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Rust resistance genotypes and expected rust responses of Australian cereal varieties

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The rust responses for Australian cereal varieties provide growers and technical advisors with updated information to make informed rust control decisions. The varietal responses for wheat (common and durum), triticale, barley and oat presented in this report are the consensus opinion of Australian cereal pathologists and breeders and are based on the most recent field trial reports as well as previous data sets. They are developed in the context of the prevailing rust pathotypes recorded in 2022 by surveys undertaken by staff at the University of Sydney's Plant Breeding Institute. Gene postulations based on multi-pathotype tests (up to 12 pathotypes of each rust pathogen) and pathogen survey results help to explain regional rust response variation, and predict varietal vulnerability to rust. For each variety showing resistance, the nature of the resistance (ASR or APR) is indicated based on current understanding as determined by the resistance carried by a variety, its field response, and occurrence (presence/absence, frequency) and distribution of pathogen virulence. As our knowledge of APR genes in Australian cereal varieties improves, it will be possible to provide more detailed information regarding the genetic basis of APR in varieties and the level of protection the genes confer.

All Stage Resistance (ASR) versus Adult Plant Resistance (APR)

Resistance to rust pathogens in cereals can be expressed at all growth stages from primary leaf emergence onwards (All Stage Resistance (ASR), aka seedling resistance, major gene resistance), or at post seedling growth stages only (Adult Plant Resistance (APR), aka minor gene resistance). Genes conferring both types of resistance occur in Australian cereal varieties- some varieties carry ASR or APR, others carry both. The identities and effectiveness of most ASR genes present in Australian cereal varieties are well understood. Research on the genetic basis of rust resistance in especially wheat and barley over the past 25 years has greatly improved our understanding of the genes that confer APR; these studies have also shown that there are other genes conferring APR that while still uncharacterized are important in protecting against rust infection and hence yield loss. Research by the Australian Cereal Rust Control Program has permitted accurate determination of the presence/ absence of four APR genes in Australian wheat varieties (*Lr34/Yr18/Sr57*, *Lr46/Yr29/Sr58*, *Lr67/Yr46/Sr55*, *Sr2*) and three genes conferring APR to leaf rust in barley (*Rph20*, *Rph23*, *Rph24*). Two of the APR genes in wheat are known to be due to a single gene that confers resistance against all three rust pathogens (*Lr34/Yr18/Sr57* and *Lr67/Yr46/Sr55*), and the resistance

Lr46/*Yr29*/*Sr58* is similarly thought to be due to a single gene. The multiple ASR resistances *Lr37*/*Yr17*/*Sr38* and *Lr24*/*Sr24* each likely comprise separate genes that are inherited as a linkage block due their presence on chromosomal segments that were introgressed into wheat from alien grass species.

Disease response categories are summarized in **Table 1**. The colour coding in this table has been used in all tables to assist in highlighting strengths and potential weaknesses in varieties with respect to the rust diseases.

Wheat and triticale

Wheat (both common and durum) and triticale are affected by stem rust, leaf rust and stripe rust, caused by *Puccinia graminis* f. sp. *tritici*, *P. triticina*, and *P. striiformis* f. sp. *tritici*, respectively. In Australia, epidemics of all three rusts have occurred in common wheat, of stripe rust in durum wheat, and of stem rust and stripe rust in triticale.

The rust responses of current Australian common wheat, durum wheat, and triticale are provided in **Tables 2**, **3** and **4**, respectively.

Long-term nation-wide annual surveys of the virulence of the cereal attacking rust pathogens have been critical in understanding and predicting the responses of cereal varieties to rust diseases and providing direction for resistance breeding. The separation of the eastern and western Australian cereal belts, the common movement of rusts from west to east, and the less common movement of rusts from east to west, have resulted in some pathotypes (and hence virulences) occurring only in eastern Australia. This has important implications for the rust responses of varieties carrying resistance genes that are overcome by such pathotypes, if grown in the east and the west.

At present, there is little difference across Australia in the pathotypes of the pathogens that cause wheat stem rust and wheat leaf rust, and for this reason a single national response rating is provided for all varieties for each disease.

With stripe rust, virulences for the resistance genes *Yr1*, *Yr17*, *Yr27*, *Yr56* (in durum wheats), and for *YrJ, YrT* and *YrB* (in triticale only) occur only in eastern Australia. For this reason, separate ratings are provided where available for each variety for eastern and Western Australia. Virulences for two further resistance genes, *Yr4* and *Yr33*, were detected in eastern Australia in 2018 and 2017 in the pathotypes 198 E16 A+ J+ T+ 17+ ("198") and 239 E237 A- 17+ 33+ ("239"), respectively.

Both pathotypes 239 and 198 were widespread and reached damaging levels in some wheat crops in eastern Australia in 2020, 2021 and 2022. The biggest and most confusing aspect for some wheat growers over 2020-2022 has been changes in the responses of certain varieties as the frequencies of these pathotypes and the newer "238" (pt. 238 E191 A+ 17+ 33+) pathotype have changed. Because some varieties are resistant to 198 but susceptible to 239, the increased frequency of the 239 pathotype in 2021 meant that while such varieties displayed resistance in 2020, they were more susceptible in 2021 and 2022. Examples of this are Catapult, Coolah, LRPB Flanker, Rockstar, and Vixen, which carry resistance genes *Yr25*, *Yr33* or another uncharacterised resistance gene ("*Yr1A*", see below), all of which protect against pathotype 198 but not pathotype 239.

Adding to the confusion is that some varieties are more vulnerable to 198 than they are to 239- for example DS Bennett, Borlaug 100, EGA Wedgetail, Illabo, LRPB Kittyhawk, and LRPB Trojan. Pathotype 198 is also a greater threat to several varieties of durum wheat due to virulence for gene *Yr56* (*eg* DBA Artemis, DBA Bindaroi, DBA Lillaroi, DBA Spes, DBA Vittaroi and EGA Bellaroi; **Table 3**) and triticale due to virulence on gene *YrB* (Astute, Berkshire, Bison and Joey; **Table 4**).

The most significant changes in rust response ratings between eastern and Western Australia in recent years has been due to a series of changes in the pathotypes of wheat leaf rust in Australia and the movement of three leaf rust pathotypes from the eastern grains belt to WA (in 2013 [pathotype 76-1,3,5,7,9,10,12 +Lr37]; in 2015 [pathotype 104-1,3,4,6,7,8,10,12 +Lr37]; in 2017 [104-1,3,4,5,7,9,10,12 +Lr37]), which led to virulences for *Lr13* and *Lr27+31* in WA for the first time. These pathotypes shifted the leaf rust response of many varieties in WA towards increased susceptibility, varieties affected include Corack, Emu Rock, and Wyalkatchem. Pathotype 104-1,3,4,6,7,8,10,12 +Lr37 combines virulence for *Lr13*, *Lr27+31* and *Lr37*, and has rendered varieties carrying one or more of these resistances more susceptible in both eastern Australia and WA.

