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1998-1999 CEREAL RUST SURVEY ANNUAL REPORT

I. SUMMARY

Wheat Stem Rust
Levels of stem rust were low to very low throughout Australia, although appreciable levels were detected in Victoria and SA during early December. All pathotypes identified from WA were of the 34-2 "group", whilst the predominant pathotype in south eastern Australia was the *Sr9g* virulent pathotype 98-1,2,3,5,6. Several other pathotypes were identified from eastern Australia, including 34-1,2,3,5,6 and 39-1,2,3,5,6, both detected for the first time.

Wheat Leaf Rust
Leaf rust was widespread in most wheat growing regions. Moderate to high levels of the disease developed in irrigated crops of Triller in southern NSW. The predominant pathotypes in all mainland states were those of the 104-2,3,(6),(7),11 group, with 104-1,2,3,(6),(7),11 being the most common, continuing the trend of recent years. The pathotype responsible for rusting of Triller was a variant of pt 104-1,2,3,(6),(7),11 with added virulence for *Lr26* (ie pt 104-1,2,3,(6),(7),9,11).

Wheat Stripe Rust
Unusually high numbers of stripe rust samples were received from barley grass collections in eastern Australia. The majority of barley grass cultures proved to be avirulent on wheat differentials. These isolates were concluded to be a form of the pathogen with adaptation to barley grass and thus have been temporarily designated barley grass stripe rust (BGYR). Standard wheat pathotypes in eastern Australia included 104 E9 A+ and 104 E137 A+. New pathotypes from New Zealand included virulence for *Yr17* (VPM1 resistance) in pt. 234 E139 A-, Yr17+, and virulence for *Yr27* (Selkirk, Opata 85 resistance) in pt. 239 E143 A-, Yr27+.

Oat Stem Rust
The pathogen population continues to show diversity in regard to a range of resistance genes. The only resistance gene providing some protection is *Pg a* although several pathotypes have shown virulence for this resistance since it's first detection in 1996. Pathotypes virulent for *Pg a* have increased in frequency in Region 1 (Qld., nNSW) and sNSW, but were at low frequency in Victoria and SA.

Oat Leaf Rust
Oat leaf rust occurred widely in eastern states, where it was common on wild oats. Twenty four pathotypes were detected, with pathotype diversity greatest in NSW and Qld. The most widespread pathotype was the Amby pathotype (0071-0), which along with the Cleanleaf pathotype (0207-6,10), accounted for about 55% of all isolates. Virulence was detected for cultivar Warrego. Virulence was not detected for the genes *Pc50*, *Pc68*, and *Pc91*, or for the cultivars Bettong and Barcoo (note that virulence for *Pc68* was, however, detected in June 1999).

Barley Stem Rust
Seven samples of stem rusted barley, most originating from SA, comprised the non- wheat attacking "scabrum" rust and isolates of *P. graminis* f. sp. *tritici* pts 21-2,7 and 98-1,2,3,5,6. Samples of stem rusted barley collected from Langhorne Creek in SA in early April 1998, and mid March 1999 yielded several wheat stem rust pathotypes plus the "scabrum" rust.

Barley Leaf Rust
Barley leaf rust was present in crops of Franklin and Gairdner in southern regions of WA during August-September, and became severe in an early sown crop of Franklin at Albany. Levels of the disease in SA were lower than usual, and in northern NSW/ Qld, were negligible. All isolates from WA comprised pt 5610P+, similar to a Franklin attacking pathotype present in eastern Australia. Two isolates of the WA pathotype were recovered from eastern Australia, suggesting that it has spread there from WA. Pathotypes 201P+, 222P+ and 242P+, detected for the first time, were isolated from eastern Australia.

Triticale and Rye Rusts
There were no reports of rusting in crops of triticale during 1998-99, and one sample of rye leaf rust, collected from Currency Creek (SA), was the only record of rust on cereal rye.

II. DETAILED REPORT

INTRODUCTION

Rust surveys or inspections conducted during 1998-99 included:

October 5-9 1998. Prof. R. A. McIntosh. Approximately 2,800km, from Forbes in central NSW to St George and Dalby in Qld; 64 inspections stops. Rust diseases of wheat were rare with stripe rust limited to one colony on barley grass at Cudal and heavy but obviously late infection on Morocco at PBI Narrabri. Leaf rust was found on two crops on the Darling Downs - a Kite- like derivative cultivar near Dalby and a Ford- type wheat south of Allora. Oat leaf rust was particularly widespread and very severe, even on wild oats. Oat stem rust was of relatively low incidence.

