OATS

Introduction

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This oat guide is designed to help growers determine which milling oat or export hay variety to grow. The guide provides variety characteristics, disease ratings, and agronomic information for oat varieties that offer the best opportunity to meet market requirements (Tables 1–12; Figures 1–7).

Many oat grain varieties are available for delivery into the Co-Operative Bulk Handling (CBH) system. CBH delivery grades are Oat1, and Oat2, while OWAN is an exclusive segregation for Wandering oats. Each variety has its strengths and weaknesses across different growing regions. Most successful oat growers choose to grow more than one variety because no single oat variety is likely to provide optimum agronomic traits, disease resistance, yield, and quality in any one year. Some grain oat varieties are suitable for baling as export hay, but hay-only varieties may provide a better option for dedicated export hay growers. This guide summarises the suitability of oat varieties for grain (Oat1, Oat2, OWAN) and hay (Table 1). It also outlines the characteristics of six of the more widely sown grain oat varieties (Table 2). The variety description section summarises the strengths and weaknesses of all grain and hay varieties documented in this bulletin.

No new oat varieties (milling or hay) were released in 2021. Lines with milling potential are being evaluated in National Variety Trials (NVT), while the Australian Exporters Company (AEXCO) is evaluating hay-only lines for potential release in 2023.

The decision on whether to grow an Oat1, Oat2 or OWAN grain oat depends on five main factors:

(1) The premium paid for different Oat1, Oat2 and OWAN varieties.

(2) Relative grain yield of oat varieties.

(3) Differences in input costs due to their agronomic and disease characteristics.

(4) Likelihood of meeting oat receival specifications.

(5) Location of receival segregations for Oat1 and Oat2 varieties.

GRAIN AND HAY OAT VARIETY CHOICE IN 2022 – WHAT SHOULD I GROW?

The popularity of Bannister continues to increase, and in 2020, Bannister was sown on the same area as Carrolup, Wandering and Williams combined (Figure 1). In 2021, Bannister increased to just under 50% of the area planted to oats suitable for delivery as grain (not shown). Growers reduced the area sown to Carrolup, Wandering and Williams to accommodate the increased planting of Bannister. There was a slight increase in Bilby plantings, while the Pallinup area remained stable at half that sown to Wandering.

Bannister is recommended if targeting the Oat1 market and the oat Septoria risk is low-moderate. Bilby and Williams are recommended in higher rainfall areas with a low risk of drought stress during grain filling. If targeting the OWAN or Oat2 market, Wandering is recommended, while Durack is a good option with a June sowing.

If targeting export hay, the hay-only varieties Brusher and Forester are suitable for the far south-west. At the same time, Mulgara and Wintaroo are options for medium to high yielding regions statewide. For high disease-risk areas, the recently released hay-only variety Koorabup and the dual-purpose variety Williams are recommended. In other areas, the dual-purpose varieties Carrolup and Yallara are also suitable for export hay production.

Kingbale may have a fit for rotations where imidazolinone (IMI) residues exist.

Kingbale

- Kingbale is a single gene, IMI tolerant oat suitable for export hay.
- Kingbale has similar agronomic characteristics to the export-hay variety Wintaroo.
- Targeted for sowing into soil with IMI residues from previous crops and for Immediately Before Sowing (IBS) use with Sentry® (imazapic + imazapyr) herbicide.
- The Australian Pesticides and Veterinary Medicines Authority (APMVA) has approved the use of Sentry® for IBS use with Kingbale oats for seed and hay production. However, a grain registration is yet to be received.

Kingbale seed will be available from InterGrain's network of Seedclub members and resellers for planting in 2022, pending receipt of a grain registration. Farmer to farmer trading of Kingbale seed will not be allowed, as with IMI tolerant wheat and barley varieties.

More information is listed below and in the factsheets at the end of the oat section of this bulletin.

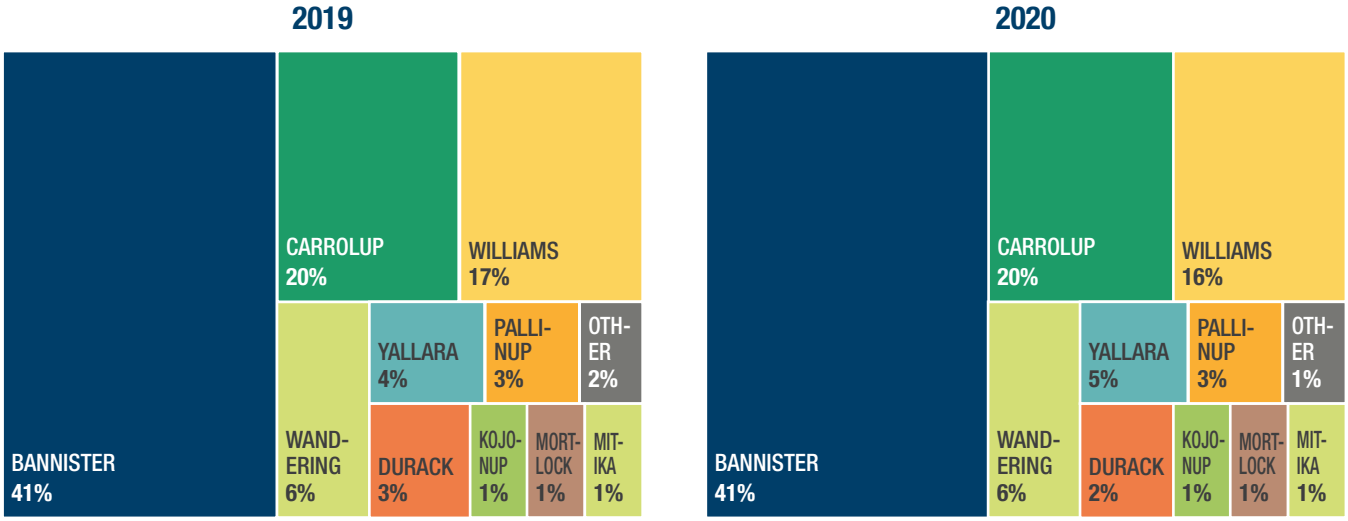

FIGURE 1. Popularity (per cent of oat area) of the top ten oat varieties plus the combined area sown to the other seven varieties delivered in WA in 2019 and 2020. The top ten varieties occupied 98% and 99% of the area planted to barley in 2019 and 2020, respectively, while the top five varieties occupied 88% and 92%, respectively.

Source: grower estimates as provided to CBH

TABLE 1. Suitability of oat varieties for grain (Oat1, Oat2, OWAN) and hay

Variety	Oat1	Oat2	OWAN	Hay
Bannister	✓	✓	-	✓
Bilby	✓	✓	-	-
Brusher	-	-	-	✓
Carrolup	✓	✓	-	✓
Durack	-	✓	-	✓
Forester	-	-	-	✓
Kangaroo	-	-	-	✓
Kingbale	-	-	-	✓
Kojonup	✓	✓	-	✓
Koorabup	-	-	-	✓
Kowari	✓	✓	-	-
Mitika	✓	✓	-	-
Mulgara	-	-	-	✓
Swan	-	-	-	✓
Tammar	-	-	-	✓
Tungoo	-	-	-	✓
Wandering	-	✓	✓	-
Williams	✓	✓	-	✓
Winjardie	-	-	-	✓
Wintaroo	-	-	-	✓
Yallara	✓	✓	-	✓

Source: GIWA and AEXCO

OTHER CONSIDERATIONS FOR OAT GROWERS

Changes in disease pathogens

No new disease pathotypes affecting oats have been detected in WA in recent years.

Early sowing reduces the risk of screenings

Early April sowing and variety selection are critical tools for meeting recently introduced Oat2 delivery standards for milling oats.

A screening limit introduced in 2019–2020 for receival of milling oat in the Oat2 grade has increased the delivery risk for milling oat growers in WA. The new limit means grain with more than 15% screenings through a 2.0mm slotted sieve is not deliverable into the bulk handling system. Research conducted by DPIRD with GRDC support (project DAW1901-002RTX) over two seasons (2019 and 2020) demonstrated that milling oat growers could reduce screenings risk by sowing earlier. Oats sown in early April had a higher hectolitre weight (up 3kg/hL) and lower screenings (down 9% through a 2.0mm sieve) while yielding 0.65t/ha more than when sown after the first week of May. Grain staining, if present, was below the reportable levels for downgrading and did not influence the risk from earlier sowing in the trials. Early sowing and choosing the best variety reduced screenings more than when and how much nitrogen (N) was applied.

TABLE 2. Summary of oat variety traits comparing six grain-oat varieties

Trait	Bannister	Carrolup	Durack	Wandering	Williams	Yallara
First year in variety trials in WA	2006	1993	2010	1997	2006	2003
State-wide MET yield (% site mean)[1]	112%	91%	89%	110%	109%	92%
Maturity relative to Carrolup (sown in late May)[2]	+3 days	-	-7 days	+1 days	+2 days	-2 days
Deliverable as	Oat1	Oat1	Oat2	Oat2	Oat1	Oat1
Suitable for export hay	Yes	Yes	Yes	No	Yes	Yes
Oat Septoria[3]	MSS	S	SVS	MSS	MS	MSS
Oat leaf rust	RMR	VS	MR	VS	MR	MR
Oat stem rust	MS	S	S	SVS	MSS	MSS
Barley and cereal yellow dwarf	MS	MSS	MSS	MS	MS	MS

Source: Blakely Paynter, Manisha Shanker and NVT Online **nvtonline.com.au**

[1]Regional differences in grain yield are masked when using a statewide average of the WA oat NVT MET data (2016–2020). Growers are directed to Tables 3 to 8 for a more precise estimate of variety performance in their region and Figures 2 and 3 to determine relative variety performance at different site yields.

[2]Days to watery ripe from a 20 May sowing at Northam based on output from DPIRD FlowerPower v7, **fp.dpird.app/**

[3]Resistance rating: VS = very susceptible, SVS = susceptible - very susceptible, S = susceptible, MSS = moderately susceptible - susceptible, MS = moderately susceptle, MRMS = moderately resistant - moderately susceptible, MR = moderately resistant, RMR = resistant - moderately resistant, R = resistant, - = no data available

Tips for nitrogen fertiliser

Nitrogen (N) strategies differ for grain and hay oats, but high rates of applied N can be detrimental to both grain and hay quality.

If growing oats to deliver milling oat grain, the recommended N strategy is to apply one-third of the N fertiliser needed at seeding and two-thirds at ten weeks after seeding. While there is some flexibility around the recommended strategy regarding when the N can be applied, applying all the N upfront is a strategy that carries the most risk.

As more N is applied to grain crops, the risk of high screenings and low hectolitre weight increases. The grain of Carrolup and Williams is more sensitive to increasing N than Bannister. The dangers of higher N rates can be offset by sowing in April and planting varieties with high grain plumpness and high hectolitre weight.

If growing oats for hay delivery, the recommended N strategy is to apply two-thirds at seeding and one-third at ten weeks after seeding. As with grain oats, late N can be applied as early as six weeks after sowing. To maximise quality, late N should be applied before stem elongation.

For hay crops, high rates of N can reduce hay quality through increased fibre production (both acid detergent fibre, ADF and neutral detergent fibre, NDF) and lower concentration of water-soluble carbohydrates (WSC). Excessive N application can also occasionally result in hay with nitrate-nitrogen levels greater than 500 ppm, which is unacceptable to many hay markets (AEXCO, aexco.com.au/producing-quality-oat-hay-chapters/)

Target plant density

The target plant density for oats depends on end-use (grain and hay) and rainfall zone.

When considering the rate of seed to be planted, it is essential to think about target plant density (plants per square metre) rather than set machinery seeding rates (kg/ha). While plant density is a fixed target, a fixed seeding rate in kg/ha will show variable plant density across seasons due to seed size (which varies with variety and seed source), seed viability and establishment conditions.

A target density of 160 plants/m^2 is appropriate for grain oats in lower rainfall areas, while 240 plants/m^2 is recommended in higher rainfall areas.

For hay oats, a target density of 240 plants/m^2 is appropriate in lower rainfall areas, while 320 plants/m^2 is recommended in higher rainfall areas.

The target density in plants/m^2 determines the seeding rate in kg/ha and is calculated using the following formula:

$$\text{Seed rate (kg/ha)} = \frac{\text{1000 kernel weight (g) x target density (plants/m}^2\text{)}}{\text{germination \% x establishment \} x 100}}$$

For example, if sowing Bannister oats with a kernel weight of 35g per 1000 kernels at a target density of 240 plants/m^2 with a germination of 96% and an expected establishment of 80%, then the seed rate in kg/ha required to establish 240 plants/m^2 is:

$$\text{seed rate in kg/ha} = 109 \text{ kg/ha} = \frac{35 \times 240}{0.96 \times 0.80 \times 100}$$

Harvest timing for grain oats

Harvest timing is critical to maximising oat yield.

To reduce shedding, it is crucial to harvest oats as soon as the crop is ripe. Harvest non-dwarf and other varieties likely to shed or lodge earlier than varieties less likely to shed or lodge. Grain can be directly harvested at a moisture content above 12% and then placed under aeration or through a grain dryer to reduce harvesting delays. If the crop ripens and dries evenly (to less than 12% moisture), direct harvesting is the most economical way to harvest oats for grain. If the oat crop is uneven in maturity or the climate does not allow for rapid grain drying, swathing should be considered as it is illegal to desiccate oat crops in Australia for delivery.

DPIRD research in 2019 examined the effect of delayed harvesting on 12 milling oat varieties. Delaying harvest by three weeks reduced grain yield by 10% and, at six weeks, by 25%. All 12 varieties responded similarly to the harvest delay in that study for both grain yield and grain quality.

Management of grain staining in grain oats

Fungicide strategies can reduce but not eliminate the risk of grain staining in oats. Variety selection is the key in high-risk environments.

