Oat Breeding Newsletter

October 2012

Aaron Kendrick & John Pitcher from Uncle Toby's with Peter McCormack, Michelle Williams, Pamela Zwer, Sue Hoppo, Kerry-Lee McMurray, Peter Wheeler & Joe Naughton on a recent tour of the R&D facility at Rutherglen

Compiled by Sue Hoppo and Pamela Zwer for the National Oat Breeding Program:

Pamela Zwer (SARDI)
Sue Hoppo (SARDI)
Peter McCormack (SARDI)
Michelle Williams (SARDI)
Peter Wheeler (SARDI)
KerryLee McMurray (SARDI)
John Sydenham (DAFWA)
Joe Naughton (DAFWA)
Max Karopoulos (DAFWA)

In conjunction with:

SARDI New Variety Agronomy Group
SARDI Gene Function Group
SARDI Field Crops Pathology
Statistics for the Australian Grain Industry (SAGI)
NVT Program
DAFWA CVT and Agronomy Group
Australian Cereal Rust Control Program (ACRCP)

Funded by:

SA and WA State Governments
GRDC
RIRDC
SAGIT
Uncle Tobys Company
AEXCO Pty Ltd

Supported by:

Oat grower co-operators across Australia
Grains Industry Western Australia – Oat Committee (GIWA)
Australian Fodder Industry Association (AFIA)

TABLE OF CONTENTS

Editors' note:

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

1. Entries for 2012 Grain Trials

1.1 NVT, CVT and S4 Grain Trials

New in 2012

- Willbriggie Stage 4 Grain trial not sown
- CCN tolerance evaluation trials not sown
- CVT Dwarf and CVT Tall trials merged into one CVT trial
- Additional CVT trial sown at Riverton in SA
- Quandialla NVT in NSW replaced Temora trial
- York CVT in WA replaced Muresk trial
- New CVT trial located at Pingelly

National Variety Testing (NVT) trials comprising either 30 or 15 entries were again sown at a total of 19 locations in 2012. NVT trials with 30 entries were sown at two locations in SA and one location in NSW. Thanks to the service providers involved for allowing the breeding program to sow these extra entries in their trials. The 15 entry NVT trial set was sown at five locations in SA, six locations in Victoria and five locations in NSW (Table 1). The CVT dwarf (DW) and non dwarf (ND) trials were merged into one 36 entry set in 2012. This trial was sown at ten locations (one additional trial compared to 2011) in WA and three locations in SA. Trial locations and plans can be found on the NVT website www.nvtonline.com.au

The Stage 4 grain trial was reduced to a 52 entry trial (down from 72 entries in 2011) and comprised 48 husked and 4 naked entries. Stage 4 grain trials were sown at five locations in SA, one location in Victoria and four locations in WA. The Stage 4 entries were also sown in nurseries to evaluate rust, barley yellow dwarf virus (BYDV) and septoria resistance in WA and were sown in a stem nematode nursery in SA in 2012. They are also evaluated for CCN resistance at the Waite Campus in SA and for rust by the Australian Cereal Rust Control Program at Cobbitty in NSW.

Table 1: NVT and CVT trial locations in 2012.

South Australia	Victoria	New South Wales	Western Australia
NVT 15	**NVT 15**	**NVT 15**	**CVT**
Paskeville	Hamilton	Wellington	Arthur River
Crystal Brook	Streatham	Cowra	Cunderdin
Waikerie	Diggora	Quandialla	Esperance R.S
Greenpatch	Yarrawonga	Condobolin	Katanning R.S.
Nunjikompita	Eastville	Oaklands	Merriden
NVT 30	Dookie	**NVT 30**	Mt Barker
Bordertown		Gerogery	Pingelly
Frances			Williams
CVT			Wongan Hills
Turretfield			York
Pinery			
Riverton			

Table 2: Stage 4 trial and nursery locations in 2012.

South Australia	New South Wales	Western Australia
Yield trials Riverton Pinery Turretfield Kybybolite **Seed increase** Arthurton **Nurseries** Farrell Flat (Stem Nematode) Waite (CCN resistance)	**Yield trials** No National Oat Breeding Program funded trials **Nurseries** Rust evaluation at ACRCP Cobbitty **Victoria** Rutherglen	**Yield trials** Wongan Hills Katanning Mt Barker Merriden **Nurseries** Mt Barker (septoria) Manjimup (BYDV) Canarvon (rust)

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

Members of the Oat Breeding Team with Harpeet Gil of Agrisearch inspecting trials at Horsham, Victoria

2. Entries for 2012 Hay Trials

2.1 Hay trials

New in 2012

- CCN tolerance evaluation trials not sown
- Additional hay trials sown for observation at Mt Barker and Merriden in WA

In 2012 the hay and late hay trials were merged with the total number of entries reduced to 60. The Stage 5 (S5) hay trial for 2012 comprised 32 entries and was sown at Wongan Hills and Katanning in WA and Horsham in Victoria. S4 hay trials included the 32 entries from the S5 trial and an additional 28 entries to make a total of 60 entries. Hay and grain yield and quality assessment will be conducted at three locations in SA, two locations in Victoria and three locations in WA (Table 3). Two hay trials for observation only were sown at Mt Barker and Merriden in WA. The Stage 4 entries were also sown in nurseries to evaluate rust, BYDV and septoria resistance in WA and stem nematode tolerance in SA. They are also evaluated for CCN resistance at the Waite Campus in SA and for rust by the Australian Cereal Rust Control Program at Cobbitty in NSW.

Information about the hay yield and hay quality as well as grain yield of released lines is included in section 6 of this newsletter.

