



Cereal Rust Report

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New oat crown rust pathotype with virulence for *Pc91*

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A new pathotype of oat crown rust with virulence for the resistance gene *Pc91* was isolated from a sample collected in late 2012 from Queensland. This is the first detection of virulence for *Pc91* in Australia since we began monitoring this resistance gene in the early 1990s. Cultivars Drover and Aladdin are known to carry *Pc91*: while the new pathotype is virulent on seedlings of cultivar Drover, it is not able to attack cv. Aladdin presumably due to additional resistance provided by gene *Pc50*. Growers of Drover oats should monitor crops regularly for the presence of crown rust as it is vulnerable to this new pathotype.

A sample of crown rust from wild oats collected from Warwick (Queensland) on 12 November 2012 and sent to the Plant Breeding Institute for pathotype analysis was found to comprise a mixture of 4 pathotypes, one of which is new and carries virulence for the seedling (all stage) resistance gene *Pc91*. Comparative greenhouse experiments at PBI have confirmed that this new pathotype most likely arose as a single-step mutation for virulence for *Pc91* in an existing pathotype, 0107-1,4,6,7,10,12 +Warrego +Nugene +Gwydir. The new pathotype has the designation 1107-1,4,6,7,10,12 +Warrego +Nugene +Gwydir. This is the first detection of virulence for *Pc91* in Australia since we began monitoring this resistance gene in the early 1990s.

Greenhouse seedling tests of key oat cultivars

In further greenhouse tests, the new “Pc91-pathotype” was used to infect a range of oat cultivars. Cultivar Drover, until now resistant to crown rust and suspected to carry *Pc91*, was found to be seedling susceptible (Fig. 1). Growers of this cultivar in 2013 should monitor crops regularly for crown rust. Cultivar Aladdin, also suspected to carry *Pc91*, was resistant

to the new pathotype (Fig. 1). It is likely that Aladdin carries *Pc91* in combination with the seedling resistance gene *Pc50*, for which the new pathotype is avirulent. It should be noted that three pathotypes with virulence for *Pc50* have been detected in northern regions of the eastern cereal belt in recent years. Aladdin is therefore considered to carry single gene resistance to crown rust, being protected from the new pathotype by *Pc50*, and from the *Pc50*-virulent pathotypes by *Pc91*. If this is the case, single-step mutation in any of these pathotypes would be expected to render Aladdin susceptible, at least at seedling growth stages.

Oat crown rust diversity in Australia

Rust pathogens are biotrophic – they require a living host on which to survive. Of all the cereal attacking rust pathogens in Australia, the two that infect oats (the stem rust pathogen *Puccinia graminis* f. sp. *avenae* and the crown rust pathogen *Puccinia coronata* f. sp. *avenae*) have the largest populations, being maintained on ubiquitous communities of weedy wild oats. Although these two rust pathogens reproduce solely by clonal (asexual) means, the large

populations maintained on wild oats allow the generation of great pathogenic diversity. Indeed, the crown rust pathogen is most likely the most genetically diverse of all cereal rust pathogens in Australia, with more than 95 unique pathotypes detected in annual pathogenicity surveys from 1998 to 2010. This contrasts with the wheat stripe rust pathogen, for which 27 pathotypes were detected during this period.

Crown rust resistance “breakdown” in oats

Attempts to develop crown rust resistant oat cultivars over the past 25 years have met with very limited success, with new pathotypes often being detected soon after the release of resistant cultivars (Table 1). While the change of a cultivar from resistant to susceptible is often referred to as resistance “breakdown”, the cause is actually a change in the pathogen.

A major difficulty in breeding oats for resistance to crown rust has been a lack of understanding of the crown resistance genes present in oat germplasm. Detailed comparative studies at PBI over the past 10 years have identified the genes present in many cultivars (Table 1). In most cases, it has been found that the resistance of new cultivars was based on single seedling (all stage or major) resistance genes. Given the size and genetic variability in oat crown rust

populations in Australia, it is therefore not surprising that these cultivars have usually succumbed to new virulent pathotypes soon after release.

Adult plant resistance to crown rust in oats

Research on crown rust resistance at PBI over the past 5 years has targeted the identification of adult plant (minor gene) resistance in hexaploid oats. Experience in wheat has shown that this type of resistance tends to be more durable than single “all stage” resistance genes, especially when 3 or more such APR genes are combined. We have found over 200 oat genotypes carrying APR to crown rust and have initiated studies to understand the genetic basis of the resistance to expedite its use in future breeding efforts.

