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Plant Breeding Institute

Cereal rust in season 2023

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We received 289 samples of rusts on cereals and grasses to the end of November 2023-24. Most (210) were the wheat stripe rust pathogen (*Puccinia striiformis* f. sp. *tritici*; *Pst*), which was first detected on 7th July in southern NSW. 168 identifications of four previously detected pathotypes (pts) of *Pst* were made *viz.* 198 E16 A+ J+ T+ 17+, 238 E191 A- J+ T+ 17+, 238 E191 A+ 17+ 33+, and 239 E237 A- 17+ 33+. 26 samples of stripe rust on barley or barley grass were all identified as the Barley Grass Stripe Rust (BGYR) pathogen *Puccinia striiformis* f. sp. *pseudohordei* (*Psph*). Fourteen of the 15 samples of leaf rust on wheat were identified as pt. 104-1,3,4,5,7,9,10,12 +Lr37, and one as pt. 76-1,3,5,7,9,10,12,13 +Lr37 (from SA). We processed two samples of stem rust on barley from Qld (comprising wheat stem rust pt. 34-1,2,7 +Sr38 and the scabrum stem rust), and 33 samples of barley leaf rust comprised one or more of pts 5457 P-, 5457 P+, or 5656 P+. So far, only one pathotype has been identified from 3 samples of oat stem rust (94-1,2), and two pathotypes of oat crown rust from 10 samples (pts 0011-2,9 and 0767-1,3,5,6,7,10,12).

Please send freshly collected samples of rust from wheat, barley, oat, triticale and on grasses in paper only to the Australian Cereal Rust Survey, at the University of Sydney, Australian Rust Survey, Reply Paid 88076, Narellan NSW 2567.

Of the 289 rust samples we have received so far, 24 failed to yield a viable isolate, 37 are currently being processed, and 228 were processed and collaborators who forwarded these samples notified of the results.

Wheat stripe rust

As detailed in Cereal Rust Report **20** Issue 1, stripe rust of wheat was first reported this year on 7th July (Jindera southern NSW), with subsequent reports coming from Bethungra NSW (14/07), Tubbul NSW (20/07), Smeaton Victoria (20/07), Naracoorte SA (24/07) and Cressy/Longford Tasmania (26/07).

To date we have received 210 samples of stripe rust on wheat, 14 of these failed to yield a viable isolate. The 168 samples we have processed so far comprised one or more of four pathotypes that were all detected in previous seasons: 198 E16 A+ J+ T+ 17+ (19 isolates); 238 E191 A- J+ T+ 17+ (12 isolates); 238 E191 A+ 17+ 33+ (47 isolates); 239 E237 A- 17+ 33+ (90 isolates).

The distributions and frequencies of these four pathotypes are shown in **Figure 1**. The dominance of the "239" pathotype in southern regions (Victoria, South Australia and Tasmania) that we reported earlier in the season (see *Cereal Rust Report* **20** Issue 2) continued

throughout the year. This could be related to differences in the varieties being grown in these regions, with some varieties being more vulnerable to the "198" group of pathotypes (eg Borlaug 100, DS Bennett, Illabo, LRPB Trojan, Wedgetail) and some being more vulnerable to the "239"/"238" group of pathotypes (eg Catapult, Devil, Rockstar, Scepter, Vixen).

Pt. 198 E16 A- J+ T+ 17+ has decreased in frequency each year since 2020 (**Fig. 2**), being detected in SA and NSW only this year. The *Yr25*-virulent derivative pathotype 238 E191 A- J+ T+ 17+, which was first detected in 2022, was detected again in 2023 at low levels. Pt. 239 E237 A- 17+ 33+ increased in frequency in 2023, it was the most commonly isolated pathotype in 2023 and was present in all regions of eastern Australia (**Figs 1 and 2**). Pt. 238 E191 A+ 17+ 33+, first detected in 2021, was again common in 2023, being isolated mostly from NSW and Queensland (**Fig. 1**).