Bannister is the most widely sown oat variety in WA for grain due to its yield advantage over Carrolup and its higher grain quality than Williams. However, Bannister is susceptible to Septoria. There is a greater risk of grain staining and subsequent receival downgrading for Bannister in higher rainfall areas than Carrolup and Williams.

In situations of high disease pressure such as growing a susceptible variety, oat-on-oat rotations, and regions of high rainfall, DPIRD research suggests that if oat Septoria becomes evident at stem elongation (>5% of leaf area affected), a two-spray regime at stem elongation and again at flag emergence will achieve the greatest control and reduce the risk of grain staining at harvest. Where disease pressure is lower, or when the disease enters the canopy later in the season, a single application at flag leaf emergence is the best strategy. Rainfall between grain-fill and harvest can also result in grain staining in Bannister but applying late fungicides is unreliable.

Using fungicides to protect hay quality in the swath

When applied using label recommendations, foliar fungicide application for in-crop disease control may provide some off-target benefit in reducing post-cutting colonisation and staining by saprophytic fungi.

Rainfall during the windrow curing process encourages the growth of saprophytic fungi, which feed on dead or decaying leaf tissue, causing hay discolouration. This, in turn, reduces hay visual quality. DPIRD, with the support of AgriFutures (project number PRJ-011029), has been examining the value of late-season fungicides on swath quality. The research suggests that foliar fungicides should be applied as needed for in-crop disease control and that effective disease control will influence hay quality through retained green leaf area. Fungicide (strobilurin and demethylation inhibitor, DMI) application can reduce saprophytic fungal colonisation of bleached (senescent) leaf material in the windrow but will not affect green leaf retention or hay nutritive quality parameters post-weathering. However, strobilurin chemistries have shown a higher and more consistent reduction in saprophytic growth than DMIs.

Please note: it is vital to avoid unnecessary fungicide applications and follow the label recommendations for rates and withholding periods to avoid chemical residues in the hay, which could jeopardise export hay markets.

Grain – yield and quality

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GRAIN YIELD

The National Variety Trials (NVT) are managed by the Grains Research and Development Corporation (GRDC) to provide a nationally independent means of assessing varietal performance and enable growers to select the best variety for their environment. The results of NVT trials are available as individual site reports or as multi-environment (MET) long-term summaries. The MET analysis generates a table of performance values for each variety compared to the mean of the NVT site. Growers and consultants can select the specific state, region, location or group of locations of their choice to choose the best variety for their environment. Both the single-site and multi-year MET analyses are available at **nvtonline.com.au**.

Tables 3 to 8 present data extracted from the Long Term MET Yield Reporter available at **nvtonline.com.au**. MET data (accuracy ≥0.8 and VAF ≥25%) are presented for each year (2016–2020) for each of the Agzones in WA except Agzone 1 and then combined across Agzones to provide a statewide MET. If there are four or more observations, a five-year weighted average has been calculated from the MET data. Caution should be exercised when examining the weighted average as it masks varietal performance over seasons within an Agzone.

Agzones were developed by DPIRD through statistical analysis to group environmental regions with similar crop performance in WA.

Table 9 uses single-site MET data to highlight the probability of one variety yielding less, the same or more than another variety when grown in the same trial with the same agronomy. Grain yields are compared using the least significant difference (p=0.05) calculated from the single-site MET analysis standard error. Only oat NVT trials where both varieties have been sown and harvested are included.

It is important to note that the single-site MET analyses only represent varietal performance under one specific set of seasonal and site conditions. Growers should not use the single-site MET analysis as their sole data source when comparing the performance of a new variety. MET analyses based on the average varietal performance of Agzones can mask variety by environment (GxE) interactions across the locations (and seasons) within the Agzone. For this reason, the relative performance of varieties in each year for the period 2016 to 2020 helps explain the variability in relative varietal performance across seasons. While Agzones is a simple way to group trials across environments, they may not accurately reflect a specific location in every season.

Differences in comparative grain yield performance between varieties can depend on the yield potential of the site. To help assess relative varietal performance at different site yields, NVT Online (through the Long Term MET Yield Reporter) presents data at half tonne yield intervals (called 'yield groups) based on trials that match the yield range. This guide presents an alternative method of viewing yield performance at different site yields using data extracted from the 'Statewide tables of yield and grain quality' available at **nvtonline.com.au**. Figures 2 and 3 used linear regression to compare varieties at different yield potentials and present varietal trends as the site-mean yield increases (the average yield of the varieties compared).

The graphs were developed by calculating differences between the grain yield of a variety relative to the site mean yield (the 'deviation'), with the deviation assessed for quadratic or linear trends. A quadratic polynomial was fitted to the data if the quadratic trend was significant ($p<0.05$). If the linear trend (but not the quadratic trend) was significant ($p<0.05$), a linear polynomial was fitted to the data. If neither the quadratic nor the linear trend was significant, the grain yield response of a variety was deemed to run parallel to the site-mean yield at the average deviation for that variety. It is worth noting that relative performance may differ depending on the years and locations analysed. This highlights the importance of examining more than one dataset and comparing the performance of new varieties over at least three seasons.

TABLE 3. Grain yield of oat varieties in AGZONE 2 expressed as a percentage of the site mean yield for each trial year (2016–2020), and the weighted average over the five-year period (where there are four or more observations)

Year		2016	2017	2018	2019	2020	2016–2020
Site mean yield (t/ha)		4.11	3.15	3.46	2.67	2.69	3.23
Variety	(No. trials)	(6)	(7)	(6)	(7)	(4)	(30)
Deliverable as Oat1							
Bannister	(30)	118	112	111	107	104	**111**
Bilby	(30)	105	106	104	106	107	**106**
Carrolup	(30)	91	91	92	88	86	**90**
Kojonup	(30)	105	102	97	90	88	**97**
Kowari	(30)	97	101	98	100	104	**100**
Mitika	(30)	94	98	94	95	100	**96**
Williams	(30)	111	109	110	106	96	**107**
Yallara	(30)	92	89	93	93	92	**92**
Deliverable as Oat2							
Durack	(30)	82	90	90	93	96	**90**
Wandering	(30)	118	105	107	107	110	**109**

Source: based on MET analysis from NVT Online, **nvtonline.com.au**

TABLE 4. Grain yield of oat varieties in AGZONE 3 expressed as a percentage of the site mean yield for each trial year (2016–2020), and the weighted average over the five-year period (where there are four or more observations)

Year		2016	2017	2018	2019	2020	2016–2020
Site mean yield (t/ha)		4.11	4.07	3.02	3.19	2.95	3.53
Variety	(No. trials)	(4)	(4)	(4)	(4)	(2)	(18)
Deliverable as Oat1							
Bannister	(18)	111	113	112	111	109	**111**
Bilby	(18)	101	101	102	101	106	**102**
Carrolup	(18)	95	99	96	99	88	**96**
Kojonup	(18)	97	107	102	108	94	**102**
Kowari	(18)	94	95	96	97	101	**96**
Mitika	(18)	91	93	93	96	96	**94**
Williams	(18)	108	115	113	109	105	**111**
Yallara	(18)	100	97	96	97	92	**97**
Deliverable as Oat2							
Durack	(18)	88	89	89	90	91	**89**
Wandering	(18)	115	106	107	107	109	**109**

Source: based on MET analysis from NVT Online, **nvtonline.com.au**

TABLE 5. Grain yield of oat varieties in AGZONE 4 expressed as a percentage of the site mean yield for each trial year (2016–2020), and the weighted average over the five-year period (where there are four or more observations)

Year		2016	2017	2018	2019	2020	2016–2020
Site mean yield (t/ha)		3.72	3.43	2.06	1.11	1.12	2.29
Variety	(No. trials)	(1)	(1)	(1)	(1)	(1)	(5)
Deliverable as Oat1							
Bannister	(5)	112	123	106	101	88	**106**
Bilby	(5)	104	109	106	101	124	**109**
Carrolup	(5)	90	86	86	90	56	**82**
Kojonup	(5)	96	110	82	73	55	**83**
Kowari	(5)	97	100	99	93	127	**103**
Mitika	(5)	93	97	92	86	117	**97**
Williams	(5)	107	107	107	107	66	**99**
Yallara	(5)	95	86	94	105	73	**91**
Deliverable as Oat2							
Durack	(5)	87	78	93	95	111	**93**
Wandering	(5)	116	125	108	109	106	**113**

Source: based on MET analysis from NVT Online, **nvtonline.com.au**

TABLE 6. Grain yield of oat varieties in AGZONE 5 expressed as a percentage of the site mean yield for each trial year (2016–2020), and the weighted average over the five-year period (where there are four or more observations)

Year		2016	2017	2018	2019	2020	2016–2020
Site mean yield (t/ha)		2.79	2.84	3.05	1.77	2.14	2.42
Variety	(No. trials)	(1)	(2)	(1)	(2)	(2)	(8)
Deliverable as Oat1							
Bannister	(8)	123	124	110	97	112	**112**
Bilby	(8)	106	109	104	104	106	**106**
Carrolup	(8)	90	87	91	88	88	**88**
Kojonup	(8)	105	108	92	78	95	**95**
Kowari	(8)	94	99	97	101	99	**99**
Mitika	(8)	89	94	92	95	94	**93**
Williams	(8)	123	117	111	100	106	**110**
Yallara	(8)	88	84	95	97	93	**91**
Deliverable as Oat2							
Durack	(8)	79	79	90	101	87	**88**
Wandering	(8)	113	115	108	101	116	**111**

Source: based on MET analysis from NVT Online, **nvtonline.com.au**

TABLE 7. Grain yield of oat varieties in AGZONE 6 expressed as a percentage of the site mean yield for each trial year (2016–2020), and the weighted average over the five-year period (where there are four or more observations)

Year		2016	2017	2018	2019	2020	2016–2020
Site mean yield (t/ha)		1.82	3.56	4.82	4.45	3.50	3.63
Variety	(No. trials)	(1)	(1)	(1)	(1)	(1)	(5)
Deliverable as Oat1							
Bannister	(5)	147	118	123	116	131	**127**
Bilby	(5)	112	106	102	106	113	**108**
Carrolup	(5)	91	95	97	92	86	**92**
Kojonup	(5)	135	115	112	108	123	**119**
Kowari	(5)	96	100	91	100	104	**98**
Mitika	(5)	88	98	88	97	99	**94**
Williams	(5)	156	118	123	111	125	**127**
Yallara	(5)	65	85	94	88	71	**81**
Deliverable as Oat2							
Durack	(5)	68	87	79	87	78	**80**
Wandering	(5)	96	101	114	109	106	**105**

Source: based on MET analysis from NVT Online, **nvtonline.com.au**

TABLE 8. Grain yield of oat varieties averaged across AGZONES 2–6 expressed as a percentage of the site mean yield for each trial year (2016–2020), and the weighted average over the five-year period (where there are four or more observations)

Year		2016	2017	2018	2019	2020	2016–2020
Site mean yield (t/ha)		3.80	3.40	3.29	2.70	2.56	3.17
Variety	(No. trials)	(13)	(15)	(13)	(15)	(10)	(66)
Deliverable as Oat1							
Bannister	(66)	117	115	112	108	109	**112**
Bilby	(66)	104	105	104	104	108	**105**
Carrolup	(66)	92	93	93	92	85	**91**
Kojonup	(66)	103	105	99	96	94	**100**
Kowari	(66)	96	99	97	99	103	**99**
Mitika	(66)	92	96	93	96	99	**95**
Williams	(66)	112	112	112	107	102	**109**
Yallara	(66)	94	90	94	94	88	**92**
Deliverable as Oat2							
Durack	(66)	84	88	89	92	91	**89**
Wandering	(66)	116	108	108	107	110	**110**

Source: based on MET analysis from NVT Online, **nvtonline.com.au**

TABLE 9. Direct comparisons between two varieties (yield difference compared using least significant difference, p=0.05, calculated using standard errors from single-site MET) – how many times (as a per cent) was variety A (comparator variety) lower-yielding, the same yield or higher-yielding than variety B (base variety) when sown together in WA oat NVT?

Variety A	Percentage of trials			Number of trials	Comparison years	Comparison
	Variety A is lower yielding than Variety B	Variety A and B yield the same	Variety A is higher yielding than Variety B			
Variety B: Bannister						
Bilby	74%	15%	11%	66	2016–2020	Bilby < Bannister
Carrolup	92%	5%	3%	66	2016–2020	Carrolup < Bannister
Durack	89%	3%	8%	66	2016–2020	Durack < Bannister
Kojonup	85%	14%	2%	66	2016–2020	Kojonup < Bannister
Kowari	86%	5%	9%	66	2016–2020	Kowari < Bannister
Mitika	89%	3%	8%	66	2016–2020	Mitika < Bannister
Wandering	39%	36%	24%	66	2016–2020	Wandering ≤ Bannister
Williams	44%	44%	12%	66	2016–2020	Williams ≤ Bannister
Yallara	85%	9%	6%	66	2016–2020	Yallara < Bannister
Variety B: Carrolup						
Bannister	3%	5%	92%	66	2016–2020	Bannister > Carrolup
Bilby	9%	9%	82%	66	2016–2020	Bilby > Carrolup
Durack	47%	29%	24%	66	2016–2020	Durack ≤ Carrolup
Kojonup	17%	18%	65%	66	2016–2020	Kojonup ≥ Carrolup
Kowari	17%	14%	70%	66	2016–2020	Kowari > Carrolup
Mitika	18%	33%	48%	66	2016–2020	Mitika ≥ Carrolup
Wandering	3%	14%	83%	66	2016–2020	Wandering > Carrolup
Williams	3%	6%	91%	66	2016–2020	Williams > Carrolup
Yallara	15%	42%	42%	66	2016–2020	Yallara ≥ Carrolup

Source: based on single-site MET data from NVT Online, **nvtonline.com.au**

The highest yielding oat varieties in WA are Bannister, Wandering, and Williams (Tables 3 to 8), although Wandering cannot be delivered into the Oat1 grade. Bannister and Williams have an advantage over Wandering above 3.5t/ha, while Wandering has an advantage below 1.5t/ha (Figure 2). Since 2016, Bannister has performed better than Williams in above 3t/ha environments and, but the same below 3t/ha (Figure 3), outyielding Williams in four out of every ten WA oat NVT (Table 9). Over the long-term (2012–2020), however, Bannister has performed similarly to Williams over a range of yield potentials (Figure 2).

