The 1998 National Fusarium Head Blight Forum

CHAPTER 5

NCR-184 and Other State Reports

Click here for Chapter Index

U.S. Wheat & Barley
Scab Initiative

Michigan State University • East Lansing, Michigan USA
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Compiled by:
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The 1998 National Fusarium Head Blight Forum

CHAPTER 5

NCR-184 and Other State Reports

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NCR-184 State Report Kansas 1998

R.L. Bowden, Kansas State University, Manhattan, KS

I. FHB situation in 1998 in Kansas

Due to cool, dry weather during grain filling, Kansas wheat generally had very high yields and low disease levels in 1998. There were only traces of Fusarium head blight in Kansas in the 1998 crop.

II. Programs and personnel involved in FHB research

1. Transgenic resistance

a) Dr. Wenpin Chen (Nanjing Agricultural University) is cooperating with Dr. Bikram Gill, Dr. S. Muthukrishnan (KSU Biochemistry), and Dr. George Liang (KSU Agronomy) to transform 'Bobwhite' wheat with a thaumatin-like anti-fungal protein from rice. The transformation was by biolistic bombardment and bialaphos was used as the selection agent. Symptoms of scab developed more slowly in transgenic plants of T_1, T_2, and T_3 generations expressing the *tlp* gene compared to non-transformed plants.

b) The same research group is working on incorporation of chitinase into wheat. Transformants have been obtained, but the gene was silenced. This needs to be repeated with a new construct.

2. Field and greenhouse screening

A field screening nursery with overhead misting was established in the fall of 1997 in Manhattan by Dr. Rollie Sears, Dr. Bill Bockus, Dr. Bob Bowden, and Mark Davis. KSU variety 2137 was highly susceptible to FHB. However, the varieties Ernie, Karl 92 and Heyne have useful levels of resistance. The source of those resistances is unknown.

Greenhouse screening gave similar results. In addition to resistance in Ernie, Karl 92 and Heyne, some resistance was confirmed in Agripro Hondo.

3. Breeding program

Dr. Rollie Sears is continuing to make crosses with advanced hard red spring wheat and soft red winter wheat lines with improved resistance to FHB. Early generations of several crosses will be evaluated in the greenhouse in the coming year.

4. Pathogen genetics and variability

Drs. Jim Jurgenson, Bob Bowden, and John Leslie produced a genetic map of a cross between a strain from Kansas and a strain from Japan using AFLPs. To date, eight linkage groups have been obtained. A pilot study to compare populations from Kansas and North Dakota using AFLPs is also under way. Data are being analyzed.

5. Gene Mapping

Dr. Gina Brown-Guidera is making some mapping crosses with Kansas sources of FHB resistance such as Heyne.

NCR-184
Management of Fusarium Head Blight of Small Grains

Minnesota State Report - 1998 Ruth Dill-Macky

State Report

Fusarium Head Blight (FHB or scab) of wheat and barley was present in the Red River Valley of Minnesota in 1998 although losses associated with FHB were likely lower than reported for any year since 1993. Moderate to severe epidemics of FHB have occurred annually in the Red River Valley since 1993. Good spring weather conditions resulted in most small grains being planted earlier than usual. Conditions early in the growing season were dry and generally accompanied by above average temperatures. Widespread and generally heavy rainfall throughout the state in mid June left standing water in many fields. Flooding, drown out, and lodging of small grains was common. The application of fungicides for the control of FHB was also common in some areas. The warm temperatures and excessive moisture promoted foliar diseases and raised concern among growers over the threat of scab. By mid July weather conditions changed and with little or no rain over much of the state. The dry conditions and above average temperatures pushed the development of all crops and likely reduced the impact of scab. The small grain crops were harvested was completed well ahead of previous years.
Growers were adversely affected by low prices for wheat (<$3.00/bu) and barley (<$1.00.bu).

Hard Red Spring Wheat

Minnesota wheat production was 41.0 bu/acre from 1,920,000 acres. Losses to FHB have been estimated at <4%. Losses to FHB were accompanied by significant losses to other leaf disease, particularly *Septoria* and tan spot. Wheat crops planted in the southern half of the state were generally less affected by all diseases, including FHB.