Table 3: Stage 5 and Stage 4 hay trial and nursery locations in 2012

<table>
<tr><th>South Australia</th><th>Victoria</th><th>Western Australia</th></tr>
<tr><td rowspan="3">Stage 4 trials
Pinery
Turretfield
Riverton
Seed increase
Arthurton
Nurseries
Farrell Flat (stem nematode)
Waite Campus (CCN resistance)</td><td>Stage 5
Horsham
Stage 4
Elmore (32 out of 60 entries cut for hay and all harvested for grain)</td><td rowspan="3">Stage 5
Wongan Hills
Katanning
Stage 4
Williams
York
Mt Barker (obs)
Merriden (obs)
Nurseries
Mt Barker (septoria)
Manjimup (BYDV)
Canarvon (rust)</td></tr>
<tr><td>New South Wales</td></tr>
<tr><td>Nurseries
Rust evaluation at ACRCP Cobbitty</td></tr>
</table>

3. Breeding Program Developments

3.1 National Oat Breeding Program now on Facebook

The National Oat Breeding Program has a Facebook page. Stay up to date with developments in the program by liking our page.

https://www.facebook.com/permalink.php?story_fbid=187021938039599&id=156517477768433#!/pages/National-Oat-Breeding-Program/156517477768433

3.2 Staff Changes

This year the SA program has lost two valued staff members to other programs. Marcus Crawford who joined the group in May, 2009 left to take a position with Balco and Paul Telfer who was with the group for about 16 months left to take a position with AGT. We wish Marcus and Paul all the best in their new jobs.

The Oat Group out to lunch for Marcus's farewell in March, 2012

Paul Telfer with his farewell present in July, 2012

3.3 Project updates

3.3.1 Extending the list of molecular markers for the breeding program
Written by Klaus Oldach

With molecular markers being available for CCN tolerance and the ongoing research on marker development for plant maturity and water-soluble carbohydrate content, markers for β-glucan content have been added to the list of traits that could be more easily selected for with molecular markers.

On average, β-glucan comprises 3.6 – 5.1 % of the oat grain, a value that can greatly vary between different oat lines and is seasonally dependant. Selection for this trait in early generations improves the chances of successfully identifying lines with high levels of β-glucan. In addition, the quantification of this high priority quality trait is costly to measure when using conventional methods. Thanks to the advances in other cereals (barley, rice) the genes that are responsible for β-glucan synthesis have been identified. This knowledge is being used to facilitate the identification of similar genes in oat. Once identified among the large number of oat genes (ca. 100,000), markers can be derived that are able to track the naturally occurring gene versions that lead to a higher β-glucan in oat. With this SAGIT funded project, we will develop marker tools that can a) replace the expensive β-glucan quantification and b) allow the identification of high β-glucan breeding lines, independent of environmental conditions.

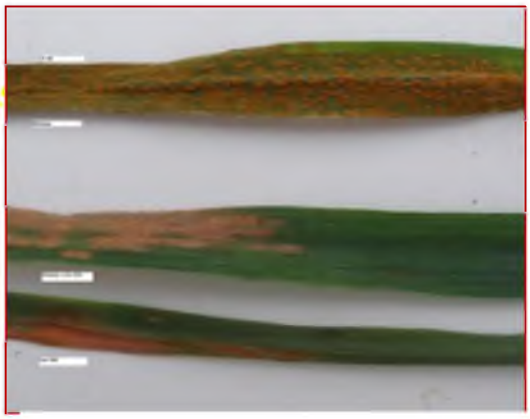
Dr. Shi Ying Yang sampling oat plants she is screening for WSC and height

3.3.2 New sources of leaf and stem rust resistance

Parminder Sidhu[1], Phil Davies[1], Ian Dundas[2], Pamela Zwer[1]
[1] SARDI, [2] University of Adelaide

Leaf rust (or crown rust) caused by the fungus *Puccinia coronata* f. sp. *avenae* can lead to significant economic losses for oat. Uncultivated wild relatives often contain useful genetic variability, such as resistance to diseases and tolerance to abiotic stresses. Our aim is to develop leaf and stem rust resistant oat varieties using uncultivated germplasm resources.

Cultivated oat cv. Wintaroo and wild diploid Clav7233 were crossed to produce an F_1 hybrid. Recurrent backcrosses to Wintaroo were made using leaf rust resistant progeny. Seed of a BC_3 population carrying leaf rust resistance that appeared to be monosomic alien chromosome addition lines were gamma-irradiated with a ^{60}Co source to induce translocations between the alien and oat chromosomes. Plants derived from the irradiated seeds showing high genetic transmission rates of resistance were selected. High transmission rates of resistance may be evidence of transfer of the resistance gene from the alien chromosome of Clav7233 to an oat chromosome. The search for translocated leaf rust resistance will continue until stable introgressed lines are obtained.



Leaf rust strain OLR 164
Wintaroo, (S) F_1 hybrid and wild diploid CIav72339(R)

Leaf rust strain OLR 567
Wintaroo (S), F_1 hybrid and wild diploid CIav7233 (R)

3.3.3 CORE Project

This research program was initiated to ensure oat's competitiveness by developing improved oat varieties through modern genomics. The information will be utilised to develop molecular markers for use in collaborating oat breeding programs globally.

The National Oat Breeding Program is part of the Collaborative Oat Research Enterprise (CORE) program. Two CORE nurseries were sent from North America representing a diverse group of oat breeding lines and varieties in 2010. More than 500 entries were processed through quarantine and then sown in the bird proof enclosure at the Waite campus in December 2011 under irrigation.

Stem rust developed early and the material was sprayed with fungicide to control the disease and ensure grain production. The lines and varieties were harvested in early June and the very late flowering material was harvested in late July. Notes were obtained for stem rust reaction as the disease continued to develop despite the fungicide spray. The entries were not sown in 2012 due to the late harvest. The CORE nurseries will be sown in 2013 to further increase seed amounts and note observations.

3.3.4 Enhancing the Grain Yield and Quality of Oat under Water Deficits—project funded by SAGIT and SARDI

The development of oat as a cereal crop occurred in Europe, Scandinavia, and the United Kingdom between 4500 and 400 BC. Selection and adaptation for cultivated oat occurred in the northern hemisphere where water was not a limiting production constraint. Yield trials conducted in low rainfall sites have not shown genotypic differences for adaptation to water-limited environments. Consequently genetic variation must be introduced.

