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Plant Breeding Institute

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As forecast earlier this year, several cereal rust diseases are already widespread and common in eastern Australia, principally NSW. Stripe rust in wheat appeared early in the season in mid-May. So far, we have received more than 4 times the number of samples of stripe rusted wheat than at this stage last year, suggesting that the current season is shaping up to be worse for stripe rust than 2021. The most commonly isolated wheat stripe rust pathotype so far is the "198" pathotype (85% of IDs), with 5 isolates of "239" and a single isolate of pathotype 238 E191 A+ 17+ 33+ also detected. We have so far identified a single pathotype of the wheat leaf rust pathogen, which has been the most commonly isolated pathotype of this pathogen in all wheat growing regions of Australia since 2017. A total of 12 pathotypes of the oat crown rust pathogen have been identified to date, with two being most common: 0071-0 (first detected in 1993) and 0767-1,3,4,5,6,7,10,12 (first detected in 2018).

The rust responses and rust resistance genes present in current Australian wheat (common and durum) and triticale varieties can be viewed in our recently released rust genotype circular (Cereal Rust Report **19** (1)) and those of older varieties in the previous rust genotype circular (Volume **17** (3)). Both documents are available for download from our website (https://www.sydney.edu.au/science/our-research/research-areas/life-and-environmental-sciences/cereal-rust-research/rust-reports.html), along with regularly updated distribution of all pathotypes on our interactive map.

Stripe rust of wheat

Widespread stripe rust in wheat in eastern Australia in 2021 and the wet summer/ autumn period of 2021/22 provided very favourable conditions for rust survival in the lead-up to the 2022 season in eastern Australia. Early reports of stripe rust in wheat were received on May 20th from Temora, Canowindra and Wallendbeen in NSW. Since stripe rust was first detected in Australia in 1979, it has reappeared in each cropping cycle sometime between mid-May and the end of September, with the long-term average date being July 23rd. Our long-term data shows a strong correlation between the date of first detection and the extent of epidemic development – earlier detection means more stripe rust.

Cultivars that are especially vulnerable to stripe rust in eastern Australia include Borlaug 100, Chief CL Plus, Emu Rock, LG Gold, LRPB Trojan, and Wyalkatchem. More detailed information on varietal responses can be obtained from our Cereal Rust Report Volume **19** (1).

To date we have received over 100 samples of stripe rust from wheat crops (**Figure 1A**), more than four times what we had received at this time last year. All but five of these have come from NSW; 4 samples were collected from Billa Billa (3) and Yelarbon (1) in Queensland, and a single sample from Culgoa in Victoria. Three pathotypes have been isolated so far:

Pathotype 198 E16 A+ J+ T+ 17+

This pathotype ("198") was first detected in eastern Australia 2018, our comparative genome sequencing analyses showed that it was introduced into Australia from either Europe or South America. It remains restricted in its distribution to eastern Australia, where it has impacted not only common wheat but also durum wheat and triticale.

This pathotype has accounted for 33 of the 39 pathotype IDs we have made so far (85%). Interestingly, and possibly coincidental is that this pathotype also dominated early in the 2021 epidemic, with the "239" pathotype (see below) becoming more common as the season progressed.

Pathotype 239 E237 A- 17+ 33+

Pathotype "239" was first detected in eastern Australia in 2017 and using whole genome sequencing and comparative bioinformatics we were able to show that it originated from Europe. Like pathotype "198" it remains restricted to eastern Australia.

So far this year we have identified 4 isolates of pathotype "239", from sites at Wagga Wagga, Trundle, and in between. Although detected a year before "198", pathotype "239" remained at low levels until the 2021 season when its frequency increased substantially from 7% of identifications in 2020 to 43% in 2021. This had an impact on the rust responses of some wheat varieties, which are resistant to "198" but vulnerable to "239" (*eg* DS Bennett, LRPB Trojan, Borlaug 100).

