



2018 Preliminary stem rust race analysis report Turkey-ICARDA Regional Cereal Rust Research Center (RCRRC) Cereal Rust Biosafety Laboratory Izmir, Turkey

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The Cereal Rust Biosafety Laboratory (CRBL) became operational after the official inauguration of Regional Cereal Rust Research Center (RCRRC) on May 30, 2018. Following the inauguration, the CRBL has received official import permits from Food and Control Directorate of Turkey for importing cereal rust pathogens from outside Turkey and to conduct race analysis of *Puccinia striiformis*, *P. graminis*, and *P. triticina* at CRBL.

This report presents the race analysis data of wheat stem rust (*Puccinia graminis*) samples collected during the 2018 rust survey from Azerbaijan, Ethiopia, Iran, Iraq, Kenya, Lebanon, and Turkey (Annex 1) which were submitted to the Cereal Rust Biosafety Laboratory (CRBL) at Turkey-ICARDA Regional Cereal Rust Research Center (RCRRC) in Izmir, Turkey.

The rust samples were collected during the national rust survey following the BGRI rust surveillance protocol. Prior to sample submission, the RCRRC provided to the country's rust surveillance representatives, individual import permit authorization for each country issued by Food and Control Directorate of Turkey, rust sampling guideline, and a shipment kit. We have used the North American stem rust race analysis system for *P. graminis* samples using the 20 stem rust differential lines (Annex 2) and the standard race-typing procedure and infection type (IT) criteria determining virulence and avirulence factors described by Jin et al. (2008). In total, 129 STEM RUST samples were submitted to RCRRC in 2018 of which, 90 isolates were recovered from stem rust samples and five stem rust isolates were recovered from contaminated leaf rust samples submitted to RCRRC from Iran (Table 1). So far, 52 isolates from the 2018 sample collection have been race typed.

Table 1. Summary of submitted stem rust samples, recovered (isolated) and typed stem rust samples at RCRRC, 2018.

Row Labels	Sample (no)	Isolate (no)	Typed Isolates (no)
Azerbaijan	1	1	1
Ethiopia	10	8	8
Iran	5	10*	7
Iraq	9	3	2
Kenya	14	14	8
Lebanon	21	21	7
Turkey	69	38	19
Grand Total	129	95	52

*- Five stem rust isolates were recovered from submitted leaf rust samples contaminated with stem rust

Azerbaijan

Import Permit Hologram No: A1150004

Only one stem rust sample received from Azerbaijan (Table 1). The sample was collected during the 2018 national rust surveillance and submitted by Azerbaijan Research Institute of Crop Husbandry to the RCRRRC. Stem rust race TKKTF ($n=1$) was the only identified race from three single pustule cultures of this sample (Table 2). The avirulence/ virulence formula of TKKTF is presented in Table 3.

Ethiopia

Import Permit Hologram No A1150005

In total, 10 stem rust samples submitted by CIMMYT- Ethiopia were received by RCRRRC of which eight samples were recovered (Table 1). Among the recovered samples, eight isolates were used in race analysis (Table 2). The race analysis data in Table 2 are mainly based on the most common races detected from isolated samples using 2-3 purified single pustule cultures from each isolate. A few single pustule cultures which showed different expected low/high infection types from the identified races, are still under purification and race typing process. Three stem rust races TKKTF ($n=3$), TKTTF ($n=3$), and TTKTT ($n=2$) were identified from submitted samples. The avirulence/ virulence formula of identified races is presented in Table 3.

Iran

Import Permit Hologram No A1150009

In total, 5 isolates from submitted stem rust samples and five isolates from submitted leaf rust samples (Table 1) by Seed and Plant Improvement Institute, Karaj, Iran were recovered. Among the recovered samples, seven isolates were used in race analysis. The race analysis data in Table 3 are mainly based on the most common races detected from isolated samples using 2-3 purified single pustule cultures from each isolate. Remaining isolates are still under single pustule purification and race typing process. Two stem rust races TKKTF ($n=1$) and TKTTF ($n=6$) were identified. The avirulence/ virulence formula of identified races is presented in Table 3.

