

New races of the stem rust pathogen detected in Kenya

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INTRODUCTION

Wheat stem rust, caused by *Puccinia graminis* f. sp. *tritici* (*Pgt*), is a reemerging disease that threatens wheat production globally. In Kenya, variants in the Ug99 race group have caused significant yield losses to wheat growers. The objective of this study was to determine the virulence composition and diversity of *Pgt* in Kenya in 2015–2019.

MATERIALS and METHODS

- **Samples collection:** ~300 wheat stem rust samples were collected in 2014 to 2019 wheat growing seasons.
- **Race analysis:** 250 single pustule isolates were race typed based on 20 North American differential set and further characterized on additional monogenic lines carrying important stem rust resistance genes.
- **Genotyping:** A set of 52 representative isolates were genotyped using the *Pgt* Core SNP assay consisting of 17 markers.
- **Germplasm screening:** 245 advanced Kenyan wheat breeding lines and 106 Ethiopian wheat varieties and breeding lines were evaluated for reaction to isolate 18KEN488-1 at the seedling stage.

RESULTS and DISCUSSION

1) Race analysis

Two new races in the Ug99 group were identified: TTKTT+ in 2018 and TTHTT in 2019. *Pgt* race TTKTT+ has added virulence to *Sr8155B1* in comparison with race TTKTT (Fig. 1). *Sr8155B1* is an important stem rust resistance gene in durum wheat and also present in some bread wheat germplasm. TTHTT is the second Ug99 variant avirulent on *Sr30* (Fig. 1).

