**The multi-rust panel:**

**Identification of Cycle II selections with resistance to stripe rust and broad-spectrum resistance to stem rust that is not due to known alleles at *Rpg5***

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Cooperators stem rust:

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Cooperators stripe rust:

Stripe rust: Isabel Alicia del Blanco and Jorge Dubcovsky, UC-Davis

The multi rust data set contains a total of 53 lines. All data are available - please see <https://barleyworld.org/ug99>. In this report we feature eight selected lines (six doubled haploids and two checks (UC1322 and Q21861)). These eight lines have contrasting alleles at *Rpg5*, and contrasting disease reactions. They eight lines are all resistant to moderately resistant to barley stripe rust.Summary data are shown in Table 1 and the experiments from which the summary data were extracted are shown in Table 2.

***Germplasm:***

**The primary impetus was to identify novel sources of resistance to stem rust (incited by** *Puccinia graminis* f. sp. *tritici***) – other than *Rpg5.* An important secondary goal was to also select for resistance to stripe rust (**incited by *Puccinia striiformis* f. sp. *hordei)*.

***Phenotype data sources***

**Multiple data sources (Table 2) were used to generate the summary data in Table 1.**

***Genotyping***

All lines were genotyped with allele-specific primers for *Rpg5*. “0” indicates no amplification of either allele.

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Table 1. Featured lines from the multi-rust data set showing *Rpg5* allele states and resistance/susceptibility to stem rust in multiple experiments. Stripe rust resistance phenotypes are based on BLUPs from multiple experiments. See code abbreviations and details on data sources in Table 2.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Line | Pedigree | *Rpg5* allele | Stem rust | Stripe rust  |
|  |  |  | CI | MN 18 | MN 19 | MN 20 | MN 21 | WSU 21 | KY 21 | ET 21 | BLUP |
| DH140080 | SH98076/10.1151 | *Rpg5* | 1.9 |  - |  - | 73 | 43 | 40S | 1MS | 60S | 0  |
| DH140278 | SH98076/Full Pint | *Rpg5* | 0.7 | 5 | 41 | 55 | 23 | 30MS | 0 | 10MS | 4 |
| DH140512 | SH98076/Full Pint | *Rpg5* | 1.9 | 3 | 68 | 33 | 23 | 20MS | 0 | 5MR | 7 |
| DH160733 | DH140512/UC1322 | *0* | 0.8 | 4 | 6 |  - | 10 | 5R | 0 | 0 | 3 |
| DH160754 | DH140512/UC1322 | *0* | 0.5 | 1 | 7 |  - | 10 | 10MR | 0 | TMS | 2 |
| DH161930 | DH140512/DH130004 | *Rpg5* | 4.0 | 35 | 80 |  - | 48 | 40S | 0 | 20M | 23 |
| UC1322 | Z055001/CIMMYT 7862 | *0* | 0.5 | 5 | 28 |  - | 33 | 30MS | 10MS | 5MS | 8 |
| Q21861 | - | *Rpg5* | 2.3  | 3 | 22  |   | 35 | 45MS | 0 | 5MS | - |

CI Coefficient of Infection based on inoculation with stem rust race TTKSK at the seedling stage

MN University of Minnesota adult plant stem rust ratings (2018 – 2021) in response to inoculation with race QCCJ

KY Kenya 2021 adult plant stem rust rating in response to natural infection

ET Ethiopia 2021 adult plant stem rust rating in response to natural infection

WSU Washington State University adult plant stem rust rating in response to natural infection

BLUP Best Linear Unbiased Predictor based on multi-environment barley stripe rust severity

*Preliminary conclusions*

The *Rpg5* check (Q21861) and doubled haploids with *Rpg5* were usually resistant to race TTKSK at the seedling stage (CI), but the resistance allele alone was not sufficient (DH161930). Three lines did not amplify for known *Rpg5* alleles (UC1322 and its progeny DH160733 and DH 160754); all three were resistant at the seedling stage. In subsequent adult plant tests in Minnesota (using race QCCJ as a surrogate), all entries except DH161930 were resistant in 2018, but in subsequent years (2019 – 2021) there was increasing susceptibility. Notable exceptions were DH160733 and DH16074, which were resistant. A similar pattern was observed in Washington in 2021, in response to adult plant infection with local races. The adult plant data from Kenya in 2021, in response to natural infection, indicate all lines are resistant (or escapes). In Ethiopia, DH140080 (with *Rpg5*) was susceptible. DH 160733 and DH16074 had the lowest disease scores. All entries are resistant to stripe rust, except for DH161930, which is moderately susceptible. Unfortunately, Q21861 was not included in the stripe rust nurseries.

DH160733 and DH160754 are spring growth habit, two-row, covered barleys that may be useful as parents for transfer of adult plant resistance to stem and stripe rust. Efforts are underway to define the genetic bases of this resistance.

Table 2. Summary of locations, phenotypes and arrays evaluated for stem and/or stripe rust at the seedling and/or adult plant stages from which data were extracted for inclusion in Table 1.

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Location/ Phenotyping event  | Stem rust Seedling | Stem rust Adult | Stripe rust Adult | Cycle 1 | Cycle 2 | Multi-rust panel | Data on selections in Table 1  |
| *St Paul 15-16 (CI)*a | X |   |   | X |   |   | X |
| **Corvallis 15-16 (BLUP)b** |   |   | X | X |   |   | X |
| Corvallis 16-17 |   |   | X | X |   |   |   |
| *St Paul 17-18 (CI, MN18)* | X | X |   |   |   |   | X |
| *St Paul 18-19 (MN19)* |   | X |   |   |   |   | X |
| *St Paul 19-20 (MN20)* |  |  |  | X |  |  | X |
| **Corvallis 17-18 (BLUP)** |   |   | X |   | X |   | X |
| **Corvallis 18-19 (BLUP)** |   |   | X |   | X |   | X |
| **Davis 17-18 (BLUP)** |   |   | X |   | X |   | X |
| **Davis 18-19 (BLUP)**  |   |   | X |   | X |   | X |
| *Kenya 21 (KY21)* |   | X |   |   |   | X | X |
| *Ethiopia 21 (Eth 21)* |   | X |   |   |   | X | X |
| *St Paul 21 (MN21)* | X | X |   |   |   | X | X |
| *Washington 21 (WSU21)* |   | X |   |   |   | X | X |

aIn italic, locations that were used for stem rust evaluations and included in Table 2. In parenthesis the abbreviation used in Table 2. CI corresponds to coefficient of infection.

bIn bold, locations used for barley stripe rust evaluations. A single value (BLUP) was generated for each line after merging phenotypic data across the tested locations and used in Table 2.