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FIELD ASSESSMENT OF COMMERCIAL WHEAT VARIETIES, ADVANCED LINES AND TRAP NURSERIES AGAINST YELLOW RUST IN SOUTH EAST ETHIOPIA

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ABSTRACT
Wheat rusts caused by Puccinia spp. is economically significant foliar syndrome in the main wheat-growing areas of Ethiopia. Safeguard of wheat from rust diseases has very exceptional worth to be profitable and reduce hunger. Screening of wheat genotypes against rust and monitoring of race development and monitoring of variability in wheat rust pathogens by international trap nurseries is vital to mitigate rust impact. In this experiment, resistance to wheat yellow rusts of 119 wheat germplasm comprising varieties, advanced lines along with 19 international yellow rust trap rust nurseries were studied under natural infection in 2018-2019 years in different geographic zones of Ethiopia. The information of this finding revealed that majority of the test cultivars displayed susceptible reaction to the prevalent yellow rust races. However, few cultivars and candidate lines exhibited lower diseases severities. Among the differentials, Yr5+, Yr10 and Yr15 are still effective to the prevalent yellow rust races. Thus, those candidate wheat genotypes tested in this experiment and showed lower diseases severities will contribute a significant role to wheat breeding program in diversification and development of cultivars with durable or long lasting resistance.

KEY WORDS
Bread, durum, genotype, septoria tritici blotch, wheat.

Wheat is one of the world’s most important staple grains and is the leading source of calories and plant-derived protein in human food (Curtis et al., 2002), with an annual global production of 772.6 million tons(Statista, 2021). A latest valuation of wheat production by the Food and Agricultural Organization of the United Nations shows that current wheat quantity is ample for global demand (http://www.fao. org/world food situation/csdb/en/). Nevertheless, future production must increase as the global population is growing fast, projected to exceed nine billion people by 2050(Edmeades *et al*., 2010).

In Ethiopia, the annual wheat production is around 5.8 million tons with mean productivity of 3 tons per hectare (tha^{-1}) (CSA 2021), which is quite lower than the realizable harvest of the yield, attainment up to 5 tha−1 (Zegeye *et al*. 2020). Wheat accounts for about 17% of total grain production in Ethiopia making it the third principal cereal crop after teff (Eragrostis tef (Zucc.) Trotter] and maize (Zea mays L.) (CSA 2021). In general, the agricultural, production growth shows oscillating trends compared to population growth (Wuletaw Mekuria, 2018).

Thus, there should be a serious necessity to produce highly productive crops like wheat to feed the world population soon (Weigand, 2011). Despite, the rapid increment of wheat in area coverage and grain yield, about 15-20% yield losses per annum are recorded due to fungal diseases of which rusts come first (Melania *et al*. 2018).

Wheat rust pathogens are the key constraints of global wheat production since the domestication of the crop and continue to threaten the world's wheat supply (Roelfs et al., 1992). It is expected that universal yearly losses to wheat rust pathogens array between US$ 4.3 to 5.0 billion (P. Pardey, University of Minnesota, unpublished); even escalate up to 5.5 million tons per year at worldwide level due to yellow rust alone(Beddow *et al*. 2015). While in Ethiopia, the recurrent rust outbreaks lead to substantial economic losses, which are estimated to be of the order of 10s of millions of US-D annually (Meyer *et al*. 2021).

During the past decades the epidemic of wheat rust and associated losses was more sever causing global concern to wheat production. To tackle the issue, breeding of new varieties and their implementation is economically and ecologically reasonable method for control rust diseases. However, the continuous evolution of new pathotypes which is exacerbated by climatic stress, especially in rainfed areas and airborne nature pose a serious threat to wheat production worldwide.

Trap nursery consists of isolines with confrontation genes, genetic stocks for additional Yr, Sr and Lr genes, selected differentials, wheat diversities resonant blends of key resistance genes, and main commercial varieties presently cultivated in diverse regions. Rusts trap nurseries are targeted for wheat growing areas and are planted at sites anywhere rusts is identified to occur naturally every year with the objective to collect information on virulence and race formation of rusts, behavior of resistant and susceptible varieties, tested under different environmental conditions. Thus, the nurseries are very imperative for Ethiopia, where all three rusts are accessible essentially everywhere where cereals are grown.

