Eritrea Wheat Rust Survey September 2009 – Summary Report

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Summary
Wheat rust Surveys were undertaken by NARI, Eritrea and FAO throughout the Central zone highland and mid-altitude wheat growing areas of Eritrea during the period 23-25th September 2009. The primary focus of the surveys was to assess the status of wheat stem rust in Eritrea in light of the emergence of new virulent races of wheat stem rust (Ug99 lineage) in East Africa. A total of 32 wheat fields were surveyed using standardized methodology. Wheat rust diseases were noticeably absent throughout the area surveyed. Wheat stem rust was not recorded during the survey. Wheat leaf rust was recorded at very low incidence and severity at only four locations and wheat yellow rust was found in trace amounts at one location. The timing of the survey was relatively early, coinciding with early milk / milk growth stage for most of the wheat crop. In addition, the season was dry and apparently not conducive to rusts. Both factors would contribute to the low incidence of wheat rusts observed. For stem rust in particular, it is recommended that repeat surveys are undertaken at a later stage of crop development (mid October onwards). Apart from wheat rusts, Septoria was observed at virtually all sites visited and net blotch on Barley was extremely common. Septoria was the predominant disease of wheat observed on the survey and its distribution has increased dramatically compared to previous surveys undertaken by NARI.

Introduction
Stem (or black) rust (*Puccinia graminis*) is one of three fungal rust diseases that can inflict serious economic damage on wheat production. In recent years, the other rust pathogens of wheat, namely leaf (or brown) rust (*Puccinia recondita*) and stripe (or yellow) rust (*Puccinia striiformis*) have caused more damage and as a result most of the research and breeding efforts worldwide have focused on these diseases. However historically stem rust has been the most feared disease of wheat, capable of causing periodic severe devastation across all continents and in all areas where wheat is grown. There is a solid foundation behind this fear as an apparently healthy crop only 3 weeks away from harvest could be reduced to nothing more than a tangle of black stems and shriveled grain by harvest. Under suitable conditions, yield losses of 70% or more are possible. In the mid 1950's over 40% of the North American spring wheat crop was lost to devastating stem rust epidemics (Leonard, 2001). These devastating losses were the result of the emergence of a new stem rust race named 15b, which overcame the genetic resistance in widely grown wheat cultivars at the time.

Since the epidemics of the 1950's, widespread use of resistant wheat cultivars worldwide has reduced the threat of stem rust to the extent that it is not a significant factor in wheat production losses. By the mid 1990's stem rust was largely considered to be a disease under control (e.g., Roelfs et al., 1992). However, with the emergence of a new virulent stem rust race lineage, popularly named Ug99, in the wheat fields of Uganda during 1998 (Pretorius et al., 2000), that perspective has now changed. As a result, stem rust is now very firmly back on the agenda of wheat scientists worldwide.

Ug99 is the only known race of stem rust that has virulence for the stem rust resistance gene *Sr31*, a unique characteristic that facilitated its original identification. However, in addition it also shows virulence to most of the stem rust resistance genes originating from wheat, plus virulence to gene *Sr38* of alien origin. This unique combination of virulence to both known and unknown resistance genes in wheat is what makes Ug99 special and why it is considered a potential major threat to global wheat production. Results from Kenya, now show that the pathogen is continuing to change, resulting in variants that exhibit differing virulence and render further *Sr* genes ineffective. An additional two new variants of Ug99 are now recognized from Kenya, all very closely related and thought to have arisen through single-step mutations (Jin et al., 2008). These new variants in Kenya have rendered additional important stem rust resistance genes ineffective, namely *Sr24* and *Sr36*. These unique combinations of virulence have rendered approximately 80% of all current global wheat varieties susceptible. Also, in South Africa a further two variants have been identified. These include the presumed progenitor of "Ug99", identical to "Ug99" apart from lacking virulence on *Sr31* and a derivative of the presumed progenitor that has acquired virulence to *Sr24*.

The emergence of the Ug99 lineage of stem rust in East Africa has prompted a global and concerted effort by wheat scientists to try and mitigate the threat posed. Nobel laureate Dr N.E. Borlaug was at the forefront of efforts to raise the alarm surrounding the potential threat of Ug99, convening an expert panel that published an assessment report in 2005 (CIMMYT, 2005). Following on from the 2005 expert panel assessment, an international global consortium termed the Borlaug Global Rust Initiative (BGRI) (http://www.globalrust.org/) has been formed bringing together institutions interested in the mitigation of wheat rust diseases.

A key component of the global efforts to address the emerging threat posed by stem rust is effective monitoring and surveillance of the pathogen. As a result, FAO has established a Global Cereal Rust Monitoring System. National surveys are an essential part of this monitoring system and in this context surveys were undertaken by NARI, Eritrea and FAO throughout the main wheat growing areas of the Central highland and mid-altitude zone of Eritrea in 2009. At present there is little information available on the status of wheat stem rust populations in Eritrea. Given the close proximity of confirmed presence of Ug99 in neighbouring countries, an update of the situation in Eritrea is considered essential. The surveys reported here are part of the process to assess the situation in Eritrea in light of the re-emerging threat of wheat stem rust in Africa.

Survey Report

A survey team from NARI and FAO undertook surveys for wheat rust throughout the main central highland and mid-altitude wheat growing areas of Eritrea during the period 23-25th September 2009. An estimated 20,000 ha of wheat were planted in the Central zone of Eritrea during the 2009 season and a survey route was chosen to cover the main areas planted to wheat – see map 1. A total of 32 wheat fields were surveyed using standard BGRI survey methodology. Maturity stage of the crop varied, but in most areas surveyed the crop was at early milk or milk stage. All survey locations were geo-referenced using GPS.

