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GRDC GROWNOTES™

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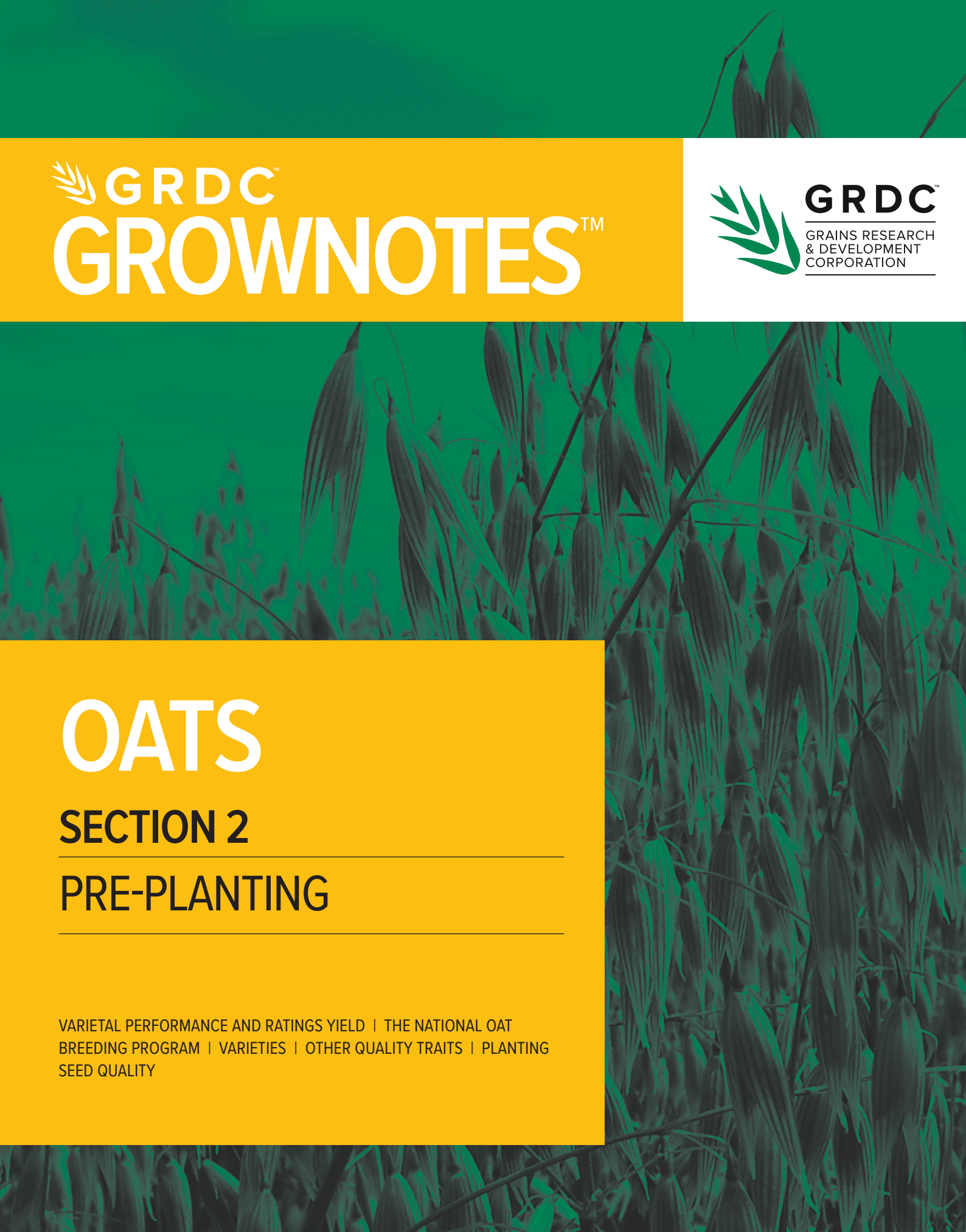

OATS

SECTION 2

PRE-PLANTING

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SECTION 2

Pre-planting

FAQ 2.1 Varietal performance and ratings yield

Identifying the option that will lead to the greatest returns for a grower is a complex problem. Yield will be one of the key determinants of returns, but grain quality is also a consideration. Two recently released varieties for Western Australia, Bannister and Williams, have shown significant yield and disease resistance improvements over other varieties and should be considered by growers.

Yield will be the main determinant of returns but grain quality is also an important consideration.

The decision to grow oats for milling, feed or hay depends on the following factors:

- The relative yields/gross margins of milling grade, feed grade and hay oat varieties.
- The likelihood that the grain will be accepted for milling grade and the premium paid for that grade.
- The quality parameters for a high yielding dual purpose or a high quality hay variety for the export market.
- Agronomic and disease constraints of the different varieties.
- The rotational benefits or costs of each crop such as weed control from a hay crop.

Choose a range of two or more varieties to suit likely sowing opportunities in your area. Assess risk factors such as disease susceptibilities, herbicide sensitivities, dockages for downgraded samples, susceptibility to weather damage, coleoptile length, tolerance to acid soil and boron toxicity.

