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

2003-2004 CEREAL RUST SURVEY ANNUAL REPORT

1. SUMMARY

Wheat Stem Rust Stem rust occurred on volunteer cereals in WA in autumn and became more widespread as the season progressed. Although uncommon in eastern Australia, stem rust occurred in SA and Vic late in 2003. Pt 98-1,2,3,5,6 was detected in both states and pt 34-1,2,7 +Sr38 was detected in SA. Pt 34-1,2,7 +Sr38 was widespread in WA in 2003. Six other pathotypes were isolated from WA, including 98-1,2,3,5,6,7, which combines virulence for *Sr8a* and *Sr15* and is able to overcome the resistance of Wyalkatchem.

Wheat Leaf Rust Pathotypes related to pt 104-1,2,3,(6),(7),11 dominated in all regions, a trend that has occurred since 1990. Leaf rust was common in eastern Australia in 2003 but did not reach damaging levels in commercial crops. Of note was the recurrence of pt 104-1,2,3,(6),(7),11 +Lr37 in SA. This pathotype was again widespread in WA during 2003, in conjunction with pt 104-1,2,3,(6),(7),11 and a variant of this pathotype with full virulence on the differential tester Gaza. Pt 104-1,2,3,(6),(7),11 +Lr24 was again isolated from all eastern states but was absent from WA.

Wheat Stripe Rust The stripe rust epidemic in eastern Australia in 2003 was the most severe in 20 years. Pathotypes detected in eastern Australia: 104 E137 A- (predominantly in northern regions), 110 E143 A+ (widely distributed in southern NSW and in SA), 134 E16 A+ (detected for the first time in eastern Australia in Sept 2003), 111 E143 A- (a new pathotype with virulence for *Yr1*, isolated from Brennan in Tas), 106 E139 A- (detected for the first time in southern NSW) and 104 E137 A- Yr17+ (the "VPM" pathotype).

Oat Stem Rust Sample numbers were slightly higher in 2003 compared to previous seasons. Pathotype 94, and its variants, were common. Virulence for *Pga* was again rare, and appeared to be confined to northern NSW and Qld. Testers for *Pg10*, *Pg15*, *Pg16* and *Pg17* were included, although most cultures were virulent. Occasional isolates showed lower responses on *Pg16*.

Oat Leaf Rust Samples from WA and SA comprised few pathotypes, which were largely avirulent on the differential set used (*viz* pts 0000-2 and 0001-0). In contrast, samples from NSW and Qld yielded more pathotypes, most virulent on current cultivars including Warrego (four pathotypes), Moola and Graza 68 (three pathotypes), Gwydir (pt. 0207-1,5,6,10,11,12 +Gwydir), Bettong and Barcoo (pt. 4473-6,10 +BB), and Culgoa (pt. 0667-5,6,10).

Barley Stem Rust Three samples from eastern Australia comprised the scabrum rust, one of which was virulent for *Sr21*.

Barley Leaf Rust Barley leaf rust reached epidemic levels in the Esperance region in WA, and a severe epidemic was experienced in SA. In WA, three pathotypes were isolated (viz. 5453P-, 5453P+, and 5610P+), and in eastern Australia, the predominant pathotype was pt 5652P+. Pt 5453P-, first detected in WA in 2001, was also isolated from eastern Australia.

Barley Grass Stripe Rust A unique form of stripe rust that is particularly adapted to wild barley grass, first detected in 1998, was commonly sampled in 2003. BGYR can infect Skiff and related cultivars; field observations in Vic and SA suggest further barley material may be vulnerable.

Triticale and Rye Rusts No reports of rust in crops of triticale or cereal rye were made in 2003

II. DETAILED REPORT

INTRODUCTION

The most notable cereal rust events during the 2003 season were the epidemic development of stripe rust throughout the eastern Australian wheat belt and the detection of a new pathotype of stripe rust in eastern Australia, first detected in WA during the 2002 season. Also of importance was the detection for the first time of virulences for *Lr37* and *Sr38* in SA.