The complementary ASR leaf rust resistance genes *Lr27+31* have been used in Australian wheat breeding since Gatcher was released in 1969 (Park & McIntosh 1994). In addition to conferring resistance to leaf rust, gene *Lr27* is associated with the durable APR stem rust resistance gene *Sr2* and *Lr31* with the non-durable APR leaf rust resistance gene *Lr12* (Singh et al. 1999). Virulence for *Lr27+31* was first detected in the early

1970s and then became very common, and but was displaced after 1990 by the buildup of an exotic leaf rust pathotype avirulent for this resistance that was first detected in 1984 (Park et al. 1995). We showed that virulence for *Lr27+31* was completely associated with virulence for the APR gene *Lr12*, and that the ASR gene *Lr31* and APR gene *Lr12* are likely one and the same (Singh et al. 1999). Virulence for *Lr27+31* was not detected again until 2014, with the appearance of pathotype 104-1,3,5,6,7,10,12 +Lr37, and is now once again common not only in eastern Australia but also WA.

Virulence for resistance gene *Lr24* was first detected in eastern Australia in 2000 (Park et al. 2002). It has been detected in all but four years since then. The frequency of virulence for *Lr24* in eastern Australia has remained low since 2015, and was present in about 4% of isolates from eastern Australia in 2022. A single national rating for leaf rust response that does not take into consideration virulence for *Lr24* was assigned by the 2022 NVT panel. Eastern Australian Growers of all varieties carrying *Lr24* are advised nonetheless to monitor crops for leaf rust closely.

Three "new" ASR rust resistance genes in Australian wheat cultivars

The ability to recognize the presence of an ASR resistance gene in a variety depends on the presence of a rust pathotype carrying avirulence that matches the resistance gene. Three rust pathotypes of exotic origins detected in recent years carry avirulence for resistance genes that were previously unknown because all existing or older pathotypes were virulent on the genes. Although it sounds counter-intuitive, some varieties that were uniformly susceptible to all pathotypes of a particular rust are now resistant to some pathotypes because of the presence of these genes.

***Yr25*:** This gene was first identified by European researchers in the 1990s. Up until the detection of pathotype 198 in 2018, all Australian pathotypes of the wheat stripe rust pathogen were virulent on this resistance gene so it was not possible to determine its possible presence in Australian wheat varieties. Pathotype 198 was the first detection of avirulence for *Yr25* in Australia, and it has allowed us to identify this gene in at least seven varieties (**Table 2**) and explain why the resistance of these varieties performed better when pathotype 198 was dominant in 2020.

Yr1A: This is an undesignated ASR gene on chromosome 1A that pathotype 198 is avirulent for but for which all other pathotypes are virulent. We were able to detect the presence of in at least 15 varieties, some of which are currently grown (**Table 2**). Once again, varieties carrying this gene performed better in 2020 than they did in 2021 and 2022, because of the dominance of 198 in 2020.

***Lr82*:** This gene was recently mapped and designated by Bariana et al. (2022). It provides protection against pathotypes in the "76" lineage, as well as pathotypes 104-1,3,4,6,7,8,10,12 +Lr37 and 104-1,3,4,5,7,9,10,12 +Lr37. Our rust tests have shown that this gene is present in Correll, EG Titanium, Espada, Orion, Tungsten and Zircon (**Table 2**).

Barley

To date, there are 23 designated seedling resistance genes (*Rph1-19, Rph21-22, Rph25-27*; note that our recent research has demonstrated that the resistance conferred by *Rph15* and *Rph16* are mediated by the same gene) and three APR genes (*Rph20, Rph23* and *Rph24*) to *P. hordei*. Of these genes, Australian barleys primarily carry *Rph2*, *Rph3*, *Rph4*, *Rph7*, *Rph9.am* (allele of *Rph12*), *Rph12, Rph19 and Rph25*, and APR genes *Rph20*, *Rph23* and *Rph24*.

Annual surveys of pathogenic variability in *P. hordei* at the Plant Breeding Institute from 1992 to 2022 revealed significant shifts in the composition of populations across Australia over that time. Virulence for the resistance gene *Rph12*, first detected in a single pathotype in Tasmania in 1991 (*viz*. 4610 P+), was subsequently detected in 1993 in South Australia, Victoria and southern New South Wales (NSW). By the end of 2001, eight pathotypes with virulence for *Rph12* had been isolated and virulence for this gene was present in all Australian barley growing regions. Virulence for *Rph3* was first detected in pathotype 5457 P+ in northern NSW in 2008, and later detected independently in pathotype 5656 P+ in South Australia in 2011 and pathotype 5457 P- in Western Australia in 2013. Surveys since 1989 have demonstrated widespread virulence for *Rph1*, *Rph2*, *Rph3*, *Rph4*, *Rph6*, *Rph8*, *Rph9.am*, *Rph10*, *Rph12*, *Rph19* and *Rph25*, and rarer virulence for *Rph5*, *Rph7*, *Rph11*, *Rph13* and *Rph14*. Virulence has not been detected in Australia for the *H. vulgare* ssp. *spontaneum* derived gene *Rph15* or the *H. bulbosum* derived *Rph18*, *Rph22* and *Rph26*. These genes have not been utilized by Australian breeding programs and therefore unlikely to be present in Australian barleys. More detailed information on pathotype occurrence and distribution can be found in our Cereal Rust Update series.

Molecular markers linked very closely to the APR barley leaf rust resistance genes *Rph20*, *Rph23* and *Rph24* were developed under the GRDC funded project US00074. We applied these markers (bPb0837 and sun690-1 (Dracatos et al. 2021) linked to *Rph20*, EbMac0603 (Singh et al. 2015) linked to *Rph23* and sun43-4 (Dracatos et al. 2021) linked to *Rph24*) and predicted the presence of genes *Rph20*, *Rph23* and *Rph24* in the Australian barley varieties reported here (**Table 5**).

A "Nil" *Rph* gene postulation means that line does not carry any seedling resistance gene effective against any of the test pathotypes we used. Certain postulations marked as "?" indicate that such postulations are inconclusive, and these specific cultivars may require further testing.

Oat

When catalogued, genes conferring resistance to oat crown rust pathogen *Puccinia coronata* f. sp. *avenae* are given the designation "*Pc*", and those to the stem rust pathogen *P. graminis* f. sp. *avenae* "*Pg*".