Traditionally, only tall oats were accepted for use in the milling industry in WA as those carrying the dwarfing genes generally did not produce suitable grain. The National Oat Breeding Program has now released a number of dwarf varieties suitable for milling (Table 1). In Western Australia these have been Williams, Kojonup, Bannister and Mitika. This means the benefits dwarf varieties offer growers in terms of higher grain yields, less lodging and less head loss are now widely available. [1]

[1] DAFWA (2015) Oats – Choosing a variety. https://www.agric.wa.gov.au/oats/oats-choosing-variety

Table 1: List of milling oat varieties for Western Australia, provided by GIWA Oat Council

2015-16 Oat varieties	Classification	Oat1	Oat2	OWAN1
		Premium Milling	Standard Milling	Oats Wandering
Bannister (new 2012)	Milling	*	*	-
Carrolup	Milling	*	*	-
Coomallo	Milling	*	*	-
Hotham	Milling	*	*	-
Kojonup	Milling	*	*	-
Mitika	Milling	*	*	-
Mortlock	Milling	*	*	-
Pallinup	Milling	*	*	-
Wandering	Wandering	-	*	*
Williams (new 2013)	Milling	*	*	-
Yallara	Milling	*	*	-

For further information please refer to the GIWA Oat Variety and Grade Update (Dec 2014) available from the GIWA website http://www.giwa.org.au/oats-council

The choice to grow oats compared to other crops is as important as the selection of an appropriate variety. Oats are often thought of as an "easy" crop to grow but attention to detail is required to produce high yields and quality. Weed control options remain limited compared to other cereal crops and timely grain harvest is important as most varieties shed their grain easily.[2]

When selecting a variety there are a number of considerations:

- What is the crop being used for?
- grazing only
- dual-purpose grazing and grain
- hay (export or domestic)
- silage
- grain (milling or stock feed)

More information

AEXCO Oats Sowing Guide

GIWA: Oats Council

GRDC Final reports DAS00091

2.1.1 Yielding ability

Bannister and Williams have excellent grain yields and are consistently the highest yielding lines in all AgZones of Western Australia. They are over 20% better yielding that Carrolup and have a more than 10% yield improvement over Wandering. Nationally, Williams is the highest yielding potential milling oat variety in National Variety Testing (NVT) trials (Table 2). [3]

[2] Agriculture Victoria (2015) Growing Oat http://agriculture.vic.gov.au/agriculture/grains-and-other-crops/crop-production/growing-oat

[3] Agriculture Victoria (2015) Growing Oat http://agriculture.vic.gov.au/agriculture/grains-and-other-crops/crop-production/growing-oat

Table 2: Average grain yield (t/ha) in Western Australia - 2005 to 2012. The number in brackets is the number of trials. (Data courtesy National Oat Breeding Program and NVT. Analysis by SAGI)

Variety	AgZone 2	Agzone 3	AgZone 4	AgZone 6	WA Overall
Bannister	3.0 (45)	3.5 (49)	1.8 (3)	4.3 (9)	3.2 (106)
Williams	3.1 (40)	3.6 (45)	1.8 (3)	4.3 (8)	3.2 (96)
Carrolup	2.6 (71)	2.9 (77)	1.5 (4)	3.4 (14)	2.6 (166)
Dunnart	2.7 (32)	3.1 (28)	1.6 (3)	3.8 (4)	2.8 (67)
Kojonup	2.7 (70)	3.2 (78)	1.6 (3)	3.8 (4)	2.8 (67)
Mitika	2.7 (66)	3.2 (71)	1.6 (4)	3.9 (13)	2.8 (154)
Possum	2.7 (29)	3.1 (32)	-	3.7 (3)	3.2 (64)
Potoroo	2.7 (16)	3.2 (15)	-	-	3.0 (31)
Wandering	2.9 (71)	3.3 (78)	1.8 (4)	4.0 (14)	3.0 (167)
Wombat	2.5 (59)	3.1 (63)	1.4 (4)	3.4 (12)	2.6 (138)

2.1.2 Quality

Milling oats are received on the basis of grain physical quality including hectolitre weight, free groats, screenings and moisture. Growers should check prices of particular varieties with potential buyers to determine the most profitable cropping options.

Table 3: Average physical grain quality characters of oat varieties

Variety	Hectolitre Weight (kg/hl)	1000 Grain Weight (g)	Screenings (%2.2mm)
Bannister	49.8	31.2	10.1
Williams	48.1	30.4	16.1
Carrolup	51.7	32.3	14.0
Echidna	48.3	30.2	16.6
Kojonup	49.2	31.5	11.1
Mitika	50.4	33.3	9.1
Possum	49.5	31.1	8.6
Potoroo	45.7	30.6	19.8
Wandering	49.5	32.0	13.0
Wombat	50.2	3.4	13.5
Yallara	51.4	32.8	8.2
No. Trials	53	33	53

Many of the physical characteristics of milling and feed oats are similar, however large differences exist in some of the desired chemical characteristics (Table 4). These are important with regard to suitability of varieties for milling or feed, where requirements for each industry may be significantly different. For example - milling requirements call for higher levels of B-glucans and lower oil percent, while oats for animal feed need lower levels of B-glucans and higher oil percent. [4]

[4] Agriculture Victoria (2015) Growing Oat http://agriculture.vic.gov.au/agriculture/grains-and-other-crops/crop-production/growing-oat

