Final Report October 10, 2008
UG99 Surveillance Workshop
Radisson Hotel, St. Paul, MN
July 30-31, 2008

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Introductions & Overview by Erick De Wolf, Kansas State University
Erick opened the workshop with an overview of the meeting objectives and discussed several key grower questions that need to be addressed. 1) What's my vulnerability? 2) How can I best respond to the risk in the short term? 3) What is the long-term prognosis for management? Clearly cultivar resistance is the best option for a long-term solution for management of stem rust, but that still leaves considerable knowledge gaps for in-season disease management. Important knowledge gaps include how best to implement regional and national level surveillance, and potential management with fungicides. The focus of this workshop is to bring small grain disease experts from land grant universities, USDA-ARS, USDA-CSREES, and USDA-APHIS together with stakeholders to address the surveillance and management issues.

David Long- Cereal Rust Surveys at the CDL
David Long reminded the group of the known paths that the cereal rusts will typically follow within North America. The major pathway has always been through the Great Plains region where rust overwinters in TX and moves north to SD, MN, ND and Manitoba Canada. Additional pathways include the Mississippi–Ohio River Valleys and the mid-Atlantic. The mid-Atlantic pathway is difficult to define because the acreage of wheat is relatively low and is geographically dispersed throughout the region. The rust pathogens are also more rare in this region.

What is the role of Mexico in the pathway? Alan Roelfs: Historically the races of stem rust and other rusts found in the U.S. have not been the same as in Mexico, suggesting movement between the two countries is minor. The potential for movement is low because the Mexican crop and US crop out of sync. (ie the dates of planting and harvest limit potential movement). Yue Jin: The wheat crop in Sonora may not impact the US because it is already harvested by April/May. The wheat acreage in Northern Mexico is very low and any inoculum arriving from Mexico arrives at the wrong time to be epidemiologically important.

Alan Roelfs: The advance of rust along the pathway in the Great Plains normally occurs in several movements but can occur in a single movement event. The rust will typically overwinter in TX but can overwinter as far North as KS if sufficient snow cover is present. Oklahoma often will escape severe epidemics of stem rust because the cool night temperatures slow disease development. The heaviest epidemics have been in the spring wheat region where the weather is more conducive for disease development. Specifically, night temperatures in MN favor pathogen reproduction and also stimulate development of dew on plant surfaces (required for the infection process). The spores are brought to the North on storm systems and deposited by rain. Spore movements are

favored by the right conditions for spore release in a source region, temperatures >80 F and dry rising air moving from south to north. Spores are transported at approximately 10,000 ft, followed by deposition associated with 65 F temperatures and rain/dew. Deposition typically occurs on the top of plant canopy – spores don't tend to penetrate the canopy. Hard rains tend to wash spores off the plant depositing them on the ground.

Heaviest statewide losses occurred in ND at approximately 50%; similar losses have also been recorded on a plot basis (50% loss in Marquis wheat in MN was the maximum loss). These losses resulted on varieties that were susceptible from seedling stages through maturity. Yield losses are hard to estimate on a regional basis. The market class of wheat does not determine loss. The losses are influenced by the distribution of different levels and types of resistance. The estimates are complicated because the resistance genes are expressed differently in seedlings and adult plants. Some resistance genes are more effective at high or low temperature.

X. Chen: Reviewed situation in the Pacific Northwest last year when a localized outbreak of stem rust caused >50% yield losses in small number of barley fields. Chen emphasized the local nature of epidemic and the potential role of barberry as an alternate host for the pathogen in this region.

What areas should we be paying attention to in our surveillance efforts?
Alan Roelfs: The best place to look in any given year is undefined. Probably best to focus on known pathways in Great Plains, Mississippi River Valley and mid-Atlantic. If stem rust is getting started you will find it in the gulf coast states (TX-FL).