Carrolup, Durack and Yallara are inferior to Bannister, Wandering, and Williams at most levels of yield potential. However, Durack becomes competitive with Bannister and Williams in environments with a yield potential below 1.5t/ha, particularly with a June sowing. Bilby is as good or better than Bannister below 2t/ha but inferior above 3t/ha (Figure 3). Kowari is mid-pack for yield potential between Carrolup and Bannister. Kowari was higher yielding than Carrolup in 70% of WA oat NVT since 2016 and lower yielding than Bannister in 85% of trials (Table 9).

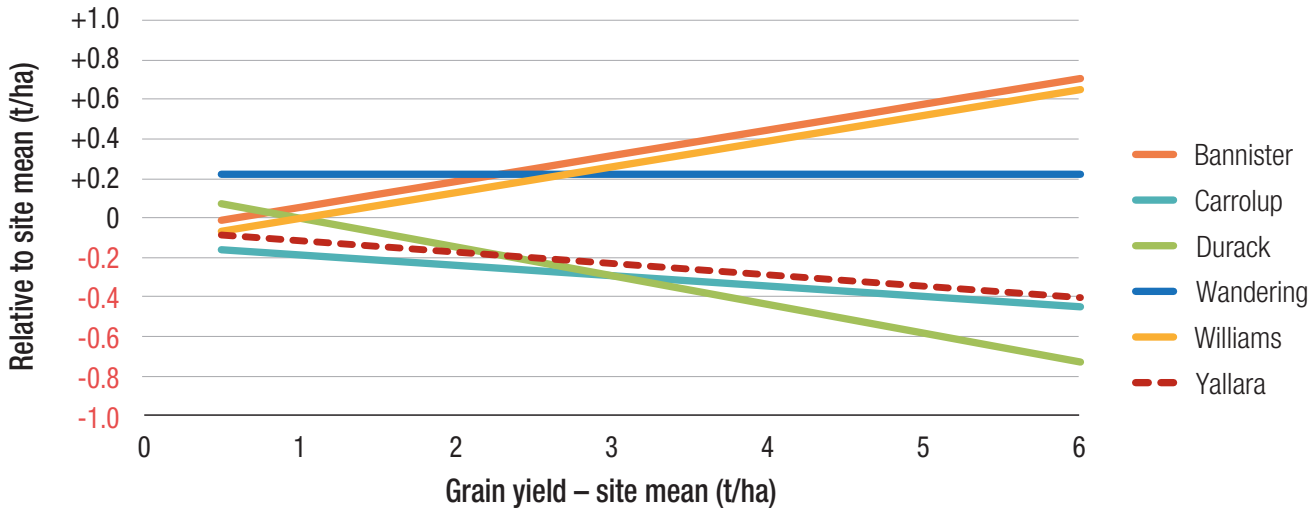

FIGURE 2. Fitted grain yield of Bannister, Carrolup, Durack, Wandering, Williams and Yallara at different site means.

Source: based on NVT statewide tables of yields and grain quality (2012–2020). Each variety sown in all 100 trial-years of data, NVT Online, **nvtonline.com.au**.

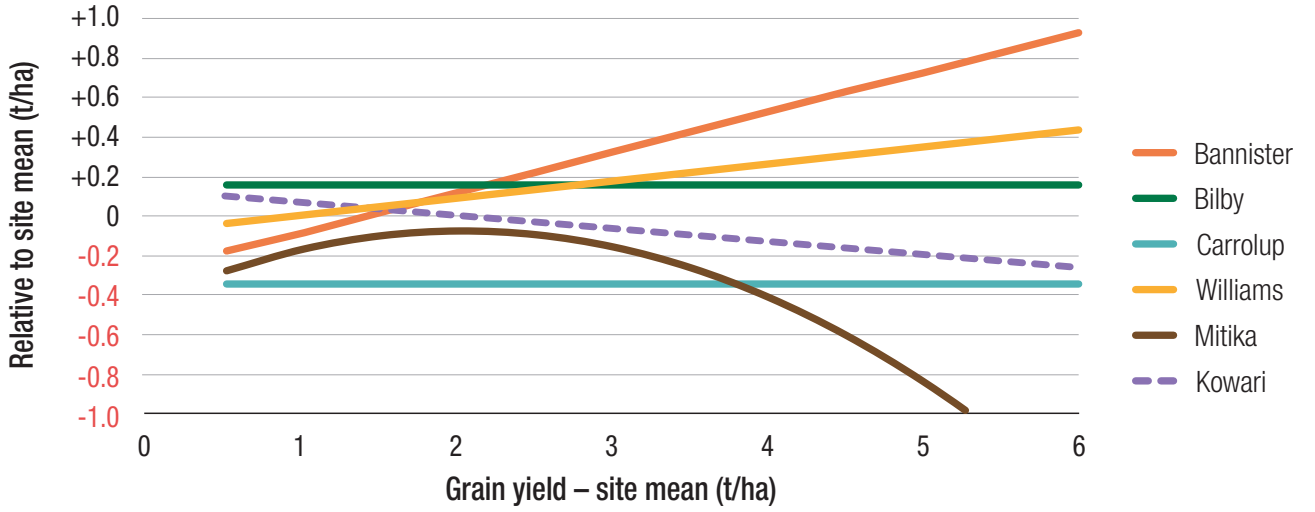

FIGURE 3. Fitted grain yield of Bannister, Bilby, Carrolup, Kowari, Mitika, and Williams at different site means.

Source: based on NVT statewide tables of yields and grain quality (2016–2020). Each variety sown in all 54 trial-years of data, NVT Online, **nvtonline.com.au**.

GRAIN QUALITY

Grain quality is an essential trait of milling oat varieties – including the hectolitre weight and percentage of screenings compared to known benchmark varieties. The physical grain quality (hectolitre weight and screenings through a 2.0mm slotted sieve) of popular milling oat varieties has been plotted relative to the site mean as the site mean increases in Figures 4 to 7. The deviation from the site mean was then assessed for quadratic and linear trends. If neither the quadratic nor the linear trend was significant, the grain quality response of a variety was deemed to run parallel to the site mean quality at the average deviation for that variety. The data used for this analysis has been extracted from the NVT statewide yield and grain quality tables available at nvtonline.com.au.

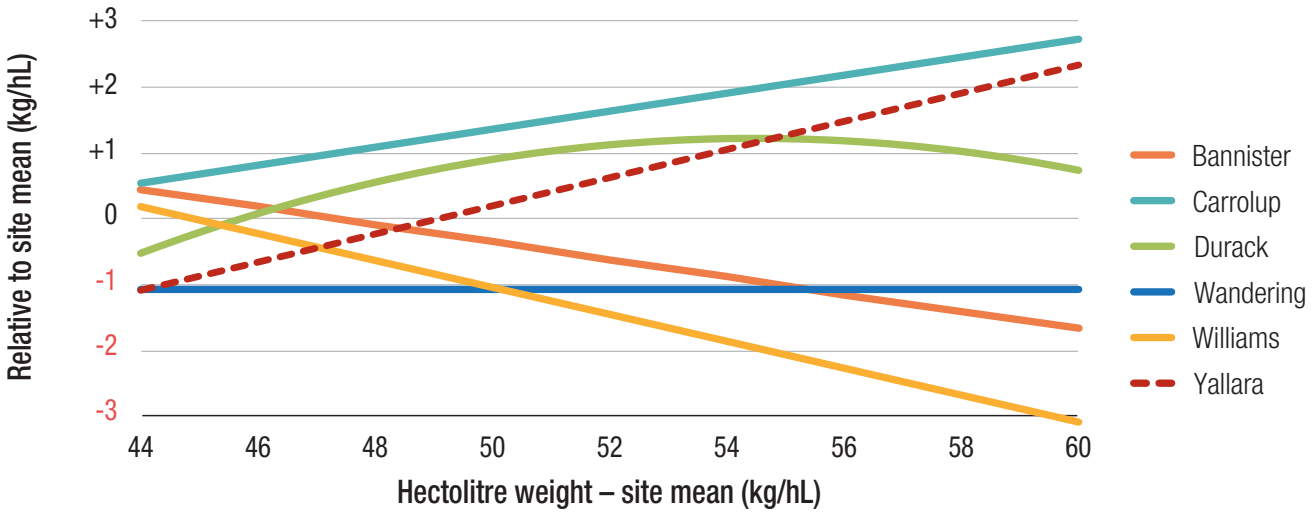

FIGURE 4. Fitted hectolitre weight of Bannister, Carrolup, Durack, Wandering, Williams and Yallara at different site means.

Source: based on NVT statewide tables of yields and grain quality (2012–2020). Each variety sown in all 73 trial-years of data, NVT Online, nvtonline.com.au.

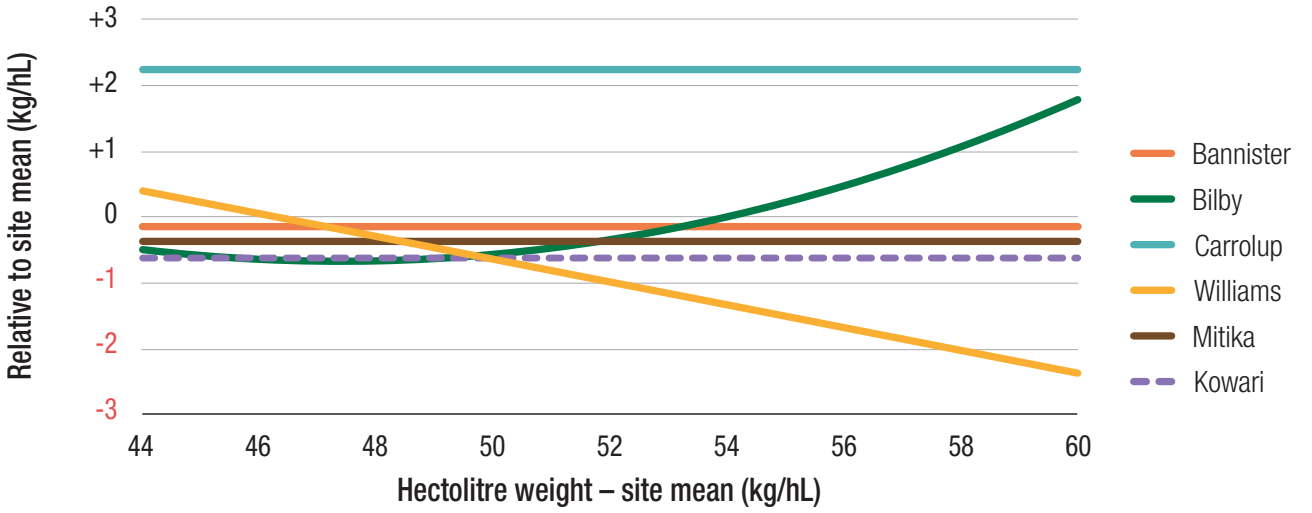

FIGURE 5. Fitted hectolitre weight of Bannister, Bilby, Carrolup, Kowari, Mitika, and Williams at different site means.

Source: based on NVT statewide tables of yields and grain quality (2016–2020). Each variety sown in all 51 trial-years of data, NVT Online, nvtonline.com.au.

None of the current milling oat varieties combine a high hectolitre weight with high grain plumpness (low screenings). The closest is Yallara, but this variety is not competitive with Bannister for grain yield (Figure 2). In WA oat NVT, the yield of Yallara was below Bannister in 85% of WA oat NVT (Table 9). Across 66 statewide NVT trials (2016–2020), Yallara averaged 82% of the yield of Bannister (Table 8).

Carrolup is the benchmark variety for hectolitre weight among milling oat varieties, followed by Durack and Yallara (Figure 4). Hectolitre weight is a receival weakness of Bannister, Wandering and Williams, although Bannister is a slight improvement over Williams (Figures 4 and 5). Bilby and Kowari, like Bannister, have inferior hectolitre weight relative to Carrolup (Figure 5).

The benchmark varieties for grain plumpness are Kowari, Mitika, and possibly Yallara (Figures 6 and 7). Genetic differences are noted at the Oat1 screenings limit of 10% through a 2.0mm slotted sieve, with greater genetic differences observed at the Oat2 screenings limit of 15%. Grain plumpness is a weakness of Carrolup and Williams, with these two varieties having the lowest grain plumpness (highest screenings) and the greatest risk of not meeting receival standards. Bannister is an improvement over Williams but is not as plump as Kowari, Mitika or Yallara. Bilby, Durack and Wandering have a slight plumpness advantage over Bannister.

