

Wheat Leaf Rust in the United States in 2023

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In 2023 wheat leaf rust caused by *Puccinia triticina*, was reported in 23 states. The crop conditions and spread and severity of leaf rust in 2023 are summarized in the final Cereal Rust Bulletin of 2023 at the Cereal Disease Laboratory website

(<https://www.ars.usda.gov/ARSUserFiles/50620500/CRBs/Final%20bulletin%20for%202023.pdf>).

Races and virulence of *Puccinia triticina*

In 2023, 49 races of *P. triticina* were identified in collections of leaf rust infected leaves that were sent to the USDA-ARS Cereal Disease Laboratory. A total of 262 isolates were processed for race identification.

MNPSD was the most common race across the United States at 15.3% of all isolates. Isolates with this race designation were found throughout the hard red wheat regions of the Great Plains. MNPSD is virulent to wheat lines with *Lr24*, *Lr37*, and *Lr39*. These genes are present in hard red winter wheat cultivars.

Race TCTNB was the second most common at 10.8% of all isolates. This race was mostly found in the southeastern states and Ohio Valley areas and is at lower levels in the Great Plains region. This race is virulent to cultivars with *Lr11* and *Lr26*, common in the soft red winter wheat regions.

In the southeastern states, TCTNB was the most common race in this region. Race MCTNB was also found in the southeast and Ohio Valley. This race is virulent to *Lr11* and *Lr26*.

In the Great Plains region of TX and OK races TFTSB (14.9%) and MGPSB (13.8) were the two most common. TFTSB is virulent to *Lr24* and *Lr26*, and MGPSB is virulent to *Lr16* and *Lr23* (J.A. Kolmer, pers observation). In KS and NE races MNPSD (28.6%) and TCTNB (19%) were the two most common races.

In the spring wheat region of SD, MN, and ND, races MNPSD (41.1%) and MNTSD (16.1%) were the two most common races. Due to the extreme drought in this region, most of the isolates were collected from susceptible spring wheat cultivars such as Morocco, Little Club, and Thatcher. Isolates of races MNPSD and MNTSD were likely selected by hard red winter wheat cultivars and urediniospores carried north in the prevailing winds to the spring wheat region.

A notable increase in the frequency of isolates with virulence to *Lr16* occurred in 2023 (Table 2) in the Great Plains region. In TX and OK virulence to *Lr16* was at 16.1%; 9.5% in KS and NE, and 8.9% in MN, SD, and ND. In the immediate previous years isolates with virulence to *Lr16* were at less than 5% in all regions. A single isolate of race MGPJL was detected in TX. This race has virulence to *Lr16* and *Lr21*, which are both in current spring wheat cultivars. Isolates of race MGPSB were found in TX, OK, KS, NE, and MN. This race is virulent to *Lr16* and *Lr23*, which are present in the current hard red spring wheat cultivars. A single isolate of race MHPSB with virulence to *Lr16* was found in MN. A single isolate of TSBJS was found in MN. This race is virulent to *Lr24*, and *Lr39*, which are in the hard red winter wheat cultivars, and *Lr16* and *Lr21*, which are in the spring wheat cultivars.

In Washington State, most isolates (77.8%) were of race MBDSG. This race was not found in any other region.

Isolates with virulence to *Lr11* and *Lr26* were at the highest frequencies in the southeastern states and Ohio Valley, and at lower levels in the Great Plain regions. Isolates with virulence to *Lr18* were also found in these two regions at low levels and were not found in other regions. Some soft red winter wheat cultivars have *Lr18*.

Isolates with virulence to *Lr24* and *Lr39* were at the highest frequencies in the Great Plains regions where winter wheat cultivars with these genes are widely grown.

The complete listing of races found in the United States in 2023 is given in Table 1. The frequency of isolates with virulence to the individual *Lr* genes is given in Table 2. The complete listing of collections, host cultivars, date of collection, collectors, location of collections, and identified races are given in Table 3.

Acknowledgments

We thank the cooperators who have sent in collections of leaf rust in the past years. This survey would not be possible without your help.

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Table 1 Number and frequency (%) of the predominant virulence phenotypes of *Puccinia triticina* in the United States in 2023 identified by virulence to 20 lines of Thatcher wheat with single genes for leaf rust resistance.