Iraq

Import Permit Hologram No A1150008

In total, 9 stem rust samples were collected by Emad Al-Maarouf, College of Agricultural Sciences Sulaimani University-Iraq, during the 2018 rust surveillance from major wheat growing areas in Northern Iraq of which 3 samples were recovered and two isolated samples were used in race analysis (Table 1). The race analysis data is presented in Table 2. Two stem rust races TKKTF ($n=1$) and TTTTF ($n=1$) were identified from the typed isolates. In Table 3, avirulence/ virulence formula of these races is presented. Race analysis data of remaining isolate will be provided after final confirmations.

Kenya

Import Permit Hologram No A1150015

In total, 14 stem rust samples were collected by Kumarse Nazari and Ruth Wanyera from wheat stem rust screening nurseries planted at stem rust phenotyping platform, KARLO, Kenya¹. All the 14 samples were recovered at CRBL of which eight samples were used in race analysis (Table 1). The race analysis data is presented in Table 2. Stem rust race TTKTT ($n=8$) was the only race identified from the eight isolates. In Table 3, avirulence/ virulence formula of TTKTT is presented. Race analysis data of remaining isolates will be provided after final confirmations.

¹ Note: The stem rust screening nursery at KALRO, Njoro is inoculated and the primary race used for inoculation is TTKTT.

Lebanon

Import Permit Hologram No A11500010

In total, 21 stem rust samples were collected by Rola El Amil and Kumarse Nazari during the 2018 rust surveillance from major wheat growing areas in Lebanon and experimental trials at ICARDA research station in Terbol. All the 21 samples were recovered at CRBL of which seven isolates were used in race analysis (Table 1). The race analysis data is in Table 2. Two stem rust races TKKTF ($n=1$) and TKTTF ($n=6$) were identified from the typed isolates. In Table 3, avirulence/ virulence formula of these races is presented. Race analysis data of remaining isolates will be provided after final confirmations.

Turkey

In total, 69 stem rust samples submitted by Plant Protection Institute and Aegean Agricultural Research Institute, Turkey to CRBL of which 38 isolates have been recovered (Table 1) and 19 isolates were used in pathotyping (Table 2). The race analysis data in Table 2 are mainly based on the most common races detected from isolated samples using 2-3 purified single pustule cultures from each isolate. Three stem rust races TKKTF ($n=3$), TKTTF ($n=15$), and TTTTF ($n=1$) were identified. The remaining isolates are still under single pustule purification and race typing process. The avirulence/ virulence formula of identified races is presented in Table 3.

The total number of identified races and overall frequency of the four *P. graminis* races identified from the 52 stem rust samples are illustrated in figure 1 and figure 2, respectively.

Table 1. List of stem rust samples, sample ID, host plant, isolate ID and identified races of *Puccinia graminis* from Azerbaijan, Ethiopia, Iran, Iraq, Kenya, Lebanon, and Turkey, RCRRRC, 2018.

Country	Sample#ID	Host plant	Isolate#ID	Race				Total
				TKKTF	TKTTF	TKKTT	TTTTF	
Azerbaijan	AZESr3	Unknown	18AZE-Sr255	1				1
Azerbaijan Total				1				1
Ethiopia	SRETH001	Unknown	18ETH-Sr464	1				1
	SRETH002	Unknown	18ETH-Sr465		1			1
	SRETH003	Unknown	18ETH-Sr466	1				1
	SRETH004	Kakaba+ local	18ETH-Sr467		1			1
	SRETH005	Dandaa	18ETH-Sr468			1		1
	SRETH006	Unknown	18ETH-Sr469	1				1
	SRETH007	Unknown	18ETH-Sr470		1			1
	SRETH009	Unknown	18ETH-Sr472			1		1
Ethiopia Total				3	3	2		8
Iran	LRIR0009	Unknown	18IRN-Sr383		1			1
	LRIR0013	Unknown	18IRN-Sr387	1				1
	SRIR0001	Unknown	18IRN-Sr370		1			1
	SRIR0002	Unknown	18IRN-Sr371		1			1
	SRIR0003	Unknown	18IRN-Sr372		1			1
	SRIR0004	Unknown	18IRN-Sr373		1			1
	SRIR0005	Unknown	18IRN-Sr374		1			1
Iran Total				1	6			7
Iraq	SRIRQ18004	Unknown	18IRQ-Sr269	1				1
	SRIRQ18007	Unknown	18IRQ-Sr272				1	1
Iraq Total				1			1	2
Kenya	KEN SR1	PBW343	18KEN-Sr399			1		1
	KEN SR11	SrDiff No31-Sr29	18KEN-Sr409			1		1