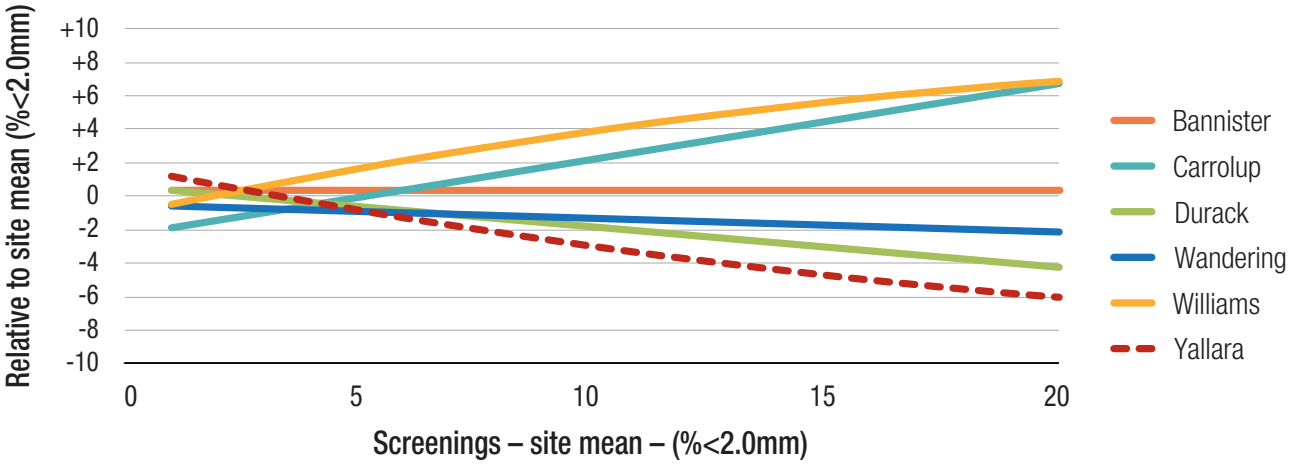

FIGURE 6. Fitted grain plumpness of Bannister, Carrolup, Durack, Wandering, Williams and Yallara at different site means.

Source: based on NVT statewide tables of yields and grain quality (2012–2020). Each variety sown in all 70 trial-years of data, NVT Online, **nvtonline.com.au**.

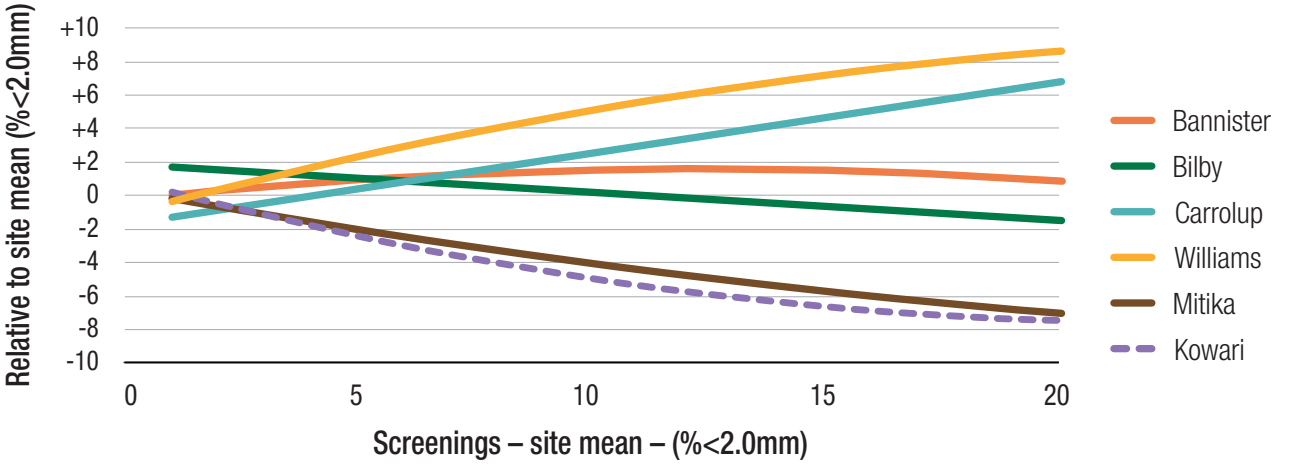

FIGURE 7. Fitted grain plumpness of Bannister, Bilby, Carrolup, Kowari, Mitika, and Williams at different site means.

Source: based on NVT statewide tables of yields and grain quality (2016–2020). Each variety sown in all 48 trial-years of data, NVT Online, **nvtonline.com.au**.

Hay – yield and quality

Blakely Paynter, Georgie Troup, and Helene Metzinger (DPIRD)

Until the end of 2020, the National Oat Breeding Program (NOBP) was responsible for developing and evaluating oat varieties for export hay. In 2021, the breeding program at the NOBP transitioned to the commercial cereal breeding company InterGrain. InterGrain will now be responsible for the national development of milling oat grain and export oaten hay varieties.

The NOBP coordinated about eight oaten hay variety trials each year, with two located in WA. Table 10 presents hay yield and quality comparisons for various varieties, some of which are also deliverable as milling oats and others that are only suitable as hay varieties. The quality measures predicted by near-infrared analysis (NIR) include digestibility, water-soluble carbohydrates (WSC), acid detergent fibre (ADF), neutral detergent fibre (NDF), and neutral detergent fibre measured after thirty hours of incubation in rumen fluid (NDFDom30). InterGrain generated data will be included in the 2023 edition of the DPIRD crop sowing guide. The analysis in Table 10 does not include data from the 2020 season as it was not available when writing this bulletin.

TABLE 10. Average hay yield and hay quality (predicted by near-infrared analysis, NIR) in National Oat Breeding Program trials in WA from 2014 to 2019, except NDFDom30, which was done from 2017 to 2019

Variety	Hay yield (t/ha)	Digestibility (% dm)	WSC[1] (% dm)	ADF (% dm)	NDF (% dm)	NDFDom30 (% dm)
(No. trials)	(13)	(9)	(11)	(10)	(11)	(5)
Deliverable as Oat1						
Bannister	6.6	69.6	32.6	27.1	47.6	59.2
Bilby	-	-	-	-	-	-
Carrolup	6.3	66.9	31.7	28.8	49.0	55.4
Kojonup	-	-	-	-	-	-
Kowari	-	-	-	-	-	-
Mitika	-	-	-	-	-	-
Williams	6.3	67.3	30.7	28.5	49.6	56.1
Yallara	6.8	67.9	32.0	28.2	48.4	54.6
Deliverable as Oat2						
Durack	6.2	66.7	30.2	28.6	49.4	53.0
Wandering	6.8	69.0	32.9	27.3	48.0	58.4
Hay-only variety						
Brusher	7.2	68.4	32.8	28.0	48.2	57.0
Forester	6.4	70.3	34.2	28.1	46.3	-
Kingbale	-	-	-	-	-	-
Koorabup	6.5	67.1	29.1	29.0	50.8	56.0
Mulgara	6.7	68.1	31.7	28.1	48.7	58.5
Swan	7.2	66.5	30.7	29.1	50.4	52.7
Tammar	6.2	68.0	30.6	28.8	49.7	-
Tungoo	6.7	68.2	31.9	28.4	48.7	-
Winjardie	7.0	66.9	31.3	28.7	49.8	55.7
Wintaroo	7.1	67.4	30.6	29.0	50.0	56.6

Source: National Oat Breeding Program

[1]WSC= water soluble carbohydrates, ADF = acid detergent fibre, NDF = neutral detergent fibre, NDFDom30 = neutral detergent fibre after 30 hour in vitro incubation in rumen fluid, and - = no data available.

TABLE 11. Quality standards to meet export hay requirements

Parameter	Grade 1	Grade 2	Grade 3	Grade 4
Crude protein (% dm)	4-10	<4	<4	<4
Est. metabolisable energy (MJ/kg DM)	>9.5	<9.5	<9.5	<9.5
In-vitro digestibility (% dm)	>60	>58	>56	>53
Water soluble carbohydrates (% dm)	>22	>18	>14	>14
Acid detergent fibre (% dm)	<30-32	>32-35	>35-37	>37-40
Neutral detergent fibre (% dm)	≤55	≤55-59	≤57-60	≤60-64
Stem thickness (mm)	<6	<8	<9	>9

Source: DPIRD

In NOBP trials, Brusher and Swan achieved the highest hay yield, about 0.4 to 1.0t/h more than the dual-purpose milling varieties Bannister, Carrolup, Durack, Wandering, Williams, and Yallara. Forester hay oat delivered the best overall hay quality, with high digestibility, high WSC, and low fibre (ADF and NDF). No data has been presented for Kingbale, but based on its breeding pedigree, it is likely to test similarly to Wintaroo. Wintaroo, presumably Kingbale too, requires close monitoring around cutting time as it tends to stay greener longer. It is crucial to monitor the stems as they tend to turn white while the top remains green. Before growing oats for export hay, it is essential to arrange a contract with an exporter.

Bannister hay was the best of the dual-purpose varieties, with improved digestibility, higher WSC and lower fibre than Carrolup, Durack, Wandering, Williams, and Yallara. The susceptibility of Bannister to oat Septoria affects the visual grading of its hay more than other dual-purpose varieties. Carrolup and Williams are the preferred varieties for export hay of the dual-purpose varieties.

Cutting at or just before watery ripe (Z71) will achieve optimum yield and quality. However, there is a window of five to seven days after Z71 before hay quality starts to fall. The window provides growers' room so they or their contractor can cut on time. Rainfall events of 10mm or more post-cutting can drastically reduce quality.

Good colour and aroma, sweet taste and fine texture are essential to export hay buyers. Hay processing companies in WA also grade based on nutritional value. The number of grades and even grading systems differs between hay processors. Some companies have five grades, others have four, and some grade hay based on a 100-point system. Unlike grain, there is no common standard on which hay is received. Hay should have a maximum bale moisture of 14% at delivery to ensure that it doesn't degrade or spoil during storage. Some export standards are as low as 12% moisture. High moisture hay (>18%) is at risk of self-combustion during storage and spoilage from mould.

The typical quality standards targeted to meet different export hay requirements in WA are outlined in Table 11. Premium grade one hay will generally have more than 4% crude protein, be more than 60% digestible with WSC above 22%, ADF less than 32%, NDF below 55%, and a stem thickness below 6mm. Export hay requires the nil presence of toxic plants and double gees. Most processors have a limit of 1% by weight of broadleaf plants and 5% of other cereals/ryegrass/wild oats. There is zero-tolerance of foreign material, such as dirt, stones, sticks, insects, wool, wire and carcases in export hay.

Livestock deaths caused by annual ryegrass toxicity poisoning from Australian hay or straw exports in an importing country could devastate the Australian hay and straw export industry. All export hay is subjected to compulsory sampling and testing designed to ensure minimum risk of contamination by the bacterium (*Rathayibacter toxicus*) that causes annual ryegrass toxicity. If contamination by this bacterium is a potential problem, it is important to implement an annual ryegrass toxicity management program by introducing twist fungus (*Dilophospora alopecuri*) or Safeguard ryegrass.

A maximum of 10% disease-affected leaves is allowed by most processors. Check withholding periods on labels of all fungicides before use. Do not apply fungicide if the likely cutting date is within the withholding period. For best control, plant disease-resistant varieties. Export markets expect a clean and green product from Australia and are checking for breaches of maximum residue limits (MRLs) for a range of herbicide, insecticide and fungicide products. Growers should follow label registrations for any product applied.

Disease and pest resistance

Manisha Shankar, Kylie Chambers, Geoff Thomas, Blakely Paynter, Carla Wilkinson, and Daniel Huberli (DPIRD)

Foliar disease abbreviations:

- OLR = oat leaf rust.
- OSR = oat stem rust.
- RLL = red leather leaf.

Disease resistance abbreviations:

- VS = very susceptible.
- SVS = susceptible to very susceptible.
- S = susceptible.
- MSS = moderately susceptible to susceptible.
- MS = moderately susceptible.
- MRMS = moderately resistant to moderately susceptible.
- MR = moderately resistant.
- RMR = resistant to moderately resistant.
- R = resistant.
- *p* = provisional rating.

ADULT RESISTANCE

Disease and virus resistance data is presented in Table 12 and again in the variety snapshots. Leaf disease ratings in this guide are for adult-stage resistance ratings, and adult plant ratings are applicable after flag leaf emergence. Still, adult ratings may be relevant as early as late tillering to stem elongation in some varieties and for some diseases. DPIRD is now screening oat varieties under contract for NVT. The foliar resistance data for milling oat varieties in Table 12 is from disease screening trials in WA. For the hay-only varieties, Koorabup was the only hay variety screened by DPIRD in 2020. Limited data is available for the other hay-only varieties. In 2021, DPIRD began screening a selected number of hay-only varieties for NVT, including Brusher, Kingbale, Mulgara, Tungoo and Wintaroo. Updated resistance data applicable to WA for those varieties will appear in the 2023 edition of the DPIRD crop sowing guide.

Variety disease ratings vary over time due to seasonal changes in disease pressure, regional disease spread, climatic conditions, stubble retention and the development of new pathotypes/races. As a result, minor changes in resistance scores of varieties can occur between sowing guides. However, in this 2022 guide, there have been no significant changes in resistance scores due to a new pathotype.

PATHOTYPE SURVEILLANCE AND FUNGICIDE RESISTANCE

Oat varieties rated as MRMS, MR or R carrying significantly higher levels of disease than expected should be sent for pathotype identification and fungicide resistance testing. Collect leaf samples before spraying the crop with a fungicide to ensure sample viability.

Place infected Septoria, oat leaf rust (OLR) and oat stem rust (OSR) in paper envelopes marked with the location, variety, disease and date collected. Fold the leaf in half so the infected area is on the inside. Please do not wrap leaf material in plastic or send in plastic-lined envelopes.

Send Septoria infected leaf material in paper envelopes to DPIRD, Locked Bag 4, Bentley Delivery Centre WA 6983 and marked attention, Manisha Shankar. For more information, contact Manisha Shanker via email at manisha.shankar@dpird.wa.gov.au or phone +61 (0)8 9368 3533.

Send OLR and OSR samples in paper envelopes directly to the University of Sydney, Australian Rust Survey, Reply Paid 88076 Narellan NSW 2567. For more information, contact Dr Will Cuddy via email at will.cuddy@dpi.nsw.gov.au or phone +61 (0)2 9351 8871.

