	The University of Sydney **Plant Breeding Institute Cobbitty** **Cereal Rust Laboratory**

2006-2007 CEREAL RUST SURVEY ANNUAL REPORT

I. SUMMARY

Wheat Stem Rust - Stem rust was detected early in 2006 in both WA and SA, however, dry conditions then prevailed and overall stem rust incidence was very low. The most common pathotype in all states from which samples were sent (WA, Tas, SA, Qld) was 34-1,2,7 +Sr38. Seven other pathotypes were detected in WA: 34-2,7; 34-1,2,7; 34-1,2,7 +Sr38 +Sr21; 34-1,2,7 +Sr38 +Norin 40; 343-1,2,3,5,6; 98-1,2,3,5,6; 98-1,2,3,5,6,7. Other pathotypes identified from eastern Australia were: 34-1,2,7 +Sr38 +Sr21; 98-1,2,3,5,6; 21-0; 34-2,12,13.

Wheat Leaf Rust - Levels of leaf rust in wheat were low throughout Australia in 2006-07, with only 28 samples being forwarded for processing. Three pathotypes were identified from WA: 104-1,2,3,(6),(7),11; 104-1,2,3,(6),(7),11 +Gaza high; 104-1,2,3,(6),(7),11 +Lr37. Six pathotypes were detected form samples collected in eastern Australia; 76-3,5,9,10 +Lr37 (isolated for the first time from SA); 10-1,3,9,10,11,12; 104-1,2,3,(6),(7),11; 104-1,2,3,(6),(7),11 +Gaza high; 104-1,2,3,(6),(7),11,13; 104-1,2,3,(6),(7),11 +Lr37.

Wheat Stripe Rust - Despite drought conditions, sample numbers were relatively high (149) although isolate recovery was relatively low due to poor sample quality. Pathotype 134 E16 A+ continues to dominate. A new pathotype, designated 134 E16 A+ Yr17+, was detected late in the season from two locations (Coleambally, southern NSW) and Horsham (Victorian Wimmera). If this pathotype survives and spreads, it could provide a threat to many wheats carrying the *Yr17* resistance. Field tests at PBI Cobbitty in 2007 will provide the basis for determining the response of *Yr17* wheats to this pathotype.

Oat Stem Rust – Variants of pathotype 94 were recovered from low sample numbers in 2006. Virulence for *Pga* was detected in northern NSW and Queensland, and this continues a tend observed over past years. Elsewhere, the low pathogen population and avirulence for *Pga* will be expected to provide some protection in *Pga* carrying cultivars (Barcoo, Culgoa II, Glider, Cleanleaf, Nobby).

Oat Leaf Rust - The incidence of oat crown rust was again low in 2006-07. Only 33 samples were received. Three pathotypes that were common in WA in recent years were again isolated from that state (0000-0; 0000-2; 0001-0). No samples of crown rust were forwarded from Victoria, Tasmania or NSW. Twelve pathotypes were identified in samples from Qld, including several carrying virulences for cultivars Bettng, Barcoo, Moola, Graza 68, Nugene and Warrego.

Barley Stem Rust - There were no reports of stem rust in commercial crops of barley in 2006-07. Eleven samples were received, from which the scabrum rust (with and without virulence for *Sr21*) and *P. graminis* f. sp. *tritici* pathotype 34-1,2,7 +Sr38 were isolated.

Barley Leaf Rust - The incidence of barley leaf rust in eastern Australia was very low but the disease did cause problems in the south coast region of WA. Thirty one samples were received, and three pathotypes were identified. Pt 5452P+ has been widespread in eastern Australia since 2000 but has not been isolated from WA. The pathotypes 5453P- and 5453P+ were the only two pathotypes isolated from WA. Both were also isolated from eastern Australia, and have now been isolated from all states including Tasmania.

Barley grass stripe rust
One sample was recovered from South Australia in 2006.

Triticale and Rye Rusts
There were no reports of stem rust or leaf rust in triticale crops in 2006-07

II. DETAILED REPORT

INTRODUCTION

Rust surveys or inspections conducted by PBI staff during 2006-07 were severely curtailed by the historic drought conditions. Prof RA McIntosh travelled to northern NSW and Queensland in August.

SEASONAL CONDITIONS

The dominating influence of drought conditions pervaded the wheat industry in 2006, and had substantial impacts on crop growth and yield, and on the incidence and severity of cereal diseases and particularly the rusts.

Most cropping regions of Australia recorded below to very much below average rainfall during the summer of 2005-06. With the exception of South Australia, the dry trend

continued throughout autumn across most states. Crops sown on May-June rainfall in eastern states struggled with low subsoil moisture reserves. This was particularly evident in southern NSW and Victoria, and crop vigor became exacerbated by severe frosts in some districts. Autumn rainfall was average to above average in the majority of South Australia's cropping regions. Good rainfalls in early June on the Eyre and Yorke Peninsulas, and through the midnorth gave hope of good crop establishment.