Rust surveys or inspections conducted during 2003-04 included:

Northern NSW and Queensland	mid October	Bob McIntosh
Southern NSW	early November	Colin Wellings
South Australia	mid October	Colin Wellings

SEASONAL CONDITIONS

Following the drought of 2002, a return to average rainfall in eastern cropping regions, and average to above average rainfall in the west, gave producers considerable hope for a recovery in grain production in 2003. Average temperatures were slightly higher than normal.

Relatively mild winter temperatures contributed to a steady progress in stripe rust development in southern regions of the eastern wheat growing region. A short period of warm to hot conditions in early September failed to check epidemic development, and a return to cool to cold and moist weather allowed stripe rust to continue to develop throughout an extended spring. Late frosts experienced in November dramatically reduced yields. Northern NSW and Queensland experienced moisture limiting conditions in late winter; storm activity brought relief to many locations, but failed to recover expected yields, especially on the Darling Downs. Western Australia experienced average seasonal conditions with yields generally to expectations.

WHEAT RUST PATHOGENS

<u>Wheat Stem Rust</u> (caused by *Puccinia graminis* f. sp. *tritici*)
R. F. Park and M. Williams
University of Sydney

Epidemiology and pathotype distribution

Stem rust was uncommon in eastern Australia but was present on volunteer cereals in WA in autumn, where it became more widespread as the season progressed. The disease occurred at low levels at several locations in SA and Vic late in 2003.

Fifteen samples of stem rusted wheat were forwarded from eastern Australia, of which 8 yielded viable isolates (Table 1). Only two pathotypes were identified: pt 98-1,2,3,5,6 was the most commonly isolated pathotype and was isolated from NSW, Victoria and SA; pt 34-1,2,7 +*Sr38* was detected in SA and Victoria. The latter pathotype was first detected in WA in 2001. It was isolated in eastern Australia initially from Arno Bay in SA in November 2003, and subsequently during March 2004 from a summer nursery at Horsham. Pt 34-1,2,7 +*Sr38* was the most commonly isolated pathotype in WA in 2003, where it became widespread. Other pts isolated from WA included 34-2; 34-2,7; 34-1,2,7; 34-2,7,10; 343-1,2,3,5,6; 98-1,2,3,5,6; and

98-1,2,3,5,6,7. The latter, detected for the first time, combines virulence for *Sr8a* and *Sr15* and is able to overcome the resistance of Wyalkatchem.

Notes on cultivars carrying genes for stem rust resistance

All cultivars with the following genes are resistant to the pathotypes isolated in 2003-04. Cultivars with *Sr30* should be considered with caution since virulence for *Sr30* has been detected in recent years, and a single isolate of a pathotype combining virulence for *Sr9g* and *Sr30* was isolated from WA during 1999-2000. Furthermore, field studies at PBIC have shown clearly that some cultivars with *Sr30* perform better than others to avirulent pathotypes (see below).

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) 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 pahtotypes by the presence of the gene combination *Sr36* + *Sr38*.

<u>Wheat Leaf Rust</u> (caused by *Puccinia triticina*; formerly *Puccinia recondita* f. sp. *tritici*)
R. F. Park and M. Williams
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Epidemiology and pathotype distribution

Six pathotypes were identified in samples forwarded in 2003-04 (Table 2), all of which were mutational derivatives of pt 104-2,3,(6),(7),11, first detected in Victoria in 1984 and now regarded as having an exotic origin. Pathotypes within this group have dominated in all Australian cereal growing regions since 1990.

Despite being common in eastern Australia in 2003, leaf rust of wheat did not reach damage in levels in commercial crops. Of note was the recurrence of pt 104-1,2,3,(6),(7),11 +*Lr37* in eastern Australia, where it was isolated from Arno Bay, Two Wells, Freeling, Wanilla and Balaklava (SA) during October/November. The most common pathotype isolated from eastern Australia was the Lr24 virulent pt 104-1,2,3,(6),(7),11,13, present in all eastern mainland states (Table 2). Other pathotypes isolated from the east were 104-1,2,3,(6),(7),9,11 (the Triller or *Lr26* virulent pathotype), 104-1,2,3,(6),(7),11 +Gaza High, 104-1,2,3,(6),(7),11,12 (virulent for *Lr17b*) and the presumed parent of all of these pathotypes, pt. 104-1,2,3,(6),(7),11 (Table 2).

