Characterization of seedling and adult-plant resistance to stem rust race Ug99 in Iranian bread wheat landraces

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INTRODUCTION

Stem or black rust, caused by *Puccinia graminis tritici*, has historically caused severe losses to wheat (*Triticum aestivum)* production worldwide. Although Pgt has been observed occasionally on local wheat cultivars, there were no significant outbreaks of the disease since the last epidemics occurred in the Caspian Sea and southern parts of the country on Iran during 1975-79. Successful control of the disease for over three decades through the use of genetic resistance has resulted in a sharp decline in research activity in recent years (Singh et al., 2006). More than 50 resistance genes are now catalogued which several of them such as Sr6, 7a, 7b, 9a, 9b, 10, 11,12, 16, 17, 31, and Wld-1 have been extensively used in agriculture.

New stem rust pathotypes identified in Uganda in 1999 (Ug99) has altered this quiet period of stem rust. Ug99 has defeated an important number of effective resistance genes including that were used in several breeding programs. Since its first observation, Ug99 has spread to Kenya (1999 – 2002), Ethiopia (2003), Yemen (2006) and in 2007 Ug99 was detected in the southwest of Iran.

The migration route of Ug99 is predicted to match that of a *Yr9*-virulent pathotype of *Puccinia striiformis* f. sp. *tritici*. The similar genetic background of wheat cultivars grown across the projected migration route indicates a high degree of risk to wheat production in Iran and neighbouring countries where resistance to stem rust relies mostly on *Sr31*.

MATERIALS AND METHODS

In 2006, 2154 Iranian bread wheat landraces (*Triticum aestivum*) from held in the Cereal Research Department collection, Seed and Plant Improvement Institute were tested at the seedling stage using an avirulent pathotype of Pgt. Seedling infection types were scored 14 days after inoculation using 0 to 4 scale (McIntosh et al., 1995).

Eighty eight resistant accessions were selected for evaluation of field resistance in Kenya under artificial field inoculation with Ug99. Field responses were scored based on the Modified Cobb's scale (Peterson et al., 1948) and disease severity (0-100%). Field responses were scored three times. Field data showed that among the accessions tested in Kenya, 22 were resistant showing field response of 5R to 20MSS (Table 1). Few of these accessions were winter type or day-length sensitive and it was not possible to score their reactions at adult-plant. However, some of the accession showed acceptable level of resistance. Among the 88 selected for resistance at seedling to an avirulent Pgt pathotype, 18 accessions were seedling tested against two virulent Pgt pts for *Sr31* detected in Iran in 2007.

RESULTS AND DISCUSSIONS

Based on the seedling infection type using an avirulent Pgt pathotype in Iran, the 2154 *Triticum* accessions were classified into two groups representing low (IT 0-3) and high (3+4) infection types. Among the 88 accessions that showed seedling resistance to an avirulent Pgt pathotype, 22 accessions were scored as resistant when tested in Kenya in 2007 against Ug99. In 2007, 18 accessions resistant to Ug99 at adult-plant were selected for seedling test using two Sr31 virulent Pgt pathotype identified in Iran in 2007. Data showed that among the accession seedling infection types ranged from ;N to 3+4 were observed. Based on the seedling infection types and adult-plant responses, it was evident that some of the accessions were susceptible to the Iranian race of Ug99. Seedling susceptibility of selected accessions resistant to Ug99 at adult plant was considered as possible indication of presence of adult-plant resistance. Some of the accessions showed seedling susceptiblity. These new sources of resistance can be used in breeding for resistance to Ug99 were scored resistant (ITs 0; to 1+) to the avirulent Pgt pt for *Sr31*.

The resistant accessions among Iranian wheat landraces can be used in breeding program as potential sources of resistance to Ug99. Introduction of new sources of resistance would help to increase the gene pool available to breeders, by incorporating, perhaps the new sources of resistance. Further investigation is required to study the genetic basis of resistance of *Triticum* accessions identified as resistant in the present study.

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Entry no.	Accession no.	pathotypes		Adult-plant responses, Kenya 2007	
		86-31 (v31)	*86-55 (v31)*	28/9/07	8/10/07
1	WC-42720	33+	3+4	40S	10S, 10R
2	WC-42929	12-	33+	10RMR	5R
3	WC-42957	;C1=	X+3+	10RMR	20M
4	WC-42959	1+2-	;N	5R	10S, 1R
5	WC-43378	XX-	1+2=	20MR	10R
6	WC-43379	11-C	22-	20MR	10R
7	WC-43470	1C	1+	15R	10R
8	WC-43473	1C	2	15RMR	20M
9	WC-43495	12-C	2-	40MSS	10M
10	WC-43521	3+	33+	40MSS	20M
11	WC-43522	1=CN	1=, 3+	10R	10M
12	WC-43545	;C1=	;N	10R	10M
13	WC-889	1-	3+	15MR	10S, 10R
14	WC-892	11-C	33+	20MSS	10S, 10R
15	WC-906	;;N	3	Very late	10S, 10R
16	WC-1032	33+	4	10MRe	10M
17	WC-1058	2++3	3+	20MSS	10M
18	WC-1276	X++3	3	Very late	TRS

Table 1. Seedling infection type and adult-plant responses of selected Iranian land races resistant to stem rust race Ug99 in Njoro, Kenya