MATERIALS AND METHODS OF RESEARCH

The experiment was executed at three yellow rust hotspot locations viz; Meraro and Bekoji (research stations) and Kulumsa (main research center) of Arsi Zone South eastern Ethiopia. Meraro substation is situated at 07° 24' 27''N, 39° 14'56''E and 2990 m.a.s.l. Its regular annual rainfall is 1196 mm signifying extreme highland and frost prone agro ecology. The lowest and supreme hotness is 5.7 and 18.1°C, respectively. Bekoji location is found at latitude 07^0 32' 37'' N and longitude 39^0 15' 21'' E with an altitude of 2780 meter above sea level. The maximum and minimum temperature was 3.8 and 20.4 ^{0}C respectively with annual rain fall 939 mm. Kulumsa research center is located at 08^0 01'10''N, 39^0 09'11''E and at 2200 meters above sea level (m.a.s.l). The site gets mean yearly rainfall of 820 mm representing highland and high rainfall agro ecology. The regular mean least and supreme hotness is 10.5 and 22.8 °C, respectively. The sites foremost soil type is loam type, which is fertile (Birhan Abdulkadir, 2011).

A set of 119 bread and durum wheat genotypes comprising commercial cultivars, advanced breeding lines and differentials lines obtained from Ethiopian national bread wheat breeding program were studied under natural infection in 2018-2019 years in at three different locations of Ethiopia.

To assess the intensity of slow rusting of wheat genotypes in the field, test materials and checks were arranged in augmented design. The entries were established in plots comprising of paired rows of 1 m long with spacing of 0.2 m intra row, 1 m between blocks and 0.5 m between plots. Plots were seeded in 150 kg ha^{-1} DAP and urea fertilizers were applied based on the recommended rate to the area. Weeds were managed by hand weeding. Disease severity notes were taken by estimating the approximate percentage of leaf area affected using modified Cobb scale (Petrson et al., 1948). Data recording was started from the first appearance of yellow rust on the susceptible check and continued every 14 days from all plants until the early dough stage (Large, 1954). Scorings of disease severity and response were noted together with severity first followed by infection type. The host response is as: TR=trace severity of resistant type infection; 10R-MR=10% severity of resistant to moderately resistant infection type; 20MR=20% severity of a moderately resistance infection type; 30MR-MS=30% severity of a moderately resistance to moderately susceptible; 40MS=40% severity of a moderately susceptible; 50MS-S=50% severity of a moderately susceptible to susceptible; and 70S =70% severity of susceptible infection types. The data acquired from disease severities and host reactions were combined to compute coefficient of infection (ACI) (Ali *et al*. 2007).

RESULTS AND DISCUSSION

Among the three locations, Meraro is characterized as too cold, high altitude and low temperature makes more conducive to occurrences of yellow rust compared with two locations; Bekoji and Kulumsa. In 2019 yellow rust developed more vigorously than 2018 since the crop season was more favorable. 2018 crop season was manifest by arid conditions along all the three locations and yellow rust developed very weakly than in 2019.

In 2018 a total of 115 wheat genotypes were evaluated of which 47.8%, 73.9% and 68.7% of tested entries had lower or, <20 average coefficient of infections were recorded at Meraro, Bekoji and Kulumsa respectively; indicating that maximum diseases pressure was avail at Meraro. The growing year was a little bit arid as compared with 2019; thus many of the tested wheat genotypes have disease severity of 0 to 80S while on universal susceptible check “Morocco” scored 90S(Table 1 and Figure 1).Most of mega and popular bread wheat cultivars which covered majority of wheat growing areas in research area like (Ogolcho, Kubsa, Hidassie, Dandaa’ Kingbird and Digalu) showed susceptible reaction near to similar severity levels to the universally susceptible check and local susceptible check Morocco and PBW343 respectively.