At this time, 92 loci conferring resistance to *Pca* in *Avena* have been designated and accepted (*Pc1-Pc85*, *Pc91-Pc96*, *Pc98*). Unlike the catalogued rust resistance genes in wheat and barley, the allelic relationships and chromosomal locations of many of the catalogued *Pc* genes are unknown. Six loci are reported as conferring APR (*Pc27*, *Pc28*, *Pc69*, *Pc72*, *Pc73*, *Pc74*) and the remaining 86 conferring ASR. Multiple alleles at five loci have been reported: *Pc2* (*Pc2*, *Pc2b*), *Pc3* (*Pc3*, *Pc3c*), *Pc4* (*Pc4*, *Pc4c*), *Pc6* (*Pc6*, *Pc6c*, *Pc6d*) and *Pc9* (*Pc9* and *Pc9c*). Four pairs of complementary genes have been designated (*Pc3+Pc4*, *Pc3c+Pc4c*, *Pc7+Pc8*, *Pc24+Pc25*).

The crown rust and stem rust responses and genotypes of current Australian oat varieties are shown in **Table 6**. Postulating the resistance genes present in oat is more difficult than it is in wheat and barley, and this has been made more difficult by the heterogeneity of especially crown rust responses of more than 50% of the varieties tested (**Table 6**). Although heterogeneity in rust response is seen in wheat and barley, it is quite rare (*eg* only three of the 99 wheat varieties listed in **Table 2** are heterogeneous for rust resistance).

None of the ASR stem rust resistance genes listed in **Table 6** are effective in Australia as pathotypes with matching virulence have been detected from both eastern Australia and WA in our long running national pathogenicity surveys.

Virulence for all of the oat crown rust resistance genes listed in **Table 6** has also been documented in our national pathogenicity surveys. The frequency of virulence for some of these genes is however much more common in eastern Australia than it is in WA, and this likely accounts for the resistance of some varieties in WA. This includes *Pc38* (Yallara, MR), *Pc39*/*Pc55*/*Pc71* (Brusher, MR), *Pc48* (Williams, MR), Mulgara (*Pc58*, MR), and Tungoo (*Pc61*).

The genes *Pc39*/*Pc55*/*Pc71* have shown identical responses in our tests of over 1,400 isolates of *Pca* collected between 2000 and 2020, and 152 historical isolates dating back to the 1950s (Park et al. 2022). This and results from North America suggest that these genes are either identical or allelic. This resistance was postulated in the varieties Bannister, Durak, Mitika, and Koala, although the first three varieties are heterogeneous for it (**Table 6**).

Several oat varieties appear to carry moderate to low levels of APR to crown rust (eg Mulgara, Tungoo, Williams; **Table 6**). Our research over the past 25 years has identified many sources of APR to crown rust in oat in germplasm sourced from overseas, some of which provides high levels of resistance and holds great promise for future efforts to control this damaging rust disease.

Grazing oat varieties

Not included in **Table 6** are grazing oat varieties. Grown principally in NSW and Queensland, many of these were resistant to crown rust when released only to be rendered susceptible soon after because of the emergence of a new pathotype with virulence. These varieties include: Aladdin (*Pc91*), Comet (*Pc15*/*16*/or *17*, *Pc91*), Drover (*Pc91*), Genie (*Pc48, Pc56*), Moola (*Pc68*), Nile (*Pc1*, *Pc58*), Saia (*Pc15, Pc16, Pc17*), Taipan (*Pc48+*), Volta (*Pc50, Pc68*), and Wizard (*Pc50*, *Pc61*). Virulence emerged for all of the ASR genes in these varieties very soon after their release.

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Rusted Plant Samples

Can be mailed in paper envelopes; do not use plastic wrapping or plastic lined packages. If possible, include the latitude and longitude of the sample location, date of collection, cultivar, and your full contact details.

Direct rust samples to:

University of Sydney
Australian Rust Survey
Reply Paid 88076
Narellan NSW 2567

The Australian Cereal Rust Control Program is supported by growers through the Grains Research & Development Cooperation.

Table 1 Response descriptors for the rust diseases

Response	Description
R	highly resistant: occasional symptoms of infection including necrotic flecks; no sporulation
RMR	resistant: symptoms evident and usually with necrosis and chlorosis, limited sporulation, and affected leaf area up to 15%
MR	moderately resistant: evidence of sporulating areas on the leaf surface with some chlorosis and necrosis, and affected leaf area up to 30%
MRMS	intermediate: restricted sporulating areas with some chlorosis, and affected leaf area up to 50%
MS	moderately susceptible: freely sporulating lesions and affected leaf area up to 70%
MSS	moderately susceptible to susceptible: freely sporulating lesions with leaf area affected up to 90%
S	susceptible: abundant sporulation across the whole leaf surface; leaf area affected up to 100%; some chlorosis and necrosis evident
SVS	susceptible to very susceptible: abundant sporulation across the leaf surface; leaf area affected up to 100%; limited chlorosis
VS	highly susceptible: abundant sporulation across the whole leaf area with no evidence of chlorosis or necrosis; 100% leaf area affected

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Table 2: Leaf rust, stem rust and stripe rust response and disease resistance genotypes of Australian common wheat varieties

