Improving the outcomes of oaten hay in the rotation

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Key findings

- Oats can achieve similar or higher biomass than wheat (Scepter Φ) and barley (Compass Φ).
- Growers have access to oat varieties with similar development speeds to Compass Φ barley and Scepter Φ wheat and are likely to flower within a similar frost risk window.
- Early May sowing of oats in 2019 achieved higher total biomass and hay yield than oats sown late May/early June in three different environments.

Background

The National Hay Agronomy (NHA) trial is a new four-year project supported by AgriFutures, focusing on improving the quality of export hay in Australia. The project is being led by Georgie Troup from the Department of Primary Industries and Regional Development (DPIRD), Western Australia and includes collaborators from SARDI and Hart Field-Site Group in SA, Agriculture Victoria and Birchip Cropping Group in Victoria and Department of Primary Industries NSW.

The core agronomy component of the NHA focusses on developing updated guidelines for export oaten hay that optimise variety selection, seeding date and in-crop nutrition requirements for South Australia, Western Australia, Victoria and New South Wales. Trials commenced in 2019 and will continue for the next two seasons at Hart in the Mid-North of SA, Muresk in WA, Kalkee in Victoria, and Yanco in NSW. In these trials, we are investigating the influence and interaction between oaten hay variety, sowing date and nitrogen to provide best practice guidelines for growers to maximise both yield and hay quality.

The 2019 season was defined by spring drought, and increased frost damage in cereal crops. These seasonal conditions coupled with a strong domestic demand for fodder, highlighted the benefit of oaten hay as a risk management strategy. Additional investment from SAGIT benchmarked oaten hay varieties with the productivity of barley and bread wheat in frost prone landscapes.

Oaten Hay Varieties

Durack

Durack is a very early maturing, moderately tall, dual purpose variety. It has good lodging resistance but is susceptible to very susceptible to stem rust in SA and Victoria and has variable resistance (resistant to susceptible) to leaf rust; depending on pathotype. It has excellent grain quality with high protein levels and good hay yield. Care needs to be taken to cut at the correct growth stage to achieve highest hay quality.

Brusher

Brusher is a tall, early to mid-maturity hay variety with good hay quality and yields, commercialised by AEXCO. It has improved stem and leaf rust resistance than Wintaroo and suits low rainfall areas.

Carrolup

Carrolup is a mid-maturity, moderately tall, dual purpose variety (milling grain and hay*)* mainly grown in WA, with lower grain yield than milling varieties Bannister and Williams. It has similar maturity to Yallara.

Forester

Forester is a very late maturing variety, adapted to high rainfall and irrigated cropping regions. It has excellent early vigour, a good foliar disease resistance package, and good hay colour but does not resist hot dry winds as well as earlier varieties. Seed is available from AGF seed.

Koorabup

Koorabup (tested as line 05096-32) was released in 2019 and commercialised by AEXCO is a mid-tall hay variety developed for the WA market. It has improved septoria resistance compared to other current hay varieties, and good rust and bacterial blight resistance.

Mulgara

Mulgara is a tall, mid-maturity hay variety commercialised by AEXCO. It is resistant to stem nematode and has improved resistance to stem rust and bacterial blight than Wintaroo. Hay quality is similar to Wintaroo but with excellent hay colour and resist brown leaf at hay cutting.

Williams

Williams is a tall, dual purpose (milling grain and hay) variety commercialised by Heritage Seeds, released in WA but also suited to eastern Australia. It has the best septoria resistance of the milling varieties and high grain yields. Hay quality is similar to Wintaroo but yield is slightly lower than other hay varieties, and care should be taken with seeding density as its main issue is stem thickness.

Wintaroo

Wintaroo is a tall, mid-maturity hay variety with good hay yield and quality, which resists brown leaf tipping. It is susceptible to stem rust, and moderately susceptible to leaf rust. It is more prone to lodging than other hay varieties.

Yallara

Yallara is a mid-maturity, medium-tall, dual purpose (milling grain and hay) variety commercialised by Seednet. It has good hay quality and thin stems suitable for the export market. It is moderately resistant to stem rust, and resistant to leaf rust.

Kingbale

Kingbale is a tall, mid-maturity hay variety with improved tolerance to soil residues of imidazolinone herbicides. Preliminary data shows that Kingbale has a similar disease and agronomic profile to Wintaroo. The original breeding work was undertaken by Grains Innovation Australia (GIA) and is being commercialised by Intergrain, with commercial seed available in 2021 subject to 2019 field testing results, and an APVMA herbicide registration.

