## 2009 Wheat Leaf Rust (Puccinia triticina) Virulence Survey

In 2009, 41 races of wheat leaf rust were described in the United States (Table 1). Races MLDSD (28.9\%), TCRKG (16.8\%), TDBGG (14.4\%), MCTSB (7.4\%) and MFPSB ( $4.9 \%$ ) were the five most common races. Races MLDSD ( $L r 9, L r 17, L r 41 / L r 39$ virulence), TDBGG ( $L r 24$ virulence) and MFPSB ( $\operatorname{Lr17}$, 24, and 26) were most common races in the Great Plains region. Races TCRKG ( $L r 26, L r 11$, and $L r 18$ virulence) and MCTSB ( $L r 11,17$ and $L r 26$ virulence) increased in 2009 and were found mostly in the southeastern states.

Races with virulence to genes $\operatorname{Lr24,Lr26,Lr17,\text {and}Lr41/Lr39\text {thatarepresentinthehardredwinterwheatswerecommonintheGreatPlainsregion(Table2).}}$ Races with virulence to Lr24, Lr26, Lr11, and Lr18 that are present in the soft red winter wheats were common in the southeastern states. Races with virulence to Lr16 that is present in the hard red spring wheats were at low frequencies in the Great Plains region. Races with virulence to Lr21 that is present in hard red spring wheats were not detected.

Table 1. Number and frequency (\%) of virulence phenotypes of Puccinia triticina in the United States in 2009 identified by virulence to $19^{a}$ lines of wheat with single genes for leaf rust resistance.

| Phenotype Virulences |  | Area 1 ${ }^{\text {b }}$ |  | Area $2^{\text {c }}$ |  | Area 3 ${ }^{\text {d }}$ |  | Area $4^{\text {e }}$ |  | Area $5^{\text {f }}$ |  | Area 6 ${ }^{\text {g }}$ |  | $\underline{\text { Area } 7^{\text {h }}}$ |  | Area $8^{\text {i }}$ |  | Total |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  |  | \# | \% | \# | \% | \# | \% | \# | \% | \# | \% | \# | \% | \# | \% | \# | \% | \# | \% |
| BBBQB | B,10 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 4 | 33.3 | 0 | 0 | 4 | 0.7 |
| CCPMB | 3,26,3ka,17,30,B,18 | 0 | 0 | 2 | 3.3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 0.3 |
| FCPNB | 2c,3,26,3ka,17,30,B,14a | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 1.2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 0.3 |
| MBBJG | 1,3,10,14a,28 | 0 | 0 | 2 | 3.3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 0.3 |
| MBDSB | 1,3,17,B,10,14a | 1 | 0.6 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 16.7 | 0 | 0 | 3 | 0.5 |
| MBGJG | 1,3,11,10,14a,28 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 20 | 2 | 0.3 |
| MBPTB | 1,3,3ka,17,30,B,10,14a,18 | 2 | 1.2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 0.3 |
| MBRKG | 1,3,3ka,11,30,10,14a,18,28 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 10 | 1 | 0.2 |
| MBTSB | 1,3,3ka,11,17,30,B,10,14a | 1 | 0.6 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0.2 |
| MCDSB | 1,3,26,17,B,10,14a | 12 | 7.3 | 0 | 0 | 0 | 0 | 2 | 1.2 | 0 | 0 | 0 | 0 | 5 | 41.7 | 0 | 0 | 19 | 3.2 |
| MCGDG | 1,3,26,11,14a,28 | 2 | 1.2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 0.3 |
| MCPQG | 1,3,26,3ka,17,30,B,10,28 | 0 | 0 | 2 | 3.3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 0.3 |
| MCPSB | 1,3,26,3ka,17,30,B,10,14a | 5 | 3 | 0 | 0 | 0 | 0 | 2 | 1.2 | 2 | 2.9 | 0 | 0 | 0 | 0 | 0 | 0 | 9 | 1.5 |
| MCRJG | 1,3,26,3ka,11,30,10,14a,28 | 0 | 0 | 1 | 1.7 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0.2 |
| MCRKG | 1,3,26,3ka,11,30,10,14a,18,28 | 0 | 0 | 2 | 3.3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 0.3 |
| MCTSB | 1,3,26,3ka,11,17,30,B,10,14a | 21 | 12.8 | 11 | 18.3 | 6 | 20 | 2 | 1.2 | 2 | 2.9 | 2 | 2.6 | 0 | 0 | 0 | 0 | 44 | 7.4 |
| MDBJG | 1,3,24,10,14a,28 | 0 | 0 | 12 | 20 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 12 | 2 |
| MFBJG | 1,3,24,26,10,14a,28 | 0 | 0 | 8 | 13.3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 8 | 1.4 |
| MFGJG | 1,3,24,26,11,10,14a,28 | 0 | 0 | 2 | 3.3 | 0 | 0 | 3 | 1.8 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 5 | 0.8 |
| MFPSB | 1,3,24,26,3ka,17,30,B,10,14a | 6 | 3.7 | 2 | 3.3 | 4 | 13.3 | 6 | 3.6 | 6 | 8.8 | 5 | 6.4 | 0 | 0 | 0 | 0 | 29 | 4.9 |
| MLDSD | 1,3,9,17,B,10,14a,41 | 12 | 7.3 | 2 | 3.3 | 1 | 3.3 | 80 | 47.3 | 38 | 55.9 | 35 | 44.9 | 1 | 8.3 | 2 | 20 | 171 | 28.9 |
| NBBKG | 1,2c,10,14a,18,28 | 0 | 0 | 2 | 3.3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 0.3 |
| PBBHG | 1,2c, 3, 10,18,28 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 5 | 50 | 5 | 0.8 |
| PCMJG | 1,2c,3,26,3ka,30,10,14a,28 | 0 | 0 | 2 | 3.3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 0.3 |
| SBBGG | 1,2a,2c, 10,28 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0.6 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0.2 |
| TBBJG | 1,2a,2c, 3, 10,14a,28 | 2 | 1.2 | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 4.4 | 2 | 2.6 | 0 | 0 | 0 | 0 | 7 | 1.2 |
| TBGJG | 1,2a,2c, 3, 11, 10, 14a,28 | 2 | 1.2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 0.3 |
| TBRKG | 1,2a,2c, 3,3ka,11,30,10,14a,18,28 | 9 | 5.5 | 0 | 0 | 0 | 0 | 1 | 0.6 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 10 | 1.7 |
| TCDSB | 1,2a,2c, 3,26,17,B,10,14a | 0 | 0 | 2 | 3.3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 0.3 |


