OAT

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INTRODUCTION

The oat section of this sowing guide is designed to help you determine which milling oat or export hay variety to grow in your region. This section provides variety characteristics, disease ratings and agronomic information for oat varieties that offer growers the best opportunity to meet market requirements. This information should be read in conjunction with industry information provided in the Grains Industry of Western Australia (GIWA) *Oat variety and grade update* (available at www.giwa.org.au/oat-council).

GIWA collaborates with Western Australian bulk handlers to review grain standards on an as-needs basis to ensure that WA grain standards are fit-for-purpose to customer requirements and set to maximise returns to the WA grain value chain. In 2018, a review was conducted and resulted in the changes shown in Table 1 to the Oat2 receival standards for the 2019-20 harvest.

Changes to receival standards for 2019-20 harvest

There are several oat grain varieties available for delivery into the CBH system. CBH delivery grades are Oat1, Oat2 and OWAN, which is an exclusive segregation for Wandering(ϕ) oats. Each variety has its own strengths and weaknesses and their characteristics will determine their suitability for your area. No one oat variety is likely to provide optimum agronomic traits, disease resistance, yield and quality in any one year. Most successful oat growers choose to grow more than one variety. The strengths and weaknesses of each oat variety are detailed in the variety description section.

Nitrogen management

When growers are making decisions on the amount of nitrogen to apply to oat crops during the growing season the following points should be considered.

- Target market for crop – grain or hay?
- Strategy for nitrogen application differs for grain and hay.
- Seasonal rainfall to date. If the season is dry the positive impact of applied nitrogen on yield is less.
- Hay yield of Bannister(ϕ) and Williams(ϕ) responds similarly to applied nitrogen (increased hay yield, but decreased hay quality).
- Increasing nitrogen results in increased screenings and decreased hectolitre weight. Williams(ϕ) and Carrolup are more sensitive than Bannister(ϕ) to increased nitrogen.

Target plant density

Traditionally, growers have sown oats with a set seeding rate. However, this approach can mean growers may not achieve their target plant density, reducing their ability to achieve optimum yield and/or quality.

Variable plant density at establishment may be due to differences in seed size, germination percentages and sowing conditions. It is recommended that growers determine the 1000

TABLE 1 Changes to oat receival standards for 2019-20 harvest.

Standard	2018-19 harvest	2019-20 harvest
Oat2 screenings (maximum)	N/A	15%
Oat2 groat count	144 per 2 black plastic measure	72 per 2 black plastic measure

Suggested target plant density.

Crop purpose	Lower rainfall zone (e.g. Agzone 4)	Higher rainfall zone (e.g. Agzone 3)
Grain	160 plants/m^2	240 plants/m^2
Export hay	240 plants/m^2	320 plants/m^2

grain weight of their seed, which is then used to determine the target sowing rate (kg/ha).

The seed rate calculation is:

$$\text{seed rate (kg/ha)} = \frac{\text{Target plant density (plants/m2)* Average grain weight (mg)]}}{\text{Expected establishment per cent (\%)}}$$

For example, if the desired plant population is 240 plants/m^2, the average grain weight is 40 milligrams (mg) and expected establishment is 80 per cent the calculation is: (240 * 40) / 80 = 120 kg/ha.

Management of grain staining

Bannister$^{\Phi}$ oats is one of the top three varieties grown in WA for grain and is becoming more popular due to its yield advantage over Carrolup$^{\Phi}$, and its better grain quality than Williams$^{\Phi}$. However, Bannister$^{\Phi}$ is susceptible to septoria and in higher rainfall areas where septoria is more prevalent there is greater risk of growers having grain downgraded at harvest due to grain staining.

Research investigating the best timing for fungicide application for septoria control and its impact on grain staining at harvest in Bannister$^{\Phi}$ oat crops (sown into oat stubble) found that:

- fungicide applied at flag leaf emergence or later significantly reduced severity of septoria on the Flag-1 leaf.
- the most effective treatment to protect the flag leaf is a two-spray regime, with the first application applied at stem elongation-flag leaf emergence and the second application at flag leaf emergence-head emergence.

