

Resistance levels of wheat varieties and breeding lines to Ug99 and effective resistance genes

Yahyaoui A¹, Abdalla O¹, Sailan A², Bedada G³, Waneyra R⁴, Rajaram S¹

¹*International Center for Agricultural Research in the Dry Areas (ICARDA)*, ²*Agriculture Research and Extension Authority (AREA), Yemen*, ³*Ethiopian Agricultural Research Institute (EIAR), Ethiopia*, ⁴*Kenyan Agricultural Research Institute, (KARI) Kenya*

Historically, stem rust, *Puccini graminis* f. sp *tritici* (*Pgt*), has caused severe losses to wheat production worldwide. Over the past 50 years genetic resistance has kept stem rust under control. However, in 1999 high stem rust susceptibility was noted on CIMMYT germplasm in Uganda. The causal race TTKS (Pretorius et.al. 2000) is commonly known as Ug99. The genetic make-up of this new race of stem rust enables it to overcome the resistance of much of the world's wheat (Singh et al. 2006) Identification of current and retired wheat varieties with resistance to Ug99 will 1) provide alternatives for emergency replacement of susceptible varieties; and 2) enable possible discovery of as of yet unknown resistance genes.

Wheat varieties as well as potential breeding lines cultivated or targeted for growing in East Africa and Red Sea regions, were assed for their reaction to Ug99 under field conditions at Njoro and Kulumsa experimental stations in the Great Rift Valley in Kenya and Ethiopia, respectively. Even though stem rust spores are present in the Rift Valley most of the crop season, wheat nurseries are artificially inoculated with the Ug99 rust population using susceptible spreader rows. These two locations were managed to allow worldwide scientists to test wheat germplasm where the Ug99 strain has established itself. Wheat varieties and breeding lines from countries at immediate risks (Table 1) were screened at Njoro experimental station where selection under disease pressure is guaranteed.

The levels of resistance among bread wheat varieties grown at the high risk areas has been determined under natural infection at the testing sites in Kenya (Njoro), and Ethiopia (Kulumsa). The field evaluation at Njoro Kenya (Table 1 revealed that the quasi totality of the varieties grown in the areas mentioned above is susceptible to Ug99. Among the Egyptian varieties tested only three accession (2%) showed adequate resistance levels to Ug99. Resistance of wheat varieties from Iran, Pakistan, and Turkey varied from 2 to 16%. Slightly over 5 % and 25% of breeding lines from ICARDA breeding program tested in 2006 and 2007 respectively, showed an adequate level of resistance.

Screening carried out at Kulumsa and Melkassa Research Centers.

- ICARDA nurseries comprising a total of 1988 entries were screened
- 517 (26%) lines were selected and advanced for further evaluation.
- CIMMYT nurseries comprising a total of 2675 entries were screened
642 (24%) lines were selected and advanced for further evaluation.
- Most Ethiopian, Pakistani, Yemen and Egyptian commercial varieties have succumbed to stem rust

Table 1. Screening wheat for resistance to Ug99 at Njoro, Kenya (2006)

Country	Total Number	Resistance level (%)	Total number of accessions	
			Resistant	Moderate resistant
Azerbaijan	83	2.4	0	2
Egypt	182	2.7	3	2
Ethiopia	100	28	10	18
Iran	278	20	20	26
Kazakhstan	15	20	0	3
Nepal	101	1.9	0	2
Pakistan	115	6.0	2	5
Russia	54	5.0	0	3
Tajikistan	23	4.3	1	0
Turkey	140	5.7	2	6
ICARDA	1889	5.0	28	68

Preliminary tests on durum wheat in Kenya have shown high levels of susceptibility to Ug99. Since Ug99 has been also detected in Ethiopia shortly after its occurrence in Kenya (Fig.1), a screening program was established at Debra Zeit, Ethiopia. In 2007, over 700 elite durum lines from ICARDA and CIMMYT were screened for resistance. These lines were more resistant than bread wheat; but the resistance was of the qualitative type that could quickly break down under wider exposure. The GRI is therefore focusing on development of durable resistance. Durum wheat production areas at immediate risk include East Africa, West and Central Asia, the Caucasus, and the Mediterranean region.

The biological trap nursery (which includes stem rust differentials and cultivars with known resistance genes to stem rust) that was grown in Ethiopia, Kenya, and Yemen showed wide virulence spectrum of Ug99. Defeated resistance genes, in addition to *Sr31*, will be discussed. Susceptibility of leading varieties (Seri82, PBW43, and Cham8) and differentials (*Sr31* (Benno)/6*LMPG) is a clear indication of the presence of Ug99 at an alarmingly high level of severity. The potential impact of stem rust is particularly serious in Yemen, where Ug99 was detected in 2006 and continues to evolve; hence further known stem rust resistance genes are defeated.

REFERENCES

- Pretorius, Z.A., R.P.Singh, et.al. (2000). Detection of virulence to wheat stem rust resistance gene *Sr31* in *Puccinia graminis* fsp. *tritici* in Ugnada. Plant Disease 84 (20): 203
- Singh, R. P., D. P. Hodson, et al. (2006). Current status, likely migration and strategies to mitigate the threat to wheat production from race *Ug99* (TTKS) of stem rust pathogen. CAB Reviews: Perspectives in Agriculture, Veterinary Science, Nutrition and Natural Resources 2006 1, No.54