



Department of
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Oat Breeding Newsletter

October 2015



Pamela and Kerry-Lee sowing early generation hill plots at Turretfield in May

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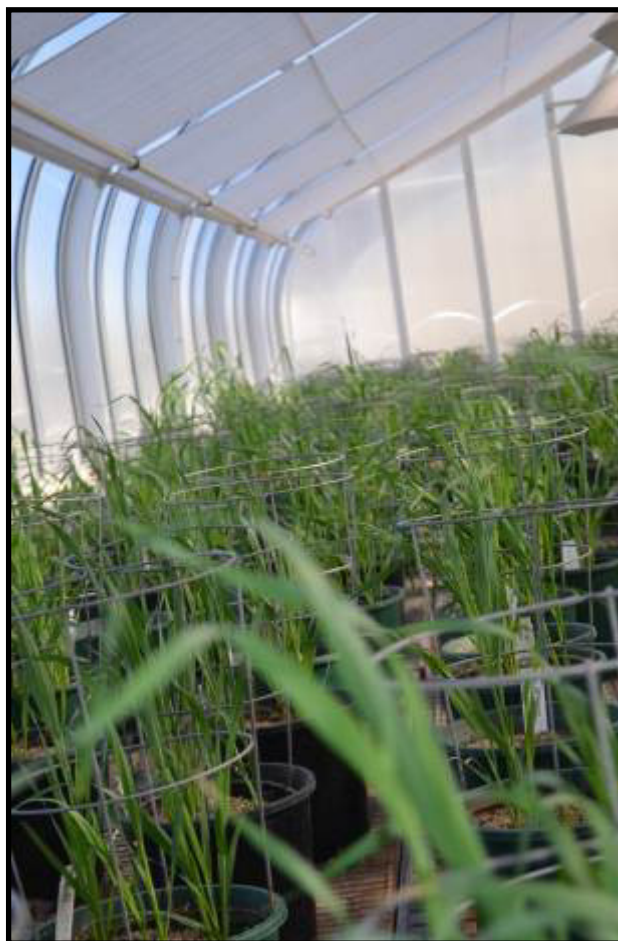


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Oats in the greenhouse – photo by Kerry-Lee McMurray

Editors' note:

Just a reminder, this newsletter should not be quoted without consent from the authors.

1. Entries for 2015 Grain Trials

1.1 NVT, CVT and S4 Grain Trials

New in 2015

- WA main trial sites located at Pingelly, Rylington Park & Cunderdin
- Trials at Katanning R.S. and Wickepin were discontinued
- New NVT trials in WA are located at Cuballing, Dandaragan & Pingrup
- Seed increase in SA moved to Wasleys
- Rutherglen Stage 4 trial discontinued

National Variety Testing (NVT) trials comprising either 28, 16 or 15 entries were sown at a total of 18 locations throughout SA, Victoria and NSW in 2015 (Table 1). The WA NVT trials had 24 entries in 2015 and were sown at 11 locations. Trials at the Katanning Research Centre and the Wickepin trial site were discontinued but trials were sown at the new locations of Cuballing, Dandaragan and Pingrup. Trial locations and plans can be found on the NVT website www.nvtonline.com.au

The Stage 4 grain trial increased from 48 to 56 entries in 2015. Stage 4 grain trials were sown at four locations in SA, one location in NSW and four locations in WA (Table 2). The Stage 4 grain entries were also sown in nurseries at Manjimup to evaluate leaf rust, barley yellow dwarf virus (BYDV) and septoria resistance in WA in 2015. A stem rust nursery was sown at Carnarvon in 2015. Stage 4 grain entries are also evaluated for CCN resistance at the Waite Campus in SA and for stem and leaf rust by the Australian Cereal Rust Control Program, the University of Sydney, at Cobbitty in NSW.



National Oat Breeding plots at Turretfield in August 2015. Photo courtesy Kerry-Lee McMurray.

Table 1: NVT trial locations in 2015.

South Australia	Victoria	New South Wales	Western Australia
NVT 15 Crystal Brook Paskeville Waikerie NVT 28 Bordertown Frances	NVT16 Diggora Dookie Eastville Hamilton Streatham Yarrawonga	NVT 15 Wellington NVT16 Condobolin Cowra Gerogery Oaklands Quandialla NVT 28 Wagga Wagga	CVT24 Cuballing Cunderdin Dandaragan Esperance R.S Holt Rock Merriden Pingelly Pingrup Rylington Park Wongan Hills York

Table 2: Stage 4 grain trial and nursery locations in 2015.

South Australia	New South Wales	Western Australia
Yield trials Riverton Pinery Turretfield Kybybolite Seed increase Wasleys Nurseries Waite (CCN resistance)	Yield trials Griffith irrigated trial Nurseries Rust evaluation at ACRCP Cobbitty Victoria -	Yield trials Cunderdin Pingelly Rylington Park Wongan Hills Nurseries Manjimup (BYDV, rust & septoria)

Information about the grain yield and quality of named lines is included in section 6 of this newsletter.



Sue and Michelle judging the oat samples at the Royal Adelaide Show in August 2015

2. Entries for 2015 Hay Trials

2.1 Hay trials

New in 2015

- Seed increase in SA moved to Wasleys
- Additional Stage 4 Hay Trial sown at Pingelly in WA
- Katanning trial site discontinued and trials moved to Cunderdin
- Elmore trial site reduced from Stage 4 to Stage 5 trial

The Stage 5 (S5) hay trial for 2015 has 40 entries and was sown at Cunderdin and Wongan Hills in WA, Horsham and Elmore in Victoria, and Finley in NSW. Four late hay entries were added to the Elmore trial for comparison. Stage 4 (S4) hay trials included the 40 entries from the S5 trial and an additional 20 entries to make a total of 60 entries. Hay and grain yield and quality assessment will be conducted at three locations in SA, two locations in Victoria, one location in NSW and two locations in WA (Table 3). The Stage 4 late hay trial for 2015 has 36 entries and was sown at three locations in SA and one location in WA. Trials sown at Riverton and Turretfield in SA will be cut for hay yield and quality assessments and all four trials will be assessed for grain yield and grain quality. The Stage 4 entries from both the hay and late hay trials were also sown in nurseries to evaluate stem and leaf rust, BYDV and septoria resistance in WA, CCN resistance at the Waite Campus in SA and stem and leaf rust by the Australian Cereal Rust Control Program. Information about the hay yield and hay quality as well as grain yield of released lines is included in section 6 of this newsletter.

Table 3: Stage 5 and Stage 4 hay and late hay trial and nursery locations in 2015

South Australia	Victoria	Western Australia
Stage 4 trials Pinery (hay & late hay) Turretfield (hay & late hay) Riverton (hay & late hay) Seed increase Wasleys Nurseries Waite Campus (CCN resistance)	Stage 5 Horsham (Longrenong) Elmore (44 entries including Forester, Kangaroo, Tammar & Tungoo)	Stage 5 Cunderdin Wongan Hills Stage 4 York Pingelly Rylington Park (late hay-observation and grain harvest) Nurseries Manjimup (septoria, BYDV, stem and leaf rust)
	New South Wales	
	Stage 5 Finley Nurseries Rust evaluation at ACRCP Cobbitty	

3. Breeding Program Developments

3.1 Staff Changes - SA

In June we farewelled our long term casual Dan with a lunch at Paparazzi! Dan has obtained a job in the mining sector and we wish him all the best!!



Pictured are (L-R) Peter, Dan, Josh, Peter, Pamela, Mark & Maha after Dan's farewell lunch

3.2 Staff Changes - WA

It was the end of an era in the West earlier this year when two of our long term employees John Sydenham and Joe Naughton called it a day and retired. John worked at DAFWA for more than 30 years and Joe worked for DAFWA for about 25 years. The National Oat Breeding Program began in 2003 and John moved from the wheat/oat breeding group to the new National Oat Breeding Program as team leader. Joe joined the program in 2009 and brought with him experience gained from the wheat/oat breeding group.

DAFWA had an afternoon tea for departing employees. John and Joe organised a BBQ a few days after their retirement at the DAFWA plant breeding building. Many past and present DAFWA employees, family, and other friends attended. It was a great afternoon and an opportunity to farewell John and Joe.



Friends turned out to farewell John and Joe with a BBQ at South Perth in the plant breeding building.



Photos from John and Joes' farewell courtesy of Pamela



Cody Hull and Deb Donovan who have been keeping the program running since John and Joe's retirement

3.3 Project updates

3.3.1 Oat Pre-Breeding Project

Dr John Harris in the Gene Function group at SARDI has provided this update of their work on this project: The CCN resistance locus previously identified in a Mortlock x Potoroo derived population has also been found in a Kangaroo X Eurabbie derived population. This shared locus has been placed on the international oat consensus genetic map through collaboration with Nick Tinker (Agriculture and Agri-Food Canada, Ottawa). This will allow identification of more genetic markers to assist in the future fine mapping of the CCN resistance locus and high-throughput marker development..