Dave Long described where CDL surveys are conducted annually. The current surveys are based on major acreage. Initially, late March-April in Texas; late berry/soft dough is the best time to find stem rust. The survey includes checking of small grain fields at approximately 20-mile intervals. Incidence and severity of rust diseases present, location, variety, note conditions, and growth stage of crop are recorded at each location. A few collections for race ID are also made. Fungicide use has increased in recent years and complicated the survey. Barley, oats and wild grasses are also included in the survey when possible.

Survey routes are based on past experience and counties with large grain production. It is important to maintain flexibility in the survey route, and sample critical regions that maximize chances of successfully finding the targeted diseases. The most productive time to survey for the rust pathogens is during mid to late stages of grain filling (berry to soft dough). Most CDL surveys occur between late March and early August. In some years the Mississippi Valley, northern WI & MI don't get surveyed because of timing – relative to other CDL activities. Dave spends up to 5 days on the survey and then returns and processes samples and distributes data through newsletter & bulletin. Alan Roelfs indicates that survey data exist for the past 70 years and indicate the first date of observed occurrence across the Great Plains in each year.

The information for the current survey is posted on the web via the CDL. The status of each sample and its race identification are updated weekly. A change in status is noted by a color change in a location marker (dot on the map). Each location is selectable to gain more information on the site and race ID.

When did you last find significant stem rust on the survey? More stem rust was found in the survey this year (2008) than in past 3 to 4 years. This increase was probably due to delayed crop development this year. This year's finds were mostly in trap plots where he knew what variety he (David Long) was looking at.

Yue Jin: Surveys this year indicate that east of the Rocky Mountains a single race dominates. A few exceptions were noted in Texas and a sample from Gary Bergstrom in NY may be another grass rust.

How do university pathologists fit into the current surveillance system?
David Long: The current surveillance effort processes samples from around the country. Approximate collection frequencies were: Leaf rust – 500-700 collections, Stem rust – about 60, Crown rust – 100-200, Stripe rust – 300-600. Samples from cooperators are important to overall function of the system. Cooperators contribute about half of the leaf rust collections cited above. Collection envelopes and forms are available by email request to the CDL.

Collections from nurseries are most useful if they are found on varieties that are known to be previously resistant. Enhancements of the efficiency in the surveillance should include more targeted sampling of this resistant material and avoid simply increasing the numbers of samples from known susceptible varieties. If large numbers of samples are required for a specific research project, then the researchers should contact the CDL personnel in advance.

Would it be possible to develop lists of sentinel varieties for each market class? That would help to make targeted samples and provide useful information back to growers.

The current rust detection plots include susceptible varieties in the Great Plains and parts of the South. Some discussion on number of varieties to include followed. In general, we are looking for a variety that is susceptible to as many races as possible (universal susceptible) and is adapted well enough to produce enough grain to replant. Cultivars like Bart, McNair 701 may be good enough in some areas. The group reviewed locations of current trap plots and felt the coverage was adequate. However, we also felt that it would be wise to expand coverage of Southeastern states (LA, MS, AL, FL) if possible.

Is the reverse pathway important epidemiologically? Alan Roelfs: Not really. You can find stem rust on volunteers around irrigated fields in the summer on the Great Plains.

Are the important areas being covered? Alan Roelfs: Mexico is not a priority because it is out of sync with the US crop. Stem rust is most likely to survive South of about 30 degrees. Gulf Coast from Castroville, Texas to Quincy, FL is an important area and usually the first rust will appear in this area each year. Rust can move up the Mississippi valley and this is an important area to monitor too.

What are strengths and weaknesses of existing system?
Strengths of the current system include the commitment of the USDA to ongoing survey. Current protocols have them following the same paths/patterns every year during the survey and they have developed large database of observations. Large networks of volunteer cooperators at land grant universities also provide considerable strength to the current effort.

The current surveillance is intended to detect large increases of the rust diseases and identify new races of the pathogens within the US. The weakness of this approach is that the timing of the survey relative to crop growth may diminish the value of the surveillance for local disease management. The information is of greater value within a growing season in the north where the greatest losses are known to occur. (Outbreaks in the South increase the risk of the pathogen moving to the northern locations). Observations during the early stages of crop growth that may be important for in-season management of rust in the southern Great Plains will need to come from land grant universities and local scouting.