	Leaf rust				Stem rust				Stripe rust				
											NVT Consensus rating		
Variety	ASR* Lr genes**	APR* Lr genes**	NVT National Consensus rating	Resistance due to:~	ASR* Sr genes**	APR* Sr genes**	NVT National Consensus rating	Resistance due to:~	ASR* Yr genes**	APR* Yr genes**	2022 Eastern States	2021 WA	EA Resistance due to:~
Anapurna	*Lr1, Lr3a, Lr17a, Lr37*	***Lr46***	MS	APR	*Sr38*	***Sr58***	MSS	APR	*Yr4, Yr17, Yr27*	***Yr29***	RMR	RMR	APR
Ascot	*Lr1, Lr3a, Lr37*	***Lr46***	RMR	APR	*Sr38*	***Sr2, Sr58***	MRMS	APR	*Yr6, Yr17*	***Yr29***	MSS	R	APR
Ballista	*Lr3a, Lr13, Lr37*	***Lr46***	S	APR	*Sr38*	***Sr58***	MR	APR	*Yr17, Yr27*	***Yr29***	MSS	RMR	APR
Beckom	*Lr3a, Lr37*	***Lr34, Lr46***	MSS	APR	*Sr9b, Sr38*	***Sr57, Sr58***	MRMS	APR	*Yr7?, Yr17*	***Yr18, Yr29***	MRMS	MR	APR
BigRed	*Lr3a, Lr13*	***Lr46***	MRMS	APR	Nil	***Sr58***	S	APR	*Yr1*	***Yr29***	RMR	No rating	APR
Boree	*Lr3a, Lr13, Lr37*	***Lr46***	S	APR	*Sr8a or Sr9b, Sr38*	***Sr58***	MR	APR	*Yr17+*	***Yr29***	SVS	MR	None
Borlaug 100	*Lr27+31, Lr37*	***Lr46***	MR	APR	*Sr8a or Sr9b, Sr38*	***Sr2***	MR	APR	*Yr17, Yr27*	***Yr29***	SVS	R	APR
Brumby	*Lr3a, Lr13, Lr20, Lr37*	***Lr46***	SVS	None	*Sr38*	***Sr58***	MR	APR	*Yr17, Yr33*	***Yr29***	MS	No rating	APR
Calibre	*Lr3a, Lr13, Lr37*	***Lr46***	S	APR	*Sr38*	***Sr58***	MR	APR	*Yr17*	***Yr29***	S	RMR	APR
Catapult	*Lr3a, Lr13*	***Lr46***	S	APR	*Sr8a,* ***Sr30***	***Sr58***	MR	ASR (Sr30)	*Yr25* (Het.)	***Yr29***	S	RMR	APR
Chief CL Plus	*Lr20,* ***Lr24***	***Lr46***	MR	APR	*Sr15,* ***Sr24***	***Sr58***	MR	ASR (Sr24)	Nil	***Yr29***	SVS	S	None
Condo	*Lr3a*	***Lr34***	S	APR	*Sr9g*	***Sr57***	MR	APR	*Yr7, Yr25* (Het.), *Yr27*	***Yr18***	MS	MR	APR
Coolah	*Lr3a,* ***Lr23***	***Lr34, Lr46***	RMR	ASR (*Lr23*)	*Sr8a,* ***Sr30***	***Sr57, Sr58***	MR	ASR (Sr30)	*Yr3, Yr25, Yr33*	***Yr18, Yr29***	MSS	RMR	APR
Coota	*Lr1, Lr13, Lr27+31, Lr37*	***Lr46***	MR	APR	*Sr12, Sr38*	***Sr2, Sr58***	RMR	ASR +APR	*Yr6, Yr17*	***Yr29***	S	MR	APR
Corack	*Lr3a, Lr13, Lr20* (Het.)	***Lr46***	SVS	None	*Sr8a,* ***Sr30***	***Sr58***	MR	ASR (Sr30)	Nil	***Yr29***	MSS	MS	APR
Cosmick	*Lr13, Lr37, Lr73*	***?***	SVS	None	*Sr8a,* ***Sr30***	***?***	MS	ASR (Sr30)	*Yr3, Yr25*	***?***	MSS	No rating	APR
Cutlass	*Lr3a,* ***Lr24****, Lr37*	***Lr34, Lr46***	RMR	ASR (*Lr24*)*	***Sr24****, Sr38*	***Sr57, Sr58***	R	ASR (Sr24)	*Yr17*	***Yr29***	MSS	RMR	APR
Denison	*Lr3a*	***Lr46***	S	None	*Sr12, Sr38*	***Sr2, Sr58***	MS	ASR +APR	*Yr?, Yr17*	***Yr29***	S	MR	APR
Devil	*Lr3a, Lr13 or 37?*	***Lr46***	SVS	None	*Sr8a, Sr9b,* ***Sr30***	***Sr58***	S	ASR (Sr30)	Nil	***Yr29***	SVS	MR	APR
DS Bennett	*Lr13*	***Lr46***	SVS	None	*Sr17,* ***Sr30***	***Sr58***	MS	ASR (Sr30)	Nil	***Yr29***	S	R	None
DS Faraday	*Lr3a, Lr27+31*	***Lr34***	R#	APR	***Sr12****,* ***Sr26***	***Sr57***	RMR	ASR (Sr12+ Sr26)	*Yr3, Yr6, YrA, Yr1A*	***Yr18***	MS	MR	APR
DS Pascal	*Lr13, Lr27+31*	***Lr46***	MS	APR	*Sr5,* ***Sr30***	***Sr58***	MSS	ASR (Sr30)	*Yr3, Yr6, Yr25, YrA*	***Yr29***	MRMS	RMR	APR
DS Tull	*Lr1*	***Lr34***	MSS	APR	*Sr9g,* ***Sr30***	***Sr57***	MR	ASR (Sr30)	*Yr7+*	***Yr18***	MS	RMR	APR
EG Jet	*Lr3a, Lr13, Lr37*	***Lr46***	S	None	*Sr38*	***Sr58***	S	None	*Yr17*	***Yr29***	MRMS	RMR	APR
EG Titanium	*Lr27+31, or Lr82*	***Lr46***	MSS	APR	*Sr30+?*	***Sr58***	MS	ASR	?	***Yr29***	MR	RMR	APR
EGA Gregory	*Lr3a,* ***Lr23***	***Lr34***	RMR#	ASR (*Lr23*)	*Sr8a,* ***Sr12****,* ***Sr30***	***Sr57***	MR	ASR (Sr12+ Sr30)	*Yr33, Yr1A*	***Yr18***	MS	MR	APR
EGA Wedgetail	*Lr13*	***Lr34, Lr46***	MSS	APR	*Sr9g,* ***Sr30***	***Sr57, Sr58***	MRMS	ASR (Sr30)	*Yr3, Yr7*	***Yr18, Yr29***	MS	MS	APR
Einstein	Fungicide treated seed	***Lr46***	S	APR?	Fungicide treated seed	***Sr58***	S	APR	Fungicide treated seed	***Yr29***	RMR		
Elmore CL Plus	***Lr24****+*	***Lr34***	RMR	ASR (*Lr24*)*	***Sr24****+*	***Sr57***	MR	ASR (Sr24)	*Yr3, Yr7, Yr1A*	***Yr18***	MS	MRMS	APR
Emu Rock	*Lr13, Lr27+31, Lr73*	***Lr46***	SVS	None	*Sr8a, Sr9g,* ***Sr30***	***Sr2, Sr58***	MS	ASR (Sr30)	*Yr4, Yr7*	***Yr29***	SVS	MRMS	APR
Grenade CL Plus	*Lr1, Lr37*	***Lr46***	SVS	None	*Sr5, Sr8a,* ***Sr12****, Sr38*	***Sr58***	MR	ASR (Sr12)	*Yr4, Yr17*	***Yr29***	MRMS	RMR	APR
Hammer CL Plus	*Lr3a, Lr13, Lr37*	***Lr46***	S	None	*Sr38*	***Sr2, Sr58***	MR	APR	*Yr17*	***Yr29***	MS	RMR	APR
Illabo	*Lr27+31, Lr37*	***Lr46***	S	None	*Sr9b, Sr38*	***Sr58***	MRMS	APR	*Yr17+*	***Yr29***	MRMS	RMR	APR
Jillaroo	*Lr3a, Lr13, Lr37*	***Lr46***	S	APR	***Sr30***	***Sr2***	MS	ASR (Sr30)	*Yr6, Yr33, Yr1A*	***Yr29***	MSS	No rating	APR
Kinsei	*Lr3a, Lr37+*	***Lr46***	MSS	ASR (?)	*Sr6, Sr8a+*	***Sr58***	MSS	APR	*Yr3, Yr17*	***Yr29***	MSS	MRMS	APR
LG Gold	*Lr1, Lr3a, +?*	***Lr46***	S	None	Nil	***Sr58***	MSS	APR	*Yr3*	***Yr29***	SVS	RMR	None
Longsword	*Lr3a, Lr13, Lr37*	***Lr46***	MR#	APR	***Sr30****, Sr38*	***Sr58***	MR	ASR (Sr30)	*Yr17, Yr27*	***Yr29***	R/S	RMR	APR
LRPB Avenger	*Lr3a, Lr13, Lr37*	***Lr46***	S	APR	*Sr8a or 9b, Sr38*	***Sr58***	MS	APR	*Yr4, Yr25*	***Yr29***	S	No rating	
LRPB Bale	*Lr1, Lr13, Lr37*	***Lr46***	MSS	APR	*Sr8a or 9b, Sr38*	***Sr58***	MRMS	APR	*Yr17*	***Yr29***	MRMS	No rating	APR
LRPB Beaufort	*Lr13, Lr37*	***Lr46***	S	APR	*Sr6, Sr11, Sr38*	***Sr58***	SVS	None	*Yr1, Yr17*	***Yr29***	RMR	RMR	APR
LRPB Cobra	*Lr1, Lr3a, Lr13, Lr27+31*	***Lr46***	MR#	APR	*Sr8a, Sr9g, Sr30+*	***Sr2, Sr58***	MR	ASR (Sr30)	*Yr7*	***Yr29***	S	MSS	APR
LRPB Dual	*Lr27+31, Lr37*	***Lr46***	MSS	APR	*Sr8a or 9b, Sr38*	***Sr58***	MRMS	APR	*Yr17*	***Yr29***	MS	No rating	APR
LRPB Flanker	*Lr3a,* ***Lr23***	***Lr34***	RMR#	ASR (*Lr23*)	*Sr8a, Sr9g,* ***Sr30****+*	***Sr57***	RMR	ASR (Sr30)	*Yr7, Yr1A*	***Yr18***	MRMS	RMR	APR
LRPB Havoc	*Lr27+31, Lr37*	***Lr46***	S	APR	*Sr9g, Sr38*	***Sr58***	S	None	*Yr7, Yr17+*	***Yr29***	MSS	MR	APR
LRPB Hellfire	*Lr1*	***Lr46***	MSS	APR	*Sr9g,* ***Sr26***	***Sr58***	MR	ASR (Sr26)	*Yr7*	***Yr29***	MRMS	RMR	APR

