

**Summary of *Puccinia striiformis* f. sp. *tritici* (*Pst*, the Wheat Stripe Rust Pathogen)
and *P. striiformis* f. sp. *hordei* (*Psh*, the Barley Stripe Rust Pathogen) Races
in the United States in 2021**

1. **Samples.** A total of 301 stripe rust samples were collected and received from wheat (257), barley (41), and grasses (3) from 13 states. From these samples, 250 *P. striiformis* f. sp. *tritici* (*Pst*) and 33 *P. striiformis* f. sp. *hordei* (*Psh*) isolates were obtained.
2. **Differential sets.** All *Pst* isolates were tested on 18 wheat differential lines each with a single *Yr* gene, and *Psh* isolates were tested on 12 barley varieties.
3. **Number of *Pst* races.** From the 350 *Pst* isolates, 18 races were identified. The virulence spectra of the races ranged from 0 to 13 with a mean of 9 on the 18 *Yr* genes.
4. **Top *Pst* races:**
 - 1) **PSTv-37** (Octal code: 171266) (virulent to *Yr6*, *Yr7*, *Yr8*, *Yr9*, *Yr17*, *Yr27*, *Yr43*, *Yr44*, *YrTr1*, *YrExp2*; and avirulent to *Yr1*, *Yr5*, *Yr10*, *Yr15*, *Yr24*, *Yr32*, *YrSP*, *Yr76*) with 76.4% frequency (No. 1), increased from 54.2.2% in 2020 (No. 1). This race was detected in all 13 states (AR, CA, KS, LA, MN, NE, OH, OK, OR, SD, TN, TX, and WA) in 2021.
 - 2) **PSTv-41** (Octal code: 175766) (virulent to *Yr6*, *Yr7*, *Yr8*, *Yr9*, *Yr10*, *Yr17*, *Yr24*, *Yr27*, *Yr32*, *Yr43*, *Yr44*, *YrTr1*, *YrExp2*); and avirulent to *Yr1*, *Yr5*, *Yr15*, *YrSP*, *Yr76*) with 4.4% frequency (No. 2), slightly increased from 4.0% in 2020 (No. 4). This race was detected in two states (TX and WA) in 2021.
 - 3) **PSTv-47** (Octal code: 571266) (virulent to *Yr1*, *Yr6*, *Yr7*, *Yr8*, *Yr9*, *Yr17*, *Yr27*, *Yr43*, *Yr44*, *YrTr1*, *YrExp2*; and avirulent to *Yr5*, *Yr10*, *Yr15*, *Yr24*, *Yr32*, *YrSP*, *Yr76*) with 3.2% frequency (No. 3), decreased from 5.6% in 2020 (No. 3). This race was detected in three states (LA, OR, and WA) in 2021.
 - 4) **PSTv-18** (Octal code: 000000) [virulent to none; and avirulent to all 18 *Yr* genes (*Yr1*, *Yr5*, *Yr6*, *Yr7*, *Yr8*, *Yr9*, *Yr10*, *Yr15*, *Yr17*, *Yr24*, *Yr27*, *Yr32*, *Yr43*, *Yr44*, *YrSP*, *YrTr1*, *YrExp2*, *Yr76*) with 2.4% frequency (No. 4), increased from 1.3% in 2020 (No. 9). This race was detected in three states (OH, OR, and WA) in 2021.
 - 5) **PSTv-119** (Octal code: 161262) (virulent to *Yr6*, *Yr7*, *Yr8*, *Yr17*, *Yr27*, *Yr43*, *Yr44*, *YrExp2*; and avirulent to *Yr1*, *Yr5*, *Yr9*, *Yr10*, *Yr15*, *Yr24*, *Yr32*, *YrSP*, *YrTr1*, *Yr76*) with 2.4% frequency (Co-No. 4), increased from 1.7% in 2020 (No. 8). This race was detected in only WA in 2021.

The remaining 13 races were all below 2.0%, and 7 of them were each detected from only one sample.

5. **New race.** No new *Pst* races were identified in 2021.

6. **Virulence frequencies.** High frequencies were found for virulence to *Yr6* (96.8%), *Yr27* (95.6%), *Yr8* (94.4%), *Yr17* (94.0%), *Yr9* (93.2%), *Yr7* (92.8%), *Yr44* (92.8%), *YrExp2* (92.8%), *Yr43* (92.4%), and *YrTr1* (89.2%); and low frequencies for virulence to *Yr1* (9.6%), *Yr10* (6.4%), *Yr76* (4.8%), *Yr24* (4.4%), *Yr32* (4.4%), and *YrSP* (3.2%). No virulence was found to either *Yr5* or *Yr15*, and therefore, these two resistance genes are still effective against all races identified so far in the U.S.

7. **Races of the barley stripe rust pathogen.** In 2021, *Psh* isolates were obtained from California and Washington, and 9 races were identified. Four races had frequencies above 15%: 1) **PSH-33** (virulent on Topper and Abed Binder 12) at 24.2% frequency detected mostly in California, decreased from 38.8% in 2020; 2) **PSH-118** (virulent on Topper, Abed Binder 12, Trumpf, and Bigo) also at 24.2% frequency identified only in Washington; 3) **PSH-81** (virulent on Topper, Abed Binder 12, and Bigo) at 18.2% frequency was detected only in Washington; 4) **PSH-116** (virulent on Topper, Hiproly, Abed Binder 12, and Bigo) at 15.2 frequency was detected only in Washington. The other five races detected from 1 or 2 samples at frequencies 3.3% or 6.1%. PSH-118 was a new race detected from samples from western Washington.

8. **Excel data and summary tables:**
 1. PSTsum2021 including the following worksheets:
 1. Summary data of *Pst* isolates sorted by states
 2. Summary data of *Pst* isolates sorted by epidemiological regions
 3. All *Pst* races, codes, virulence formulae, frequencies, and distributions
 4. *Pst* races and frequencies in each state
 5. *Pst* races and frequencies in each epidemiological region
 6. Frequencies of virulence factors to the 18 *Yr* single-gene lines used as differentials

 2. PSHsum2021 including the following worksheets:
 1. Summary data of *Psh* isolates
 2. Summary data sorted by races
 3. All *Psh* races, frequencies, and distributions
 4. New *Psh* race.