The local disease specialists are volunteers and often have other priorities that divert attention from rust surveillance. Interest and commitment to the surveillance effort differs among the volunteers. In some cases the local cooperators may need to look earlier than directed by the current survey.

Which locations are most important to emphasize early surveys? Alan Roelfs: always look to the South. The Gulf Coast & Mississippi River Valley are top priorities. Start looking about April 1 – late boot to early heading is a good growth stage target. Stripe rust surveys will need to occur prior to these dates and growth stages. Stem rust observations may be most effective later. Any trap plots should be of a highly susceptible variety and long (300 ft long) to increase the sampling area and the variety of the landscape sampled. It may be possible to look for disease in the fall and revisit these locations in the spring to check for overwintering. Fields that are highly fertilized and not grazed have the greatest potential as overwintering sites.

How quickly can the race identification be made for suspect samples? The race identification takes about 2 weeks after receiving sample for a single race. Mixed races take more time because individual races need to be isolated and re-inoculated, which adds another 2 weeks. Collections that are suspected to be UG99 or similar races are not evaluated immediately because the CDL cannot risk an escape. Testing of suspect samples can only occur in the winter. New methods for confirming the identification of suspect races are needed.

It was also noted that monitoring for these high consequence races would be different than the current system, which focuses on trap plots of varieties to most races of stem rust. Any outbreak of disease on a previously resistant cultivar would be cause for concern, and other research plots will likely play an important role in the detection of the UG99. We need to know what varieties should be resistant to the different rust diseases so we can tell what is abnormal. The availability of this information varies with wheat and barley market class and region.

Yue Jin has developed a list of suggested trap nursery entries that breeders in the Great Plains are already planting. These entries have different configurations of the Sr31, Sr24, Sr36 resistance genes. Sr 36 is widely used in soft red wheat. Not as much is known about the Pacific Northwest region. Juliet Windes and Eric Jackson have some of this information and will cover it in more dept on next day of the workshop.

What would UG99 do in Mexico? This is difficult to predict. They are changing varieties now to include more resistance, so it probably won't do much. From Sonora it could go into CA, or possibly CO. UG99 probably will not go directly to TX from Mexico because there's no wheat planted until about Dec 15. Again, only low probability of movement to TX directly from Mexico. However, there are some past examples of durum rust moving from Sonora, Mexico into AZ. Movement from Toluca to TX is unlikely because wheat in Toluca is harvested in September and wheat is not planted in TX until December.

What level of barberry monitoring still occurs in the US? Dave Long does some monitoring of common barberry because he knows where some populations of the bushes exist (WI & MN). We know the barberry populations are increasing again but most are not checked. It is also unclear if the barberry is coming back into grain-growing areas. Apparently the barberry eradication program was not able to get the barberries that were difficult to access deep in wooded areas. Birds are likely moving them out again.

Yue Jin: Barley and rye isolates of the stem rust pathogen are found on barberry in Southeastern and Central WI and Southern MN. We have not seen aecial infection on barberry in recent years. Wheat is so resistant in the spring wheat region that there are no teliospores/basidiospores available to infect barberry. We are far more likely to pick UG99 or other novel races in wheat because it is grown on such a large acreage.

The races of stem rust fungus currently known to occur in the Midwest are low telial producers. Recombination in barberry of a UG99 race could be important. Virulence is recessive, so ¾ of individuals from barberry are not new races (1/4 homozygous dominant or ½ heterozygous). Note these genetic ratios will vary depending on the genetic status (homozygous or heterozygous) of the parents.

What is the possibility of virulence developing out of the Pacific Northwest where barberry is also known to occur? Alan Roelfs: New virulence can and has developed

in this region, but most wheat is resistant. This limits the potential for recombination events. We could have our own homegrown race (US race x US race) with unusual virulence developing from recombination on barberry. It is also possible that additional traits will also be impacted by recombination. Latent period for example can vary tremendously.