October 19-22 1998. Dr C. R. Wellings. South Australia, incorporating the mid north and northern Yorke Peninsula, the lower and mid Eyre Peninsula, the south east and Mallee to Mount Lofty, and the mid North and Clare Valley. Cereal crops were in excellent condition. Wheat leaf rust was widespread and severe in favoured regions of the Mid North. Stripe rust on weedy barley grass was evident in crops which showed no sign of wheat stripe rust infection.

November 1-4 1998. Dr R. F. Park. Approximately 2,100km, throughout southern NSW and northern Victoria; 50 inspections of crops or volunteer cereals/ grasses. Of particular significance was the widespread and often severe occurrence of stripe rust on barley grass, despite its absence in all but one wheat crop. Leaf rust of wheat was common throughout the survey area, and was moderate to severe in some crops in the Murrumbigee Irrigation Area. Oat leaf rust was also widespread on wild oats.

November 30- December 1 1998. Prof R. A. McIntosh. Long season winter wheats, northern tablelands; Walcha, Uralla, Armidale, Deepwater and Emmaville. The severity of leaf rust was very high at Uralla and to the west of Armidale. Stem rust and stripe rust were not found in any crop, but stripe rust was present on barley grass growing in headlands and pasture adjacent to crops.

December 7-9 1998. Prof. R. A. McIntosh. Approximately 1,350 km, long season winter wheats growing regions west of Melbourne to Naracoorte; 50 inspections. Stem rust was present in almost all crops inspected, except in the Newlyn- Dean area northeast of Ballarat. Leaf rust was also present in most crops. Stripe rust was present on barley grass whenever green plants were found.

December 13-14 1998. Prof. R. A. McIntosh. Long season winter wheats, southern tablelands, Canberra to Delegate; 17 crop inspections. Leaf rust was present but at extremely low levels and only on a few plants of Gordon at Williamsdale. Stem rust and stripe rust were not detected in wheat, but again, stripe rust was collected from infected barley grass. Oat rusts were collected near Canberra but on the southern tablelands, wild oats were rust free.

SEASONAL CONDITIONS

Above average rainfall patterns, especially in the eastern wheat growing regions, were reflected in above average grain yield. However, overall grain receivals were lower than the previous season due, in part, to excessive winter-spring rains which exacerbated foliar leaf diseases and contributed to waterlogging and crop lodging in some instances. High humidity and warm temperatures favoured the widespread development of yellow leaf spot in wheat. The *Sr2*-related pseudo- black- chaff syndrome (PBC) was of particular concern to some growers in Qld.

Despite ideal conditions for wheat rusts, crop losses were not reported. Rust diseases of barley and oats were widespread.

WHEAT RUST PATHOGENS

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

Levels of stem rust were low to very low throughout Australia, although appreciable levels were detected in Victoria and SA during early December. Forty five samples were received, two of which did not produce viable isolates (**Table 1**). All pathotypes identified from WA were of the 34-2 “group”. The predominant pathotype in south eastern Australia was the *Sr9g* virulent pathotype 98-1,2,3,5,6, which was identified in samples collected from southern NSW (near Gundagai), Victoria (throughout south western regions) and SA (both south and north of Adelaide). Stem rusted wheat and barley was detected at Langhorne Creek in SA in early April 1998, and mid March 1999, and samples collected yielded pathotypes 21-2,7, 98-1,2,3,5,6 and 343-1,2,3,5,6, plus two different isolates of the non- wheat attacking “scabrum” stem rust. Pt 21-2,7 has not been detected in surveys for many years and was isolated from stem rusted barley. Pt 98-1,2,3,5,6 was also recovered from stem rusted wheat growing in a summer nursery near Horsham in early March 1999.

Other stem rust pathotypes detected during 1998- 99 included 34-1,2,3,5,6 and 39-1,2,3,5,6 (both detected for the first time and considered to be derives of pathotype 98-1,2,3,5,6 by the acquisition of virulence for *Sr7b*, and *sr21*, respectively). A single isolate recovered from stem rusted wheat collected at Streatham (Victoria) was provisionally identified as pt 34-0. Further tests are needed to fully characterise this isolate as pt 34-0 is an uncommon pathotype which was last isolated from Australia in 1965.

Notes on Cultivars Carrying Genes for Stem Rust Resistance

All cultivars with the following genes are resistant to the pathotypes isolated in 1998-99 (note, however, that virulence for *Sr30* has been detected in recent years):

Sr9e (Sunland and Yarralinka)

Sr22 (Schomburghk)

Sr24 (Cunningham, Datatine, Goroke, Janz, Krichauff, Perouse, Sunco, Sunelg, Swift, Tasman and Worrakatta)

Sr26 (Hybrid Apollo, Blade, Chough, Currawong, Darter, Flinders, Hybrid Gemini, Harrier, Hybrid Mercury, Petrel, Hybrid Pulsar, Shrike, Snipe, Sunelg, Sunlin, Tern and Yanak)

Sr30 (Ajana, Arrino (heterogeneous), Brookton, Buckley, Calingiri, Cranbrook, Cunderdin, Frame, Hybrid Galaxy, Kalannie, Katunga, Molineux, Osprey, Rosella, Silverstar, Sunfield, Sunmist).