Table 4: Average chemical grain quality characters of oat varieties

Variety	NIR Protein (%)	NIR Oil (%)	NIR Groat (%)	Grain Brightness	Estimated ME (MG/kg dm)	B-Glucan (dry basis)	Hull Lignin
Bannister	11.1	7.1	75.1	59.1	12.0	4.3 (3)	High
Williams	11.1	6.8	7.7	-	-	-	-
Carrolup	13.1	5.5	75.6	60.0	11.7	4.7(3)	High
Echidna	11.2	6.0	74.3	0.7	11.7	5.0 (1)	High
Kojonup	13.4	5.6	78.4	60.2	12.0	5.4 (2)	High
Mitika	12.6	6.5	75.6	58.8	12.6	5.5 (3)	Low
Possum	12.5	5.7	76.3	58.6	11.7	4.9 (3)	High
Potoroo	11.6	6.6	74.4	61.0	11.8	5.0 (3)	High
Wandering	12.3	6.2	74.2	61.7	1.6	4.9 (3)	High
Wombat	12.4	6.1	77.5	59.9	12.0	5.0 (3)	High
Yallara	11.6	4.6	79.3	61.3	11.7	5.1 (3)	High
No. Trials	48	42	40	34	15		

2.1.3 Disease Resistance

The major diseases that affect oats are stem rust, leaf rust, Barley Yellow Dwarf Virus (BYDV) and *Septoria avenae* blotch, with the severity changing with seasons. BYDV, which occurs most commonly in southern high rainfall areas west of the Albany Highway, can cause significant losses. In the medium and low rainfall areas, diseases of oats are usually of reduced significance.

Bannister and Williams offer advantages in their rust resistance profiles over other varieties. Although still showing susceptibility to septoria the S and MS ratings these varieties carry should show visible improvements in the field over VS lines (Table 5).[5]

Table 5: Disease reactions of oat varieties

Variety	Stem Rust	Leaf Rust	BYDV	Septoria
Bannister	R-MR	R	MS	S
Williams	MR	R	MR-MS	MS
Carrolup	MS	S	MS	S-VS
Echidna	S	S	MS	S-VS
Kojonup	R-MS	S	MS	S-VS
Mitika	MR-S	R	S	S-VS
Possum	MR-S	MR	S	S-VS
Potoroo	MS	S	MS	S
Wandering	MS	VS	MR-MS	S-VS
Wombat	MR-S	S	MR	S
Yallara	MR-MS	R	MS	S

BYDV = Barley Yellow Dwarf Virus. R = resistant, MR = moderately resistant, MS = moderately susceptible, S = susceptible, VS = very susceptible. Rust reactions may vary in different regions depending on the prevailing pathotypes.

[5] Agriculture Victoria (2015) Growing Oat http://agriculture.vic.gov.au/agriculture/grains-and-other-crops/crop-production/growing-oat

2.2 The National Oat Breeding Program

The National Oat Breeding Program is a partnership between:

Department of Agriculture and Food Western Australia (DAFWA)

South Australian Research and Development Institute (SARDI)

Grains Research and Development Corporation (GRDC)

Rural Industries Research and Development Corporations (RIRDC)

Its mission is to release improved oat varieties for grain or hay production, adapted to Western Australia, South Australia, Victoria and southern New South Wales.

The trial work conducted by GRDC National Variety Trials or NVT are a reflection of the most recent year's crop yield's and a long term average for a number of districts. This trail work covers numerous crops including oats

The NVT program was established in 2005 by the GRDC and is managed by the Australian Crop Accreditation System Limited (ACAS). It is a national program of comparative crop variety testing with standardised trial management, data generation, collection and dissemination. This is managed through an internet accessed database that ensures a common approach and uniformity across the system.[6]

To go to the website click on the link: http://www.nvtonline.com.au/

2.3 Varieties

Variety selection depends on the crop use, sowing date, likely diseases, and tolerance to acid soil, grain quality and possible market outlet. Most varieties are suitable for grazing.

Growers are warned that there are now no commercial varieties with resistance to all the current field pathotypes of stem rust.

Milling varieties

Milling oats are dehulled, steamed and flaked or milled before processing. The healthy oats are made into oatmeal and breakfast foods, health bars, bakery goods and baby foods. Interest by consumers in oat noodles, oat milk, oat rice and oat health care products is also growing.[7]

Bannister.A Released in Western Australia in 2012 as a milling oat variety for the western region. It has high grain yield potential and has performed well in trials in WA It is taller than Mitika and heads about 3 to 4 days later than Mitika. It is susceptible to and intolerant to cereal cyst nematodes. Bannister is resistant to leaf rust and moderately resistant to bacterial blight. Bannister has slightly lower hectolitre weight and slightly higher screenings compared to Mitika. In seasons with pre-harvest rainfall growers have experienced some problems with septoria on the seed. Seed can be purchased through Seednet.

Mitika.A Mitika is a dwarf milling oat released in 2005. It is earlier maturing than Possum and Echidna and this trait favours Mitika in a dry finish. Mitika was resistant to stem rust until 2010 when a new pathotype of stem rust was identified, rendering it susceptibleModerately susceptible to leaf rust. Mitika has improved resistance to bacterial blight and is superior to Echidna for septoria resistance. Mitika is susceptible to BYDV, septoria and red leather leaf disease. It is very susceptible and intolerant of cereal cyst nematode and moderately intolerant of stem nematode and is not recommended in areas where either of these nematodes are a problem. Mitika has high hectolitre weight, low screenings and high groat percent compared to Echidna. Mitika

[6] Agriculture Victoria (2015) Growing Oat http://agriculture.vic.gov.au/agriculture/grains-and-other-crops/crop-production/growing-oat

[7] AEGIC Australian Grain Note: Oats http://www.aegic.org.au/media/23324/140214%20Oats%20Note.pdf

also has improved feed quality with low husk lignin and high grain digestibility. Heritage Seeds.