Barley Grass Stripe Rust

The fungal species that causes stripe rust, *Puccinia striiformis*, has specialised forms ("f. sp.") that are specialised to different crops: for example, *P. striiformis* f. sp. *tritici* infects wheat, and *P. striiformis* f. sp. *hordei* (*Psh*) infects barley. *Psh* does not occur in Australia and is considered a serious exotic threat due to the high susceptibility of many current barley varieties to this pathogen.

A third form of *P. striiformis*, first detected in Australia in 1998, is known colloquially as "BGYR" ("Barley Grass Stripe (Yellow) Rust"). BGYR is very common on wild barley grass weed species like *Hordeum glaucum* and *Hordeum leporinum*. It does not infect wheat and although it can infect barley it has not caused problems in barley crops to date.

Late in 2021 we found a BGYR variant in samples of stripe rust collected from wild barley grass and from several crops of RGT Planet in NSW, and subsequently in Victoria and Queensland. The new pathotype was designated "BGYR+". Our research with the new variant established clearly that it has increased virulence on a significant number of barleys at seedling growth stages, with the varieties Capstan, Empress, Finniss, Keel, Ketch, Prior and Ulandra all being rendered seedling susceptible.

The BGYR+ pathotype represents a large change in virulence that has led to increased vulnerability of barley to stripe rust in Australia. It is now well established and widespread in eastern Australia. Although most fortunately there have been no reports of damaging levels of stripe rust in barley crops, there have been more reports of low levels of stripe rust in barley crops every year since it was first detected in 2021.

The ongoing common occurrence of the BGYR+ pathotype on wild barley grass especially will provide opportunities for it to undergo further changes in virulence. Ongoing monitoring and research to understand the vulnerability of our current barley varieties to potential future changes in this pathogen will be vital in assessing and managing the risk it poses to our barley industry.

Barley stem rust and barley leaf rust

We processed two samples of stem rust on barley from Qld (comprising wheat stem rust pt. 34-1,2,7 +Sr38 (2 isolates) and the scabrum stem rust (1)). The scabrum stem rust is an asexual hybrid between the forms of the stem rust pathogen that infect wheat and cereal rye that was first discovered in Australia. Staff at the University of Sydney have led the world in identifying asexual hybrids in cereal rusts, being the first to document this between isolates of the wheat stem rust pathogen *Pgt* (1957), between forms of the stem rust pathogen (1963), and between isolates of the wheat leaf rust pathogen *P. triticina* (in 1990 and 2016). They have also identified several other probable asexual hybridisation events in two other cereal rust species.

Thirty three samples of leaf rusted barley were received from which three pathotypes have been identified: 5457 P- (23 isolates), 5457 P+ (9), 5656 P+ (4). All of these carry virulence for the resistance gene *Rph3*, which was first deployed in in Australia in the cultivar Yarra (released in 2005) and is currently present in 20 barley cultivars (Alestar, Banks, Bass, Bottler, Brewstart, Charger, Commander, Compass, Fairview, Finniss, Fitzroy, Gramnger, Henley, Maltstar, Oxford, RGT Planet, Starmalt, Topstart, Westminster, Wimmera). Virulence for *Rph3* was first detected in 2009, and since then has been very common in both eastern and Western Australia. Pathotypes 5457 P- and 5457 P+ belong to a single clonal lineage of the Australian *P. hordei* population that we first detected in WA in 2001 and considered to have had an exotic origin. Since then, members of this lineage have dominated Australian *P. hordei* populations, in 2023 accounting for 89% of all isolates pathotyped. Our work on fungicide insensitivity revealed that members of this lineage are insensitive to several DMI fungicides (see Cereal Rust Report **19** Issue 3).

Oat stem rust and oat crown rust

We received only 13 samples of rust on oats in 2023, a significant reduction in comparison with the number of samples we have received since we began monitoring both stem rust and crown rust of oat in 1936.

So far, only one pathotype has been identified from three samples of oat stem rust, 94-1,2, which has been

common in eastern Australia since at least 2015. This pathotype is virulent for the resistance genes *Pg1*, *Pg2*, *Pg3* and *Pg4*, making it virulent on all currently recommended oat varieties except those carrying the *Pga* resistance (Kowari, Mitika, Yallara). Virulence for the *Pga* resistance does occur in eastern Australia and was common in 2022.