Barley production

Minnesota barley production was 25,025,000 bushels harvested from 455,000 acres. The total production figure fell below that of 1997 and indicated another significant drop in production from 1996. Yields averaged 54 bu/acre which represents a significant reduction from 64 bu/acre in 1996. Losses to FHB were likely compounded by damage due to standing water and some loss due to foliar diseases. Financial losses to barley producers also resulted from discounted prices related to the presence of DON in harvested grain.

In Minnesota, a cooperative research program aimed addressing issues relating to the management and control of FHB was established in 1993 with funding from the Minnesota state legislature, the Minnesota Wheat Council, Minnesota Barley Council and the American Malting Barley Association.

Wheat - variety development, germplasm introduction, and biotechnology

J.A. Anderson (Agron.& Plant Genet.), R.H. Busch (USDA-ARS), R. Dill-Macky (Plant Path.), G.J. Muehlbauer (Agron. & Plant Genet.), J.J. Wiersma (AES-NWES), J.V. Wiersma (AES-NWES).

Breeding for resistance to FHB is currently the primary focus of the hard red spring wheat breeding program in Minnesota. Expansion of the breeding effort is anticipated following the recent appointment of Jim Anderson to the faculty of Agronomy and Plant Genetics. Selection is being used in an attempt to combine various sources of resistance. Germplasm currently being used for resistance include Sumai 3, Wang Shui Bai, Ermai 9, F-5114, F-5125, F-60096, Ning 7840, Ning 8306, Ning 8331, Wuhan, Wen Zhou Hong He Shang (WZHHS), Yumai 7, Yanshi 9 and the Japanese line Nyu Bai. New sources of resistance and Agripro's intermated scab resistant sources are also being evaluated. Field screening continues to be conducted at multiple locations including; St. Paul, West Central Experiment Station (WCES), Morris, and Northwest Experiment Station (NWES), Crookston. All nurseries are inoculated and misted. Greenhouse screening is being conducted at St. Paul using point inoculations to evaluate Type II resistance. Winter increase nurseries are being conducted in California. Molecular approaches to developing resistance in wheat have been expanded following the appointment of Gary Muehlbauer and Jim Anderson to the faculty. Research has focussed on the discovery of novel anti-fungal genes and the utilization of genes in genetically engineered wheat and on

determining the relationship of new resistance genes to known resistance genes in wheat.

Barley - variety development, germplasm introduction, and biotechnology

R. Dill-Macky (Plant Path.), G.J. Muehlbauer (Agron. and Plant Genet.), D.C. Rasmusson (Agron. & Plant Genet.), J.J. Wiersma (AES-NWES), J.V. Wiersma (AES-NWES).

Resistance to *Fusarium* infection and reduction in the production of DON in grain are equally important goals of the barley program. Screening nurseries have been conducted at multiple locations (St. Paul, WCES, NWES) since 1994. Greenhouse evaluations are being conducted using macroconidial inoculum applied with an airbrush inoculator. Breeding material is also evaluated at two locations in P.R. China in cooperation with NDSU. Potential sources of FHB resistance under evaluation include; Chevron, Gobernadora, Kitchen, Zhedar 1, and Zaoshu 3. DON analysis are being used routinely in the evaluation of breeding materials. Molecular work has been directed to the discovery of new genes for resistance, mapping of resistance genes in barley, and to the development of marker-assisted selection to introduce resistance into and barley. A search for a new faculty position in barley breeding is currently in progress at the University of Minnesota.

Toxicology - DON detection and analysis

A Department of Plant Pathology Research Facility managed by W. Xie (Plant Path.)

Analytical services for the detection and quantification of DON have been established to provide for the needs of breeding programs, other research projects and for crop surveys. Barley lines are also being evaluated at a laboratory at NDSU under the direction of Dr Paul Schwartz.

Epidemiology, disease management, and chemical and biological control

R. Dill-Macky (Plant Path.), R.K. Jones (Plant Path.), A.L. Sims (AES-NWES)

Research aimed at examining the relationship between the decomposition of host residues and the survival and production of *G. zeae*/*F. graminearum* inoculum were initiated last fall. This research compliments earlier studies on the role of tillage and residue management strategies. Continuing studies on the efficacy of chemicals to control FHB were conducted in 1998. As in previous years, tebuconazole and benomyl provided the greatest reduction in FHB, scabby kernels and DON levels.

