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

1997-1998 CEREAL RUST SURVEY ANNUAL REPORT

I. SUMMARY

The Annual Cereal Rust Survey forms an integral component of the National Cereal Rust Control Program (NCRCP) through the monitoring of cereal rust diseases and the associated collection of samples for assessment of pathotype variation in the pathogen populations. The survey functions through a co-operative network established among field based advisory and research staff, and is supplemented by regular trips undertaken by staff of the NCRCP.

Wheat Stripe Rust
Low sample numbers reflected low inoculum availability, resistant cultivars and dry spring conditions. Crop losses were not reported. Despite low sample number, pathotype diversity remained relatively high with 12 pathotypes recovered from 50 sample accessions. No new pathotypes were detected and currently deployed resistances are expected to remain effective.

Wheat Stem Rust
Levels of stem rust in wheat remain at very low levels in eastern Australia. Stem rust was detected in WA in early to mid October in the Scaddan - Grasspatch and Lake Grace region and by the end of the season it was widespread throughout this region at low to trace levels. Samples of stem rusted wheat and barley collected in Victoria during April, 1997, yielded predominantly pt 98-1,2,3,5,6. The most common pathotype in eastern Australia was the Oxley pt, 343-1,2,3,5,6. Pt 34-2,7 predominated in isolates from WA (*ca*. 75% of isolates), and pts 34-2 and 34-2,7,10 were also recovered.

Wheat Leaf Rust
Although widespread, leaf rust remained at low to moderate levels throughout the eastern and western wheat belts. There was little change from 1996 in the composition of pathotypes. All samples from WA yielded pt 104-1,2,3,(6),(7),11, and this pathotype also predominated in most other regions. Pts 104-2,3,(6),(7),11, 76-1,3,5,10,12 (from a single sample collected near Walcha) and 10-1,2,3,4 were also detected in samples from eastern Australia. Two new pathotypes, 104-1,2,3,(6),(7),9,11(virulent for *Lr26*, isolated from cv Triller near Griffith) and 53-1,(6),(7),10,11,12 (isolated from cvv Longbow and Lawson in Tasmania), were isolated.

Oat Stem Rust
Virulence for *PgA* (Culgoa, Amby, Nobby, Cleanleaf) continued to increase in frequency since first detected in 1996. It has now become more widespread and has reached southern areas for the first time. Variants of pathotype 41 (virulent on *Pg1, Pg2, Pg3, Pg4, Pg8* and *PgSaia*) continued to predominate.

Oat Leaf Rust
The most striking feature of the oat leaf rust pathogen continues to be the apparently high degree of pathogenic variability. Some 77 pathotypes were identified, primarily from Qld, nNSW, and WA. Two pathotypes predominated in Region 1 (0207-5,6,10 (virulent on Cleanleaf) and 0001-0), and two in WA (0001-0 and 0001-2). As in 1996-97, virulence for the cultivar Cleanleaf was common. Virulences were also detected for *Pc50, Pc56, Pc68*, and PcBettong, and the cultivar Barcoo.

Barley Stem rust
Five samples of stem rusted barley were collected from Victoria/ SA during April. Three samples yielded wheat stem rust (2 isolates pt 98-1,2,3,5,6 and 1 isolate pt 343-1,2,3,5,6), one "scabrum" rust, and one rye stem rust. Seven further samples of stem rusted barley were received from Qld, all of which were identified as comprising the "scabrum" rust. Most of these isolates were virulent for *Sr21*.

Barley Leaf Rust
Levels of leaf rust in barley were generally low, and very few samples were received. Three isolates of the Franklin pt 4610P+ were identified from samples collected in Victoria and SA. Two samples from near Ravensthorpe (WA) yielded the Franklin pathotype with additional virulence for barley line PI366444.

Triticale and Rye Rusts
There were no reports of rusting in crops of triticale during 1997-98. One isolate of the Satu pt, 34-2,12,13 was isolated from an experimental wheat plot in Queensland in late December. Two samples of stem rusted rye were received, both of which were typed as the "scabrum" stem rust.

II. DETAILED REPORT

INTRODUCTION

The NCRCP was fortunate to have two visiting scientisits during 1997. The first was Dr Henriette Goyeau, INRA, Laboratoire de Patalogie Végétale, F-78850 Thiverval - Grignon, France, whose research interests include leaf rust in wheat. Dr Goyeau visited during June-July, and conducted multipathotype leaf rust tests on a range of European wheats. Prof Z.A. Pretorius, Department of Plant Pathology, University of the Orange Free State, Bloemfontein, South Africa visited from July to December. Prof Pretorius has broad interests in cereal rusts and conducted several projects with various NCRCP staff members.

Rust surveys or inspections during 1997-98 included:

Western Australia, 27-29 September 1997. Dr R. F. Park and Prof. Z. A. Pretorius. The route taken was south east from Perth to Brookton, Narrogin, Katanning, Mount Barker, west to Munglinup and then returning to Ravensthorpe before heading north west to Newdegate, Lake Grace, Corrigin, Quairading and York. A total of 1500km was covered and included 43 stops, 53 cereal crop inspections, and inspections of volunteer cereals and roadside weeds.