Sr31 (Grebe, Mawson,Tennant,Triller and Warbler)

Sr38 (Bowie, Camm, Sunbri, Sunstate, Sunvale and Trident)

The gene *Sr2* confers adequate adult plant resistance and is present in the cultivars Arnhem, Batavia (heterogeneous), Baxter, Brennan, Carnamah, Diamondbird, Dollarbird, Eradu, Goldmark, Gordon, Hartog, Houtman, Kennedy, Leichardt, Lowan, Machete, Nyabing, Pelsart, Rowan, Sunbrook, Suneca, Sunstate, Tailorbird. Cultivars with *Sr13* (Gutha, Machete, Stiletto, Sunmist and Wialki) are moderately susceptible to moderately resistant.

Wheat Leaf Rust (caused by *Puccinia recondita* f. sp. *tritici*)

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Epidemiology and Pathotype Distribution

Leaf rust was widespread in most wheat growing regions. Moderate to high levels of the disease developed in irrigated crops of Triller in southern NSW in the MIA. The predominant pathotypes in all mainland states were those of the 104-2,3,(6),(7),11 group, with 104-1,2,3,(6),(7),11 being the most common, continuing the trend of recent years.

All isolates from WA were identified as comprising pt 104-1,2,3,(6),(7),11, or a variant of this with complete virulence on the *Lr23* differential cultivar Gaza. This variant was also detected in sNSW, Victoria and SA, and is not expected to be an increased threat to cultivated wheats. The pathotype responsible for rusting of Triller was shown to be a variant of pt 104-1,2,3,(6),(7),11 with added virulence for *Lr26* (ie pt 104-1,2,3,(6),(7),9,11). The adult plant responses of other cultivars with *Lr26* (ie Grebe, Mawson, Tennant, Warbler) to this pathotype are currently unknown. The Triller pathotype was also detected from northern NSW (Narrabri) and Victoria (Quambatook and Korong Vale) during 1998, and in trial plots of Mawson growing at Kingsthorpe, Qld, during June 1999. Also of significance was the detection of pt 53-1,(6),(7),10,11,12 in Victoria and SA. This pathotype was first detected in Tasmania during 1997, and recurred in that state during 1998. It was also detected in New Zealand for the first time during 1998. Along with pt 76-1,3,5,10,12, this pathotype combines virulence for *Lr13* and *Lr17b*, a gene combination present in several long season dual purpose wheats. Pathotype 76-1,3,5,10,12 was isolated from long season wheats growing in the Armidale/ Glen Innes region of northen NSW in late November - early December 1998.

Pts 53-(6),(7),12 and 53-1,(6),(7),12 were isolated from samples collected in New Zealand **(Table 2).** Both were isolated in 1996 and differ considerably from other pathotypes of leaf rust occurring in Australasia. These pathotypes were first detected in New Zealand in 1990, and the most likely explanation for their origin is that the former was introduced into New Zealand, and that the latter was subsequently derived by acquiring virulence for *Lr20*. All isolates of these pathotypes, including those identified in 1998, have originated from the Canterbury district. Both are avirulent for most of the catalogued resistance genes, with pt 53-(6),(7),12 being virulent for *Lr2c*, *Lr10*, and *Lr17b* only.

Notes on Cultivars Carrying Genes for Leaf Rust Resistance

All cultivars with *Lr17a* (Baxter, heterogeneous), *Lr24* (Cunningham, Datatine, Goroke, Janz, Krichauff, Nyabing, Perouse, Sunco, Sunelg, Swift, Tasman and Worrakatta) and *Lr37* (Bowie, Camm, Sunbri, Sunstate, Sunlin, Sunvale and Trident) are resistant to all pathotypes isolated from Australasia during 1998-99. Cultivars with *Lr13* in combination with *Lr1* (Hybrid Apollo, Arnham, Batavia, Cunderdin, Diamondbird, Dollarbird, Goldmark, Hartog, Kennedy, Leichardt, Lowan, Hybrid Pulsar, Rowan, Silverstar, Sunbrook, Suneca, Sunfield and Tailorbird) or *Lr2a* (Sunmist) are also resistant to the pathotypes isolated, however pt 64-(6),(7),(10),11 combines virulence for *Lr1* with partial virulence for *Lr13* and the response of wheats with these genes to this pathotype is not known. Cultivars with *Lr26* (Grebe, Mawson, Triller and Warbler) are seedling susceptible to pt 104-1,2,3,(6),(7),9,11, detected in southern NSW in 1997. Sunland (*Lr28*) is resistant to the pathotypes isolated during 1998-99.

