of rain post cutting, this did drop the quality a grade however the payment grade was unchanged as both fell within the range of the lowest pay grade. The most significant final shift as a result of quality reduction was in Williams, which when cut was at the highest grade but dropped two grades by baling. The Williams, Carrolup, Brusher and Bannister all endured 27.6mm of rainfall between cutting and baling. Carrolup and Bannister both dropped one grade between cutting and baling.

The long season varieties had little to no rain fall on them between cutting and baling. Tungoo endured 2.8mm whereas Genie, Forester and Aladdin did not receive any rain. However their visual scores fell rapidly between baling and cutting which much of the price reduction can be attributed to.

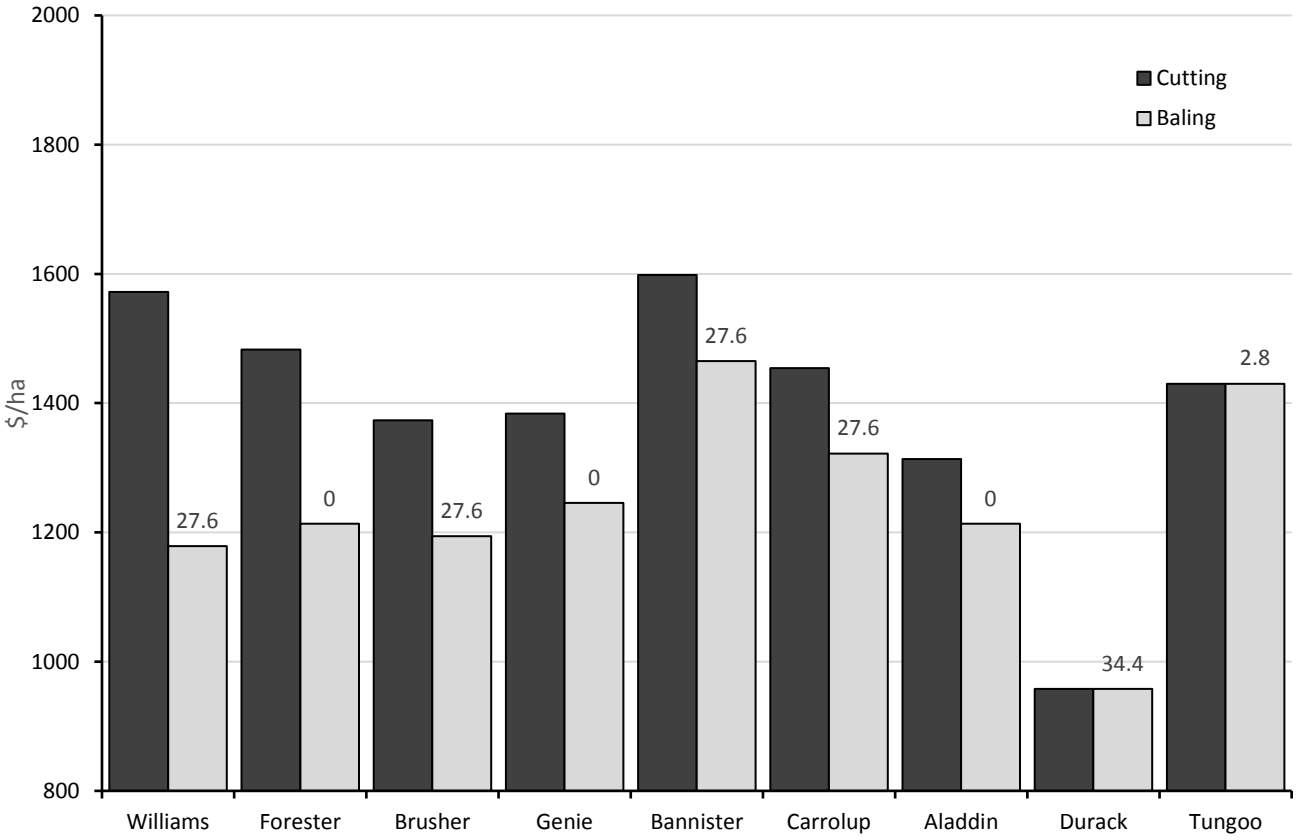

Figure 3: Changes in returns based upon change in quality of Varieties in Time of Sowing 1 (TOS1). Numbers above baling columns indicate amount of rainfall (mm) which fell on varieties between cutting and baling.