The major oat producing countries still remain in the northern hemisphere where water limiting environments are not a production constraint. Hence there is virtually no research in oat for drought tolerance globally. Research conducted globally for drought tolerance in other cereals is being utilised to develop this project in oat.
A three year project was funded by SAGIT to identify traits associated with adaptation to water limited environments and develop techniques to quantify or phenotype the traits. Genetic variation will be introduced by crossing Avena fatua and Avena sterilis with adapted breeding lines and varieties.
Two trials were sown in 2012 at Pinery and Waikerie. The trials consist of 30 diverse lines and varieties replicated three times. The following traits are being measured at Pinery: early vigour, leaf greenness, flowering date, canopy temperature, water soluble carbohydrates, cereal cyst nematode resistance and tolerance, yield components, grain yield, and grain quality.

3.3.5 New funding from GRDC and RIRDC

On July 1, 2012 a new project to support the National Oat Breeding Program commenced. For the first time this project is jointly funded by GRDC and RIRDC in an effort by both RDC's to consolidate reporting and milestones for oat breeding. This is a welcome move for the program.

CORE material growing in the birdproof enclosure in summer 2011-12

3.4 New partnership with AEXCO and launch of Forester

In May, 2012, the National Oat Breeding Program (NOBP) announced that AEXCO had been chosen as the commercial partner for the hay component of the breeding program for the next 5 years. This will ensure that AEXCO continues the existing relationship with the NOBP to produce and market new and improved varieties suitable for hay production.

In February, 2012, the new late hay variety Forester was launched at the Sungold Field Days in Warnambool. Seed of Forester is available from AGF Seeds.

Murray Smith (Balco), Gary Hansen (Coomandook), Pamela, Sue, Peter and Denis McGrath (AEXCO) at the AFIA conference in Hobart in August, 2012

3.5 International Oat Conference, Beijing China

In June, 2012 the 9th International Oat Conference was held in Beijing, China. Pamela and Sue both attended the conference.

Scientific and technical information about oat genomics, breeding, processing, and product development was exchanged at the 9th International Oat Conference (IOC) and the China-Baicheng Agricultural Science and Technology Innovation International Cooperation Conference.

As Chair of the IOC Pamela held responsibilities during the conference including opening and closing remarks, conducting the business meeting, and general conference queries. She was also invited to speak at the opening Plenary Session of the IOC and the China-Baicheng Agricultural Science and Technology Innovation International Cooperation Conference about the National Oat Breeding Program. Sue

presented a poster written by Michelle Williams outlining the development of an NIR calibration for B-glucan and acted as the secretary for the IOC committee meeting.

Strong collaborative linkages were established with several Chinese Oat Scientists and the Deputy Director General for International Cooperation for future opportunities in the SARDI National Oat Breeding Program. A Memorandum of Understanding was signed for the exchange of germplasm with Zhangjiakou Academy of Agricultural Science.

Outcomes for the National Oat Breeding Program are access to new sources of germplasm that have not been available to any global oat breeding program. The germplasm will introduce novel genetic variation for abiotic stresses such as salinity and drought tolerance, disease resistance, naked oat, and male sterility.

Sue Hoppo at the 9th IOC in Beijing, China

Pamela presenting her paper at the conference

Chinese women during a demonstration of traditional oat recipes

Pamela and Sue visited oat plots during the conference

3.6 WA program developments

3.6.1 Launch of Bannister$^{\phi}$ at Wagin Woolarama

The new potential milling quality dwarf oat variety Bannister (tested as WAOAT2354) was launched in March 2012 at the Wagin Woolarama by the WA Minister for Agriculture The Hon. Terry Redman. Minimal seed is available from SeedNet and a brochure is available from Jenny Garlinge at DAFWA.

Pamela and Peter with the Hon. Terry Redman at the launch of Bannister oats

Joe Naughton, Toni Cure, Max Karopoulis and John Sydenham at the Wagin Woolarama

3.6.2 New commercial partner for oat selected for the WA component of the NOBP

Seedmark was selected to commercialise new varieties released from the WA component of the National Oat Breeding Program for the next five years. Varieties from the SA component of the National Program will still be available from Viterra.

The SA Oat Breeding Team during seeding in May 2012.

Michelle Williams and Kerry-Lee McMurray sowing hill plots at Turretfield

Peter Wheeler and Paul Telfer sowing plots at Pinery

4. New varieties

New developments for 2012 include commercial seed production of three hay varieties and three milling varieties.

Tammar (SV96098-24) and Forester (SV97200-3) were released in 2011. Tammar is later than Tungoo by about four to seven days with excellent disease resistance and colour. Forester is the first very late line released from the program. It heads about seven to 10 days later than Glider, almost 16 days later than Tammar, and three weeks later than Wintaroo. It has much better early vigour than Glider and good foliar disease resistance. About 100 t of Tammar and 200 t of Forester seed will be produced in 2012. Although Tungoo was released in 2010 there has been limited seed availability. Expected production for Tungoo is 250 t in 2012. Seed of Tungoo and Tammar is available from AEXCO and seed of Forester is available from AGF Seeds.

Wombat (SV87181-12) is the first dwarf milling variety with CCN resistance and tolerance. Seed production is expected to be about 200 t in the 2012 growing season. The second milling variety was named Dunnart (SV98146-26). It is about 10 to 15 cm taller than Possum, Wombat, and Mitika. Dunnart is also resistant and moderately tolerant to CCN with improved resistance to barley yellow dwarf virus. Seed will be increased in 2012 and limited seed will be available to growers in 2013. Viterra is the commercial partner for Wombat and Dunnart.

A new milling variety, Bannister, was released in Western Australia this year. It has high grain yield potential with improved disease resistance compared to other Western Australian oat varieties. Bannister is in the seed production phase with seed available for eastern Australia in 2014. CBH is the commercial partner for this variety and SeedNet is undertaking seed production.

WA2332 is a mid tall, high yielding line adapted to Western Australia. It flowers slightly earlier than Carrolup and about a week to 10 days earlier than Kojonup. WA2332 is moderately resistant to stem rust and resistant to leaf rust in WA. It also has improved septoria resistance compared to Carrolup and Wandering. WA2332 is a potential milling variety. Hectolitre weight is similar to Kojonup and slightly lower than Carrolup. Screenings are similar to Carrolup and groat percent slightly lower than Carrolup and Mitika.

