Prevalent races of wheat rust pathogens in Lebanon, Morocco, and Tunisia in 2024

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Introduction

Tracking rust pathogen variability and identifying rust races is especially challenging in resource-limited countries, where the frequent emergence of new wheat rust races with greater virulence complicates breeding efforts for rust resistance and genetic control. This initiative emphasized in-country rust surveillance, sample collection, and race analysis at the Turkiye-ICARDA Regional Cereal Rust Research Center in Izmir, Türkiye. The resulting race analysis data assists breeding programs, decision-makers, and farmers in developing resistant cultivars and planning effective rust control strategies.

Summary

During the 2024 rust surveys, wheat rust samples were gathered from farmer fields and research stations in CWANA including Lebanon, Morocco, and Tunisia using the RCRRC sampling kit. The Turkiye-ICARDA Regional Cereal Rust Research Center in Izmir received a total of 595 samples, with 88 from these three countries: 21 from Lebanon, 49 from Morocco, and 18 leaf rust samples from Tunisia. Severe drought prevented yellow rust observations in Morocco and Tunisia, but Lebanon's yellow rust samples were classified as PstS2+virYr27 and PstS17. Additionally, three stem rust races were identified: TKKTF in Lebanon, and TKTTF and TTTTF in Morocco. We were not able to retrieve the rust samples from Tunisia because of poor sampling and preservation conditions. There was more than 4 months before sampling and receiving samples to RCRRC. Leaf rust samples are currently undergoing race analysis following several purification steps.

Materials and Methods

Viable yellow and stem rust samples were tested for races of Pst and Pgt at the Regional Cereal Rust Research Center (RCRRC) in Izmir, Türkiye, under strict quarantine procedures. Two 0.5-cm segments of each infected stem sheet were incubated in a Petri dish at 20°C Pgt for 3 h for rehydration of urediniospores. Fresh urediniospores were multiplied on 10-day-old seedlings of susceptible cultivar Morocco and McNair grown in a spore-free growth chamber at 18°C and 16-h light. Inoculated seedlings were placed at 18°C for 16-h dark and 8-h fluorescent light and 95% relative humidity. Three days after moving the pots to growth chambers with 16-h light (220 µmol/ m2 s), each pot was covered using a cellophane bag. Bulk urediniospores of each collection were collected 14 days post- inoculation from a cellophane bag using a mini cyclone spore collector connected to a gelatin capsule.

After spore multiplication of Pgt samples, the single pustule isolates were inoculated on the 20 North American differential lines. Before the inoculation of stem rust samples, the samples from the deep freezer were laced in a water bath for 10 minutes at 42°C for heat shock. One milliliter of 3M Novec oil was added to each capsule, and Pgt spores were inoculated onto 20 North American stem rust differential lines using the standard procedures (Jin et al. 2008). Pre-inoculation, inoculation, incubation, and post-inoculation conditions were the same as above. Seedling infection types (ITs) were recorded 14 days post-inoculation using a 0 to 4 scale (Stakman et al. 1962). Race designation followed the five-letter code nomenclature described by Jin et al. (2008). To confirm virulence/avirulence on *Sr24*, *Sr31*, and *Sr36*, cultivars Siouxland (PI 483469, *Sr24 + Sr31*) and Sisson (PI 617053, *Sr36 + Sr31*) were also inoculated.

The procedure for inoculation, incubation, and post-inoculation conditions was adjusted slightly for yellow rust, with temperatures of 10°C and 16°C used during incubation and post-incubation phases, respectively. A 0 to 9 scale was applied to record seedling infection types in the yellow rust differential set.

Results

Wheat rust samples were collected during the 2024 CWANA's rust surveys conducted across farmer fields and research stations, including Lebanon, Morocco, and Tunisia, using the RCRRC sampling kit. The Turkiye-ICARDA Regional Cereal Rust Research Center in Izmir received a total of 595 samples from CWANA, with 88 samples collected from Lebanon, Morocco, and Tunisia (Table 1). These included 21 samples from Lebanon (12 yellow rust, 4 stem rust, and 5 leaf rust), 49 samples from Morocco (47 stem rust and 2 leaf rust), and 18 leaf rust samples from Tunisia. In 2024, yellow rust was not observed in Morocco and Tunisia due to severe drought conditions.

The recovered yellow rust samples from Lebanon were identified as PstS2+*virYr27*. The stem rust race analysis included 18 representative isolates, three from Lebanon and 15 samples from Morocco. The three isolates from Lebanon were typed as TKKTF race. Of the stem rust isolates from Morocco, 14 were classified as the TKTTF race, and one as TTTTF. Recovered leaf rust samples have undergone multiple purification steps, and race typing is currently in progress. The TKKTF race showed avirulence for *Sr11*, *Sr36, Sr24*, and *Sr31*, while the TKTTF race exhibited avirulence for the same genes, with additional avirulence for *Sr36*. The TTTTF race was avirulent only on *Sr24* and *Sr31* among the 20 stem rust resistance genes included in the North American stem rust differential lines (Table 2). For yellow and stem rust samples that were not recovered, DNA extraction is being performed to enable genetic grouping through the MARPLE diagnostics system.

Table 1. The CWANA 2024 rust sampling and sample recovery

Disease	COUNTRY	Race typed	Recovered	Unrecovered	Grand Total
Leaf rust	GEORGIA			12	12
	KENYA			3	3
	LEBANON			**5**	**5**
	MOROCCO		**2**		**2**
	TUNISIA		**11**	**7**	**18**
	TURKIYE	29	19	27	75
	TURKMENISTAN		7	6	13
	UZBEKISTAN		2	2	4
Stem rust	GEORGIA		2	39	41
	KENYA	4		6	10
	LEBANON	**3**		**1**	**4**
	MOROCCO	**15**		**32**	**47**
	TURKIYE	18	9	2	29
Yellow rust	AZERBAIJAN			10	10
	GEORGIA			15	15
	IRAQ	5		14	19
	KENYA			10	10
	LEBANON	**7**	**1**	**4**	**12**
	TURKIYE	26	74	110	210
	TURKMENISTAN		5	14	19
	UZBEKISTAN		1	36	37
Grand Total		**107**	**133**	**355**	**595**

Table 2. Avirulence and virulence formula of stem rust races identified in 2024 from Lebanon and Morocco

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**

References

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