Pathotype 238 E191 A+ 17+ 33+

This was one of two new pathotypes detected for the first time in 2021. Based on its virulence for All Stage Resistance genes, it should not pose any greater threat to current common wheat varieties than either of the two pathotypes "198" or "239".

The second new pathotype detected in 2021, which has not yet been detected this year, is 238 E191 A+ J+ T+ 17+. This is a mutational derivative of the 198 E16 A+ J+ T+ 17+ pathotype with added virulence for the resistance gene *Yr25*. Although several Australian wheat varieties carry resistance gene *Yr25* (Catapult, Coolah, Rockstar, Scepter), they are no more vulnerable to the new 238 E191 A+ J+ T+ 17+ pathotype than they are to pathotype "239".

Leaf rust of wheat

At the time of writing, we had received 13 samples of leaf rust on wheat, mainly from NSW (8) but also from SA (1) and Queensland (4) as far north as Emerald. Only one pathotype has been detected from the samples processed to date, *viz*. 104-1,3,4,5,7,9,10,12 +Lr37. This pathotype was first detected in 2016 in SA, and in the following 14 months it spread to all wheat growing regions of Australia and has remained the dominant wheat leaf rust pathotype in all regions in all years since.

Cultivar responses and genes for rust resistance can be viewed in our recent Cereal Rust Report (Volume **19**, Issue 1). Cultivars that are known to be significantly vulnerable to leaf rust infection include Corack, Devil, DS Bennett, Emu Rock, LRPB Impala, RGS Accroc, RGT Zanzibar, Sherriff CL: Plus, SQP Revenue, Sting and Vixen.

So far in 2022, we have not detected virulence for resistance gene *Lr24*. First detected in eastern Australia in 2000, virulence for this resistance gene has been detected in all but four years since then. While the frequency of virulence for *Lr24* in eastern Australia has remained low since 2015, in the past 2 years has increased somewhat (to 22% in 2021). A single national rating for leaf rust response that does not take into consideration virulence for *Lr24* was assigned by the 2021 NVT panel. Eastern Australian growers of all varieties carrying *Lr24* (Chief CL Plus, Cutlass, Elmore CL Plus, LRPB Lancer, LRPB Orion, LRPB Oryx, LRPB Parakeet, LRPB Stealth, RGT Cesario, Sunchaser) are advised nonetheless to monitor crops for leaf rust closely.

Crown rust of oat

Our work over many years has shown the crown rust pathogen of oat to be the most variable of all cereal rust pathogens in terms of virulence. Our whole genome sequencing work has revealed that despite this variability in virulence, populations of this pathogen in Australia comprise 4 genetic groups, each containing pathotypes that we believe are mutational derivatives of exotic incursions.

Early reports of crown rust of oat were received from northern NSW. To date, we have received 51 samples for pathotype analysis, 13 from Queensland and 38 from NSW (**Figure 1B**). A total of 14 of these samples were collected off weedy wild oats. Our long-term work on pathotype analysis in the oat crown rust pathogen has clearly shown a strong relationship between the pathotypes that occur on wild oats and those that occur on cultivated oat, hence samples collected from wild oat provide an important supplement to those from oat

crops in monitoring the incidence and identities of pathotypes of this rust pathogen.

We have identified 12 pathotypes of the oat crown rust pathogen from the samples received so far. Of these, the most commonly isolated are pathotypes 0071-0 (first detected in 1993) and 0767-1,3,4,5,6,7,10,12 (first detected in 2018). These pathotypes belong to two genetic groups that trace back to probable exotic incursions in the 1980s. The former carries virulence for the resistance genes *Pc45*, *Pc58*, *Pc59* and *Pc61*, and it or one of its mutational derivative pathotypes have been associated with cultivars carrying one or more of these resistance genes (*eg* Barcoo, Bettong, Bimbil, Eurabbie, Nile). Pathotype 0767-1,3,4,5,6,7,10,12 has been commonly isolated from the grazing oat variety Wizard, released in 2016, which carries the resistance genes *Pc50* and *Pc61*. It belongs to a large family of genetically similar pathotypes that are typified by virulence on the resistance genes *Pc38* and *Pc39*, with variants carrying virulence for genes including *Pc50* (*eg* Qantom, Volta), *Pc52* (Cleanleaf), *Pc56* (Gwydir), *Pc68* (*eg* Graza 51, Graza 68, Marloo, Moola), and *Pc91* (*eg* Aladdin, Drover).