October, 1997. Dr McIntosh undertook the northern rust survey via the Northern Tablelands NSW (winter wheats), rust nurseries at The Leslie Centre, Gatton, Darling Downs, Goondiwindi, Narrabri, Liverpool Plains, Coolah, Dubbo, Parks and Orange. Very little wheat rust was found apart from a moderate level of stripe rust in two crops near Coolah. Oat rusts were probably at lower levels than usual.

Southern NSW and northern Victoria, November 1997. Dr C. R. Wellings. A distance of 2350km was surveyed and included 42 crop and roadside inspections. The route taken was Bathurst, Cowra, Young, Cootamundra, Junee, Narrandera, Leeton, Griffith, Darlington Point, Colleambally, Jerilderie, Shepparton, Seymour, Benalla, Mulwala, Corowa, Howlong, Walbunderie, Walla Walla, Henty, The Rock, Wagga, and Gundagai.

December, 1997. Dr McIntosh made separate inspections of winter wheats on Northern Tablelands NSW, Southern Tablelands, and Melbourne - Hamilton - Narracorte, SA.

March-April, 1998. The above areas were again surveyed. Barley and an adjacent block of wheat breeders seed increase were heavily infected with stem rust. Stripe rust on cocksfoot was widespread around Ballarat but wheat stripe rust on barley grass was not located despite the frequent occurrence of green barley grass.

SEASONAL CONDITIONS

National wheat yields of 18.5 million tonnes harvested from 10.8 million hectares gave an average yield of 1.71 tonnes per hectare and represented a ten percent increase over the five year average. Barley (5.9 m tonnes from 3.2 m hectares), oats (1.7 m tonnes from 1.1 m hectares) and triticale (0.4 m tonnes from 0.25 m hectares) were also above average.[1]

Persistent dry conditions in Queensland resulted in delayed sowings and relatively low yields in areas which were able to establish crops. Yields in the Darling Downs were in the 2-3 tonne range, although yields in the more marginal Western Downs and Burnett were below expectations.

Summer rain provided opportunities for moisture conservation throughout much of NSW, Victoria and South Australia. However mild, dry conditions during autumn proved to be a limiting factor in crop development in most areas. Reduced grain size was a common feature which indicated that moisture was limiting at critical phases in crop development, especially in the unusually warm dry period in September- October. However, some districts benefited from late rains which assisted grain filling.
Self sown cereals following summer rains in WA provided inoculum carryover for leaf and stem rust in wheat and barley. Rust was a problem in northern zone crops late in the season although infection was too late to cause significant crop losses.

WHEAT RUSTS

Wheat Stripe Rust (caused by *Puccinia striiformis* f. sp. *tritici*)
CR Wellings[A] and KR Kandel
([A] on secondment from NSW Agriculture)

The relatively low number of samples received in the 1997-98 survey period resulted from a combination of low inoculum carryover, resistant cultivars and dry conditions in early spring. No crop losses were reported. A total sample number of 50 was distinctly lower than previous seasons (229 in 1996; 127 in 1995) while the sample recovery rate of 80% was comparable to prior results.

Stripe rust of cocksfoot (caused by *Puccinia striiformis* f.sp. *dactylidis*) was detected in several locations in Victoria in late March, and in NSW in November. Although the symptoms of wheat and cocksfoot stripe rust are similar, the causal pathogens contrast distinctly in biology and especially in their separate hosts.

Epidemic Development

A sample of stripe rust infected barley grass was collected in late March, 1997, in Victoria. Although this represented an early detection of the disease, a viable sample could not be established and hence the pathogenic identity in regard to wheat is unknown. The locations and means of over-summer survival of stripe rust continues to be uncertain.

[1] Source: “Australian Grain Yearbook 1998", GRDC, 1998.

The first disease samples for the 1997 season were received from breeders plots in South Australia (late September), Tasmania (early October) and northern NSW (early October). However, samples from farmers fields were not received until mid-late October (South Australia and northern NSW). The onset of warm and dry conditions during this period ensured that any initial establishment of infection was restricted from further spread. For the first time in 18 years, surveys through southern NSW and Victoria failed to detect stripe rust in farmers fields.

Samples from New Zealand were received from late October through to early February. However, sample numbers were also significantly reduced compared to 1996 and no reports of crop loss were noted.

Pathotype Detection

The responses of differential cultivars to the major wheat stripe rust pathotypes detected in 1997 are presented in **Table 1**. Despite low sample numbers in Australia and New Zealand, pathotype diversity continues to be high.

New Zealand pathotypes continue to show distinctive characteristics compared to those of Australia. Several miscellaneous cultures of unusual characteristics were detected and are undergoing further comparative tests. Although the latter may include some potentially new pathotypes, the data indicates that these are avirulent in regard to certain resistance genes and therefore do not pose any threat to commercial wheat cultivars.

