First report of the new yellow rust (*Puccinia striiformis* f.sp. *tritici*) races and expansion of virulent races of stem rust (*Puccinia graminis* f. sp. *tritici*) in irrigated wheat production areas of Ethiopia (during 2020/21 and 2021/22 cropping seasons).

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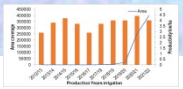


1. Introduction

In Ethiopia, wheat is cultivated on nearly 1.7 million hectares and accounts for 13.49% of the crop land, with an annual production of 4.5 million metric tons both in rain fed and irrigated ecologies (CSA, 2019). The irrigated environment has better productivity than the rain fed.

Stem (***Puccinia graminis* f.sp. *tritici***) and yellow (***Puccinia striiformis* f.sp. *tritici***) rust pathogens are the two major biotic stresses in wheat in Ethiopia.

The objective of this study was to determine the virulence composition and race diversity of Pgt and Pst pathogens in irrigated agro ecologies of Ethiopia in 2020/21 and 2021/22.

2. Material and Methods

Samples collection: ~51 and 66 wheat stem rust samples were collected from irrigated wheat producing areas of Ethiopia in 2020/21 to 2021/22 growing seasons respectively with Stackman et al., (1962) procedures.

3. Results and Discussion

3.1. Pgt Pathogen Race Variability

In 2020/21, out of 11 viable Isolates 0, 4, 0, 2, 1, 3, 1 were typed to be TTKTTT, TTKTF, TKKTF, TTRTF, TTTTF, TKTTF and TKPTF isolates, respectively

In 2021/22 Out of 44 viable Isolates 21, 13, 3, 0, 4, 1, 0 were typed to be TTKTTT, TTKTF, TKKTF, TTRTF, TTTTF, TKTTF and TKPTF isolates, respectively

TTKTT was the most dominant races being identified from 18 (49%) samples and followed by TTKTF which was identified from 17 (38.6) samples.

On the other hand, TTTTF, TKKTF and TKKTF appeared at low frequency being identified from 4 (9.1%), 3 (6.8%), and 2 (4.5%).

The new race TTKTT has been detected in Arsi, Silte, Kembata, Guji, Bale, East Shoa, Wolayita and East Harerge zones.

3.2. Pst Pathogen Race Variability

In 2020/21, the Pst race found were only two they are not viable.

In 2021/22 2 new races of yellow rust have been detected in the irrigated areas.

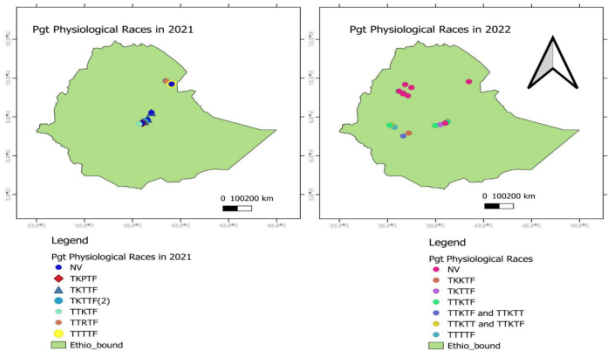
A total of 68 samples collected from research plots and farmers' fields were shipped to the global rust reference center in Aarhus Denmark.

Two major races were identified. These are the PstS11 in 34 fields and PstS16 in 35 fields which are the major races found in Ethiopia.

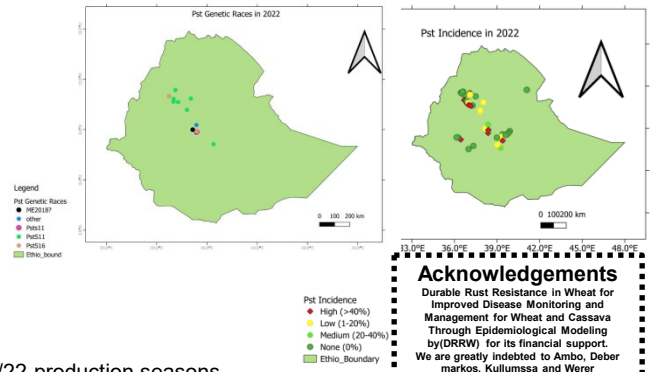
Two new races have just been detected in irrigated areas (ME2018 and an unknown).

- Current likely impact is unknown, but they will need careful monitoring. ME2018 may possibly affect durum wheat more.

Spatial and temporal Pgt race distribution in 2020/21 and 2021/22 irrigated wheat production seasons



Spatial Pst race distribution and intensity in 2021/22 irrigated wheat production seasons



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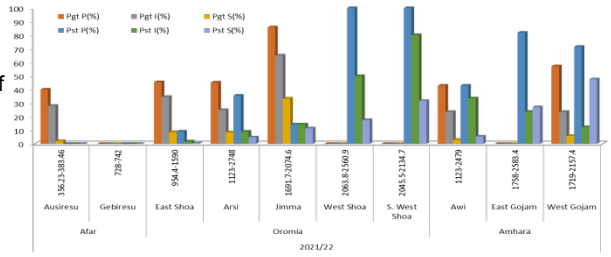
Pgt race composition for 2020/21 and 2021/22 production seasons

Year	Collected Sample	Viability (%)	TTKTT	TTKTF	TKKTF	TTRTF	TTTTF	TKTTF	TKPTF
2020/21	51	21.6	0	36.4	0	18.2	9.1	27.3	9.1
2021/22	66	66.6	49	38.8	6.8	0	9.1	4.5	0

3.3. Pathogen Virulence

- Most virulent at the same time dominant race in 2021/22 or current study were TTKTT (95%) and only Sr 36 was non compatible to TTKTT.
- The second dominant race was TTKTF with 36.4 and 38.8% of frequency respectively for 2020/21 and 2021/22 production years.
- TTTTF(90%) as virulent to 19 and 18 differential gene respectively and only Sr 24 and Sr 31 were non compatible to this race.
- TKKTF TTRTF and TKTTF were also known for their wider virulence frequency found in the irrigated wheat production ecologies of Ethiopia respectively.

Disease intensity for Pgt and Pst



4. Conclusion

- In 2020/21 and 2021/22 production years the stem rust isolates were analyzed and typed to five races Viz TTKTT, TTKTF, TKKTF, TTRTF, TTTTF, TKTTF, and TKPTF
- stem rust resistance genes, Sr24 and Sr31 were effective to four races except to TTKTT.
- The races are variable both spatially and temporally
- Resistance gene, Sr24 was indanger due to outbreak of TTKTT, 20 of Sr resistance gene available in country were being susceptible.
- Therefore searching for effective resistance genes like cutting age advancements in science i.e hardy wild grass relative resistance wheat genes then introducing to Ethiopian wheat cultivar is crucial to sustain wheat production

Locations and varieties from which the races were identified from irrigated areas in 2022

Race	Location/Zone	Varieties
TKKTF	West Arsi, East shoa, Jimma	Amibara, Kakaba, Unknown
TKTTF	West Arsi, East shoa,	Fentale 2, Ogolcho,
TTTTF	West Arsi, Buno Bedele	Limmu, Unknown
TTKTF	West Arsi, East Shoa, Buno Bedele, Jimma, Awi	Amibara, Kakaba, Ogolcho, Kingbird, Wane, Danda'a,
TTKTT	Jimma, Buno Bedelle	Kakaba, Danda'a, Oborra