| TCJDB | 1,2a,2c,3,26,11,17,14a | 1 | 0.6 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0.2 |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| TCQJG | 1,2a,2c,3,26,3ka,11,10,14a,28 | 1 | 0.6 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0.2 |
| TCRKG | 1,2a,2c, 3,26,3ka,11,30,10,14a,18,28 | 70 | 42.7 | 4 | 6.7 | 17 | 56.7 | 5 | 3 | 1 | 1.5 | 2 | 2.6 | 0 | 0 | 0 | 0 | 99 | 16.8 |
| TCTJG | 1,2a,2c, 3,26,3ka,11,17,30,10,14a,28 | 2 | 1.2 | 2 | 3.3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 4 | 0.7 |
| TDBGB | 1,2a,2c, 3, 24, 10 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 1.2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 0.3 |
| TDBGG | 1,2a,2c, 3,24,10,28 | 4 | 2.4 | 0 | 0 | 0 | 0 | 43 | 25.4 | 9 | 13.2 | 29 | 37.2 | 0 | 0 | 0 | 0 | 85 | 14.4 |
| TDBJG | 1,2a,2c, 3, 24, 10, 14a, 28 | 8 | 4.9 | 2 | 3.3 | 2 | 6.7 | 7 | 4.1 | 3 | 4.4 | 0 | 0 | 0 | 0 | 0 | 0 | 22 | 3.7 |
| TDRKG | 1,2a,2c, $3,24,3 \mathrm{ka}, 11,30,10,14 \mathrm{a}, 18,28$ | 0 | 0 | 0 | 0 | 0 | 0 | 4 | 2.4 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 4 | 0.7 |
| TFBGG | 1,2a,2c, 3,24,26,10,28 | 0 | 0 | 0 | 0 | 0 | 0 | 4 | 2.4 | 0 | 0 | 1 | 1.3 | 0 | 0 | 0 | 0 | 5 | 0.8 |
| TFBJG | 1,2a,2c,3,24,26,10,14a,28 | 3 | 1.8 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 2.9 | 0 | 0 | 0 | 0 | 0 | 0 | 5 | 0.8 |
| TJBGG | 1,2a,2c, 3, 16,24,10,28 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 1.2 | 2 | 2.9 | 2 | 2.6 | 0 | 0 | 0 | 0 | 6 | 1 |
| TNRJJ | 1,2a,2c, $3,9,24,3 \mathrm{ka}, 11,30,10,14 \mathrm{a}, 28,41$ | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 1.8 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 0.5 |
| Total |  | 164 |  | 60 |  | 30 |  | 169 |  | 68 |  | 78 |  | 12 |  | 10 |  | 591 |  |


Lr41.
${ }^{\mathrm{b}}$ States of AL, AR, GA, LA, MS, NC, SC
${ }^{\text {c }}$ States of MD, NY, PA, VA
${ }^{\mathrm{d}}$ States of IL, MI, WI
${ }^{\text {e }}$ States of OK, TX
${ }^{\mathrm{f}}$ States of OK, TX
${ }^{\mathrm{g}}$ States of KS, NE
${ }^{\text {h }}$ States of AZ, CA
States of ID, WA

Table 2. Number and frequency (\%) of isolates of Puccinia triticina in the United States in 2009 virulent to 19 lines of wheat with single resistance genes for leaf rust resistance.