Survey site details and survey results are summarized in Table 1. Survey site locations are mapped along with observed wheat rust disease status in Map 1. Wheat stem rust was not recorded at any of the survey sites. Wheat leaf rust was observed at very low levels of incidence and severity at only 4 sites (Digisa, Tzeazega and 2 sites near Himbirti). Wheat yellow rust was only observed at a single site (Himbirti) and at trace levels. For both leaf and yellow rust, it appeared that infections were only just starting to occur on the wheat crop and innoculum levels were extremely low at the time of survey.

Early timing of the surveys and environmental conditions that were non-conducive to rust development would both contribute to the near absence of wheat rusts observed in the survey. Most probably leaf and yellow rust infections will increase as the wheat crop matures, but given the lack of any observed significant early infection any losses are likely to be neglible. Later appearance of stem rust is also considered highly likely and it is recommended that repeat surveys and monitoring are undertaken as the crop approaches maturity. If stem rust does appear, collection of samples so that race analysis can be subsequently undertaken would be extremely valuable.

The surveys also revealed both high incidence and severity of Septoria on wheat. Septoria was recorded at virtually all survey sites and at some sites infections were very severe (including on the glumes). This widespread distribution contrasts with previous surveys that only observed Septoria in restricted areas. Net blotch on barley was also present at all sites visited.

Conclusion

Wheat rusts were noticeable by their absence during the current survey. Wheat stem rust was not recorded and both leaf and yellow rust were present at very low levels. Early timing of the surveys (early milk / milk) and environmental conditions that were non-conducive to rust development would both contribute to the near absence of wheat rusts observed in the survey. Most probably leaf and yellow rust infections will increase as the wheat crop matures, but given the lack of any observed significant early infection any losses are likely to be neglible. Later appearance of stem rust is also considered highly likely and it is recommended that repeat surveys and monitoring are undertaken as the crop approaches maturity. If stem rust does appear, collection of samples so that race analysis can be subsequently undertaken would be extremely valuable. Confirmation of stem rust pathotypes present in Eritrea is urgently required, given the close proximity of the Ug99 lineage in neighbouring countries.

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Table 1. Survey sites summary table

Date of Survey (d/m/y)	Location Name	Latitude	Longitude	Elev (m)	Growth Stage	Field Area (Ha)	Variety	Stem Rust Incidence	Leaf Rust Incidence	Leaf Rust Severity	Yellow Rust Incidence	Yellow Rust Severity
22/09/2009	Embadorho	15.51433	38.84051	2271	flowering	0.2		none	none		none	
22/09/2009	Shimanugus	15.48059	38.85552	2363	milk	0.5		none	none		none	
22/09/2009	Adi Abeito	15.39678	38.91087	2314	milk	1	Australia	none	none		none	
22/09/2009	Adi-Abeito	15.39028	38.91203	2323	flowering	0.3		none	none		none	
23/09/2009	Selah-Dahro	15.27125	38.90028	2315	flowering	0.5		none	none		none	
23/09/2009	Adi-Guahdad	15.19067	38.86834	2280	flowering	0.5		none	none		none	
23/09/2009	Shiketi	15.15487	38.86764	2024	milk	0.5		none	none		none	
23/09/2009	Terameni	15.03206	38.85906	1885	milk	0.2	mixed	none	none		none	
23/09/2009	Terami	15.01453	38.8368	1901	milk	0.3		none	none		none	
23/09/2009	Senafe	14.65339	38.85515	1956	milk	5	Sudanese	none	none		none	
23/09/2009	Sangergo	14.71463	38.84362	1919	milk	5	Sudanese	none	none		none	
23/09/2009	Mendefera	14.86085	38.81081	1946	dough	2		none	none		none	
23/09/2009	Dander	14.88557	38.78318	1997	dough	0.2		none	none		none	
23/09/2009	Shekawedidistra	14.92981	38.81434	2004	milk	0.2		none	none		none	
23/09/2009	Halhari	15.04919	38.82032	1913	milk	0.5		none	none		none	
23/09/2009	Terami	15.02921	38.82197	1899	milk	0.3		none	none		none	
24/09/2009	Arhada	15.19007	38.9874	2221	milk	1		none	none		none	
24/09/2009	Mai-Harasat	14.99733	39.27482	2464	milk	0.2		none	none		none	
24/09/2009	Derha	14.95807	39.34385	2500	flowering	10	Sudanese	none	none		none	
24/09/2009	Tekonda	14.81114	39.4003	2491	milk	0.2		none	none		none	
24/09/2009	Senafe	14.71566	39.43081	2414	flowering	0.3		none	none		none	
24/09/2009	Tekonda	14.82517	39.38841	2355	milk	0.1		none	none		none	
24/09/2009	Aba Selama	14.88887	39.32492	2315	milk	0.5		none	none		none	
24/09/2009	Digisa	14.98464	39.222	2081	dough	0.3		none	low	low	none	
24/09/2009	Wekerti	15.13966	39.00286	2182	milk	0.1	mixed	none	none		none	
25/09/2009	Tzeazega	15.34253	38.8218	2250	milk	0.4		none	low	low	none	

25/09/2009	Adi-Teulai	15.30287	38.76831	2218	milk	0.2		none	none		none	
25/09/2009	Himbirti	15.26333	38.74789	2145	milk	0.4		none	none		none	
25/09/2009	Himbirti	15.24535	38.71074	2162	milk	0.2		none	none		none	
25/09/2009	Himbirti	15.24593	38.72002	2173	milk	0.5		none	low	low	none	
25/09/2009	Himbirti	15.2435	38.76234	2179	milk	0.2		none	low	low	low	low

Notes:

Incidence (plot level) & severity (plant) levels: Low (<20%), Moderate (20-40%), High (>40%)

Map 1. Wheat Rust Survey Locations in Eritrea 23-25th September 2009