Average winter rainfall was below to very much below average across most cropping districts. August was a particularly dry month, with some grain growing regions recording

their lowest winter rainfall on record. Queensland districts experienced a variable winter period, with the best crops being found in the central region. Northern NSW received average winter rainfall and crop development was satisfactory, but the situation declined rapidly further south. Winter conditions in Victoria saw a sharp decline in yield potential following extended dry conditions. Similarly, dry August periods in SA and WA severely reduced yield potential.

Spring conditions continued to be dry although variable, with Victoria experiencing some of the highest spring temperatures on record. At the end of the season, it was estimated that the area planted to wheat in 2006-07 was 11.1 million hectares with production estimated at 9.7 million tonnes. This represented a decline of 61% compared to the previous season. Barley production was estimated to have fallen to around 3.7 million tonnes, representing a 63% drop from the previous year.

Sources: ABARE 'Australian Crop Reports' www.abareconomics.com

WHEAT RUST PATHOGENS

Wheat Stem Rust (caused by *Puccinia graminis* f. sp. *tritici*)
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Epidemiology and Pathotype Distribution

Stem rust was detected early in 2006 in both Western Australia and South Australia, and in both states, the amount of stem rust present during March and April was a considerable concern. In Western Australia in late March to April, stem rust samples were forwarded from the central south to south eastern regions from Manjimup, Kendenup, Jerramungup, Ravensthorpe, Hyden and Katanning. Later in the season the disease was present in the central wheat belt, mainly associated with cultivar Yitpi, and it was also reported from as far north as Carnarvon. In South Australia, stem rust was common on the lower Eyre and Yorke Peninsulas during April, but dry conditions during the main growing season kept overall stem rust levels very low.

A total of 77 samples of stem rust were forwarded from WA, eight of which proved to be unviable (Table 1). Eight pathotypes were identified, the most common of which was 34-1,2,7 +Sr38, which accounted for 59 of the 82 isolates (*ca*. 72%) pathotyped. This pathotype, along with four others that were detected (pts 34-2,7; 34-1,2,7; 34-1,2,7 +Sr38 +Sr21; 34-1,2,7 +Sr38 +Norin 40), are all regarded to be mutational derivatives of pt 34-2. The additional three pathotypes detected were pts 343-1,2,3,5,6 (the Oxley pathotype), 98-1,2,3,5,6 (the Paterson pathotype), and 98-1,2,3,5,6,7 (the Wyalkatchem pathotype) (Table 1).

Of the 48 samples of stem rust received from eastern Australia, 42 came from SA. Nineteen samples were sent from volunteer cereals during April, from which four pathotypes were identified: 34-1,2,7 +Sr38 (19 isolates), 34-1,2,7 +Sr38 +Sr21 (1 isolate), 98-1,2,3,5,6 (1 isolate), and 343-1,2,3,5,6 (3 isolates). No further pathotypes were identified from SA during 2006-07, and of the four identified, pt 34-1,2,7 +Sr38 comprised about 87% of the isolates pathotyped (Table 1). Levels of stem rust in other eastern states were very low and the only samples received were from experimental plots in Tasmania (1 sample) and Queensland (5 samples) (Table 1). Of interest was the detection of pt 34-1,2,7 +Sr38 from Tasmania and Queensland. This pathotype was first detected in WA in 2001, and has now been isolated from all Australian states. Also of interest was the isolation of pts 21-0 and 34-2,12,13 from Queensland. Both were isolated from samples collected at Kingsthorpe. The former is a highly avirulent pathotype that was common in the 1950s and declined in frequency during the 1960s. Although not detected from 1970 to 1993, a single isolate of this pathotype was recovered from Queensland (Wellcamp) in 1994. It is interesting that this pathotype should survive at such a low frequency, and given its avirulence on most if not all wheat cultivars grown in Region 1 for many years, it is likely that it has survived on grasses or barley. The isolation of pt 34-2,12,13 (the Satu triticale pathotype) was also of interest. This pathotype has been isolated only rarely since 1990; two isolates were recovered from Toowoomba in 1991, a single isolate from Narrabri in 1995, and a single isolate from Wellcamp in 1997.

Notes on the Pathotypes Isolated

The 10 pathotypes isolated during 2006-07 belong to one of two clonal lineages:

1. The "race 21" lineage, established following the introduction of pt 21-0, which was first detected in 1954-

• 21-0	Possibly the original ancestor of this lineage
• 34-2,7	Derived from pt 21-0 via step-wise acquisition of virulence for *Sr5*, *Sr11* and *Sr15*.
• 34-1,2,7	Derived from 34-2,7 via acquisition of virulence for *Sr6*
• 34-1,2,7 +Sr38	The "VPM" pathotype. Derived from pathotype 34-1,2,7 via acquisition of virulence for *Sr38*.This pathotype was first detected in WA in 2001, and presumably spread to eastern Australia, being first detected there in SA at Arno Bay in November 2003. It has now been detected in all Australian states.
• 34-1,2,7 +Sr38 +Sr21	Derived from 34-1,2,7 +Sr38 via acquisition for *Sr21*.
• 34-1,2,7 +Sr38 +Norin 40	Derived from 34-1,2,7 +Sr38 via acquisition for an uncatalogued resistance gene in Norin 40. This resistance gene is not present in Australian wheat cultivars.
• 34-2,12,13	The Satu triticale pathotype, arose from the Coorong triticale pathotype (34-2,12) via acquisition of virulence for *SrSatu*. First detected in 1984.