Pathotype Distribution

The data in **Table 2** details the detection of pathotypes across various regions of Australia and New Zealand. Although sample number was low, certain previously observed trends continue to emerge:

1. The relatively avirulent pathotypes 104 E9 A-/+ remain in the population in Australia, although they have no obvious advantage to aid survival.
2. Pathotype 104 E137 A- continues to be isolated from northern areas of the eastern Australian wheat growing region.
3. Virulence for *Yr6* (pathotypes 108 E141 A-/+) appears to have disappeared, following on from a steady decline in recent years. These pathotypes formed the basis of epidemics in the mid to late 1980s but have progressively dwindled as cultivars with the corresponding resistance gene have been replaced in commercial cropping.
4. Virulence for *Yr7* and *Yr9* continue to be important in New Zealand.

The rare pathotype 106 E139 A-, Sk+ was recovered for only the second time in New Zealand. The previous record was in 1991. The resistance gene *YrSk* is widely deployed in international spring wheats and hence the occurrence of this pathotype continues to provide a warning in regard to the long term usefulness of the resistance.

Cultivar Response

The pathotype distribution in 1997 suggests that there should be no change in expected cultivar response to stripe rust in wheat growing regions. It is anticipated that the resistance genes *Yr10, Yr17, Yr18* and various uncatalogued adult plant resistances will continue to provide effective protection.

<u>Wheat Stem Rust</u> (caused by *Puccinia graminis* f. sp. *tritici*)
R. F. Park and L. Ferrari
Plant Breeding Institute

Epidemiology and Pathotype Distribution

The five samples of stem rust received from Queensland were all collected from experimental plots. All samples yielded the Oxley pathotype (343-1,2,3,5,6), and one also comprised the Satu triticale pathotype 34-2,12,13 (**Table 3**).

Five samples of stem rusted wheat and barley were collected in the lake Bolac region (Victoria) during April, 1997, from which seven isolates were established (**Table 3**). The predominant pathotype isolated was pt 98-1,2,3,5,6. Two isolates of the Oxley pathotype were also identified, and one of pt 343-1,2,3,4,5,6,10. The latter pathotype was first detected in 1996 in samples collected from Victoria. It was also isolated from SA during 1997, along with one isolate of pt 98-1,2,3,5,6 and three of pt 343-1,2,3,5,6 (**Table 3**).
Stem rust was detected in WA in early to mid October in crops (primarily cv Amery) throughout the Scaddan - Grasspatch and Lake Grace regions. By the end of the season it was widespread throughout this region at low to trace levels. Two samples were also collected in the north near Geraldton. Pt 34-2,7 predominated (*ca*. 75% of isolates) in samples from the north and the south. Pt 34-2, which is considered to be the precursor of 34-2,7 (which has additional virulence for *Sr15*) was also isolated, mainly from samples collected from the Scadden - Grasspatch region. Both 34-2 and 34-2,7 have been identified in past surveys, although the difference between these two pathotypes is often difficult to establish reliably due to the high temperature sensitivity of gene *Sr15*. However, the difference between the two pathotypes was very clear in the tests conducted from samples received in the current survey. A third pathotype, 34-2,7,10, was detected for the first time, and is considered to have originated from pt 34-2,7 by mutation to virulence for an uncatalogued resistance gene in the durum wheat Entrelago de Montijo. It is not expected that this pathotype would differ from pts 34-2 or 34-2,7 in its pathogenicity on Australian wheat cultivars

The cultivar Trident was included in the differential set used for samples collected during 1997 to monitor pathogenicity for gene *Sr38*. No virulence was detected.

Notes on Cultivars Carrying Genes for Stem Rust Resistance

All cultivars with *Sr9e* (Sunland and Yarralinka), *Sr26* (Hybrid Apollo, Blade, Currawong, Darter, Flinders, H. Gemini, Harrier, H. Mercury, Petrel, H. Pulsar, Shrike, Sunelg, Tern and Yanak), *Sr24* (Cunningham, Datatine, Goroke, Janz, Krichauff, Perouse, Sunco, Sunelg, Swift and Tasman), *Sr22* (Schomburghk), *Sr31* (Grebe, Mawson, Triller and Warbler) and *Sr38* (Sunbri, Sunstate, Sunvale and Trident) are resistant to all pathotypes isolated in 1997-98. The gene *Sr2* confers moderate adult plant resistance and is present in the cultivars Arnham, Batavia (heterogeneous), Dollarbird, Eradu, Hartog, Houtman, Leichardt, Lowan, Pelsart, Rowan, Sunbrook, Suneca, Sunstate and Tennant. Cultivars with *Sr13* (Gutha, Machete, Stiletto, Sunmist and Wialki) are moderately susceptible to moderately resistant. Cultivars with *Sr30* (Frame, Goldmark, Gordon, Rosella and Silverstar) are resistant to the pathotypes isolated in 1997-98, however, virulence for *Sr30* has been detected in recent years.