In high disease pressure scenarios (e.g. growing a susceptible variety, oat-on-oat rotation, or high rainfall regions), the data generated from research suggests that if disease pressure becomes evident at stem elongation then growers should implement a two-spray regime, with applications applied at stem elongation and flag emergence to provide the greatest benefit. Where disease pressure is lower or when disease enters the canopy later in the season, a single application at flag leaf emergence will provide more protection than other spray strategies, protecting the flag leaf and potentially providing a yield benefit.

Pre-harvest rainfall (between grain filling and harvest) has also resulted in grain staining in Bannister$^{\Phi}$ crops. In this scenario, applying late fungicides to reduce grain staining has proved to be unreliable.

What's new?

One new oat grain variety – Bilby$^{\Phi}$ (tested as 06204-16) – and one new oat hay variety – Koorabup$^{\Phi}$ (tested as 05096-32) – were released for commercial production in 2019. Bilby$^{\Phi}$ underwent commercial milling evaluation in early 2019 and was approved for Oat1 milling classification in Western Australia. While there is no commercial hay variety evaluation, Koorabup$^{\Phi}$ has performed similarly to other accepted export hay varieties in yield and quality.

Bilby$^{\Phi}$ is a cross between two breeding lines, 98011-6 and 98240-19. Bilby$^{\Phi}$ is a dwarf, early-mid season variety. Its grain yield and quality are between that of Kojonup$^{\Phi}$ and the higher-yielding varieties Bannister$^{\Phi}$ and Williams$^{\Phi}$ (based on data from NVT 2016–18 and DPIRD oat agronomy 2017-18). Without a yield advantage over Bannister$^{\Phi}$ or Wandering$^{\Phi}$, it is not expected that Bilby$^{\Phi}$ will displace these dominating varieties in the WA oat growing environment. The National Oat Breeding Program has developed this variety, along with Kowari$^{\Phi}$, to have high β-glucan, an important nutritional quality trait that is valued by oat markets worldwide.

Seed is available through Heritage Seeds. PBR and EPR of $2.50/tonne (exc. GST) apply.

Koorabup$^{\Phi}$ is a cross between two WA breeding lines. Koorabup$^{\Phi}$ is a mid-tall, early mid to mid-season variety. Koorabup$^{\Phi}$ has excellent hay colour and similar in quality to Wintaroo$^{\Phi}$. Hay yield is slightly higher than Carrolup, but lower than Brusher$^{\Phi}$ (based on data from the National Oat Breeding Program). Koorabup$^{\Phi}$ has good resistance to septoria, rust and bacterial blight. The National Oat Breeding Program has developed this variety with improved grain quality compared with other hay varieties and improved septoria resistance.

Seed is available through AEXCO. PBR and EPR of $2/tonne (exc. GST) apply.

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What should I grow?

Based on their performance in the NVT and agronomy trials, varieties have been suggested for the high, medium and low-rainfall areas. The decision whether to grow milling oats depends on three main factors:

1. profitability of Oat1 and Oat2 grain production;
2. likelihood that grain will meet Oat1 or Oat2 receival specifications; and
3. location of receival segregations for Oat1 and Oat2 varieties.

Grain

If growers are targeting the Oat1 market and have low-moderate septoria risk, then Bannister(Φ) is suggested. In high-rainfall areas with low risk of drought stress during grain filling, Williams(Φ) is recommended.

If growers are targeting the OWAN or Oat2 market, then Wandering(Φ) is suggested.

Newly released variety Bilby(Φ) performed well in the 2018 NVT series, but performance over multiple seasons is required to determine best fit for this variety.