LRPB Impala	*Lr37*	***Lr34***	SVS	None	*Sr5*, ***Sr12***, *Sr38+*	***Sr57***	MR	ASR (Sr12)	*Yr17+*	***Yr18***	MRMS	MR	APR
LRPB Kittyhawk	*Lr13, Lr37*	***Lr34***	MR	APR	*Sr38*	***Sr57***	MRMS(S)	APR	*Yr3, Yr7, Yr17*	***Yr18***	MR	RMR	APR
LRPB Lancer	***Lr24***	***Lr34***	RMR#	ASR (*Lr24*)*	***Sr24, Sr36***	***Sr57***	R	ASR (Sr24+ Sr36)	*Yr6, Yr1A* (Het.)	***Yr18***	RMR	RMR	APR
LRPB Mustang	*Lr37*	***Lr34***	MSS	APR	*Sr5, Sr9g,* ***Sr30***	***Sr57***	MRMS	ASR (Sr30)	*Yr7, Yr1A*	***Yr18***	RMR	RMR	APR
LRPB Nighthawk	*Lr1*	***Lr34***	MSS	APR	*Sr5,* ***Sr30***	***Sr57***	RMR	ASR (Sr30)	*Yr4*	***Yr18***	MRMS	RMR	APR
LRPB Nyala	*Lr3a* (Het.)	***Lr34***	S	None	*Sr5, Sr38+*	***Sr57***	SVS	None	*Yr17+*	***Yr18***	MS	RMR	APR
LRPB Orion	*Lr1, Lr13,* ***Lr24****, Lr37*	***Lr46***	R	ASR (*Lr24*)*	***Sr24****, Sr38*	***Sr58***	MR	ASR (*Sr24*)	*Yr17*	***Yr29***	MS	MR	APR
LRPB Oryx	***Lr24***	***Lr34***	RMR#	ASR (*Lr24*)*	***Sr24, Sr36***	***Sr57***	MR	ASR (Sr24+ Sr36)	Not tested	***Yr18***	MS	RMR	
LRPB Parakeet	*Lr1,* ***Lr24****, Lr37*	***Lr34***	R	ASR (*Lr24*)*	***Sr24, Sr36****, Sr38*	***Sr57***	MR	ASR (Sr24+ Sr36)	*Yr4, Yr17+*	***Yr18***	MR	RMR	APR
LRPB Raider	*Lr13, Lr27+31*	***Lr34***	R#	APR	*Sr38*	***Sr57***	RMR		*Yr17*	***Yr18***	MR	RMR	
LRPB Reliant	*Lr3a,* ***Lr23***	***Lr34***	RMR	ASR (*Lr23*)	***Sr36+***	***Sr57***	R	ASR (Sr36)	*Yr33*	***Yr18***	MR	RMR	APR
LRPB Scout	*Lr1, Lr37*	***Lr46***	MS	APR	*Sr8a or 9b, Sr38*	***Sr58***	MRMS	APR	*Yr17+*	***Yr29***	MS	No rating	APR
LRPB Spitfire	*Lr1*	***Lr46***	S	APR	***Sr26***	***Sr2****,* ***Sr58***	MR	ASR (Sr26)	*Yr7*	***Yr29***	MR(S)	MR	APR
LRPB Stealth	***Lr24***	***Lr34, Lr46***	RMR#	ASR (*Lr24*)*	***Sr24***	***Sr2, Sr57, Sr58***	R	ASR (*Sr24*)	?	***Yr18, Yr29***	RMR	RMR	APR
LRPB Trojan	***Lr23***	***Lr46***	MR#	ASR (*Lr23*)	*Sr6,* ***Sr30***	***Sr2, Sr58***	MRMS	ASR (*Sr30*)	Nil	***Yr29***	S	MR	APR
Mace	*Lr3a, Lr13, Lr20, Lr37*	***Lr46***	S	APR	*Sr8a,* ***Sr30****, Sr38*	***Sr2***	MRMS	ASR (*Sr30*)	*Yr17*	***Yr29***	SVS	No rating	None
Magenta	*Lr1, Lr24*	***Lr46***	RMR	ASR (*Lr24*)*	***Sr24***	***Sr58***	MR	ASR (*Sr24*)	*Yr6* and/or *Yr7*	***Yr29***	S	No rating	APR
Manning	***Lr23****, Lr26, Lr37*	?	MSS	ASR (*Lr23*)	***Sr31****, Sr38*	?	MR	ASR (*Sr31*)	*Yr9, Yr17, Yr1A*	**?**	RMR	RMR	APR
Mitch	*Lr13, Lr27+31*	***Lr46***	MSS	APR	*Sr9g,* ***Sr30***	***Sr2, Sr58***	MRMS	ASR (*Sr30*)	Nil	***Yr29***	MRMS	MR	APR
Naparoo	*Lr24, Lr37*	?	MS	APR	***Sr24****, Sr38*	?	MRMS	ASR (*Sr24*)	*Yr17+*	**?**	MR	No rating	APR
Ninja	*Lr3a, Lr13*	***Lr46***	S	APR	*Sr9b*	***Sr58***	S	APR	*Yr7*	***Yr29***	MSS	No rating	APR
Razor CL Plus	*Lr3a, Lr37*	***Lr46***	S	None	*Sr8a or 9b, Sr38*	***Sr58***	MR	APR	*Yr17*	***Yr29***	MS	RMR	APR
Rebel 65	*Lr1, Lr13, Lr27+31*	***Lr46***	MSp	APR	*Sr17, Sr38*	***Sr2, Sr58***	MSSp	APR	*Yr17*	***Yr29***	MSSp	No rating	APR
Rebel Rat	*Lr23, Lr37*	***Lr46***	MSS	APR	*Sr17, Sr38*	***Sr58***	MRMS	APR	*Yr4, Yr17, Yr73+74*	***Yr29***	MSp	No rating	APR
RGT Accroc	*Lr13*	***Lr46***	SVS	None	*Sr8a, Sr9g*	***Sr58***	MS	APR	*Yr7+*	***Yr29***	RMR	R	APR
RGT Calabro	*Lr37*	***Lr46***	MSS	APR	*Sr8a or 9b, Sr38*	***Sr58***	MS	APR	*Yr7, Yr17*	***Yr29***	RMR	RMR	APR