More detailed information including yield, quality and disease resistance attributes for these lines is included in sections 5 and 6 in this newsletter.

5. Long term grain trial results

Results for individual NVT and CVT trials are not presented in this newsletter. However, they are incorporated into the long term performance of varieties and advanced breeding lines which are presented in this newsletter in Tables 4 to 6. Grain yield and grain quality information for individual sites is available at the NVT web site: www.nvtonline.com.au.

Table 4 shows the relative yield performance of new varieties compared to existing varieties for four different states. Table 5 and 6 show the relative grain quality and Tables 7, 8, and 9 show the relative disease resistance characteristics for these varieties in different regions. Care needs to be taken to look at not only grain yield but grain quality and disease resistance characteristics to determine if a variety is suitable for your region.

Brochures are available for new varieties from the website, the SA and WA components of the NOBP and our commercial partners; AEXCO who commercialises our hay varieties, Viterra who commercialises the milling and feed varieties from the SARDI node of the National Oat Breeding Program and SeedNet for Bannister and Seedmark for any future WA released varieties.

5.1 Grain Variety Summary

Wombat[Φ]

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

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

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

Dunnart[Φ]

Dunnart (tested as SV98146-26) is a dwarf potential milling variety commercialised by Viterra. It averages about 10 to 15 cm taller than Possum, Wombat, and Mitika.

Dunnart is resistant and moderately tolerant to CCN with improved resistance to barley yellow dwarf virus (BYDV). It is moderately resistant to leaf rust.

Dunnart has slightly lower hectolitre weight and groat percent compared to Mitika, but lower screenings and higher grain weight.

Dunnart has improved plant colour compared to Mitika, Possum, and Wombat.

Bannister[Φ]

Bannister (tested as WA2354) is a tall dwarf potential milling quality high yielding oat suited to Western Australia. It has similar hectolitre weight, grain size and lower screenings than Kojonup and similar groat percent to Carrolup. Bannister is a mid season maturing oat similar in height and maturity to Wandering and is an improvement compared to other WA varieties for stem rust, leaf rust and septoria resistance.

Bannister is being commercialised by SeedNet in WA.

Yallara[Φ]

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

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

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

Mitika[Φ]

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

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

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

Possum[Φ]

Possum is a dwarf milling grain variety developed by SARDI and released with PBR in 2003. It was commercialised by AWB Seeds Ltd, and is a replacement for Echidna in medium and high rainfall areas.

Possum has similar yield to Echidna in high rainfall zones and slightly lower yield in medium rainfall zones. It has better milling quality than Echidna and has similar hectolitre weight and fewer screenings than Euro. It is an improvement compared to Echidna for stem rust, leaf rust, and septoria resistance. Like Echidna, Possum is susceptible to bacterial blight, moderately susceptible to BYDV and susceptible and intolerant to CCN.

Possum is not recommended for areas where cereal cyst or stem nematode is a problem. Possum is susceptible to red leather leaf and moderately intolerant of stem nematode.

WA2332

WA2332 is a mid tall, high yielding line adapted to Western Australia. It flowers slightly earlier than Carrolup and about a week to 10 days earlier than Kojonup. WA2332 is moderately resistant to stem rust and resistant to leaf rust in WA. It also has improved septoria resistance compared to Carrolup and Wandering. WA2332 is a potential milling variety. Hectolitre weight is similar to Kojonup and slightly lower than Carrolup. Screenings are similar to Carrolup and groat percent slightly lower than Carrolup and Mitika.

SV02203-46N

SV02203-46N is a dwarf naked line with improved yield potential compared to Numbat. It has improved stand establishment and good early vigour compared to Bandicoot and Numbat. SV02203-46N is an improvement for stem and leaf rust resistance and barley yellow dwarf virus resistance. Note if the Pga pathotype of stem rust is present it will be susceptible. SV02203-46N has similar hectolitre weight compared to Numbat, with a larger grain size and lower average screenings. Protein and oil are similar to Numbat.

Pamela talking about oat varieties at the Hart Field Day, 2012

Table 4. Average grain yields (t/ha) in four states and the average for all states for fourteen oat varieties (2005 to 2011) with the number of trials in brackets. Data courtesy National Oat Breeding Program, NVT Programs in SA, Vic and NSW and CVT Program in WA. Analysis by SAGI.

Variety	State				All Zones
	SA	VIC	NSW	WA	
Bannister	2.9 *(28)*	3.3 *(9)*	3.6 *(19)*	3.6 *(83)*	3.3 *(139)*
Carrolup (tall)	2.6 *(28)*	-	3.0 *(26)*	3.0 *(150)*	2.9 *(204)*
Dunnart	3.0 *(70)*	2.9 *(28)*	3.0 *(46)*	3.2 *(52)*	3.0 *(196)*
Echidna	-	-	-	-	-
Kojonup	3.0 *(51)*	2.9 *(16)*	3.0 *(32)*	3.3 *(150)*	3.0 *(249)*
Mitika	3.0 *(78)*	3.0 *(32)*	3.1 *(60)*	3.2 *(138)*	3.1 *(308)*
Possum	3.0 *(78)*	2.9 *(32)*	3.0 *(60)*	3.2 *(61)*	3.0 *(231)*
Potoroo	3.0 *(76)*	2.9 *(24)*	3.0 *(40)*	3.0 *(28)*	3.0 *(168)*
Wandering	3.0 *(32)*	-	3.3 *(17)*	3.4 *(151)*	3.2 *(200)*
Wombat	3.0 *(44)*	2.9 *(18)*	3.0 *(32)*	3.2 *(48)*	3.0 *(142)*
Yallara (tall)	2.8 *(78)*	2.7 *(32)*	2.9 *(58)*	3.0 *(122)*	2.8 *(290)*
WA2332 (tall)	3.0 *(24)*	3.4 *(9)*	3.7 *(19)*	3.7 *(73)*	3.4 *(125)*
Numbat (naked)	1.6 *(42)*	1.1 *(11)*	2.1 *(32)*	2.3 *(46)*	1.8 *(131)*
SV02203-46N	1.7 *(28)*	1.2 *(7)*	2.3 *(21)*	2.1 *(30)*	1.8 *(86)*

Table 5. Average physical and chemical grain quality (measured using NIR) characteristics for fourteen oat varieties (combined SA, Victoria, WA and NSW data), 2005 to 2011. Data courtesy National Oat Breeding Program. Analysis by Chris Lisle, SAGI.