The *Lr37* virulent pathotype was widespread in WA during 2003, in conjunction with pt 104-1,2,3,(6),(7),11 and a variant of this pathotype with full virulence on the differential tester Gaza. The frequencies of these pathotypes, as estimated by their rate of recovery from samples received, was about equal.

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 virulence for this gene. Cultivars with *Lr13* in combination with *Lr1* (Arnhem, Batavia, Bowerbird, Cunderdin, Diamondbird, Glover, Hartog, Kukri, Leichardt, Sunbrook, Sunfield and Tailorbird), *Lr2a* (Sunmist), *Lr23* (EGA Hume, Strzelecki), *Lr24* (Dennis, Giles, Petrie and Sunsoft 98) or *Lr37* (Braewood, Rudd and Sunstate) are also resistant to the pathotypes isolated in 2003–04. Cultivars with *Lr26* (Grebe and Warbler) are seedling susceptible to pt 104-1,2,3,(6),(7),9,11, now present in all eastern states, and it is anticipated that Tennant (*Lr26*) will be at least seedling susceptible to this pathotype.

Cultivars with *Lr37* in combination with *Lr13* (see above) or *Lr24* (QAL2000) are resistant to all pathotypes isolated from Australasia during the 2003-04 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 2003–04. 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.

Wheat Stripe Rust (caused by *Puccinia striiformis* f. sp. *tritici*)

C. R. Wellings* and K. R. Kandel
(*on secondment from NSW Agriculture)

Disease development

Stripe rust was first reported from wheat growing areas in eastern Australia in early August (Narrabri northern NSW) and then several weeks later in late August (Narrabri; Parkes central west NSW; Wagga Wagga southern NSW). Samples were not received from SA or Victoria until late September. The epidemic in eastern Australia became a major production issue when it emerged that many commercial wheats were more heavily diseased than expected, due to the arrival of the WA pathotype. This pathotype was first detected in southern NSW and SA in mid September, and quickly established throughout most of the eastern wheat belt with the exception of Queensland where the epidemic was late and losses minimal. However southern states were severely affected, with the industry estimating fungicide expenditure in the vicinity of $43 million. The epidemic was clearly the most significant to affect eastern Australia since the severe epidemics of 1983-84.

Samples from WA were received from late August to early September. This was a similar time of epidemic onset compared to the previously severe epidemic in 2002, although sample number was subsequently low (150 samples in 2002, compared to 28 samples in 2003). The marked reduction in intensity and severity of the epidemic in WA in 2003 was been attributed to effective extension campaigns targeting reduction of green bridge material to support carry over of inoculum, and widespread use of pre-plant fungicides (seed dressings, fungicide amended fertilizer).

Pathotypes detected

The main pathotypes detected in 2003-04 are described below. The features of these pathotypes are described in terms of avirulence genes that indicate the corresponding host resistance genes that remain effective in providing protection against the particular pathotype.