The long season dual purpose wheats Longbow and More (*Lr13*), Gordon (*Lr17b* plus possibly *Lr13*), and Lawson, Muchmore (*Lr17b* and *Lr13)* are all seedling susceptible to pts 73-1,3,5,10,12 and 53-1,(6),(7),10,11,12. Declic (*Lr13*, *Lr14a*, *Lr17b*) is resistant to all pathotypes except 76-1,3,5,10,12. It is anticipated that Tennant (*Lr26*) will be at least seedling susceptible to the Triller pathotype. It is possible that these cultivars may possess additional adult plant resistance.

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

C. R. Wellings[1] and K.R. Kandel
([1]on secondment from NSW Agriculture)

A total of 139 samples received during the survey period represented a return to average numbers in 1998 compared to a lower sample size in the previous season. This reflected, in part, favourable climatic conditions in winter and early spring following on from summer survival opportunities in 1997-98. However, an unusual feature of the stripe rust survey was the relatively large number of samples received from barley grass: 50% of the 139 total sample size. Stripe rust on barley grass was frequently collected from roadsides and ‘in-crop’ situations which showed no evidence of stripe rust on adjacent wheat.

Recovery of viable isolates from samples received continues to be satisfactory at approximate 80%. One sample of stripe rust on cocksfoot (caused by *Puccinia striiformis* f. sp. *dactylidis*) was received from Victoria in April.

Epidemic Development

Initial samples from wheat growing regions were received from South Australia in late August.
The late seasonal occurrence of the disease essentially precluded significant rust development in crops prior to spring. The majority of samples, which were received in a four week period commencing mid September, were collected from southern NSW , Victoria and South Australia. The late occurrence of rust and the deployment of resistant cultivars in eastern Australia resulted in no reported crop losses.

Samples from New Zealand were received from mid October through to early December, and were collected from the wheat growing regions of the South Island.

Pathotype Detection and Distribution

The data for pathotype distribution are presented in **Table 3**. The major pathotypes in eastern Australia were 104 E9 A+ and 104 E137 A+ which have been common in recent years. These pathotypes are relatively avirulent and hence cultivars carrying previously ineffective seedling resistances, such as *Yr6, Yr7*, would be

expected to remain resistant. However, several isolates of pathotype 110 E143 A+ were also detected. This pathotype is virulent for *Yr6, Yr7* and hence any continuing reliance on these genes would not be warranted.

Two new pathotypes were detected in New Zealand. Virulence for *Yr17* was found in pathotypes 234 E139 A-, Yr17+ and 234 E139 A+, Yr17+ which were sampled from cultivar Torfrida (4 samples) and Acclaim and Hussar (1 sample each). These pathotypes combine virulence for *Yr7, Yr9, Yr17* and are expected to increase in frequency over the coming seasons in New Zealand. Virulence for *Yr17* has been previously reported in North America and UK. Australian cultivars possesing *Yr17* (Trident, Sunbri, Sunstate, Sunvale) are not currently at risk, although they will be evaluated in New Zealand in 1999.

The second new pathotype detected in New Zealand was 239 E143 A-, Yr27+ which combines virulence for *Yr1,Yr6, Yr7, Yr9, Yr27*. Although virulence for each gene has been periodically detected in New Zealand, this is the first pathotype which combines all five virulences and hence it might be expected to increase in frequency. Experience has shown that pathotypes with increasing combinations for virulence may have lower competitive fitness attributes. However, international experience suggests that pathotypes with virulence for *Yr9* are highly competitive in the pathogen population and will preferentially survive and cause crop damage, especially in situations where the resistance gene *Yr9* is deployed in current cultivars.

Barley Grass Stripe Rust

Stripe rust collections from barley grass were received from all states in Regions 1,2 and 3, although a majority of samples were collected in southern NSW (**Table 4**). Several pathotypes of wheat stripe rust were detected which were similar to those identified from wheat samples. However, a large portion of the samples proved to be generally avirulent on the wheat stripe rust differential set. These samples were shown to be partially virulent on the wheat differential tester Chinese 166 and on Skiff barley, and related cultivars, in seedling tests. Although these initial indications suggested that barley stripe rust (*P. striiformis* f. sp. *hordei*) was detected, it was subsequently concluded that a form of *P. striiformis* has become adapted to barley grass. This form is referred to as Barley Grass Stripe Rust (BGYR) and it is characterised by avirulence for most wheat and barley genotypes. Further work is in progress to determine relationships among the various forms of *P. striiformis*.