<u>Wheat Leaf Rust</u> (caused by *Puccinia recondita* f. sp. *tritici*)
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Plant Breeding Institute

Epidemiology and Pathotype Distribution

Although present throughout the eastern wheat belt, leaf rust remained at low levels in this region. The disease became widespread in WA after being first detected on volunteer wheat in the Mingenew district in late June.

There was little change from 1996 in the composition of pathotypes. All samples originating from WA yielding pt 104-1,2,3,(6),(7),11 (**Table 4**). As in recent years, this pathotype predominated in most other regions as well. Several isolates of pt 104-2,3,(6),(7),11 were recovered from samples collected in NSW, and a single isolate of pt 10-1,2,3,4 was isolated from a sample collected in SA. The latter pathotype has been isolated from SA on a regular basis since the mid 1970s.

Of interest was the detection of a new pathotype, 104-1,2,3,(6),(7),9,11, with virulence for *Lr26*. This pathotype was isolated from a sample collected from a field of cv Triller near Griffith, and is considered to be a single step mutant of pt 104-1,2,3,(6),(7),11. In addition to Triller, this pathotype is capable of attacking wheats such as Mawson and Warbler, although it is possible that these wheats may also have additional effective adult plant resistance. Grebe, which also possesses gene *Lr26*, is thought to possess *Lr13*, and if so would be protected from this new pathotype.

Also of interest was the isolation of a new pathotype from Tasmania, pt 53-1,(6),(7),10,11,12. This pathotype is considered to be a single step mutant of pt 53-1,(6),(7),10,11, with added virulence for the gene *Lr17b* (formerly *LrH*). The latter pathotype was isolated in Tasmania for the first time during 1996, from a leaf rusted sample of Longbow (*Lr13*) collected from Cressy. Its occurrence in Tasmania in that year was surprising since prior to this, it had not been detected in Australia further south than The Rock (southern NSW). Given that this pathotype occurs in New Zealand, it was suggested that it may have reached Tasmania from that country. Two isolates of the new pathotype were isolated in 1997; one from a sample of rusted Longbow collected at Sassafrass, and one from a sample of rusted Lawson collected at Nile, some 80km south east. Multipathotype leaf rust tests including this new pathotype clearly confirmed the presence of the gene *Lr17b* in several long season dual purpose wheats (Lawson, Paterson, Gordon, Declic, and Muchmore). It is to be expected that all of these cultivars, except Declic (which also has *Lr14a*), will be susceptible to this pathotype at least at seedling growth stages.

Only one isolate of pt 76-1,3,5,10,12 (syn. 76-1,3,5 and 76-1,3,5,10) was recovered in samples from Australia, and this came from a leaf rust sample collected from Walcha in northern NSW. This pathotype is believed to have originated from New Zealand, where it was first detected in 1989. As with the new pt 53-1,(6),(7),10,11,12, pt 76-1,3,5,10,12 is significant in that it combines virulence for *Lr13* with *Lr17b* (formerly referred to as *LrH*) and as such is virulent at least at seedling growth stages on most of the long season dual purpose wheats. In addition, pt 76-1,3,5,10,12 is also virulent for *Lr14a*, making it also virulent on seedlings of Declic.

Single isolates of pts 53-(6),(7),12 and 53-1,(6),(7),12 were isolated from rust samples collected in New Zealand (**Table 4**). Both were isolated in 1996 and are very different to other pathotypes of leaf rust occurring in Australasia. The most likely explanation for the origin of these rusts is that the former was introduced into New Zealand, and that the latter was subsequently derived by acquiring virulence for *Lr20*. Comparative greenhouse studies using isolates from the PBIC rust collection have indicated that 53-(6),(7),12 was present in two collections made in New Zealand in 1990. It appears that these isolates were mistaken for pt 53-1,(6),(7),10,11 at that time, because of the superficial similarity of the two pathotypes.

All isolates of these pathotypes 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.

The cultivar Trident was included in differential sets during 1997 to monitor pathogenicity for the resistance gene *Lr37*, present not only in Trident but also Sunbri, Sunvale and Sunstate. All isolates tested were avirulent.

Classification of Wheat Leaf Rust Pathotypes

The Australian cultivar Harrier (*Lr17b*) was included as Australian Supplementary Differential Number 12 in 1997. Australasian pathotypes known to be avirulent for this gene are 53-(6),(7),10,11, 53-1,(6),(7),10,11, 64-(6),(7),(10),11 (syn. 64-11), and all pathotypes in the 104-2,3,(6),(7),11 group.

Notes on Cultivars Carrying Genes for Leaf Rust Resistance

All cultivars with *Lr24* (Cunningham, Datatine, Goroke, Janz, Krichauff, Perouse, Sunco, Sunelg, Swift and Tasman) and *Lr37* (Sunbri, Sunstate, Sunvale and Trident) are resistant to all pathotypes isolated from Australasia in the past. Cultivars with *Lr13* in combination with *Lr1* (H. Apollo, Arnham, Batavia, Cunderin, Dollarbird, Goldmark, Hartog, Leichardt, Lowan, H. Pulsar, Rowan, Silverstar, Sunbrook, Suneca and Sunfield) 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 needs to be established. 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 1997-98.