Hay Quality of Time of Sowing Two

The most rain which fell on any variety in the second time of sowing was 2.8mm. This included all the short season varieties in Bannister, Williams, Kojonup, Brusher, Carrolup, Mulgara and Durack. The long season varieties did not have any rain fall on them which included Forester, Genie, Aladdin and Tungoo.

Less time on the ground and less exposure to rainfall than the first time of sowing resulted in generally less quality reductions (appendix table 3). The short season varieties spent 18-26 less days on the ground than their TOS1 counterparts. Durack had the greatest difference in 26 days as its cutting time was earlier than the other short season varieties in TOS1 but aligned with them in TOS2. Carrolup and Mulgara were the only two short season varieties to show no difference in quality. Durack indicated an increase in quality but this was likely a sampling error as Durack was close to the bottom grade in both samples.

Forester had the largest drop in quality which can be attributed directly to stem thickness. The stem thickness in the sample collected at baling failed to meet the requirements of an exportable grade and hence dropped price rapidly. Again unfortunate sampling could account for such a rapid variation. Aladdin and Tungoo did not change in grades likely due to ideal drying conditions. Genie dropped from an OH1QQV grade to OH1QQ due to increased browning of the sample which again can probably be attributed to unfortunate sampling.

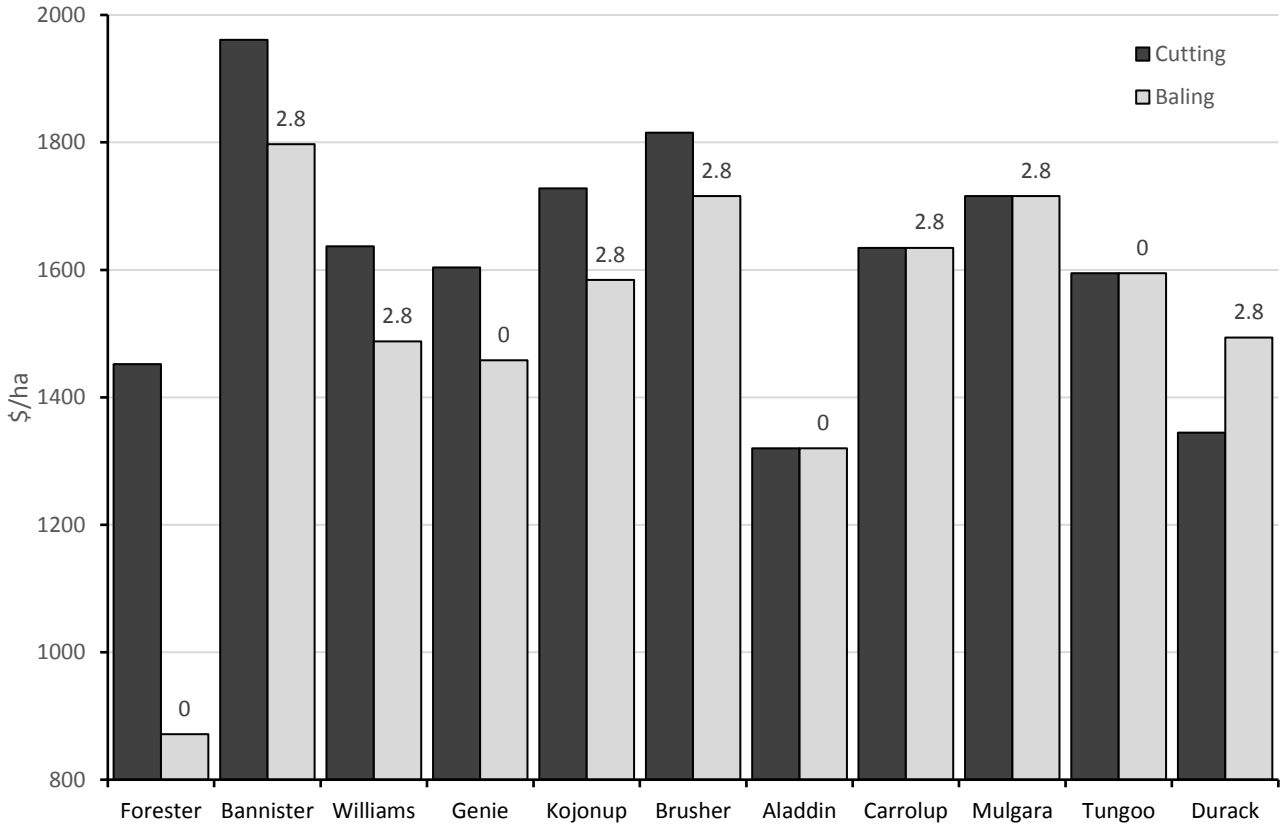

Figure 4: Changes in returns based upon change in quality of Varieties in Time of Sowing 2 (TOS2). Numbers above baling columns indicate amount of rainfall (mm) which fell on varieties between cutting and baling.

Economics

The second time of sowing (17/05) returned the highest yield and generally maintained higher quality than the first time of sowing. As a result all TOS2 except for Forester which had significant quality disparity gave a greater return than their TOS1 equivalent. For example Bannister sown on the 27th of April returned $1465.2/ha and the later sown (17/05) returned $1797.4. This is an additional $332.2/ha. Genie, Aladdin and Forester were the only TOS2 varieties to give a worse return than the most profitable TOS1 variety (Bannister).

Bannister TOS2 gave a greater return ($81.40/ha) than Brusher due to its higher quality. The near neighbour Brusher control plots near to the Bannister however yielded more and were of comparable quality, this would have made them more profitable. Bannister, Brusher, Mulgara, Carrolup, Tungoo and Kojonup all gave a return from TOS2 which was higher than the site average. No return from TOS1 was higher than the average of TOS2.

Brusher, Mulgara and Bannister all gave a higher return than Carrolup with Bannister returning an additional $162.2/ha with comparable quality. Williams which performed similar in terms of yield to Carrolup in both times of sowing had quality similar in TOS1 but one grade worse in TOS2.