OAT RUST PATHOGENS

Oat Stem Rust (caused by *Puccinia graminis* f. sp. *avenae*)
C. R. Wellings and M. Whale
(on secondment from NSW Agriculture)

Sample numbers were comparable to the previous season with initial samples received from South Australia and Queensland in early to mid July. The majority of samples were received from northern and southern NSW and South Australia. This contrasted with the previous season when northern NSW appeared to be more affected. Oat stem rust samples from Western Australia were appreciably lower in 1998 compared to 1997.

Pathotype Distribution

Pathotype distribution for the oat stem rust pathogen is presented in **Table 5**. The majority of pathotypes were variants of Race 94 which combines virulence for *Pg1, Pg2, Pg3, Pg4, Pg8, Pg9*. The next three pathotype groups comprised Races 30, 31 and 41 which exhibit avirulence for *Pg3* and *Pg9*. These trends represent a marked difference from the results of the 1997 survey when Race 41 was dominant. The reasons

for these apparent seasonal fluctuations in pathotype groups remains unclear due to the absence of comprehensive data in regard to the resistance genotypes of current cultivars.

Pathotype diversity also appears to vary seasonally: 39 pathotypes were detected in 1996, rising to 46 in 1997 and falling to 20 in 1998. Multiple pathotypes were frequently recovered from a single sample which is consistent with previous data and further highlights the inherent variability in the pathogen population.

Variation within pathotype groups was apparent using the following supplementary differentials:
1 = *Pg9*; 2 = *Pg13*; 3 = *Pg Saia*; 4 = *Pg a.* Virulence for the latter has been of particular significance since it was first detected in Region 1 in 1996. Frequency of *Pg a* virulence has risen steadily from 2% (1996), to 18% (1997) and now to 27% in 1998. However, it appears that the distribution of *Pg a* virulent pathotypes continues to remain predominantly in Region 1 and southern NSW which was a similar pattern observed in the previous season.

Cultivar Response

Cultivars carrying *Pg a* in Region 1 (Amby II, Barcoo, Cleanleaf, Nobby) are expected to be affected by oat stem rust in the coming season. However, cultivars Glider and Quoll may continue to show protection due to *Pg a* in South Australia. Resistance gene *Pg16* was tested with several cultures during the survey period but failed to show evidence of useful resistance. The lack of effective resistance will continue cause concern for oat seed producers in seasons of high stem rust incidence.

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

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Epidemiology and Pathotype Distribution

Oat leaf rust occurred widely in the eastern mainland states, where it was commonly on wild oats. A concerted effort was made in 1998 to obtain a detailed picture of pathogenic variability in this pathogen. This task is a difficult one with *P. coronata* as most collections are made from wild oats, and in nearly all cases, such collections comprise 2 or more pathotypes. Coupled with this, the host: pathogen interaction with many of the genes represented in the differential set is temperature sensitive, making it essential to have good temperature control in order to obtain meaningful results.

The differential set used in 1998- 99 was the same as that used in 1997- 98 (**Table 6**) but with the addition of cv. Warrego from November onwards. Tests of “old” differentials (used prior to 1995) with isolates obtained during the 1998- 99 survey period indicated that some of these differentials may still be of use, and further testing will be dome during 1999.

About 70% of the samples received comprised two or more (up to four) pathotypes. This contrasts with about 12% for the 1998- 99 survey of wheat leaf rust, and meant that a great deal of subculturing was necessary to identify the pathotypes involved. Some 281 samples were received, from which 546 isolates were established and pathotyped. The results indicated that although considerable pathogenic variability exists in the *P. coronata* population (24 pathotypes were detected), the population is clearly structured and there is good evidence of groups of pathotypes within which individuals have been derived via single step mutation. As shown in previous surveys, pathotype diversity was greatest in NSW and Qld. The most widespread pathotype was 0071-0 (the Amby pathotype, formerly pt 384), which was detected in all eastern states. This pathotype, along with the Cleanleaf pathotype (0207-6,10) were by far the most commonly isolated pathotypes, accounting for about 55% of all isolates. The Cleanleaf pathotype was first detected in

1995 following the release of this cultivar in 1992, and its frequency has increased rapidly in the years since. Despite the common occurrence of the Cleanleaf pathotype in NSW and Qld, it was not detected in other regions.

Virulence was detected for the new cultivar Warrego, in a variant of pt 0007-6,8,10. Virulence was not detected for the genes Pc50, Pc68[1], and Pc91, or for the cultivars Bettong and Barcoo. Previous claims for virulence on Bettong and Barcoo were not confirmed and it is considered that virulence for these cultivars has not been detected to date.