Our long-term and detailed national surveillance of the oat crown rust pathogen has clearly established that it is the most pathogenically diverse of all cereal rusts– for example, from 1979 to 2021 we identified 107 pathotypes from more than 1,700 samples of crown rusted cultivated and wild oats. The next most pathogenically variable cereal rust pathogen over that period was the leaf rust pathogen of barley, with just 31 pathotypes.

So far in 2023, we have identified two pathotypes of oat crown rust from 10 samples: pt. 0011-2,9 (5 isolates, from WA, SA and Victoria) and 0767-1,3,5,6,7,10,12 (1 isolate from northern NSW). The former belongs to a family of pathotypes that was first detected in eastern Australia in 1998 and WA in 2011. The latter pathotype is virulent on many oat varieties, including Warrego (*Pc61*+), Nugene (*Pc48*+), Volta (*Pc50*) and Genie (*Pc48*, *Pc56*). Although it is avirulent for the resistance gene *Pc91* (present in the varieties Aladdin and Drover), virulence for *Pc91* does exist being first detected by us in 2013 (see *Cereal Rust Report* **11** Issue 1) and has been common in north-eastern Australia in most years since.

We continue to process rust samples received and will send results to collaborators who forward samples and update the rust map weekly, which can be accessed via our website:

https://www.sydney.edu.au/science/our-research/research-areas/life-and-environmental-sciences/cereal-rust-research.html)