Similarly, wheat varieties like Pavon 76, Mitike, Galema, Abola, Tusie, Katar, Shina, Hawi, Tura, Madawalau, Simba, Sofumar,Tossa, Senkegna, Meraro and Tsehay displayed susceptible reaction with average coffient of infection exceeding 20 at Meraro, Bekoji and Kulumsa in both cropping seasons. On contrary, the formerly most popular variety” Dashen” which carries Yr9 gene exhibited low yellow rust severity. This might be due to the elimination of the race virulent to Yr9 gene.

On the other hand, among the candidate lines viz ETBW5800, ETBW5879, ETBW5890, ETBW6093, ETBW6094, ETBW6098, ETBW6647, ETBW6496, ETBW6696, ETBW7698, ETBW6939 and ETBW7255 only ETBW5879, ETBW5890, ETBW6696 and ETBW7698 showed ACI below 20 across all the three locations. However, in 2019 none of them displayed lower ACI especially at hotspots; Meraro and Bekoji.

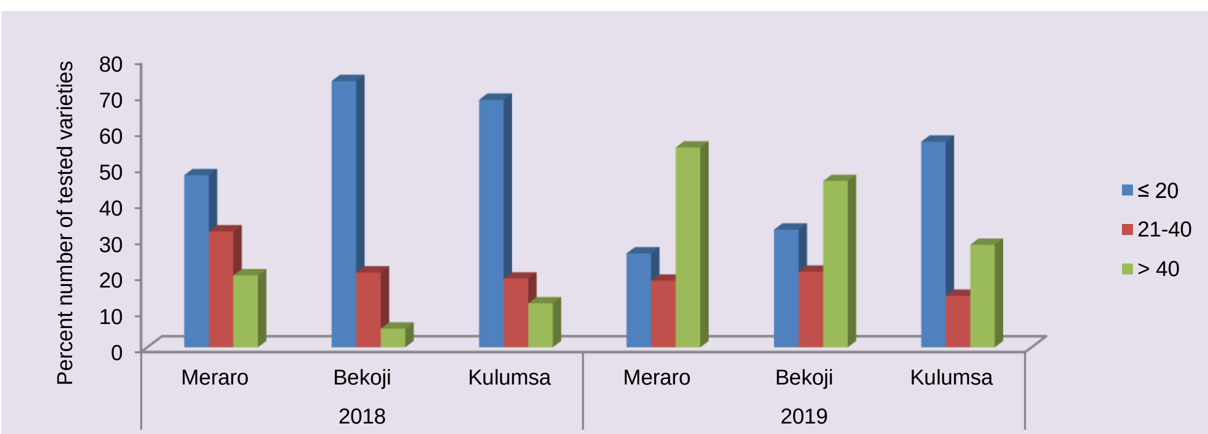

Figure 1 – Response of commercial and candidate wheat genotypes to yellow rust at Meraro, Bekoji and Kulumsa in 2018 and 2019 cropping seasons

Data on trap nurseries over two years indicated that several known resistance genes Yr6, Yr7, Yr8, and Yr18 have limited utility as host lines carrying them displayed susceptibility in both years. The varieties Kubsa(Yr27+), Medawlabu, Hoggana, Millinium and Meraro that carried Yr17 shown disease severities from trace MS under relatively hot weather(Kulumsa) to 80S at highland hot spot(Meraro and Bekoji) conditions. Broadly speaking, cultivars and candidate lines that are not consisting Yr5+,Yr10 and Yr15 showed highly susceptible reaction where epidemics is more sever on highlands. The assessments information revealed that, genes Yr5, Yr6, Yr7, Yr9, Yr17, Yr18, Yr26 and Yr27 were heavily injured over time and space. Moreover, even if the degree of virulence varies, majority of the genes under diffentials broken by the prevalent yellow rust races at all locations.