RGT Cesario	*Lr13,* ***Lr24****, Lr37?*	***Lr46***	RMR	ASR (*Lr24*)*	***Sr24***	***Sr58***	R	ASR (*Sr24*)	*Yr7+*	***Yr29***	RMR	R	APR
RGT Ivory	***Lr28***	***Lr46***	MR#	ASR (*Lr28*)*	Nil	***Sr58***	SVS	None	*Yr8??*	***Yr29***	MR	MR	APR
RGT Zanzibar	*Lr37*	***Lr46***	SVS	None	*Sr38*	***Sr58***	VS	None	*Yr17+*	***Yr29***	MRMS	R	APR
RockStar	*Lr3a, Lr20*	***Lr46***	S	None	*Sr9g, Sr15,* ***Sr30***	***Sr58***	MR	ASR (Sr30)	*Yr7, Yr17, Yr25*	***Yr29***	S	RMR	APR
Scepter	*Lr3a, Lr27+31, Lr37+*	***Lr46***	MSS	APR	*Sr8a, Sr9g, Sr38*	***Sr2****,* ***Sr58***	MRMS	APR	*Yr17, Yr25*	***Yr29***	MSS	MR	APR
SEA Condamine	*Lr27+31*	***Lr46***	RMR#	APR	***Sr26***	***Sr58***	MRMS	ASR (Sr26)	Nil	***Yr29***	MS	MR	APR
Severn	*Lr13, Lr37*	***Lr46***	MRMS	APR	*Sr38+?*	***Sr58***	MS	APR	*Yr17*	***Yr29***	RMR	RMR	APR
Sheriff CL Plus	*Lr3a, Lr13, Lr20*	***Lr46***	SVS	None	*Sr8a, Sr15+*	***Sr58***	MS	APR or seedling?	Nil	***Yr29***	S	MS	APR
SQP Revenue	*Lr20, Lr27+31, Lr37*	***Lr46***	VS	None	*Sr15, Sr38*	***Sr58***	RMR	APR	*Yr17+*	***Yr29***	RMR	R	APR
Sting	*Lr3a, Lr13, Lr37*	***Lr46***	SVS	None	*Sr38*	***Sr58***	MRMS	APR	*Yr17*	***Yr29***	S	MR	None
Sunblade CL Plus	*Lr1, Lr3a, Lr27+31, Lr37*	**-**	MSS	APR	*Sr5, Sr38*	***Sr2***	MS	APR	*Yr17*	**-**	MRMS	MR	APR
Suncentral	*Lr1, Lr3a, Lr13, Lr27+31*	***Lr46***	RMR	APR	*Sr30*	***Sr2, Sr58***	MRMS	ASR (*Sr30*) + APR	?	***Yr29***	MSS	MR	APR
Sunchaser	***Lr24****,* ***Lr23***	***Lr34***	R	ASR (*Lr24*)*	***Sr24***	***Sr57***	MR	ASR (Sr24 + Sr26)	?	***Yr18***	RMR	RMR	APR
Sunflex	*Lr3a, Lr27+31, Lr37*	***Lr46***	RMR/S	ASR	*Sr38*	***Sr2, Sr58***	MR	APR	*Yr17, Yr27?*	***Yr29***	MRMS	RMR	APR
Sunlamb	*Lr37*	***Lr46***	MRMS	APR	*Sr38+*	***Sr2, Sr58***	RMR	ASR (Sr26)	*Yr3, Yr17, Yr27*	***Yr29***	MR	MR	APR
Sunmaster	*Lr3a, Lr27+31, Lr37*	?	RMR#	APR	*Sr38*	?	MS	APR	*Yr17*	?	MRMS	MR	APR
Sunmate	*Lr3a, Lr27+31, Lr37*	***Lr46***	MR	APR	***Sr30****, Sr38*	***Sr2, Sr58***	MRMS	ASR (Sr30)	*Yr17, Yr27*	***Yr29***	MR	R	APR
Sunmax	*Lr1, Lr20, Lr27+31, Lr37*	***Lr46***	MS	APR	*Sr8a or Sr9b, Sr38*	***Sr2, Sr58***	MRMS	APR	*Yr15, Yr17+*	***Yr29***	RMR	RMR	ASR
Sunprime	*Lr13,* ***Lr23***	***Lr34, Lr46***	MR#	ASR (*Lr23*)	*Sr8a, Sr9g,* ***Sr30***	***Sr57, Sr58***	MRMS	ASR (Sr30)	*Yr7, Yr1A*	***Yr18, Yr29***	MS	RMR	APR
Suntime	*Lr1, Lr27+31, Lr37*	***Lr46***	MS	APR	*Sr8a,* ***Sr30****, Sr38*	***Sr2, Sr58***	MS	ASR (Sr30)	*Yr17*	***Yr29***	MR	RMR	APR
Suntop	*Lr3a, Lr27+31, Lr37*	?	MR	APR	***Sr30****, Sr38*	***Sr2***	MRMS	ASR (Sr30)	*Yr31*	**?**	MRMS	MR	APR
Supreme	*Lr24, Lr37*	***Lr46***	RMR	ASR (*Lr24*)*	***Sr24****, Sr38*	***Sr58***	MRMS	ASR (*Sr24*)	*Yr17, Yr25*	***Yr29***	MS	No rating	APR
Tungsten	*Lr27+31,* ***Lr82***	?	MS#	ASR (*Lr82*)*	***Sr30***	?	MRMS	ASR (Sr30)	*Yr33*	***Yr18***	MS	RMR	APR
Valiant CL Plus	*Lr3a, Lr37*	***Lr46***	S	None	*Sr38+?*	***Sr58***	MR	ASR	*Yr3, Yr17*	***Yr29***	MSS	RMR	APR
Vixen	*Lr3a, Lr20, Lr37*	***Lr46***	SVS	None	*Sr8a, Sr9g,* ***Sr30****, Sr38*	***Sr58***	MRMS	ASR (Sr30)	*Yr7, Yr17+*	***Yr29***	SVS	MRMS	APR
Wyalkatchem	*Lr3a, Lr13, Lr20* (Het.)	***Lr46(H)***	S	None	*Sr8a, Sr9g, Sr15* (Het.)	***Sr2****,* ***Sr58******	MSS	APR	Nil	***Yr29***	VS	S	None