Fusarium Head Blight research at the USDA-ARS Cereal Rust Laboratory, St Paul

W.R. Bushnell (USDA-ARS), K.J. Leonard (USDA-ARS), L.J. Szabo (USDA-ARS)

ARS funding resulted in the addition of two scientific positions, one in epidemiology and the other in fungal genetics, to the staff of the Cereal Rust Laboratory. These two positions, in combination with a redirection of the research efforts of other positions at the CRL will result in the equivalent of two full time positions working on Fusarium Head Blight. Research on Fusarium Head Blight of hard red spring wheat, hard red winter wheat and barley will be undertaken. Candidate interviews for these positions are presently in process.

FUSARIUM HEAD BLIGHT IN CANADA IN 1998

J. Gilbert and A. Tekauz

Parts of western Canada, especially southern Manitoba, have experienced losses in yield and quality of wheat since 1993 due to fusarium head blight (FHB). In 1998, incidence and severity of the disease were similar to the 1996 and 1997 levels, resulting in estimated losses in yield of $50 M in wheat. In barley, losses were about $10 M representing an increase of 2-3 times over 1997, although, as in past years, barley sustained lower losses than wheat, 5.5% compared to16%, respectively. The disease was found in all fields surveyed. A high proportion of severely-infected fields (more than 20% FHB) were in the west of the province, as in 1997, but also further north than in past years. Levels of FHB varied from field to field reflecting variability in rainfall patterns during the flowering period. Later-seeded crops escaped significant levels of infection, but the main wheat and barley crops (75%) were seeded by the end of April - beginning of May, as a result of an early spring and these were hardest hit by FHB. For a second consecutive year, winter wheat planting significantly increased in Manitoba as producers sought to avoid FHB. Unfortunately, June rains resulted in widespread disease. Individual fields were severely infected, indicating that the currently grown cultivars are highly susceptible to the disease. Winter wheat fields in the centre of the province were hardest hit, although overall levels of FHB were only 2.5% as opposed to 16% in the spring wheats.

The increased levels of FHB occurring in Saskatchewan are a cause for concern. It is estimated that incidence increased ten fold in each of 1997 and 1998 in southeastern Saskatchewan. In 1998, the disease was widespread across the province, and at high levels in individual fields. In general, however, levels were low in comparison to Manitoba. The predominant species causing FHB in Manitoba is *Fusarium graminearum*; in Saskatchewan, other *Fusarium* species, including *F. poae*, *F. avenaceum*, *F. sporotrichioides*, and *F. culmorum* were common. *Fusarium graminearum* was isolated from grain close to the Manitoba border and in the northwest parts of the wheat-growing areas of the province.

In Alberta, the predominant species isolated from seed included *F. avenaceum* and *F. culmorum,* but *F. graminearum* was isolated at trace to low levels from a few samples from all crop districts of the province. This is in contrast to a 1995 survey when no *F. graminearum* was isolated.

In eastern Canada, no data from uniform regional surveys are available to report at this time. In southern Ontario, FHB was local and did not cause significant losses in winter wheat. Measured as DON content, the average levels were well below 1.0 ppm with a few spikes measuring 1.0 to 3.0 ppm. In eastern Ontario, rain at flowering resulted in infection in the spring wheat crop. In Quebec, high levels of the disease occurred. Information for the maritime provinces is unavailable at this time.

1998 STATE REPORT ON *FUSARIUM* HEAD BLIGHT FOR THE COMMONWEALTH OF VIRGINIA

Carl A Griffey

Small grain production in Virginia was severely impeded by a late-spring freeze, excessive precipitation and epidemics of previously minor diseases such as *Fusarium* Head Blight, Tan Spot and Basal Glume Rot (*Pseudomonas* spp.). Scab epidemics were widespread especially in fields planted no-till behind corn, and resulted in great yield loss. The state average wheat yield in 1998 was 20 bushels lower than the record set in 1997. This loss of 5 million bushels in production alone represents a fiscal loss of 12.5 million dollars, and does not account for any loss due to reduced quality. While scab was prevalent in both conventional and no-till fields, its incidence and severity were much higher in fields planted into corn stubble. In the absence of disease epidemics, no-till production of small grain is beneficial both economically and environmentally; however, until effective and stable resistance to *Fusarium* is incorporated into commercial wheat cultivars, the crop is at grave risk under this regime. Therefore, this phenomenon is likely to have a global impact on both crop production and the environment unless major research is directed towards this area.

