Efficiency of yellow rust resistance genes *Yr's* in improving two susceptible Egyptian bread wheat cultivars Sids 12 and Gemmeiza 11

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Introduction

Wheat (*Triticum aestivum* L.) is the most widely grown and consumed cereal food crop over all the world as well as Egypt. Stripe or yellow rust, caused by *Puccinia striiformis* f. sp. *tritici*, is an important wheat disease and causes considerable yield losses in wheat growing areas worldwide (Shahin *et al.,* 2020). Most of the widely cultivated wheat cultivars in Egypt possess low levels of adult plant resistance (APR) to stripe rust, due to the sudden occurrence of new aggressive races of wheat stripe rust pathogen in Egypt (Shahin 2002).

Releasing new high yielding and stress resistant wheat cultivars is the main goal of the national breeding program. Biotic and abiotic stresses are becoming more and more challenges to wheat production in current circumstances due to narrow genetic base and climate changes.

The objective of this study was to examine the efficiency of incorporating the four stripe rust resistance genes *Yr5*, *Yr10*, *Yr15* and *YrSp* in improving resistance of the two susceptible bread wheat cultivars Sids12 and Gemmeiza11.

Materials and Methods

A filed and greenhouse study was conducted at Sakha Agricultural Research Station during 2015-2020 wheat seasons to enhance stripe rust resistance of the two Egyptian bread wheat cultivars Sids12 and Gemmeiza11 using the four monogenic lines *Yr5, Yr10, Yr15* and *YrSp*.

In addition to identify of resistance genes *Yr's* by molecular marker in early generation of crosses.

Results and Discussion

The wheat genotypes showed a wide range of rust responses during the 2017 to 2019 growing seasons. Adult plant response to stripe rust for Sids12 and Gemm.11 cultivars, the four *Yr* monogenic and their eight F_1 crosses during 2017/2018 season are presented in Table 1. Over 200 F_2 plants from each cross were scored for stripe rust field response. The test confirmed the previous result from F_1 of dominating resistant reaction over susceptibility in all crosses except the cross Gemmeiza11//*YrSp*/6* Avocet S, it was the opposite.

Segregation ratios of Sids12 crosses indicated that the cultivar differ in two genes with the monogenic lines carrying *Yr5*, *Yr10* and *YrSp* while it differ in three genes with the line carrying *Yr15* gene. The observed ratios fitted the theoretical expected ratios, 15:1, 11:5, 11:5 and 57:7, respectively. On the other hand, segregation ratio of Gemm.11 crosses indicated that the cultivar differ in two genes with the monogenic lines carrying *Yr15* or *YrSp* and in three genes and one gene with lines carrying *Yr5* (57:7) or *Yr10* genes (3:1), respectively. The difference of segregation ratios indicate that there were different types of epistatic interactions (Table 2). Intensive genetic and molecular studies are beneficial for developing high yielding and disease resistant wheat cultivars in Egypt (Fig1).

Table 1. The adult plant field response to stripe rust under field condition for the two Egyptian bread wheat cultivars Sids12 and Gemmeiza11, four monogenic lines and their eight F_1 crosses 2017/2018 season.

Cross name	Adult plant field response to stripe rust‡		
	P_1	**P_2**	**F_1**
Sids12//*Yr5*	S	R	R
Sids12//*Yr10*	S	R	R
Sids12//l*Yr15*	S	R	R
Sids12//*YrSp*	S	MRMS	R
Gemm.11//*Yr5*	S	R	R
Gemm.11//*Yr10*	S	R	R
Gemm.11//*Yr15*	S	R	R
Gemm.11//*YrSp*	S	MRMS	MR

‡ R= resistance, MR= moderately resistance, MS= moderately susceptible and S= susceptible.

Table 2. Adult plant response for stripe rust, observed hypothetical ratios, chi-square and probability values for nine wheat F2 populations inoculated with Pst under field conditions during 2018/2019.

Cross	No. of plants			Ratio	χ^2	P. value	Number of genes and mode of inheritance†
	R*	S**	Total				
Sids12//*Yr5*	214	19	233	15 : 1	1.44	0.23	2D
Sids12//*Yr10*	170	93	263	11 : 5	2.07	0.15	1R, 1D
Sids12//*Yr15*	266	30	296	57 : 7	0.20	0.66	3D
Sids12//*YrSp*	226	92	318	11 : 5	0.80	0.37	1R, 1D
Gemm.11//*Yr5*	218	28	246	57 : 7	0.02	0.89	3D
Gemm.11//*Yr10*	172	54	226	3 : 1	0.15	0.70	1D
Gemm.11//*Yr15*	178	35	213	13 : 3	0.75	0.39	1R, 1D
Gemm.11//*YrSp*	110	122	232	7 : 9	1.27	0.30	2R

*R=resistance .and ** S= susceptible ; †D = dominant and R = recessive.
Interpretation for some ratios can be found in Fasoulas (1980).

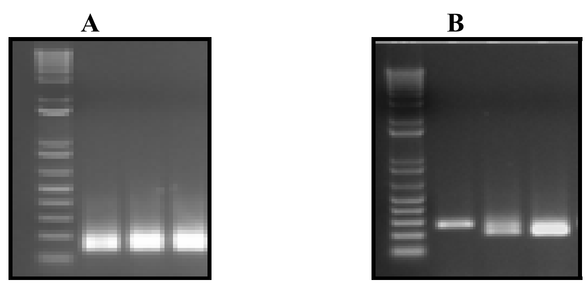

Fig. 1. Amplification products of PCR using A. *YrSP* marker (158bp) and B. *Yr10* marker (240bp)in certain crossing (F_2), Egyptian cultivars; Sids12 and Gemm.11 and monogenic.

Selected Reference

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