Yitpi	*Lr13*	***Lr46***	S	None	***Sr30***	***Sr58***	S	ASR (Sr30)	*Yr4+*	***Yr29***	MS	MRMS	APR
Zen	*Lr13, Lr20*	***Lr46***	S	APR	*Sr8a, Sr15*	***Sr58***	S	APR	Nil	***Yr29***	S	No rating	APR

* ASR= All Stage Resistance, APR= Adult Plant Resistance
** Genes in **bold** face are still effective against all current pathotypes in Australia
~ Indicates what the major component of the resistance of a cultivar is due to. NB in most cases where effective ASR and APR occur together, both resistances will contribute to the cultivar response.
/ Indicates alternate responses to different pathotypes. Mostly used when a cultivar may be more susceptible to a rare pathotype
+ or ? Indicate the presence of an uncharacterised resistance gene
Het Indicates a mixed (heterogeneous) response to the disease or for the presence of a resistance gene
p Indicates a provisional rating that requires further testing to validate
Used as a warning, used when the response to a new or rare pathotype is unknown

Table 3: Leaf rust, stem rust and stripe rust response and disease resistance genotypes of Australian durum wheat varieties

	Leaf rust			Stem rust			Stripe rust		
		2021 NVT consensus	Resistance		2021 NVT consensus	Resistance		2021 NVT consensus	
Variety	ASR* Lr genes**	National	due to~:	ASR* Sr genes**	National	due to:~	ASR* Yr genes**	Eastern states	WA
Bitalli	**?**	MR	ASR	*Sr9e*+	RMR	ASR	*Yr4, Yr6, Yr56*	MRMS	MR
Caparoi	**?**	RMR	ASR	?	MR	ASR	*Yr56*	MS	MR
DBA Artemis	**?**	RMR	ASR	?	MR	ASR	*Yr7, Yr56*	MR	RMR
DBA Bindaroi	**?**	MR	ASR	?	MRMS	ASR	*Yr4, Yr56*	MS	RMR
DBA Lillaroi	**?**	RMR	ASR	?	RMR	ASR	*Yr4, Yr56*	MS	RMR
DBA Mataroi	**?**	MR	ASR	?	MR	ASR	**?**	MR	RMR
DBA Spes	**?**	R	ASR	?	R	ASR	*Yr7, Yr56*	MS	RMR
DBA Vittaroi	**?**	RMR	ASR	*Sr9g*+	MR	ASR	*Yr4, Yr56*	MS	MR
DBA Aurora	**?**	R	ASR	*Sr9e*+	RMR	ASR	*Yr7, Yr56*	MRMS	RMR
EGA Bellaroi	**?**	RMR	ASR	*Sr9g*+	MR	ASR	*Yr4, Yr56*	MS	RMR
Jandaroi	**?**	MRMS	ASR	?	R/MSS	ASR	*Yr4, Yr7*+	MR	MR
Westcourt	**?**	RMR	ASR	?	RMR	ASR	**?**	MR	RMR

* ASR= All Stage Resistance, APR= Adult Plant Resistance
** Genes in **bold** face are still effective against all current pathotypes in Australia
~ Indicates what the major component of the resistance of a cultivar is due to. NB in most cases where effective ASR and APR occur together, both resistances will contribute to the cultivar response.
/ Indicates alternate responses to different pathotypes. Mostly used when a cultivar may be more susceptible to a rare pathotype
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Het Indicates a mixed (heterogeneous) response to the disease or for the presence of a resistance gene
p Indicates a provisional rating that requires further testing to validate
Used as a warning, used when the response to a new or rare pathotype is unknown

Plant Breeding Institute

Table 4: Leaf rust, stem rust and stripe rust response and disease resistance genotypes of Australian triticale varieties

	Leaf rust			Stem rust			Stripe rust			
		2021 NVT consensus	Resistance		2021 NVT consensus	Resistance		2021 NVT consensus		Resistance
Variety	ASR* Lr genes**	National	due to:~	ASR* Sr genes**	National	due to:~	ASR* Yr genes**	Eastern states	WA	due to:~
Astute	**?**	RMR	ASR	**?** *(+Sr9g?)*	RMR	ASR	*YrJ* &/or *YrT, YrB*	MSS	RMR	APR (ES) or ASR (WA)
Cartwheel	**?**	R	ASR	***SrSatu***+	R	ASR	**?**	RMR	R	ASR
Fusion	**?**	R	ASR	***SrSatu***+	R	ASR	*Yr4, YrJ* &/or *YrT*	S	RMR	ASR (WA)
Goanna	**?**	RMR	ASR	***SrNin***, ***SrSatu*** *(+Sr9g?)*	R	ASR	*YrJ* &/or *YrT*	SVS	RMR	ASR (WA)
Joey	**?**	RMR	ASR	***SrNin*** *(+Sr9g?)*	S	ASR	*Yr4, YrJ* &/or *YrT, YrB*	MSS	MR	APR (ES) or ASR (WA)
KM10	**?**	MR/Sp		**?**	R		**?**	S	MR	ASR (WA)
Kokoda	**?**	RMR	ASR	***SrSatu***+	R	ASR	**?**	RMR#	R	ASR
Normandy	**?**	RMR	ASR	***SrNin***+	R	ASR	**?**	RMR	R	ASR
Wonambi	**?**	R	ASR	***SrNin***+ *(+Sr9g?)*	R	ASR	*YrJ* &/or *YrT*	S	MR	ASR (WA)