Variety	Hectolitre weight kg/hl	1000 grain weight g	Screenings %<2 mm	NIR Protein %	NIR Oil %	NIR Groat %
Bannister	48.8	31.6	12.0	10.8	7.3	72.8
Carrolup (tall)	50.8	31.8	16.7	12.7	5.8	73.4
Dunnart	48.2	36.0	6.9	10.9	5.9	72.5
Echidna	47.2	29.9	14.6	10.9	6.1	71.6
Kojonup	48.2	31.8	11.8	12.7	5.8	75.9
Mitika	49.9	33.8	8.7	12.4	6.6	73.8
Possum	48.5	31.9	9.1	12.0	5.9	73.8
Potoroo	44.7	30.5	20.4	11.5	6.7	72.5
Wandering	47.8	30.9	14.6	12.0	6.3	71.9
Wombat	48.6	31.3	15.7	11.9	6.2	75.3
Yallara (tall)	50.7	32.2	9.8	11.2	4.9	76.9
WA2332 (tall)	48.1	30.4	16.1	11.1	6.8	71.7
Numbat (naked)	57.3	23.9	40.0	17.2	9.9	-
SV02203-46N	57.5	26.3	29.8	16.6	9.8	-
No. trials	*70*	*44*	*29*	*65*	*59*	*57*

Table 6. NIR measured Minolta L (2008-2011), NIR measured estimated metabolisable energy (2008-2011) and NIR β-glucan (2010-2011) characteristics for fourteen oat varieties (combined SA, Victoria, WA and NSW data). Data courtesy National Oat Breeding Program. Analysis by Chris Lisle, SAGI.

Variety	Minolta L	Estimated ME MJ/kg dm	B-glucan (dry basis)	Hull lignin
Bannister	55.8	11.7	5.0	High
Carrolup (tall)	56.5	11.5	4.5	High
Dunnart	56.3	11.4	4.0	High
Echidna	57.1	11.5	-	High
Kojonup	57.1	11.8	4.4	High
Mitika	54.7	12.5	4.8	Low
Possum	55.4	11.5	4.9	High
Potoroo	57.2	11.6	4.5	High
Wandering	57.7	11.4	4.5	High
Wombat	56.5	11.7	4.7	High
Yallara (tall)	58.6	11.5	4.0	High
WA2332 (tall)	56.7	11.5	4.4	Mod high
Numbat (naked)	-	14.3	-	-
SV02203-46N	-	14.2	-	-
No. trials	*29*	*29*	*11*	-

Table 7. Stem rust and leaf rust reactions for fourteen grain varieties in South Australia and Victoria and in New South Wales.

	SA and Victoria		New South Wales	
Variety	Stem rust[1] Field	Leaf rust[1] Field	Stem rust[1] Field	Leaf rust[1] Field
Bannister	MR-S	R	MS-S	MR-S
Carrolup (tall)	S	VS	S	S-VS
Dunnart	MR-S	MR	MR-MS	R-S
Echidna	S	S	S	S
Kojonup	S	VS	S	MS-VS
Mitika	MR-S	R	MR-S	MS-S
Possum	MS-S	MS	S	MS-S
Potoroo	S	S	S	MS-S
Wandering	S	VS	S	VS
Wombat	MS-S	MS	MS-S	MS-S
Yallara (tall)	MR-S	R	MR-MS	MS-S
WA2332 (tall)	MR	R	MR	MR
Numbat (naked)	MR-MS	R	MS	R
SV02203-46N	MR	R-MS	S	MS

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

Table 8. Stem rust, leaf rust, BYDV and septoria reactions for fourteen grain varieties in Western Australia.

Variety	Western Australia			
	Stem rust[1] Field	Leaf rust[1] Field	BYDV[2] Field	Septoria[1] Field
Bannister	R-MR	R	MS	S
Carrolup (tall)	MS	S	MS	S-VS
Dunnart	MR	MR	MR	S
Echidna	S	S	MS	S-VS
Kojonup	R-MS	S	MS	S-VS
Mitika	MR-S	R	S	S-VS
Possum	MR-S	MR	S	S-VS
Potoroo	MS	S	MS	S
Wandering	MS	VS	MR-MS	S-VS
Wombat	MR-S	S	MR	S
Yallara (tall)	MR-MS	R	MS	S
WA2332 (tall)	MR	R	MR-MS	MS
Numbat (naked)	MS	R	S	MS-VS
SV02203-46N	MR	R	MS	MS-S

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

Table 9. Septoria, bacterial blight, CCN, stem nematode and red leather leaf (spermospora) disease reactions for fourteen grain varieties grown in South Australia and Victoria.

Variety	Septoria[1]	Bacterial blight[1]	Red leather leaf[1]	CCN R[1]	CCN T[2]	Stem Nematode[2]
Bannister	-	MR-S	MS	VS	I	MI
Carrolup (tall)	MR	MR-S	S	S	I	VI
Dunnart	MS	MR-S	MS	R	MT	MT
Echidna	S	MS-S	MS	S	I	MT
Kojonup	MR	MS-S	MS	VS	I	MI
Mitika	S	MR	MS	VS	I	I
Possum	MS	MS-S	MS-S	VS	I	I
Potoroo	S	MS-S	S-VS	R	MT	MI
Wandering	S	MR-S	MS	VS	I	I
Wombat	MS	MR-MS	MS	R	MT	MT
Yallara (tall)	MS	MR-MS	VS	R	I	I
WA2332 (tall)	-	R	MS	S	I	I
Numbat (naked)	MR	S	MS	S	I	I
SV02203-46N	-	MR-S	MS	S	I	MI

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

[2] *T=tolerant, MT= moderately tolerant, MI=moderately intolerant, I=intolerant*

6. Long term hay trial results

Tables 10 to 16 show the long term hay yield and quality and grain yield of varieties in the hay series and tables 17 to 21 show the long term hay yield and quality and grain yield of varieties in the late hay series. Table 22 shows the disease reactions of current and new hay varieties in SA and Victoria.