Hay

High-yielding, high-quality hay varieties Brusher(Φ), Forester(Φ) (southern high yield area only), Mulgara(Φ), and Wintaroo(Φ) are suggested for medium to high- yield areas. For high disease risk areas the new variety Koorabup(Φ) and Williams(Φ) are recommended. For growers wanting a dual-purpose (milling oat and export hay eligible) variety Carrolup, Williams(Φ) and Yallara(Φ) are suggested.

Variety eligibility for delivery

TABLE 2 Oat varieties and their suitability for grain (Oat1, Oat2, OWAN) and export hay.

Variety	Oat1	Oat2	OWAN	Export hay
Bannister(Φ)	✓	✓		✓
*Bilby(Φ)	✓	✓		
Brusher(Φ)				✓
Carrolup	✓	✓		✓
Coomallo	✓	✓		
Durack(Φ)		✓		✓
Forester(Φ)				✓
Hotham	✓	✓		
Kojonup(Φ)	✓	✓		✓
*Koorabup(Φ)				✓
Kowari(Φ)	✓	✓		
Mitika(Φ)	✓	✓		
Mortlock	✓	✓		
Mulgara(Φ)				✓
Pallinup	✓	✓		
Tammar(Φ)				✓
Tungoo(Φ)				✓
Wandering(Φ)		✓	✓	
Williams(Φ)	✓	✓		✓
Winjardie				✓
Wintaroo(Φ)				✓
Vasse				✓
Yallara(Φ)	✓	✓		✓

*Released in 2019

YIELD COMPARISONS

Variety trials are conducted across Australia and are supported and overseen by the Grains Research and Development Corporation (GRDC) through the National Variety Trials (NVT). Grain yield comparisons are presented in Tables 3 to 7. Each year the NVT coordinates approximately 31 oat variety trials, of which 10 are located in Western Australia.

Data presented is based on trials from 2014 to 2018. While many varieties are included in the NVT (current and older varieties, new experimental varieties and some specialty varieties), only current deliverable milling oat varieties are included here. To find the latest NVT data (long-term and seasonal), visit www.nvtonline.com.au or download the NVT yield app.

Grain yield data is presented by grouping the trials into six Agzones. These Agzones have been developed to group together environmental regions that give similar crop performance in WA.

TABLE 3 Grain yield in Agzone 2 expressed as a per cent of site mean yield, 2014–18.

Year		2014	2015	2016	2017	2018
Site mean yield (t/ha)		3.35	2.97	4.11	3.15	3.67
	No. trials	(5)	(7)	(6)	(7)	(5)
DELIVERABLE AS A MILLING (OAT1 OR OAT2) VARIETY						
Bannister(Φ)	(30)	107	113	122	115	117
Bilby(Φ)	(30)	104	110	109	112	112
Carrolup	(30)	91	93	95	96	99
Durack(Φ)	(30)	96	96	87	94	94
Kojonup(Φ)	(30)	101	98	106	102	100
Kowari(Φ)	(30)	100	103	100	104	104
Mitika(Φ)	(30)	98	98	97	100	99
Wandering(Φ)	(30)	110	114	123	110	113
Williams(Φ)	(30)	108	113	114	113	114
Yallara(Φ)	(30)	96	95	93	92	94

SOURCE: BASED ON MET ANALYSIS FROM NVT ONLINE, NVTONLINE.COM.AU

TABLE 4 Grain yield in Agzone 3 expressed as a per cent of site mean yield, 2014–18.

Year		2014	2015	2016	2017	2018
Site mean yield (t/ha)		3.36	3.03	4.11	4.07	3.02
	No. trials	(3)	(3)	(4)	(4)	(4)
DELIVERABLE AS A MILLING (OAT1 OR OAT2) VARIETY						
Bannister(Φ)	(18)	112	111	113	112	115
Bilby(Φ)	(18)	97	107	102	102	105
Carrolup	(18)	96	92	101	98	100
Durack(Φ)	(18)	90	97	93	93	91
Kojonup(Φ)	(18)	117	101	102	109	108
Kowari(Φ)	(18)	90	100	98	96	98
Mitika(Φ)	(18)	89	95	96	93	96
Wandering(Φ)	(18)	106	111	117	109	112
Williams(Φ)	(18)	121	117	111	116	114
Yallara(Φ)	(18)	97	96	101	98	96

SOURCE: BASED ON MET ANALYSIS FROM NVT ONLINE, NVTONLINE.COM.AU

TABLE 5 Grain yield in Agzone 4 expressed as a per cent of site mean yield, 2015–18.

