NC-227 Sorghum Ergot

Meeting Minutes
Puerto Vallarta, Mexico
19-21 March 2002

Administrative Adviser:	**Chair:**	**Secretary:**
Dr. Dale Vanderholm Associate Dean & Director University of Nebraska 207 Ag Hall Lincoln, Nebraska 68583	**Dr. Gary Odvody** Texas A&M University Department of Plant Pathology & Microbiology Agricultural Exp't Station Corpus Christi, Texas 78410	**Dr. Jeffrey Pedersen** USDA ARS University of Nebraska Department of Agronomy Lincoln, Nebraska 68583
402-472-2046 dvanderholm2@unl.edu	361-265-9201 g-odvody@tamu.edu	402-472-1754 jfp@unlserve.unl.edu

Project/Activity Number: **NC-227**
Project/Activity Title: Ergot - A New Disease of U.S. Grain Sorghum
Period Covered: 1 January 2001 to 31 December 2001
Date of This Report: 31 March 2002
Annual Meeting Date(s): 19-21 March 2002

Participants

Members in attendance:

1. Gary Odvody, Texas A&M University
2. Charlie Rush, Texas A&M University
3. Bill Rooney, Texas A&M University
4. Noe Montes, Texas A&M University/INIFAP
5. Jim Stack, University of Nebraska
6. Dale Vanderholm, University of Nebraska (Administrative advisor for NC-227)
7. Larry Claflin, Kansas State University
8. Mitch Tuinstra, Kansas State University
9. Ken Kofoid, Kansas State University
10. Kitty Cardwell, USDA-CSREES, Washington D.C. (CSREES liaison to NC-227)

Members not in attendance:

11. Jeff Pedersen, USDA-ARS, University of Nebraska

Guests:

1. Jeff Dahlberg, National Grain Sorghum Producers, Lubbock, Texas
2. Florencio Jimenez, INIFAP, Coahuila,
3. John Jaster, Pioneer, Taft, Texas
4. Oscar Rodriguez, Monsanto, Bishop, Texas
5. Victor Pecina, INIFAP, Rio Bravo, Tamp.
6. Juan Valdez, INIFAP, Tampico,
7. Rodolfo Velasquez Valle, INIFAP, Pabellon, Ags.
8. Hector Williams Alanis, INIFAP, Rio Bravo, Tamp.
9. Jesus Narro Sanchez, INIFAP, Celaya, Gto
10. Andres Encinas, Pioneer, Irapuato, Gto
11. Victor Vidal-Martinez, INIFAP, Santiago, Nayarit
12. M. Hernandez, INIFAP, Celaya, Gto
13. Leonardo Soltero, INIFAP, Ocotlan, Jalisco

The annual meeting of NC-227 was held at the Hacienda Hotel, Puerto Vallarta, Mexico on 19-21 March 2002. This meeting site and date were selected to facilitate interaction with scientists from INIFAP as well as to allow tours of sorghum ergot research plots by several member scientists.

Gary Odvody, Chair of NC-227 and Noe Montes, coordinated this meeting.

Dr. Odvody called the meeting to order at 8:18 a.m.

Review Agenda: The meeting agenda was presented and a motion to adopt was passed by the committee. Each person attending introduced themselves.

Approve minutes of 2000 NC-227 meeting: Jeff Dahlburg suggested amended the minutes to reflect the discussion about moving the USDA ARS Stan Jensen position to Kansas State University. Gary noted that that discussion was not part of the meeting but rather occurred after the meeting. A motion was put forward to approve the minutes from the previous meeting and that motion was passed.

NC-227 Administrative Advisor report: Dale Vanderholm then addressed the group. He discussed the status of funding and the organizations that impact the activities of NC-227. Among the topics discussed was the research prioritization process undertaken by the experimentation directors at their 2000 and 2001 meetings. A new initiative on agro-security was added for $212 million. He also discussed the new direction (NIMS) of paperless reporting for regional groups.

Progress of NC-227 was deemed satisfactory and continuation was recommended after mid-term reviews by the NCA-1 (agronomy) and NCA-14 (plant pathology). The NC-227 termination date is 30 September 2004. Plans for continuation or direction change needs to begin at this meeting.

