

Zimbabwe Wheat Rust Survey September 2009 – Summary Report

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Summary

Wheat rust Surveys were undertaken by the Crop Breeding Institute, Dept of Research & Specialist Services and FAO throughout the wheat growing areas of Zimbabwe during the period 7-11th September 2009. The primary focus of the surveys was to assess the status of wheat stem rust in Zimbabwe in light of the emergence of new virulent races of wheat stem rust (Ug99 lineage) in East Africa. A total of 21 wheat fields were surveyed using standardized methodology. Wheat stem rust was recorded at 4 sites – Gwebi Variety Testing Centre, Birchenough, Sisal Farm Mutare, and Nyanga. At Gwebi, this was the first report of stem rust since 2003. At Nyanga, high levels of stem rust infections were observed on small-holder plots. At one location farmers reported prior removal of 2 wheat plots due to the high levels of infection they experienced. Five stem rust samples were collected and sent to Prof. Z. Pretorius, University Free State, RSA for race analysis. Until completion of the race analysis it is unknown if these occurrences of wheat stem rust constitute existing local races or exotic introductions such as Ug99. In addition to stem rust, wheat leaf rust was recorded at 11 of the 21 sites surveyed. Powdery mildew was also regularly recorded at survey sites.

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 the Crop Breeding Institute, Harare and FAO throughout the wheat growing areas of Zimbabwe in 2009. At present there is a very large knowledge gap regarding the status of wheat stem rust in countries south of Kenya in Africa. The last wheat rust surveys undertaken in Zimbabwe were in 2002, so the surveys reported here provide a timely update in light of the re-emerging threat of wheat stem rust in Africa.

Survey Report

A survey team consisting of personnel from the Crop Breeding Institute, Harare and FAO undertook surveys for wheat rust throughout the wheat growing areas of Zimbabwe during the period 7-11th September 2009. An estimated 8-9,000 ha of wheat were planted in Zimbabwe during the 2009 winter season (AGRITEX estimate) and a survey route was chosen to cover the main areas planted to wheat. The survey route included sites within the highveld and the lowveld (Ratray Arnold, Bindura, Kadoma, Masvingo, Chiredze, Chisumbanje, Mutare, Nyanga) – see map 1. A total of 21 wheat fields were surveyed using standard BGRI survey methodology. Maturity stage of the crop varied, but in most areas surveyed the crop was at milk or dough stage. All survey locations were geo-referenced using GPS.

Survey site details and survey results are summarized in Table 1. Wheat stem rust was recorded at 4 sites: Gwebi Variety Testing Centre, Birchenough, Sisal Farm Mutare, and Nyanga (Map 1). At Gwebi, this was the first report of wheat stem rust since 2003. At Nyanga, high levels of stem rust infections were observed on small-holder plots. At one location in Nyanga, farmers reported prior removal of 2 wheat plots due to the high levels of infection they experienced. Five stem rust samples were collected and sent to Prof. Z. Pretorius, University Free State, RSA for race analysis. After the current survey had been completed, subsequent reports of wheat stem rust from a farm near Harare were received. Two additional wheat stem rust samples were sent to Prof. Z. Pretorius. Sites at which stem rust was recorded were predominantly in the eastern part of the survey area and at higher elevations.

Wheat leaf rust was widespread throughout the different regions, recorded at 11 of the 21 sites surveyed (Map 2). Notable was the observation of very high leaf rust incidence and severity (80-90S) on the variety sc Stallion at Kunatsa Estate. This variety had previously exhibited good resistance to leaf rust.

Conclusion

The current surveys provided a timely update on the situation regarding wheat rusts in Zimbabwe. The emergence of the Ug99 lineage of stem rust races in Africa is considered a potential threat to global wheat production, with an estimated 80% of current varieties showing susceptibility. Very little information is currently available on the status of wheat stem rust in African countries south of Uganda and Kenya. Wheat stem rust was recorded at 4 sites during the current survey and at an additional site after the survey. At present, it is unknown if these instances represent local races of wheat stem rust or exotic introductions such as Ug99. Results from samples currently undergoing race analysis at the University of the Free State, South Africa should provide confirmation of the races currently present in Zimbabwe.