Table 1 – The response of wheat genotypes for yellow rust at three locations Meraro, Bekoji and Kulumsa in 2018 and 2019

	n/n	2018						2019					
		Meraro		Bekoji		Kulumsa		Meraro		Bekoji		Kulumsa	
		TRS	CI	TRS	CI	TRS	CI	TRS	CI	TRS	CI	TRS	CI
1	Laketch	60S	60	60S	60	80S	80	90S	90	80S	80	80S	80
2	Kenya Nyangumi	10MS	8	10MS	8	5MR	2	30MS	24	30S	30	TMR	0.8
3	Kenya Leopard	10MR	4	5MR	2	5MR	2	20MS	16	50S	50	10MR	4
4	Africa Mayo	30MS	24	5MR	2	TR	0.4	15MR	6	10S	10	5MR	2
5	Trophy	20MS	16	10MS	8	10MS	8	40MS	32	70S	70	10MR	4
6	Bounty	-	-	-	-	-	-	40S	40	50S	50	10MS	8
7	Bonny	10MR	4	5MR	2	0	0	20MS	16	40S	40	TMR	0.8
8	Frontach	30MS	24	20MS	16	30MS	24	60S	60	50S	50	40S	40
9	Kenya Kudu	40MSS	36	20S	20	40S	40	60S	60	60S	60	50S	50
10	Enkoy	10MR	4	TMR	0.8	TMS	1.6	70S	70	70S	70	60S	60
11	K6290 Bulk	40S	40	40S	40	20MS	16	70S	70	80S	80	70S	70
12	K6295-4A	40S	40	40S	40	50S	50	80S	80	60S	60	60S	60
13	ET13A2	40S	40	20S	20	40S	40	70S	70	60S	60	50S	50
14	Pavon 76	40S	40	30S	30	40S	40	30S	30	40S	40	30S	30
15	Dashen	5MR	2	0	0	15S	15	15MR	6	10MS	8	TMS	1.6
16	Mitike	70S	70	20S	20	40S	40	70S	70	60S	60	50S	50
17	Galema	30S	30	5MR	2	10MR	4	40S	40	40S	40	30MS/S	24
18	Kubsa	60S	60	50S	50	60S	60	80S	80	80S	80	80S	80
19	Abola	50S	50	30S	30	50S	50	80S	80	80S	80	80S	80
20	ETBW6809	5MR	2	0	0	TMR	0.8	20MR	8	10MS	8	TMR	0.8
21	Tusie	40S	40	30S	30	10MR	4	20MS	16	20S	20	15MS	12
22	Katar	60S	60	10MR	4	60S	60	40S	40	70S	70	50S	50
23	Shina	20MS	16	30S	30	20MR	16	TMR	0.8	5MSMR	4.5	TMS	1.6
24	Tura	20MS	16	5MR	2	10MR	4	30MSS	27	60S	60	40S	40
25	Hawi	40S	40	10MR	4	30S	30	80S	80	80S	80	70S	70
26	Madda Walabu	30S	30	20MS	16	30MS	30	80S	80	80S	80	80S	80
27	Simba	20S	20	10MR	4	40S	40	10MR	4	TMS	1.6	5MR	2
28	Sofumar	80S	80	60S	60	70S	70	90S	90	80S	80	80S	80
29	Wetera	40S	40	40S	40	5MR	2	TMS	1.6	10MS	8	0	0
30	Dodota	40S	40	20MS	16	5MS	4	90S	90	0	8	30S	30