OAT SEPTORIA

Oat Septoria begins as small dark-brown to purple, oval or elongated spots on leaves. Spots grow into larger light or dark-brown blotches with surrounding yellow areas that can cover and kill the entire leaf. Infection may spread to leaf sheaths and through these to stems, where greyish-brown or shiny black lesions may cause lodging. Dark-brown blotches can also occur on the head. In some varieties, the

fungus can sometimes cause a dark discolouration of the grain when unseasonably late rain occurs.

Septoria (*Phaeosphaeria avenaria* f.sp. *avenaria* (asexual stage: Stagonospora (formerly *Septoria*) *avenae* f.sp. *avenaria*), also known as Septoria avenae blotch, is the most common oat disease in Western Australia. It occurs throughout the cereal growing areas and is most severe in the high rainfall areas. In extreme cases, Septoria may cause up to 50% yield loss and crop lodging, but losses of around 10% are more common in high rainfall areas. Tall or slow-maturing oats are less likely to be affected by the disease than short (dwarf) or fast-maturing varieties. Septoria reduces hay yield, quality, and appearance and is a significant constraint to hay production. Oat Septoria does not infect wheat, and wheat Septoria does not infect oats.

Most oat varieties are rated as MS or below to Septoria. Williams (MS) has the best resistance of the milling oat varieties, and Koorabup (MRMS) has the best resistance of the hay-only varieties (of those with resistance data presented).

OAT LEAF RUST (OLR)

OLR appears on leaves as small, circular to oval pustules, containing orange to yellow powdery spores. Under heavy infection, pustules can also occur on stems and heads. As the crop matures, pustules darken and produce black spores embedded in leaf tissue. The spore masses in the pustules are readily dislodged.

Leaf rust (*Puccinia coronata* var. *avenae*), also known as crown rust, causes losses of up to 50% in forage, hay and grain yield. It may also reduce forage and hay palatability. The word ‘crown’ refers to the shape of spores produced by this fungus, not the disease symptoms. Leaf rust develops most rapidly in temperatures of 15–22°C under moist conditions. OLR does not infect wheat, and wheat leaf rust does not infect oats.

Most milling oat varieties have good resistance to OLR except Carrolup (VS), Kojonup (SVS) and Wandering (VS). Winjardie (SVS) and Wintaroo (SVS) have the weakest resistance of the hay-only varieties with resistance data.

OAT STEM RUST (OSR)

OSR appears as elongated pustules containing reddish-brown powdery spores, mainly on stems and potentially on the leaves and head in heavy infections. The spore masses in the pustules can dislodge readily.

Stem rust (*Puccinia graminis* f.sp. *avenae*) is a fungal foliar disease of oats that can cause up to 90% yield loss and reduce grain quality in susceptible varieties. It reduces hay yield, quality and appearance. Widespread outbreaks are very damaging but rare, and regional outbreaks are more common, causing losses over limited areas. Stem rust development and spread are favoured by warm (18-30°C) humid conditions, and an epidemic is more likely if the spring is suitably wet. The latent period (the approximate time taken for an infection to result in new spores) of stem rust is 7-10 days under these optimal temperature conditions. Disease severity can increase extremely rapidly once a crop is uniformly infected. OSR does not infect wheat, and wheat stem rust does not infect oats.

Milling oat varieties are rated as MS or below to OSR. Varieties with the best resistance are the hay-only varieties Mulgara (MRMS) and Wintaroo (MR). The performance of other hay-only varieties is unknown at this stage.

RED LEATHER LEAF (RLL)

RLL appears as small, pale blue coloured lesions with a red/red-brown edge, typically during the tillering stages. During the stem elongation to head emergence stages, symptoms appear as red, irregular-shaped lesions spread across leaves. Later in the season, affected leaves take on a ‘leathery’ appearance, turning red, brown, and maybe slightly rolled.

RLL (*Spermospora avenae*) has not been detected or confirmed in WA. RLL suspected samples should be sent to DPIRD Diagnostic Laboratory Services (DDLS) marked Grain Guard. For more information about plant disease testing, sample submission forms and sampling techniques, contact DDLS via email at **DDLS@dpird.wa.gov.au** or phone +61 (0)8 9368 3533.

CROWN ROT

Crown rot (*Fusarium pseudograminearum*) is a fungal, soil-borne disease most common in continuous cereal rotations. It affects the sub-crown internode, crown and lower stems and is not usually noticed until after heading when whiteheads are visible in wheat and sometimes barley. Whiteheads are not observed in oats. The browning at the base of infected tillers is the most reliable indicator of crown rot in oats.

Seed dressings are registered to suppress crown rot. However, there are no fungicide options

to control crown rot once the crop has been established. Including non-cereals in the rotation (such as pulses, oilseed, lupin, and grass-free pasture) can reduce inoculum levels. Inter-row seeding and maintaining reasonable grass weed control in break crops and between crops are also effective measures. Varietal resistance and tolerance to crown rot are limited.

Research in Western Australia suggests that oats are more resistant to crown rot than wheat and barley. Research at Merredin and Wongan Hills has demonstrated that high levels of crown rot can cause average yield losses of 19% in wheat and 18% in barley. Trials with oats observed an average yield loss to crown rot of 4% in milling oats. No differences in tolerance were observed among the oat varieties evaluated.

BARLEY AND CEREAL YELLOW DWARF (BYD/CYD)

Both barley yellow dwarf (BYD) and cereal yellow dwarf (CYD) viruses occur in WA. As screening for varietal resistance to BYD and CYD occurs in the field, resistance scores reflect the rating for the presence of both viruses. However, BYD is more frequent than CYD at a ratio of about 2:1. BYD can reduce grain yield by up to 80% with seedling infection and up to 20% with later infection. Oat plants primarily become infected from infected oat (*Rhopalosiphum padi*) or corn leaf (*Rhopalosiphum maidis*) aphids.

Varietal resistance reduces the impact of the virus on plant growth but does not reduce the effect of aphid feeding on plant growth. Therefore, varietal resistance to BYD and CYD does not reduce the need to spray for aphids to prevent yield loss from feeding damage once they reach threshold levels in the crop (50% of tillers with 15 or more aphids).

Most oat varieties are rated as MS or below to BYD/CYD, except Brusher (MRMS).

ROOT LESION NEMATODE (RLN)

Root lesion nematodes (RLN, *Pratylenchus* species) are microscopic, worm-like animals that feed on plant roots causing yield loss in susceptible crops including wheat, barley and canola. Growing susceptible crops and varieties will increase RLN population numbers and increase the risk of yield losses. RLN can be found in about 6.25 million hectares (nearly 74% of the winter cropping area of WA). *Pratylenchus neglectus* is the dominant species found in 70% of paddocks in WA, followed by *P. quasitereoides* (formerly *P. teres*) in 29% of paddocks. Nematode populations potentially limit the yield of barley and wheat in at least 54% of infested paddocks. Yield loss in oat crops has not been tested.

Oat variety resistance trials are underway in WA. DPIRD, with GRDC investment, commenced screening a select number of oat varieties for their resistance to *P. neglectus* and *P. quasitereoides* in 2021. Provisional resistance data relevant to Western Australia for those select varieties will appear in the 2023 edition of the DPIRD crop sowing guide. In general, oats are more resistant than wheat to *P. neglectus* and more susceptible than wheat to *P. quasitereoides*.

CEREAL CYST NEMATODE (CCN)

Cereal cyst nematode (CCN, *Heterodea avenae*) is present in cropping regions around Geraldton and the Avon Valley around Northam, but it can occur sporadically across the WA wheatbelt. CCN is not a significant constraint to oaten hay production in WA because of the short growing season. However, CCN numbers can build up in the crop to threaten subsequent cereal crops.

Unlike barley, oat varieties do not tolerate CCN, and some yield loss can be expected when infection occurs. CCN resistance and tolerance ratings sourced from SARDI indicate that Bannister and Durack have the best tolerance to CCN of the milling oat varieties. At the same time, Mulgara, Tammar, Tungoo and Wintaroo are moderately tolerant among the hay-only varieties (Table 12).

The planting of CCN-resistant oat varieties retards nematode development, leading to lower nematode levels in the soil for subsequent crops. The milling oat varieties, Bannister, Durack, and Yallara, retard CCN numbers. Among the hay-only varieties, Brusher, Mulgara, Tammar, Tungoo and Wintaroo retard CCN numbers.

TABLE 12. Oat leaf disease, virus and nematode resistance profiles when grown in WA

Disease[1]	Oat septoria	Oat leaf rust	Oat stem rust	Barley and cereal yellow dwarf[4]	CCN resistance	CCN tolerance
Pathotype[2]	Mixed	0001-2 [4,7]	94-1,2,4	–	–	–
Growth stage[3]	Adult	Adult	Adult	Seedling and Adult	Seedling and Adult	Seedling and Adult
Deliverable as Oat1						
Bannister	MSS	RMR	MS	MS	R	MI
Bilby	S	MR	S	MS*p*	S	-
Carrolup	S	VS	S	MSS	S	I
Kojonup	SVS	SVS	MSS	MS	VS	I
Kowari	SVS	R	S	MSS	S	-
Mitika	SVS	MR	S	S	VS	I
Williams	MS	MR	MSS	MS	S	I
Yallara	MSS	MR	MSS	MS	R	I
Deliverable as Oat2						
Durack	SVS	MR	S	MSS	R	MI
Wandering	MSS	VS	SVS	MS	VS	I
Hay-only variety						
Brusher	SVS	-	-	MRMS	R	MI
Forester	MSS	-	-	MS	MS	MI
Kingbale	-	-	-	-	R*p*	-
Koorabup	MRMS	MRMS	MSS	MSS	S	-
Mulgara	-	MR	MRMS	MSS	R	MT
Swan	-	-	-	-	MR	I
Tammar	-	-	-	-	MR	MT
Tungoo	-	-	-	-	R	MT
Winjardie	SVS	SVS	-	MSS	S	I
Wintaroo	MSS	SVS	MR	MS	R	MT

Source: Manisha Shanker, National Oat Breeding Program and NVT Online, **nvtonline.com.au**

[1]Resistance rating: VS = very susceptible, SVS = susceptible - very susceptible, S = susceptible, MSS = moderately susceptible - susceptible, MS = moderately susceptible, MRMS = moderately resistant - moderately susceptible, MR = moderately resistant, RMR = resistant - moderately resistant, R = resistant, MT = moderately tolerant, MI = moderately intolerant, I = intolerant, p = provisional, and - = no data available.

[2]Pathotype: the strain of the pathogen used in evaluating the disease reaction of the different oat varieties, which represents the most common pathotype present in WA. Therefore, on-farm reactions of varieties may differ if the pathotype present differs from the pathotype used in testing.

[3]Growth stage: the seedling resistance score reflects resistance at the two to the three-leaf stage, and the adult resistance score reflects resistance after flag leaf emergence.

[4]Barley and cereal yellow dwarf: plants become infected from infected oat and corn leaf aphids. Varietal resistance reduces the effect of the virus on plant growth but does not reduce the impact of aphid feeding on plant growth.

Variety snapshots

Blakely Paynter and Georgie Troup (DPIRD)

Variety snapshots are presented for:

- seven dual-purpose varieties (Bannister, Carrolup, Durack, Kojonup, Wandering, Williams, and Yallara) that are deliverable into milling oat segregations in WA and suitable for export hay.
- three grain-only varieties (Bilby, Kowari and Mitika) that are deliverable into milling oat segregations in WA but not suitable for export hay.
- ten hay-only varieties (Brusher, Forester, Kingbale, Koorabup, Mulgara, Swan, Tammar, Tungoo, Winjardie, and Wintaroo) that can be cut for export hay but cannot be delivered into milling oat segregations in WA.

The comment section in each snapshot describes essential characteristics of a variety, including their yield relative to another variety and key weaknesses and strengths.

Grain yield data extracted from the Long Term MET Yield Reporter (available at NVT online, **nvtonline.com.au**) are presented relative to a control variety (typically Bannister) rather than the site-mean yield (as shown in Tables 3 to 8) for each year in the period 2016 to 2020. Single-site MET data from Table 9 has been used in the comments section to highlight the probability of one variety yielding less, the same, or more than another variety when grown under the same agronomy (in the same trial).

Disease and nematode resistance ratings are sourced from Table 12 and presented for the adult growth stages of the plant (if known). DPIRD collects disease resistance data for grain varieties under a service agreement with GRDC for the NVT system. Disease data for the hay varieties (except Koorabup) supplied by the NOBP.

Phenology information is an output of the new flowering date predictive program, 'FlowerPower' oat (available at **fp.dpird.app/**), developed by DPIRD. 'FlowerPower' oat is a statistical model that predicts the date of the watery ripe (Z71) growth stage for oats in two WA environments (Northam and Katanning). Model predictions use historical temperature data from 2011, sourced from the SILO database hosted by the Queensland Department of Environment and Science (**longpaddock.qld.gov.au/silo/point-data/**). The phenology data presented in the snapshots is the median predicted date to Z71 (date expected for 50% of seasons) based on 'FlowerPower' oat version v7.0.4.1. Data presented relative to a control variety (typically the dual-purpose variety Carrolup and the hay variety Brusher) for two model environments (Northam and Katanning) for five sowing dates (10-April, 20-April, 10-May, 20-May, and 10-June).