	KEN SR13	SrDiff No40-Sr10	18KEN-Sr411		1	1
	KEN SR2	SrDiff No1-Sr5	18KEN-Sr400		1	1
	KEN SR5	SrDiff No11-Sr9f	18KEN-Sr403		1	1
	KEN SR6	SrDiff No19-Sr16	18KEN-Sr404		1	1
	KEN SR7	SrDiff No26-Sr24	18KEN-Sr405		1	1
	KEN SR8	SrDiff No27-Sr25	18KEN-Sr406		1	1
Kenya Total					8	8
Lebanon	IZM 23	Unknown	18LBN-Sr275		1	1
	IZM 26	Unknown	18LBN-Sr278	1		1
	IZM 27	Unknown	18LBN-Sr279		1	1
	IZM 32	Unknown	18LBN-Sr284		1	1
	IZM 34	Unknown	18LBN-Sr286		1	1
	IZM 41	Unknown	18LBN-Sr293		1	1
	IZM 44	Unknown	18LBN-Sr296		1	1
Lebanon Total					1	6
Turkey	EK1	BW/ Unknown	18TUR-Sr36		1	1
	EK1	BW/ Unknown	18TUR-Sr40		1	1
	HH18-102	BW/ Unknown	18TUR-Sr31	1		1
	HH18-116	BW/ Unknown	18TUR-Sr29		1	1
	HH18-117	BW/ Unknown	18TUR-Sr30			1
	HH18-141	BW/ Unknown	18TUR-Sr48		1	1
	HH18-142	BW/Unknown	18TUR-Sr49		1	1
	Sr25	BW/ Unknown	18TUR-Sr25		1	1
	Sr33	DW/ Unknown	18TUR-Sr33	1		1
	Sr55	Unknown	18TUR-Sr239		1	1
	Sr56	Unknown	18TUR-Sr240		1	1
	Sr57	Unknown	18TUR-Sr241		1	1
	Sr59	Unknown	18TUR-Sr243		1	1
	Sr60	Unknown	18TUR-Sr244		1	1

Sr61	Unknown	18TUR-Sr245	1					1
Sr62	Unknown	18TUR-Sr246		1				1
Sr67	Unknown	18TUR-Sr251		1				1
SRIZM	Sr Diff NA: Sr11	18TUR-Izmir		1				1
SrTUR11	DW/DWLR-315	18TUR-Sr1		1				1
Turkey Total				3	15		1	19
Grand Total				10	30	10	2	52