Methods

NHA agronomy trial

Aim: Update guidelines that optimise variety selection, seeding date and in-crop nutrition requirements for export oaten hay in South Australia

Location: Hart (as well as Kalkee-Vic, Yanco-NSW and Muresk-WA)

Varieties: Nine oat varieties (listed above, excluding Kingbale ⓑ)

Management treatments:

- Two times of sowing (TOS), early May and late May / early June.
- Three nitrogen (N) rates (30 kg N/ha, 60 kg N/ha or 90 kg N/ha) for all varieties. Yallara ⓑ, Mulgara ⓑ and Wintaroo ⓑ also had an additional three N treatments of 10 kg N/ha, 120 kg N/ha and 150 kg N/ha to ensure we were in the right ballpark for N management.
- Nitrogen treatments were split with two thirds applied at seeding, and on third applied six weeks after seeding when the plants were tillering. This split was according to current best practice for hay to achieve good early vigour, plant establishment and thin stems.
- The Hart target seeding rate was 320 plants/m^2 which equates to an average sowing rate of 165 kg/ha (ranged from 139 – 195 kg/ha).

Expansion sowing date trials

Aim: Improve productivity of oats for both grain and domestic hay in frost prone landscapes

Location: Lameroo in the Mallee (LRZ) and Tarlee in the Mid-North (HRZ)

Management treatments:

- At both sites, Carrolup was replaced with Kingbale ⓑ.
- One barley (Compass ⓑ) and one wheat (Scepter ⓑ) variety were included for comparison.
- At all sites in SA (Lameroo, Hart and Tarlee), varieties were sown at two times, either early May (May 6, May 3 and May 1 respectively) or late May / early June (May 28, June 5 and May 31 respectively).
- At Lameroo, single N rate was used, calculated on starting soil N and expected hay yields, which equated to 45 kg N/ha at Lameroo and 80 kg N/ha at Tarlee. The targeted seeding rate at Lameroo was 240 plants/m^2 and 320 plants/m^2 for Tarlee.

Growth stage of varieties were monitored from heading, and hay cuts were taken for each plot (four rows x one metre) when the variety reached watery ripe (GS 71). Hay was cut at 15 cm height above the ground, before being dried for two days at 60°C, and hay yield determined. Hay cuts were then ground to <1mm, and hay quality determined by NIR.

Results and discussion

2019 Season

In 2019, Hart received 162 mm of growing season rainfall (GSR) from May to October, and 188 mm annual rainfall, resulting in a decile one year, and low hay yields for the season. Responses to applied N were significant but small and given this is the first year of trials, it is too early to draw conclusions based on these results. The increase in N from 30 to 60 kg N/ha increased biomass yields when sown in early May (3.0 to 3.6 t/ha), however there was no increased biomass as a result of increasing applied N above 30 kg N/ha when the crop was sown in early June. This result is not surprising as both the availability of applied N, and the plants ability to uptake applied N would have been low in 2019, due to the reduced in-season rainfall, and shortened growing season.

The 2019 season at Lameroo and Tarlee was also much drier than average, with Lameroo recording a decile three year for GSR and decile one year for annual rainfall with 196 mm GSR (218 mm annual rainfall), and Tarlee recording a decile one year with 215 mm GSR (255 mm annual rainfall).

Oat development differences

Due to the dry conditions experienced at Hart, many varieties flowered in the boot which made flowering date observations difficult. This is a problem in some varieties and is likely to influence hay quality. Cut dates were similar at Hart and Lameroo. In general, cut dates were seven to 14 days after flowering depending on the variety. Table 1 shows the dates and number of days until mid-flowering at both Lameroo and Tarlee and can be used to estimate hay cut timing.

The spread in flowering date between oat varieties with the exception of Forester was three weeks when sown early May or two weeks when sown late May. Durack was the earliest flowering oat variety, flowering and cut for hay at a similar time to Compass barley. On average Durack flowered one week before all other varieties. A number of the early-mid maturing oat varieties (Mulgara, Brusher, Williams) flowered and were cut for hay at a similar date to Scepter wheat. Forester is a very slow developing variety and did not flower under all environments. In lower rainfall areas, both the early May and late May sown Forester were cut on the same day at flowering after observing a halt in biomass growth over the previous two weeks. Forester is unlikely to be a suitable variety for the low-medium rainfall environment of SA.

Table 1. Date of mid-flowering (GS 65) and in brackets days from sowing to flowering for both sites and sowing dates.

