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# Recent Research in Wheat Stripe Rust Australian and International Developments

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There have been several recent developments that have improved our understanding of the wheat stripe rust pathogen. Colleagues in the USA have published for the first time the occurrence of a sexual stage in the stripe rust life cycle. This is a very important development in our understanding of the biology of this pathogen, and unlocks a mystery that has remained unanswered for more than a century. The nature of this research and the implications for Australia are discussed below. At a more local level, isolates of the stripe rust pathogen collected in eastern Australia in 2009 have recently been identified as potentially significant to certain wheat and triticale varieties.

## The Discovery of the Wheat Stripe Rust Sexual Stage in USA

The wheat stripe rust pathogen has a 30 year history in Australia, and over this time we have seen the pathogen adapt through a series of newly emerging pathotypes. Several of these have had specific adaptation to certain wheat and triticale varieties, and in some instances have caused significant economic losses. The source of new pathotype variation has been principally new mutations in the existing pathogen population and, more rarely, the introduction of a new pathotype from overseas. The former can be predicted to a limited extent, based on knowledge of the current pathogen population and an understanding of resistance genes present in commercial wheat varieties. However a pathotype incursion from overseas is by nature unpredictable in its potential to cause crop losses.

Rust diseases of cereals and grasses may have a complete life cycle, including up to five spore stages, or variations with fewer spore stages. The complete life cycle in a macrocyclic cereal rust fungus will include spore stages on the grass host and also on a herbaceous dicot plant. This latter stage of the life cycle typically aids the pathogen to survive between crop seasons and permits the pathogen to undergo a sexual stage with the possibility of genetic recombination. The significance of the sexual stage lies not only in pathogen survival but importantly in the potential for recombination of virulence and the emergence of pathotypes with greater capacity to cause crop damage. A typical macocyclic rust pathogen is *Puccinia graminis* f.sp. *tritici* (pathogen causing wheat stem rust), and great effort and expense was focused in the USA during the mid to latter twentieth century in identifying and removing the herbaceous sexual host.

The stripe rust pathogen was first described formally in 1827. In the ensuing years, research confirmed that the pathogen appeared to be microcyclic (only three spore stages) and population studies in regions such as Australia suggested that the pathogen was clonal, *ie* there was no evidence for sexual recombination. However, international studies have in recent years gathered increasing evidence for recombination in stripe rust pathogen populations in some regions of the world, and this led to a resurgence in speculation

for the possible existence of a sexual host. The publication of the stripe rust sexual host by USA researchers in May 2010 has now confirmed this, and opened the door to new opportunities in understanding the genetic nature of the pathogen.

From an Australian perspective, the discovery of the sexual host on a species of ornamental *Berberis* (common name Barberry) is likely to have no significance in expanding the capability of the pathogen population. The main reason is that the *Berberis* species of concern are rare or unreported in Australia, and so we can expect that the reproductive behaviour of the stripe rust pathogen will remain clonal.

## Recent Developments in the Stripe Rust Population in Australia

The stripe rust pathogen survey for 2009 was largely completed and sample results reported to co-operators by December. A season summary was presented in Cereal Rust Report Volume 7, Issue 11 December 2009. Unusual observations from the field in 2009 have been the subject of further investigation using isolates collected from certain varieties.

### *Isolates from Tobruk triticale in 2009*

Unexpected severe symptom development on Tobruk triticale was reported in Cereal Rust Report Volume 7, Issue 10 (November 2009). Initial work confirmed that the 'Jackie' pathotype was frequently associated with these affected crops, but this was expected and did not explain the severe rusting of Tobruk in the field. Recent experiments have confirmed that isolates collected from Tobruk are capable of causing more severe infection on Tobruk in adult plants compared to the 'Jackie' pathotype in greenhouse tests. This is compelling evidence for new pathogenic variation caused by the 'Tobruk' pathotype, and must in large part be responsible for the poor performance of Tobruk in 2009. The illustration in Figure 1 shows the contrast in infection types between the 'Jackie' and 'Tobruk' pathotypes on Tobruk and Endeavour triticale.

The implications of the 'Tobruk' pathotype for varietal responses in triticale for the 2010 cropping season will remain uncertain until the nature and extent of disease responses in field plot studies are completed.

### *Isolates collected from Lincoln and Bolac wheat in 2009*

Isolates collected from these varieties across several locations in 2009 yielded the usual pathotype spectrum. Preliminary observations noted in Cereal Rust Report (Volume 7, Issue 10 (November 2009) also suggested evidence for the presence of an older pathotype among these isolates. Recent research has confirmed the identity of these isolates as a pathotype first detected in 1998 and which remained rarely isolated over the following seasons. Comparative studies between this pathotype and the 'Jackie' pathotype indicate that Lincoln and Bolac are more vulnerable to this old pathotype in adult plants at Growth Stage 32 (second node). However the extent and nature of stripe rust response in these varieties to this pathotype in commercial agriculture will not be known until further greenhouse and field work is completed in the 2010 season. Therefore Lincoln and Bolac remain unchanged at their current R-MR response to stripe rust.

## Rust Reports in 2010

Several rust samples have been received from co-operators at the Cereal Rust Laboratory. Leaf rust on *Phalaris tuberosa* has been received from a wide range of locations in eastern Australia. The samples will be tested on cereal genotypes, but it is not expected to yield a cereal rust pathogen. Phalaris is a pasture grass with several cultivars released for pasture improvement and has in past seasons been affected by leaf rust in autumn.

Wheat stem rust has been received from a summer nursery location in northern NSW.

There have been no stripe rust samples received to date, despite above average conditions for green bridge survival in large areas of eastern Australia.

A B

**Figure 1**. Paired leaves of triticale cultivars Tobruk and Endeavour compared to the susceptible Jackie, inoculated with the 'Jackie' pathotype (A) and 'Tobruk' pathotype (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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