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

6.1 Hay Variety Summary

Forester$^{\phi}$

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

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

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

Tammar$^{\phi}$

Tammar is a medium tall late variety that will be available in limited seed amounts from AEXCO in 2012. It is four to seven days later than Tungoo to cut.

Tammar also has an excellent disease resistance profile. It is moderately resistant to stem and leaf rust, septoria, BYDV, and bacterial blight. Tammar is the first late variety available with resistance to CCN and SN, tolerance to CCN, and moderate tolerance to SN.

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

Seed is available through AEXCO.

Mulgara$^{\phi}$

Mulgara was released in 2009 and commercialised by AEXCO. It is a tall mid season variety with excellent early vigour and good straw strength. Hay yield is lower than Wintaroo, but

hay quality is better than Wintaroo. Mulgara also retains good hay colour and resists brown leaf tipping. Grain yield is similar to Wintaroo, but Mulgara has slightly better grain quality with the exception of high hull lignin.

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

Tungoo$^{\phi}$

Tungoo was released in 2010. However, seed was not available until 2012, due to problems with commercial seed bulk-up. It is a medium tall mid to late season variety.

Tungoo has an excellent disease resistance profile. It combines resistance and moderate tolerance to CCN and SN. It also is resistant to leaf rust and the only variety with red leather leaf resistance. Tungoo is moderately resistant to BYDV, septoria, and bacterial blight and moderately susceptible to stem rust. It has the best combination of disease resistance compared to all other varieties except Tammar.

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

Seed is available through AEXCO.

Yallara$^{\phi}$

See section 1.1

Michelle weighing hay at the Riverton trial site, October 2012

Table 10. Average hay yield (t/ha) for sixteen oat varieties in three states during the period 2005 to 2011. Data courtesy National Oat Breeding Program. Analysis by Chris Lisle, SAGI.

Variety	South Australia	Victoria	Western Australia	All States
Bannister	7.7	8.2	8.6	8.4
Brusher	8.0	9.0	9.3	8.9
Carrolup	7.6	8.6	8.3	8.4
Eurabbie	7.7	7.9	9.0	8.5
Kangaroo	8.0	7.7	9.3	8.8
Mulgara	8.1	8.4	9.2	8.9
Swan	8.1	8.0	9.0	8.8
Tammar	7.8	8.0	8.8	8.6
Tungoo	7.9	7.6	9.0	8.6
Vasse	8.5	7.8	9.4	9.1
Wallaroo	7.7	8.4	8.3	8.4
Wandering	7.6	8.5	8.1	8.4
WAOAT2332	7.9	8.2	8.7	8.6
Winjardie	7.8	8.5	8.7	8.6
Wintaroo	8.5	8.7	10.0	9.4
Yallara	7.8	8.2	8.3	8.4
No. sites	*19*	*9*	*16*	*45*

Table 11. Average grain yield (t/ha) for sixteen oat varieties in three states during the period 2005 to 2011. Data courtesy National Oat Breeding Program. Analysis by Chris Lisle, SAGI.

Variety	South Australia	Victoria	Western Australia	All States
Bannister	3.2	3.9	3.0	3.1
Brusher	2.7	3.3	2.2	2.5
Carrolup	2.6	3.3	2.5	2.5
Eurabbie	2.9	3.4	2.7	2.8
Kangaroo	2.5	3.1	2.3	2.4
Mulgara	2.7	3.2	2.2	2.6
Swan	2.6	3.0	2.1	2.4
Tammar	2.3	3.0	2.0	2.1
Tungoo	2.5	3.2	2.3	2.3
Vasse	2.6	3.1	2.5	2.4
Wallaroo	2.6	3.2	2.2	2.5
Wandering	2.7	3.4	2.6	2.6
WAOAT2332	3.3	4.1	3.0	3.1
Winjardie	2.8	3.3	2.5	2.7
Wintaroo	2.8	3.3	2.3	2.6
Yallara	3.0	3.5	2.5	2.8
No. sites	29	9	22	*60*

Table 12. Average hay yield (t/ha) for sixteen oat varieties in seven years averaged for three states. Data courtesy National Oat Breeding Program. Analysis by Chris Lisle, SAGI.

Variety	2005	2006	2007	2008	2009	2010	2011
Bannister	9.8	4.8	7.4	7.0	9.6	8.3	10.5
Brusher	10.4	5.3	7.7	7.5	10.1	8.8	11.2
Carrolup	9.4	5.3	7.3	6.7	9.5	8.6	10.5
Eurabbie	10.2	4.4	7.6	7.3	9.9	7.9	10.4
Kangaroo	10.7	4.7	7.5	7.5	9.9	8.8	10.5
Mulgara	10.4	5.1	7.7	7.3	10.0	8.7	10.9
Swan	10.4	5.0	7.7	7.1	10.0	8.7	10.8
Tammar	10.2	4.8	7.7	7.0	9.9	8.3	10.5
Tungoo	10.3	4.5	7.5	7.2	9.8	8.3	10.4
Vasse	11.1	5.1	8.5	6.9	10.6	8.6	11.0
Wallaroo	9.6	5.3	7.4	6.6	9.6	8.7	10.4
Wandering	9.2	5.3	7.2	6.4	9.4	8.7	10.4
WAOAT2332	9.8	4.9	7.4	6.9	9.7	8.5	10.7
Winjardie	9.9	5.1	7.5	7.0	9.8	8.5	10.7
Wintaroo	11.5	5.3	8.5	7.7	10.9	9.0	11.5
Yallara	9.6	5.2	7.5	6.5	9.6	8.5	10.4
No. sites	*7*	*6*	*6*	*5*	*8*	*5*	*8*

Table 13. Average grain yield (t/ha) for sixteen oat varieties in seven years averaged over three states. Data courtesy National Oat Breeding Program. Analysis by Chris Lisle, SAGI.