USDA Action Plan. Marty Draper, and Rick Bennett
UG99 is a high profile issue in Washington DC and developing a plan for what happens if/when UG99-like race appears in the US is a community effort. Rick Bennett and Kay Simmons USDA-ARS have received input from the breeding community and within USDA. They are taking the lead to develop the action plan. A workshop was held in Baltimore to begin this process in April of 2008. A summary of Baltimore workshop is on CDL website and longer version will be in Phytopathology News next month. Recommendations from this group (the current workshop) will be important to the next draft of the document.

Steve Poe: We learned a lot from the soybean rust introduction; there was no prevention. It would be best to spend energy on education, early detection, and to plan for entry. Our preparation for the stem rust should be similar. Important differences are also present and stem rust will be regulated very differently. Although this is not a select agent, it needs to be treated similarly should it be discovered, i.e., chain of communication; and the responsible individuals that need to know before press is alerted. Discovery of the UG99 in North America could potentially have political and market ramifications.

31 July 2008 – At Cereal Disease Lab

Les Szabo – Update on diagnostics
Developed SSR microsatellite markers that show UG99 is distinct from anything else currently held in the USDA's collection of isolates from around the world. UG99 is very different based on a suite of approximately 15 SSR markers. Another set of markers developed recently appears to be better than the first. The USDA had a dry run this summer and was able to prove that a collection with suspected Sr31 virulence was not UG99 within 48 hours.

The current assay can be used with leaf tissue, but the technology will not be easily deployed to the diagnostic labs at land grant universities. The Szabo lab is working to develop a RT-PCR assay that would better meet the needs of the diagnostic labs.

What is the timeline for the RT-PCR assay for use in diagnostic laboratories? Les Szabo: The timeline is unknown, but we will hopefully have an assay in 1 to 2 years. The genome of this fungus is difficult to work with; SSR alleles are not unique, it's the combination of alleles that's unique. The Szabo lab would be willing to train diagnosticians for National Plant Diagnostic Network when the diagnostic assay is

available. The number of participants that could be accommodated in each training event is unclear.

Protocol for handling suspect samples.
Marty Carson, Yue Jin and Les Szabo developed a set of criterion that can be used in the decision process related to suspect samples of UG99.

1) We need to know the variety if possible to determine if suspected stem rust has overcome current resistance genes. It is also important to recognize that most varieties have off-type plants, which could complicate the identification of an unusual virulence reaction. Percent incidence can provide valuable information (low incidence suggests volunteer or off-type).

2) We need local expertise to ensure the disease is stem rust and not leaf rust or stripe rust.

3) If the sample is suspect, it should be sent to the CDL for molecular diagnostics. The CDL cannot increase suspect races during a growing season and risk escape. Information about the suspect sample should be kept to the smallest circle possible. Complete verification is needed before information is released to the public.

If UG99 appears, an intermediate step is needed to prevent the inundation of the CDL with samples. The extension specialists need to be involved in the prescreening and determining which samples to send to the CDL. The NPDN labs should also be utilized for preliminary confirmation. We might consider having simulations in the diagnostic labs and states to identify communication issues.

Local disease epidemics will need to be treated as any normal disease issue. Failure of resistance to cereal rusts can and does happen regularly. Communication to growers about occurrence of an outbreak stem rust on a formerly resistant variety doesn't need to include "UG99" but only that a new race seems to be present. Official declaration of the race as UG99 can come later after verification is complete.

Gene Milus- Enhanced monitoring
Develop a network of people who understand the problem so they can correctly identify the disease if it occurs. We could potentially develop a fact sheet with photos and information on variety reactions to help others with identification. Discussion was supportive of developing a fact sheet/pocket card to explain the issues. Jeff Stein said he has a grant to develop a "First detector module" for stem rust and will be working on that this fall.