Robert Park and Jeremy Roake from the University of Sydney are working on the characterisation of adult plant resistance to stem and leaf rust. They will also develop molecular markers for any resistances identified.

Hugh Wallwork and Ester at SARDI are currently testing four red leather leaf (RLL) isolates to identify the medium that will give best growth and sporulation and later will be testing these isolates for pathogenicity. They have seven isolates.

See section 3.3.2 for the drought tolerance component of this project.

3.3.2 Enhancing the Grain Yield and Quality of Oat under Water Deficits—project funded by SAGIT, GRDC and SARDI (Dr Mahalakshmi Mahadevan)

The major oat producing countries still remain in the northern hemisphere where water limiting environments are not a production constraint. Hence there is virtually no research in oat for drought tolerance globally. Australia is now the six largest oat producing country globally and with increasing domestic and export demand production will increase.

Increasing oat variety productivity in low and high rainfall regions will increase confidence to dedicated oat growers and encourage new growers to include oat as a rotation. This research project set the foundation for future research to increase variety performance in low rainfall regions, but also take advantage of increased yield in the 'good years'.

- Current milling varieties, particularly Bannister and Mitika have stable grain yield in low rainfall, but have the highest responsiveness to produce high grain yield in high rainfall.
- Chlorophyll content in leaves at four growth stages: booting, panicle emergence, anthesis, and milk development, were significantly correlated with grain yield in low rainfall and high rainfall environments. This will be incorporated as a selection tool in the National Oat Breeding Program.
- Research results will be used to improve efficiency in identifying oat varieties with higher grain yield potential in low rainfall regions, but responsive to higher grain yield for favourable growing seasons.

3.4 WA program developments

3.4.1 New GRDC Funded Agronomy Project (summary courtesy Georgina Troup, DAFWA)

In WA the Oat Agronomy team has been busy monitoring their grain and hay trials located at Cunderdin, Merredin and Holt Rock, along with the phenology trials located near Northam and Katanning to name a few. The early sown trials are 50% through hay cuts, with early maturing WA02Q302-9 leading the way.

Interest in oats has increased significantly in 2015, as a direct result of the strong milling oat price, with nearly 150 people attending the recent GIWA Oat Spring Forum at Narrogin. With many farmers thinking about adding oats back into their rotation, or younger farmers keen to learn how to grow a quality oat crop for the first time, there has been plenty of variety and agronomy enquiries coming through.

Variety selection is one of the most important factors in growing a successful oat crop; with recently released varieties Williams and Bannister bringing significant yield advantages to growers. However, their agronomy does require careful consideration as trial results indicate that to achieve a quality hay or grain requires the right package. In addition they are more sensitive to nitrogen, seeding rate and some herbicides than commonly grown varieties Carrolup and Yallara.

Tips for oat production in 2016:

1. Select the right variety for your Agzone – see NVT online for yield information
2. Speak to the exporters – whether you intend to grow milling oats or export hay, you need to contact your local exporter to ensure your variety selection and quality targets meet the current market demand.
3. Select the right paddock – with herbicide options limited, ensure you pick a clean paddock and consider the herbicide history.
4. Prepare your paddock now – spray topping or utilising chaff carts to reduce the weed burden.
5. Get the right agronomy for your end use – select the right seeding rate and fertiliser package for the intended end use (hay or grain)

The Oat Agronomy and Industry Development in the Western Region Project is supported by GRDC and work was reported at crop updates in 2015. Agronomic packages for varieties will be done for the crop updates in 2016 after this year's trial data is added. For further oat agronomy support contact Georgie Troup on (08) 9690 2215 or Georgie.troup@agric.wa.gov.au



WA02Q302-9 at Cunderdin (Variety x Seed rate x Time of sowing) & Research Officer Georgie Troup presenting at the West Midlands Group Spring Field Day on 7th September



Peter McCormack and Deb Donovan spreading infected straw on the Septoria nursery at Manjimup in late July 2015 (photo courtesy Cody Hull)



Dr Raj Malik and Georgie Troup inspecting oat trials at Pingrup in July 2015 (photo courtesy Georgina Troup)

3.5 Chinese visit

Peter McCormack, Pamela Zwer, and Derek Gamble from Quaker Oats were invited to participate in the China-Australia Academic Workshop in Zhangjiakou City 10-13 August 2015. It was the inaugural meeting for the China-Australia International Cooperation Project. The workshop was organised by Mr. Yangcai from the Zhangjiakou Institute of Agricultural Research. Peter, Pamela, and Derek were among the eight speakers at the Workshop. There were tours of the oat growing region near Zhangjiakou City, oat processing businesses, and trial plots.



A selection of photos from Pamela and Peter's recent visit to the Zhangjiakou Academy of Agricultural Sciences in China (courtesy of Pamela)

4. New varieties

WA02Q302-9

Commercial production of a new release from the National Oat Breeding Program, WA02Q302-9, will be launched in 2016 and will be available to growers in 2017. It is a moderately tall variety similar in height to Carrolup and Yallara measuring between 80 and 90 cm. Check out this new variety as it is a minimum of one week earlier than any other variety released from the program. WA02Q302-9 has good lodging and shattering resistance and good early vigour. Grain yield is similar to the tall varieties Carrolup and Yallara across all states and an improvement compared to tall varieties bred for hay. Grain quality for this line is excellent. Hay yield averaged over low, medium, and high rainfall sites is lower than other longer season varieties. Care will need to be taken to cut this very early maturing variety at the correct growth stage. Monitoring the crop will be the key to achieving the highest hay quality.

03198-18

The breeding line, 03198-18, has dwarf stature measuring 65 to 70 cm. It is slightly taller than Mitika. It has a maturity similar to Mitika, but is 2 to 8 days earlier to head than Yallara, 8 to 10 days earlier than Bannister and 3 to 10 days earlier than Williams. 03198-18 is 4 to 8 days later to head than WA02Q302-9.

03198-18 has similar grain yield to Mitika and Kojonup, but lower than Bannister and Williams. The grain quality is excellent. 03198-18 has slightly lower hectolitre weight than Mitika, but it has higher 1000 grain weight compared to Mitika. It has the lowest screenings percent of the varieties, high protein, and slightly higher groat percent compared to Mitika. The trait of interest for this variety is improved β -glucan content. The β -glucan content was measured using a flow injection instrument. 03198-18 has 5.2% (dm basis) compared to 4.4% for Mitika and Kojonup. The β -glucan content is the same as Williams, however the groat percent for 03198-18 is significantly higher than Williams.



*Senior Agricultural Officer Mark Hill in the oat plots at Wasleys in August 2015.
(Photo courtesy Kerry-Lee McMurray)*

5. Long term grain trial results

Results for individual NVT trials are not presented in this newsletter. However, they are incorporated into the long term performance of varieties and advanced breeding lines which are presented in this newsletter in Tables 4 to 8. Grain yield and grain quality information for individual sites is available at the NVT web site: www.nvtonline.com.au.

Table 4 shows the relative yield performance of new varieties compared to existing varieties for four different states and Tables 5 to 8 show the relative yield performance of new varieties compared to existing varieties for regions within states. An updated analysis for grain quality was available for this newsletter. Tables 9 and 10 show the relative grain quality across all states and Tables 11 to 16 show the relative grain quality parameters by state. Tables 18 and 19 show the relative disease resistance characteristics for these varieties in different regions. Care needs to be taken to look at not only grain yield but grain quality and disease resistance characteristics to determine if a variety is suitable for your region. **Please note:** Stem and leaf rust reactions reported for all oat varieties will vary by region due to genetic variation in the pathogen population. A pathotype that overcomes most resistance genes for stem rust is now present in southern Australia. Hence it is important to monitor oat crops for early detection of rust, so fungicide applications can be applied to control the disease.

Brochures are available for new varieties from the website, the SA and WA components of the NOBP and our commercial partners; AEXCO who commercialises the hay varieties and Seednet and Heritage who commercialise the milling varieties from the SARDI node of the National Oat Breeding Program and Seednet for Bannister and Heritage Seeds for Williams and future WA released varieties.

5.1 Grain Variety Summary

Bannister[Ⓢ]

Bannister is a dwarf milling variety with high grain yield released for Western Australia in 2012. Bannister is suited to eastern Australia as well as Western Australia. It is adapted to low, medium, and high rainfall zones of southern Australia. It is 13 cm taller than Mitika and heads about 3 to 4 days later than Mitika. Seednet is the commercial partner.

Bannister is resistant to leaf rust and moderately resistant to bacterial blight. It is susceptible and intolerant to CCN.

Bannister has slightly lower hectolitre weight and slightly higher screenings compared to Mitika. It is similar to Mitika for groat percent.