State Reports*

Texas

Bill Rooney: Discussed the progress towards developing and evaluating sorghum populations with putative ergot resistance. Differences among the evaluated lines were determined. He observed high genotype by environment interactions during the course of this research.

Gary Odvody: Discussed the occurrence and impact of sorghum ergot in South Texas. He discussed the continuing work that he conducting in collaboration with Debra Frederickson in Africa.

Noe Montes: Reported on progress on developing a prediction model and conidium survival. Model parameters based on five years of weather data include relative humidity and five day average maximum and minimum temperatures as a function of flowering. Three factor surface regression model. The model predicts that ergot incidence in Northern Mexico would be very low from day 175 to day 275 of the year. A discussion ensued concerning whether we know enough about the basic biology of *Claviceps africana* with respect to effects of temperature and relative humidity on germination and infection events. This would be important to the applicability of the model to other locations.

Louis Prom: Report on progress of research on the survival of *Claviceps africana* sphaecelia in soil at several locations. Replicated trial with buried sphaecelia in packets. Recover packets and determine viability and infectivity of sphacelia. Survival declined from 70% to 20% in 4-8 months. Survival in buried sclerotia declined rapidly. Working on inoculation/infection methods.

Charlie Rush: Report on the progress of research concerning the occurrence of sorghum ergot and the application of prediction models using US Weather Service data including doppler radar. Proposing to use the doppler radar data to predict where ergot risk is high.

Kansas

Mitch Tuinstra: Progress report on combining ability of ergot resistance. Four sources of resistance and one susceptible tested (RCB at multiple locations). Inoculated with conidia at 50,000/ml. Highest ergot at South Africa location. Screened exotic sorghums to identify new sources of genetic resistance to ergot.

Ken Kofoid: Discussed the progress of research in Mexico and Kansas. Inoculated TX430 prior to flowering (up to a week prior to flowering). Got very high levels of infection (70%) even in those inoculated 7 days before flowering. Some genotypes were identified with respect to receptivity to infection. The newer females with extended receptivity seem to be more susceptible; that is not absolute. He suspects that their technique results in direct ovary infection rather than the fungus growing down the style as the pollen does.

Larry Claflin: Report on the progress of research concerning application of Mclaren's model of ergot prediction to the US. Also reported on spore trap data from NE, KS, OK, and TX. Applied a sorghum growth `model to ergot prediction using 30 years climate data.

Nebraska

Jim Stack: Discussed progress on the research of the biology of *Claviceps africana* and the ergot surveillance program in Nebraska. The influence of conidium matrix on the effects of temperature on macroconidium germination was discussed. The continued impact of head blight in Nebraska was discussed.

INIFAP Presentations

Victor Vidal-Martines: INIFAP scientists gave reports of their research on sorghum ergot. This included the relationship of ergot incidence and severity to panicle type (open to compact). The more open the panicle the less ergot. Indicated need for additional research including chemical and biological control using bacteria and fungi. They indicated an interest in continuing collaborations with other scientists and organizations.

Jesus Narro: Investigating methods for evaluating commercial hybrid sorghum for susceptibility to ergot as a function of low temperatures. Determining risk estimates to ergot by monitoring temperature profiles in June, July, August, and September. Evaluated fungicides for efficacy with respect to germination of conidia on sphacelia and germination of sorghum seed. The pathogen can reduce the germination of sorghum seed. There seemed to be an interaction between effect on ergot and effect on the pathogen. The best fungicide for ergot control wasn't the fungicide with the greatest activity against conidium germination.

Victor Pecina: Research focus is biotechnology. Investigated the effect of fungicides and hybrids. They are monitoring commercial grain production areas. The are contributing data to the development of the prediction model that Noe Montes presented earlier. Looking for sources of genetic variability with respect to susceptibility to *Claviceps africana*. Developing methods involving AFLPs and satellite DNA for pathogen analysis.