Year		2014	2015	2016	2017	2018
Site mean yield (t/ha)			2.19	3.72	3.43	2.06
	No. trials		(1)	(1)	(1)	(1)
DELIVERABLE AS A MILLING (OAT1 OR OAT2) VARIETY						
Bannister(Φ)	(4)	-	113	115	133	115
Bilby(Φ)	(4)	-	114	106	116	115
Carrolup	(4)	-	96	95	99	99
Durack(Φ)	(4)	-	95	93	77	101
Kojonup(Φ)	(4)	-	97	100	111	90
Kowari(Φ)	(4)	-	109	100	105	107
Mitika(Φ)	(4)	-	106	96	103	99
Wandering(Φ)	(4)	-	109	122	129	119
Williams(Φ)	(4)	-	103	112	109	116
Yallara(Φ)	(4)	-	90	99	86	98

SOURCE: BASED ON MET ANALYSIS FROM NVT ONLINE, NVTONLINE.COM.AU

TABLE 6 Grain yield in Agzone 5 expressed as a per cent of site mean yield, 2014–18.

Year		2014	2015	2016	2017	2018
Site mean yield (t/ha)		2.30	3.17	2.79	2.84	3.05
	No. trials	(1)	(2)	(1)	(2)	(1)
DELIVERABLE AS A MILLING (OAT1 OR OAT2) VARIETY						
Bannister(Þ)	(7)	109	113	130	133	114
Bilby(Þ)	(7)	109	108	115	122	109
Carrolup	(7)	95	93	102	99	98
Durack(Þ)	(7)	100	95	85	83	97
Kojonup(Þ)	(7)	93	99	112	111	98
Kowari(Þ)	(7)	105	102	101	107	102
Mitika(Þ)	(7)	101	98	95	101	96
Wandering(Þ)	(7)	114	116	118	117	115
Williams(Þ)	(7)	106	111	129	124	118
Yallara(Þ)	(7)	98	97	89	82	98

SOURCE: BASED ON MET ANALYSIS FROM NVT ONLINE, NVTONLINE.COM.AU

TABLE 7 Grain yield in Agzone 6 expressed as a per cent of site mean yield, 2014–18.

Year		2014	2015	2016	2017	2018
Site mean yield (t/ha)		4.13	3.73	1.82	3.56	4.82
	No. trials	(1)	(1)	(1)	(1)	(1)
DELIVERABLE AS A MILLING (OAT1 OR OAT2) VARIETY						
Bannister(Þ)	(5)	110	131	150	118	128
Bilby(Þ)	(5)	110	136	135	112	111
Carrolup	(5)	90	84	100	98	104
Durack(Þ)	(5)	94	83	79	86	85
Kojonup(Þ)	(5)	104	111	128	118	115
Kowari(Þ)	(5)	104	119	105	102	97
Mitika(Þ)	(5)	101	111	88	101	91
Wandering(Þ)	(5)	105	103	109	97	118
Williams(Þ)	(5)	108	116	168	114	132
Yallara(Þ)	(5)	90	64	71	82	92

SOURCE: BASED ON MET ANALYSIS FROM NVT ONLINE, NVTONLINE.COM.AU

DISEASE RESISTANCE RATINGS

Disease and virus resistance data are presented in Table 8.

TABLE 8 Disease characteristics of oat varieties, 2019.