Williams[Ⓢ]

Williams is a tall milling variety commercialised by Heritage. Williams formerly known as the breeding line, WA2332, is an early to midseason variety similar to Yallara, but three to seven

days later than Mitika. Williams is 15 cm taller than Mitika, 5 cm taller than Bannister, and 15 cm shorter than Yallara.

Although classified as MS for septoria, Williams has the highest level of septoria resistance compared to all other current oat varieties. It is resistant to leaf rust and depending on the stem rust pathotype present can range from moderately resistant to susceptible. Williams is resistant to bacterial blight and moderately resistant to moderately susceptible for BYDV. It is susceptible and intolerant to CCN.

Williams has grain yield similar to Bannister except in the lower rainfall regions where it yielded less. Williams yielded similar to Mitika except in the Mid North where it yielded significantly more grain.

Grain quality is slightly lower than Mitika. Williams has higher screenings than Mitika, Yallara, and Bannister, especially in the low rainfall regions.

Williams had similar hay yield compared to other hay varieties at Pinery and Turretfield, but lower hay yield at Riverton. Hay quality is also similar to hay varieties, except for slightly higher crude protein. Care must be taken to achieve high plant populations to reduce stem thickness.

Wombat[®]

Wombat is a dwarf milling variety that was commercialised by Seednet. It is similar in height to Possum and slightly taller than Mitika. It is a midseason variety flowering about six days later than Mitika.

Wombat is the first dwarf milling variety with CCN resistance and tolerance. It is also moderately tolerant to stem nematode.

Wombat has high hectolitre weight and low screenings compared to the feed variety Potoroo, which was the first dwarf variety with CCN resistance and tolerance. It also has high groat percent, slightly higher than Mitika.

Yallara[®]

Yallara is a medium tall early to midseason variety similar to Euro for flowering and maturity. Yallara, released in 2009, is a milling line with slightly better grain quality than Euro but not as susceptible to stem rust. It has bright, plump grain suitable for the milling industry and specialised feed end-uses. Seednet is the commercial partner.

Yallara is a Euro look alike with improved leaf rust resistance. It is resistant but intolerant to CCN. It is moderately susceptible to BYDV, bacterial blight, and septoria. Yallara is susceptible and intolerant to stem nematode and susceptible to red leather leaf.

Yallara has excellent grain quality. It has high hectolitre weight, low screenings, and high groat percent. The grain is plump and bright and could suit niche markets like the horse racing industry in addition to human consumption. Yallara was evaluated for hay production and although the hay yield is lower than popular hay varieties it has excellent hay quality.

Mitika[®]

Mitika is a dwarf milling oat commercialised in 2005 by Heritage Seeds. It is earlier maturing than Possum and Echidna and this trait favours Mitika in a dry finish.

Mitika is moderately resistant to leaf rust. It has improved resistance to bacterial blight and is superior to Echidna for septoria resistance. Mitika is similar to Echidna for BYDV and red leather leaf resistance. It is very susceptible and intolerant to cereal cyst nematode (CCN) and moderately intolerant of stem nematode (SN) and is not recommended in areas where either of these nematodes are a problem.

Mitika has high hectolitre weight, low screenings, and high groat percent compared to Echidna. It also has higher levels of β -glucan than current varieties. Mitika also has improved feed quality with low husk lignin and high grain digestibility.



The oat group out on a weed control mission at Turretfield in August, 2015

Table 4. Average grain yield (t/ha) in four states and the average for all states for twelve oat varieties and two breeders lines (2010 to 2014). Data courtesy National Oat Breeding Program, NVT Programs in SA, Vic and NSW and CVT Program in WA. Analysis by Chris Lisle, SAGI.

Variety	State				All Zones
	NSW	SA	VIC	WA	
Bannister	3.9	3.4	4.1	3.8	3.7
Carrolup (tall)	3.4	2.9	3.3	3.1	3.1
Dunnart	3.8	3.2	3.8	3.5	3.5
Echidna	3.6	3.0	3.4	3.2	3.2
Kojonup	3.6	3.1	3.7	3.5	3.4
Mitika	3.7	3.1	3.5	3.4	3.4
Possum	3.6	3.1	3.5	3.5	3.4
Potoroo	3.7	3.1	3.8	3.7	3.5
03198-18	3.7	3.2	3.5	3.4	3.4
WA02Q302-9 (tall)	3.5	2.9	3.2	3.2	3.2
Wandering	3.8	3.0	3.6	3.6	3.4
Williams (tall)	3.9	3.4	4.2	3.8	3.7
Wombat	3.6	3.1	3.8	3.5	3.5
Yallara (tall)	3.5	2.8	3.3	3.2	3.1
<i>No. trials</i>	<i>34</i>	<i>50</i>	<i>24</i>	<i>43</i>	<i>151</i>

Table 5. Average grain yield (t/ha) by site in South Australia for twelve oat varieties and two breeders lines (2010 to 2014). Data courtesy National Oat Breeding Program, NVT Programs in SA, Vic and NSW and CVT Program in WA. Analysis by Chris Lisle, SAGI.

Variety	South Australia					
	Lower EP	Upper EP	Yorke Peninsula	Mid North	South East	Mallee
Bannister	3.3	1.6	4.4	3.9	3.7	2.4
Carrolup (tall)	3.0	1.6	4.0	3.1	3.2	1.9
Dunnart	3.0	1.6	4.1	3.6	3.5	2.3
Echidna	2.8	1.6	4.1	3.3	3.4	2.2
Kojonup	3.1	1.5	4.3	3.5	3.4	2.1
Mitika	3.1	1.5	4.2	3.7	3.3	2.2
Possum	3.1	1.5	4.2	3.6	3.4	2.1
Potoroo	2.9	1.6	4.2	3.4	3.5	2.2
03198-18	3.1	1.5	4.4	3.7	3.4	2.3
WA02Q302-9 (tall)	2.8	1.4	3.7	3.4	3.1	2.1
Wandering	2.6	1.5	3.8	3.3	3.4	2.3
Williams (tall)	3.3	1.6	4.2	3.9	3.7	2.4
Wombat	3.2	1.6	4.2	3.5	3.5	2.1
Yallara (tall)	2.7	1.5	3.2	3.2	3.2	2.0
<i>No. trials</i>	<i>4</i>	<i>4</i>	<i>5</i>	<i>14</i>	<i>15</i>	<i>9</i>

Table 6. Average grain yield (t/ha) by site in Victoria for twelve oat varieties and two breeders lines (2010 to 2014). Data courtesy National Oat Breeding Program, NVT Programs in SA, Vic and NSW and CVT Program in WA. Analysis by Chris Lisle, SAGI.

Variety	Victoria		
	North Central	North East	South West
Bannister	3.9	3.8	5.0
Carrolup (tall)	3.0	3.2	4.3
Dunnart	3.7	3.4	4.6
Echidna	3.4	3.0	4.5
Kojonup	3.5	3.6	4.4
Mitika	3.5	3.1	4.4
Possum	3.4	3.2	4.4
Potoroo	3.6	3.7	4.7
03198-18	3.6	3.0	4.5
WA02Q302-9 (tall)	3.3	2.8	3.8
Wandering	3.4	3.3	4.7
Williams (tall)	4.1	4.1	4.9
Wombat	3.5	3.7	4.6
Yallara (tall)	3.2	3.2	3.9
<i>No trials</i>	9	12	4

Table 7. Average grain yield (t/ha) by site of New South Wales for twelve oat varieties and two breeders lines (2010 to 2014). Data courtesy National Oat Breeding Program, NVT Programs in SA, Vic and NSW and CVT Program in WA. Analysis by Chris Lisle, SAGI.

Variety	New South Wales			
	South West	South East	North West	North East
Bannister	3.6	4.3	4.0	3.7
Carrolup (tall)	3.2	3.8	2.8	3.3
Dunnart	3.4	4.2	3.6	3.6
Echidna	3.2	4.1	3.2	3.3
Kojonup	3.3	3.9	3.8	3.5
Mitika	3.4	4.1	4.1	3.3
Possum	3.4	4.0	3.8	3.4
Potoroo	3.4	4.0	3.4	3.8
03198-18	3.4	4.2	4.3	3.2
WA02Q302-9 (tall)	3.2	4.0	3.5	3.3
Wandering	3.5	4.0	2.7	4.0
Williams (tall)	3.5	4.3	4.0	3.8
Wombat	3.4	4.0	3.5	3.6
Yallara (tall)	3.2	3.8	2.7	3.5
<i>No. trials</i>	13	17	1	4

Table 8. Average grain yield (t/ha) by site for Western Australia for twelve oat varieties and two breeders lines (2010 to 2014). Data courtesy National Oat Breeding Program, NVT Programs in SA, Vic and NSW and CVT Program in WA. Analysis by Chris Lisle, SAGI.