104 E137 A-/A+	avirulent on resistance genes *Yr6* (*eg* Sunbrook), *Yr7* (*eg* Diamondbird), *Yr9* (*eg* Mawson), *Yr17* (*eg* Sunbri) and a range of adult plant resistance genes including *Yr18*. First detected in 1979.
110 E143 A+	avirulent on *Yr9*, *Yr17* and adult plant resistances. First detected in 1986 and has become more recently associated with severe disease on cultivar H45 since 2002.
104 E137 A-, Yr17+	avirulent on *YrA, Yr6, Yr7, Yr9* and adult plant resistances. First detected in 1999 on wheats carrying *Yr17* (*eg* Camm, Trident) and continues to be recovered at low frequency.
104 E153 A-	identical to 104 E137 A- with additional virulence for *Yr8.* First detected in 1985, and occasionally recovered in the survey. This pathotype has no obvious advantage for survival and is not expected to cause problems.
106 E139 A-	identical to 104 E137 A- with additional virulence for *Yr7*. First detected in 2003 from southern NSW.
111 E143 A-	detected in Tasmania for the first time in 2002 and identical to 110 E143 A+ with additional virulence for *Yr1*. The potential importance of this pathotype is difficult to determine, given that *Yr1* is rare in Australian wheats (*eg* More).
238 E143 A+	detected for the first time in several locations in southern NSW. Similar to 110 E143 A+ with additional virulence for *Yr9*. Although recovered from wheat, this pathotype could cause some problems to triticale if it becomes more widely established.
134 E16 A+	first detected in Western Australia in 2002 and in eastern Australia in 2003. Avirulent on *Yr17* and adult plant resistances including *Yr18*. This pathotype has rapidly established in its first season in the east, comprising 50% of isolates. Several collections from barley grass in eastern Australia yielded this pathotype. However, WA barley grass communities appeared to remain unaffected by this pathotype.

Miscellaneous pathotypes included those of unusual pathogenicity combinations requiring further study.

Pathotype distribution

The frequency and distribution of pathotypes detected in 2003-04 are indicated in Table 3. A feature of the survey was the unusually high frequency of pathotype mixtures obtained from individual samples (379 viable samples in eastern Australia yielded 446 pathotypes). The time required to separate cultures from mixtures resulted in significant delays in finalising the survey results.

Although 10 *Pst* pathotypes were detected, over 80% of isolates were represented by just four pathotypes. The main pathotype in eastern Australia was 134 E16 A+ which became widely distributed in its first year of appearance. This pathotype was most frequently isolated from cultivar H45. Several samples from triticale crops in southern Victoria were noted to be 134 E16 A+, presumably due to its virulence for *Yr9* and the presence of this gene in commercial triticales. This pathotype remained the only one detected in Western Australia. The “H45 pathotype” (110 E143 A+) remained at relatively high frequency, especially in southern NSW. Pathotype 104 E137 A- Yr17+ (“VPM pathotype”) was at relatively low frequency, but remains a significant pathotype for those cultivars protected only by *Yr17* (*ie* Camm, QAL 2000). This pathotype can be expected to survive, given its comparative advantage on these cultivars.

Notes on current resistances

Resistance genes *YrA, Yr6, Yr7, Yr9, Yr10, Yr17, Yr18* are deployed in certain Australian wheats and these will generally continue to provide varying protection in areas where the prevailing pathotypes remain avirulent. Among these genes, however, only *Yr18* is expected to provide durable resistance in association with other undescribed adult plant resistances.

Pathotype 134 E16 A+ has evidently caused higher levels of disease on eastern Australian wheats than previously anticipated. Preliminary data suggests than one or more APR genes have been overcome by this pathotype, although *Yr17* and additional APR continues to provide good protection in certain cultivars. Notes on variety X pathotype disease response has been circulated in several Cereal Rust Reports and placed on the PBI website.

OAT RUST PATHOGENS

Oat Stem Rust (caused by *Puccinia graminis* f. sp. *avenae*)

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(*on secondment from NSW Agriculture)

Increased sample numbers in 2003 compared to 2002 provided an improved opportunity to assess pathogenic diversity in *P. graminis avenae*. A total of 92 isolates, derived from 67 viable samples, comprised 8 pathotypes (Table 4). Testers for *Pg10*, *Pg15*, *Pg16* and *Pg17* were included, although most cultures were virulent. Occasional isolates showed lower responses on *Pg16*.

Pathotype group 94 continued to predominate, with variants virulent for *Pg13* and *PgSaia* (94-2,3) recovered at greatest frequency. This pathotype has been common over recent years in both eastern and western cereal growing regions.

Virulence for *Pga* remains localised to the eastern regions, especially northern NSW and Queensland. Approximately 17% of isolates carried virulence for *Pga*, and this represents a slight increase over recent years. The pathotype was first detected in 1997 and reached 20% of isolates before declining to 10%. Cultivars carrying the *Pga* resistance (Barcoo, Culgoa II, Glider, Cleanleaf, Nobby) can be expected perform well in the absence of the corresponding virulent pathogen.