31	Dure	0	0	0	0	0	0	0	0	0	8	TMR	0.8
32	KBG-01	80S	80	30S	30	30MS	24	90S	90	85S	85	60S	60
33	Sirbo	30S	30	40S	40	20S	20	20MS	16	20S	20	30SMS	27
34	Bobicho	50S	50	30S	30	50S	50	40S	40	50S	50	60S	60
35	Tossa	50S	50	30S	30	20MS	16	90S	90	80S	80	60S	60
36	Meraro	30S	30	5MR	2	10MR	4	40S	40	40S	40	10MS	8
37	Senkegna	10MSS	9	10MR	4	0	0	10MR	4	10MR	4	0	0
38	Tay	10MR	4	0	0	0	0	TMR	0.8	TS	0.2	0	0
39	Sulla	80S	80	50S	50	60S	60	80S	80	80S	80	80S	80
40	Alidoro	30MSS	27	5MR	2	10MSMR	6	40MSS	36	40S	40	20SMS	18
41	Millennium	10MSS	9	0	0	10S	10	80S	80	TMS	1.6	TMR	0.8
42	Dinknesh	5MR	2	0	0	TS	2	10MR	4	0	0	0	0
43	Menze	60S	60	30S	30	50S	50	80S	80	60S	60	60S	60
44	Kulkulu	80S	80	30S	30	50S	50	90S	90	70S	70	80S	80
45	Bolo	50S	50	10MR	4	50S	50	90S	90	60S	60	60S	60
46	Danda'a	20MS	20	5MR	2	20MS	16	60S	60	60S	60	20MS	16
47	Kakaba	40S	40	20MS	16	10MR	4	70S	70	60S	60	40S	40
48	Hoggana	40S	40	20MS	16	40S	40	50S	50	60S	60	10MR	4
49	Shorima	30MSS	27	0	0	5MSMR	3	60S	60	40S	40	10MR	4
50	Huluka	30MSS	27	10MR	4	20MS	16	70S	70	40S	40	10MR	4
51	Gambo	30MSS	27	TR	0.4	20MS	16	60S	60	50S	50	30S	30
52	Galil	10MS	8	0	0	20MS	16	50S	50	50S	50	50S	50
53	Jafersson	20MSS	18	10MS	8	10S	10	60S	60	40S	40	30S	30
54	Tsehay	5MR	2	TMR	0.8	5MR	2	60S	60	20MR	8	TMR	0.8
55	Arendeto	10MS	8	10MR	4	0	0	TMR	0.8	TMS	1.6	15MR	6
56	Hitossa	2MR	0.8	0	0	0	0	TMR	0.8	0	0	TMS	1.6
57	Werer	5MR	2	0	0	TMR	0.4	TMR	0.8	TMS	1.6	5MS	4
58	Denbi	0	0	0	0	TS	2	TMR	0.8	TMS	1.6	TMR	0.8
59	Selam	30MSS	27	10MR	4	5MR	2	60S	60	40S	40	10MS	8
60	Megenagna	10MR	4	10MR	4	5MR	2	40S	40	20MS	16	10MR	4
61	Mettaya	0	0	TR	0.4	0	0	TMR	0.8	TMR	0.8	TMR	0.8
62	Ejersaa	2MR	0.8	5MR	2	TMS	1.6	TMR	0.8	TMR	0.8	0	0
63	Flakit	0	0	TMR	0.4	5MR	2	40S	40	TS	2	60S	60
64	Malefia	50S	50	50S	50	30S	30	20MR	16	20MS	16	80S	80
65	Mossobo	30MSS	27	10MR	4	5MSMR	3	40S	40	20S	20	60S	60