Variety	Western Australia			
	Agzone 2	Agzone 3	Agzone 4	Agzone 6
Bannister	3.7	3.6	1.8	2.6
Carrolup (tall)	3.1	3.0	1.6	2.3
Dunnart	3.5	3.4	1.7	2.5
Echidna	3.2	3.1	1.6	2.3
Kojonup	3.4	3.4	1.6	2.4
Mitika	3.4	3.2	1.5	2.5
Possum	3.4	3.3	1.6	2.5
Potoroo	3.6	3.5	1.9	2.5
03198-18	3.4	3.2	1.6	2.5
WA02Q302-9 (tall)	3.2	3.1	1.4	2.4
Wandering	3.7	3.3	2.0	2.8
Williams (tall)	3.7	3.7	1.7	2.5
Wombat	3.4	3.4	1.6	2.4
Yallara (tall)	3.2	3.1	1.4	2.4
<i>No. trials</i>	20	18	2	1

Table 9. Average physical and chemical grain quality (measured using NIR) characteristics for twelve oat varieties and two breeders lines (combined SA, Victoria, WA and NSW data), 2011 to 2014. Data courtesy National Oat Breeding Program. Analysis by Chris Lisle, SAGI.

Variety	Hectolitre weight kg/hl	1000 grain weight g	Screenings %<2 mm	NIR Protein %	NIR Oil %	NIR Groat %
Bannister	49.2	33.1	12.0	10.9	7.7	71.0
Carrolup (tall)	50.7	34.6	14.4	11.9	6.5	72.4
Dunnart	47.1	37.2	18.1	10.6	6.6	70.4
Echidna	48.2	32.2	12.5	11.1	7.5	70.8
Kojonup	47.8	34.5	8.7	11.8	6.6	74.2
Mitika	49.9	36.2	8.3	12.2	7.3	72.8
Possum	47.9	34.9	20.9	11.5	6.5	71.2
Potoroo	44.7	32.4	12.0	11.0	7.3	70.5
03198-18	49.0	36.1	8.1	12.4	7.2	73.5
WA02Q302-9 (tall)	51.9	35.2	10.0	12.5	7.2	72.7
Wandering	47.7	34.0	12.0	11.5	7.0	70.7
Williams (tall)	48.1	32.0	15.9	10.9	7.5	69.4
Wombat	48.9	35.1	13.8	11.6	6.9	73.5
Yallara (tall)	50.2	34.6	8.9	10.8	5.6	74.7
<i>No. trials</i>	46	27	47	48	48	48

Table 10. NIR measured Minolta L (2008-2014), NIR measured estimated metabolisable energy (2008-2014) and hull lignin characteristics for twelve oat varieties and two breeders lines (combined SA, Victoria, WA and NSW data). Data courtesy National Oat Breeding Program. This data is unanalysed means.

Variety	Minolta L	Min L no. trials	Estimated ME MJ/kg dm	Est ME no. trials	Hull lignin
Bannister	58.7	153	11.8	153	High
Carrolup (tall)	59.1	218	11.6	218	High
Dunnart	59.0	204	11.4	204	High
Echidna	60.9	207	11.6	207	High
Kojonup	59.8	39	11.9	39	High
Mitika	57.1	204	12.5	204	Low
Possum	57.2	207	11.5	207	High
Potoroo	59.4	162	11.6	162	High
03198-18	58.0	153	12.5	153	Low
WA02Q302-9 (tall)	59.8	153	11.7	153	High
Wandering	60.5	198	11.5	198	High
Williams (tall)	59.5	203	11.5	203	High
Wombat	59.4	207	11.7	207	High
Yallara (tall)	61.2	208	11.6	208	Mod high

Table 11. Average hectolitre weight (kg/hl) in four states and the average for all states for twelve oat varieties and two breeders lines (2010 to 2014). Data courtesy National Oat Breeding Program, NVT Programs in SA, Vic and NSW and CVT Program in WA. Analysis by Chris Lisle, SAGI.

Variety	State				All Zones
	NSW	SA	VIC	WA	
Bannister	51.5	47.8	50.7	49.8	49.2
Carrolup (tall)	54.0	50.5	50.9	50.4	50.7
Dunnart	49.4	46.4	48.4	47.2	47.1
Echidna	50.4	46.9	49.6	48.7	48.2
Kojonup	50.7	47.1	49.0	47.7	47.8
Mitika	52.6	49.6	50.0	49.6	49.9
Possum	51.0	47.8	48.6	47.4	47.9
Potoroo	47.2	43.7	47.0	44.9	44.7
03198-18	51.4	48.8	49.2	48.8	49.0
WA02Q302-9 (tall)	54.9	51.6	51.6	51.6	51.9
Wandering	50.7	46.8	49.2	47.7	47.7
Williams (tall)	50.3	46.9	49.6	48.7	48.1
Wombat	51.8	48.5	49.6	48.7	48.9
Yallara (tall)	53.4	49.8	50.7	49.8	50.2
No. trials	4	19	2	21	46

Table 12. Average 1000 grain weight (g) in four states and the average for all states for twelve oat varieties and two breeders lines (2010 to 2014). Data courtesy National Oat Breeding Program, NVT Programs in SA, Vic and NSW and CVT Program in WA. Analysis by Chris Lisle, SAGI.

Variety	State				All Zones
	NSW	SA	VIC	WA	
Bannister	33.9	32.7	36.1	-	33.1
Carrolup (tall)	36.1	34.0	37.6	-	34.6
Dunnart	37.4	36.9	40.8	-	37.2
Echidna	33.6	31.8	34.5	-	32.2
Kojonup	35.9	34.1	36.1	-	34.5
Mitika	37.6	35.8	37.5	-	36.2
Possum	35.9	34.5	36.3	-	34.9
Potoroo	34.2	31.9	34.4	-	32.4
03198-18	36.8	35.8	37.1	-	36.1
WA02Q302-9 (tall)	36.4	34.9	36.3	-	35.2
Wandering	35.1	33.4	37.7	-	34.0
Williams (tall)	32.6	31.5	36.0	-	32.0
Wombat	37.2	34.8	34.9	-	35.1
Yallara (tall)	36.0	34.1	36.4	-	34.6
<i>No. trials</i>	4	21	2	-	27

Table 13. Average screenings percent (% < 2mm) in four states and the average for all states for twelve oat varieties and two breeders lines (2010 to 2014). Data courtesy National Oat Breeding Program, NVT Programs in SA, Vic and NSW and CVT Program in WA. Analysis by Chris Lisle, SAGI.

Variety	State				All Zones
	NSW	SA	VIC	WA	
Bannister	4.9	10.7	3.9	13.0	12.0
Carrolup (tall)	4.9	9.1	6.3	17.6	14.4
Dunnart	7.0	12.9	7.0	8.8	18.1
Echidna	4.0	7.9	5.7	21.6	12.5
Kojonup	2.9	5.6	3.8	15.5	8.7
Mitika	2.8	5.2	3.7	10.6	8.3
Possum	7.8	14.6	8.4	10.2	20.9
Potoroo	4.9	10.7	3.9	25.8	12.0
03198-18	2.7	5.2	3.6	9.8	8.1
WA02Q302-9 (tall)	3.2	5.9	4.7	12.7	10.0
Wandering	4.4	10.0	4.3	13.5	12.0
Williams (tall)	7.0	13.5	5.1	17.6	15.9
Wombat	4.9	7.5	6.1	17.6	13.8
Yallara (tall)	3.0	6.2	3.8	10.6	8.9
<i>No. trials</i>	4	20	2	21	47

Table 14. Average NIR protein (% dm) in four states and the average for all states for twelve oat varieties and two breeders lines (2010 to 2014). Data courtesy National Oat Breeding Program, NVT Programs in SA, Vic and NSW and CVT Program in WA. Analysis by Chris Lisle, SAGI.

Variety	State				All Zones
	NSW	SA	VIC	WA	
Bannister	9.9	11.7	11.0	10.2	10.9
Carrolup (tall)	11.1	12.7	12.1	11.3	11.9
Dunnart	9.6	11.5	10.8	10.0	10.6
Echidna	9.9	12.0	11.0	10.6	11.1
Kojonup	10.9	12.6	11.9	11.3	11.8
Mitika	11.5	12.9	12.5	11.6	12.2
Possum	10.7	12.4	11.6	10.8	11.5
Potoroo	10.0	11.9	11.1	10.3	11.0
03198-18	11.8	13.2	12.7	11.7	12.4
WA02Q302-9 (tall)	12.5	13.4	13.2	11.6	12.5
Wandering	10.4	12.2	11.5	11.0	11.5
Williams (tall)	9.8	11.7	11.0	10.3	10.9
Wombat	10.2	12.3	11.4	11.1	11.6
Yallara (tall)	9.8	11.7	10.9	10.1	10.8
<i>No. trials</i>	4	21	2	21	48

Table 15. Average NIR oil (% dm) in four states and the average for all states for twelve oat varieties and two breeders lines (2010 to 2014). Data courtesy National Oat Breeding Program, NVT Programs in SA, Vic and NSW and CVT Program in WA. Analysis by Chris Lisle, SAGI.