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 possible that these cultivars may possess additional adult plant resistance.

OAT RUSTS

<u>Oat Leaf Rust</u> (caused by *Puccinia coronata* f. sp. *avenae*)

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Two sets of differentials were used to pathotype isolates of the oat leaf rust pathogen. The first set of differentials were arranged in four sets of three, permitting a four digit code on the basis of an octal pathotype nomenclatural system (**Table 5**). This set has been in use since the 1995-96 survey period. A second set of differentials, comprised 12 genotypes plus the oat cultivars Riel, Nobby, Amby, Bettong and Barcoo. To simplify the presentation of pathotype codes, the 12 genotypes were numbered from 1 to 12 (**Table 6**), and virulence on each differential was indicated by including the corresponding number in the same way as has been used for leaf rust and stem rust of wheat.

The most striking feature of the oat leaf rust pathogen continues to be the apparently high degree of pathogenic variability occurring in Australasia. A total of 161 samples were received, of which 16 failed to yield a viable isolate. The 239 isolates that were established from the remaining samples comprised 77 pathotypes, of which 57 were detected only once. The distribution and frequency of the 20 pathotypes which were detected more than once are given in **Table 7**. Few samples were collected in Regions 2, 3, and 5, making it impossible to comment on the pathotype composition of those regions. The two most common pathotypes in Region 1 were 0207-5,6,10 (virulent on Cleanleaf) and 0001-0, the latter being virulent only on the susceptible control Swan. Pt 0001-0 was also more common in Region 4, along with pts 0001-2, and 0000-2 (**Table 7**).

Pathotypes which were detected only once were:

Qld	0001-2,3; 0003-1,6,10,11,12; 0007-1,11,12; 0007-1,6,10,11,12; 0007-1,6,8,10,11,12; 0007-5,6,8,10; 0007-6,12; 0065-11,12; 0071-5,10; 0071-5,6,10; 0073-5,6; 0073-6,10; 0073-8,10,11; 0075-1,7,11,12; 0203-10; 0207-1,5,6,10, Bettong;0207-6,10,12; 2207-1,5,6,10,11,12; 4407-6,10,12; 4471-0; 6207-1,5,6,10,11.
NNSW	0001-2,7,9; 0001-6; 0003-1; 0003-6,10,11,12; 0003-5,6,10; 0007-0; 0017-3,6,10, Barcoo; 0017-3,6,8,10; 0071-0, Bettong; 0071-5,7; 0073-6; 0073-10; 0073-10, Bettong; 0077-5; 0077-5,6,7,9; 0207-1,5,6,10,12; 0207-1,6,10; 0207-5,6,10, (Bettong); 2707-6,10.
SNSW	0007-6,10,11,12; 0207-1,6,10,11,12.
SA	0071-6.
WA	0000-2,6; 0001-1,10; 0001-6,10; 0003-2,7; 0003-2,10; 0003-6,10; 0005-6; 0005-10; 0007-2; 0007-6; 0071-2,10; 0607-5,6,10; 2003-10.
NZ	007-4,6,10.

As in 1996-97, virulence for the cultivar Cleanleaf was commonly detected. Pathotypes for which the third digit of the octal code is either 2, 3, 6, or 7, are virulent on Cleanleaf (*ie* 0207, 2207, 2707). Seventeen Cleanleaf virulent pathotypes were detected, coming from samples collected from Qld, nNSW, and sNSW. Single isolates of two of these pathotypes were also detected in SA and WA. Because greenhouse contamination may account for this, further conformation is necessary. The frequency of virulence for Cleanleaf in Region 1 was 53%.

Virulences for *Pc50, Pc56, Pc68*, and *PcBettong*, although not detected during the past two surveys, were detected in 1997-98. Two pathotypes (0001-2,3 and 0017-3,6,10, Barcoo, isolated from Qld and nNSW, respectively) were virulent on *Pc50*, five pathotypes (0075-1,7,11,12 from Qld; 0001-2,7,9, 0071-5,7, and 0077-5,6,7,9, from nNSW, and 0003-2,7 from WA) were virulent on *Pc56*, one pathotype (2707-6,10, isolated from nNSW) was detected which was virulent for *Pc68*, and three pathotypes (0071-0, Bettong and 0073-10, Bettong from nNSW; 0207-1,5,6,10, Bettong from Qld) were detected which were virulent on Bettong. A single pathotype was also detected which possessed virulence for the cultivar Barcoo (0017-3,6,10, Barcoo, nNSW), which has uncharacterised resistance.