Mortlock. Medium height, strong strawed grain oat. Can be leniently grazed. It has a consistently high test weight, protein content and lower screening losses with light coloured grain, but discolours easily. Low yielding compared to Mitika and Possum. Released by Agriculture Western Australia in 1983.

http://pir.sa.gov.au/case_studies/case_study/sardi/national_oat_breeding_program

Williams.A Released in Western Australia in 2013, Williams has a high grain yield potential and has performed well in trials throughout WA. Williams is an early to mid season variety similar to Yallara, but three to seven days later than Mitika. Taller than Mitika by 15 cm, 5 cm taller than Bannister, and 15 cm shorter than Yallara. Williams is resistant to leaf rust and depending on the stem rust pathotype present can range from moderately resistant to susceptible. It is susceptible and intolerant to cereal cyst nematodes. Williams is resistant to bacterial blight and moderately resistant to moderately susceptible to BYDV. Williams has lower hectolitre weight and higher screenings compared to Mitika. Williams is not recommended for low rainfall areas due to higher screenings. Heritage Seeds.

Yallara A A medium–tall, early to midseason variety similar to Euro for flowering and maturity. Yallara was released in 2009. Yallara is a Euro look-alike milling line with slightly better grain quality, but not as susceptible to stem rust. It is resistant but intolerant to cereal cyst nematode. It is moderately susceptible to BYDV and septoria. Yallara is susceptible and intolerant to stem nematode and moderately susceptible to red leather leaf disease. Yallara has excellent grain quality. It has a high hectolitre weight, low screenings and a high groat percent. Yallara has bright, plump grain suitable for the milling industry and specialised feed end-uses like the horse racing industry as well as human consumption. Yallara was evaluated for hay production and although the hay yield is lower than popular hay varieties it has excellent hay quality. Seednet.

Feed grain, hay and grazing varieties

Intermediate and late-maturing varieties remain vegetative until late in the season and provide a longer duration of grazing for livestock. [8]

Brusher.A A tall, early-mid season hay variety with improved hay digestibility. Resistant and moderately intolerant to cereal cyst nematode. Intolerant of stem nematode. Low husk lignin. Released by SARDI in 2003. AEXCO.

Carrolup A Widely sown variety as a premium milling variety and the most commonly grown export hay variety (a good dual purpose variety). Carrolup is a tall variety with lower yields than new milling varieties Bannister and Williams. Released in 1993 by the Department of Agriculture and Food, Western Australia (DAFWA).

Forester.A Very late hay variety adapted to high rainfall and irrigated cropping regions. It is three days later than Riel and three weeks later than Wintaroo. Forester has excellent early vigour, lodging and shattering resistance. Good foliar disease resistance spectrum. It is moderately susceptible to cereal cyst nematode. Good hay colour, but like all late hay varieties may not resist hot dry winds as well as earlier varieties. Forester has excellent hay quality. Released by SARDI in 2012. Seed of Forester is available from AGF Seeds, Smeaton, Victoria.

Genie.A Late maturity erect grazing variety with quick early growth and very high dry matter yields. Susceptible to leaf and stem rust in the northern region. Selected for Queensland and northern NSW. Released by DAFF Qld and Heritage Seeds in 2008 and available through Heritage Seeds. Graza 51.A Erect, quick growing, medium to late grazing variety developed by Agriculture Canada. Susceptible to leaf and stem rust in the northern region. Released by Pioneer Hi-Bred in 2007. Seed available through Elders.

[8] DAFF (2015) Forage Oat Variety Guide https://www.daf.qld.gov.au/__data/assets/pdf_file/0004/61969/forage-oat-variety-guide.pdf

Graza 80.A Erect, quick growing, late maturing grazing variety developed by Agriculture Canada. Susceptible to leaf and stem rust in the northern region. Released by Pioneer Hi-Bred in 2005. Seed available through Elders.

Mammoth. A is a true forage oat, with excellent establishment vigour. It was identified in 2007 from the Heritage Seeds' program that specifically targets high forage yield and quality for southern Australia. In particular, the program looked at early establishment vigour and winter yield to select Mammoth. Mammoth has shown excellent autumn and winter performance, and good overall yield in multiple locations over a number of years. Heritage Seeds.

Mulgara.A Tall mid season hay oat similar in heading time and height to Wintaroo with cereal cyst nematode and stem nematode resistance and tolerance. Mulgara is an improvement compared to Wintaroo for resistance to stem rust and bacterial blight, lodging and shattering resistance and early vigour. Hay yield is an improvement compared to Brusher but slightly lower than Wintaroo. Hay quality is similar to Wintaroo. Mulgara has excellent hay colour and resists brown leaf at hay cutting. Grain yield and quality is similar to Wintaroo with lower screenings, higher protein and groat percent. Mulgara has high husk lignin. Released by SARDI in 2009. AEXCO.

Graza 50. Erect, quick growing grazing variety developed by Agriculture Canada. Released by Pioneer Hi-Bred in 1994. Austgrains International.

Swan is a tall, medium maturing, older Western Australian hay variety released in 1967 by DAFWA. Swan is not widely accepted by hay exporters as the stem tends to be too thick. It is grown successfully for export, however, in eastern areas. Grain yield is not as high as others although it does have low husk lignin. Seedmark.