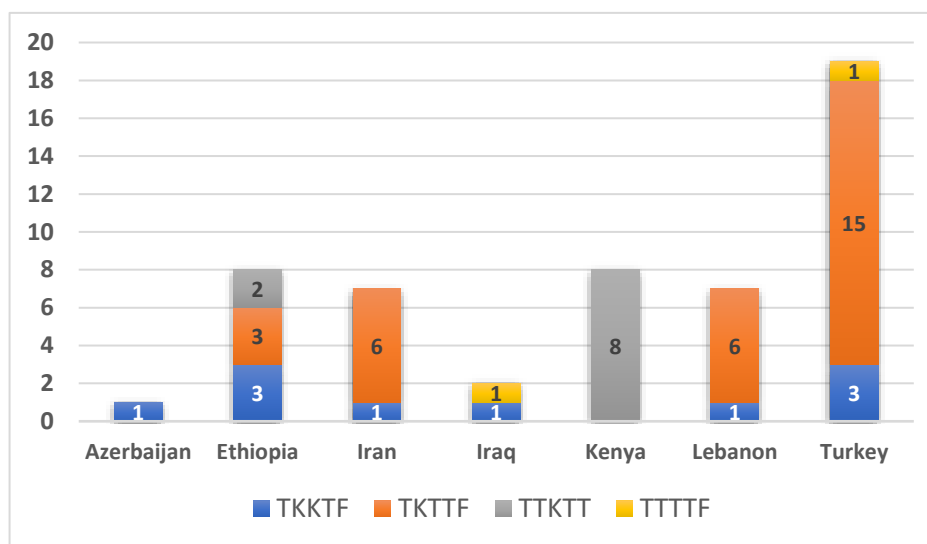


Figure 1. Total number of *P. graminis* races from Azerbaijan, Ethiopia, Iran, Iraq, and Lebanon, RCRRC, 2018

Table 3. Virulence/ Avirulence formula of *Puccinia graminis* races identified from submitted stem rust samples to RCRRRC in 2018.

Race	Avirulence (Sr)	Virulence (Sr)
TKKTF	11, 36, 24, 31	5, 21, 9e, 7b, 6, 8a, 9g, 9b, 30, 17, 9a, 9d, 10, Tmp, 38, McN
TKTTF	11, 24, 31	5, 21, 9e, 7b, 6, 8a, 9g, 36, 9b, 30, 17, 9a, 9d, 10, Tmp, 38, McN
TTTTF	24, 31	5, 21, 9e, 7b, 11, 6, 8a, 9g, 36, 9b, 30, 17, 9a, 9d, 10, Tmp, 38, McN
TKKTT	36	5, 21, 9e, 7b, 11, 6, 8a, 9g, 9b, 30, 17, 9a, 9d, 10, Tmp, 24, 31, 38, McN

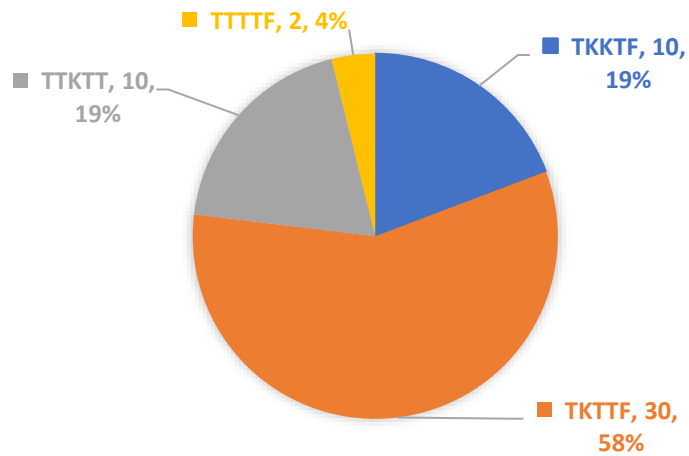


Figure 2. Frequency of identified *P. graminis* races from 52 typed stem rust samples during 2018 at RCRRRC

Reference

Jin, Y., et al. 2008. Plant Dis. 92:923. 10.1094/PDIS-92-6-0923

Annex 1. List of countries and contact information for stem rust samples submitted to RCRR, 2018.