Variety	State				All Zones
	NSW	SA	VIC	WA	
Bannister	8.0	8.0	7.9	7.4	7.7
Carrolup (tall)	6.5	6.7	6.9	6.2	6.5
Dunnart	6.7	6.8	7.0	6.4	6.6
Echidna	7.2	7.3	7.4	7.7	7.5
Kojonup	6.6	6.8	7.0	6.3	6.6
Mitika	7.5	7.6	7.6	7.0	7.3
Possum	6.5	6.7	6.9	6.2	6.5
Potoroo	7.4	7.5	7.5	7.0	7.3
03198-18	7.4	7.5	7.5	6.9	7.2
WA02Q302-9 (tall)	7.3	7.4	7.5	6.9	7.2
Wandering	7.1	7.2	7.3	6.7	7.0
Williams (tall)	7.7	7.8	7.8	7.3	7.5
Wombat	7.0	7.2	7.3	6.6	6.9
Yallara (tall)	5.5	5.8	6.2	5.4	5.6
<i>No. trials</i>	4	21	2	21	48

Table 16. Average NIR groat percent in four states and the average for all states for twelve oat varieties and two breeders lines (2010 to 2014). Data courtesy National Oat Breeding Program, NVT Programs in SA, Vic and NSW and CVT Program in WA. Analysis by Chris Lisle, SAGI.

Variety	State				All Zones
	NSW	SA	VIC	WA	
Bannister	71.9	70.2	72.0	71.5	71.0
Carrolup (tall)	74.0	71.7	74.1	72.7	72.4
Dunnart	71.9	70.8	71.4	69.7	70.4
Echidna	72.0	69.9	71.6	71.3	70.8
Kojonup	74.3	72.7	73.4	72.7	72.8
Mitika	72.9	72.1	72.3	70.0	71.2
Possum	71.5	69.3	71.6	71.5	70.5
Potoroo	71.9	70.2	72.0	71.5	71.0
03198-18	74.4	73.3	73.8	73.5	73.5
WA02Q302-9 (tall)	74.8	72.7	73.4	72.2	72.7
Wandering	71.9	69.4	72.0	71.6	70.7
Williams (tall)	70.7	68.2	70.1	70.3	69.4
Wombat	74.4	72.8	74.4	73.9	73.5
Yallara (tall)	76.4	74.8	76.1	74.1	74.7
No. trials	4	21	2	21	48

Table 17. Stem rust and leaf rust reactions for twelve grain varieties and two breeders lines in South Australia and Victoria and in New South Wales.

Variety	SA and Victoria		New South Wales	
	Stem rust ¹	Leaf rust ¹	Stem rust ¹	Leaf rust ¹
	Field	Field	Field	Field
Bannister	MR-S	R	MS-S	MR-S
Carrolup (tall)	S	VS	S	S-VS
Dunnart	MR-S	MR	MR-MS	R-S
Echidna	S	S	S	S
Kojonup	S	VS	S	MS-VS
Mitika	MR-S	R	MR-S	MS-S
Possum	MS-S	MS	S	MS-S
Potoroo	S	S	S	MS-S
03198-18	S	R	-	-
WA02Q302-9 (tall)	S-VS	R-S	-	-
Wandering	S	VS	S	VS
Williams (tall)	MR-S	R	MR	MR
Wombat	MS-S	MS	MS-S	MS-S
Yallara (tall)	MR-S	R	MR-MS	MS-S

¹ Disease reactions from field trials conducted in SA, Victoria and New South Wales where R= resistant, MR=moderately resistant, MS=moderately susceptible, S= susceptible, VS=very susceptible. Rust reactions may vary in different regions depending on the prevailing pathotypes. None of these varieties are resistant to the Pga virulent pathotype of stem rust which can be found in New South Wales, Victoria and parts of South Australia.

Table 18. Stem rust, leaf rust, BYDV and septoria reactions for twelve grain varieties and two breeders lines in Western Australia.

Variety	Western Australia			
	Stem rust ¹ Field	Leaf rust ¹ Field	BYDV ² Field	Septoria ¹ Field
Bannister	R-MR	R	MS	S
Carrolup (tall)	MS	S	MS	S-VS
Dunnart	MR	MR	MR	S
Echidna	S	S	MS	S-VS
Kojonup	R-MS	S	MS	S-VS
Mitika	MR-S	R	S	S-VS
Possum	MR-S	MR	S	S-VS
Potoroo	MS	S	MS	S
03198-18	S	R	MS	S
WA02Q302-9 (tall)	MR-MS	R-S	MS-S	S-VS
Wandering	MS	VS	MR-MS	S-VS
Williams (tall)	MR	R	MR-MS	MS
Wombat	MR-S	S	MR	S
Yallara (tall)	MR-MS	R	MR-MS	MS-S

¹ Disease reactions from field trials conducted in WA where R= resistant, MR=moderately resistant, MS=moderately susceptible, S= susceptible, VS=very susceptible. Rust reactions may vary in different regions depending on the prevailing pathotypes.

Table 19. Septoria, bacterial blight, CCN, stem nematode and red leather leaf (spermospora) disease reactions for twelve grain varieties and two breeders lines grown in South Australia and Victoria.

Variety	Septoria ¹	Bacterial blight ¹	Red leather leaf ¹	CCN R ¹	CCN T ²	Stem Nematode ²
Bannister	-	MR-S	MS	VS	I	MI
Carrolup (tall)	MR	MR-S	S	S	I	VI
Dunnart	MS	MR-S	MS	R	MT	MT
Echidna	S	S	MS	S	I	MT
Kojonup	MR	MS-S	MS	VS	I	MI
Mitika	S	MR	S	VS	I	I
Possum	MS	S	MS-S	VS	I	I
Potoroo	S	VS	S-VS	R	MT	MI
03198-18	S	MR	MS	VS	--	I
WA02Q302-9 (tall)	MS	MR-S	MS	R	MI-MT	I
Wandering	S	MR-S	MS	VS	I	I
Williams (tall)	-	R	MS	S	I	I
Wombat	MS	MS	MS	R	MT	MT
Yallara (tall)	MS	MR-MS	MS	R	I	I

¹ Disease reactions where R= resistant, MR=moderately resistant, MS=moderately susceptible, S= susceptible, VS=very susceptible

² T=tolerant, MT= moderately tolerant, MI=moderately intolerant, I=intolerant

6. Long term hay trial results

Tables 20 to 27 and 30 to 32 show the long term hay yield, hay quality, grain yield, and grain quality of varieties in the hay series. Grain quality data is a simple mean for the five year period 2010-2014. Tables for hay and grain yield and hay and grain quality by rainfall region have been deleted but tables have been added for hay quality by state. Tables 28 and 29 show the disease reactions of current and new hay varieties in SA and Victoria and in WA. **Please note:** Stem and leaf rust reactions reported for all oat varieties will vary by region due to genetic variation in the pathogen population. A pathotype that overcomes most resistance genes for stem rust is now present in southern Australia. Hence it is important to monitor oat crops for early detection of rust, so fungicide applications can be applied to control the diseases.

Seeding rate is important to reduce stem thickness. Oat varieties differ in seed weight by almost 10g, so it is important to calculate kg/ha by the desired plant population and variety. Start by determining the seed weight of your seed. Count 200 seeds and get the grain weight in grams. For example you have selected Mulgara and the 200 seed weight is 7.7g. Take 7.7 divided by 200 = .0385 g for each grain. You decided on a plant population of 350 plants per square metre. The following equation will tell you how many kg/ha to sow to reach the desired plant population per square metre:

$X = 10 \times Y \times Z$ where X= unknown kg/ha, Y = single grain weight, and Z = desired plants m^{-2}
For this example $X = 10 \times .0385 \times 350$, $X = 135 \text{ kg/ha}$ to achieve 350 plants m^{-2} . Each variety will differ due to the range of grain weight.

For more detailed or specific information please contact the National Oat Breeding Program.

The Breeding Program sincerely thanks AEXCO for their support of our breeding program.



Members of the Oat Breeding Team Mark Hill and Peter Wheeler cutting hay plots at Turretfield in October 2015.

6.1 Hay Variety Summary

***Forester*[®]**

Forester is a very late hay variety adapted to high rainfall and irrigated cropping regions that was released in 2012. It is seven to 10 days later than Glider, three days later than Riel, two days later than Targa, and three weeks later than Wintaroo. Forester has excellent early vigour and is an improvement compared to Glider. It has excellent lodging and shattering resistance.

Forester has an excellent foliar disease resistance spectrum. It is moderately susceptible to CCN. It has good hay colour, but like all late hay varieties may not resist hot dry winds as well as earlier varieties. Forester has excellent hay quality and is an improvement compared to Glider, Tammar, Targa, and Vasse, but similar to Riel.