Wandering A A dwarf feed variety that has received recognition by the export horse feed industry. A special segregation at selected sites for Wandering has been in place since 2005. Also accepted as an export hay variety. Wandering is suited to mid to late sowings and has good hectolitre weight. Susceptible to leaf and stem rust. Wandering was released in 1999 by DAFWA.

More information

NSW DPI: Using oats as an alternative grain in opportunity feedlot rations

NSW DPI: Yield and digestibility of legume and oat forages

NSW DPI: Feed energy

GRDC Ground Cover: Oats

Agriculture Victoria: Harvesting forage cereals

NSW DPI: Successful silage

2.4 Other quality traits

FAQ

2.4.1 Grazing value

Financial returns from grazing oats can be based on:

- Changes in body weight throughout the grazing period. Weight gains of 1.2 kilograms per head per day for steers, and 200 grams per head per day for lambs are common
- Stock value before and after grazing
- Current agistment rates for stock, and
- Hand feeding costs for the same period.

Feed quality tests can accurately measure whole grain digestibility, protein levels and metabolisable energy. For livestock feeding grain protein is an important attribute. Oats can vary widely in protein levels due to varietal factors, paddock variability, fertiliser inputs and yield levels. Oats with low protein levels (<12%) may limit growth rates of young animals.[9]

[9] NSW DPI Winter Crop Variety Sowing Guide 2015 http://www.dpi.nsw.gov.au/__data/assets/pdf_file/0011/272945/winter-crop-variety-sowing-guide-2015.pdf

Table 6: Grain quality comparisons

Variety	Hectolitre Weight (kg/hl)	Screenings <2mm	1000 Grain weight (g)	Kernel (%)	Probability of reaching milling grade	Protein (%)	Oil (fat) (%)	Hull lignin content
Semi-dwarf (husked)								
Bannister	MH	ML	MH	MH	H	M	M	H
Echidna	M	MH	M	ML	L	M	M	MH
Mitika	H	L	H	MH	H	MH	M	L
Possum	MH	L	MH	MH	H	MH	M	H
Potoroo	L	MH	M	ML	-	M	MH	H
Wombat	H	M	MH	H	H	MH	M	H
Semi-dwarf (naked)								
Numbat	VH	H	L	-	-	H	VH	-
Tall (husked)								
Brusher	M	M	MH	M	-	MH	M	L
Forester	L	M	L	L	-	M	M	H
Glider	L	M	M	ML	-	MH	ML	L
Kangaroo	M	ML	MH	ML	-	M	M	H
Mulgara	M	M	MH	MH	-	MH	M	H
Tammar	L	H	L	ML	-	MH	M	SEG
Tungoo	L	H	L	ML	-	MH	M	L
Wallaroo	M	M	M	MH	-	M	MH	L
Williams	MH	M	M	M	MH	M	M	MH
Wintaroo	M	M	MH	MH	-	M	M	L
Yallara	H	L	H	H	VH	MH	L	H

Value for trait: L = low, ML = moderately low, M = medium, MH = moderately high, H = high, VH = very high, - not applicable

Research conducted at Wagga Wagga Agricultural Institute in 2003, as part of the GRDC-supported Premium Grains for Livestock Program, shows great variations in the digestibility and suitability of common oat varieties as cost-effective feed grains.

The research revealed more than a 20% variation in digestibility among eight oats tested in a cattle production trial.

Both variety and environment (growing conditions) influence digestibility. The varietal effect is correlated with lignin (an indigestible carbohydrate) levels in the hulls of the grain — high lignin content results in low digestibility.

Dual-purpose oat varieties like Cooba have high digestibility and varieties grown strictly for milling score poorly.[10]

The South Australian Research and Development Institute (SARDI) leads the National Oat Breeding program, developing improved milling oats – including improved nutritional value.

One of the program's most successful varieties, Mitika, now comprises more than 80% of the oats used by Uncle Tobys Australia in popular porridge and muesli bar snacks.

Mitika has high grain yield potential, improved disease resistance – as well as increased levels of β-glucan (beta-glucan) compared to other oat varieties.

2.4.2 Maturity

The maturity, or length of time taken for a variety to reach flowering, depends on vernalisation, photoperiod and thermal time requirements. Recommended sowing times

[10] GRDC (2003) Oats are oats are oats? Not at all http://grdc.com.au/Media-Centre/Ground-Cover/Ground-Cover-Issue-43-SA/Oats-are-oats-are-oats-not-at-all-by-Roger-Nicoll#sthash.7DBgVSl2.dpuf

are arrived at by assessing the maturity of varieties in different environments and with different sowing times.

2.4.3 Grain

While not often used as a grain in feedlot rations, the performance of cattle that are fed oats is equivalent to performance when cattle are fed other more commonly used grains. Oats have a slightly lower energy range than most other grains. They have a high fibre content, and are considered a safer grain to feed than either wheat or barley. When trialled experimentally, oats-fed cattle consumed similar amounts of grain to barley-fed cattle.