Miguel Hernandez: Evaluating the low temperature tolerant sorghum germplasm from Neal Mclaren. Cold tolerant lines have more than 90% pollen fertility compared to Mclaren's. Flowering period is a function of altitude; the higher the altitude the longer the pollination period. Identifying lines tolerant to ergot and incorporating the genes into commercial lines. Studying the biology of flowering as a function of genotype. Using allozyme analysis of cold tolerant lines to identify differences and better understand the biochemistry of tolerance. Identified differences in exudate profiles among susceptible and tolerant hybrids.

Juan Valdez: The most important impact of ergot has been on the issues of quarantine. They moved a seed production area. Evaluating hybrids for susceptibility to ergot. Used a ratoon crop because the environmental conditions are ideal for ergot during this period. It was a very severe test. Used a rating system to evaluate the hybrids; 0, 1/3, 2/3, and 3/3 kernels affected. They could identify no complete source of resistance. They grouped the hybrids according to tolerance rating and were able to make recommendations accordingly. Developing ergot inoculation techniques; spray panicle with water using spray bottle or atomizer, spray panicle with water then cover, or use of a sponge as well as time and frequency of inoculation. Evaluations were made at 10, 15, and 20 days after inoculation. Similar results from inoculation techniques but a big difference with plus or minus covering the plants after inoculation.

Leonardo Soltero: Area near Chalapa Lake, Jalisco State has maximum temperatures of 30 C and 75-80% RH. Determining the host range of the ergot pathogen. Determining incidence and severity on commercial grain and seed production fields. Distributed information sheets to producers to help them identify tolerant hybrids. The information includes agronomic data on flowering characteristics and maturity features. Evaluating lines for leaf blight resistance, stalk rot resistance, and ergot tolerance using natural inoculation.

Business

Discussion of future direction of NC-227 began. The suggestion to invite representatives from industry to become full members of the committee was discussed and met with general agreement. The inclusion of INIFAP as part of NC-227 meetings is considered to be very positive and should continue. It was decided to hold a meeting in spring of 2003 to discuss the future of this regional committee perhaps in association with the Grain Sorghum Research & Utilization Conference (NGSP/SICNA) scheduled for February 16-19, 2003 in Albuquerque, NM.

The committee ratified the appointment of Jeff Pedersen to become Chairman of NC-227 for the next year. Charlie Rush of the Texas Agricultural Experiment Station Texas A&M University was elected NC-227 secretary for 2002-03.

The members of NC-227 thanked Gary Odvody for his service as chair of this committee for 2000-2001 and thanked Dale Vanderholm for his service as administrative advisor to this committee.

The meeting was adjourned at 1:30 PM on 20 March 2002 and attendees embarked on the field tour of breeding nurseries and commercial seed production fields.

Approved:

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James Stack date
Acting NC-227 Secretary 2001

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Dale Vanderholm date
NC-227 Administrative Advisor 2002

*Full reports from each state follow in Appendix A

Appendix A

NC-227 Sorghum Ergot
State Reports: 2002

Nebraska

investigators	**contact**
Dr. James Stack University of Nebraska Department of Plant Pathology South Central Research & Extension Center Clay Center, Nebraska 68933	e-mail: jstack@unlnotes.unl.edu phone: 402-762-4435 fax: 402-762-4422
Dr. James Partridge University of Nebraska Department of Plant Pathology Plant Science Building Lincoln, Nebraska 68583	e-mail: jpartridge@unlnotes.unl.edu phone: 402-472-3160 fax: 402-472-
Dr. Jeffrey Pedersen USDA-ARS University of Nebraska Department of Agronomy Lincoln, Nebraska 68583	e-mail: jfl@unlserve.unl.edu phone: 402-472-1754 fax: 402-472-

Project Number: NC-227

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Period Covered: 1 January 2001 to 31 December 2001

Date of this Report: 19 March, 2002

Annual Meeting Dates: 19-21 March 2002

Accomplishments and Impacts:

Biology of *Claviceps africana* and sorghum ergot disease: Research continued on the effects of temperature on infection and development of ergot in susceptible sorghum hybrids. Research resumed on the biology of conidia germination as affected by temperature, suspension matrix, and bacterial competition. Differential temperature effects were observed as a function of suspension matrix; macroconidia within a honeydew matrix were much less sensitive to extremes of temperature than macroconidia within water. This was true for both high (50^{O} C) and low (-20^{O} C) temperatures.