Race	Virulence combination (ineffective Lr genes)	Southeast		NY State		Ohio Valley		TX - OK		KS- NE		SD- MN- ND		WA		Total	
		#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%
KFBJG	2a,2c,3,24,26,10,14a,28	0	0	0	0	0	0	1	1.1	0	0	0	0	0	0	1	0.4
MBDJJ	1,3,17,10,14a,28,39	0	0	0	0	0	0	1	1.1	0	0	0	0	0	0	1	0.4
MBDSD	1,3,17,B,10,14a,39	0	0	0	0	0	0	3	3.4	2	9.5	3	5.4	0	0	8	3.1
MBDSG	1,3,17,B,10,14a,28	0	0	0	0	0	0	0	0	0	0	0	0	7	77.8	7	2.7
MBJSD	1,3,11,17,B,10,14a,39	0	0	0	0	0	0	2	2.3	0	0	0	0	0	0	2	0.8
MBPSB	1,3,3ka,17,30,B,10,14a	0	0	0	0	0	0	5	5.7	0	0	0	0	0	0	5	1.9
MBRNG	1,3,3ka,11,30,B,14a,28	1	1.9	0	0	0	0	0	0	0	0	0	0	0	0	1	0.4
MBTNB	1,3,3ka,11,17,30,B,14a	4	7.7	0	0	4	12.1	1	1.1	0	0	2	3.6	0	0	11	4.2
MCDSG	1,3,26,17,B,10,14a,28	0	0	0	0	0	0	0	0	0	0	0	0	2	22.2	2	0.8
MCJSD	1,3,26,11,17,B,10,14a,39	0	0	0	0	0	0	4	4.6	0	0	0	0	0	0	4	1.5
MCPSB	1,3,26,3ka,17,30,B,10,14a	0	0	0	0	0	0	1	1.1	0	0	0	0	0	0	1	0.4
MCTNB	1,3,26,3ka,11,17,30,B,14a	11	21.2	2	50	7	21.2	0	0	0	0	0	0	0	0	20	7.6
MGPJL	1,3,16,3ka,17,30,10,14a,21	0	0	0	0	0	0	1	1.1	0	0	0	0	0	0	1	0.4
MGPSB	1,3,16,3ka,17,30,B,10,14a	0	0	0	0	0	0	12	13.8	2	9.5	2	3.6	0	0	16	6.1
MHPSB	1,3,16,26,3ka,17,30,B,10,14a	0	0	0	0	0	0	0	0	0	0	1	1.8	0	0	1	0.4
MJBJG	1,3,16,24,10,14a,28	0	0	0	0	0	0	1	1.1	0	0	0	0	0	0	1	0.4
MKPSB	1,3,16,24,26,3ka,17,30,B,10,14a	0	0	0	0	0	0	0	0	0	0	1	1.8	0	0	1	0.4
MLPSD	1,3,9,3ka,17,30,B,10,14a,39	0	0	0	0	0	0	0	0	4	19	0	0	0	0	4	1.5
MNDSG	1,3,9,24,17,B,10,14a,39	2	3.8	0	0	0	0	4	4.6	0	0	0	0	0	0	6	2.3
MNJSD	1,3,9,24,11,17,B,10,14a,39	0	0	0	0	0	0	0	0	0	0	1	1.8	0	0	1	0.4
MNPSD	1,3,9,24,3ka,17,30,B,10,14a,39	2	3.8	0	0	0	0	9	10.3	6	28.6	23	41.1	0	0	40	15.3
MNTSB	1,3,9,24,3ka,11,17,30,B,10,14a,39	0	0	0	0	0	0	1	1.1	0	0	0	0	0	0	1	0.4
MNTSD	1,3,9,24,3ka,11,17,30,B,10,14a,39	0	0	0	0	0	0	2	2.3	0	0	9	16.1	0	0	11	4.2
MPJSD	1,3,9,24,26,11,17,B,10,14a,39	0	0	0	0	0	0	1	1.1	1	4.8	0	0	0	0	2	0.8
MPPSD	1,3,9,24,26,3ka,17,30,B,10,14a,39	0	0	0	0	0	0	5	5.7	2	9.5	3	5.4	0	0	10	3.8
MPTSD	1,3,9,24,26,3ka,11,17,30,B,10,14a,39	0	0	0	0	0	0	1	1.1	0	0	3	5.4	0	0	4	1.5
TBJSD	1,2a,2c,3,11,17,B,10,14a,39	0	0	0	0	0	0	1	1.1	0	0	0	0	0	0	1	0.5
TBRDG	1,2a,2c,3,3ka,11,30,14a,28	2	3.8	0	0	0	0	2	2.3	0	0	1	1.8	0	0	5	1.9
TBRNG	1,2a,2c,3,3ka,11,30,B,14a,28	0	0	0	0	0	0	1	1.1	0	0	0	0	0	0	1	0.4
TBTNB	1,2a,2c,3,3ka,11,17,30,B,14a,28	5	9.6	2	50	4	12.1	0	0	0	0	2	3.6	0	0	13	5
TBTSB	1,2a,2c,3,3ka,11,17,30,B,10,14a,28	1	1.9	0	0	2	6.1	1	1.1	0	0	0	0	0	0	4	1.5
TCJG	1,2a,2c,3,26,11,10,14a,28	1	1.9	0	0	0	0	2	2.3	0	0	0	0	0	0	3	1.1
TCJSB	1,2a,2c,3,26,11,17,B,10,14a,28	1	1.9	0	0	0	0	0	0	0	0	0	0	0	0	1	0.4
TCJTB	1,2a,2c,3,26,11,17,B,10,14a,28	3	5.8	0	0	0	0	0	0	0	0	0	0	0	0	3	1.1
TCRDG	1,2a,2c,3,26,3ka,11,30,14a,28	1	1.9	0	0	1	3	0	0	0	0	0	0	0	0	2	0.8
TCRFG	1,2a,2c,3,26,3ka,11,30,14a,28	1	1.9	0	0	0	0	0	0	0	0	0	0	0	0	1	0.4
TCRKG	1,2a,2c,3,26,3ka,11,30,10,14a,28	0	0	0	0	0	0	1	1.1	0	0	0	0	0	0	1	0.4
TCSQB	1,2a,2c,3,26,3ka,11,17,B,10,14a,28	0	0	0	0	2	6.1	0	0	0	0	0	0	0	0	2	0.8
TCTNB	1,2a,2c,3,26,3ka,11,17,30,B,14a,28	13	25	0	0	3	9.1	5	5.7	4	19	2	3.6	0	0	27	10.8
TCTSB	1,2a,2c,3,26,3ka,11,17,30,B,10,14a,28	4	7.7	0	0	5	15.2	1	1.1	0	0	0	0	0	0	10	3.8
TDTSB	1,2a,2c,3,24,3ka,11,17,30,B,10,14a,28	0	0	0	0	0	0	1	1.1	0	0	0	0	0	0	1	0.4
TFKDB	1,2a,2c,3,24,26,11,17,30,14a,28	0	0	0	0	3	9.1	0	0	0	0	0	0	0	0	3	1.1
TFPSB	1,2a,2c,3,24,26,3ka,17,30,B,10,14a,28	0	0	0	0	1	3	0	0	0	0	0	0	0	0	1	0.4
TFTJB	1,2a,2c,3,24,26,3ka,11,17,30,B,10,14a,28	0	0	0	0	0	0	2	2.3	0	0	0	0	0	0	2	0.8
TFTNB	1,2a,2c,3,24,26,3ka,11,17,30,B,10,14a,28	0	0	0	0	1	3	0	0	0	0	0	0	0	0	1	0.4
TFTSB	1,2a,2c,3,24,26,3ka,11,17,30,B,10,14a,28	0	0	0	0	0	0	13	14.9	0	0	0	0	0	0	13	5
TNBJS	1,2a,2c,3,9,24,10,14a,21,28,39	0	0	0	0	0	0	0	0	0	0	1	1.8	0	0	1	0.4
TNBSS	1,2a,2c,3,9,24,B,10,14a,21,28,39	0	0	0	0	0	0	2	2.3	0	0	1	1.8	0	0	3	1.1
TSBJS	1,2a,2c,3,9,16,24,10,14a,21,28,39	0	0	0	0	0	0	0	0	0	0	1	1.8	0	0	1	0.4
Total		52		4		33		87		21		56		9		262	