Variety	Septoria	Rust		BYDV[1]	Bacterial blight	CCN[2] Resistance	CCN tolerance
		Leaf	Stem				
Bannister(Þ)	S	R	RMS	MRMS	MRS	R	MI
Bilby(Þ)	S	R	MSVS	MRMS	MS	S	No data
Brusher(Þ)	S-S	RMS	MRS	MRMS	MRS	R	MI
Carrolup	SVS	SVS	MSS	MSS	MRS	S	I
Durack(Þ)	SVS	RS	MS	MSS	MRS	R	MI-MT
Forester(Þ)	MRS	RMS	RMS	MS	MSS	MS	MI
Kojonup(Þ)	SVS	SVS	MSS	MS	MRS	VS	I
Koorabup(Þ)	MRMS	RMR	RMS	MS	MR	S	No data
Kowari(Þ)	SVS	R	MRMS	MS	MR	VS	I
Mitika(Þ)	SVS	MR	MRMS	S	MR	VS	I
Mulgara(Þ)	MRS	MR	MRMS	MSS	MR	R	MT
Wandering(Þ)	SVS	VS	MSVS	MS	MRS	VS	I
Williams(Þ)	MRMS	RMR	MR	MRMS	R	S	I
Winjardie	SVS	SVS	MRS	MSS	S	S	I
Wintaroo(Þ)	MSS	SVS	MR	MS	MR	R	MT
Yallara(Þ)	S	RMS	MRMS	MS	MRS	R	I

SOURCE: NATIONAL OAT BREEDING PROGRAM

Note: Stem rust, leaf rust, [1] Barley yellow dwarf virus (BYDV) and Septoria reactions are from WA trials. Bacterial blight and [2] cereal cyst nematode (CCN) are from SA and Victorian trials. Rust and BYDV reactions may vary in different regions and with different seasonal conditions depending on the prevalent pathotype/serotype. Crop monitoring is essential. CCN tolerance indicates the ability of the variety to grow and yield in the presence of CCN. Resistance refers to the ability of the variety to reduce CCN carryover.

VS = very susceptible S = susceptible MS = moderately susceptible MR = moderately resistant MI = moderately intolerant MT = moderately tolerant R = resistant T = tolerant I = intolerant

GRAIN QUALITY

Grain quality characteristics are important to consider when selecting an oat variety.

In Western Australia, delivery of oat grain into the segregations of Oat1 and Oat2 is limited mainly by two key grain quality specifications: hectolitre weight and screenings.

Hectolitre weight, screenings and 1000 grain weight of the 12 oat varieties suggested for WA when grown in WA are in Table 9.

TABLE 9 Grain quality data of oat varieties from trials in Western Australia, 2014–18.

Variety	Hectolitre weight (kg/hL)	1000 grain weight (g)	Screenings (%)
Bannister(Þ)	48.9	39.9	4.6
Bilby(Þ)	47.1	39	5.8
Carrolup	46.9	36.9	6
Durack(Þ)	48.3	36.2	5.3
Kojonup(Þ)	47.7	36.9	4.3
Koorabup(Þ)	49	36.6	3.5
Kowari(Þ)	49	38	4.2
Mitika(Þ)	50	38.8	3.3
Wandering(Þ)	47.5	39.4	4.8
Williams(Þ)	50.5	38.2	5.9
Yallara(Þ)	49.2	35.9	4.7
No. trials	18	16	18

SOURCE: NVT AND NATIONAL OAT BREEDING PROGRAM

HAY YIELD AND QUALITY COMPARISONS

Hay yield and quality comparisons are provided by the National Oat Breeding Program, led by Pamela Zwer at the South Australian Research and Development Institute. Trials conducted in Western Australia are delivered by the DPIRD staff based at Northam. The focus of the National Oat Breeding Program is to improve productivity and quality in new oat varieties developed for hay and grain end users. Average hay yield comparisons for varieties eligible for export hay are listed in Table 10.

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TABLE 10 Average hay yield (t/ha) of varieties from trials in Western Australia, 2014–18.