Suggestions for extension publications included:
-A tri-fold laminated card focused on identification of the three major rusts of wheat. Include diagnostic indicators of how to differentiate the diseases.
-Fact sheet that provides detailed information about stem rust and the importance of UG99 races.

-Needs to be a unified set of publications that provide consistent information. It is desirable to have a format that can support the logos of local institutions (key for getting local buy-in and use of the publications).
-IPM programs may be able to help with National Pest Alert type publication. The NC-IPM Center has done similar publications for soybean rust and other disease. We may approaching this group about the possibility of helping with the stem rust publications.
-A Website that supports the printed factsheets should also be available. The web format will provide more information and is easier to update with current information.

First priority: Diagnostics guide needs to be in place ASAP
Second priority: Diagnostic guide needs to be supported by a publication and website with more information. (Variety reactions to stem rust, UG99 facts, management info)

It was noted that we are really starting at ground zero as far as awareness. We would like to enhance the monitoring but we also need to be sensitive to information overload.

Discussion of what is needed in terms of educational outcomes followed. Stem rust already occurs, so education needs to include varietal reactions to bias samples towards potentially new races. Because stem rust has not been important, any significant outbreak needs to be investigated.

Publication should be housed on CDL site for central distribution site. Most people will use a search engine to find information and CDL usually at the top of the list for rust information. Marty Carson is best contact to start that process. The group also proposed having flexibility to customize the publications with the logo of their local institution. This can be important for local buy-in and distribution support.

A sub-committee was charged the responsibility to develop a draft of the publication and present to the group. Lead: Jeff Stein. Members: Gene Milus, Char Hollingsworth, Albert Tenuta, Tim Murray, Pierce Paul, Erick De Wolf.

Where do we get information about variety reactions?
Data on varieties is currently scattered and incomplete. Bob Bowden is compiling information for hard winter wheat but gaps still exist. In some wheat classes we don't really know what genes might be present as there because several different companies may market a single release. Some states may be able to focus on a list of recommended varieties.

Gene Milus raised the possibility of screening for stem rust (domestic races) in Arkansas and Yue Jin volunteered to test for stem rust resistance in a field test in MN. The wheat breeders also have a nursery near Castorville, TX that regularly gets enough stem rust to rate variety reactions. From a disease resistance perspective, we need to identify genotypes with adult-plant resistance (APR) (Sr2) (Thatcher in spring wheat is also APR). APR is difficult to select for in breeding programs without markers. We need to establish a nursery to target APR.

Do we need to have an extensive network of trap plots? The discussion suggests that this type of network is not needed given the ongoing surveillance efforts. The system already has a network of trap plots and extensive group of volunteers looking at research plots and commercial fields. This network varies with the regional and personnel priorities. However, we might consider some enhancements to the current surveillance effort. David Long suggests we consider adding additional trap plots in Southeastern U.S. (Fairhope, Quincy, Raleigh). How many varieties or lines are needed? Depends on the state- don't need a large number. One hundred linear feet of row is a good target. McNair 701 is a good susceptible check. Gene Millus will talk with potential AL and FL cooperators about trap plots for 2009 season.

Expansion of the surveillance of research plots and commercial fields will be of most value if we know the resistance genes in varieties. This is clear priority. Individuals volunteer to gather information about variety reactions for the group.
Soft reds and soft white: Pierce Paul and Gene Millus; PNW wheat Eric Jackson, Juliet Windes. Hard red winter: Erick De Wolf; Spring wheat: Marcia McMullen. Priorities for these groups include: 1) Check with regional nurseries to see what is already known. 2) Start with reactions for the top 25% of varieties that in performance tests (varieties that on large acreages). 3) If knowledge gaps are present, make arrangements to get seed to Blair Goates, USDA-ARS Aberdeen, ID by February for inclusion of entries that need to go for international testing.

Are we also thinking of other potential ports of entry?
The models of transport are in place from soybean rust, but not fully calibrated for stem rust. We had knowledge of were soybean rust was in South America prior to movement to the US. This knowledge allowed us to model the movement of this disease.