Table 2 Number and frequency (%) of isolates of *Puccinia triticina* in the United States in 2023 virulent to 20 lines of wheat with single resistance genes for leaf rust resistance.

Resistance gene	Southeast		NY State		Ohio Valley		TX-OK		KS- NE		SD,MN,ND		WA		Total	
	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%
Lr1	52	100	4	100	33	100	86	98.9	21	100	56	100	9	100	261	99.6
Lr2a	32	61.5	2	50	22	66.7	33	37.9	4	19	8	14.3	0	0	101	38.5
Lr2c	32	61.5	2	50	22	66.7	33	37.9	4	19	8	14.3	0	0	101	38.5
Lr3	52	100	4	100	33	100	87	100	21	100	56	100	9	100	262	100
Lr9	4	7.7	0	0	0	0	25	28.7	13	61.9	42	75	0	0	84	32.1
Lr16	0	0	0	0	0	0	14	16.1	2	9.5	5	8.9	0	0	21	8
Lr24	4	7.7	0	0	5	15.2	43	49.4	9	42.9	43	76.8	0	0	104	39.7
Lr26	35	67.3	2	50	23	69.7	37	42.5	7	33.3	10	17.9	2	22.2	116	44.3
Lr3ka	45	86.5	4	100	30	90.9	65	74.7	18	85.7	49	87.5	0	0	211	80.5
Lr11	48	92.3	4	100	32	97	42	48.3	5	23.8	20	35.7	0	0	151	57.6
Lr17	46	88.5	4	100	32	97	77	88.5	21	100	52	92.9	9	100	241	92
Lr30	45	86.5	4	100	31	93.9	65	74.7	18	85.7	49	87.5	0	0	212	80.9
LrB	47	90.4	4	100	29	87.9	76	87.4	21	100	53	94.6	9	100	239	91.2
Lr10	14	26.9	0	0	10	30.3	78	89.7	17	81	49	87.5	9	100	177	67.6
Lr14a	52	100	4	100	31	93.9	87	100	21	100	56	100	9	100	260	99.2
Lr18	4	7.7	0	0	0	0	1	1.1	0	0	0	0	0	0	5	1.9
Lr21	0	0	0	0	0	0	3	3.4	0	0	3	5.4	0	0	6	2.3
Lr28	6	11.5	0	0	1	3	11	12.6	0	0	4	7.1	9	100	31	11.8
Lr39	4	7.7	0	0	0	0	35	40.2	15	71.4	45	80.4	0	0	99	37.8
Lr42	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	52		4		33		87		21		56		9		262	