Agronomic traits are tabulated based on published data generated by NOBP in their annual newsletters (**pir.sa.gov.au/research/research_specialties/crop_sciences/crop_improvement**), data collected by DPIRD, research findings from the DPIRD-GRDC co-funded projects DAW00107, DAW00227, and DAW1901-002RTX and in some cases, directly from the breeder. Data presented includes:

- Plant type is based on the genetic background of the variety. Data sourced from NOBP.
- Coleoptile and coleoptile + mesocotyl length. Short = 40–60mm, medium = 60–80mm, long = 80–100mm, very long = 100–120mm, and extremely long = >120mm. Oat seedlings emerge by elongation of the mesocotyl and coleoptile (in wheat and barley, it is only through elongation of the coleoptile) so oats can safely be sown deeper than wheat and barley. The coleoptile and mesocotyl length were measured after germinating seeds in rolled, moistened filter paper for 15 days at 15°C in the dark. DPIRD collected data.
- Hull lignin ratings are based on data published by NOBP. Hull lignin is an empirical phloroglucinol test where colour develops or does not. There is a 0–5 scale where 0 is no hull lignin. Hull lignin is also measurable by near-infrared spectroscopy (NIR). Data sourced from NOBP.
- Stem diameter ratings based on data published by NOBP where fine = <4mm, moderate = 4–6mm, thick = 7–8mm and very thick = >8mm. Data sourced from NOBP.

Variety information including pedigree, the seed licensee, seed trading restrictions and the EPR payable sourced from breeding companies, Variety Central (**varietycentral.com.au/**) and IP Australia Plant Breeders Rights database (**pericles.ipaustralia.gov.au/pbr_db/search.cfm**).

BANNISTER(ф)

OAT1 GRAIN AND HAY VARIETY

Comments

Bannister (tested as WAOAT2354) is a medium spring, tall milling oat variety suitable for export hay. Bannister is susceptible to grain staining. Growers should avoid sowing Bannister in high risk, grain staining scenarios, oat-on-oat rotations, and where the occurrence of pre-harvest rain is a high risk. Carrolup has been the dominant dual-purpose variety cut for export hay, but the popularity of Bannister amongst export hay growers is growing. Bannister hay has better quality than Carrolup in NOBP trials with improved hay yield. While its hay yields are lower than Brusher, hay quality in NOBP trials were comparable. Bannister is the most widely sown oat variety in WA, occupying two in every five oat-ha.

Grain yield (% Carrolup)	2016	2017	2018	2019	2020
Agzone 1	-	-	-	-	-
Agzone 2	130	123	121	122	121
Agzone 3	117	114	117	112	124
Agzone 4	124	143	123	112	157
Agzone 5	137	143	121	110	127
Agzone 6	162	124	127	126	152
State-wide	127	124	120	117	128
Disease resistance	**Rating**				
Septoria	MSS				
Leaf rust	RMR				
Stem rust	MS				
BYD and CYD	MS				
'FlowerPower' predicted days to watery ripe (Z71)	**Relative to Carrolup**				
	10-Apr	**20-Apr**	**10-May**	**20-May**	**10-Jun**
Northam	+3	+3	+3	+3	+3
Katanning	+3	+3	+3	+2	+3
'FlowerPower' predicted days to watery ripe (Z71)	**Relative to Brusher**				
	10-Apr	**20-Apr**	**10-May**	**20-May**	**10-Jun**
Northam	+1	+1	+1	+1	+1
Katanning	+1	+1	+1	+0	+0
Agronomic traits					
Plant type	Dwarf				
Coleoptile length	Medium				
Coleoptile + mesocotyl length	Extremely long				
Hull lignin	High				
Stem diameter	Moderate				
Variety information					
Pedigree	93Q440-44-12/95Q624-30				
Breeder / Seed licensee	DPIRD / Seednet				
Access to seed	Seednet Partners				
EPR ($/t, excl GST)	$2.30				

CARROLUP

OAT1 GRAIN AND HAY VARIETY

Comments

Carrolup (tested as 81Q:346) is a medium spring, mid-tall milling oat variety suitable for export hay. Carrolup has a significantly lower grain yield than the new milling varieties Bannister and Williams. Carrolup grain has the best hectolitre weight of current milling varieties, but screenings tend to be high, similar to Williams. Hay quality of Carrolup is comparable to many of the specialist hay varieties but at a lower hay yield. Carrolup is the second most widely grown oat variety in WA after Bannister, occupying one in every five oat-ha.

Grain yield (% Bannister)	2016	2017	2018	2019	2020
Agzone 1	-	-	-	-	-
Agzone 2	77	81	83	82	83
Agzone 3	86	88	86	89	81
Agzone 4	80	70	81	89	64
Agzone 5	73	70	83	91	79
Agzone 6	62	81	79	79	66
State-wide	79	81	83	85	78
Disease resistance	**Rating**				
Septoria	S				
Leaf rust	VS				
Stem rust	S				
BYD and CYD	MSS				
'FlowerPower' predicted days to watery ripe (Z71)	**Relative to Bannister**				
	10-Apr	**20-Apr**	**10-May**	**20-May**	**10-Jun**
Northam	-3	-3	-3	-3	-3
Katanning	-3	-3	-3	-2	-3
'FlowerPower' predicted days to watery ripe (Z71)	**Relative to Brusher**				
	10-Apr	**20-Apr**	**10-May**	**20-May**	**10-Jun**
Northam	-2	-2	-2	-2	-2
Katanning	-2	-2	-2	-2	-3
Agronomic traits					
Plant type	Non-dwarf				
Coleoptile length	Medium				
Coleoptile + mesocotyl length	Extremely long				
Hull lignin	High				
Stem diameter	Moderate				
Variety information					
Pedigree	Mortlock/80Q256				
Breeder / Seed licensee	DPIRD				
Access to seed	Free to trade				
EPR ($/t, excl GST)	No EPR payable				

KOJONUP(b)

OAT1 GRAIN AND HAY VARIETY

Comments

Kojonup (tested as 91Q291-23-23) is a medium spring, medium height, milling oat variety suitable for export hay. Dual purpose (milling grain and hay) variety. Grain yield is between Carrolup and Bannister. It has good grain quality, large seed size, high hectolitre weight and low screenings. Kojonup is susceptible to oat Septoria and leaf rust. Kojonup is not recommended for lower rainfall regions (e.g. less than 200mm growing season rainfall). While Kojonup is suitable for export hay, its hay yields are generally lower than Carrolup. Kojonup is a minor variety occupying about 1% of the planted area to oats.

Grain yield (% Bannister)	2016	2017	2018	2019	2020
Agzone 1	-	-	-	-	-
Agzone 2	89	91	87	84	85
Agzone 3	87	95	91	97	86
Agzone 4	86	89	77	72	63
Agzone 5	85	87	84	80	85
Agzone 6	92	97	91	93	94
State-wide	88	91	88	89	86
Disease resistance	**Rating**				
Septoria	SVS				
Leaf rust	SVS				
Stem rust	MSS				
BYD and CYD	MS				
'FlowerPower' predicted days to watery ripe (Z71)	**Relative to Carrolup**				
	10-Apr	**20-Apr**	**10-May**	**20-May**	**10-Jun**
Northam	-	-	-	-	-
Katanning	-	-	-	-	-
'FlowerPower' predicted days to watery ripe (Z71)	**Relative to Brusher**				
	10-Apr	**20-Apr**	**10-May**	**20-May**	**10-Jun**
Northam	-	-	-	-	-
Katanning	-	-	-	-	-
Agronomic traits					
Plant type	Dwarf				
Coleoptile length	Medium				
Coleoptile + mesocotyl length	Extremely long				
Hull lignin	High				
Stem diameter	-				
Variety information					
Pedigree	83Q:384/Coomallo				
Breeder / Seed licensee	DPIRD				
Access to seed	Free to trade				
EPR ($/t, excl GST)	$2.25				

WILLIAMS(b)

OAT1 GRAIN AND HAY VARIETY

Comments

Williams (tested as WAOAT2332) is a medium spring, mid-tall milling oat variety suitable for export hay. Williams has the best overall foliar disease resistance of milling and dual-purpose varieties, slightly better than Yallara to oat Septoria. Williams has a similar grain yield to Bannister and Wandering but may lodge in high yielding environments. Its grain has lower hectolitre weight and higher screenings than Bannister and Yallara, especially in lower rainfall regions. Williams grain has a higher level of grain ß-glucan. Williams is suitable for export hay. Its hay yields are around 0.5-1.0t/ha lower than specialist hay varieties like Brusher, Mulgara and Winjardie at a comparable hay quality. Hay quality is similar to Wintaroo, with slightly lower water-soluble carbohydrates and slightly higher crude protein. The main issue with Williams hay is stem thickness, so a target density of 320 plants/m^2 is required when grown for export hay. Williams is the third most widely sown oat variety, occupying one in every six oat-ha.

Grain yield (% Bannister)	2016	2017	2018	2019	2020
Agzone 1	-	-	-	-	-
Agzone 2	94	97	99	99	92
Agzone 3	97	102	101	98	96
Agzone 4	96	87	101	106	75
Agzone 5	100	94	101	103	95
Agzone 6	106	100	100	96	95
State-wide	96	97	100	99	94
Disease resistance	**Rating**				
Septoria	MS				
Leaf rust	MR				
Stem rust	MSS				
BYD and CYD	MS				
'FlowerPower' predicted days to watery ripe (Z71)	**Relative to Carrolup**				
	10-Apr	**20-Apr**	**10-May**	**20-May**	**10-Jun**
Northam	+3	+2	+2	+2	+2
Katanning	+3	+2	+2	+2	+3
'FlowerPower' predicted days to watery ripe (Z71)	**Relative to Brusher**				
	10-Apr	**20-Apr**	**10-May**	**20-May**	**10-Jun**
Northam	+1	+0	+0	+0	+0
Katanning	+1	+0	+0	+0	+0
Agronomic traits					
Plant type	Non-dwarf				
Coleoptile length	Medium				
Coleoptile + mesocotyl length	Very long				
Hull lignin	Moderately high				
Stem diameter	Moderately thick				
Variety information					
Pedigree	85Q845-59/Carrolup//93Q496-13/Carrolup				
Breeder / Seed licensee	SARDI / Barenbrug				
Access to seed	Barenbrug				
EPR ($/t, excl GST)	$2.30				

YALLARA(þ)

OAT1 GRAIN AND HAY VARIETY

Comments

Yallara (tested as SV97001-13-4) is a medium spring, mid-tall milling oat variety suitable for export hay. Grain yields are similar to Carrolup, with improved disease resistance. Yallara grain has a slightly lower hectolitre weight than Carrolup grain but improved grain plumpness (lower screenings). Yallara has bright grain and high grain digestibility, making it suitable for the horse racing industry. Yallara's hay yields are slightly higher than Williams and comparable to the specialist hay variety Brusher. It can produce high-quality hay with moderately fine stems. Yallara is replacing Winjardie as a hay variety in the northern half of Agzone 2. Yallara has some tolerance to oat Septoria and stem rust, with good resistance to leaf rust. Yallara is the fifth most popular oat variety in WA, occupying 5% of the area sown to oats.

Grain yield (% Bannister)	2016	2017	2018	2019	2020
Agzone 1	-	-	-	-	-
Agzone 2	78	79	84	87	88
Agzone 3	90	86	86	87	84
Agzone 4	85	70	89	104	83
Agzone 5	72	68	86	100	83
Agzone 6	44	72	76	76	54
State-wide	80	78	84	87	81
Disease resistance	**Rating**				
Septoria	MSS				
Leaf rust	MR				
Stem rust	MSS				
BYD and CYD	MS				
'FlowerPower' predicted days to watery ripe (Z71)	**Relative to Carrolup**				
	10-Apr	**20-Apr**	**10-May**	**20-May**	**10-Jun**
Northam	-1	-2	-1	-2	-2
Katanning	-1	-2	-1	-2	-1
'FlowerPower' predicted days to watery ripe (Z71)	**Relative to Brusher**				
	10-Apr	**20-Apr**	**10-May**	**20-May**	**10-Jun**
Northam	-3	-4	-3	-4	-4
Katanning	-3	-4	-3	-4	-4
Agronomic traits					
Plant type	Non-dwarf				
Coleoptile length	Medium				
Coleoptile + mesocotyl length	Extremely long				
Hull lignin	High				
Stem diameter	Moderately fine				
Variety information					
Pedigree	Euro/ND931075//Euro				
Breeder / Seed licensee	SARDI / Seednet				
Access to seed	Seednet Partners				
EPR ($/t, excl GST)	$2.00				

DURACK(þ)

OAT2 GRAIN AND HAY VARIETY

Comments

Durack (tested as WA02Q302-9) is an early spring, mid-tall, milling variety suitable for export hay. Durack is only deliverable as an OAT2 variety. When evaluated, Durack was not granted Oat1 status as it failed to meet the target grain ß-glucan target of 4%. It is similar in height and grain yield to Carrolup and Yallara with comparable hectolitre weight but improved grain plumpness relative to Carrolup. Grain plumpness (or screenings) is similar to Yallara. Durack is the earliest maturing oat variety of any current milling or hay variety. Whilst earlier flowering helps produce large grains, it may also increase the risk of frost during flowering, so growers are encouraged to sow between May and mid-June when sown in frost-prone areas. Durack is suitable for export hay, but its hay yields are generally lower than Carrolup and Williams. Durack is susceptible to oat Septoria and stem rust. Durack was the seventh most popular oat variety in 2020 but occupying only 2% of the area sown to oats.