What are the current source regions for UG99? Africa, Yemen, Iran. Can it jump the Atlantic in the Southern hemisphere? That potential needs further evaluation and risk assessment analysis. Is there surveillance in Argentina and Brazil? We simple don't know if they are watching for UG99. Stem rust is most likely to move into the US from South America by storm systems if it moves North of the equator. Accidental or malicious introduction into U.S. cannot be ruled out. The current feeling is that stem rust is more likely to be moved by accident than by intentional introduction.

Do we need pilot programs to test the surveillance protocols using other rust diseases? Group feels that the elevated activity of stem rust experienced this past year suggests that adequate samples could be gathered to test the protocols. Adding leaf rust or stripe rust might dilute the effort and confuse the objectives. The group also considered potential improvement for methods of communication and communications with stakeholders.

What is the vision for how we might enhance the communications?
Scott Isard, aerobiologist from Penn State has a companion Critical Issues grant from USDA-CSREES to support the wheat pathology community (this group). Isard presented some of the tools that were developed for soybean rust including aerobiology

models that are used to predict its movement. Tools include an observations calendar to see how the rust was previously moving. On demand modeling could be integrated for stem rust. We have tremendous database of native stem rust data. Can we use this information to predict a potential pathway? An interface could include filtering or layered access depending upon needs and interests. Possible layers of information availability include general public, and specialists.

The group discussed what we can do, what we can afford to do, and what is sustainable. We suggest the core of the communication be maintained by CDL if possible. The group suggests we find a way to track and display information already collected by the surveillance efforts and newsletters. Information will likely need to remain at county level.

Knowledge Gaps in Disease Management – Pierce Paul

What can be done if resistant varieties are not in place before the new races of stem rust arrive? Management will likely depend on fungicides. A number of fungicide products available for use on wheat including strobilurin, triazole and premix products. Some limitations related to use were discussed. For example, the pre-harvest interval varies among these products and influences timing of applications. Serious knowledge gaps in product efficacy remain. Expected yield response, application timing, rate effects are all relatively unknown for stem rust. We can draw some information from our experience with other rusts. Erick DeWolf commented on data he has summarized from the Pacific Northwest. This data set is older fungicide evaluations done by Rollie Line and looks at only Folicur (a.i. tebuconazole) and Tilt (a.i. propiconazole). Overall yield response similar for other rusts. Folicur looks slightly stronger than Tilt. In general, single flag leaf and boot stage application timings were more effective than jointing applications. Combinations of jointing plus boot/heading applications are slightly better than solo applications. Rates used for other diseases are also likely to be effective.

Discussion of the interaction with application timing and impact on management of Fusarium head blight followed. Rick Ward suggested the importance of communicating the potential of strobilurin fungicides to increase deoxynivalenol levels associated with FHB damaged wheat. Clearly continued education in the US and internationally on this issue is required. Recommended use of this product depends on regional risk of FHB.

What can we expect from fungicides?

The current fungicides should perform well against stem rust. There is no evidence that suggests a race specific reaction to fungicides, and efficacy testing on native races of stem rust should provide useful information. The group suggests that we pursue some additional testing of newer products to establish efficacy ratings, rates and growth stage timing protocols. Where possible we should also develop collaborations with researchers in Africa.

Fungicide research in Africa: Ruth Wanyera

Most fungicides in Africa are in the triazole class but a few strobilurin fungicides are available. Most fungicide screens are looking at control of stripe rust, and no specific recommendation was in place for stem rust control in Kenya when UG99 emerged. In Kenya stem rust shows up about two months after planting. Ruth presented results summarizing the impact of fungicides on disease severity; yield gains and percent yield gain. Amistar (a.i. azoxystrobin; U.S. tradename: Quadris), Silvacur (a.i. tebuconazole and triadimenol) and Folicur (a.i. tebuconazole) are recommended products. Fungicides are applied at flowering and 2 weeks later.