2. The "race 326" lineage, established following the introduction of pt 326-1,2,3,5,6, which was first detected in 1969-

• 343-1,2,3,5,6	The "Oxley" pathotype. Derived from pt 326-1,2,3,5,6 via acquisition of virulence for *Sr5*.
• 98-1,2,3,5,6	The "Paterson" pathotype. Derived from pt 343-1,2,3,5,6 via acquisition of virulence for *Sr9g*.
• 98-1,2,3,5,6,7	The "Wyalkatchem" pathotype. Derived from pt 98-1,2,3,5,6 via acquisition of virulence for *Sr15*.

Notes on Cultivars Carrying Genes for Stem Rust Resistance

The stem rust responses of wheat cultivars are not expected to change from those of 2004.

Sr9e Sunland and Yarralinka (a single isolate of a pathotype virulent for *Sr9e* was identified from WA in 2002).

Sr22 Schomburghk

Sr24 Anlace, Annuello, Babbler, Cunningham, Datatine, Dennis, Giles, Harrismith, Janz, Koelbird, Krichauff, Lang, Mira, Mitre, Mulgara, Pardalote, Perouse, Petrie, QAL2000, QALBis, Sunco, Sunsoft 98, Swift and Worrakatta

Sr26 Chough, Currawong, Darter, Hybrid Mercury, Petrel, Snipe, Sunlin, and Wylah

Sr30
1. (close monitoring required; significant rust may develop even with Sr30-avirulent isolates): Ajana, Arrino (heterogeneous), Kalgarin, Yitpi
2. Batavia, Brookton, Calingiri, Chara, Cunderdin, EGA Bonnie Rock, EGA Hume, EGA Wedgetail, Frame, H45, Kalannie, Katunga, Lark, Lorikeet, Osprey, Rosella, Silverstar, Sunfield, Sunmist.

Sr31 Grebe, Tennant and Warbler

The gene *Sr2* confers adequate adult plant resistance and is present in the cultivars Arnhem, Batavia (heterogeneous), Baxter, Bowerbird, Brennan, Carnamah, Diamondbird, Dollarbird, Eradu, Glover, Goldmark, Hartog, Kennedy, Kukri, Leichardt, Lowan, Machete, Mackellar, Nyabing, Sunbrook, Sunstate and Tailorbird. Cultivars with *Sr13* (Gutha, Machete, Stiletto, Sunmist and Wialki) are moderately susceptible to moderately resistant. The cultivars Braewood and Sunvale are protected from all stem rust pathotypes by the presence of the gene combination *Sr36* + *Sr38*.

<u>Wheat Leaf Rust</u> (caused by *Puccinia triticina*; formerly *Puccinia recondita* f. sp. *tritici*)

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Epidemiology and Pathotype Distribution

Levels of leaf rust in wheat were low throughout Australia in 2006-07, with only 28 samples being forwarded for processing (Table 2).

Three pathotypes were identified from seven samples forwarded from WA during 2006-07: 104-1,2,3,(6),(7),11; 104-1,2,3,(6),(7),11 +Gaza high; 104-1,2,3,(6),(7),11 +Lr37 (Table 2). These were also the only pathotypes detected in that state during 2005-06.

Six pathotypes were detected form samples collected in eastern Australia. A single sample of leaf rust from cultivar Frame collected at Minlaton (SA) in April was typed as pt 76-3,5,9,10 +Lr37. This pathotype was also identified from Penong (SA) and from Horsham (Vic). Pt 76-3,5,9,10 +Lr37 was first detected at Inverleigh (Vic) in late July 2006, and was subsequently detected during 20006 at 10 sites across south western Victoria as well as at Wagga Wagga, Temora and Narrabri in NSW. It is clearly an exotic introduction and is of potential concern because it combines virulence for *Lr13* and *Lr37*. Three isolates of the “Mackellar” pathotype, 10-1,3,9,10,11,12, were recovered from samples collected in northern NSW and Tasmania. Like pt 76-3,5,9,10 +Lr37, the “Mackellar” pathotype is also regarded to be of exotic origin. It was first detected at Bairnsdale (Vic) in October 2004, and has now been detected in Victoria, New South Wales and Tasmania. It is potentially important because it combines virulence for *Lr1*, *Lr2a* and *Lr26* with virulence for *Lr13*. Other pathotypes detected in eastern Australia were 104-1,2,3,(6),(7),11 (two isolates), 104-1,2,3,(6),(7),11 +Gaza high (1 isolate), 104-1,2,3,(6),(7),11,13 (the *Lr24* virulent pathotype; 5 isolates from Qld, NSW, Vic and SA), and 104-1,2,3,(6),(7),11 +Lr37 (8 isolates from Qld, NSW, Vic and SA) (Table 2).