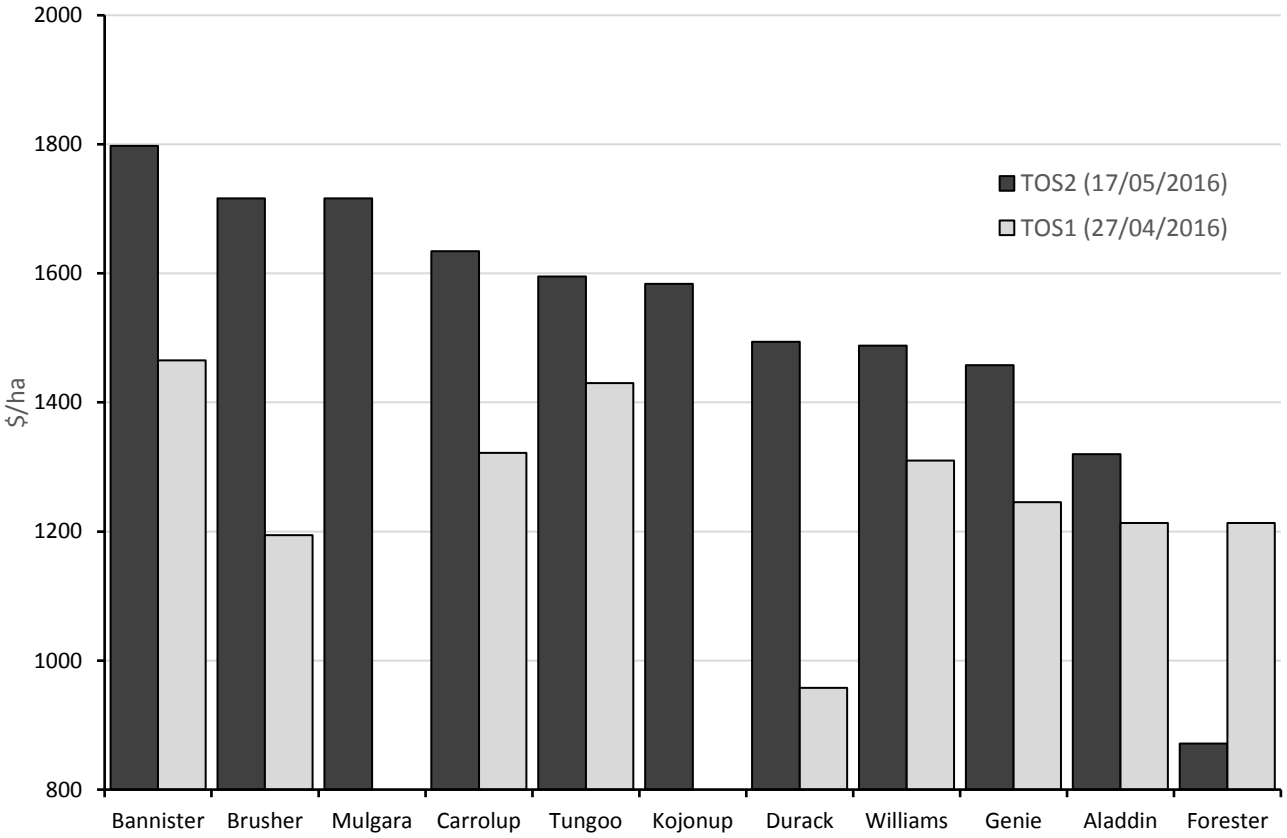

Figure 5: Economic returns of varieties based on yield and hay quality

Discussion

The mild conditions and early moisture favoured the growth of varieties in the second time of sowing with all varieties returning a higher yield than their time of sowing one counterparts. The later sowings allowed biomass to be slowly accumulated rather than for the varieties to rush to maturity. The lower temperatures over winter and spring was observed to prolong the growing window of oats as crops were visually smaller after equivalent growth periods early in the season. By later in the spring however the biomass was visibly larger in the later sown crops compared to the equivalent early sown. These results indicate that growers should reconsider their decision to sow oaten hay early

By the end of the season however the 20 days of difference between time of sowing one and two resulted in an 18 day difference between cutting times of the short season varieties such as Carrolup, Bannister, Brusher and Williams. The long season varieties such as Aladdin, Genie and Forester were cut on the same day regardless of planting date.

The second time of sowing of Bannister was the best performer in the trial in terms of economic return and the second best in terms of yield falling just behind Brusher. This result reflects other trials conducted by the SARDI oat breeding program. Bannister out performed Brusher in economic return due to quality, however the near neighbour Brusher plots returned equivalent quality and higher yields. It has been observed in years with a drier finish that Bannister does not properly emerge from the boot, this was not observed this season in trials. The implications of this poor emergence is prolonged drying times due to trapped moisture, these factors can result in poor hay quality in these seasons.

After two seasons of trials with Brusher performing well it remains the preferred hay variety. The multiple replications of Brusher in this trial also increase the confidence we can have in the performance of the variety. The lower production risk of Brusher compared to Bannister also makes its use preferable. Compared to the traditional benchmark variety (Carrolup), Brusher returned an additional $81.4/ha. Carrolup continued to perform consistently, though on par with the yield of Williams its quality was superior which gave it a greater financial return. Mulgara did perform superiorly to Carrolup in terms of yield and equal in terms of quality. However it's unlikely to fill a production gap as it failed to give any variation in cutting date and did not perform as well as Brusher or Bannister which would fit a similar role.