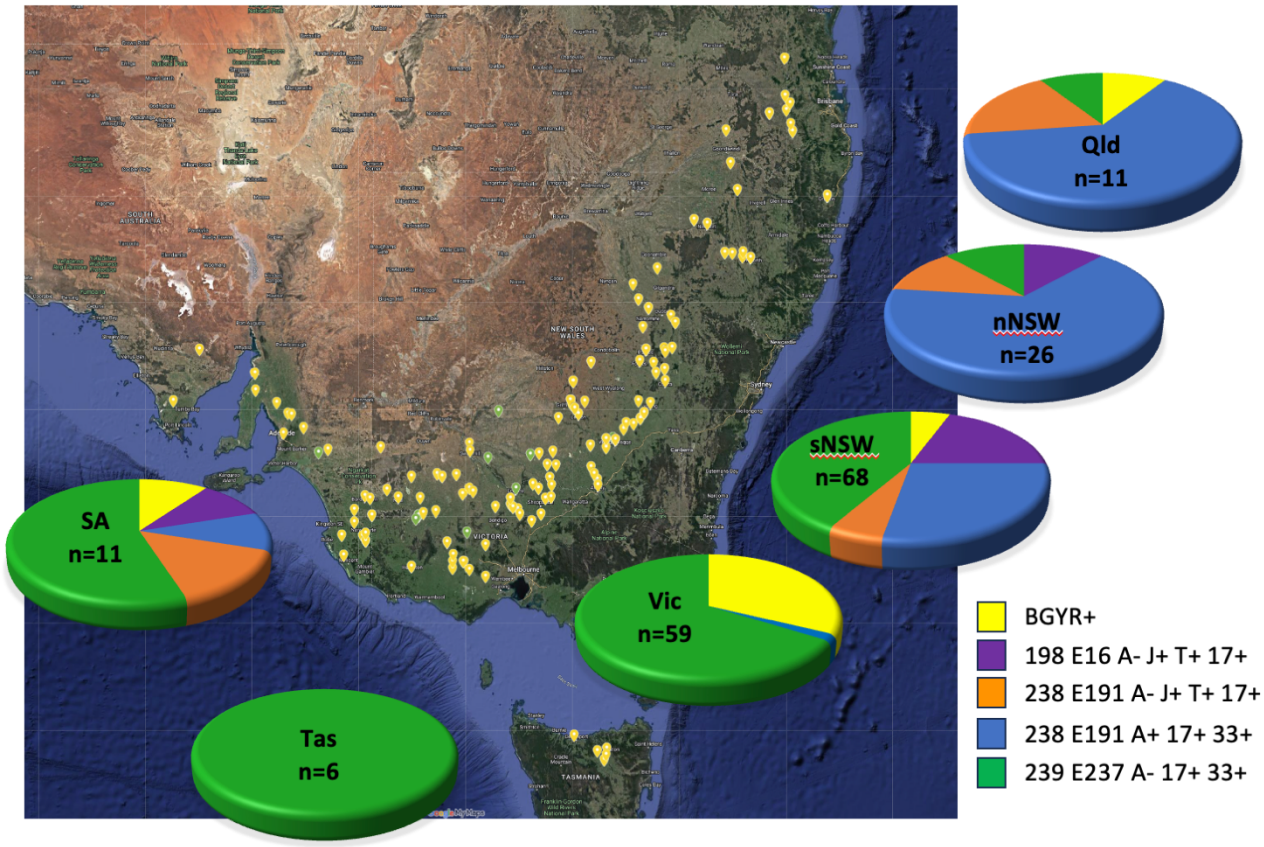

Figure 1: Locations from stripe rust samples were received, April 1 through November 30 2023, along with frequencies of pathotypes identified in six regions of eastern Australia

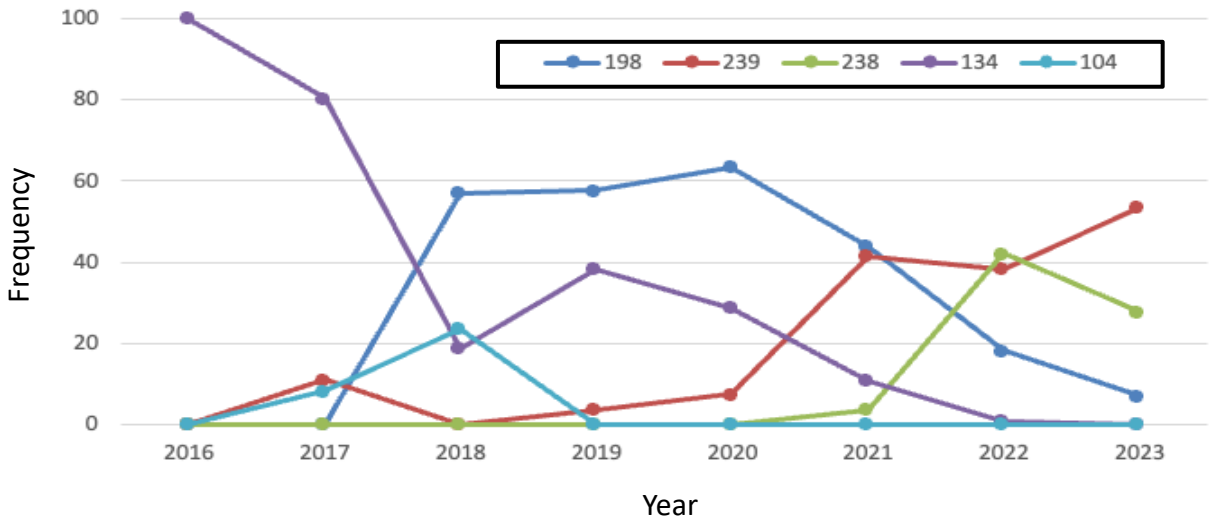

Figure 2: Frequency (%) of the five different pathotype groups of the wheat stripe rust pathogen in eastern Australia, 2016 through 2023

The success of our rust surveys depends entirely on the samples received for analysis- hence as always, growers and other stakeholders are encouraged to monitor crops closely for rust in the coming season, and to forward freshly collected samples in paper only to the Australian Cereal Rust Survey, at University of Sydney, Australian Rust Survey, Reply Paid 88076, Narellan NSW 2567.

We cannot stress enough how important it is not to post samples in plastic of any kind – rust fungi do not like this!

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Rusted Plant Samples

Can be mailed in paper envelopes. **Do not use plastic wrapping or plastic lined packages**. If possible, include the latitude and longitude of the sample location, date of collection, cultivar, and your full contact details.

Direct rust samples to:

University of Sydney
Australian Rust Survey
Reply Paid 88076
Narellan NSW 2567

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