Oat Leaf Rust (caused by *Puccinia coronata* f. sp. *avenae*)

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Epidemiology and pathotype distribution

Twenty pathotypes of *P. coronata* f. sp. a*venae* were identified from the 68 samples received that yielded a viable rust isolate (Table 5). Surveys from recent years have shown that pathotypes can be placed broadly into four categories:

1. virulent for *Pc55*, *Pc71*, and either or both *Pc38* and *Pc39*
2. virulent for *Pc58*, *Pc59* and *Pc61*
3. virulent for *Pc39* and *Pc61*
4. avirulent for all of these genes

Members of group 1 appear to be step-wise mutational derivatives and are related to the Cleanleaf pathotype 0207-5,6,10. Many pathotypes have been identified in this group, which includes virulence not only for Cleanleaf but also Warrego, Gwydir and Nugene. Members of the second group appear to be mutational derivatives of the Amby pathotype 0071-0. Only a few pathotypes have been identified as members of this group. The third group comprises two pathotypes, 4473-6,10, thought to be a somatic hybrid between a member of group 1 and one from group 2, and a mutational derivative of this pathotype with added virulence for Bettong and Barcoo (4473-6,10 +BB). Groups 1, 2 and 3 have tended to dominate in Region 1 (northern NSW and Qld) over the past 5 years. Group 4 pathotypes, while avirulent on many of the differential genotypes now used, appear to be a diverse group of pathotypes, some at least of which have been present for many years. Whilst some of these pathotypes have been isolated from Region 1 in recent years, they tend to be infrequent most likely because they are avirulent on many of the oat cultivars grown there. In contrast, these pathotypes dominate in Regions 2, 3 and 4.

Only four pathotypes were isolated from WA, of which pts 0000-2 and 0001-0 were the most common (Table 5). Both pathotypes were also commonly isolated from samples collected in SA, along with a third pathotype, 4001-10. Although the latter appears to be virulent on *PcH458* and *Pc71*, it is possible that the host:pathogen interaction in both cases are temperature sensitive and that this pathotype is in fact avirulent on these genes. Further tests are needed to investigate this. Pt 0000-2 is pathogenically very similar to pathotypes in the PBI rust collection that were isolated in the early 1970s.

Many of the pathotypes isolated from NSW and Qld were virulent on current cultivars including Warrego, Moola and Graza 68, Gwydir, Bettong and Barcoo, and Culgoa. Of interest was the isolation of a new pathotype virulent on cultivar Gwydir (pt 0071-1,7, 4,12 +Gwydir; Table 5). The pathogenicity of this pathotype, plus that of the first Gwydir-virulent pathotype detected (0207-1,5,6,10,12 +Gwydir), implicate the presence of genes *Pc36* and *Pc56* in this cultivar. Also of interest was the isolation of a new pathotype with virulence for Culgoa, pt 0667-5,6,10. This pathotype was first isolated from leaf rusted Mortlock oats in Queensland. Results from greenhouse seedling tests have indicated that Culgoa and Mortlock share a common resistance gene.

Notes on cultivars carrying genes for leaf rust resistance

With the exception of cultivar Volta, released in 2003 and not yet tested in detail, all current Australian oat cultivars are susceptible to leaf rust. 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 (Table 6).

BARLEY RUST PATHOGENS

<u>Barley Stem Rust</u> (caused by *Puccinia graminis*)
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Of the five samples of stem rusted barley collected from eastern Australia, only one yielded a viable isolate (Table 7). This was collected in Queensland and comprised the scabrum rust with virulence for *Sr21*. Six of the 12 samples forwarded from WA all yielded the wheat stem rust pathogen, and were typed as pts 34-1,2,7 (1 isolate), 34-1,2,7 +Sr38 (6 isolates).