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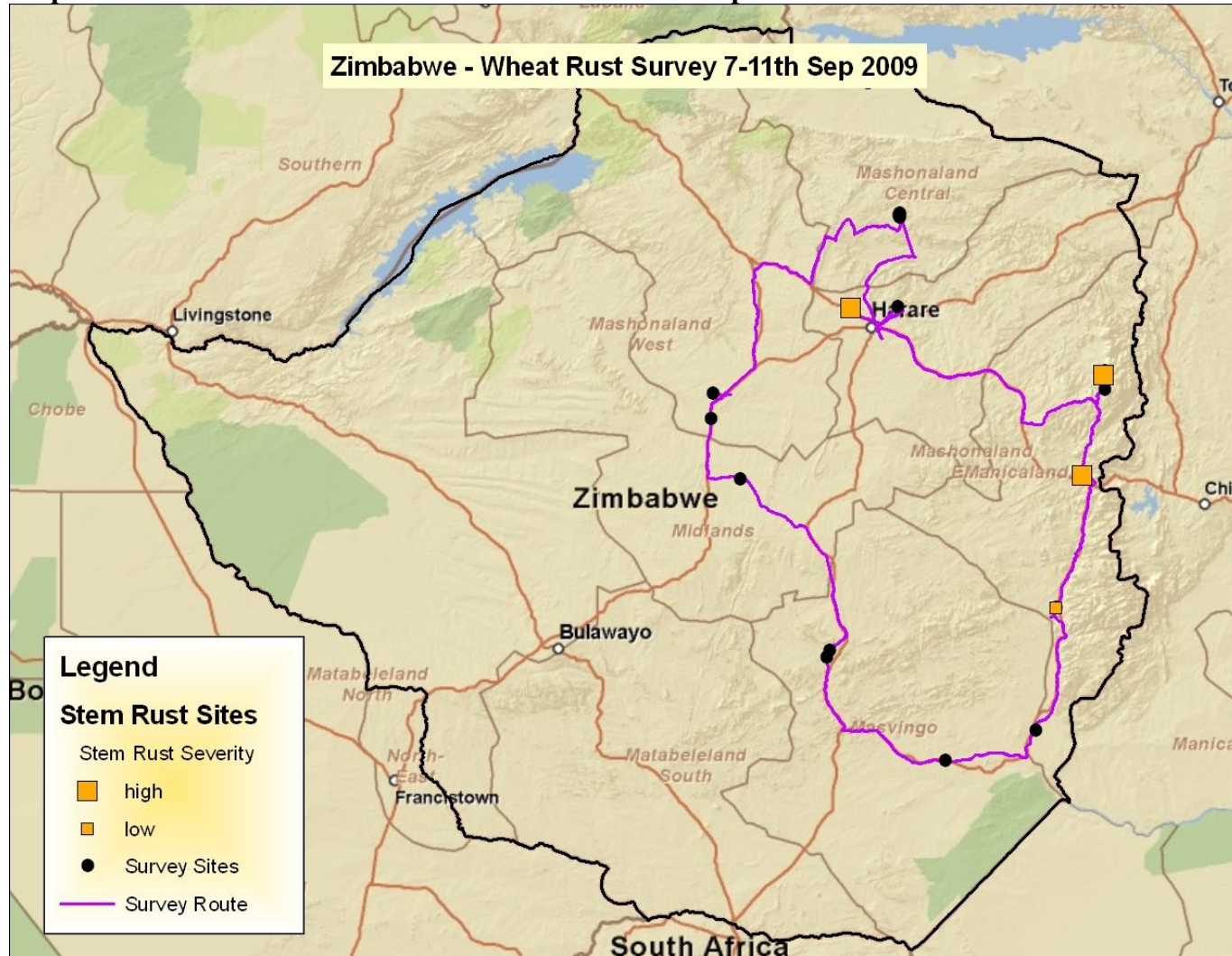
Table 1. Survey sites summary table

Date of Survey (d/m/y)	Location Name	Latitude	Longitude	Elev (m)	Site Type	Growth Stage	Field Area (Ha)	Variety	Stem Rust Intensity	Stem Rust Severity	Leaf Rust Intensity	Leaf Rust Severity
07/09/2009	Ratray Arnold	-17.674870	31.216850	1347	trial	milk		sc nduma			low	moderate
07/09/2009	Gwebi Variety Testing Centre	-17.682160	30.865490	1445	trial	dough	0.4	kana	low	high		
09/09/2009	Kadoma south	-18.499140	29.832410	1110	crop	milk	18.0	dante				
09/09/2009	Masvingo	-20.212160	30.708250	901	crop	milk	0.5	sc nduma			low	low
09/09/2009	Masvingo	-20.262550	30.691590	853	crop	milk	2.0	sc nduma			moderate	low
09/09/2009	Kadoma, seed co	-18.316680	29.849000	1120	trial	dough					low	low
09/09/2009	Sandspruit Farm	-18.942870	30.049130	1202	crop	boot	9.0	sc nduma				
10/09/2009	Chisumbanje Research Station	-20.799420	32.235540	399	trial	dough	1.0					
10/09/2009	Chiredze Research Station	-21.018830	31.567670	419	trial	maturity	0.5					
10/09/2009	Birchenough	-19.895680	32.381300	502	crop	milk	1.0		low	low	moderate	moderate
08/09/2009	Kunatsa Estate 1	-17.012960	31.229080	1190	crop	dough	150.0	sc stallion				
08/09/2009	Kunatsa Estate 2	-17.012860	31.229180	1189	crop	dough	150.0	sc stallion				
08/09/2009	Kunatsa Estate 3	-17.000050	31.221550	1180	crop	dough	150.0	sc stallion			high	high
08/09/2009	Kunatsa Estate 4	-16.99481	31.22724	1187	crop	dough	150.0	sc stallion				
08/09/2009	Kunatsa Estate 5	-16.98677	31.23166	1187	crop	dough	150.0	sc stallion				
11/09/2009	Sisal Farm, Mutare	-18.915780	32.576850	1065	trial	milk	1.0	mixed	low	high	low	low
11/09/2009	Sisal Farm 2, Mutare	-18.913450	32.580800	1056	crop	dough	2.0	kana			high	high
11/09/2009	Nyanga Research Station	-18.288210	32.744950	1824	trial	emergence	0.2	Dande/Kana				
11/09/2009	Nyanga 1	-18.174710	32.735720	1480	crop	maturity	1.0	sc nduma	high	high	low	low
11/09/2009	Nyanga 2	-18.173710	32.733970	1475	crop	dough	0.5	sc smart			high	moderate
11/09/2009	Nyanga 3	-18.151490	32.741450	1441	crop	milk	0.2	sc nduma			low	low

Notes:

Severity & Intensity levels: Low (<20%), Moderate (20-40%), High (>40%)

Map 1. Wheat Stem Rust Locations in Zimbabwe 7-11th September 2009



Map 2. Wheat Leaf Rust Locations in Zimbabwe 7-11th September 2009