Notes on the Pathotypes Isolated

The six pathotypes of *P. triticina* isolated during 2005-06 are believed to belong to one of three clonal lineages:

<u>1. The “104-2,3,(6),(7),11” lineage.</u> Pt 104-2,3,(6),(7),11 was first detected in a sample collected from Mt Derimut in Victoria in July 1984. We have since detected many single step mutational derivatives, and from 1989-2006, with few exceptions, one or more of these pathotypes have been the most frequently isolated pathotype in all regions of Australia surveyed-

- Pt 104-1,2,3,(6),(7),11 — Derived from pt 104-2,3,(6),(7),11 via acquisition of virulence for *Lr20*. First detected in NSW in 1989 and subsequently spread to all Australian wheat growing regions.
- Pt 104-1,2,3,(6),(7),11 +GH — Derived from pt 104-1,2,3,(6),(7),11 via acquisition of virulence for an uncharaterised seedling resistance gene present in the *Lr23* tester Gaza. This uncharaterised resistance gene is effective against other pathotypes within the “104-2,3,(6),(7),11” lineage, and is ineffective to all other Australian pathotypes of *P. triticina* virulent for *Lr23*.

- Pt 104-1,2,3,(6),(7),11,13 — The "Lr24" pathotype. Derived from pt 104-1,2,3,(6),(7),11 via acquisition of virulence for *Lr24*. This pathotype was first detected in SA in October 2000, and has since been isolated from all eastern states. It is not known to occur in WA.
- Pt 104-1,2,3,(6),(7),11 +Lr37 — The "VPM" pathotype. Derived from pt 104-1,2,3,(6),(7),11 via acquisition of virulence for *Lr37*. This pathotype was first detected in WA early in 2002 from a self sown crop of Camm near Albany. It was subsequently detected in the south eastern corner of SA in December 2002 and is now well established throughout all wheat growing regions of Australia.

<u>2. The "Mackellar" lineage.</u> Pt 10-1,3,9,10,11,12 was first isolated from Victoria at Bairnsdale in October 2004, and is now known to be more widespread in Victoria, NSW and Tasmania. This pathotype has a number of unusual attributes and is regarded as an exotic introduction.

<u>3. The 76-3,5,9,10 +Lr37 lineage.</u> Regarded as an exotic introduction, first isolated from Inverleigh (Vic) in late July 2006, and now present throughout Victoria, southern and northern NSW and South Australia.

Notes on Cultivars Carrying Genes for Leaf Rust Resistance

It is possible that some cultivars with *Lr17a* (Baxter, heterogeneous; Perenjori), may be more susceptible to a variant of pt 104-1,2,3,(6),(7),11 that has been detected in most wheat growing regions, which appears to have increased but still incomplete virulence for this gene. In addition, there is evidence from seedling tests that the new pt 76-3,5,10 +Lr37 may be fully virulent for *Lr17a*.

Cultivars with *Lr13* in combination with *Lr1* (Arnhem, Batavia, Bowerbird, Cunderdin, Diamondbird, Glover, Hartog, Kukri, Leichardt, Sunbrook, Sunfield and Tailorbird) or *Lr2a* (Sunmist) could be vulnerable to the new "Mackellar" pathotype. Cultivars with *Lr13* in combination with *Lr23* (EGA Hume, Strzelecki) or *Lr24* (Dennis, Giles, Petrie and Sunsoft 98) are resistant to all pathotypes isolated in 2006. Cultivars carrying *Lr13* and *Lr37* (Braewood, Rudd and Sunstate) may be vulnerable to the new pt 76-3,5,10 +Lr37. The combination of *Lr13* and *Lr17b*, found in several winter wheats (Gordon, Mackellar, Paterson) is ineffective in protecting against pt 10-1,3,9,10,11,12. Declic, which carries *Lr14a* in addition to *Lr13* and *Lr17b*, is seedling susceptible to pt 10-1,3,9,10,11,12.

Cultivars with *Lr26* (Grebe, Tennant and Warbler) are at least seedling susceptible to pts 10-1,3,9,10,11,12 and 76-3,5,9,10 +Lr37. Field data from 2005 suggest that Tennant is rated "S" (susceptible) to the "Mackellar' pathotype. Mawson is seedling susceptible to pt 76-3,5,9,10 +Lr37 but carries an unidentified seedling resistance gene that is effective against pt 10-1,3,9,10,11,12.

QAL2000 (*Lr37* + *Lr24*) is resistant to all pathotypes isolated from Australasia during the 2005 survey period.

Cultivars with *Lr21* (Thornbill), *Lr28* (Sunland) and the complementary seedling resistance genes *Lr27*+*Lr31* (Carnamah and Karlgarin) are resistant to all pathotypes isolated in 2006. Genetic studies at PBIC have indicated that Carnamah and Kalgarin should also carry the adult plant resistance gene *Lr12*, which is completely linked to *Lr31*, and in fact may be the same gene.

It is apparent that many cultivars protected previously by *Lr24*, and at least some cultivars protected previously by *Lr37* have some adult plant resistance to pathotypes virulent for these genes.