	Lameroo		**Tarlee**	
Sowing date	*May 6*	*May 28*	*May 1*	*May 31*
Compass	Aug 28 (114)	Sep 20 (112)	Sep 1 (123)	Sep 20 (112)
Scepter	Sep 14 (131)	Sep 28 (123)	Sep 14 (136)	Sep 28 (123)
Durack	Sep 1 (118)	Sep 15 (110)	Sep 1 (123)	Sep 20 (112)
Williams	Sep 8 (125)	Sep 27 (122)	Sep 11 (133)	Sep 28 (120)
Mulgara	Sep 10 (127)	Sep 25 (120)	Sep 11 (133)	Sep 28 (120)
Brusher	Sep 11 (128)	Sep 25 (120)	Sep 9 (131)	Sep 27 (119)
Yallara	Sep 12 (129)	Sep 23 (118)	Sep 8 (130)	Sep 29 (121)
Wintaroo	Sep 12 (129)	Sep 30 (125)	Sep 20 (142)	Oct 3 (125)
Kingbale	Sep 18 (135)	Sep 30 (125)	Sep 21 (143)	Oct 3 (125)
Koorabup	Sep 19 (136)	Sep 29 (124)	Sep 20 (142)	Sep 30 (122)
Forester	Oct 22 (169)	N/A*	Oct 10 (162)	Oct 25 (147)

**Forester flowered inconsistently in some parts of the plot but a decision to cut was made for the same time as the May 6 TOS. Both Lameroo plots were cut on October 22.*

Hay biomass yields

At all three sites, hay biomass was maximised from early May sowing (Table 2). At Lameroo, Compass sown either early or late May, produced similar hay yield to the best performing early May sown oats. At Tarlee, neither Compass or Scepter could match the hay yield of the best performing oats. Although there was little variation in cutting date between most of the varieties, earlier maturing varieties (Durack, Brusher, Mulgara, Yallara), particularly at Lameroo were high yielding. At Tarlee, Mulgara and Kingbale sown in early May were the highest yielding varieties. Kingbale is a new imi-tolerant variety and yielded similar to Wintaroo at each site from early May sowing.

Table 2. Hay biomass yields (t/ha) for all SA sites. Within a site, varieties that have different letters indicate significant differences in hay yield (p≤0.05).

	Hart		Lameroo		Tarlee	
Sowing date	*May 3*	*June 5*	*May 6*	*May 28*	*May 1*	*May 31*
Compass ◊	-	-	6.3 bcde	6.2 bcde	10.5 bcd	10.7 bc
Scepter ◊	-	-	5.4 efgh	5.2 fgh	11.0 bc	9.4 defgh
Koorabup ◊	3.6 b	2.4 ef	6.0 cdef	5.1 fgh	10.0 cde	8.7 fghi
Brusher ◊	3.8 ab	2.4 ef	7.2 ab	5.4 efgh	9.9 cdef	8.5 ghi
Durack ◊	3.7 b	2.4 e	7.3 a	5.9 defg	9.1 efg	7.9 i
Forester ◊	1.9 g	1.1 h	5.2 fgh	4.5 h	10.2 bcde	8.2 hi
Mulgara ◊	3.9 a	2.6 d	6.7 abcd	5.8 defg	12.3 a	10.0 cde
Williams ◊	3.3 c	2.0 fg	6.2 cde	4.6 h	10.1 cde	8.6 ghi
Wintaroo ◊	3.9 a	2.5 de	6.7 abcd	5.4 efgh	10.4 bcd	9.5 defg
Yallara ◊	3.8 ab	2.6 d	7.0 abc	5.9 defg	11.0 bc	9.9 cdef
Carrolup	3.3 c	2.6 d	-	-	-	-
Kingbale ◊	-	-	6.0 cdef	5.0 gh	11.4 ab	9.1 efgh
LSD (P≤0.05)	*0.4 (0.2 within same TOS)*		*0.9 (0.9 within same TOS)*		*1.2 (1.0 within same TOS)*	

Conclusion

This first season of trials have provided baseline data on the performance of oaten hay varieties under tough seasonal conditions. There are a number of oat varieties that will flower in a similar window to both Compass and Scepter. Most oat varieties are fast to mid-fast development speed and will flower from early May sowing within a two to three-week period in September.

At all three sites oaten hay yields were maximised from earlier sowing and were similar to those achieved with wheat and barley. There were limited differences between varieties, with the exception of Forester which was too slow in its phenology to be suitable for export oaten hay in this environment. Hay samples are still being analysed to assess the effect of sowing time and nitrogen on hay quality.

Useful resources

https://grdc.com.au/2020-south-australian-crop-sowing-guide

https://www.agric.wa.gov.au/oats/2019-oat-variety-sowing-guide-updated

http://aexco.com.au/producing-quality-oat-hay/

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