Notes on Cultivars Carrying Genes for Leaf Rust Resistance

The detection of virulence for cv Warrego during 1998, and for the gene *Pc68* in 1999 (Graza 68, and Moola) are yet further examples of the ability of *P. coronata* to rapidly overcome newly deployed resistance genes. Few of the current suite of oat cultivars possess effective seedling resistance to leaf rust. The resistances of Bettong and Barcoo have remained effective, and studies are underway to gain a better understanding of the genetic control of these resistances. Preliminary studies of Bettong by Dr David Bonnett suggested the presence of a single gene only.

BARLEY RUST PATHOGENS

Barley Stem Rust (caused by *Puccinia graminis*)
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Epidemiology and Pathotype Distribution

Ten samples of stem rusted barley were received, with most originating from SA (**Table 7**). Four samples failed to yield viable isolates, and from those remaining, four isolates of scabrum rust with additional virulence for *Sr21*, and isolates of *P. graminis* f. sp. *tritici* pts 21-2,7 and 98-1,2,3,5,6 were identified. Samples of stem rusted barley collected from Langhorne Creek in SA in early April 1998, and mid March 1999, yielded pathotypes 21-2,7, 98-1,2,3,5,6 and 343-1,2,3,5,6, plus two different isolates of the non-wheat attacking “scabrum” stem rust.

Barley Leaf Rust (caused by *Puccinia hordei*)
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Epidemiology and Pathotype Distribution

Barley leaf rust was detected in crops of Franklin and Gairdner in southern regions of WA during August-September, and was severe in an early sown crop of Franklin at Albany. In SA, the disease caused less damage than usual and was present at low levels on the Yorke Peninsula, the Mid- and Lower- North, and observations by Dr H. Wallwork (SADI) suggested that the alternate host, *Ornithogalum umbellulatum*, was not an important source of inoculum during 1998. Levels of leaf rust of barley were negligible in northern NSW and Qld in 1998.

[1]Note that virulence for *Pc68* was detected in June 1999, in samples of leaf rusted Graza 68 and Moola collected from Toowoomba and Warwick, Qld. The new *Pc68* virulent pathotype is designated 0307-6,10, and is clearly a single step mutant derived from the Cleanleaf pathotype.

All isolates identified from samples collected in WA comprised pt 5610P+, which possesses virulence for the genes *Rph4* and *Rph12*, and which differs from isolates of this pathotype collected in previous years in eastern states in at least two pathogenic attributes (**Table 8**). Pts 4610P+ and 220P+ were the most commonly isolated from samples originating from eastern states; two isolates of the former, one from SA (Bute, collected in October) and one from Victoria (Inverleigh, collected in December), resembled the WA 5610P+ pathotype, suggesting that this pathotype has spread from WA to the east.

Three pathotypes were detected for the first time during 1998- 99; 201P+, 222P+ and 242P+.

TRITICALE AND RYE RUST PATHOGENS

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There were no reports of rusting in crops of triticale during 1998-99, and one sample of rye leaf rust, collected from Currency Creek (SA), was the only record of rust on cereal rye.

MISCELLANEOUS RUST PATHOGENS ON GRASSES

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A sample of stem rusted *Triticum tauschii* collected from experimental plots at Toowoomba was found to comprise an isolate of the “scabrum” rust with virulence for *Sr21*. Several samples of stem rusted barley grass did not produce viable isolates. Samples of stem and leaf rusted rye grass were used to inoculate a selection of wheat, barley, rye and oat genotypes. Apart from an occasional fleck type response on Black Winter Rye with some isolates of leaf rust, no symptoms were produced.

Table 1 Wheat stem rust isolates identified by region, 1998-99.

Pathotype	**Number of Isolates**						
	Region 1		Region 2		Region 3	Region 4	**Total**
	QLD	nNSW	sNSW	VIC	SA	WA	
21-2,7	-	-	-	-	1	-	**1**
34-2	-	-	-	-	-	1	**1**
34-2,7	-	-	-	-	-	4	**4**
34-2,7,10	-	-	-	-	-	1	**1**
34-0	-	-	-	1	-	-	**1**
34-1,2,3,5,6	-	-	-	4	1	-	**5**
39-1,2,3,5,6	-	-	-	1	-	-	**1**
98-1,2,3,5,6	-	-	2	21	11	-	**34**
343-1,2,3,5,6	1	-	-	-	2	-	**3**
222-1,2,3,5,6,7	-	-	-	1	-	-	**1**
Total Isolates	**1**	**0**	**2**	**28**	**15**	**6**	52
Samples Received	**1**	**0**	**2**	**26**	**11**	**5**	**45**
Failed Samples	**0**	**0**	**0**	**2**	**0**	**0**	**2**

Table 2 Wheat leaf rust isolates identified by region, 1998-99.