Grain yield (% Bannister)	2016	2017	2018	2019	2020
Agzone 1	-	-	-	-	-
Agzone 2	69	80	81	87	92
Agzone 3	79	79	79	81	83
Agzone 4	78	63	88	94	126
Agzone 5	64	64	82	104	78
Agzone 6	46	74	64	75	60
State-wide	72	77	79	85	83
Disease resistance	**Rating**				
Septoria	SVS				
Leaf rust	MR				
Stem rust	S				
BYD and CYD	MSS				
'FlowerPower' predicted days to watery ripe (Z71)	**Relative to Carrolup**				
	10-Apr	**20-Apr**	**10-May**	**20-May**	**10-Jun**
Northam	-6	-7	-7	-7	-7
Katanning	-7	-7	-7	-7	-6
'FlowerPower' predicted days to watery ripe (Z71)	**Relative to Brusher**				
	10-Apr	**20-Apr**	**10-May**	**20-May**	**10-Jun**
Northam	-8	-9	-9	-9	-9
Katanning	-9	-9	-9	-9	-9
Agronomic traits					
Plant type	Non-dwarf				
Coleoptile length	Medium				
Coleoptile + mesocotyl length	Extremely long				
Hull lignin	High				
Stem diameter	Moderate				
Variety information					
Pedigree	01Q211/94Q601-45-28				
Breeder / Seed licensee	SARDI / Barenbrug				
Access to seed	Barenbrug				
EPR ($/t, excl GST)	$2.30				

WANDERING

OAT2 GRAIN AND HAY VARIETY

Comments

Wandering (tested as WAOAT2052) is a medium spring, medium height feed variety received as Oat2 and OWAN only. Wandering has comparable grain yield to Bannister and Williams but is less competitive at sites with a yield potential above 3t/ha. Wandering is suitable for cutting for hay but not preferred by the export industry. Hay yields are generally higher than Carrolup, with improved digestibility and water-soluble carbohydrates. Wandering is susceptible to leaf rust and stem rust. Wandering is the fourth most popular oat variety, occupying 6% of the area sown to oats in 2019 and 2020.

Grain yield (% Bannister)	2016	2017	2018	2019	2020
Agzone 1	-	-	-	-	-
Agzone 2	100	94	96	100	106
Agzone 3	104	94	96	96	100
Agzone 4	104	102	102	108	120
Agzone 5	92	93	98	104	104
Agzone 6	65	86	93	94	81
State-wide	99	94	96	99	101
Disease resistance	**Rating**				
Septoria	MSS				
Leaf rust	VS				
Stem rust	SVS				
BYD and CYD	MS				
'FlowerPower' predicted days to watery ripe (Z71)	**Relative to Carrolup**				
	10-Apr	**20-Apr**	**10-May**	**20-May**	**10-Jun**
Northam	+2	+1	+1	+1	+1
Katanning	+2	+1	+1	+1	+2
'FlowerPower' predicted days to watery ripe (Z71)	**Relative to Brusher**				
	10-Apr	**20-Apr**	**10-May**	**20-May**	**10-Jun**
Northam	+0	-1	-1	-1	-1
Katanning	+0	-1	-1	-1	-1
Agronomic traits					
Plant type	Dwarf				
Coleoptile length	Medium				
Coleoptile + mesocotyl length	Extremely long				
Hull lignin	High				
Stem diameter	Moderate				
Variety information					
Pedigree	SA Seln 41/75Q36-144-31				
Breeder / Seed licensee	DPIRD				
Access to seed	Free to trade				
EPR ($/t, excl GST)	No EPR payable				

BILBY(ɬ)

OAT1 GRAIN VARIETY

Comments

Bilby (tested as 06204-16) is an early-medium spring, short milling oat variety not suitable for export hay. The grain quality of Bilby is comparable to Bannister but with a lower grain yield above 3t/ha. Its grain yields are between Kojonup and Wandering. Bilby has high ß-glucan and lower oil than other dwarf varieties with bright grain. Bilby is susceptible to oat Septoria and stem rust. Bilby occupies less than 1% of the area sown to oats and is not expected to grow in popularity.

Grain yield (% Bannister)	2016	2017	2018	2019	2020
Agzone 1	-	-	-	-	-
Agzone 2	89	95	94	99	103
Agzone 3	91	89	91	91	97
Agzone 4	93	89	100	100	141
Agzone 5	86	88	95	107	95
Agzone 6	76	90	83	91	86
State-wide	89	91	93	96	99
Disease resistance	**Rating**				
Septoria	S				
Leaf rust	MR				
Stem rust	S				
BYD and CYD	MSS*p*				
'FlowerPower' predicted days to watery ripe (Z71)	**Relative to Carrolup**				
	10-Apr	**20-Apr**	**10-May**	**20-May**	**10-Jun**
Northam	-	-	-	-	-
Katanning	-	-	-	-	-
'FlowerPower' predicted days to watery ripe (Z71)	**Relative to Brusher**				
	10-Apr	**20-Apr**	**10-May**	**20-May**	**10-Jun**
Northam	-	-	-	-	-
Katanning	-	-	-	-	-
Agronomic traits					
Plant type	Dwarf				
Coleoptile length	Medium				
Coleoptile + mesocotyl length	Extremely long				
Hull lignin	High				
Stem diameter	-				
Variety information					
Pedigree	98011-6/98240-19				
Breeder / Seed licensee	SARDI / Barenbrug				
Access to seed	Barenbrug				
EPR ($/t, excl GST)	$2.50				

KOWARI(b)

OAT1 GRAIN VARIETY

Comments

Kowari (tested as SV03198-18) is a medium spring, medium height milling oat variety not suitable for export hay. Kowari is an alternate to Bilby, but with lower yield potential, similar hectolitre weight and improved grain plumpness (lower screenings). Kowari is an improvement over Mitika for grain yield at a comparable grain quality and slightly longer straw. Kowari grain is attractive to millers seeking health claims of their products as it has a higher level of grain ß-glucan. Kowari is susceptible to oat Septoria and stem rust. Kowari grain has low hull lignin, which improves feed grain quality. Kowari occupies less than 0.5% of the area sown to oats.

Grain yield (% Bannister)	2016	2017	2018	2019	2020
Agzone 1	-	-	-	-	-
Agzone 2	82	90	88	93	100
Agzone 3	85	84	86	87	93
Agzone 4	87	81	93	92	144
Agzone 5	76	80	88	104	88
Agzone 6	65	85	74	86	79
State-wide	82	86	87	92	94
Disease resistance	**Rating**				
Septoria	SVS				
Leaf rust	R				
Stem rust	S				
BYD and CYD	MSS				
'FlowerPower' predicted days to watery ripe (Z71)	**Relative to Carrolup**				
	10-Apr	**20-Apr**	**10-May**	**20-May**	**10-Jun**
Northam	-	-	-	-	-
Katanning	-	-	-	-	-
'FlowerPower' predicted days to watery ripe (Z71)	**Relative to Brusher**				
	10-Apr	**20-Apr**	**10-May**	**20-May**	**10-Jun**
Northam	-	-	-	-	-
Katanning	-	-	-	-	-
Agronomic traits					
Plant type	Dwarf				
Coleoptile length	Medium				
Coleoptile + mesocotyl length	Extremely long				
Hull lignin	Low				
Stem diameter	-				
Variety information					
Pedigree	Mitika/WAOAT2099				
Breeder / Seed licensee	SARDI / Barenbrug				
Access to seed	Barenbrug				
EPR ($/t, excl GST)	$2.50				

MITIKA(b)

OAT1 GRAIN VARIETY

Comments

Mitika (tested as SV94046-57) is a medium spring, short height milling oat variety not suitable for export hay. The grain yield of Mitika is an improvement on Carrolup, but significantly lower than Bannister and Williams. Mitika grain is comparable to Kowari for hectolitre weight and grain plumpness, but the variety is lower yielding. Mitika, like Kowari, has higher levels of ß-glucan than current milling and dual-purpose varieties. Mitika is susceptible to oat Septoria and stem rust. Mitika has improved feed quality due to low husk lignin and high grain digestibility. Mitika is a minor variety occupying less than 1% of the area planted to oats.

Grain yield (% Bannister)	2016	2017	2018	2019	2020
Agzone 1	-	-	-	-	-
Agzone 2	80	88	85	89	96
Agzone 3	82	82	83	86	88
Agzone 4	83	79	87	85	133
Agzone 5	72	76	84	98	84
Agzone 6	60	83	72	84	76
State-wide	79	83	83	89	91
Disease resistance	**Rating**				
Septoria	SVS				
Leaf rust	MR				
Stem rust	S				
BYD and CYD	S				
'FlowerPower' predicted days to watery ripe (Z71)	**Relative to Carrolup**				
	10-Apr	**20-Apr**	**10-May**	**20-May**	**10-Jun**
Northam	-	-	-	-	-
Katanning	-	-	-	-	-
'FlowerPower' predicted days to watery ripe (Z71)	**Relative to Brusher**				
	10-Apr	**20-Apr**	**10-May**	**20-May**	**10-Jun**
Northam	-	-	-	-	-
Katanning	-	-	-	-	-
Agronomic traits					
Plant type	Dwarf				
Coleoptile length	Medium				
Coleoptile + mesocotyl length	Extremely long				
Hull lignin	Low				
Stem diameter	-				
Variety information					
Pedigree	0X87;072-13/0X87;080-1//0X88;045-12				
Breeder / Seed licensee	SARDI / Barenbrug				
Access to seed	Barenbrug				
EPR ($/t, excl GST)	$2.00				

BRUSHER(ϕ)

HAY VARIETY

Comments

Brusher (tested as SV87103-109) is a tall, medium spring hay oat variety. Brusher reaches watery ripe about five days earlier than Wintaroo and two days later than Carrolup across a range of sowing dates. Brusher hay is similar in height to Wintaroo with thinner stems and lower fibre levels. It also has improved digestibility, metabolisable energy and water-soluble carbohydrates than Wintaroo. Brusher has improved hay yield and quality relative to Carrolup and is the most widely sown hay-only variety cut for export hay. Brusher is susceptible to oat Septoria and suitable for sowing in lower rainfall areas. Specialist hay varieties require more detail to management than dual purpose varieties like Carrolup. Brusher grain has low hull lignin, which improves feed grain quality.

Hay yield and quality	Brusher	Carrolup
Hay Yield (t/ha)	7.2	6.3
Digestibility (% dm)	68.4	66.9
WSC (% dm)	32.8	31.7
ADF (% dm)	28.0	28.8
NDF (% dm)	48.2	49.0
NDFDom30 (% dm)	57.0	55.4

Disease resistance	Rating
Septoria	SVS
Leaf rust	-
Stem rust	-
BYD and CYD	MRMS

'FlowerPower' predicted days to watery ripe (Z71)	Relative to Carrolup				
	10-Apr	20-Apr	10-May	20-May	10-Jun
Northam	+2	+2	+2	+2	+2
Katanning	+2	+2	+2	+2	+3

'FlowerPower' predicted days to watery ripe (Z71)	relative to Wintaroo				
	10-Apr	20-Apr	10-May	20-May	10-Jun
Northam	-5	-5	-5	-5	-4
Katanning	-5	-5	-5	-4	-4

Agronomic traits	
Plant type	Non-dwarf
Coleoptile length	Medium
Coleoptile + mesocotyl length	Extremely long
Hull lignin	Low
Stem diameter	Moderate

Variety information	
Pedigree	Dumont/Wallaroo//Bandicoot
Breeder / Seed licensee	SARDI / AEXCO
Access to seed	AEXCO seed distributor
EPR ($/t, excl GST)	$2.00

FORESTER(ϕ)

HAY VARIETY

Comments

Forester (tested as SV97200-3) is a tall, very late spring hay variety adapted to high rainfall areas. Forester reaches watery ripe about a month later than Brusher and Carrolup and is best suited to very early sowing opportunities in WA. Forester has good early vigour, excellent straw strength and high shattering resistance. It has good hay colour, but like all late hay varieties, it may not resist hot dry winds than earlier varieties. Forester has excellent hay quality and is an improvement compared to Tammar.

Hay yield and quality	Forester	Carrolup
Hay Yield (t/ha)	6.4	6.3
Digestibility (% dm)	70.3	66.9
WSC (% dm)	34.2	31.7
ADF (% dm)	28.1	28.8
NDF (% dm)	46.3	49.0
NDFDom30 (% dm)	-	55.4

Disease resistance	Rating
Septoria	MSS
Leaf rust	-
Stem rust	-
BYD and CYD	MS

'FlowerPower' predicted days to watery ripe (Z71)	Relative to Carrolup				
	10-Apr	20-Apr	10-May	20-May	10-Jun
Northam	+35	+32	+28	+27	+24
Katanning	+31	+30	+29	+28	+28

'FlowerPower' predicted days to watery ripe (Z71)	Relative to Brusher				
	10-Apr	20-Apr	10-May	20-May	10-Jun
Northam	+33	+30	+26	+25	+22
Katanning	+29	+28	+27	+26	+25

Agronomic traits	
Plant type	Non-dwarf
Coleoptile length	Medium
Coleoptile + mesocotyl length	Extremely long
Hull lignin	Low
Stem diameter	Moderately thick

Variety information	
Pedigree	OT285/OX92;056-4
Breeder / Seed licensee	SARDI / AEXCO
Access to seed	AEXCO seed distributor
EPR ($/t, excl GST)	$2.00

KINGBALE(ϕ)

HAY VARIETY

Comments

Kingbale (tested as GIA17010-I) is a single gene, imidazolinone (IMI) tolerant, hay oat variety. Preliminary data shows Kingbale has a similar agronomic and disease profile to Wintaroo. Kingbale was developed through mutation breeding from Wintaroo by Grains Innovation Australia (GIA). InterGrain are commercialising Kingbale. The breeding process was similar to the development of Scope CL from Buloke barley. Kingbale has improved tolerance to soil residual IMI herbicides as a plant back option. The APMVA have registered the Sentry® herbicide for pre-plant incorporation by seeding (IBS) for seed and hay, although there is currently no registration for use in grain. Kingbale cannot be sprayed post-emergent with an IMI herbicide. If the Sentry® application for on-farm grain use is approved, Kingbale seed will be available from InterGrain's network of Seedclub members and resellers for planting in 2022. Farmer to farmer trading of Kingbale seed will not be allowed, as with IMI tolerant wheat and barley varieties.