<u>Barley Leaf Rust</u> (caused by *Puccinia hordei*)
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University of Sydney

Epidemiology and pathotype distribution

Barley leaf rust reached epidemic levels in the Esperance region in WA, and an epidemic in SA was possibly the most severe ever experienced there. In WA, the cultivation of Gairdner, Fitzgerald, Baudin and Hamelin, and in SA the increased area sown to Keel, have favoured the development of this disease.

Eleven pathotypes were isolated from samples collected in 2003, only one of which was avirulent for *Rph12* (pt 272P+; Table 8). In WA, three pathotypes were isolated (viz. 5453P-, 5453P+, and 5610P+), and in eastern Australia, the predominant pathotype was pt 5652P+ (Table 8). Pt 5453P-, and the presumed mutational derivative with added virulence for *Rph19* 5453P+, were first detected in WA in 2001 and 2002, respectively. Both pathotypes were isolated from eastern Australia (SA, Victoria, Tasmania and southern NSW) for the first time during 2002-03.

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 since their adult plant responses to the *Rph12* virulent pathotypes detected in the region last year are currently unknown. Only Galaxy has effective seedling resistance to leaf rust in Australia, 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.

Barley Grass Stripe Rust (caused by *Puccinia striiformis*)

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([1]on secondment from NSW Agriculture)

Disease distribution

The barley grass pathogen, first detected in 1998, continues to be frequently isolated from barley grass communities and occasional barley lines. The pathogen was again most frequent in southern NSW and Victoria (Table 3). No crop losses were reported, although field observations in Victoria and South Australia suggested that some barley lines were noticeably more affected than in previous seasons. Greenhouse tests failed to confirm the hypothesis that the pathogen has undergone further mutational change, although this hypothesis will continue to be investigated. Barley grass stripe rust has not been recorded in WA.

TRITICALE AND RYE RUST PATHOGENS

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There were no reports of rust in commercial crops of triticale or cereal rye in 2003-04. One sample of cereal rye leaf rust was forwarded from an experimental plot of Rysun grown at the Elizabeth Macarthur Agricultural Research Institute (NSW Primary Industries) near Sydney.

MISCELLANEOUS RUST PATHOGENS ON GRASSES

Samples of rusted *Poa annua*, *Phalaris*, *Fescue*, and several unidentified weed species did not infect a standard set of wheat, barley, rye and oat genotypes, and were concluded to be likely non-cereal attacking rust pathogens.

III ACKNOWLEDGEMENTS

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Table 1. Pathotypes of *Puccinia graminis* f. sp. *tritici* (wheat stem rust pathogen) identified by region, 1 April 2003 – 31 March 2004.

	Number of Isolates							
	Region 1	Region 2	Region 3	Region 4		Region 5	Region 6	
Pathotype	QLD	NNSW	SNSW	VIC	TAS	SA	WA	TOTAL
34-1,2,7	-	-	-	-	-	-	14	14
34-1,2,7 +Sr38	-	-	-	3	-	1	67	71
34-1,2,7,10	-	-	-	-	-	-	1	1
34-2	-	-	-	-	-	-	1	1
34-2,7	-	-	-	-	-	-	5	5
34-2,7,10	-	-	-	-	-	-	2	2
98-1,2,3,5,6	-	1	1	3	-	1	3	9
98-1,2,3,5,6,7	-	-	-	-	-	-	8	8
98-1,2,3,5,6,7 +Sr7b	-	-	-	-	-	-		
343-1,2,3,5,6	-	-	-	-	-	-	14	14
Total no isolates	**0**	**1**	**1**	**6**	**0**	**2**	**115**	**125**
Total no samples	**1**	**2**	**1**	**9**	**0**	**2**	**127**	**142**
No failed samples	1	1	0	4	0	1	30	37

Table 2. Pathotypes of *Puccinia triticina* (wheat leaf rust pathogen) identified by region, 1 April 2003 – 31 March 2004.