Seed of Forester is available from AGF Seeds, Smeaton, Victoria.

***Tammar*[®]**

Tammar is a medium tall late variety that was released in 2012 and commercialised by AEXCO. It is four to seven days later than Tungoo to cut. Tammar also has an excellent disease resistance profile. It is moderately resistant to stem and leaf rust, septoria, BYDV, and bacterial blight. Tammar is the first late variety available with resistance to CCN and SN, tolerance to CCN, and moderate tolerance to SN.

Tammar has improved hay quality compared to Kangaroo. It has high crude protein and hay digestibility with lower WSC than Mulgara and Brusher, but higher than Kangaroo.

***Mulgara*[®]**

Mulgara was released in 2009 and commercialised by AEXCO. It is a tall mid season variety with excellent early vigour and good straw strength. Hay yield is lower than Wintaroo, but hay quality is better than Wintaroo. Mulgara also retains good hay colour and resists brown leaf tipping. Grain yield is similar to Wintaroo, but Mulgara has slightly better grain quality with the exception of high hull lignin. The seed size of Mulgara is larger than other hay varieties and similar to Swan. Care should be taken to sow this variety at the correct seed density taking into account its seed weight.

Mulgara has excellent disease resistance. It is resistant and tolerant to CCN and SN. Compared to Wintaroo, Mulgara has improved leaf rust, bacterial blight, and red leather leaf resistance.

***Tungoo*[®]**

Tungoo was released in 2010. However, seed was not available until 2012, due to problems with commercial seed bulk-up. It is a medium tall mid to late season variety and seed is available through AEXCO. Tungoo has an excellent disease resistance profile. It combines resistance and moderate tolerance to CCN and SN. It also is resistant to leaf rust and the only variety with red leather leaf resistance. Tungoo is moderately resistant to BYDV, septoria, and bacterial blight and moderately susceptible to stem rust. It has the best combination of disease resistance compared to all other varieties except Tammar.

Hay yield is slightly lower than Kangaroo, but Tungoo's hay quality is an improvement compared to Kangaroo. Tungoo has grain quality similar to Kangaroo, but the grain size is smaller resulting in higher screenings. Tungoo has low hull lignin which improves feed grain quality.

Brusher[®]

Brusher is an early-mid season hay variety commercialised by AEXCO. Brusher is a tall line about three to seven days earlier to head than Wintaroo. It has good early vigour, but slightly less than Wintaroo. Brusher has excellent hay yield in low to medium rainfall zones and has consistently had excellent hay quality to match the yield. Brusher is an improvement compared to Wintaroo for hay quality, stem rust, leaf rust, bacterial blight and septoria resistance. It is resistant but moderately intolerant to CCN and stem nematode. Brusher has proved to be a popular variety in the earlier regions of SA, WA, and VIC.

Yallara[®] and WA02Q302-9

See section 5.1



The recently held WA Oat open day at Narrogin went off well with an attendance of 150 people from farmers to industry leaders and every one in between. Growers and other people involved in the oat industry were given the opportunity to hear from industry leaders about past, present and future activities in the industry and what other movements are happening around the globe in the oat industry. Farmers were given the opportunity to see firsthand some upcoming varieties such as WA02Q302-9 and 05096-32 next to other known varieties such as Yallara and Bannister. (Photo and description courtesy Cody Hull, DAFWA).



WA02Q302-9 sown on the 7th May at Kerang (Picture courtesy Trevor Bray, UniGrain Pty Ltd)

Table 20. Average hay yield (t/ha) for twenty one oat varieties in three states during the period 2011 to 2014. Data courtesy National Oat Breeding Program. Analysis by Chris Lisle, SAGI.

Variety	New South Wales	South Australia	Victoria	Western Australia	All States
Early – Mid Season Varieties					
Bannister	11.5	10.4	10.2	9.9	10.2
Brusher	11.3	10.4	10.2	9.5	10.1
Carrolup	11.6	9.9	10.5	8.8	9.7
Mulgara	11.0	10.1	10.2	9.4	9.9
Swan	11.2	10.0	9.7	9.8	9.9
WA02Q302-9	11.3	9.8	10.2	8.0	9.3
Wallaroo	11.9	9.7	10.2	9.3	9.7
Wandering	11.7	10.1	10.1	9.3	9.9
Williams	11.3	10.0	10.1	8.9	9.7
Winjardie	11.6	9.8	10.5	9.1	9.8
Wintaroo	11.6	10.6	10.5	10.0	10.4
Yallara	12.3	10.7	10.5	9.5	10.3
Mid-Late to Very Late Varieties					
Eurabbie	10.2	9.5	9.9	9.3	9.6
Forester	10.4	9.7	10.0	9.7	9.8
Glider	10.5	9.5	9.8	9.3	9.5
Kangaroo	11.2	10.0	9.8	9.5	9.8
Riel	11.0	10.1	10.1	9.3	9.9
Tammar	11.0	10.3	10.1	9.3	9.9
Targa	11.1	9.8	10.3	8.8	9.6
Tungoo	10.4	9.9	9.9	8.7	9.5
Vasse	11.0	10.7	10.2	9.9	10.3
<i>No. sites</i>	<i>1</i>	<i>12</i>	<i>8</i>	<i>11</i>	<i>32</i>

Table 21. Average grain yield (t/ha) from hay trials for twenty one oat varieties in three states during the period 2011 to 2014. Data courtesy National Oat Breeding Program. Analysis by Chris Lisle, SAGI.

Variety	South Australia	Victoria	Western Australia	All States
Early – Mid Season Varieties				
Bannister	4.6	3.3	4.0	4.6
Brusher	3.2	2.0	2.8	3.1
Carrolup	3.9	2.6	3.4	3.9
Mulgara	3.1	2.5	3.1	3.5
Swan	2.7	1.9	2.6	3.0
WA02Q302-9	4.1	3.1	3.7	4.0
Wallaroo	3.1	2.2	2.9	3.3
Wandering	4.2	3.0	3.7	4.5
Williams	4.3	3.3	3.9	4.6
Winjardie	3.6	2.4	3.2	3.8
Wintaroo	3.1	2.2	2.9	3.5
Yallara	3.7	2.9	3.5	4.0
Mid-Late to Very Late Varieties				
Eurabbie	4.0	2.4	3.3	4.1
Forester	3.3	1.3	2.3	2.6
Glider	3.3	1.8	2.7	3.0
Kangaroo	3.2	2.1	2.9	3.4
Riel	3.0	1.3	2.3	2.9
Tammar	3.8	2.1	3.0	3.3
Targa	3.5	1.3	2.5	3.0
Tungoo	3.1	1.8	2.6	3.0
Vasse	4.0	2.3	3.2	3.9
<i>No. sites</i>	<i>1</i>	<i>11</i>	<i>8</i>	<i>13</i>

Table 22. Average hay quality for twenty one oat varieties for trials conducted in three states during the period 2011 to 2014. Data courtesy National Oat Breeding Program. Analysis by Chris Lisle, SAGI.

Variety	Digestibility (%dm)	WSC* (%dm)	ADF* (%dm)	NDF* (%dm)	Crude Protein (%dm)
Early – Mid Season Varieties					
Bannister	64.0	24.2	30.5	51.9	8.0
Brusher	62.7	26.0	31.8	52.0	7.7
Carrolup	61.2	25.2	32.7	52.4	7.6
Mulgara	62.3	25.3	32.8	52.4	7.9
Swan	61.9	24.4	33.0	53.5	7.7
WA02Q302-9	63.0	23.8	33.1	53.2	7.8
Wallaroo	61.7	24.5	32.7	53.0	7.8
Wandering	64.2	24.5	30.6	51.0	8.2
Williams	61.4	22.4	32.5	53.5	8.2
Winjardie	62.6	25.1	32.2	53.1	7.5
Wintaroo	61.5	23.8	33.2	53.2	7.7
Yallara	62.4	27.5	31.8	51.0	7.5
Mid-Late to Very Late Varieties					
Eurabbie	66.1	27.1	28.9	49.5	8.2
Forester	67.5	26.9	28.2	49.1	7.8
Glider	62.9	23.0	31.4	53.8	8.0
Kangaroo	59.9	20.9	34.9	56.9	7.9
Riel	65.0	27.1	29.7	50.5	7.6
Tammar	62.3	22.4	33.3	55.1	8.0
Targa	65.2	24.1	29.4	50.6	7.9
Tungoo	62.3	22.8	33.1	54.6	8.2
Vasse	62.9	22.4	32.6	53.9	7.9
<i>No. sites</i>	25	25	25	25	25

*WSC=water soluble carbohydrates, ADF=acid detergent fibre, NDF=neutral detergent fibre

Table 23. Average hay digestibility (%dm) for twenty one oat varieties in different states during the period 2011 to 2014. Data courtesy National Oat Breeding Program. Analysis by Chris Lisle, SAGI.