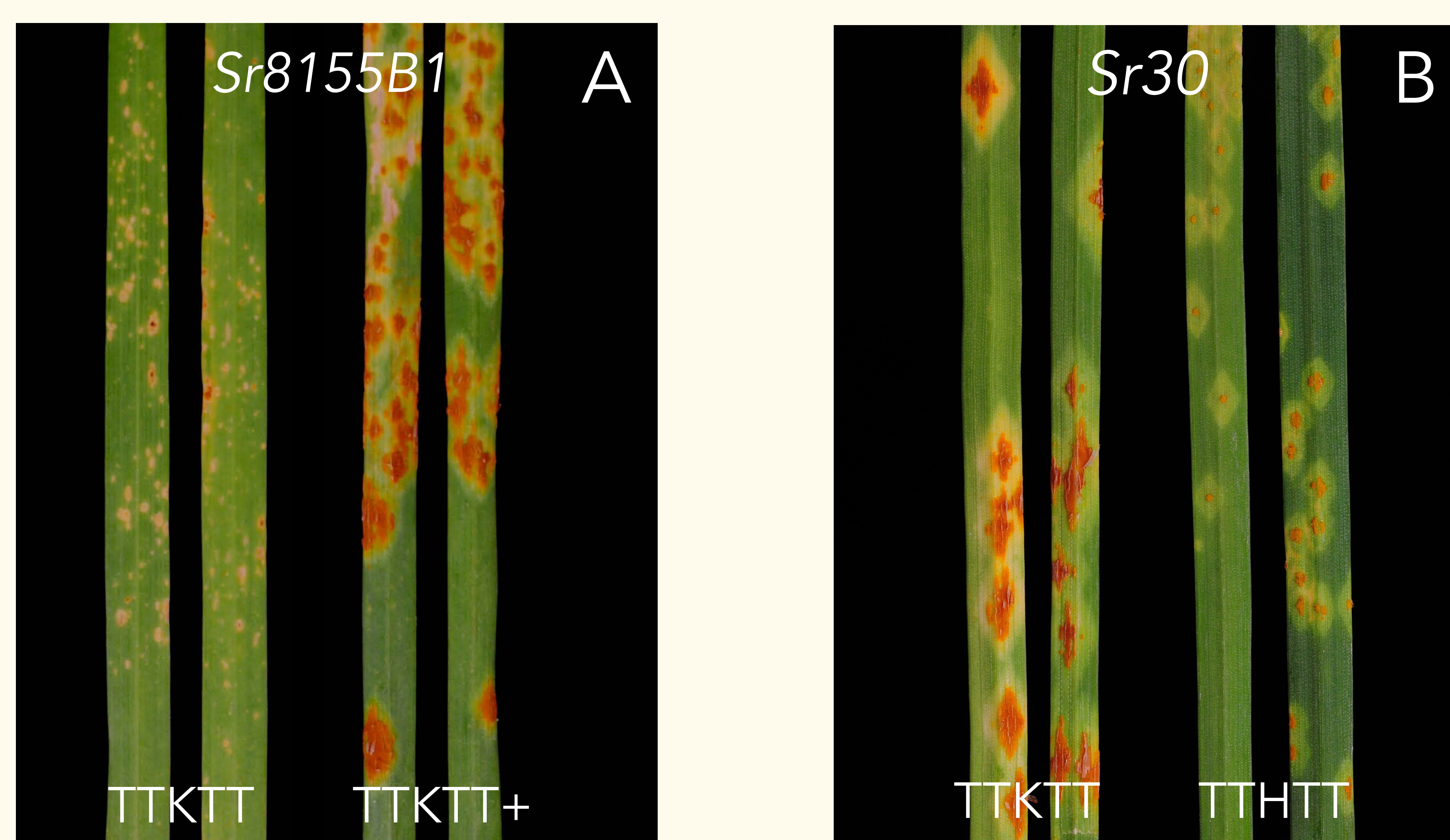


Figure 1. Infection types observed in A) line carrying *Sr8155B1* caused by Ug99 variants TTKTT and TTKTT+ and B) line carrying *Sr30* caused by Ug99 variants TTKTT and TTHTT.

In addition, races outside of the Ug99 race group including TKTTF, TKKTF, TTRTF, TTTTF, TKPTF, and PKPTF have been identified in Kenya since 2015. Some of these races have a broad geographical distribution and carry virulence to Ug99-resistant genes including *Sr35*, *Sr37*, *Sr13b*, and *Sr1RS^{Amigo}*.

Table 1. Year and number of isolates of non-Ug99 *Pgt* races identified in Kenya in 2015-2019.

	2015	2017	2018	2019
TTTTF	10	2	3	3
PKPTF	4			
TKTTF		22	1	
TKPTF		2		
TTRTF			2	3
TKKTF				5

2) Genotyping

All variants in the Ug99 race group were confirmed to be clade I, whereas the non-Ug99 races belonged to clades III (TTRTF) and IV (TKTTF, TTTTF, TKKTF).

Table 2. Core SNP assay genotypes of selected isolates derived from stem rust samples collected in Kenya between 2015 and 2019.

ISOLATE	YEAR	RACE	Clade	MLG	Core SNP Assay																
					A101	A105	A106	A107	A109	A111	A119	A121	A126	A127	A128	A129	A130	A131	A133	A134	A135
18KEN266-1	2018	TTKST	I	CoA01-	CA	CT	TG	TC	GC	AG	CC	AG	GA	AA	CG	CC	TC	GA	GT	CA	TT
18KEN262-1	2019	TTKTK	I	Co-A01	CA	CT	TG	TC	GC	AG	CC	AG	GA	AA	CG	CC	TC	GA	GT	CA	TT
18KEN486-1	2019	TTKTT	I	Co-A01	CA	CT	TG	TC	GC	AG	CC	AG	GA	AA	CG	CC	TC	GA	GT	CA	TT
18KEN488-1	2018	TTKTT+	I	Co-A01	CA	CT	TG	TC	GC	AG	CC	AG	GA	AA	CG	CC	TC	GA	GT	CA	TT
19KEN102-1	2019	TTHTT	I	Co-A01	CA	CT	TG	TC	GC	AG	CC	AG	GA	AA	CG	CC	TC	GA	GT	CA	TT
18KEN452-1	2018	TTRTF	III-B	Co-A04	CA	CT	TG	CC	CC	GG	CC	AA	AA	AA	GG	CC	TC	GG	GG	CA	TT
19KEN108-1	2019	TTTTF	IV-F	Co-A14	CC	CT	TG	TC	CC	GG	TC	AG	GA	AA	CG	TC	TC	GA	GG	CC	CT
19KEN111-1	2018	TKKTF	IV-F	Co-A14	CC	CT	TG	TC	CC	GG	TC	AG	GA	AA	CG	TC	TC	GA	GG	CC	CT
18KEN869-1	2019	TKTTF	IV-B	Co-A07	AA	CT	TG	TC	CC	AA	TT	AG	GA	GA	GG	TC	TT	GG	GG	CC	CT

3) Germplasm screening

- Forty five percent of advanced Kenyan breeding lines were susceptible to race TTKTT+ at the seedling stage, including Kasuko, a stem rust resistant cultivar released in 2018.
- More than 100 Ethiopian wheat varieties and breeding lines were also evaluated against race TTKTT+ and 65% were susceptible.

Table 3. Number and percentage of Kenyan breeding lines and Ethiopian cultivars and breeding lines susceptible to *Pgt* race TTKTT+.

	Number	Percentage
Kenyan breeding lines	111	45.3
Ethiopian cultivars and breeding lines	69	65.1

Acknowledgements

This research is funded by USDA-ARS and Delivering Genetic Gain in Wheat (DGGW) project administrated by Cornell University and funded by the Bill & Melinda Gates Foundation and the United Kingdom DFID.