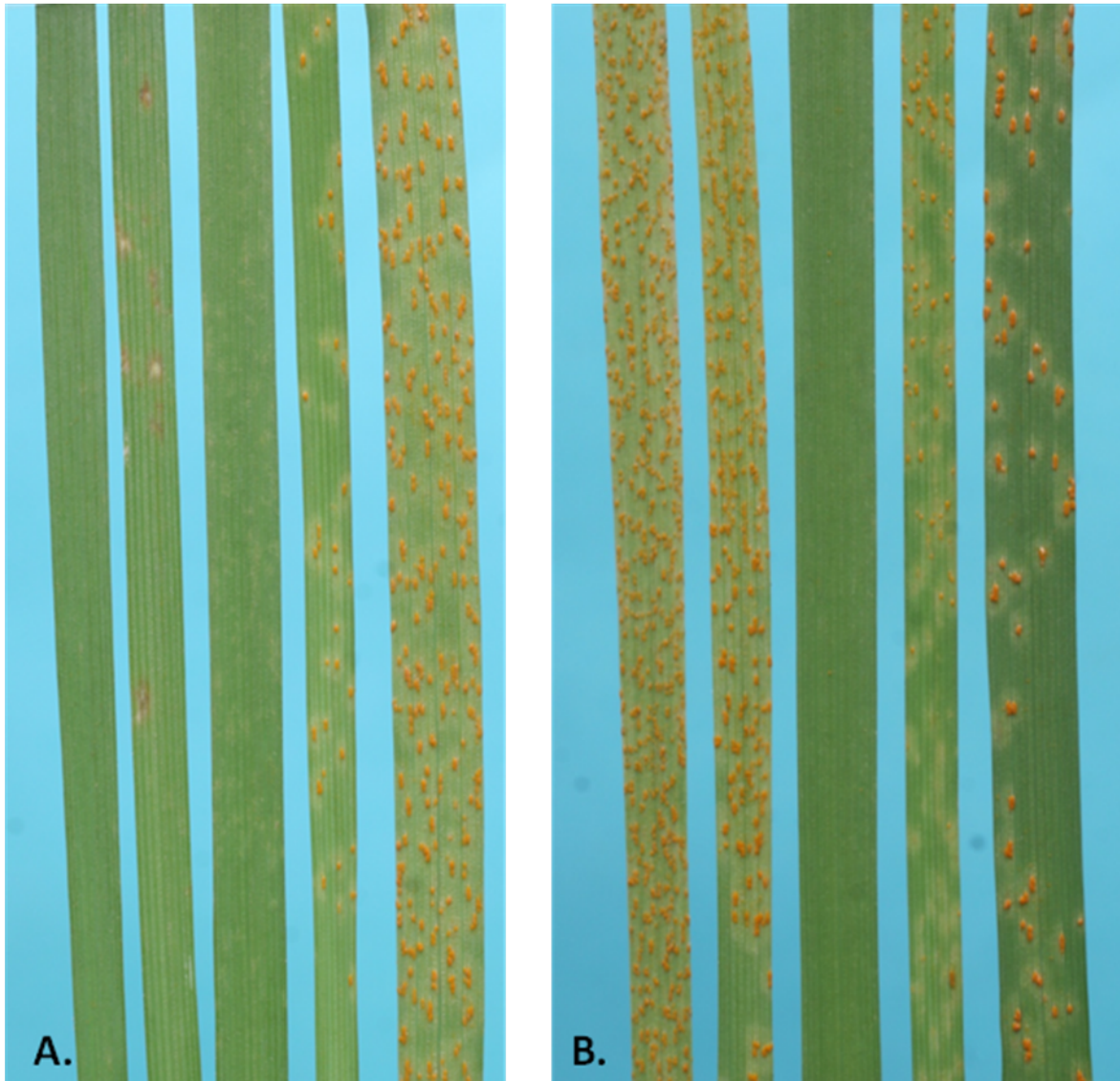
Monitoring rust variability and forwarding samples for virulence analyses

As always, monitoring rust pathotype variability is a crucial part of utilising genetic resistance to these diseases. Readers are encouraged to submit samples for confirmation of rust identity and subsequent pathotype analysis. See instructions below.

Table 1. Selected oat cultivars, year of release and first detection of virulence in the crown rust pathogen matching resistance genes.

Cultivar	Year of release	Virulence first detected	Seedling resistance genes
Culgoa II	1991	1996	<i>PcMortlock, PcCulgoa</i>
Bettong	1992	2001	<i>PcBett</i>
Cleanleaf	1992	1995	<i>Pc38, Pc39, Pc52</i>
Barcoo	1996	2001	<i>Pc39, Pc61, PcBett</i>
Graza 68	1997	1999	<i>Pc68</i>
Moola	1998	1999	<i>Pc68</i>
Gwydir	1999	2001	<i>Pc56</i>
Warrego	1999	1998	<i>Pc61+</i>
Nugene	2000	2005	<i>Pc48+</i>
Taipan	2001	2005	<i>Pc48+</i>
Volta	2003	2008	<i>Pc50, Pc68</i>
Genie	2008	2010	<i>Pc48, Pc56</i>
Drover	2006	2012	<i>Pc91</i>
Galileo	2006	?	Not tested
Qantom	2006	2008	<i>Pc50*</i>
Dawson	2009	?	Not tested
Aladdin	2011	Not yet detected	<i>Pc50, Pc91</i>

Figure 1: Seedling leaves of oat cultivars (L to R) Amagalon (*Pc91*), Drover, Aladdin, Genie and Swan; infected with crown rust pathotype: (A.) 0307-3,4,5,6,10 +Warrego +Volta, (B.) 1107-1,4,6,7,10,12 +Warrego +Nugene +Gwydir (“Pc91-pathotype”). Note that Aladdin is resistant to the new “Pc91-pathotype” shown in Figure B.



GENERAL ENQUIRIES

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RUSTED PLANT SAMPLES

can be mailed in paper envelopes;
 do not use plastic wrapping or plastic
 lined packages.
 Direct samples to:

 Australian Cereal Rust Survey
 Plant Breeding Institute
 Private Bag 4011, Narellan NSW 2567

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