Hay yield and quality	Kingbale	Carrolup
Hay Yield (t/ha)	-	6.3
Digestibility (% dm)	-	66.9
WSC (% dm)	-	31.7
ADF (% dm)	-	28.8
NDF (% dm)	-	49.0
NDFDom30 (% dm)	-	55.4

Disease resistance	Rating
Septoria	-
Leaf rust	-
Stem rust	-
BYD and CYD	-

'FlowerPower' predicted days to watery ripe (Z71)	Relative to Carrolup				
	10-Apr	20-Apr	10-May	20-May	10-Jun
Northam	-	-	-	-	-
Katanning	-	-	-	-	-

'FlowerPower' predicted days to watery ripe (Z71)	Relative to Brusher				
	10-Apr	20-Apr	10-May	20-May	10-Jun
Northam	-	-	-	-	-
Katanning	-	-	-	-	-

Agronomic traits	
Plant type	Non-dwarf
Coleoptile length	Medium
Coleoptile + mesocotyl length	Extremely long
Hull lignin	-
Stem diameter	-

Variety information	
Pedigree	MIOLRP-86-3/Echidna//Wallaroo
Breeder / Seed licensee	GIA / Intergrain
Access to seed	Seedclub members and resellers
EPR ($/t, excl GST)	$3.65

KOORABUP(ϕ)

HAY VARIETY

Comments

Koorabup (tested as 05096-32) is a new medium spring, hay oat variety developed for WA. Relative to Carrolup, it is about a week later to cut, with a similar plant height and hay yield but improved Septoria resistance. It has a comparable grain yield to Carrolup, allowing ease of bulk-up for next year's hay crop. Koorabup hay yields are lower than Brusher and Wintaroo and close to Mulgara. It has better lodging and shattering resistance than Wintaroo and Brusher and is similar to Mulgara.

Hay yield and quality	Koorabup	Carrolup
Hay Yield (t/ha)	6.5	6.3
Digestibility (% dm)	67.1	66.9
WSC (% dm)	29.1	31.7
ADF (% dm)	29.0	28.8
NDF (% dm)	50.8	49.0
NDFDom30 (% dm)	56.0	55.4

Disease resistance	Rating
Septoria	MRMS
Leaf rust	MRMS
Stem rust	MSS
BYD and CYD	MSS

'FlowerPower' predicted days to watery ripe (Z71)	Relative to Carrolup				
	10-Apr	20-Apr	10-May	20-May	10-Jun
Northam	+6	+6	+6	+6	+6
Katanning	+6	+6	+6	+5	+6

'FlowerPower' predicted days to watery ripe (Z71)	Relative to Brusher				
	10-Apr	20-Apr	10-May	20-May	10-Jun
Northam	+1	+1	+1	+1	+1
Katanning	+1	+1	+1	+1	+1

Agronomic traits	
Plant type	Non-dwarf
Coleoptile length	Medium
Coleoptile + mesocotyl length	Extremely long
Hull lignin	High
Stem diameter	Moderately fine

Variety information	
Pedigree	WAOAT2282/WAOAT2236
Breeder / Seed licensee	SARDI / AEXCO
Access to seed	AEXCO seed distributor
EPR ($/t, excl GST)	$2.00

MULGARA(Þ)

HAY VARIETY

Comments

Mulgara (tested as SV96025-7) is a tall, medium spring hay oat variety. Mulgara reaches watery ripe at a similar time to Brusher and about 3 days later than Carrolup across a range of sowing dates. Mulgara has excellent resistance to rust but a current resistance rating for oat Septoria is not available. It is an improvement compared to Wintaroo for lodging, shattering resistance and early vigour. Hay yield in NOBP trials was an improvement over Carrolup, but lower than Brusher. Hay digestibility is better than Carrolup but similar for water soluble carbohydrates and fibre. Mulgara has excellent hay colour and resists brown leaf tipping.

Hay yield and quality	Mulgara	Carrolup
Hay Yield (t/ha)	6.7	6.3
Digestibility (% dm)	68.1	66.9
WSC (% dm)	31.7	31.7
ADF (% dm)	28.1	28.8
NDF (% dm)	48.7	49.0
NDFDom30 (% dm)	58.5	55.4

Disease resistance	Rating
Septoria	-
Leaf rust	MR
Stem rust	MRMS
BYD and CYD	MSS

'FlowerPower' predicted days to watery ripe (Z71)	Relative to Carrolup				
	10-Apr	20-Apr	10-May	20-May	10-Jun
Northam	+3	+3	+3	+3	+3
Katanning	+3	+3	+3	+3	+4

'FlowerPower' predicted days to watery ripe (Z71)	Relative to Brusher				
	10-Apr	20-Apr	10-May	20-May	10-Jun
Northam	+1	+1	+1	+1	+1
Katanning	+1	+1	+1	+1	+1

Agronomic traits	
Plant type	Non-dwarf
Coleoptile length	Long
Coleoptile + mesocotyl length	Extremely long
Hull lignin	High
Stem diameter	Moderate

Variety information	
Pedigree	OX89;030-26/93-112
Breeder / Seed licensee	SARDI / AEXCO
Access to seed	AEXCO seed distributor
EPR ($/t, excl GST)	$2.00

SWAN

HAY VARIETY

Comments

Swan (tested as Oat 3) is a tall, medium spring, hay oat variety. Relative to Carrolup, it is ready for cutting at a similar time, with taller hay of higher yield that is susceptible to lodging, of comparable hay quality, and has a similar disease resistance profile. Older hay varieties such as Swan (first registered in 1967) are not widely accepted by export due to their thicker stems. Best suited to lower rainfall environments. Swan grain has low hull lignin, which improves feed grain quality.

Hay yield and quality	Swan	Carrolup
Hay Yield (t/ha)	7.2	6.3
Digestibility (% dm)	66.5	66.9
WSC (% dm)	30.7	31.7
ADF (% dm)	29.1	28.8
NDF (% dm)	50.4	49.0
NDFDom30 (% dm)	52.7	55.4

Disease resistance	Rating
Septoria	-
Leaf rust	-
Stem rust	-
BYD and CYD	-

'FlowerPower' predicted days to watery ripe (Z71)	Relative to Carrolup				
	10-Apr	20-Apr	10-May	20-May	10-Jun
Northam	-	-	-	-	-
Katanning	-	-	-	-	-

'FlowerPower' predicted days to watery ripe (Z71)	Relative to Brusher				
	10-Apr	20-Apr	10-May	20-May	10-Jun
Northam	-	-	-	-	-
Katanning	-	-	-	-	-

Agronomic traits	
Plant type	Non-dwarf
Coleoptile length	Medium
Coleoptile + mesocotyl length	Extremely long
Hull lignin	Low
Stem diameter	Moderately thick

Variety information	
Pedigree	Kent/Ballidu
Breeder / Seed licensee	DPIRD
Access to seed	Free to trade
EPR ($/t, excl GST)	No EPR payable

TAMMAR

HAY VARIETY

Comments

Tammar (tested as SV96098-24) is a medium-tall, late hay oat variety. Tammar reaches watery ripe about seven days later than Brusher and nine days later than Carrolup across a range of sowing dates. Hay yields in NOBP trials were comparable to Carrolup, with improved digestibility but water-soluble carbohydrates. Tammar has excellent early vigour, lodging and shattering resistance.

Hay yield and quality	Tammar	Carrolup
Hay Yield (t/ha)	6.2	6.3
Digestibility (% dm)	68.0	66.9
WSC (% dm)	30.6	31.7
ADF (% dm)	28.8	28.8
NDF (% dm)	49.7	49.0
NDFDom30 (% dm)	-	55.4

Disease resistance	Rating
Septoria	-
Leaf rust	-
Stem rust	-
BYD and CYD	-

'FlowerPower' predicted days to watery ripe (Z71)	Relative to Carrolup				
	10-Apr	20-Apr	10-May	20-May	10-Jun
Northam	+9	+9	+9	+9	+9
Katanning	+9	+9	+9	+9	+10

'FlowerPower' predicted days to watery ripe (Z71)	Relative to Brusher				
	10-Apr	20-Apr	10-May	20-May	10-Jun
Northam	+7	+7	+7	+7	+7
Katanning	+7	+7	+7	+7	+7

Agronomic traits	
Plant type	Non-dwarf
Coleoptile length	-
Coleoptile + mesocotyl length	Extremely long
Hull lignin	Segregating
Stem diameter	Moderately fine

Variety information	
Pedigree	Zlatak/Euro//OX89;153-122
Breeder / Seed licensee	SARDI / AEXCO
Access to seed	AEXCO seed distributor
EPR ($/t, excl GST)	$2.00

TUNGOO

HAY VARIETY

Comments

Tungoo (tested as SV95137-6-3) is a medium-tall, late season hay oat variety. Tungoo reaches watery ripe about seven days later than Brusher and nine days later than Carrolup across a range of sowing dates. Hay yields in NOBP trials were slightly above Carrolup, with improved digestibility and similar quality for water-soluble carbohydrates and fibre. Tungoo grain has low hull lignin, which improves feed grain quality.

Hay yield and quality	Tungoo	Carrolup
Hay Yield (t/ha)	6.7	6.3
Digestibility (% dm)	68.2	66.9
WSC (% dm)	31.9	31.7
ADF (% dm)	28.4	28.8
NDF (% dm)	48.7	49.0
NDFDom30 (% dm)	-	55.4

Disease resistance	Rating
Septoria	-
Leaf rust	-
Stem rust	-
BYD and CYD	-

'FlowerPower' predicted days to watery ripe (Z71)	Relative to Carrolup				
	10-Apr	20-Apr	10-May	20-May	10-Jun
Northam	+9	+9	+9	+9	+9
Katanning	+9	+9	+9	+8	+9

'FlowerPower' predicted days to watery ripe (Z71)	Relative to Brusher				
	10-Apr	20-Apr	10-May	20-May	10-Jun
Northam	+7	+7	+7	+7	+7
Katanning	+7	+7	+7	+6	+6

Agronomic traits	
Plant type	Non-dwarf
Coleoptile length	-
Coleoptile + mesocotyl length	Extremely long
Hull lignin	Low
Stem diameter	Moderate

Variety information	
Pedigree	Glider/OX89;019-137
Breeder / Seed licensee	SARDI / AEXCO
Access to seed	AEXCO seed distributor
EPR ($/t, excl GST)	$2.00

WINJARDIE

HAY VARIETY

Comments

Winjardie (tested as Oat 146) is a tall, medium spring hay oat variety. Its low disease resistance profile makes it unsuitable for disease-prone locations. However, Winjardie can produce quality export hay when grown in the northern half of Agzone 2 where disease pressure is reduced. Winjardie grain has low hull lignin, which improves feed grain quality.

Hay yield and quality	Winjardie	Carrolup
Hay Yield (t/ha)	7.0	6.3
Digestibility (% dm)	66.9	66.9
WSC (% dm)	31.3	31.7
ADF (% dm)	28.7	28.8
NDF (% dm)	49.8	49.0
NDFDom30 (% dm)	55.7	55.4

Disease resistance	Rating
Septoria	SVS
Leaf rust	SVS
Stem rust	-
BYD and CYD	MSS

'FlowerPower' predicted days to watery ripe (Z71)	Relative to Carrolup				
	10-Apr	20-Apr	10-May	20-May	10-Jun
Northam	-	-	-	-	-
Katanning	-	-	-	-	-

'FlowerPower' predicted days to watery ripe (Z71)	Relative to Brusher				
	10-Apr	20-Apr	10-May	20-May	10-Jun
Northam	-	-	-	-	-
Katanning	-	-	-	-	-

Agronomic traits	
Plant type	Non-dwarf
Coleoptile length	Medium
Coleoptile + mesocotyl length	Very long
Hull lignin	Low
Stem diameter	Moderate

Variety information	
Pedigree	66Q01-44/XBVT183
Breeder / Seed licensee	DPIRD
Access to seed	Free to trade
EPR ($/t, excl GST)	No EPR payable

WINTAROO(b)

HAY VARIETY

Comments

Wintaroo (tested as SV88083-4) is a tall, medium-late spring, hay oat variety. Wintaroo reaches watery ripe about five days later than Brusher and seven days later than Carrolup across a range of sowing dates. While it is moderately resistant to stem rust, it is very susceptible to leaf rust. It resists brown leaf tipping by hot winds and maintains good colour longer than most varieties. Care must be taken to monitor the stems as they tend to turn white while the top remains green. Specialist hay varieties require more detail to management than dual purpose varieties like Carrolup. Wintaroo hay is sought after by export hay houses. Experienced hay growers with cutting, conditioning and bailing equipment or access to a contractor will be advantaged in achieving the maximum potential from Wintaroo. Wintaroo grain has low hull lignin, which improves feed grain quality, but its grain yield is not as high as other hay or grain varieties.

Hay yield and quality	Wintaroo	Carrolup
Hay Yield (t/ha)	7.1	6.3
Digestibility (% dm)	67.4	66.9
WSC (% dm)	30.6	31.7
ADF (% dm)	29.0	28.8
NDF (% dm)	50.0	49.0
NDFDom30 (% dm)	56.6	55.4

Disease resistance	Rating
Septoria	MSS
Leaf rust	SVS
Stem rust	MR
BYD and CYD	MS

'FlowerPower' predicted days to watery ripe (Z71)	Relative to Carrolup				
	10-Apr	20-Apr	10-May	20-May	10-Jun
Northam	+7	+7	+7	+7	+6
Katanning	+7	+7	+7	+6	+7

'FlowerPower' predicted days to watery ripe (Z71)	Relative to Brusher				
	10-Apr	20-Apr	10-May	20-May	10-Jun
Northam	+5	+5	+5	+5	+4
Katanning	+5	+5	+5	+4	+4

Agronomic traits	
Plant type	Non-dwarf
Coleoptile length	Medium
Coleoptile + mesocotyl length	Extremely long
Hull lignin	Low
Stem diameter	Moderate

Variety information	
Pedigree	MIOLRP-86-3/Echidna//Wallaroo
Breeder / Seed licensee	SARDI / AEXCO
Access to seed	AEXCO seed distributor
EPR ($/t, excl GST)	$2.00

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Notes