<u>Wheat Stripe Rust</u> (caused by *Puccinia striiformis* f. sp. *tritici*)

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Disease development

First samples from commercial areas were received from Esperance (WA) in late July. At mid August, samples were also received from central districts in the Great Southern, suggesting independent pathogen survival in the initial phases of the epidemic in WA in 2006. Mid August also witnessed the first samples from eastern Australia in early monitoring trials in Queensland. The late beginning to disease development and the severe drought conditions combined to reduce pathogen development in all cereal growing districts.

However despite these circumstances, sample numbers were surprisingly high. It was evident that monitoring plots in Queensland and northern NSW, and those crops able to manage with supplementary irrigation in southern NSW were affected by the pathogen. Crop losses were not reported.

Pathotype distribution

Viable isolates were recovered from approximately 80% of samples. This represented a fall in recovery over previous seasons, possibly due to poor sample quality under drought conditions. Pathotypes recovered in the 2006-07 season are presented in Table 3.

Pathotype 134 E16 A+ continued to predominate, and this has been a feature since its first detection in WA in 2002 and eastern Australia in 2003. A new pathotype, designated 134 E16 A+ Yr17+, was detected in southern NSW (Coleambally) and Victoria (Horsham) late in the season. In both cases, the samples were recovered from wheats carrying the *Yr17* resistance and the symptoms were distinctly susceptible. This pathotype represents a significant development in the pathogen population as a range of current and many newly released cultivars carry this resistance. The gene *Yr17* provides excellent protection to the currently dominant pathotype 134 E16 A+, and so the future value of this resistance will depend on the ability of the new pathotype to survive and spread.

Pathotype 150 E16 A+, first detected in 2005, was not recovered in 2006.

Notes on current resistances

The dominant pathotype 134 E16 A+ is avirulent for *Yr17* and this resistance continues to provide good protection in varieties that carry this gene, *eg* Barham, Binnu, Bowie Braewood, Camm, Carinya, Derrimut, EGA Eaglehawk, EGA Jaeger, Ellison, Gladius, H46
Marombi, Pugsley, QAL 2000, Rudd, Stylet, Sunbri, Sunlin, Sunstate, Sunvale, Sunzell, Trident, Ventura, Yenda, Young. The response of these wheats to pathotype 134 E16 A+ Yr17+ will be evaluated in field nurseries in 2007. Currently available information will be distributed as issues of the Cereal Rust Report, and will be available from the PBI website.

The adult plant resistances *Yr18* and *Yr29* also remain effective and are expected to provide protection, especially when combined with other resistances.

OAT RUST PATHOGENS

<u>Oat Stem Rust</u> (caused by *Puccinia graminis* f. sp. *avenae*)
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Historically low sample numbers were received in 2006. Variants of pathotype 94, which combines virulence for *Pg1, Pg2, Pg3, Pg4, Pg8, Pg9,* were recovered. Isolates virulent for *Pga* were again evident in northern regions (94-2,4 in Queensland; 94-2,3,4 in northern NSW). The latter pathotypes are virulent on *Pga* and cultivars carrying this gene (Barcoo, Culgoa II, Glider, Cleanleaf, Nobby) are not expected to provide crop protection in these regions if/when pathogen populations resume historical levels.

<u>Oat Crown Rust</u> (caused by *Puccinia coronata* f. sp. *avenae*)
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Epidemiology and Pathotype Distribution

The incidence of oat crown rust was again low in 2006-07. Only 33 samples were received, 21 of which were from cultivated oats and 12 of which were from wild oats (Table 5). Two of the 33 samples failed to yield a viable isolate, and from the remaining 31 samples, 46 isolates were pathotyped (Table 5).

As indicated in last years' report, our greenhouse studies suggest that the isolates of *P. coronata* f. sp. *avenae* that have been isolated over the past 5-10 years can be placed into one of 4 groups:

1. Pathotypes virulent for differentials carrying *Pc55*, *Pc71* and either or both *Pc38* and *Pc39* (triplet codes 0007, 0107, 0207, 0307 and others).
2. Pathotypes virulent for differentials carrying *Pc58*, *Pc59* and *Pc61* (triplet codes 0011 and 0071).
3. Pathotypes virulent for differentials *Pc39* and *Pc61* (triplet code 4473).
4. Pathotypes avirulent for all differentials carrying these genes (triplet codes 0000 and 0001).

Groups 1 and 2 appear to be clonal lineages, each comprising step-wise mutational derivatives from a common ancestor. Pathotypes in these groups have been commonly isolated from northern NSW and Qld and include those carrying virulence corresponding to the cultivars Culgoa, Cleanleaf, Moola, Graza 68, Warrego, Gwydir and Nugene (Group 1), and Amby and Nobby (Group 2). Pathotypes in Group 3 are also virulent on Amby and Nobby, and one pathotype in this group can attack Bettong and Barcoo. Almost all isolates recovered from Victoria, SA and WA belong to Group 4, and although less frequent pathotypes within this group are also present in New South Wales and Queensland. Group 4 pathotypes are similar to or the same as many of the old pathotypes of *P. coronata* f. sp. *avenae* in the PBI cereal rust collection.