Pathotype	**Number of Isolates**								
	Region 1		Region 2		Region 3	Region 4		Region 5	**Total**
	QLD	nNSW	sNSW	VIC	SA	WA	Tas	NZ	
53-1,(6),(7),10,11,12	-	-	-	8	2	-	2	1	**13**
64-11	1	-	-	-	-	-	-	-	**1**
76-1,3,5,10,12	-	8	-	8	1	-	-	-	**17**
104-1,3,10,12	-	-	-	-	-	-	-	2	**2**
104-2,3,(6),(7),11	-	-	-	1	-	-	-	2	**3**
104-1,2,3,(6),(7),11	3	2	28	36	49	20	-	2	**140**
104-1,2,3,(6),(7),11 +Gaza	-	-	1	3	2	2	-	-	**8**
104-1,2,3,(6),(7),9,11	-	1	13	2	-	-	-	-	**16**
122-1,2,3,(6),(7),11	-	-	-	1	1	-	-	-	**2**
53-(6),(7),12	-	-	-	-	-	-	-	**1**	**1**
53-1,(6),(7),12	-	-	-	-	-	-	-	**2**	**2**
Total Isolates	**4**	**11**	**42**	**59**	**55**	**22**	**2**	**10**	**205**
Samples Received	**5**	**10**	**42**	**45**	**55**	**27**	**2**	**7**	**193**
Failed Samples	**1**	**0**	**5**	**4**	**2**	**5**	**0**	**0**	**17**

Table 3 Wheat stripe rust isolates identified in regions of Australia and New Zealand in 1998-99.

Pathotype	**Number of Isolates**							
	Region 1		Region 2			Region 3	Region 5	**Total**
	QLD	nNSW	sNSW	VIC	TAS	SA	NZ	
104 E9 A-	-	1	1	-	-	-	-	**2**
104 E9 A+	1	-	5	3	-	11	-	**20**
104 E137 A-	-	2	1	2	-	-	-	**5**
104 E137 A+	-	1	3	4	-	3	-	**11**
110 E143 A-	-	-	-	-	-	-	1	**1**
110 E143 A+	1	-	3	-	-	2	3	**9**
111 E143 A-	-	-	-	-	-	-	2	**2**
232 E137 A-	-	-	-	-	-	-	1	**1**
234 E139 A-	-	-	-	-	-	-	2	**2**
234 E139 A-, Yr17+	-	-	-	-	-	-	6	**6**
234 E139 A+, Yr17+	-	-	-	-	-	-	2	**2**
235 E139 A-	-	-	-	-	-	-	1	**1**
238 E143 A-	-	-	-	-	-	-	3	**3**
238 E143 A+	-	-	-	-	-	-	4	**4**
239 E143 A-, Yr27+	-	-	-	-	-	-	1	**1**
Miscellaneous	-	2	6	1	1	4	4	**18**
BGYR	-	1	15	5	1	7	-	**29**
Total isolates	**2**	**7**	**34**	**16**	**2**	**26**	**30**	**117**
Samples received	**2**	**9**	**43**	**20**	**2**	**31**	**32**	**139**
Failed samples	**-**	**3**	**10**	**6**	**-**	**5**	**4**	**28**

Table 4 Isolates of stripe rust collected from barley grass in eastern Australia, 1998-99

Pathotype	**Number of Isolates**						
	Region 1		Region 2			Region 3	**Total**
	QLD	nNSW	sNSW	VIC	TAS	SA	
104 E9 A+	-	-	4	-	-	4	**8**
104 E137 A-	-	-	1	2	-	-	**3**
104 E137 A+	-	-	2	1	-	-	**3**
104 E137 A-	-	-	1	-	-	-	**1**
110 E143 A+	1	-	2	-	-	-	**3**
Miscellaneous	-	1	3	-	1	2	**7**
BGYR	-	1	14	5	1	3	**24**
Total isolates	**1**	**2**	**27**	**8**	**2**	**9**	**49**
Samples received	**1**	**5**	**37**	**13**	**2**	**9**	**67**
Failed samples	**-**	**3**	**10**	**5**	**-**	**1**	**19**

Table 5 Isolates of oat stem rust identified in regions of Australia and New Zealand, 1998-99

