FACULTY OF AGRICULTURE, FOOD & NATURAL RESOURCES

THE UNIVERSITY OF SYDNEY

PLANT BREEDING INSTITUTE

Cereal Rust Report

Season 2012

VOLUME 10 ISSUE 3
20 December 2012

Wheat leaf rust and virulence for *Lr23*

ROBERT PARK

The University of Sydney, Plant Breeding Institute, Cobbitty
Email: robert.park@sydney.edu.au, Phone: 02-9351 8806

The Australian wheat leaf rust flora has been dominated by a clonal lineage of pathotypes derived via single-step mutation from pathotype 104-2,3,(6),(7),11 in most years since this pathotype was first detected in Victoria in 1984. Most pathotypes within this lineage have been regarded as being fully virulent on *Lr23*, despite producing an intermediate response on the Lr23-differential Gaza. Recent tests have indicated that this is not the case, and all but four pathotypes in the lineage are in fact partially virulent only on *Lr23*. These pathotypes will now be given the designation "(2)", to indicate their partial virulence on *Lr23*.

We received a report of leaf rust in a wheat trial at Mackay (Qld) in October, with unexpectedly higher levels of leaf rust observed on several cultivars. Based on these observations and previous leaf rust resistance gene postulations in the cultivars affected, it was initially suspected that one or more pathotypes with virulence for *Lr13* were present. Pathotype analysis at PBI indicated that a single pathotype was responsible, 104-1,2,3,(6),(7),11 +Gaza High - avirulent on *Lr13*. This was not expected, firstly because several of the cultivars affected were thought to carry *Lr13*, and secondly because this pathotype had previously been recorded only rarely in the northern part of the eastern Australian wheat belt.

Pathotypes 104-2,3,(6),(7),11 +Gaza High and 104-1,2,3,(6),(7),11 +Gaza High

Pathotype 104-1,2,3,(6),(7),11 +Gaza High was first detected in eastern and Western Australia in 1998, and 104-2,3,(6),(7),11 +Gaza High was detected in eastern Australia in the following year. Gaza is used in Australian leaf rust pathogenicity surveys to monitor virulence for *Lr23*. Prior to 1998, all isolates of pathotype 104-2,3,(6),(7),11 and derivatives of this pathotype were avirulent on Gaza. A series of detailed studies in the early 1990s led to the conclusion that this family of pathotypes were virulent on *Lr23*, and that the low Infection Type (IT) observed on Gaza was due to the presence of a second unidentified resistance gene. A crucial piece of evidence in making this conclusion was that the low IT on Gaza produced by these pathotypes was ";12+" to "X+", depending on post-inoculation temperature, much higher than the typical ";" IT produced by other Australian pathotypes avirulent for *Lr23*.

One or both of the pathotypes fully virulent on Gaza were common in eastern Australia in 1999 (Victoria), but since then have been isolated infrequently. In contrast, pathotype 104-1,2,3,(6),(7),11 +Gaza High was very common in WA from 1999 through 2004, after which it declined in frequency and was isolated infrequently. Single isolates of two further pathotypes with full virulence on Gaza were detected subsequently (104-1,2,3,5,(6),(7),11 +Gaza High; 122-1,2,3,(6),(7),11 +Gaza High).

Comparative greenhouse tests to resolve the significance of full virulence on Gaza

A comparative greenhouse test was conducted in which 170 Australian wheat cultivars and an additional 26 control genotypes were tested with 8 leaf rust pathotypes:

1. 26-0
2. 53-1,4,(6),(7),10,11,12
3. 76-3,5,7,9,10,12 +Lr37
4. 104-1,2,3,(6),(7),11,13
5. 104-1,2,3,(6),(7),11 +Lr37
6. 122-1,2,3,(6),(7),11
7. 104-1,2,3,(6),(7),11 +Gaza High
8. 122-1,2,3,(6),(7),11 +Gaza High

The first three pathotypes are all avirulent on *Lr23* and give the typical ";" low IT. While pathotypes 4 through 6 all give the intermediate ";12+" IT on Gaza, 7 and 8 are fully virulent on Gaza (IT "3+"). The pathotype identified from the Mackay trial was the same as pathotype 7. The tests were conducted at warmer than usual post-inoculation temperatures of 23-25°C.

The tests clearly indicated that pathotypes 4 through 6 are intermediate in virulence on *Lr23*, and that this intermediacy most likely accounts for the intermediate IT on Gaza - previously thought to be due to the presence of a second uncharacterised resistance gene in this differential. While Thatcher was susceptible to all pathotypes, the line near isogenic to Thatcher but carrying *Lr23* generated ITs of ";" to the first three pathotypes, "X" to pathotypes 4 though 6, and "3+" to pathotypes 7 and 8. Figure 1 illustrates this by showing the ITS observed on selected key genotypes with three representative pathotypes.