	Number of Isolates							
	Region 1	Region 2	Region 3	Region 4		Region 5	Region 6	
Pathotype	QLD	NNSW	SNSW	VIC	TAS	SA	WA	TOTAL
104-1,2,3,(6),(7),11	-	-	-	2	1	2	44	49
104-1,2,3,(6),(7),9,11	-	1	-	-	-	-	-	1
104-1,2,3,(6),(7),11 +GH*	-	1	1	1	-	1	42	46
104-1,2,3,(6),(7),11,12	-	-	-	2	-	2	-	4
104-1,2,3,(6),(7),11,13	8	1	2	2	-	14	-	27
104-1,2,3,(6),(7),11+Lr37	-	-	-	-	-	5	53	58
Total no isolates	**8**	**3**	**3**	**7**	**1**	**24**	**139**	**185**
Total no samples	**11**	**3**	**3**	**9**	**1**	**15**	**147**	**189**
No failed samples	3	1	0	2	0	5	40	51

* Fully virulent on the differential tester Gaza

Table 3. Pathotypes of *Puccinia striiformis* f. sp. *tritici* (wheat stripe rust pathogen) identified by region, 1 April 2003 – 31 March 2004.

	Number of Isolates							
	Region 1	Region 2	Region 3	Region 4		Region 5	Region 6	
Pathotype	QLD	NNSW	SNSW	VIC	TAS	SA	WA	TOTAL
104 E137 A-	1	8	3	1	-	-	-	13
104 E137 A+	1	4	3	4	-	-	-	12
104 E137 A- Yr17+	1	-	3	4	-	1	-	9
104 E153 A-	-	3	2	-	-	-	-	5
106 E139 A-	1	3	17	-	-	-	-	21
64 E0 A-	3	6	2	1	-	-	-	12
110 E143 A+	-	7	26	5	-	4	-	42
111 E143 A-	-	2	10	1	5	2	-	20
238 E143 A+	-	-	2	-	-	-	-	2
134 E16 A+	-	30	108	53	4	23	23	241
BGYR	-	1	17	11		10	-	39
Miscellaneous	-	7	5	3	2	4	5	26
Total no isolates	**7**	**71**	**198**	**83**	**11**	**44**	**28**	**442**
Total no samples	**8**	**66**	**186**	**83**	**11**	**49**	**28**	**431**
No failed samples	1	9	18	9	3	12	2	54

Table 4. Pathotypes of *Puccinia graminis* f. sp. *avenae* (oat stem rust pathogen) identified by region, 1 April 2003– 31 March 2004.

	Number of Isolates						
	Region 1		Region 2		Region 3	Region 4	
Pathotype	QLD	NNSW	SNSW	VIC	SA	WA	TOTAL
31-1	-	-	-	-	-	2	2
41	-	1	1	-	6	-	8
41-2	-	-	-	-	1	-	1
94	-	-	-	-	-	5	5
94-2	1	2	-	-	1	13	17
94-3	-	1	3	1	7	1	13
94-2,3	5	10	1	1	6	7	30
94-2,3,4	6	7	3	-	-	-	16
Total no isolates	**12**	**21**	**8**	**2**	**21**	**28**	**92**
Total no samples	**10**	**17**	**6**	**2**	**13**	**24**	**72**
No failed samples	1	1	-	-	-	3	5

Table 5. Pathotypes of *Puccinia coronata* f. sp. *avenae* (oat leaf rust pathogen) identified by region, 1 April 2003 – 31 March 2004.