| Resistance gene | Area 1 ${ }^{\text {a }}$ |  | Area $2^{\text {b }}$ |  | Area 3 ${ }^{\text {c }}$ |  | Area $4^{\text {d }}$ |  | Area $5^{\text {e }}$ |  | Area $6^{\text {f }}$ |  | Area $7^{\text {g }}$ |  | Area $8^{\text {h }}$ |  | Total |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | \# | \% | \# | \% | \# | \% | \# | \% | \# | \% | \# | \% | \# | \% | \# | \% | \# | \% |
| Lr1 | 164 | 100 | 58 | 96.7 | 30 | 100 | 167 | 98.8 | 68 | 100 | 78 | 100 | 8 | 66.7 | 10 | 100 | 583 | 98.6 |
| Lr2a | 102 | 62.2 | 10 | 16.7 | 19 | 63.3 | 72 | 42.6 | 20 | 29.4 | 36 | 46.2 | 0 | 0 | 0 | 0 | 259 | 43.8 |
| Lr2c | 102 | 62.2 | 14 | 23.3 | 19 | 63.3 | 74 | 43.8 | 20 | 29.4 | 36 | 46.2 | 0 | 0 | 5 | 50.0 | 270 | 45.7 |
| Lr3 | 164 | 100 | 58 | 96.7 | 30 | 100 | 168 | 99.4 | 68 | 100 | 78 | 100 | 8 | 66.7 | 10 | 100 | 584 | 98.8 |
| Lr9 | 12 | 7.3 | 2 | 3.3 | 1 | 3.3 | 83 | 49.1 | 38 | 55.9 | 35 | 44.9 | 1 | 8.3 | 2 | 20.0 | 174 | 29.4 |
| Lr16 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 1.2 | 2 | 2.9 | 2 | 2.6 | 0 | 0 | 0 | 0 | 6 | 1.0 |
| Lr24 | 21 | 12.8 | 26 | 43.3 | 6 | 20.0 | 74 | 43.8 | 22 | 32.4 | 37 | 47.4 | 0 | 0 | 0 | 0 | 186 | 31.5 |
| Lr26 | 123 | 75.0 | 40 | 66.7 | 27 | 90.0 | 26 | 15.4 | 13 | 19.1 | 10 | 12.8 | 5 | 41.7 | 0 | 0 | 244 | 41.3 |
| Lr3ka | 117 | 71.3 | 28 | 46.7 | 27 | 90.0 | 25 | 14.8 | 11 | 16.2 | 9 | 11.5 | 0 | 0 | 1 | 10.0 | 218 | 36.9 |
| Lr11 | 109 | 66.5 | 22 | 36.7 | 23 | 76.7 | 18 | 10.7 | 3 | 4.4 | 4 | 5.1 | 0 | 0 | 3 | 30.0 | 182 | 30.8 |
| Lr17 | 63 | 38.4 | 23 | 38.3 | 11 | 36.7 | 94 | 55.6 | 48 | 70.6 | 42 | 53.8 | 8 | 66.7 | 2 | 20.0 | 291 | 49.2 |
| Lr30 | 116 | 70.7 | 28 | 46.7 | 27 | 90.0 | 25 | 14.8 | 11 | 16.2 | 9 | 11.5 | 0 | 0 | 1 | 10.0 | 217 | 36.7 |
| LrB | 60 | 36.6 | 21 | 35.0 | 11 | 36.7 | 94 | 55.6 | 48 | 70.6 | 42 | 53.8 | 12 | 100 | 2 | 20.0 | 290 | 49.1 |
| Lr10 | 161 | 98.2 | 58 | 96.7 | 30 | 100 | 167 | 98.8 | 68 | 100 | 78 | 100 | 12 | 100 | 10 | 100 | 584 | 98.8 |
| Lr14a | 160 | 97.6 | 56 | 93.3 | 30 | 100 | 117 | 69.2 | 57 | 83.8 | 46 | 59.0 | 8 | 66.7 | 5 | 50.0 | 479 | 81.0 |
| Lr18 | 81 | 49.4 | 10 | 16.7 | 17 | 56.7 | 10 | 5.9 | 1 | 1.5 | 2 | 2.6 | 0 | 0 | 6 | 60.0 | 127 | 21.5 |
| Lr21 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Lr28 | 103 | 62.8 | 41 | 68.3 | 19 | 63.3 | 73 | 43.2 | 20 | 29.4 | 36 | 46.2 | 0 | 0 | 8 | 80.0 | 300 | 50.8 |
| Lr41 | 12 | 7.3 | 2 | 3.3 | 1 | 3.3 | 83 | 49.1 | 38 | 55.9 | 35 | 44.9 | 1 | 8.3 | 2 | 20.0 | 174 | 29.4 |
| Total | 164 |  | 60 |  | 30 |  | 169 |  | 68 |  | 78 |  | 12 |  | 10 |  | 591 |  |

${ }^{\text {a }}$ States of AL, AR, GA, LA, MS, NC, SC
${ }^{\mathrm{b}}$ States of MD, NY, PA, VA
${ }^{\text {c }}$ States of IL, MI WI
${ }^{\text {d }}$ States of IL, MI, W
e States of OK, TX
States of KS, NE
${ }^{\mathrm{f}}$ States of MN, ND, SD
${ }^{\mathrm{g}}$ States of AZ, CA
${ }^{\mathrm{h}}$ States of ID, WA