Variety	2005	2006	2007	2008	2009	2010	2011
Bannister	3.9	2.2	2.9	1.8	3.4	3.5	4.1
Brusher	2.8	1.9	2.5	1.9	2.5	3.5	2.8
Carrolup	2.7	2.0	2.5	1.8	2.7	3.1	3.2
Eurabbie	3.8	2.1	2.6	1.6	3.0	2.8	3.5
Kangaroo	3.1	1.8	2.1	1.8	2.5	2.6	2.8
Mulgara	3.0	2.1	2.7	2.0	2.7	3.3	2.7
Swan	2.9	1.9	2.5	1.8	2.4	3.2	2.6
Tammar	2.8	1.2	1.5	1.6	1.9	2.8	2.7
Tungoo	2.8	1.6	2.1	1.7	2.3	3.0	2.9
Vasse	3.3	1.6	2.0	1.4	2.5	2.5	3.3
Wallaroo	2.8	2.0	2.5	1.9	2.5	3.3	2.6
Wandering	3.2	2.0	2.5	1.7	2.8	2.9	3.5
WAOAT2332	4.1	2.1	2.8	1.9	3.4	3.9	4.0
Winjardie	3.1	2.2	2.7	2.0	2.9	3.1	3.0
Wintaroo	3.1	2.1	2.6	2.0	2.7	3.2	2.7
Yallara	3.5	2.1	2.9	1.9	3.0	3.5	3.2
No. sites	*11*	*8*	*6*	*12*	*9*	*5*	*9*

Table 14. Average hay yield (t/ha) for sixteen oat varieties by rainfall zone averaged over three states for the period 2005 to 2011. Data courtesy National Oat Breeding Program. Analysis by Chris Lisle, SAGI.

Variety	<375mm	375-500mm	>500mm
Bannister	5.5	9.4	12.7
Brusher	5.9	10.0	13.0
Carrolup	5.5	9.4	12.2
Eurabbie	5.4	9.4	13.3
Kangaroo	5.6	9.8	13.5
Mulgara	5.9	9.8	13.1
Swan	5.9	9.7	13.1
Tammar	5.6	9.5	13.1
Tungoo	5.5	9.5	13.3
Vasse	6.2	10.0	13.8
Wallaroo	5.5	9.4	12.4
Wandering	5.6	9.3	12.1
WAOAT2332	5.7	9.5	12.7
Winjardie	5.6	9.6	12.7
Wintaroo	6.3	10.4	14.0
Yallara	5.6	9.4	12.5
No. sites	*12*	*29*	*4*

Table 15. Average grain yield (t/ha) for sixteen oat varieties by rainfall zone averaged over three states during the period 2005 to 2011. Data courtesy National Oat Breeding Program. Analysis by Chris Lisle, SAGI.

Variety	<375mm	375-500mm	>500mm
Bannister	2.3	3.6	4.3
Brusher	1.6	2.9	3.7
Carrolup	1.9	3.0	3.4
Eurabbie	2.0	3.2	4.1
Kangaroo	1.7	2.7	3.5
Mulgara	1.7	2.9	3.8
Swan	1.5	2.8	3.6
Tammar	1.4	2.6	3.3
Tungoo	1.7	2.8	3.4
Vasse	1.9	2.9	3.5
Wallaroo	1.6	2.8	3.6
Wandering	2.0	3.1	3.6
WAOAT2332	2.2	3.7	4.5
Winjardie	1.9	3.0	3.7
Wintaroo	1.7	2.9	3.9
Yallara	1.8	3.2	4.2
No. sites	*17*	*32*	*10*

Table 16. Average hay quality for sixteen oat varieties in three states during the period 2005 to 2011. Data courtesy National Oat Breeding Program. Analysis by Chris Lisle, SAGI.

Variety	Digestibility (%dm)	WSC* (%dm)	ADF* (%dm)	NDF* (%dm)	Metabolisable Energy (MJ/kg DM)	Crude Protein (%dm)
Bannister	65.2	25.9	29.5	49.2	9.4	8.7
Brusher	65.0	27.8	30.4	49.1	9.4	8.4
Carrolup	63.1	26.9	31.0	49.5	9.1	8.5
Eurabbie	67.4	28.0	27.7	46.9	9.8	8.9
Kangaroo	62.8	23.2	33.0	53.0	9.0	8.7
Mulgara	64.0	26.7	31.6	50.0	9.3	8.7
Swan	63.6	26.7	31.6	50.4	9.1	8.0
Tammar	63.8	24.3	31.5	50.8	9.2	8.7
Tungoo	64.0	24.5	32.0	52.1	9.2	8.8
Vasse	65.1	26.1	30.9	50.2	9.4	8.4
Wallaroo	63.5	25.7	31.9	51.1	9.1	8.5
Wandering	65.4	25.7	29.7	48.9	9.5	9.1
WAOAT2332	63.9	24.4	30.6	50.8	9.2	9.2
Winjardie	64.2	25.8	31.0	50.5	9.3	8.5
Wintaroo	63.0	25.3	32.2	50.9	9.0	8.2
Yallara	63.8	28.6	30.8	49.0	9.2	8.4
No. sites	*39*	*39*	*39*	*39*	*40*	*37*

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

Table 17. Average hay yield (t/ha) for nine oat varieties grown in late hay trials in two states and in medium and high rainfall zones during the period 2005 to 2011. Data courtesy National Oat Breeding Program. Analysis by Chris Lisle, SAGI .