Sorghum Ergot surveillance and detection program: Surveys were conducted throughout the growing season across the state of Nebraska. Plots plants to a susceptible male sterile hybrid were planted at specific locations and monitored for the presence of the disease. Ergot was not detected at any location on any hybrids at any point during the growing season. Progress on the development of PCR-based techniques for the detection of *C. Africana* and to distinguish between *Claviceps* species slowed this year but this research remains a priority.

Related Sorghum Research: Based on the previous four years observations, we predicted ergot to be low or non existent in Nebraska for 2001. Consequently, we conducted research on other prevalent sorghum diseases in Nebraska. Panicle diseases are major constraints to sorghum [*Sorghum bicolor* (L.) Moench] production in the Northern Great Plains. F_1 hybrids with four nuclear genotypes in each of two cytoplasms (A_1 and A_2) were planted in three diverse locations in Nebraska. The incidence and severity of head blight and grain molds were recorded. Fusarium head blight ranged in incidence from 13% to 100% across all locations. Grain mold, caused primarily by species of *Alternaria* and *Cladosporium*, ranged in incidence from 5% to 100% across all locations. There was a significant effect of hybrid on the incidence of head blight and grain mold and the severity of grain mold at all three locations. Cytoplasm had no significant effect at any location.

Publications:

REFEREED JOURNAL ARTICLES

Stack, J. P. and Pedersen, J. F. 2001. Expression of Susceptibility to Fusarium Head Blight and Grain Mold in A1 and A2 Cytoplasms of Sorghum Bicolor (l.) Moench. (submitted to Plant Disease)

Partridge, J.E., Stack, J.P., Delserone, L.M., Tooley, P.W., Jensen, S.G. 2001. A PCR-based Diagnostic Procedure for the Identification of *Claviceps africana*. (submitted)

PROCEEDINGS

Stack, J. P. 2000. "Recurring and Emerging Sorghum Diseases in North America." in Proceedings of Global 2000: Sorghum and Pearl Millet Diseases III, September 23-30, 2000. Guanajuato, Mexico: {In Press}

EXTENSION ARTICLES

Stack, J. P. 2000. "Sorghum Ergot in the Northern Great Plains." EC00-1879. University of Nebraska Cooperative Extension.

Kansas

K. D. Kofoid
Kansas State University

Major activity was collaborative effort with Mitch Tuinstra, Jacob Reed, Larry Claflin and Neil McLaren on genetic study of resistance in A3 hybrids of lines tentatively identified as resistant. Results of this study are being given by Dr. Tuinstra.

The study comparing seed set when pollination was delayed by 1-3 days after ergot inoculation was repeated. Results of this test were unexpected. Either the inoculum load was too heavy or the environment favored the quick development of the disease as there was no seed on any inoculated head, even when pollination was delayed by only 3 hours. A water only check had full seed set indicating that water on the stigmas did not interfere with normal seed set. This study is being repeated again this year.

Another study was conducted to determine the length of time before flowering that inoculum can remain viable. Panicles of 3 fertile inbred lines, RTx430, 86EON361, and RTx435 were inoculated when the head was half out of the boot (approximately 7 days before flowering), completely out of the boot (3 days before flowering), and 1 day before flowering. Five heads were inoculated at each treatment and all heads were bagged to prevent subsequent inoculation. While the bag may increase the humidity level, which favors disease development, it also increases temperature, which should retard disease development. Results of this study showed that all heads of RTx430 had ergot. The youngest heads of 86EON361 did not have ergot, but the other treatments did. RTx435 was intermediate in that 2 heads of the youngest treatment had only a few florets infected. It would appear from this study that ergot inoculum can stay viable for at least a week under favorable conditions. These results, coupled with a previous study that showed that steriles remain receptive to ergot infection for at least 16 days after flowering, means that there is a 3 week period of vulnerability to ergot infection.