<u>Oat Stem Rust</u> (caused by *Puccinia graminis* f.sp. *avenae*)
S. Meldrum, J.D. Oates and C.R. Wellings

Samples of oat stem rust were initially received from Queensland (Toowoomba) in early June and Western Australia (Ogilvie) and northern NSW (Tamworth) in early July. The early occurrence of disease was reflected in relatively higher sample numbers in these regions throughout the course of the season. Sample number was also high in South Australia, although initial stem rust collections were not received until October.

Pathotype Detection and Distribution

A recovery rate of 75% from 112 samples allowed the establishment of 174 isolates for pathotype analysis. Pathotypes detected in 1997-98 are presented in **Table 8**. Standard pathotypes were further subdivided on the basis of the response of supplemental differential testers and these are indicated by a series of numbers according to the following:

1 indicates virulence of *Pg9*
2 indicates virulence on *Pg13*
3 indicates virulence on *PgSaia*
4 indicates virulence on *PgA*

A wide diversity of pathotypes (46 in 1997 compared to 39 in 1996) continues to be a feature of the *P.graminis avenae* population. Variants of standard pathotype 41 continue to predominate, with pathotype groups 30 and 94 comprising significant proportions of the population.

Virulence for *PgA*, which was first detected in four pathotypes in Region 1 in 1996, became more widespread and doubled in frequency during 1997. Virulence was detected in an additional seven pathotypes and was recorded for the first time in South Australia and Western Australia.

Cultivar Response

Cultivars with *PgA* (Culgoa, Amby, Nobby and Cleanleaf) are expected to show evidence of increased rusting in commercial fields. Resistance genes *Pg15* and *Pg17*, which were reported to offer some resistance, have proved to be of no value in tests with several isolates in the 1997 survey. Effective resistance to the current population of *P.graminis avenae* is not available, although efforts will continue to search for new genes and gene combinations.

BARLEY RUSTS

R. F. Park and L. Ferrari
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There were no reports of damage to barley crops due to rust during the 1997-98 survey period.

Barley Stem Rust (caused by *Puccinia graminis*)

Five samples of stem rusted barley were collected from Victoria/ SA during April. Three samples yielded wheat stem rust (pts 98-1,2,3,5,6 [2 isolates] and 343-1,2,3,5,6 [1 isolate]), one scabrum rust, and one rye stem rust. Seven further samples of stem rusted barley were received from Queensland, all of which were identified as comprising the scabrum rust. Tests in recent years have indicated that some isolates of scabrum rust possess virulence for the gene *Sr21*, a gene present in the wheat stem rust differential Einkorn (*Triticum monococcum*). Einkorn was therefore included in the differential set which is used to test stem rusts from barley, cereal rye, and grasses, for the 1997-98 survey. Of the seven isolates of scabrum originating from Qld, 6 were virulent for *Sr21* and 1 was avirulent. The single isolate of scabrum rust from SA was virulent for *Sr21*.

Barley Leaf Rust (caused by *Puccinia hordei*)

Levels of leaf rust in barley were generally low, and consequently very few samples were received. The disease was observed on the southern Yorke peninsula, and reached low levels across most of eastern SA. One sample from sNSW yielded pt 220P+, and two from Victoria and one from SA yielded the Franklin pt 4610P+.

Two samples of leaf rusted barley were collected from near Ravensthorpe (WA), both of which were identified as the Franklin pathotype but with additional virulence for an uncharacterised gene in the barley line PI366444 (**Table 9**). This barley line is of interest as it is a source of resistance to Russian Wheat Aphid, and preliminary studies showed that it also possessed a gene for resistance to leaf rust. The origin of this pathotype in WA is not clear, particularly because samples of leaf rust of barley from WA have not been analysed for pathogenicity for many years. Greenhouse tests comparing the pathogenicity of 4 isolates of pt 4610P+, comprising an isolate collected in Tasmania in 1990 and isolates collected from Victoria and SA in 1997, indicated that all were avirulent for the gene in PI3664444.

TRITICALE AND RYE RUSTS

R. F. Park and L. Ferrari, Plant Breeding Institute

There were no reports of rusting in crops of triticale during 1997-98. One isolate of the Satu pt, 34-2,12,13 was isolated from an experimental wheat plot in Queensland in late December. Two samples of stem rusted rye were received, one from Bega (NSW) and one from Milang (SA), both of which were typed as the “scabrum” stem rust. Both were avirulent for *Sr21*.

MISCELLANEOUS RUSTS ON GRASSES

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A variety of stem rusts and leaf rusts on grasses were received. Of these, the only ones which comprised cereal attacking rusts were one isolate of scabrum rust (virulent on *Sr21*) from the grass *Elymus scabrus* (syn. *Agropyron scabrum*) collected in Qld in early July, and one isolate of rye stem rust from stem rusted barley grass collected at Dean in Victoria in early April.

Table 1. Responses of selected differential wheats to pathotypes of *Puccinia striiformis* f. sp. *tritici* commonly detected in the 1997 wheat stripe rust survey.