Three pathotypes, 0000-0 (1 isolate), 0000-2 (1 isolate) and 0001-0 (6 isolates) were identified from the eight samples forwarded from WA. Over the past five years, pts 0000-2 and 0001-0 have been the most commonly isolated pathotypes of *P. coronata* f. sp. *avenae* from WA. No samples of crown rust were forwarded from Victoria, Tasmania or New South Wales. A total of 29 isolates were pathotyped from 16 samples collected in Qld. Two isolates were identified as pathotypes from Group 4 (single isolates of pts 0001-0 and 0001-2), two as the Group 2 pathotype 0071-0, one as the Group 3 pathotype 4473-6,10 +Bettong +Barcoo, and 24 isolates as pathotypes from Group 1 (Table 5). With the exception of pt 0071-1,4,7,12 +Gwydir (detected in 2005 and belonging to Group 2), all pathotypes detected to date that are virulent for the cultivars Cleanleaf, Moola, Graza 68, Nugene, Gwydir and Warrego belong to Group 1. A range of pathotypes with virulence to these cultivars have now been detected, with some combining virulence for two or more of these cultivars:

Pathotype	First detected	Cleanleaf	Pc68*	Warrego	Gwydir	Nugene
0071-1,4,7,12 +Gwydir	2003				v**	
0007-4,6,10 +Warrego	1999			v		
0007-4,6,8,10 +Warrego	1998			v		
0007-4,6,8,10 +Nugene	2005					v
0107-4,6,10	2006		v			
0107-3,4,6,10	1999		v			
0107-4,6,8,10	2001		v			
0107-4,6,10 +Nugene	2005		v			v
0107-4,6,8,10 +Nugene	2005		v			v
0107-4,6,10 +Warrego	2006		v	v		
0107-4,6,10 +Warrego +Nugene	2005		v	v		v
2107-1,4,6,10,12	2005		v			
0207-4,5,6,10	1995	v				
0207-1,4,5,6,10,11,12	1998	v				
0207-4,6,10 +Warrego	1999	v		v		
0207-4,5,6,10 +Nugene	1999	v				v
0207-1,4,5,6,10,11,12 +Gwydir	2000	v			v	
0607-4,5,6,10	1998	v				
2207-4,5,6,10	1998	v				
0307-4,5,6,10	1999	v	v			
0307-4,5,6,8,10	2003	v	v			
0307-4,5,6,10 +Nugene	2005	v	v			v
0307-4,5,6,10 +Warrego	2003	v	v	v		
0307-4,5,6,10 +Warrego +Nugene	2005	v	v	v		v
0307-1,4,5,6,7,10,12	2004	v	v			
2307-4,5,6,10	2001	v	v			
2307-5,6,10 +Warrego	2003	v	v	v		
2307-1,5,6,10,12 +Warrego	2003	v	v	v		

* present in cultivars Moola and Graza 68
** v indicates virulence for the respective cultivar

Notes on Cultivars Carrying Genes for Leaf Rust Resistance

With the exception of cultivar Volta, released in 2003, all current Australian oat cultivars are susceptible to leaf rust. It was included in the differential set used in 2006-07 and was resistant to all isolates processed. Greenhouse tests have provided clear evidence of the Warrego resistance (*Pc61*?) plus additional unidentified seedling resistance in Volta. Cultivar Taipan, released in 2001, has the Nugene resistance. Some of the cultivars released in Region 1 and regarded at the time of release as resistant to *P. coronata* f. sp. *avenae*, are now susceptible to a range of pathotypes. These cultivars were believed to carry new genes for resistance to *Pca*, but it now seems that the resistance in practically all can be explained on the basis of known resistance genes.

BARLEY RUST PATHOGENS

<u>Barley Stem Rust</u> (caused by *Puccinia graminis*)
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There were no reports of stem rust in commercial crops of barley in 2006-07. Eleven samples were received, 5 of which failed to yield a viable isolate (Table 6). A sample from Hermitage Research Station in Warwick (Qld) comprised the "scabrum" stem rust with added virulence for *Sr21*. Several samples collected from a barley increase block at Glen Innes, northern NSW during January 2007 were unviable. Two samples from SA comprised the "scabrum" rust and *P. graminis* f. sp. *tritici* pathotype 34-1,2,7 +Sr38, and three samples from WA were found to comprise *P. graminis* f. sp. *tritici* pathotype 34-1,2,7 +Sr38 (Table 6).

<u>Barley Leaf Rust</u> (caused by *Puccinia hordei*)
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Epidemiology and Pathotype Distribution

The incidence of barley leaf rust in eastern Australia was very low. Problems were however encountered in the south coast region of WA. Thirty one samples were received, of which nine were found to be unviable (Table 7). From the remaining 22 samples, 31 isolates were identified as either pt 5452P+, 5453P- or 5453P+, all of which are virulent for an unidentified seedling resistance gene in the barley genotype PI366444. The latter two pathotypes were the only two pathotypes isolated from WA. Both were also isolated from eastern Australia, and have now been isolated from all states including Tasmania. Although widespread in eastern Australia from 2000 onwards, pt 5452P+ has not been isolated from WA.