The trial showed that when daily feed intake is similar between animals fed either barley or oats, there is a strong similarity between their average daily gains (ADG) and their feed conversion ratios (FCR).[11]

Table 7: Properties of various grains

Foodstuff	Dry matter (DM) (%)	Starch (%)	Metabolisable energy (ME) (MJ/kg DM)		Crude protein (CP) (% DM)	
			Average	Tested range	Average	Tested range
Oats	90	50	10.5	8.5–12.5	10.5	8–12
Barley	90	59–61	13	12.5–13	11	10–12
Wheat	90	60–76	13	12.5–13.5	12	11–13
Sorghum	90	75	13	12.5–13	9	5–11
Maize	90	76	13.5	13–14	9.5	9.0–10

Feeding value of oats grain

The GRDC-supported Premium Grains for Livestock Production project demonstrated large differences between varieties in whole grain digestibility. Cattle feeding trials have subsequently demonstrated these differences translate into large differences in grain digestibility. Most of the difference in whole grain digestibility is caused by varietal differences in the lignin content of the oat husk. Where varieties have a high husk lignin content, digestion of both the husk and the underlying grain is poor. Husk lignin content is assessed using a simple staining test (phloroglucinol stain test). A list of lignin ratings of a range of oat varieties is presented in the following table. While other seasonal factors affect whole grain digestibility, varieties with a high husk lignin rating will inherently have low whole grain digestibility. NIR tests have been developed to measure the feeding value of grains. [12]

Table 8: Hull lignin rating of a range of oat varieties—low is better for rumnant feed value

Low	Medium	Medium-high	High
Bass, Bimbil, Brusher, Carbeen, Cooba, Eurabbie, Graza 68, Mannus, Mitika, Mulgara, Nile, Tungoo, Wintaroo, Yarran, Yiddah	Blackbutt (variable), Graza 80, Quoll	Euro, Potoroo, Wandering	Bannister, Carrolup, Coolabah, Dawson, Drover, Dunnart, Echidna, Forester, Genie, Graza 50, Kangaroo, Mortlock, Nugene, Possum, Taipan, Williams, Wombat, Yallara

[11] NSW DPI (2007) Using Oats as an Alternative Grainin Opportunity Feedlot Rations http://www.dpi.nsw.gov.au/__data/assets/pdf_file/0017/101339/Using-oats-as-an-alternative-grain-in-opportunity-feedlot-rations.pdf

[12] http://www.dpi.nsw.gov.au/__data/assets/pdf_file/0011/272945/winter-crop-variety-sowing-guide-2015.pdf

Table 9: Feedlot performance (117 days)

	Barley*	Oats*
Daily feed intake (kg)	13.50	13.42
Average daily gain (kg/day)	1.39	1.35
Feed conversion ratio (kg DM / kg LW)	9.72	10.02

Table 10: A guide to the metabolisable energy content of Australian grains based on their crude protein (CP) content (dry matter basis)

Source: Derived from the NSW Agriculture Feed Evaluation Database.[13]

	Metabolisable energy (MJ/kg)				
CP (%)	Sorghum	Maize	Oats	Wheat	Barley
6	10.2	11.4	12.4	12.7	13.2
7	10.6	12	12.9	13	13.5
8	10.8	12.4	13.1	13.4	13.7
9	11	12.8	13.3	13.6	13.9
10	11.1	13	13.6	13.8	14
11	11.4	13.2	13.7	14.1	14
12	11.5	13.3	13.8	14.2	14.2
13	11.6	–	13.9	14.3	14.2
14	11.7	–	14	14.4	14.3
15	11.9	–	14.1	14.5	14.3
16	12	–	14.1	14.5	14.3

2.4.4 Hay

Australia exports up to 700,000 tonnes of oaten hay a year.[14]

Choose a suitable variety for the anticipated market. Increase seed and nitrogen fertiliser rates by at least 20% above those for a grain crop. Pay particular attention to soil test results for potassium if repeated hay crops are taken from the same paddock. There are specific requirements for the export markets that are different to usual on-farm needs. These include earlier cutting times, green hay colour, low moisture content, freedom from weeds, and thin-strawed varieties. At all stages of the hay crop growers should check exporters specific requirements if they are interested in this market. [15]

Hay quality is essential to meet export hay standards and is greatly influenced by seasonal and nutritional conditions. However, some varieties are more likely to produce hay of higher quality than others.

It is imperative that you check with your hay processor about the quality standards required to make export grade quality hay before you sow a hay crop. [16]

Before growing oats for export hay, talk to your hay processor. Hay processors have different requirements which will affect how you manage your crop. Your processor can advise you about the production of export hay.

Many export hay companies have preferred varieties they will receive whilst others have no preference. Check with you hay processor prior to planting for their list of preferred varieties. Often they will recommend growing an oat variety suited to your region and ensure the cutting time is correct.

Many common grain varieties (such as Carrolup, Wandering and Winjardi) are grown successfully as export hay. The National Oat Breeding Program has released hay

13 http://www.dpi.nsw.gov.au/agriculture/livestock/dairy-cattle/feed/research/energy

14 Primary Industries and Regions SA,National Oat Breeding Program http://pir.sa.gov.au/case_studies/case_study/sardi/national_oat_breeding_program

15 DAFWA (2015) Oats: Essentials https://www.agric.wa.gov.au/hay-production/oats-essentials?page=0%2C2

16 Oat Variety Sowing Guide 2015 http://pir.sa.gov.au/__data/assets/pdf_file/0009/237906/oats.pdf

More information

GIWA Oat Variety and Grade Update 2014

DAFWA: Oats hay quality export and domestic markets

PI SA Oats

DAFWA Bannister - Milling quality oat WA

Seednet: Bannister fact sheet

DAFWA: Williams – New milling oat WA

Heritage Seeds: Williams fact sheet

varieties (Wintaroo and Brusher) with potential for some regions of Western Australia. Older varieties such as Massif, Swan and Vasse are not widely accepted by hay processors as the stems tend to be too thick. [17] The newly released milling oat variety Williams may have a role as a duel purpos variety with some export hay companies.