Larry E. Claflin
Kansas State University

Kramer-Collins spore traps were positioned at Corpus Christi and Crosbyton, TX; Lahoma, OK; Garden City, Hays, Hesston and Manhattan, KS; and Clay Center, NE during the growing seasons of 1999-2000. Traps were monitored on a weekly basis to determine the presence of *Claviceps africana* micro- and macroconidia. Conidia were recovered at all locations throughout the time intervals. Ergot was observed in Corpus Christi and Manhattan in 1999 and only in Corpus Christi in 2000. Ergot conidia were not recovered from a sampler designed to collect fungal spores from rain. Viability of ergot conidia collected in Manhattan was approximately 75%.

An ergot prediction model developed by McLaren in South Africa and which was primarily based on minimum temperatures for pollen viability and optimum temperatures for ergot incidence was coupled with the SORKAM growth model. SORKAM is a growth model utilizing planting dates, irrigation scheduling, and yield potential based on moisture. Weather parameters for 30 consecutive years was utilized to determine the potential for ergot incidence in various Kansas locations and at Grand Island, NE. The maximum potential ergot incidence was less than 30% in all locations. For example, the location at Russell, KS would expect ergot incidence (28%) if sorghum was planted on June 20 and if relative humidity was 95% or more during a portion of grain development. Those locations East of Highway 81 would rarely observe ergot in sorghum. In general, those locations further North and at higher altitudes would be more likely to observe a greater incidence of ergot.

Resistance has been identified in several accessions to *Claviceps africana*. The mechanism of resistance remains unknown. Three accessions; TxARG1 (susceptible), IS8525 (intermediate) and IS14131 (resistant) were inoculated when the panicles had emerged from the boot with ergot conidia and then covered with plastic bags. After six and 13 hours, several florets were removed from the inoculated panicles, placed on a glass slide and the style dissected. The tissue was stained with cotton blue and examined under a 63x objective to determine if the conidia had germinated and the germ tube had penetrated the stylar tissue. Preliminary evidence indicates that more conidia had germinated and ramified the stylar tissue in TxARG1 than in IS8525 and IS 14131. Research is in progress to determine the ramification of floret tissue by ergot spores after 24, 36, and 48 hrs. In addition, if research reveals that the mechanism of resistance is likely physiological, *C. africana* conidia will be labeled with Green Fluorescent Protein to more accurately determine the exact site of penetration and the numbers of conidia that germinate in sorghum accessions with genetic variability.

M. R. Tuinstra
Kansas State University

Ergot Resistance in Grain Sorghum
J.D. Reed, M.R. Tuinstra, N.W. McLaren, K.D. Kofoid, N.W. Ochanda, and L.E. Claflin

Two experiments were conducted to evaluate ergot resistance in sorghum. In the first study, the objective was to evaluate combining ability for ergot resistance among previously identified sources of resistance. Five A3-tester lines and five pollinator lines representing different sources of ergot resistance were intercrossed using a Design-II mating scheme. The parent lines and hybrids were evaluated using a RCBD with 3 replications at three locations—Puerto Rico, Mexico, South Africa. Random heads were labeled and spray inoculated every other day throughout flowering (1×10^6 conidia ml^{-1}). Differences in ergot severity (%) were recorded at 30 d after inoculation and used to determine the ergot breakdown point for each entry. Significant differences in resistance were identified (Table 1). IS8525 appeared to have the best combining ability for ergot resistance across locations; however, the expression of resistance was highest in warmer environments.

In another study, 75 wild sorghum accessions were screened for ergot resistance in a greenhouse using a RCBD with 2 replications. Panicles were inoculated with a conidial suspension at tip flowering ($1x10^6$ conidia ml^{-1}). The panicles were then covered with a plastic bag to induce sterility. Plastic bags were removed after 7 d and inoculations were repeated. Differences in ergot severity were determined 30 d after inoculation. Analyses of variance were conducted to evaluate differences in resistance among entries. Six accessions were found to be free of ergot under these conditions (Table 2). These accessions are being crossed to A3TX430 for further characterization of F1 hybrids in male-sterile cytoplasm.