* ASR= All Stage Resistance, APR= Adult Plant Resistance
** Genes in **bold** face are still effective against all current pathotypes in Australia
~ Indicates what the major component of the resistance of a cultivar is due to. NB in most cases where effective ASR and APR occur together, both resistances will contribute to the cultivar response.
/ Indicates alternate responses to different pathotypes. Mostly used when a cultivar may be more susceptible to a rare pathotype
+ or ? Indicate the presence of an uncharacterised resistance gene
Het Indicates a mixed (heterogeneous) response to the disease or for the presence of a resistance gene
p Indicates a provisional rating that requires further testing to validate
Used as a warning, used when the response to a new or rare pathotype is unknown

Table 5: Leaf rust response and disease resistance genotypes of Australian barley varieties

Variety	NVT 2022 Consensus rating		Seedling Resistance Gene	Adult Plant Resistance Gene			Resistance due to:**
	Low	High		*Rph20*	*Rph23*	*Rph24*	
Alestar	MS	MRMS	*Rph3*	+	-	?	APR
Banks	S	S	*Rph3*	-	-	-	N/A
Bass	SVS	VS	*Rph3*	-	-	-	N/A
Baudin	SVS	VS	*Rph12*	-	-	+	N/A
Beast	MS	SVS	*Nil*	-	-	?	APR
Bottler	MR	MS	*Rph3*	+	-	+	APR
Buff	S	SVS	*Nil*	-	-	?	N/A
Combat	MS	S	*Rph9.am*	+	-	+	APR
Commander	MSS	SVS	*Rph19+Rph3**	-	-	-	APR
Commodus CL	MS	S	*Rph3*	-	-	-	APR
Compass	S	VS	*Rph3*	-	-	-	N/A
Cyclops	S	VS	*Nil*	-	-	-	N/A
Fairview	MS	SVS	*Rph3*	-	-	-	APR
Fandaga	MR	MSS	*Nil*	+	-	+	APR
Fathom	MRMS	MS	*Rph+?*	+	-	-	Seedling + APR
Flinders	MS	S	*Rph12+*	+	-	+	Seedling + APR
Gairdner	MSS	S	*Rph12*	-	-	-	APR
Grout	S	VS	*Rph2*	-	-	-	N/A
Hindmarsh	MRMS	S	*Rph9.am+*	-	-	-	Seedling + APR
Keel	SVS	VS	*Rph19?*	-	-	-	N/A
Kiwi	MRMS	MS	*Rph3*	+	-	-	APR
La Trobe	MS	S	*Rph9.am*	-	-	-	APR
Laperouse	MSS	SVS	*Rph3**	-	-	+	APR
Leabrook	MSS	SVS	*Rph3*	-	-	NT	APR
Litmus	S	SVS	*Nil*	-	-	-	APR
Maritime	MR-S	S	*Rph12*	-	-	+	N/A
Maximus CL	MSS	S	*Nil*	-	-	-	APR
Minotaur	S	SVS	*Nil*	-	-	-	N/A
Mundah	S	SVS	*Rph2*	-	-	+	N/A
Navigator	S	VS	*Nil*	-	+	-	N/A
Oxford	S	VS	*Rph3*	+	-	+	APR
RGT Planet	MR	MS	*Rph3*	+	-	+	APR
Rosalind	MR	MRMS	*Nil*	+	-	+	APR
SakuraStar	MSS	S	*Nil*	-	-	-	APR
Schooner	S	SVS	*Rph19*	-	-	-	N/A
Scope CL	MSS	SVS	*Nil*	-	-	-	N/A
Shepherd	S	SVS	*Nil*	+	-	+	APR

Spartacus CL	MR	S	*Rph9.am*	-	-	-	APR
Titan AK	S	SVS	Not tested	-	-	NT	N/A
Topstart	MRMS	MS	*Rph3*	+	-	+	APR
Urambie	MSS	S	*Nil or Rph?*	-	-	+	APR
Westminster	MR	MRMS	*Rph3*	+	-	+	APR
Yagan	MSS	S	*Rph25*	NT	NT	NT	APR
Yeti	MSS	SVS	*Rph3*	-	-	+	APR
Zena CL	MS	S	*Rph3*	+	-	NT	APR

Nil postulation means that line does not carry any seedling resistance gene to any of the test pathotypes.
Rph+ = uncharacterized resistance
Rph? = doubtful postulation
+ = presence of marker and - = absence of marker
* = heterogeneous
** = In some cases, the resistance present will be inadequate to prevent yield loss

Table 6: Leaf rust response and disease resistance genotypes of Australian oat varieties

	Crown rust				Stem rust		
		Crown rust consensus rating				Stem rust consensus rating	
Variety	**ASR OCR gene(s)**	**WA**	**EA South**	**EA North**	**ASR OSR gene(s)**	**WA**	**EA**
Archer	*Pc48*	*			*Pg1, Pg2*	*	MS
Bannister#	*Pc39, Pc55 or Pc71*	MRMS	MSS	SVS	*Pg2*	MS	S
Bilby#	*Pc48*	MRMS	MS	S	*Pg1*	SVS	S
Brusher#	*Pc39*	MRp	MSp	Sp	*Pg2*	S	SVS
Carrolup	*Nil*	VS	MS	MSS	*Pg4*	S	S
Durack#	*Pc39, Pc55, or Pc71*	MRMS	MSS	S	*Pg3*, Pg4*	SVS	S
Echidna	*?*	SVS	SVS	S	*Pg4*	S	MS
Koala	*Pc39, Pc55, or Pc71*	MR	MSS	S	*Pg2*	MRMS	MSS
Kojonup#	*Pc1*	SVS	S	S	*Pg2*	MSS	MSS
Koorabup	Not tested	MRMS	MSS	S	Not tested	MSS	S
Kowari#	*Pc48*	MRMS	S	SVS	*Pga**	S	S
Mitika#	*Pc39, Pc55 or Pc71*	MRMS	MSS	SVS	*Pga**	S	S
Mulgara	*Pc58*	MR	MR	MRMS	*Pga*	MR	MRMS
Possum	Not tested	MRMS	MSS	S	Not tested	S	SVS
Tungoo#	*Pc61*	RMR	MR	MSS	*Pg2, Pg13*	MS	MS
Wandering#	*Pc1*	VS	SVS	SVS	*Pg2*	SVS	SVS
Williams#	*Pc48*	MR	MRMS	MSS	*Pg4*	MSS	S
Wintaroo	*Nil*	S	MSS	MSS	*Pg4**	MS	MSS
Yallara#	*Pc38+?*	MR	S	SVS	*Pga*	MSS	MSS

signifies heterogeneity within the variety seed source used for multi-pathotype testing

p Indicates a provisional rating that requires further testing to validate