Variety	South Australia	Victoria	375-500mm	>500mm	All Trials
Eurabbie	10.3	9.8	9.5	10.7	10.3
Forester	11.3	10.4	9.4	12.2	10.8
Glider	11.6	9.9	9.7	12.2	10.8
Kangaroo	12.5	9.8	10.8	12.5	11.2
Riel	11.3	10.3	9.5	12.2	10.9
Tammar	11.6	9.7	10.5	11.5	10.8
Targa	11.4	9.8	9.5	12.0	10.8
Tungoo	12.0	10.0	10.9	11.8	11.2
Vasse	12.0	9.8	11.0	11.6	11.1
No. Sites	*12*	*10*	*15*	*7*	*22*

Table 18. Average grain yield (t/ha) for nine oat varieties grown in late hay trials in two states and for two rainfall zones during the period 2005 to 2011. Data courtesy National Oat Breeding Program. Analysis by Chris Lisle, SAGI.

Variety	South Australia	Victoria	375-500mm	>500mm	All Trials
Eurabbie	2.0	3.9	3.1	5.6	3.7
Forester	1.3	2.4	1.7	3.7	2.2
Glider	1.5	2.7	2.1	3.9	2.5
Kangaroo	2.0	3.2	2.8	4.5	3.2
Riel	1.3	2.7	1.7	4.0	2.3
Tammar	2.0	2.9	2.7	4.1	3.1
Targa	1.3	3.1	1.9	4.6	2.6
Tungoo	1.7	2.6	2.6	3.8	2.9
Vasse	1.8	3.6	2.7	5.1	3.3
No. Sites	*16*	*8*	*19*	*5*	*24*

Table 19. Average hay yield (t/ha) for nine oat varieties grown in late hay trials by year during the period 2005 to 2010. Data courtesy National Oat Breeding Program. Analysis by Bev Gogel, SAGI

Variety	2005	2006	2007	2008	2009	2010	2011
Eurabbie	12.0	7.0	8.8	10.6	12.6	12.7	10.7
Forester	14.1	7.2	9.5	10.5	12.8	12.5	11.3
Glider	13.8	7.5	8.7	10.5	12.6	13.8	10.7
Kangaroo	14.2	7.3	8.3	10.8	13.6	15.3	11.7
Riel	13.9	7.3	9.8	10.6	12.5	13.0	11.2
Tammar	12.8	7.1	8.8	10.9	13.2	14.9	11.5
Targa	13.3	7.8	10.0	10.7	11.7	14.5	10.2
Tungoo	13.4	7.0	9.6	11.1	13.6	15.2	12.4
Vasse	13.2	6.9	9.3	11.1	13.7	15.4	12.3
No. Sites	*4*	*5*	*3*	*3*	*3*	*2*	*2*

Table 20. Average grain yield (t/ha) for nine oat varieties grown in late hay trials by year during the period 2005 to 2011. Data courtesy National Oat Breeding Program. Analysis by Chris Lisle, SAGI

Variety	2005	2006	2007	2008	2009	2010	2011
Eurabbie	4.7	3.0	3.9	2.0	2.8	2.6	2.3
Forester	3.0	1.0	1.8	1.3	0.7	0.7	1.5
Glider	3.2	1.3	2.3	1.5	1.3	1.1	1.8
Kangaroo	3.8	2.0	3.3	1.9	2.3	1.8	2.4
Riel	3.2	1.2	2.0	1.4	0.8	0.8	1.4
Tammar	3.5	1.7	3.1	1.8	2.2	1.7	2.5
Targa	3.7	1.7	2.3	1.4	1.1	1.2	1.4
Tungoo	3.6	1.8	2.8	1.6	1.9	1.9	2.1
Vasse	4.2	2.4	3.4	1.9	2.3	2.0	2.1
No. Sites	*5*	*3*	*3*	*8*	*4*	*2*	*3*

Table 21. Average hay quality for nine oat varieties grown in the late hay trials during the period 2005 to 2011. Data courtesy National Oat Breeding Program. Analysis by Chris Lisle, SAGI .

Variety	Digest-ibility (%dm)	WSC (%dm)	ADF (%dm)	NDF (%dm)	Metabolisable Energy (MJ/kg DM)	Crude Protein (%dm)
Eurabbie	65.7	27.5	28.5	47.9	9.6	8.6
Forester	64.6	25.9	29.4	48.9	9.4	8.5
Glider	63.6	23.7	30.6	51.4	9.2	9.3
Kangaroo	60.3	20.4	33.7	54.2	8.7	8.6
Riel	64.4	27.0	29.3	49.0	9.4	8.7
Tammar	61.3	21.7	32.8	53.5	8.8	8.8
Targa	62.8	23.9	30.6	50.9	9.1	8.6
Tungoo	62.0	22.6	32.2	52.4	9.0	8.8
Vasse	63.6	24.0	31.1	51.0	9.2	8.6
No. Sites	*12*	*14*	*15*	*15*	*12*	*14*

Table 22. Disease reactions in SA and Victoria and comparative stem diameter for current and new hay variety releases.

Variety	Stem rust[1]	Leaf rust[1]	BYDV[1]	Sep-toria[1]	Bacterial blight[1]	CCN R[1]	CCN T[2]	Stem Nematode R[1]	Stem Nematode T[2]	Red leather leaf[1]	Stem diam-eter[3]
Bannister	R-MR	R	MS	S	MR-S	MS	I	na	MI	MS	M
Brusher	MS-S	MR-MS	MS	MS	MR-MS	R	MI	MS	I	MR-MS	M
Carrolup	MS	VS	MS	S-VS	MR-S	S	I	MS	VI	S	M
Forester	R-S	MR-MS	MR-S	MR	MS-S	MS	MI	S	I	R-MR	MT
Kangaroo	MS-S	MS	MR-S	MR-MS	MR-MS	R	MT	MS	MI	MS	MF
Mulgara	MS-S	MR	MS	MS	MR	R	MT	R	MT	MS	M
Tammar	MR-S	MR	MS	MR	MR	MR	MT	R	MT	R-MS	MF
Tungoo	MS-S	MR	MR-MS	MR	MR	R	MT	R	MT	R	M
Wandering	MS	VS	MR-MS	S-VS	MR-S	VS	I	VS	I	MS	M
Wintaroo	S	MS	MR-MS	MR-MS	MR	R	MT	MR	MT	MS	M

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

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

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

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

Pete cutting hay at the Riverton trial site, October 2012