66	Toltu	2R	0.4	0	0	TMR	0.8	20MR	16	0	0	20MS	16
67	Obssa	0	0	0	0	TMR	0.8	20MR	16	0	0	40S	40
68	Lellisso	30MSS	27	TMR	0.4	5MS	4	50S	50	60S	60	10MR	4
69	Tate	2R	0.4	TMR	0.4	5S	5	40S	40	0	0	10MR	4
70	Bakalcha	20MS	16	TMR	0.4	5MR	2	50S	50	10MS	8	10MR	4
71	Oda	20MS	16	5MR	2	10MR	4	40S	40	10MS	8	30S	30
72	Kokate	10MR	4	10MR	4	5MR	2	60S	60	50S	50	50S	50
73	Local Red	50S	50	TMR	0.4	20S	20	40S	40	10MS	8	TMR	0.8
74	HAR 727	2R	0.4	TMR	0.4	0	0	0	0	TMS	1.6	15MR	6
75	HAR 723	40MSS	36	40S	40	40S	40	60S	60	80S	80	TMS	1.6
76	HAR 934	2R	0.4	0	0	5S	5	10MR	4	TMS	1.6	5MS	4
77	HAR 1018	10MR	4	0	0	TMS	1.6	20MR	8	5MS	4	TMR	1.6
78	HAR 820	10MR	4	10MR	4	0	0	30MSS	27	30S	30	10MS	8
79	HAR 1407	5MR	2	0	0	TMR	0.8	20MR	8	10MS	8	10MR	4
80	HAR 1331	10MR	4	20MS	16	5MR	2	40S	40	60S	60	10MR	4
81	HAR 719	30MS	24	30S	30	20MR	16	90S	90	70S	70	25S	25
82	Hidassie	20MS	16	20MS	16	5S	5	60S	60	40S	40	20MR	8
83	Ogolcho	30MS	24	10MR	4	5MR	2	70S	70	40S	40	10MR	4
84	ETBW5800	30MS	24	5MR	2	TMS	1.6	50S	50	30S	30	TMR	1.6
85	ETBW5879	10MR	4	TMS	1.6	5MR	2	70S	70	40S	40	10MR	4
86	ETBW5890	5MR	2	0	0	0	0	60S	60	40S	40	TMR	1.6
87	ETBW6093	50S	50	30S	30	40S	40	90S	90	70S	70	40S	40
88	ETBW6094	60S	60	20S	20	50S	50	90S	90	70S	70	50S	50
89	ETBW6098	80S	80	40S	40	40S	40	90S	90	70S	70	60S	60
90	Kingbird	30MS	24	30S	30	15MSMR	9	70S	70	60S	60	20S	20
91	Mandoyu	2R	0.4	TMR	0.8	5MS	4	30MSS	27	40S	40	5MR	0.8
92	Sanate	2R	0.4	0	0	TMS	1.6	TMS	1.6	0	0	TMR	0.8
93	Gassay	10MR	4	0	0	0	0	20MS	16	40S	40	10MR	4
94	ETBW6647*	60S	60	20S	20	40S	40	90S	90	70S	70	40S	40
95	ETBW6496*	20MR	8	0	0	5MS	4	90S	90	70S	70	50S	50
96	ETBW6696*	10MR	4	0	0	5S	5	30MSS	27	40S	40	5MR	2
97	ETBW7698*	10MR	4	0	0	0	0	20MR	8	30S	30	TMR	1.6
98	ETBW6939*	40MSS	36	5MR	2	5S	5	80S	80	60S	60	50S	50
99	ETBW7255*	50S	50	10MR	4	40S	40	70S	70	70S	70	40S	40
100	ETBW6861* Lemu	10MR	4	TMS	1.6	10MS	8	60S	60	50S	50	10MR	4
101	ICARDA ELITE 107	20MSMR	12	TMR	0.8	5S	5	70S	70	50S	50	10MR	4
102	AGUILAL/3/PYN	40MSS	36	TMR	0.4	5MS	4	60S	60	50S	50	10MR	4
103	Israel	25MS	20	40S	40	30MS	24	90S	90	80S	80	40S	40
104	Bonde	40MSS	36	30S	30	50S	50	90S	90	80S	80	50S	50
105	Kvz/7c	40MSS	36	40S	40	40S	40	90S	90	70S	70	60S	60
106	FH4-2-11	0	0	10S	10	5MR	2	TMR	0.8	5MS	4	10S	10
107	Cocorit 71	30MSS	27	TR	0.8	20MS	16	60S	60	50S	50	10MR	4
108	Gerado	50S	50	10MS	8	10S	10	70S	70	50S	50	5MR	2
109	LD 357	30MSS	27	40S	40	30S	30	90S	90	60S	60	10MR	4
110	Bichena	10MR	4	5MR	2	5MR	2	80S	80	50S	50	10MR	4
111	ETBW6130 WANE	10MR	4	0	0	TMR	0.8	40S	40	30S	30	TR	0.4
112	ETBW6861 LEMU	5MR	2	TR	0.4	10MS	8	70S	70	40S	40	20MR	8
113	Munal	40S	40	30S	30	40S	40	90S	90	80S	80	50S	50
114	Dereselign	60S	60	30S	30	30S	30	90S	90	80S	80	70S	70
115	Batu	30MS	24	20S	20	30S	30	30MSS	27	40S	40	30S	30
116	Digalu							90S	90	30S	30	60S	60
117	Kingbird							70S	70	40S	40	20MR	8
118	Wane							50S	50	10S	10	10MS	8
119	Daka							50S	50	20MS	16	15MS	12
120	Morocco	60S	60	90S	90	90S	90	90S	90	70S	70	90S	90
121	PBW343	50S	50	50S	50	50S	50	70S	70	40S	40	50S	50