The results enabled revised postulations for the presence of *Lr23* among the 170 Australian cultivars tested. Among those tested, the following appear to carry the gene:

AGT Scythe	*Lr23*+
Binnu	*Lr3a*, *Lr23*, *Lr37*
Carnamah	*Lr23*
Cobra	*Lr23*
Currawong	*Lr23*
Drysdale	*Lr3a*, *Lr23*
EGA 2248	*Lr3a*, *Lr23*
EGA Gregory	*Lr3a*, *Lr23*
Endure	*Lr23*
Kennedy	*Lr1*, *Lr13*, *Lr23*
Machete	*Lr23*
Rosella	*Lr23*
Strzelecki	*Lr13*, *Lr23*
Westonia	*Lr23*

Some of these postulations are the same as what we have presented in the past. Note that we believe that Kennedy and Strzelecki carry both *Lr13* and *Lr23*. These genes are linked in repulsion on chromosome 2BS, and presumably have been combined in coupling phase linkage in these cultivars. Distinguishing these two genes, especially when present in combination, has been difficult because of the great similarity in the ITs generated for *Lr13* and *Lr23* by pathotypes with partial virulence for the latter.

Revised pathotype nomenclature

Since first detecting pathotype 104-2,3,(6),(7),11 in 1984, our surveys have detected at least 14 mutational derivatives. In light of the results presented here, the former and revised nomenclature for each of these pathotypes is shown in Table 1.

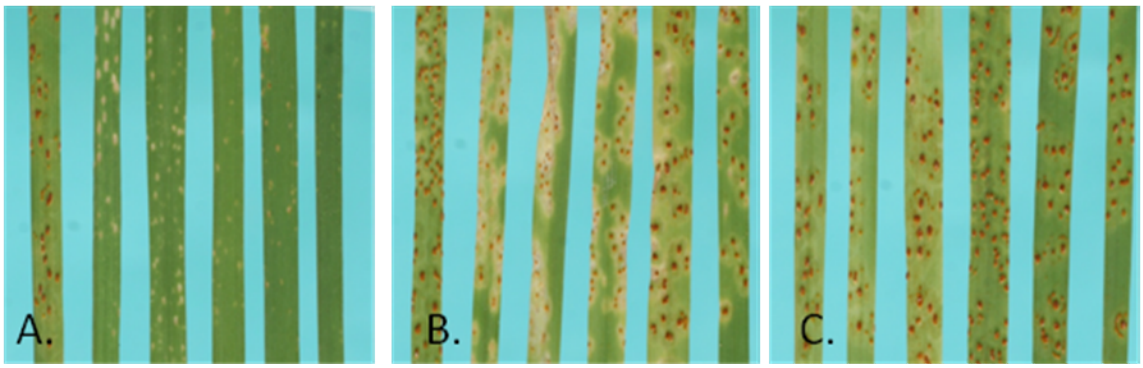
Monitoring rust variability and forwarding samples for virulence analyses

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: Revised pathotype nomenclature to demonstrate partial and full virulence for *Lr23* among relevant wheat leaf rust pathotypes

Formerly:	Now:
104-2,3,(6),(7),11	104-(2),3,(6),(7),11
104-2,3,5,(6),(7),11	104-(2),3,5,(6),(7),11
104-1,2,3,(6),(7),11	104-1,(2),3,(6),(7),11
104-1,2,3,(6),(7),9,11	104-1,(2),3,(6),(7),9,11
104-1,2,3,(6),(7),11,12	104-1,(2),3,(6),(7),11,12
104-1,2,3,(6),(7),9,11,12	104-1,(2),3,(6),(7),9,11,12
104-1,2,3,(6),(7),11,13	104-1,(2),3,(6),(7),11,13
104-1,2,3,(6),(7),11 +Lr37	104-1,(2),3,(6),(7),11 +Lr37
104-1,2,3,4,(6),(7),11	104-1,(2),3,4,(6),(7),11
122-1,2,3,(6),(7),11	122-1,(2),3,(6),(7),11
122-1,2,3,4,(6),(7),11	122-1,(2),3,4,(6),(7),11
104-2,3,(6),(7),11 +Gaza High	104-2,3,(6),(7),11
104-1,2,3,(6),(7),11 +Gaza High	104-1,2,3,(6),(7),11
104-1,2,3,5,(6),(7),11 +Gaza High	104-1,2,3,5,(6),(7),11
122-1,2,3,(6),(7),11 +Gaza High	122-1,2,3,(6),(7),11

Figure 1: Seedling leaves of wheat cultivars (L to R) Thatcher, Thatcher +Lr23, Gaza, AGT Scythe, Currawong, EGA Gregory; infected with leaf rust pathotype (A.) 26-0, (B.) 122-1,(2),3,(6),(7),11, and (C.) 122-1,2,3,(6),(7),11. The ITs generated with the first pathotype are typical of those associated with Lr23; those with the second pathotype indicate intermediate virulence, and those with the third pathotype indicate full virulence.



GENERAL ENQUIRIES

Plant Breeding Institute
Private Bag 4011,
Narellan NSW 2567

107 Cobbitty Road
Cobbitty NSW 2570
T 02-9351 8800 (Reception)
F 02-9351 8875

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

The Australian Cereal Rust Control Program is supported by growers through the Grains Research & Development Corporation.