Rick Ward added reports of large amounts of spraying done by airplane in Kenya. These applications appeared to be very effective.

The group desires to have uniform testing of fungicide products but it is unclear who would sponsor such an effort. If minor gene resistance is deployed we will need to know the potential interaction of fungicide with APR resistance. Jeff Stein and Pierce Paul are willing to help coordinate a uniform test. Group suggests they also look to establish international contacts for testing in other nations. Australia may be one possibility. Rick Ward offers to have Global rust initiative serve as a starting point for this type of contact.

Application Techonology: Bob Wolf, Ag engineer, K-State
Application technology may be an issue of importance. Research plots may not accurately represent efficacy in a commercial field. Technologies to watch include electrostatic application. Bob is concerned that this technology has not been proven for agricultural applications, but units are being sold anyway. May involve the carrier volumes of 1 gal/A. Air assisted booms do get better penetration into the crop canopy, and tend to stir the canopy. This is not valuable in low canopy when crop is small. Airplanes can get the job done too.

Nozzle technology has changed. Flat fan nozzles can be drift prone if operated at pressures needed to generate required droplet size. The turbo flat fan nozzles can reduce the drift problem. Based on results from soybean canopies, the best penetration into the canopy with flat fan or turbo flat fan nozzles. A new version of the turbo with double head looks like it will also perform well. Air induction nozzles will not likely work well. The strength of this type of nozzles is drift reduction and not coverage. There is some evidence of reduced coverage in herbicide applications.

It may not be possible to use the same nozzle configuration to apply both an herbicide and a fungicide. These applications require different rates of carrier (5 gal/acre herbicide, 15 gal/acre fungicide for ground applications).

The droplet size issue is very important to understand. There are six categories of droplet size ranging from very fine to coarse. Fungicides typically will require smaller droplet size than herbicide applications. Several important issues remain for stem rust control: 1) We do not know if it will be important to cover the stems. 2) It may be very difficult to relate the efficacy data from small plots to applications made with an airplane.

Do we have realistic estimates of potential losses in the US?
No, we are currently basing our estimates on reports of past epidemics in the U.S. For example, losses reported for the spring wheat areas during the 1930-1950's approached 40 to 50%. Barberry had been nearly eliminated from these areas by 1927 and likely was not a significant source of local inoculum for these epidemics. Barberry may have played a role in the development of 15B races of stem rust that emerged in the 1950's, but inoculum from the southern plains appears to be the major source of inoculum for the spring wheat states. The timing of movement of stem rust into a region/state relative to crop growth may be important (arrival at early growth stages = greater severity and greater risk of yield losses). It is also clear that the environment and cultural practices in Kenya are very different. The stem rust arrives very early in the development of the crop (possibly from local sources of inoculum). We also do not know very much about these new variants of the stem rust and their ability to cause yield losses. We should be careful to not draw too heavily on international reports when predicting loss estimates for UG99 in the US.

Final notes on communications:
The group agreed it would be desirable to establish a list serv of this group to follow-up on the discussion started here. The CDL will host and maintain the list serv. Contact Mark Hughes (CDL) or Erick De Wolf for more information.

Leaders of sub-committees will serve as contact points for the Global Rust Initiative.

Topic	**Contact person**
Diagnostics	Les Szabo, USDA-ARS, St. Paul, MN
Extension publication	Jeff Stein (lead) members: E. DeWolf, G. Milus, P. Paul, A. Tenuta, C. Hollingsworth, and T. Murray
U.S. surveillance	David Long, USDA-ARS survey; representing land grant institutions: Erick De Wolf and Gene Milus
Variety reactions	Pacific Northwest: Juliet Windes and Eric Jackson Hard red winter wheat: Erick De Wolf and Bob Bowden Spring wheat: Marcia McMullen Soft red wheat and soft white wheat: Pierce Paul and Gene Milus
Fungicides	Jeff Stein and Pierce Paul

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