2.4.5 Silage

Table 11: Yield and ME content of triticale, oats and wheat silage cut at the boot, anthesis, milk and soft dough stage at Terang, Victoria.

Crop	Stage	Yield (t DM/ha)	ME (MJ ME/kg DM)
Triticale	Boot	5.1	10.4
	Anthesis	11.9	8.6
	Milk	13.8	8.7
	Soft dough	17.9	8.8
Oats	Boot	7.5	10.4
	Anthesis	7.7	10.5
	Milk	10.3	9.9
	Soft dough	10.4	8.9
Wheat	Boot	7.9	10.2
	Anthesis	8.4	9.6
	Milk	10.1	9
	Soft dough	10.9	9.3

2.5 Planting seed quality

Use plump good quality seed from paddocks with a good fertiliser history, uniform in size, not cracked or broken, stored in dark cool dry conditions (not more than one year old) and free from pests and disease.

Seed should have a high percentage germination, free from weed seeds and inert rubbish.[18]

2.5.1 Seed size

Early seedling growth relies on stored energy reserves in the seed. Good seedling establishment is more likely if seed is undamaged, stored correctly and from a plant that had adequate nutrition. Seed should not be kept from paddocks that were rain-affected at harvest. Seed grading is an effective way to separate good quality seed of uniform size from small or damaged seeds and other impurities, such as weed seeds. Seed size is also important—the larger the seed, the greater the endosperm and starch reserves. While size does not alter germination, bigger seeds have faster seedling growth, a higher number of fertile tillers per plant and potentially higher grain yield.

Seed size is usually measured by weighing 1000 grains, known as the 1000-grain weight. Sowing rate needs to vary according to the 1000-grain weight for each variety, in each season, in order to achieve desired plant densities. To measure 1000-grain weights, count out 10 lots of 100 seeds, then weigh. When purchasing seed, remember to request the seed analysis certificate, which includes germination percentage, and the seed weight of each batch where available. The coleoptile is the pointed, protective sheath that encases the emerging shoot as it grows from the seed to the soil surface. Coleoptile length is an important characteristic to consider when planting a oat crop, especially in drier seasons when sowing deep to reach soil moisture.

[17] DAFWA (2015) Oats: Hay Quality for Export and Domestic Markets https://www.agric.wa.gov.au/hay-production/oats-hay-quality-export-and-domestic-markets

[18] DAFWA (2014) Oats: Seeding and Establishment https://www.agric.wa.gov.au/oats/oats-seeding-and-establishment?page=0%2C0

2.5.2 Seed germination and vigour

Use plump good quality seed from paddocks with a good fertiliser history, uniform in size, not cracked or broken, stored in dark cool dry conditions (not more than one year old) and free from pests and disease.

Seed should have a high percentage germination, free from weed seeds and inert rubbish. [19]

Seed germination and vigour greatly influence establishment and yield potential.

Germination begins when the seed absorbs water, and ends with the appearance of the radicle. It has three phases:

- water absorption (imbibition)
- activation
- visible germination [20]

Seed vigour affects the level of activity and performance of the seed or seed lot during germination and seedling emergence. Loss of seed vigour is related to a reduction in the ability of the seeds to carry out all of the physiological functions that allow them to perform.

This process, called physiological ageing (or deterioration), starts before harvest and continues during harvest, processing and storage. It progressively reduces performance capabilities due to changes in cell membrane integrity, enzyme activity and protein synthesis. These biochemical changes can occur very quickly (a few days) or more slowly (years), depending on genetic, production and environmental factors not yet fully understood. The end point of this deterioration is death of the seed (i.e. complete loss of germination).

However, seeds lose vigour before they lose the ability to germinate. That is why seed lots that have similar, high germination values can differ in their physiological age (the extent of deterioration) and so differ in seed vigour and therefore the ability to perform. [21]

For more information on factors affecting germination, see Section 4: Plant growth and physiology.

Request a copy of the germination and vigour analysis certificate from your supplier for purchased seed. For seed stored on-farm, you can send a sample to a laboratory for analysis (http://aseeds.net.au/seed-testing).

While a laboratory seed test for germination should be carried out before seeding to calculate seeding rates, a simple on-farm test can be done in soil at harvest and during storage:

- Use a flat, shallow, seeding tray (about 5 cm deep). Place a sheet of newspaper on the base to cover drainage holes, and fill with clean sand, potting mix or freely draining soil. Ideally, the test should be done indoors at a temperature of ~20°C or lower.
- Alternatively, lay a well-rinsed plastic milk container on its side and cut a window in it, place unbleached paper towels or cotton wool in the container, and lay out the seeds. Moisten and place on a window-sill. Keep moist, and count the seeds as outlined below.
- Randomly count out 100 seeds, do not discard damaged ones, and sow 10 rows of 10 seeds at the correct seeding depth. This can be achieved by placing the seed

[19] DAFWA (2014) Oats: Seeding and establishment https://www.agric.wa.gov.au/oats/oats-seeding-and-establishment

[20] NSW DPI Agronomists (2007) Wheat growth and development. PROCROP Series, NSW Department of Primary Industries, http://www.dpi.nsw.gov.au/__data/assets/pdf_file/0006/449367/Procrop-wheat-growth-and-development.pdf

[21] ISTA (1995) Understanding seed vigour. International Seed Testing Association, http://www.seedtest.org/upload/prj/product/UnderstandingSeedVigourPamphlet.pdf

on the smoothed soil surface and pushing in with a pencil marked to the required depth. Cover with a little more sand/soil and water gently.