Notes on pathotypes isolated

5452P+ (+PI366444)	First detected in Tasmania in 1999, and also detected in SA later that year. It has been widespread in eastern Australia since then, being first detected in Victoria and southern NSW in 2000, in Qld in 2003, and in northern NSW in 2004. Not detected from WA.
5453P– (+PI366444)	First detected in WA in 2001. It was then detected in SA in 2002, Tasmania, Victoria and southern NSW in 2003, and in northern NSW and Qld in 2005. This pathotype differs markedly from all other Australian *Rph12* virulent pathotypes except from pt 5453P+ (+PI366444) which is believed to be a mutational derivative. Origin unknown.
5453P+ (+PI344666)	A mutational derivative of pt 5453P- (+PI366444) with added virulence for *Rph19* (the "Prior" resistance). First detected in WA in 2002, then in Tasmania, Victoria and southern NSW in 2003, SA in 2005, and Qld in 2006.

Notes on Cultivars Carrying Genes for Leaf Rust Resistance

Many Australian barley cultivars carry seedling genes for resistance to *P. hordei*, however most of these genes are ineffective against pathotypes that currently prevail. Before 1999–2000, the cultivars Tallon and Lindwall (*Rph12*) were regarded as resistant to the pathotypes occurring in Region 1. These cultivars will now need to be monitored carefully because their adult plant responses to the *Rph12* virulent pathotypes detected in the region last year are not well understood. The only barley cultivars known to carry effective seedling resistance to leaf rust are Galaxy (likely *Rph7*), Fitzroy and Yarra (likely *Rph3*). However, not all cultivars will become severely infected and cultivars like Gilbert are known to have good levels of resistance at later growth stages.The cultivars Baudin (*Rph12*) and Hamelin (no resistance gene), released in WA during 2002, are susceptible pathotypes predominating in all barley growing regions. The newly released cultivar Grout (formerly Cameo/Arupo 31-04) carries *Rph2* and is therefore seedling susceptible to all three pathotypes isolated in 2006-07.

<u>Barley Grass Stripe Rust</u> (caused by *Puccinia striiformis*)

C. R. Wellings[1] and K.R. Kandel
University of Sydney
([1]on secondment from NSW Department Primary Industries)

One sample was recovered from barley grass in South Australia in 2006. BGYR has not been detected in WA.

TRITICALE AND RYE RUST PATHOGENS

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([1]on secondment from NSW Department Primary Industries)

There were no reports of stem rust, leaf rust or stripe rust in triticale crops in 2006-07.

MISCELLANEOUS RUST PATHOGENS ON GRASSES

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Samples of rust on Phalaris from SA, on Yorkeshire fog grass from WA and Tasmania, and on False brome grass from WA all failed to yield a viable isolate, indicating that the rust present was either not viable or did not infect the cereal genotypes used.

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Table 1. Wheat stem rust isolates identified by region, 1 April 2006 - 31 March 2007

	Number of Isolates							
	Region 1	Region 2	Region 3	Region 4		Region 5	Region 6	
Pathotype	QLD	NNSW	SNSW	VIC	TAS	SA	WA	**TOTAL**
21-0	1	-	-	-	-	-	-	**1**
34-1,2,7	-	-	-	-	-	-	2	**2**
34-1,2,7 +Sr38	3	-	-	-	1	40	59	**103**
34-1,2,7 +Sr38 +Sr21	-	-	-	-	-	2	1	**3**
34-1,2,7 +Sr38 +Norin 40	-	-	-	-	-	-	5	**5**
34-2,7	-	-	-	-	-	-	1	**1**
34-2,12,13	1	-	-	-	-	-	-	**1**
98-1,2,3,5,6	-	-	-	-	-	1	4	**5**
98-1,2,3,5,6,7	-	-	-	-	-	-	9	**9**
343-1,2,3,5,6	-	-	-	-	-	3	1	**4**
Total no isolates	**5**	**0**	**0**	**0**	**1**	**46**	**82**	**134**
Total no samples	**5**	**0**	**0**	**0**	**1**	**42**	**77**	**125**
No failed samples	0	0	0	0	0	1	8	**9**

Table 2. Wheat leaf rust isolates identified by region, 1 April 2006 – 31 March 2007

	Number of Isolates							
	Region 1	Region 2	Region 3	Region 4		Region 5	Region 6	
Pathotype	QLD	NNSW	SNSW	VIC	TAS	SA	WA	**TOTAL**
10-1,3,9,10,11,12	-	1	-	-	2	-	-	**3**
76-3,5,9,10 +Lr37	-	-	-	1	-	2	-	**3**
104-1,2,3,(6),(7),11	1	-	1	-	-	-	5	**7**
104-1,2,3,(6),(7),11 +Gaza high*	-	-	-	1	-	-	1	**2**
104-1,2,3,(6),(7),11,13	2	-	1	1	-	1	-	**5**
104-1,2,3,(6),(7),11 +Lr37	2	2	1	-	-	2	6	**13**
Total no isolates	**5**	**3**	**3**	**3**	**2**	**5**	**12**	**33**
Total no samples	**3**	**4**	**2**	**3**	**2**	**7**	**7**	**28**
No failed samples	1	2	0	1	0	4	1	**9**

* Differential Gaza carries uncharacterised resistance in addition to *Lr23* that is effective to some pathotypes of leaf rust. This pathotype is fully virulent on Gaza.