The long season varieties continue to demonstrate that they are a risky option. The returns from these varieties sown early is behind the short season varieties for a later sowing. The early sowing of late season varieties was unable to compete with the late sowing of short varieties and gained only 15 days later cutting. The early and late plantings of the long season varieties were both cut on the same day with the late sowings generally returning a higher profit. The hay quality from the long season varieties sown earlier was also generally lower than that of the short season varieties sown late. The comparatively low yields and returns to gain 15 days later cutting is hard to justify. Tungoo though the best performing long season variety economically from the first time of sowing gave no advantage in cutting date as it was cut at the same time as the short season varieties in the second time of sowing. The risk of a dry year and a poor finish makes the benefits of long season varieties less tangible as was observed in the 2015 season. It's likely that more variety specific agronomy could boost the performance of these varieties, however it's likely that these changes will come with additional costs.

Time of Sowing and Risk Management.

To demonstrate the difference in risk we have used Brusher Oats as the example.

Delaying sowing from the 24th of April until the 17th of May resulted in 1.75T/ha more yield. We believe this is because the crop did not rush on and was able to accumulate more biomass by progressing through the development stages more slowly.

The early sown Brusher achieved on average an OH1V grade returning $180/T.

The later sown Brusher achieved on average an OH1QV grade returning $208/T.

The later sown Brusher was also cut 18 days later than the early sown Brusher. Over this period the temperature increased and the probability of rainfall reduced resulting in quicker drying times (28 Days vs 10 Days).

This represents a significant increase in returns ($520/ha) and a massive reduction in risk to growers.

This was not the case in 2015 where there was a drought finish and decile 1 rainfall. The early sown Brusher returned $320/ha more than the later sown crop.

This is very valuable work and needs to be repeated over a number of seasons to help growers manage the risk of drought and rainfall post cutting.

Conclusions

- Brusher over the past 2 seasons has been the most consistent performer
- In 2016 mid-May planting of oaten hay resulted in significantly higher yield, quality and return than late-April plantings.
- Bannister shows good promise as a dual purpose oat, however a dry finish comes with cutting risk. Assessments in less favourable seasons will determine how substantial this risk is.
- The fit of long season varieties remains in doubt as their relatively poorer economic performance makes the benefits of later cutting less appealing.
- Carrolup remains a solid performer returning yields comparable to Williams but superior hay quality with less stem diameter risk.
- Short season later sown varieties spent significantly less time on the ground between cutting and baling.

Appendix

Table 2: Time of Sowing One grade, payment, feed value and visual test results

	Green	Brown	Weather	Stem	Maturity	Aroma	ADF	NDF	WSC	ME	CP	Grade	Payment
BRUSHER 1	3	2	2	2	2	2	30.6	54.6	28.1	9.4	4.3	OH1	180
TUNGOO	1	2	2	2	2	2	28.7	52.6	27.7	10.0	5.1	OH1QQV	220
GENIE	3	3	2	2	2	2	29.2	53.7	26.9	10.0	3.7	OH1	180
BRUSHER 2	2	2	2	2	2	2	30.6	54.6	28.1	9.4	4.3	OH1	180
BANNISTER	1	2	2	2	2	2	28.5	53.1	26.4	9.9	5.5	OH1QQV	220
Durack	2	2	3	2	2	2	34.7	60.7	16.2	8.2	6.0	OHMIN	180
BRUSHER 3	2	2	2	2	2	2	30.1	53.9	27.5	9.4	5.0	OH1V	180
CARROLUP	2	2	2	2	2	2	30.0	53.8	29.1	9.5	4.4	OH1QV	200
WILLIAMS	2	2	2	2	2	2	30.0	54.4	25.9	9.4	5.4	OH1QV	200
BRUSHER 4	2	2	2	2	2	2	30.8	54.7	29.1	9.4	4.1	OH1V	180
FORESTER	3	3	2	2	2	2	28.1	51.7	29.2	10.5	3.9	OH1	180
ALADDIN	3	3	2	2	2	2	28.6	53.1	25.8	10.2	4.4	OH1	180
BRUSHER 5	2	2	2	2	2	2	30.0	53.6	28.1	9.5	4.9	OH1QV	200