Pathotype	**Number of Isolates**							
	Region 1		Region 2		Region 3	Region 4	Region 5	**Total**
	QLD	n NSW	s NSW	VIC	SA	WA	NZ	
1	-	-	-	-	1	-	-	**1**
2	-	-	-	-	1	-	-	**1**
20	-	1	-	-	-	-	-	**1**
30-1	-	-	1	-	-	-	-	**1**
30-3	-	-	4	2	2	-	-	**8**
30-1,2,3	1	1	-	-	1	-	-	**3**
30-1,2,3,4	-	2	-	-	1	-	-	**3**
31	-	-	1	-	1	1	-	**3**
31-3	-	-	1	-	1	-	-	**2**
41	1	-	1	1	2	-	-	**5**
41-2	-	1	1	1	-	-	-	**3**
41-2,4	-	-	1	-	-	-	-	**1**
69-1	-	-	-	-	1	-	-	**1**
94	-	-	1	-	2	-	-	**3**
94-2	1	5	1	-	3	-	1	**11**
94-3	1	3	5	2	13	2	-	**26**
94-2,3	2	9	5	1	3	-	-	**20**
94-2,4	1	-	1	-	-	-	-	**2**
94-3,4	-	1	2	-	-	-	-	**3**
94-2,3,4	5	12	6	1	-	-	-	**24**
Total isolates	**12**	**35**	**31**	**8**	**32**	**3**	**1**	**122**
Samples received	**12**	**33**	**28**	**8**	**27**	**6**	**1**	**115**
Failed samples	**1**	**5**	**3**	**1**	**2**	**3**	**-**	**15**

Table 6 Oat leaf rust isolates identified by region, 1998-99.

Pathotype	**Number of Isolates**							
	Region 1		Region 2		Region 3	Region 4	Region5	**Total**
	QLD	nNSW	sNSW	VIC	SA	WA	NZ	
0000-2	-	1	4	1	8	-	-	**14**
0001-0	4	26	50	1	16	5	-	**102**
0001-1	-	1	2	-	-	-	-	**3**
0001-2	-	-	1	2	9	-	-	**12**
0001-2,9	-	-	2	-	12	-	-	**14**
0001-1,7	-	1	-	-	-	-	-	**1**
0001-1,11,12	-	1	-	-	-	-	-	**1**
0003-10	-	-	-	-	1	-	-	**1**
0003-6,10	-	-	1	-	1	-	-	**2**
0003-1,6,10,11,12	-	3	2	-	-	-	-	**5**
0003-(1),6,10,(11),(12)	-	-	3	-	-	-	-	**3**
0005-0	-	-	-	-	1	-	-	**1**
0071-0	22	48	46	1	7	-	-	**124**
4473-6,10	3	3	3	-	-	-	-	**9**
0007-6,10	7	4	10	-	-	-	-	**21**
0007-6,8,10	8	18	7	-	-	-	2	**35**
0007-6,8,10+ Warrego	3	-	1	-	-	-	-	**4**
0207-6,10	34	78	70	-	-	-	1	**183**
0207-1,6,10,11,12	-	1	1	-	-	-	-	**2**
0207-(2),6,10	1	-	1	-	-	-	-	**2**
0607-6,10	1	2	-	-	-	-	-	**3**
2207-6,10	2	2	-	-	-	-	-	**4**
Total Isolates	**85**	**189**	**204**	**5**	**55**	**5**	**3**	**546**
Samples Received	**44**	**88**	**98**	**3**	**40**	**6**	**2**	**281**
Failed Samples	**1**	**4**	**7**	**0**	**1**	**0**	**0**	**13**

Table 7 Barley stem rust isolates identified by region, 1998-99.

Rust/ Pathotype	**Number of Isolates**						
	Region 1		Region 2		Region 3	Region 4	Total
	QLD	nNSW	sNSW	VIC	SA	WA	
Pgt[a] 21-2,7	-	-	-	-	1	-	1
Pgt 98-1,2,3,5,6	-	-	-	-	3	-	3
Scabrum[b] +*Sr21*	1	-	-	-	4	-	5
Scabrum -*Sr21*	-	-	-	-	1	-	**1**
Total Isolates	**1**	**0**	**0**	**0**	**9**	**0**	**10**
Samples Received	**3**	**0**	**0**	**0**	**7**	**0**	**10**
Failed Samples	**2**	**0**	**0**	**0**	**2**	**0**	**4**

Table 8 Barley leaf rust isolates identified by region, 1998-99.

	Number of Isolates						
	Region 1		Region 2		Region 3	Region 4	**Total**
Pathotype	QLD	nNSW	sNSW	VIC	SA	WA	
200P+	-	-	5	-	-	-	**5**
201P+	-	-	1	-	-	-	**1**
210P+	-	-	1	-	-	-	**1**
220P+	-	1	10	3	6	-	**20**
222P+	-	-	-	-	1	-	**1**
242P+	-	-	-	1	-	-	**1**
243P+	-	-	2	-	-	-	**2**
4610P+	-	-	11	1	4	-	**16**
5610P+ (+PI366444)	-	-	-	1	1	8	**10**
Total Isolates	**0**	**1**	**30**	**6**	**12**	**8**	**57**
Samples Received	**0**	**1**	**16**	**3**	**10**	**14**	**44**
Failed Samples	**0**	**0**	**0**	**0**	**3**	**6**	**9**