- Keep soil moist but not wet, as overwatering will result in fungal growth and possible rotting.
- After 7–10 days, the majority of viable seeds will have emerged.
- Count only normal, healthy seedlings. If you count 78 normal vigorous seedlings, the germination percentage is 78%.
- Germination of 80% is considered acceptable for cereals.
- The results from a laboratory seed-germination test should be used for calculating seeding rates. [22]

2.5.3 Disease

Grain retained for seed from a wet harvest is more likely to be infected with seed-borne disease. It is also more likely to suffer physical damage during handling, increasing the potential for disease. Seed-borne disease generally cannot be identified from visual inspection, so requires laboratory testing.). [23]

2.5.4 Seed storage

The aim of storage is to preserve the viability of the seed for future sowing and maintain its quality for market. A seed is a living organism that releases moisture as it respires. The ideal storage conditions are listed below.

- Temperature <15°C. High temperatures can quickly reduce seed germination and quality. This is why germination and vigour testing prior to planting is so important in the northern region.
- Moisture control. Temperature changes cause air movements inside the silo, carrying moisture to the coolest parts of the seed. Moisture is carried upwards by convection currents in the air; these are created by the temperature difference between the warm seed in the centre of the silo and the cool silo walls, or vice versa. Moisture carried into the silo head space may condense and fall back as free water, causing a ring of seed to germinate against the silo wall.
- Aeration slows the rate of deterioration of seed with 12.5–14% moisture. Aeration markedly reduces grain temperature and evens out temperature differences that cause moisture movement.
- No pests. Temperature <15°C stops all major grain insect pests from breeding, slowing down their activity and causing less damage. [24]

2.5.5 Safe rates of fertiliser sown with the seed

Crop species differ in tolerance to N fertiliser when applied with the seed at sowing. Recent research work funded by Incitec Pivot Fertilisers has shown that the tolerance of crop species to ammonium fertilisers placed with the seed at sowing is related to the fertiliser product (ammonia potential and osmotic potential), the application rate, row spacing and equipment used (such as a disc or tine), and soil characteristics such as moisture content and texture. [25]

[22] GRDC (2011) Retaining seed. Saving weather damaged grain for seed, northern and southern regions. GRDC Fact Sheet Jan. 2011, http://storedgrain.com.au/wp-content/uploads/2013/06/GRDC_FS_RetainingSeed2.pdf

[23] GRDC (2011) Retaining seed. Saving weather damaged grain for seed, northern and southern regions. GRDC Fact Sheet Jan. 2011, http://storedgrain.com.au/wp-content/uploads/2013/06/GRDC_FS_RetainingSeed2.pdf

[24] NSW DPI Agronomists (2007) Wheat growth and development. PROCROP Series, NSW Department of Primary Industries, http://www.dpi.nsw.gov.au/__data/assets/pdf_file/0008/516185/Procrop-wheat-growth-and-development.pdf

[25] BigN (2014) Nitrogen fertiliser placement and crop establishment. Incitec Pivot Ltd, http://bign.com.au/Big%20N%20Benefits/Nitrogen%20Fertiliser%20Placement%20and%20Crop%20Establishment

The safest application method for high rates of high ammonium content fertilisers is to place them away from the seed by physical separation (combined N–phosphorus products) or by pre- or post-plant application (straight N products). For the lower ammonium content fertilisers, e.g. mono-ammonium phosphate (MAP), close adherence to the safe rate limits set for the crop species and the soil type is advised. [26]

High rates of N fertiliser applied at planting in contact with, or close to, the seed may severely reduce seedling emergence. If a high rate of N is required, then it should be applied pre-planting or applied at planting but not in contact with the seed (i.e. banded between and below sowing rows). Rates should be reduced by 50% for very sandy soil and increased by 30% for heavy-textured soils or if soil moisture conditions at planting are excellent. [27] See Tables 1 and 2 for more detail.

Nitrogen rates should be significantly reduced when using narrow points and press wheels or disc seeders. When moisture conditions are marginal for germination, growers need to reduce N rates if fertiliser is to be placed with, or close to, the seed.

Table 12: Suggested safe rates (kg/ha) of some nitrogen fertilizer products sown with oat seed at planting

Row spacing Maximum nitrogen rate Urea DAP MAP

Row spacing		Maximum nitrogen rate	Urea	DAP	MAP
cm	in				
18	7	30	65	158	230
36	14	15	33	79	115

More information

GRDC: Care with fertiliser and seed placement

[26] BigN (2014) Nitrogen fertiliser placement and crop establishment. Incitec Pivot Ltd, http://bign.com.au/Big%20N%20Benefits/Nitrogen%20Fertiliser%20Placement%20and%20Crop%20Establishment

[27] BigN (2014) Nitrogen fertiliser placement and crop establishment. Incitec Pivot Ltd, http://bign.com.au/Big%20N%20Benefits/Nitrogen%20Fertiliser%20Placement%20and%20Crop%20Establishment