All current oat cultivars are vulnerable to crown rust infection in eastern Australia, the most current ratings for this disease for milling and hay oats are available on the NVT website.

Stripe rust on wild barley grass and barley

A form of the stripe rust pathogen *P. striiformis* that was 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*. BGYR does not infect wheat and while it can infect barley, all varieties other than Skiff, Tantangara and Maritime have good levels of resistance to it.

Earlier this year we reported in Ground Cover™ on the detection of a new variant of stripe rust that infects wild barley grass, which was detected in late 2021. It was isolated from samples of stripe rust collected from wild barley grass and from several crops of RGT Planet in NSW, and subsequently in Victoria and Queensland. So far this year we have received one sample of the BGYR+ pathotype from an off-type plant in a barley crop in Victoria.

Our greenhouse seedling screens in 2021 established clearly that the new "BGYR+" variant 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.

Given that there were no reports of serious stripe rust in barley crops in 2021, we anticipate that most if not all current varieties have adult plant resistance over and above the resistance seen in our seedling tests.

The new BGYR+ pathotype was very common on wild barley grass in 2021, and we expect the same will occur in 2022. Common occurrence of this rust will provide opportunities for it to undergo further changes in virulence. Understanding the vulnerability of our current barley varieties to potential future changes in this pathogen will be vital in assessing the risk it poses to our barley industry. We encourage all collaborators to forward samples of stripe rust from wild barley grass to help us in our efforts to monitor this pathogen.

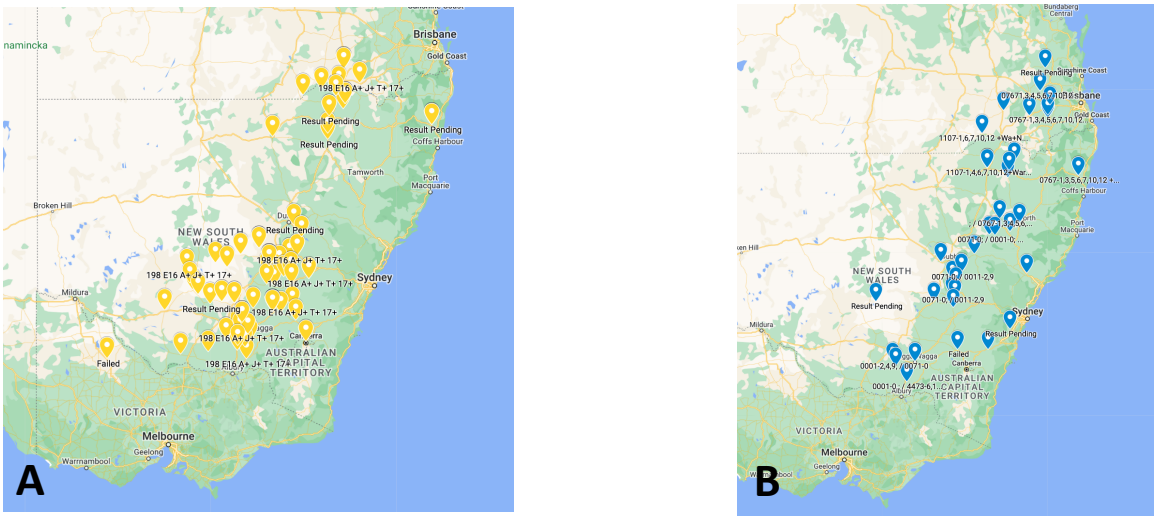

Figure 1: Distribution of samples received for (**A**) stripe rust of wheat, (**B**) crown rust of oat. 15th August 2022.

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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