Table 3. Stripe rust isolates identified by region, 1 April 2006 – 31 March 2007

	Number of Isolates							
	Region 1	Region 2	Region 3	Region 4		Region 5	Region 6	
Pathotype	QLD	NNSW	SNSW	VIC	TAS	SA	WA	**TOTAL**
134 E16 A+	23	49	9	5		5	28	**119**
134 E16 A+ Yr17+	-	-	1	1	-	-	-	**2**
BGYR	-	-	-	-	-	1	-	**1**
Total no isolates	**23**	**49**	**10**	**6**	**-**	**6**	**28**	**122**
Total no samples	**26**	**54**	**14**	**10**		**9**	**35**	**149**
No failed samples	3	5	4	4		3	7	**27**

Table 4. Oat stem rust isolates identified by region, 1 April 2006 – 31 March 2007

	Number of Isolates							
	Region 1	Region 2	Region 3	Region 4		Region 5	Region 6	
Pathotype	QLD	NNSW	SNSW	VIC	TAS	SA	WA	**TOTAL**
94-2	-	-	-	-	-	-	2	**2**
94-3	-	-	-	-	-	1	-	**1**
94-2,3	-	-	-	-	-	1	2	**3**
94-2,4	2	-	-	-	-	-	-	**2**
94-2,3,4	**-**	**1**	**-**	**-**	**-**	**-**	**-**	**1**
Total no isolates	**2**	**1**	**-**	**-**	**-**	**2**	**4**	**-**
Total no samples	**2**	**1**				**2**	**4**	**9**
No failed samples								

Table 5. Oat leaf rust isolates identified by region, 1 April 2006 – 31 March 2007

	Number of Isolates							
	Region 1	Region 2	Region 3	Region 4		Region 5	Region 6	
Pathotype	QLD	NNSW	SNSW	VIC	TAS	SA	WA	**TOTAL**
0000-0	-	-	-	-	-	-	1	**1**
0000-2	-	-	-	-	-	6	1	**7**
0001-0	1	-	-	-	-	3	6	**10**
0001-2	1	-	-	-	-	-	-	**1**
0071-0	2	-	-	-	-	-	-	**2**
4473-4,6,10 +Bettong +Barcoo	1	-	-	-	-	-	-	**1**
0007-4,6,8,10 +Nugene	2	-	-	-	-	-	-	**2**
0107-4,6,10	1	-	-	-	-	-	-	**1**
0107-4,6,10 +Nugene	5	-	-	-	-	-	-	**5**
0107-4,6,10 +Warrego	2	-	-	-	-	-	-	**2**
0107-4,6,10 +Warrego +Nugene	3	-	-	-	-	-	-	**3**
0107-6,10 +Warrego +Nugene	1	-	-	-	-	-	-	**1**
0307-4,5,6,10 +Nugene	6	-	-	-	-	-	-	**6**
0307-4,5,6,10 +Warrego +Nugene	4	-	-	-	-	-	-	**4**
Total no isolates	**29**	**0**	**0**	**0**	**0**	**9**	**8**	**46**
Total no samples	**16**	**0**	**0**	**0**	**0**	**9**	**8**	**33**
No failed samples	0	0	0	0	0	2	0	**2**
Samples from cultivated oats	14	0	0	0	0	1	6	**21**
Samples from wild oats	2	0	0	0	0	8	2	**12**

Table 6. Barley stem rust isolates identified by region, 1 April 2006 – 31 March 2007

	Number of Isolates							
	Region 1	Region 2	Region 3	Region 4		Region 5	Region 6	
Pathotype	QLD	NNSW	SNSW	VIC	TAS	SA	WA	**TOTAL**
Scabrum	-	-	-	-	-	1	-	**1**
Scabrum +Sr21	1	-	-	-	-	-	-	**1**
P. graminis f. sp .tritici:								
34-1,2,7 +Sr38	-	-	-	-	-	1	3	**4**
Total no isolates	**1**	**0**	**0**	**0**	**0**	**2**	**3**	**6**
Total no samples	**1**	**1**	**0**	**0**	**0**	**2**	**7**	**11**
No failed samples	0	1	0	0	0	0	4	**5**

Table 7. Isolates of *Puccinia hordei* identified by region, 1 April 2006 – 31 March 2007

	Number of Isolates							
	Region 1	Region 2	Region 3	Region 4		Region 5	Region 6	
Pathotype	QLD	NNSW	SNSW	VIC	TAS	SA	WA	**TOTAL**
5452P+	1	-	-	-	-	-	-	**1**
5453P- (+PI366444)	-	-	-	1	1	-	14	**16**
5453P+ (+PI366444)	1	-	-	1	1	-	11	**14**
Total no isolates	**2**	**0**	**0**	**2**	**2**	**0**	**25**	**31**
Total no samples	**2**	**0**	**0**	**2**	**1**	**0**	**26**	**31**
No failed samples	0	0	0	0	0	0	9	**9**