Variety	Hay yield (t/ha)
Bannister(Φ)	7
Brusher(Φ)	7.3
Carrolup	6.6
Durack(Φ)	6.2
Forester(Φ)	6.9
Koorabup(Φ)	6.7
Mulgara(Φ)	6.9
Swan	7.4
Wandering(Φ)	7
Williams(Φ)	6.7
Winjardie	7.3
Wintaroo(Φ)	7.5
Yallara(Φ)	7.1
No. sites	11

Analysis by Chris Lisle, BBAGI SOURCE: DATA COURTESY NATIONAL OAT BREEDING PROGRAM

TABLE 11 Quality standards to meet export hay requirements in Western Australia.

Parameter	Grade 1	Grade 2	Grade 3	Grade 4
Crude protein (% CP)	>4	<4	<4	<4
Water soluble carbohydrates (% WSC)	>22	>18	>14	>14
Estimated metabolisable energy (est. ME MJ/kg DM)	>9.5	<9.5	<9.5	<9.5
Acid detergent fibre (% ADF)	<30-32	>32-35	>35-37	>37-40
Neutral detergent fibre (% NDF)	<55	<55-59	<64	>64
In vitro digestibility (% DMD)	>60	>58	>56	>53
Stem thickness (mm)	<6	<8	<9	>9-12

The quality of hay is determined by the variety grown, agronomy applied to the crop, the crop growth stage at which the hay is cut and the conditions during the period between cutting and baling. Table 11 describes the suggested quality specifications growers need to achieve to meet export hay requirements.

Hay varieties differ in their quality. All of the varieties listed in Table 12 are deliverable as export hay varieties when grown in the right environment, with the right agronomy and the right seasonal conditions. Growers are encouraged to discuss with their intended hay buyer which variety they intend to sow to ensure that it meets current market demands.

TABLE 12 Average hay quality of oat varieties in Western Australia, 2014–18.

Variety	Digestibility (% dm)	[1]WSC (% dm)	[2]ADF (% dm)	[3]NDF (% dm)	Crude protein (%dm)	Stem diameter[4]
Bannister(Φ)	69.3	32.5	27.5	48.5	7.2	M
Brusher(Φ)	67.6	32.9	28.2	49.3	6.8	M
Carrolup	66.3	31.9	29.2	49.8	6.8	M
Durack(Φ)	66.2	30.2	29	50	7.1	M
Forester(Φ)	68.9	34.2	28.2	46.7	6.9	MT
Koorabup(Φ)	66.1	29.5	29.3	51.2	6.8	MF
Mulgara(Φ)	67.7	32	28.3	49.4	6.8	M
Swan	66.3	30.8	29.4	50.9	6.7	M
Wandering(Φ)	68.9	33.3	27.5	48.8	7.2	M
Williams(Φ)	66.7	30.7	29	50.1	7.5	MT
Winjardie	67	31.3	28.9	50.4	6.7	M
Wintaroo(Φ)	66.8	30.6	29.3	50.7	6.2	M
Yallara(Φ)	67.5	32	28.5	48.6	6.7	MF
No. sites	7	9	8	9	9	

Analysis by Chris Lisle, BBAGI SOURCE: DATA COURTESY NATIONAL OAT BREEDING PROGRAM

[1]WSC=water soluble carbohydrates [2]ADF=acid detergent fibre [3]NDF=neutral detergent fibre [4]Stem diameter: F = fine MF = moderately fine MT = moderately thick T = thick VT = very thick.

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Company and industry abbreviations:

- BBAGI - Bioinformatics and Biometrics for the Australian Grains Industry
- CBH – Co-operative Bulk Handling
- CBB – Centre for Bioinformatics and Biometrics
- DPIRD – Department of Primary Industries and Regional Development (formerly DAFWA)
- GIWA – Grain Industry Association of Western Australia
- GRDC – Grains Research and Development Corporation
- NVT – National Variety Trials
- SAGI – Statistics for the Australian Grains Industry

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