Table 3: Time of Sowing Two grade, payment, feed value and visual test results

	Green	Brown	Weather	Stem	Maturity	Aroma	ADF	NDF	WSC	ME	CP	Grade	Payment
BRUSHER 6	1	2	2	2	2	2	28.7	50.5	32.3	9.9	4.1	OH1QQV	220
MULGARA	1	2	1	2	2	2	28.9	50.9	31.9	9.9	4.1	OH1QQV	220
KOJONUP	1	2	2	3	2	2	26.0	46.6	33.8	10.7	4.5	OH1QQV	220
TUNGOO	2	2	2	2	2	2	28.9	52.6	27.4	10.1	4.5	OH1QQV	220
BRUSHER 7	2	2	2	2	2	2	28.8	50.9	31.4	9.9	4.0	OH1QQV	220
GENIE	2	3	2	2	2	2	29.0	52.2	27.7	10.2	4.3	OH1QQ	200
BANNISTER	1	2	2	2	2	2	27.6	50.2	29.2	10.3	4.8	OH1QQV	220
Durack	1	2	2	2	2	2	29.8	51.7	29.9	9.5	4.8	OH1QV	200
BRUSHER 8	1	2	2	2	2	2	28.7	50.8	31.0	10.0	4.4	OH1QQV	220
CARROLUP	1	2	2	2	2	2	28.4	50.6	31.6	9.9	4.9	OH1QQV	220
WILLIAMS	1	2	2	2	2	2	29.1	52.4	28.6	9.7	5.0	OH1QV	200
BRUSHER 9	1	2	2	2	2	2	29.6	51.4	29.1	9.9	4.1	OH1QV	200
FORESTER	2	3	2	3	2	2	27.0	50.2	30.1	10.7	4.5	OH4	120
ALADDIN	1	3	2	3	2	2	27.7	51.3	26.8	10.4	4.9	OH1QQV	220
BRUSHER 10	1	1	1	3	2	2	30.2	53.0	29.2	9.4	4.6	OH1V	180

Table 4: Cutting date and Baling date of each variety by time of sowing

	TOS1		**TOS2**	
Variety	**Cut date**	**Bale Date**	**Cut date**	**Bale Date**
Brusher	22-Sep	20-Oct	10-Oct	20-Oct
Tungoo	10-Oct	20-Oct	22-Oct	8-Nov
Genie	25-Oct	8-Nov	25-Oct	8-Nov
Bannister	22-Sep	20-Oct	10-Oct	20-Oct
Durack	14-Sep	20-Oct	10-Oct	20-Oct
Carrolup	22-Sep	20-Oct	10-Oct	20-Oct
Williams	22-Sep	20-Oct	10-Oct	20-Oct
Forester	25-Oct	8-Nov	25-Oct	8-Nov
Aladdin	25-Oct	8-Nov	25-Oct	8-Nov
Mulgara			10-Oct	20-Oct
Kojonup			10-Oct	20-Oct

Table 5: Economic loss per day calculated from reduced quality and time between cutting and baling.

	TOS1		TOS2	
	Time on ground (days)	Loss per day ($)	Time on ground (days)	Loss per day ($)
Brusher	28	6.4	10	14.9
Tungoo	10	0.0	17	0.0
Genie	14	9.9	14	10.4
Bannister	28	4.8	10	14.4
Durack	36	0.0	10	0.0
Carrolup	28	4.7	10	9.9
Williams	28	14.0	10	14.9
Forester	14	19.3	14	41.5
Aladdin	14	7.2	14	0.0
Mulgara			10	0.0
Kojonup			10	0.0