Texas

Gary Odvody
Texas A&M University

Occurrence and Impact of Sorghum Ergot in South Texas

Yearly recurrent in South Texas
    Active survival through the winter on feral sorghum and johnsongrass
    Not always seen during the growing season, especially dry years
    Ergot most prominent in November/December:cool temperature male-sterility, heavy dews
        - grain sorghum primarily winter nurseries in LRGV
        -forage sorghum: planted and volunteer or regrowth
        -johnsongrass

No sclerotia production in Corpus Christi
    Timed collections of infected male-sterile sorghum: no sclerotial development over 30 days from initial symptoms
        -High humidity favors fungal degradation most times of the year

Pearl millet ergot observed in LRGV early spring 2001, Beeville December 2001:Spp unk

Debbie Frederickson in Zimbabwe

Survival of *C. africana* conidia in honeydew and sphacelia was very poor under several natural and storage environments in southern Zimbabwe with most viability lost before 20 weeks after experiment initiation

Sclerotial formation only in the latest of three dates of planting in Southern Zimbabwe.
    Sclerotia in 60-70% of panicles/ only 4 and 8% sphacelia produced sclerotia in 2 varieties
    Hyperparasitism interrupted sclerotial development

Secondary conidia
At 60-80% RH, germination of secondary conidia optimal at 15ºC and iterative (preliminary).

Germination as low as 11ºC/as high as 34ºC (germ tube only)
    Resumed iterative germination within few hours at 20C

Under natural ergot infection in Southern Zimbabwe
    Lower survival (6 hr): higher ultraviolet irradiation (UVB) of the rainy season
    Higher survival (8-8.5 hr): lower UVB irradiation and temperature mid-May-June

Other Hosts
Physiological distinct population of *C. africana* on Hyparrhenia spp (grass)
    (collaborative with Sylvie Pazoutova, Czech Republic)

L.W. Rooney
Texas A&M University

Variation and Heritability of Ergot Tolerance in IS8525: A Progress Report

R.A. Mateo and W.L. Rooney
Texas A&M University
March, 2002

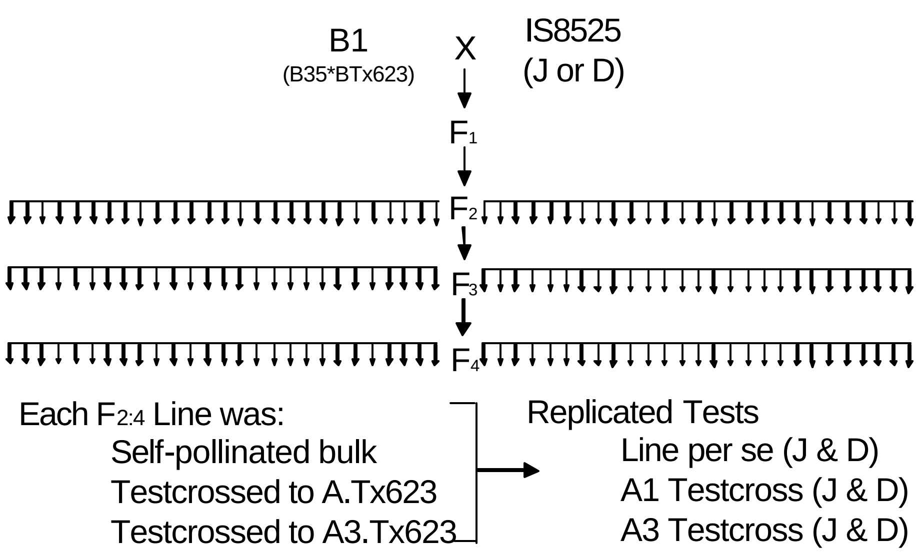
Introduction

IS8525 reported to have some level of tolerance to ergot (Claviceps africana)
Two distinct forms of IS8525
IS8525 juicy midrib (later, taller)
IS8525 dry midrib (earlier, shorts)
Need to evaluate both types

Objectives

Develop populations that can be used to determine if the ergot tolerance in IS8525 is real and heritable
Evaluate populations in multiple environments to determine variation and heritability for ergot tolerance
Line per se (fertile)
A1 cytoplasm testcross hybrids
A3 cytoplasm testcross hybrids

Population Development



Evaluation Environments

Line per se:

- Corpus Christi 2001
- College Station 2001
- Weslaco (fall) 2001

Testcross Hybrids

- Weslaco (fall) 2001
- Corpus Christi 2002
- College Station 2002

Experimental Design

Each combination in a RCBD with 2 replications (J = 40 RILs; D = 50 RILs)
Each plot inoculated with a hand sprayer at 25% anthesis. 10 panicles/plot inoculated over two days.
Ergot Ratings (three weeks post-inoculation)

- Incidence
- Severity

Severity Rating Scale

Ergot severity is the percentage of florets on a panicle that were infected with ergot on a scale of 0 to 5, where

0	0% of florets infected
1	1-5% of the florets infected
2	6-10% of the florets infected
3	11-25 % of the florets infected
4	26-50% of florets infected
5	> 50% of the florets were infected

Ergot Severity - Line per se

RIL extremes across environments

B1 X IS8525J Population

Loc	Entry	Pedigree	Severity	
CS	28	(B1*IS8525(J))-CS5	3.5	a
CS	17	(B1*IS8525(J))-CS35	3.3	a
CS	11	(B1*IS8525(J))-CS22	3.2	a
CS	33	(B1*IS8525(J))-CS45	0.9	b
CS	9	(B1*IS8525(J))-CS17	0.7	b
CS	34	(B1*IS8525(J))-CS46	0.7	b
CC	34	(B1*IS8525(J))-CS46	2.5	a
CC	5	(B1*IS8525(J))-CS11	2.3	a
CC	7	(B1*IS8525(J))-CS14	2.1	a
CC	33	(B1*IS8525(J))-CS45	0.0	b
CC	8	(B1*IS8525(J))-CS15	0.0	b
CC	9	(B1*IS8525(J))-CS17	0.0	b

B1 X IS8525D Population

Loc	Entry	Pedigree	Severity	
CS	53	(B1*IS8525(D))-CS9	2.7	a
CS	39	(B1*IS8525(D))-CS55	2.6	a
CS	31	(B1*IS8525(D))-CS40	1.9	a
CS	8	(B1*IS8525(D))-CS15	0.2	b
CS	19	(B1*IS8525(D))-CS28	0.2	b
CS	28	(B1*IS8525(D))-CS38	0.1	b
CC	12	(B1*IS8525(D))-CS2	1.5	a
CC	28	(B1*IS8525(D))-CS38	1.0	a
CC	48	(B1*IS8525(D))-CS66	1.0	a
CC	8	(B1*IS8525(D))-CS15	0.0	b
CC	19	(B1*IS8525(D))-CS28	0.0	b
CC	9	(B1*IS8525(D))-CS16	0.0	b

Line per se Summary

Ergot occurred in both locations and populations.
Significant differences among lines within a population (in both populations) .
Significant genotype x location interaction
Results indicate low to moderate heritability in all locations
Weslaco (fall) nursery had heavier ergot pressure, but is still be analyzed
Once WE (fall) nursery is ready, a combined analysis will be completed

Testcross Hybrid Results

A1 and A3 TC hybrids evaluated in Weslaco (fall) 2001.
All hybrids were male sterile
Infection was found in all hybrids, but there appeared to be variation among lines for severity.
Currently analyzing the data.
Hybrids will be evaluated in Corpus Christi and College Station this summer

Plans

Evaluation of A1 and A3 Testcross hybrids in Corpus Christi and College Station
Combined analysis of Line per se populations from 3 environments. Estimate GxE and heritability.
Individual and combined analysis of A1 and A3 testcross hybrids. Estimate GxE and heritability, and gene action for ergot tolerance.