Country	Name	Institute	Address	e-mail
Azerbaijan	Konul Aslanova	Azerbaijan Research Institute of Crop Husbandry	Pirshagi set. No2 Sovkhoz, Az 1098, Baku, Azerbaijan	konul_ak@yahoo.com
Ethiopia	Dave Hodson	International Maize and Wheat Improvement Center (CIMMYT)-Ethiopia	PO Box 5689, Addis Ababa, Ethiopia	D.Hodson@cgiar.org
Iran	Ali Malhipour	Seed and Plant Improvement Institute (SPII)	P.O. Box 31585-4119, Karaj, Iran	a.malihipour@gmail.com
Iraq	Emad Al-Maarroof	College of Agricultural Sciences, Sulaimani University	Bakrajo, Sulaimani, Iraq	ealmaarroof@yahoo.com
Kenya	Ruth Wanyera	Kenya Agricultural Livestock and Research Organization (KALRO)	P.O. Private Bag Njoro 20107, Kenya	wanyerar@gmail.com
Lebanon	Rola El Amil	Lebanese Agricultural Research Institute (LARI)	287 Zahleh, Bekaa, Lebanon	ramil@lari.gov.lb
Turkey	Ali PEKSÜSLÜ	Aegean Agricultural Research Institute (AARI)	PO Box 35661-9, Menemen, Izmir, Turkey	ali.peksuslu@tarimorman.gov.tr
Turkey	Hakan Hakimhan	Aegean Agricultural Research Institute (AARI)	PO Box 35661-9, Menemen, Izmir, Turkey	hakanhakimhan@hotmail.com
Turkey	Ömer ÖZTÜRK	Directorate of Plant Protection Institute	Bornova-İzmir Genclik Cad. No:6, 35040 Bornova-Izmir-Turkey	-

Annex 2. List of North American stem rust differential cultivars, pedigree and seed source information used in stem rust race analysis 2018 at RCRR, Izmir, Turkey

Ent	Gene	Name	Origin/Pedigree	Source
1	<i>Sr5</i>	ISr5-Ra CI 14159	Thatcher/Chinese Spring	Jin, USDA
2	<i>Sr21</i>	<i>T monococcum</i> /8*LMPG-6 DK13	Einkorn CI 2433	Fetch, AAFC
3	<i>Sr9e</i>	Vernstein PI 442914	Little Club //3* Gabo/2* Charter /3/3* Steinwedel / CI 7778	Jin, USDA
4	<i>Sr7b</i>	ISr7b-Ra CI 14165	Hope/Chinese Spring	Jin, USDA
5	<i>Sr11</i>	Lee/6*LMPG-6 DK37	Lee (CI 12488)	Knott 1990
6	<i>Sr6</i>	ISr6-Ra CI 14163	Red Egyptian/Chinese Spring	Jin, USDA
7	<i>Sr8a</i>	CI 14167/9*LMPG-6 DK04	Red Egyptians/CS (CI 14167)	Knott 1990
8	<i>Sr9g</i>	Chinese Spring*7/Marquis 2B	Selection from Kubanka (CI 1516)	Fateh, AAFC
9	<i>Sr36</i>	W2691SrTt-1 CI 17385	CI 12632 T. timopheevii	Jin, USDA
10	<i>Sr9b</i>	Prelude*4/2/Marquis*6/Kenya 117A	Kenya 117A	Fetch, AAFC
11	<i>Sr30</i>	Selection from Webster F3:F4 #6	Webster CI 3780	Fetch, AAFC
12	<i>Sr17</i>	Prelude/*8Marquis*2/2/Esp 518/9	Esp 518/9	Fetch, AAFC
13	<i>Sr9a</i>	ISr9a-Ra CI 14169	Red Egyptian/Chinese Spring	Jin, USDA
14	<i>Sr9d</i>	ISr9d-Ra CI 14177	Hope/Chinese Spring	Jin, USDA
15	<i>Sr10</i>	W2691Sr10 CI 17388	Marquis*4/Egypt NA95/2/2*W2691	Jin, USDA
16	<i>SrTmp</i>	CsSSrTmp	08 Aberdeen Inc. Source : 06 AB JY	Jin, USDA
17	<i>Sr24</i>	LeSr24Ag	Little club/Agent (CI 13523)	Jin, USDA
18	<i>Sr31</i>	Sr31 (Benno)/6*LMPG-6 DK42	Benno (Sr31)	Knott 1990
19	<i>Sr38</i>	VPM 1	Yr Diff INRA France	Claude, INRA-
20	-	McNair 701	VA 2001 Increase	Jin, USDA