Variety	New South Wales	South Australia	Victoria	Western Australia	All States
Early – Mid Season Varieties					
Bannister	59.1	64.5	63.5	64.5	64.0
Brusher	57.6	63.2	62.0	64.1	62.7
Carrolup	56.6	61.4	60.1	63.9	61.2
Mulgara	56.9	62.9	61.5	63.4	62.3
Swan	56.8	62.5	60.9	63.2	61.9
WA02Q302-9	58.3	63.3	62.3	64.5	63.0
Wallaroo	56.4	62.3	60.8	63.2	61.7
Wandering	59.2	64.7	63.7	64.7	64.2
Williams	56.6	61.8	60.3	63.5	61.4
Winjardie	57.6	63.0	61.8	64.0	62.6
Wintaroo	56.3	62.4	60.5	62.4	61.5
Yallara	57.4	62.7	61.5	64.1	62.4
Mid-Late to Very Late Varieties					
Eurabbie	61.8	66.7	66.0	65.7	66.1
Forester	64.1	67.9	67.6	67.0	67.5
Glider	58.0	63.5	62.2	63.8	62.9
Kangaroo	55.0	60.5	58.5	62.0	59.9
Riel	60.5	65.8	64.6	64.5	65.0
Tammar	57.1	63.0	61.4	62.9	62.3
Targa	61.4	65.4	64.8	66.0	65.2
Tungoo	57.8	62.8	61.4	63.8	62.3
Vasse	58.1	63.6	62.1	63.6	62.9
<i>No. sites</i>	<i>1</i>	<i>12</i>	<i>8</i>	<i>4</i>	<i>25</i>

Table 24. Average hay water soluble carbohydrates (% dm) for twenty one oat varieties in different states during the period 2011 to 2014. Data courtesy National Oat Breeding Program. Analysis by Chris Lisle, SAGI.

Variety	New South Wales	South Australia	Victoria	Western Australia	All States
Early – Mid Season Varieties					
Bannister	20.1	21.7	28.4	24.1	24.2
Brusher	23.9	24.5	30.0	23.1	26.0
Carrolup	23.0	23.0	29.4	23.8	25.2
Mulgara	24.8	24.3	28.4	21.9	25.3
Swan	24.1	23.0	27.4	22.3	24.4
WA02Q302-9	20.5	22.8	26.9	21.4	23.8
Wallaroo	23.8	23.7	27.4	21.4	24.5
Wandering	22.6	21.9	29.2	23.7	24.5
Williams	22.5	20.9	25.5	21.0	22.4
Winjardie	21.6	23.0	29.3	23.9	25.1
Wintaroo	21.3	22.8	26.9	21.3	23.8
Yallara	26.2	26.2	30.9	24.9	27.5
Mid-Late to Very Late Varieties					
Eurabbie	25.2	25.2	31.2	25.2	27.1
Forester	29.3	26.1	29.3	23.8	26.9
Glider	24.2	21.7	25.8	21.2	23.0
Kangaroo	18.6	19.2	24.1	20.2	20.9
Riel	26.2	25.8	30.5	24.6	27.1
Tammar	21.5	21.1	25.2	21.1	22.4
Targa	21.4	22.5	27.6	22.9	24.1
Tungoo	20.9	21.5	25.9	21.0	22.8
Vasse	22.4	21.2	24.9	20.9	22.4
<i>No. sites</i>	<i>1</i>	<i>12</i>	<i>8</i>	<i>4</i>	<i>25</i>

Table 25. Average hay ADF for twenty one oat varieties in different states during the period 2011 to 2014. Data courtesy National Oat Breeding Program. Analysis by Chris Lisle, SAGI.

Variety	New South Wales	South Australia	Victoria	Western Australia	All States
Early – Mid Season Varieties					
Bannister	36.7	30.5	28.8	32.2	30.5
Brusher	38.4	31.5	30.5	33.3	31.8
Carrolup	39.5	32.9	31.4	32.8	32.7
Mulgara	38.9	32.6	31.7	34.2	32.8
Swan	40.3	32.6	32.3	33.7	33.0
WA02Q302-9	38.8	33.4	31.6	33.8	33.1
Wallaroo	38.3	32.5	31.7	33.9	32.7
Wandering	37.6	30.5	29.1	31.8	30.6
Williams	38.2	32.3	31.4	33.7	32.5
Winjardie	39.8	32.0	31.1	33.1	32.2
Wintaroo	41.1	32.5	32.7	34.3	33.2
Yallara	37.2	31.8	30.4	33.0	31.8
Mid-Late to Very Late Varieties					
Eurabbie	35.0	28.7	27.1	31.7	28.9
Forester	34.4	27.8	26.6	30.9	28.2
Glider	37.6	31.1	30.4	32.9	31.4
Kangaroo	39.4	34.6	34.4	35.8	34.9
Riel	33.4	29.4	28.2	32.5	29.7
Tammar	39.0	33.0	32.8	34.0	33.3
Targa	32.8	29.4	27.8	31.8	29.4
Tungoo	37.1	33.2	32.0	33.8	33.1
Vasse	38.0	32.2	31.8	33.9	32.6
<i>No. sites</i>	<i>1</i>	<i>12</i>	<i>8</i>	<i>4</i>	<i>25</i>

Table 26. Average hay NDF for twenty one oat varieties in different states during the period 2011 to 2014. Data courtesy National Oat Breeding Program. Analysis by Chris Lisle, SAGI.

Variety	New South Wales	South Australia	Victoria	Western Australia	All States
Early – Mid Season Varieties					
Bannister	59.5	52.9	51.1	48.8	51.9
Brusher	59.9	53.0	51.1	49.0	52.0
Carrolup	61.0	53.6	51.2	48.8	52.4
Mulgara	59.3	53.0	52.2	49.5	52.4
Swan	60.8	54.0	53.6	49.9	53.5
WA02Q302-9	61.6	54.4	52.2	49.4	53.2
Wallaroo	59.9	53.3	53.2	50.1	53.0
Wandering	58.5	52.2	49.8	47.8	51.0
Williams	61.2	54.3	53.2	49.5	53.5
Winjardie	61.0	53.8	52.5	49.9	53.1
Wintaroo	61.1	53.8	52.8	50.0	53.2
Yallara	57.5	51.7	50.6	48.4	51.0
Mid-Late to Very Late Varieties					
Eurabbie	57.0	50.4	48.0	47.8	49.5
Forester	55.1	49.4	48.7	47.9	49.1
Glider	61.2	54.2	54.0	50.4	53.8
Kangaroo	65.6	57.4	57.5	52.2	56.9
Riel	55.5	50.3	50.9	49.0	50.5
Tammar	62.9	55.4	55.6	51.1	55.1
Targa	56.6	51.0	50.3	48.4	50.6
Tungoo	62.4	55.4	54.6	50.3	54.6
Vasse	61.1	54.1	54.3	50.6	53.9
<i>No. sites</i>	<i>1</i>	<i>12</i>	<i>8</i>	<i>4</i>	<i>25</i>

Table 27. Average hay crude protein for twenty one oat varieties in different states during the period 2011 to 2014. Data courtesy National Oat Breeding Program. Analysis by Chris Lisle, SAGI.

Variety	New South Wales	South Australia	Victoria	Western Australia	All States
Early – Mid Season Varieties					
Bannister	5.9	8.4	6.5	9.9	8.0
Brusher	5.6	8.5	5.8	10.0	7.7
Carrolup	5.5	8.1	5.9	9.8	7.6
Mulgara	5.7	8.4	6.4	9.9	7.9
Swan	5.4	8.3	6.1	10.1	7.7
WA02Q302-9	6.2	8.3	6.4	9.8	7.8
Wallaroo	5.4	8.4	6.0	10.1	7.8
Wandering	6.2	8.7	6.7	10.1	8.2
Williams	5.7	8.7	6.5	10.4	8.2
Winjardie	5.1	8.1	5.8	9.9	7.5
Wintaroo	5.3	8.5	5.7	10.1	7.7
Yallara	5.6	7.9	6.1	9.8	7.5
Mid-Late to Very Late Varieties					
Eurabbie	6.5	8.9	6.5	9.8	8.2
Forester	6.3	8.5	6.1	9.4	7.8
Glider	6.4	8.7	6.2	10.0	8.0
Kangaroo	6.1	8.4	6.5	10.0	7.9
Riel	5.9	8.3	5.7	9.9	7.6
Tammar	6.2	8.5	6.4	9.9	8.0
Targa	6.4	8.7	6.0	9.8	7.9
Tungoo	6.2	8.6	6.9	10.1	8.2
Vasse	5.6	8.4	6.2	10.1	7.9
<i>No. sites</i>	<i>1</i>	<i>12</i>	<i>8</i>	<i>4</i>	<i>25</i>

Table 28. Disease reactions in SA and Victoria and comparative stem diameter for current and new hay variety releases.