			2018						2019					
			Meraro		Bekoji		Kulumsa		Meraro		Bekoji		Kulumsa	
Number	Variety/line	YR gene	TRS	CI	TRS	CI	TRS	CI	TRS	CI	TRS	CI	TRS	CI
1	YR1/6* Avocet S	YR1	20S	20	20S	20	5MR	3	30s	30	30s	30	20s	20
2	YR5/6* AOC CX86.6.1.20	YR5	50S	50	40S	40	40S	40	70s	70	80s	80	80S	80
3	YR6/6* AOC CX94.2.2.25	YR6	60S	60	60S	60	90S	90	90s	90	100S	100	80S	80
4	YR7/6* Avocet S	YR7		0	0	0	0	0	90s	90	100S	100	70S	70
5	YR8/6* Avocet S	YR8	40S	40	60S	60	60S	60	30s	30	30S	30	10S	10
6	YR9/6* Avocet S	YR9	50S	50	50S	50	60S	60	90s	90	100S	100	50S	50
7	YR10/6* Avocet S	YR10	0	0	0	0	0	0	0	0	0	0	0	0
8	YR15/6* Avocet S	YR15	0	0	0	0	0	0	0	0	0	0	0	0
9	YR17/3* AOC CX94.8.1.25	YR17	60S	60	60S	60	60S	60	90s	90	100S	100	80S	80
10	YR18/3* AOC CX94.10.1.7	YR18	60S	60	60S	60	90S	90	90s	90	100S	100	70S	70
11	YR26/3* AOC CX96.17.1.	YR26	40S	40	40S	40	10MS	8	80s	80	80S	80	60S	60
12	YRSP/6* AOC CX94.14.1.1	YRSP	40S	40	50S	50	30S	30	90s	90	70S	70	10MR	6
13	YR27/3* AOC CX94.19.1.1	YR27	50S	50	50S	50	20S	20	90s	90	100S	100	70S	70
14	AVOCET R	R	60S	60	60S	60	80S	80	60s	60	80S	80	60S	60
15	AVOCET S	S	10S	10	TR	0.2	0	0	0	0	30S	30	0	0
16	Lassik(-Yr5)	Lassik(-Yr5)	30S	30	TMR	0.4	0	0	60s	60	40S	40	10MR	6
17	Lassik(+Yr5)	Lassik(+Yr5)	TR	0	0	0	0	0	0	0	0	0	0	0
18	Yr morocco	Yr morocco	90S	90	90S	90	100S	100	100s	100	NA	100	90S	90
19	Morocco	Morocco	90S	90	80S	80	80S	80	100s	100	NA	100	90S	90
20	Kubsa/ local check	Kubsa	80S	80	60S	60	50S	50	90s	90	100S	100	80S	80

The two most popular cultivars Kubsa which carried Yr27 but affected by yellow rust race PStS6 and Ogolcho affected by a race PStS16 remained ineffective even under warm weather conditions. Over all, wheat yellow rust resistant genes of Yr5+, Yr10 and Yr15 are still persisted effective and could have a significant contribution in the development of new wheat varieties under breeding program in Ethiopia.

CONCLUSION

The information of this finding revealed that majority of the test cultivars displayed susceptible reaction to the prevalent yellow rust races. However, few cultivars and candidate lines exhibited lower diseases severities. Among the differentials, Yr5+, Yr10 and Yr15 are still effective to the prevalent yellow rust races. Thus, those candidate wheat genotypes tested in this experiment and showed lower diseases severities will contribute a significant role to wheat breeding program in diversification and development of cultivars with durable or long lasting resistance.

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CONFLICTS OF INTERESTS

The authors declare no conflict of interests. The funders had no role in the study design; data collection analysis or interpretation; in writing of the manuscript, or in the decision to publish the results.

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