Pathotype	Differential Cultivar						
	Avocet R *YrA*	Chinese 166 *Yr1*	Heines VII *Yr2*	H. Kolben *Yr6*	Lee *Yr7*	Clement *Yr9*	Selkirk *YrSk*
104 E9 A-							
104 E9 A+	S						
104 E137 A-			S				
104 E137 A+	S		S				
106 E139 A-, Sk+ *			S		S		S
110 E143 A-			S	S	S		
110 E143 A+	S		S	S	S		
111 E143 A- *	S	S	S	S	S		
232 E137 A-			S			S	
234 E139 A+ *	S		S		S	S	
238 E143 A- *			S	S	S	S	
238 E143 A+	S		S	S	S	S	

S = susceptible response, blank = resistant response, * = New Zealand pathotype

Table 2. Frequency of *P. striiformis* pathotypes identified in regions of Australia and New Zealand in 1997-98.

Pathotype	Number of Isolates							
	Region 1		Region 2			Region 3	Region 5	**Total**
	QLD	nNSW	sNSW	VIC	TAS	SA	NZ	
104 E9 A-	-	3	1	1	-	-	-	**4**
104 E9 A+	-	1	-	-	-	6	-	**7**
104 E137 A-	2	2	-	-	-	-	-	**4**
104 E137 A+	-	2	-	-	-	1	1	**4**
106 E139 A-, Sk+	-	-	-	-	-	-	1	**1**
110 E143 A-	-	-	-	-	-	-	1	**1**
110 E143 A+	-	-	-	-	2	-	1	**3**
111 E143 A-	-	-	-	-	-	-	1	**1**
232 E137 A-	1	1	-	-	-	-	-	**2**
234 E139 A+	-	-	-	-	-	-	1	**1**
238 E143 A-	-	-	-	-	-	-	2	**2**
238 E143 A+	-	-	-	1	-	-	2	**3**
Miscellaneous	1	3	-	-	3	1	1	**9**
Samples received	4	12	1	6	5	8	14	**50**
Failed samples	-	1	-	4	-	-	3	**8**
Total isolates	4	11	1	2	5	8	11	**42**

Table 3. *Puccinia graminis* f. sp. *tritici* pathotypes identified in regions of Australia and New Zealand, 1997-98.

Pathotype	Number of isolates							
	Region 1		Region 2		Region 3	Region 4	Region 5	**Total**
	QLD	nNSW	sNSW	VIC	SA	WA	NZ	
34-2	-	-	-	-	-	7	-	**7**
34-2,7	-	-	-	-	-	25	-	**25**
34-2,7,10	-	-	-	-	-	1	-	**1**
34-2,12,13	1	-	-	-	-	-	-	**1**
98-1,2,3,5,6	-	-	-	4	1	-	-	**5**
343-1,2,3,5,6	5	-	-	2	3	-	-	**10**
343-1,2,3,4,5,6,10	-	-	-	1	1	-	-	**2**
Total Isolates	6	-	-	7	5	33	-	**51**
Failed Samples	-	-	-	-	-	2	-	**2**
Samples received	5	-	-	5	5	33	-	**48**

Table 4. *Puccinia recondita* f. sp. *tritici* pathotypes identified in regions of Australia and New Zealand, 1997-98.

Pathotype	Number of isolates								
	Region 1		Region 2			Region 3	Region 4	Region 5	**Total**
	QLD	nNSW	sNSW	VIC	TAS	SA	WA	NZ	
10-1,2,3,4	-	-	-	-	-	1	-	-	**1**
53-1,(6),(7),10,11,12	-	-	-	-	2	-	-	-	**2**
53-(6),(7),9,10,11[a]	-	-	-	-	-	-	-	1	**1**
53-(6),(7),12	-	-	-	-	-	-	-	1	**1**
53-1,(6),(7),12	-	-	-	-	-	-	-	1	**1**
76-1,3,5,10,12	-	1	-	-	-	-	-	-	**1**
104-2,3,(6),(7),11	-	3	2	-	-	-	-	-	**5**
104-1,2,3,(6),(7),11	5	7	5	1	1	15	63	1	**98**
104-1,2,3,(6),(7),9,11	-	-	1	-	-	-	-	-	**1**
Total isolates	5	11	8	1	3	16	63	4	**111**
Failed samples	-	-	-	-	-	-	18	1	**19**
Samples received	5	8	6	1	2	15	81	4	**123**

[a] this isolate is identical to another pathotype isolated from New Zealand in previous years, except that it is virulent for *Lr10*.

Table 5. *Puccinia coronata* f. sp. *avenae* pathotypes identified in regions of Australia and New Zealand, 1997-98 using differentials arranged as coded triplets .