DISEASE PROFILE

Variety	Stem rust ¹	Leaf rust ¹	BYDV ¹	Septoria ¹	Bacterial blight ¹	CCN R ¹	CCN T ²	Stem Nematode R ¹	Stem Nematode T ²	Red leather leaf ¹	Stem diameter ³
Bannister	MR-S	R	MS	NA	MR-S	VS	I	NA	MI	MS	M
Brusher	MS-S	MR-MS	MS	MS	MR-MS	R	MI	MS	I	MS	M
Forester	R-S	MR-MS	MR-S	MR	MS-S	MS	MI	S	I	R-MR	MT
Kangaroo	MS-S	MS	MR-S	MR-MS	MR-MS	R	MT	MS	MI	MS	MF
Mulgara	MS-S	MR	MS	MS	MR	R	MT	R	MT	MS	M
Tammar	MR-S	MR	MS	MR	MR	MR	MT	R	MT	R-MS	MF
Tungoo	MS-S	MR	MR-MS	MR	MR	R	MT	R	MT	R	M
Wallaroo	S	S	MS	S	S	R	MT	MS	MI	MS	F
Wandering	MR-S	VS	MR-MS	S-VS	MR-S	VS	I	VS	I	MS	M
WA02Q302-9	S-VS	R-S	MS-S	MS	MR-S	R	MI/MT	NA	I	MS	M
Williams	MR-S	R	MR-MS	MS	R	S	I	NA	I	MS	MT
Wintaroo	S	MS	MR-MS	MR-MS	MR	R	MT	MR	MT	MS	M
Yallara	MR-S	R	MS	MS	MR-MS	R	I	S	I	MS	MF

¹ Disease reactions where R= resistant, MR=moderately resistant, MS=moderately susceptible, S= susceptible, VS=very susceptible

² T=tolerant, MT= moderately tolerant, MI=moderately intolerant, I=intolerant

³ F=fine, MF=moderately fine, MT=moderately thick, T=thick, VT=very thick

(Rust and BYDV reactions may vary in different regions and with different seasonal conditions depending on the prevalent pathotype/serotype. Monitoring your oat crop is therefore essential.)

Table 29. Disease reactions in WA.

DISEASE PROFILE FOR HAY VARIETIES IN WA

Variety	Stem rust ¹	Leaf rust ¹	BYDV ¹	Septoria ¹	Bacterial blight ¹	CCN R ¹	CCN T ²	Red leather leaf ¹	Stem diameter ³
Brusher	MR-S	R-MS	MR-MS	S-VS	MR-MS	R	MI	MS	M
Carrolup	MS	S	MS	S-VS	MR-S	S	I	S	M
Forester	R	R-MS	MS	MS-S	MS-S	MS	MI	R-MR	MT
Kangaroo	R-S	MS-S	MR-S	MS-S	MR-MS	R	MT	MS	MF
Mulgara	MR-MS	MR	MS-S	MR-S	MR	R	MT	MS	M
Tammar	R-MR	R-MR	MS-S	MS	MR	MR	MT	R-MS	MF
Tungoo	MR-S	R-MS	MR-MS	MS-S	MR	R	MT	R	M
Wallaroo	MS-S	VS	MS	S-VS	S	R	MT	MS	F
Wandering	MR	VS	MS-S	S-VS	MR-S	VS	I	MS	M
WA02Q302-9	MR-MS	R-S	MS-S	S-VS	MR-S	R	MI/MT	MS	M
Williams	MR	R	MR-MS	MS	R	S	I	MS	MT
Winjardie	MR-S	S-VS	MS-S	S-VS	S	S	I	MS	M
Wintaroo	MR	S-VS	MR-MS	MS-S	MR	R	MT	MS	M
Yallara	MR-MS	R	MR-MS	MS-S	MR-MS	R	I	MS	MF

¹ Disease reactions where R= resistant, MR=moderately resistant, MS=moderately susceptible, S= susceptible, VS=very susceptible

² T=tolerant, MT= moderately tolerant, MI=moderately intolerant, I=intolerant

³ F=fine, MF=moderately fine, MT=moderately thick, T=thick, VT=very thick

Note: Stem rust, leaf rust, BYDV & Septoria reactions are from WA trials, Bacterial blight, CCN & red leather leaf reactions are from SA trials

(Rust and BYDV reactions may vary in different regions and with different seasonal conditions depending on the prevalent pathotype/serotype. Monitoring your oat crop is therefore essential.)

Table 30. Average physical grain quality characteristics for twenty one hay oat varieties (combined SA, Victoria and WA data), 2010 to 2014. Data are unanalysed means from hay trials courtesy National Oat Breeding Program.

Variety	Hectolitre weight kg/hl	1000 grain weight g	Screenings %<2 mm	No. trials
Early – Mid Season Varieties				
Bannister	49.2	31.0	15.0	34
Brusher	48.0	32.9	13.2	42
Carrolup	52.2	31.4	16.4	41
Mulgara	47.7	35.5	10.4	43
Swan	48.5	35.2	18.0	37
WA02Q302-9	53.3	32.6	9.5	33
Wallaroo	46.8	33.1	16.7	41
Wandering	48.6	29.0	16.1	36
Williams	47.8	28.8	20.1	41
Winjardie	45.3	30.2	16.7	41
Wintaroo	47.4	33.7	16.6	42
Yallara	50.9	31.9	12.1	33
Mid-Late to Very Late Varieties				
Eurabbie	44.8	28.4	17.4	53
Forester	42.7	32.0	9.9	21
Glider	41.4	31.2	16.2	22
Kangaroo	45.4	31.6	16.1	34
Riel	45.8	24.5	36.7	23
Tammar	44.0	29.9	21.6	35
Targa	44.6	33.3	12.9	14
Tungoo	43.7	29.4	21.3	33
Vasse	42.5	31.4	16.9	26

Table 31. Average chemical grain quality (measured using NIR) characteristics for twenty one hay oat varieties (combined SA, Victoria and WA data), 2010 to 2014. Data are unanalysed means from hay trials courtesy National Oat Breeding Program.

Variety	NIR Protein %	NIR Oil %	NIR Groat %	No. trials
Early – Mid Season Varieties				
Bannister	11.6	7.8	71.1	34
Brusher	12.1	6.8	71.4	42
Carrolup	12.5	6.4	73.1	41
Mulgara	13.4	7.0	73.9	43
Swan	11.8	6.7	70.1	37
WA02Q302-9	12.7	7.2	72.8	33
Wallaroo	11.9	7.6	69.9	41
Wandering	11.8	7.0	70.1	36
Williams	11.8	7.5	69.5	41
Winjardie	10.7	5.7	70.4	41
Wintaroo	12.2	7.3	70.1	42
Yallara	11.3	5.5	75.3	33
Mid-Late to Very Late Varieties				
Eurabbie	11.7	5.9	68.4	53
Forester	13.0	6.2	68.2	21
Glider	13.4	5.7	68.6	22
Kangaroo	12.0	6.1	70.1	34
Riel	12.0	5.9	69.4	23
Tammar	12.9	6.6	70.3	35
Targa	13.4	6.4	66.3	14
Tungoo	12.5	6.6	70.2	33
Vasse	12.6	6.1	68.6	26

Table 32. NIR measured Minolta L, estimated metabolisable energy and hull lignin (2010-2014) characteristics for twenty hay oat varieties (combined SA, Victoria, WA and NSW data). Data are unanalysed means from hay trials courtesy National Oat Breeding Program.

Variety	Minolta L	Estimated ME MJ/kg dm	Hull lignin	No. trials
Early – Mid Season Varieties				
Bannister	62.0	11.9	9.8 (high)	34
Brusher	59.3	12.5	4.7 (low)	42
Carrolup	61.9	11.7	11.0 (high)	41
Mulgara	62.7	12.1	9.4 (high)	43
Swan	60.0	12.5	4.7 (low)	37
WA02Q302-9	62.2	11.9	11.0 (high)	33
Wallaroo	58.5	12.6	4.5 (low)	41
Wandering	63.6	11.7	10.6 (high)	36
Williams	62.8	11.7	11.3 (high)	41
Winjardie	60.3	12.4	3.7 (low)	41
Wintaroo	59.9	12.6	4.6 (low)	42
Yallara	65.1	11.7	11.3 (high)	33
Mid-Late to Very Late Varieties				
Eurabbie	60.0	12.2	4.7 (low)	53
Forester	64.1	11.8	8.9 (high)	21
Glider	62.0	12.2	5.4 (low)	22
Kangaroo	61.8	11.7	10.4 (high)	34
Riel	62.3	12.1	6.7 (low)	23
Tammar	60.2	12.4	5.4 (low)	35
Targa	63.2	12.0	8.7 (high)	14
Tungoo	61.4	12.4	5.6 (low)	33
Vasse	61.3	11.8	8.9 (high)	26