	Number of Isolates							
	Region 1	Region 2	Region 3	Region 4		Region 5	Region 6	
Pathotype	QLD	NNSW	SNSW	VIC	TAS	SA	WA	TOTAL
0000-2	-	1	-	-	-	15	13	29
0001-0	2	3	1	-	-	8	10	24
0001-2	1	-	-	-	-	3	-	4
0003-2,8	-	-	-	-	-	-	1	1
0007-6,8,10	3	-	-	-	-	1	-	4
0007-6,8,10 +Warrego	1	-	-	-	-	-	-	1
0071-0	1	-	-	-	-	-	-	1
0071-1,4,12 +Gwydir	-	1	-	-	-	-	-	1
0207-1,5,6,10,12 +Gwydir	1	1	-	-	-	-	-	2
0107-6,10	1	-	1	-	-	-	-	2
0107-6,8,10	1	2	-	-	-	-	-	3
0107-6,10 +Warrego	2	-	-	-	-	2	-	4
0307-5,6,10	3	-	-	-	-	1	-	4
0307-5,6,10 +Warrego	2	1	-	-	-	3	-	6
0667-5,6,10	5	1	-	-	-	-	-	6
2107-1,6,10 +Warrego	-	1	-	-	-	2	-	3
4003-10	-	-	-	-	-	15	5	20
4003-6,10	-	-	-	-	-	1	-	1
4473-6,10	-	2	1	-	-	-	-	3
4473-6,10 +Bettong, Barcoo	3	-	-	-	-	1	-	4
Total no isolates	**26**	**13**	**3**	**0**	**0**	**52**	**29**	**123**
Total no samples	**12**	**7**	**2**	**1**	**0**	**27**	**24**	**73**
No failed samples	0	1	1	1	0	1	1	5

Table 6. Pathotypes of *P. coronata* f. sp. *avenae* virulent for eight oat cultivars released in Region 1

Cultivar	Pathotype	Year First Detected
Culgoa	4473-6,10	1996-97
	4473-6,10 +BB	2001-02
	0607-5,6,10	1998-99
	0667-5,6,10	2002-03
Moola/Graza 68	0107-6,10	2002-03
	0107-6,8,10	2002-03
	0107-6,10 +Warrego	2002-03
	0307-5,6,10	1999-00
	0307-5,6,10 +Warrego	2002-03
	2107-1,6,10 +Warrego	2002-03
Warrego	0007-6,8,10 +Warrego	1998-99
	0007-6,10 +Warrego	1999-00
	0107-6,10 +Warrego	2002-03
	0207-5,6,10 +Warrego	1999-00
	0307-5,6,10 +Warrego	2002-03
	2107-1,6,10 +Warrego	2002-03
Gwydir	0207-1,5,6,10,12 +Gwydir	2001-02
	0071-1,4,12 +Gwydir	2002-03
Nugene	0207-5,6,10 +Nugene	2001-02
Bettong/Barcoo	4473-6,10 +BB	2001-02

Table 7. Barley stem rust isolates identified by region, 1 April 2003 – 31 March 2004.

	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 +Sr21	1	-	-	-	-	-	-	1
P. graminis f. sp .tritici	-	-	-	-	-	-	6	6
Total no isolates	**1**	**0**	**0**	**0**	**0**	**0**	**6**	**7**
Total no samples	**4**	**1**	**0**	**0**	**0**	**0**	**12**	**17**
No failed samples	3	1	0	0	0	0	6	10

Table 8. Pathotypes of *Puccinia hordei* (barley leaf rust pathogen) identified by region, 1 April 2003 – 31 March 2004.

	Number of Isolates							
	Region 1	Region 2	Region 3	Region 4		Region 5	Region 6	
Pathotype	QLD	NNSW	SNSW	VIC	TAS	SA	WA	TOTAL
272P+ (+PI366444)	-	-	-	1	-	-	-	1
4610P+	1	-	-	-	-	1	-	2
4673P+ +Rph13)	-	-	-	-	1	-	-	1
5452P+	1	-	12	6	12	12	-	43
5453P- (+PI366444)	-	-	1	1	1	1	17	21
5453P+ (+PI366444)	-	-	5	2	2	-	9	18
5610P+	-	-	-	-	1	1	2	4
5652P+ (+Rph13)	-	-	-	-	-	1	-	1
5653P+ (+Rph13)	-	-	1	-	1	-	-	2
5653P+ (-Rph13)	-	-	-	1	1	2	-	4
5673P+	-	-	-	1	-	-	-	1
Total no isolates	**2**	**0**	**19**	**12**	**19**	**18**	**28**	**98**
Total no samples	**3**	**0**	**17**	**10**	**15**	**14**	**25**	**84**
No failed samples	1	0	4	3	0	1	5	14