Differential Line	Resistance gene(s)	Octal value
Swan	-	0001
PC39	*Pc39*	0002
PC38	*Pc38*	0004
PC61	*Pc61*	0010
TAM-312	*Pc59*	0020
TAM-301	*Pc58*	0040
PC68	*Pc68*	0100
Cleanleaf	*Pc38, Pc39, PcCl*	0200
Culgoa	*PcCul*	0400
Amagalon	*Pc91*	1000
WIX	*PcWIX1, PcWIX2*	2000
H548	*PcH548*	4000

Table 6. Supplementary differential lines used for the differentiation of pathotypes of *Puccinia coronata* f. sp. *avenae*, 1997-98 .

Number	Differential	Resistance gene
1	PC36	*Pc36*
2	PC46	*Pc46*
3	PC50	*Pc50*
4	PC51	*Pc51*
5	PC52	*Pc52*
6	PC55	*Pc55*
7	PC56	*Pc56*
8	PC63	*Pc63*
9	PC64	*Pc64*
10	PC71	*Pc71*
11	X534	?
12	X716	?
-	Riel	*Pc38, Pc39*
-	Nobby	*Pc58, Pc59, Pc61?*
-	Amby	*Pc61*
-	Bettong	*PcBet*
-	Barcoo	?

Table 7. *Puccinia coronata* f. sp. *avenae* pathotypes for which more than one isolate was identified in Australia and New Zealand in 1997-98.

Pathotype	Number of Isolates							
	Region 1		Region 2		Region 3	Region 4	Region 5	**Total**
	QLD	nNSW	sNSW	VIC	SA	WA	NZ	
0	-	-	-	-	-	7	-	**7**
35794	3	15	-	-	1	18	-	**37**
35795	4	-	-	-	-	-	-	**4**
35796	-	2	-	-	-	10	-	**12**
35804	-	-	-	-	-	2	-	**2**
35853	-	-	-	-	-	3	-	**3**
35863	-	-	-	-	-	2	-	**2**
35916	-	1	-	-	-	1	-	**2**
35985	1	-	-	-	-	1	-	**2**
0007-5,6,10	1	2	-	-	-	-	-	**3**
0007-6,10	1	2	-	-	-	1	-	**4**
0007-6,10,12	2	-	-	-	-	-	-	**2**
0007-6,8,10,12	2	-	-	-	-	-	-	**2**
0071-0	5	7	-	-	-	2	-	**14**
0207-1,5,6,10,11,12	1	1	-	-	-	-	-	**2**
0207-5,6,10	45	10	-	-	-	1	-	**56**
0207-5,6,10,12	1	1	-	-	-	-	-	**2**
0207-5,6,10,11,12	-	2	-	-	-	-	-	**2**
0207-6,10,11,12	1	1	-	-	1	-	-	**3**
0207-6,10	-	5	-	-	-	-	-	**5**
Total isolates	64	47	-	-	2	48	**-**	
Failed samples								
Samples received								

Table 8. Frequency of *Puccinia graminis* f.sp. *avenae* pathotypes identified in regions of Australia and New Zealand in 1997.

Pathotype	**Number of Isolates**							
	Region 1		Region 2		Region 3	Region 4	Region 5	**Total**
	QLD	nNSW	sNSW	VIC	SA	WA	NZ	
1		1		1	2	2		**6**
1-3		1			2			**3**
18	1		1		1			**3**
30					1	3		**4**
30-3	1	2			3	1		**7**
30-1,2	1	1						**2**
30-1,3		2			1	2		**5**
30-2,3	1					1		**2**
30-1,2,3		2				1		**3**
30-1,2,3,4	2	1						**3**
31		2			4			**6**
31-2		2				1		**3**
31-3		1				1		**2**
41		4	1		1	1		**7**
41-1		7	2	5	5	4		**23**
41-1,2	4	6	1		1	2	2	**16**
41-1,4	1	4			2			**7**
41-1,2,4	8	8			1			**17**
76						2		**2**
76-2	1	1						**2**
76-3		1				1		**2**
94		1			2	9		**12**
94-2		2	1			1		**4**
94-4		1			1	3		**5**
94-2,4	2	2				3		**7**
Miscellaneous	5	8		2	1	4	1	**21**
Samples Received	15	39	3	6	15	22	12	112
Failed Samples	**-**	16	**-**	1	**-**	**-**	9	26
Total Isolates	**27**	**60**	**6**	**8**	**28**	**42**	**3**	**174**

Table 9. *Puccinia hordei* pathotypes identified in regions of Australia, 1997-98.

Pathotype	**Number of Isolates**								
	Region 1		Region 2			Region 3	Region 4	Region 5	
	QLD	nNSW	sNSW	VIC	TAS	SA	WA	NZ	**Total**
220P+	-	-	1	-	-	-	-	-	**1**
4610P+	-	-	-	2	-	1	-	-	**3**
4610P+, PI366444+[a]	-	-	-	-	-	-	2	-	**2**
Total isolates	-	-	1	2	-	1	2	-	**6**
Failed samples	1	-	-	-	-	-	-	-	**1**
Samples received	1	-	1	2	-	1	2	-	**7**

[a] PI366444 possesses an uncharacterised gene for resistance to leaf rust. It is also a source of resistance to Russian Wheat Aphid.