Charlie Rush and Fekede Workneh
Texas A&M University

Epidemiological Studies on Sorghum Ergot and Development of a Disease Risk Assessment Model

Since the widespread 1997 epidemic, the occurrence of ergot in hybrid sorghum seed production fields has been sparse, easing fears that the hybrid seed industry in the Panhandle might be endangered. To determine whether climatic factors were associated with observed variations in prevalence of ergot, weather data (temperature, precipitation, and relative humidity) were collected from 7 weather stations in the Texas Panhandle. Sorghum ergot prevalence data for the period 1997 to 2000 were collected from records of seed companies in the Panhandle and related to weather variables. Results showed that, in the southern section of the Panhandle, maximum temperature and precipitation between August 1 and August 15 were associated (r^2 =0.98, P = 0.001 and r^2 = 0.81, P = 0.0193, respectively) with variations in the prevalence of ergot during the 4-year period. In the northern section, only maximum temperature during July 16 to July 31 was significantly associated (r^2 = 0.91, P = 0.0111) with disease prevalence. Over all, 1997 was wetter and cooler, during the August 1 to 15 period, than each of the subsequent 3 years. In addition to creating humid conditions for ergot development, precipitation was associated with suppression of maximum temperature enhancing ergot-favorable temperature conditions. Examination of historic weather data for the region showed that there were many instances in the past where temperature depression was associated with a rise in cumulative precipitation, creating ergot-favorable conditions similar to those in 1997. Cross-spectral analysis was used to determine whether such association is periodic. Weather data from 5 of the 7 locations in the region showed peaks of significant coherency (α < 0.05) at 2 to 4 years and 7 to 10 years or greater, indicating the existence of a periodic cycle in the temperature-precipitation association. The results of the investigation revealed that association of precipitation with temperature depression is a primary factor in development of ergot in the Texas Panhandle, and such association has a periodic cycle. For this reason, development of a user-friendly, weather-based disease risk assessment model would be beneficial to producers and the Texas hybrid sorghum seed industry.

Claviceps africana only infects flowering plants and cool humid weather favors disease development, however, such conditions are uncommon in the Texas Panhandle during peak flowering periods. Based on personal observations, analysis of past weather records and disease incidence data, we hypothesized that scattered thundershowers, which result in localized lower temperatures and elevated humidity, are highly correlated with development of ergot in seed production fields. Verification of this hypothesis would allow development of a disease-forecasting model for sorghum ergot, but the number and distribution of weather stations needed for recording such data is impractical. However, with NexRad radar, precipitation events from remote rural areas can be mapped with a high degree of resolution. With this technology, it should be possible to verify the correlation between scattered rainfall events and ergot development in seed production fields. Using NexRad radar in conjunction with climatic data and plant growth stage, we are in the process of developing a disease-forecasting model that provides an assessment of risk for individual grower's fields and early warning through an existing weather-based computer network. We have initiated collaboration with the National River Forecasting Authority in Tulsa and Ft. Worth, who will supply archived NexRad radar data, and Dr. Srinivasan with the Spatial Sciences Laboratory at Texas A&M University. His expertise is in modeling and computer programming and he has considerable experience in developing crop yield models based on remote sensing and NexRad radar data. This methodology will be used for our disease risk assessment model and Dr. Srinivasan's computer programming and crop modeling experience will facilitate transferring information to producers and seed companies.

Tom Isakeit and Noe Montes
Texas A&M University

To observe the effect of age of the sphacelium and temperature variation on the germination of *Claviceps africana* conidia through time, a test was conducted under controlled environment conditions. There were 16 treatments out of the combination of four ages of the sphacelium (0, 7, 14 and 21 days old beginning from the day that the sphacelium was first observed on the sorghum panicle) and exposure of the sphacelium to different temperatures (0, 7, 14, and 21/C).

Conidia located outside the sphacelium and stored at 21 /C lost more than 80% their viability after one month and germination was zero after 5 months exposure. External conidia exposed to 0 and 7 /C showed no differences among them and still had 10% germination after 6 months exposure to these temperatures. Conidia inside the sphacelium exposed to 14/C had > 40% germination at the beginning of the test but this germination declined rapidly to 5% after the fourth month. Internal conidia exposed to 0 and 7/C showed the same trend with greatest germination at the beginning but had a higher germination, 10 to 15 %, after 6 months. Conidia exposed to 21/C had zero germination at 6 months after the treatment.

The youngest conidia (0 and 7 days old) collected from the external surface of the sphacelium showed more germination at the beginning of the test but after six months it was the inverse situation with more germination of older conidia. Inside the sphacelium, it was the same situation at the start of the test but six months later the conidia collected from sphacelia aged 0 and 7 days old, gave a higher germination value of > 10%.