Research on *Fusarium* in Virginia is focused on germplasm evaluation, breeding and epidemiology. Through germplasm evaluation during the past two years, seven Chinese wheat lines were confirmed to possess very good type II resistance, and the Virginia cultivar Roane was shown to possess type IV and V resistance. Seven additional resources with type II resistance and three soft red winter wheat cultivars with type IV and V resistance were verified in 1998 tests. Type II resistance from spring wheat genotypes has been incorporated into soft red winter wheat backgrounds, some of which possess type IV and V resistance. Several F4 lines with type II and/or other type of resistance were selected and advanced for further testing in 1999. A diallel cross among ten resistant parents of diverse origin was made this year in order to genetically differentiate them and to facilitate introgression of diverse genes into adapted cultivars. Climatic data was collected and spore counts were assessed to discern the relationship between time and magnitude of conidial spore release, plant growth stage and incidence and severity of *Fusarium* infection.

NCR-184 REGIONAL COMMITTEE SCAB OF WHEAT PROGRESS REPORT 1998

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Status of FHB in 1998.

Fusarium Head blight of did not occur naturally this year due to the drought conditions throughout much of the state.

1. Overview of State Research Programs.

a. Fungicide *Field Trials*. (P. Hart and R. Ward). Three winter wheat varieties (Bavaria - highly susceptible; Freedom- moderately susceptible; and Ramrod- moderately susceptible) were inoculated at described above, and evaluated for yield, test weight, disease incidence, disease severity, and DON levels (Table 1). Fungicides were Benlate/manzate, Tilt, Quadris, and Folicur. The affect of fungicide treatment on yield was variable. When the affect of fungicides on DON levels were averaged across all varieties there was no fungicide that provided superior reduction over the other fungicides. However, as in the 1997 fungicide trials the application of Quadris at growth stage 10.3 generally increased the levels on DON. Fungicide trial plots were irrigated with fine mist overhead sprinkling. All experimental treatments were replicated four times.

b. Variability of deoxynivalenol in truckloads of wheat (P. Hart and O. Schabenberger). DON was found to be heterogeneous throughout truckloads of freshly harvested spring wheat in Grand Forks, N. D. In the five truckloads sampled, DON was distributed unequally in both discrete layers, and in depth. This study confirmed the 1996 sampling study showing heterogeneity between probes, and in addition showed heterogeneity as discrete samples were collected at different levels in the trucks. Statistical analysis is underway to validate or modify the sampling recommendations developed from the 1996 study.

c. Screening a nursery of commercial varieties for FHB reaction (Ward and Hart). Commercial varieties were screened for FHB reactions. Inoculation and irrigation were as described above. At this location, located in Clarkesville, MI., the incidence and severity of FHB was low. DON levels ranged from a low of zero to a high of 3.2 with an overall average of 0.9 g DON/g grain.

d.Toxic Effects of Trichothecenes (J.J. Pestka). Leukocytes (or white blood cells) are primary targets of the trichothecenes. *We have hypothesized that the levels of VT and closely related 8-ketotrichothecenes required for cytokine and apoptosis induction will be identical in mouse and human leukocytes*. Three critical leukocyte types- the macrophage, T cell and B cell are being assessed in this study. We are currently evaluating murine cell clones as sources for these leukocyte types and will follow these studies up by reconstituting these findings with purified subsets obtained from spleens and lymph nodes of mice. Using the above approaches , we will develop quantitative structure-activity relationship(QSAR) models for members of the 8-ketotrichothecenes including 3-acetyl deoxynivalenol, 15-acetyl deoxynivalenol, nivalenol and fusarenone as well as their specific detoxification products. Specifically, we will correlate biological activities with structural features (Free Wilson analysis) or with molecular properties such as lipophilicity, polarizabilty, electonic and steric properties. With the availability of Fusarium Head Scab research funds, we will expand these models to include human macrophage, T cell and B cell clones and subsequently evaluate primary cultures derived from peripheral blood mononuclear cells (PBMC) of human volunteers.

The RAW 264.7 murine cell line was used as a macrophage model to assess effects of the VT on proliferation and the production of nitric oxide (NO), hydrogen peroxide (H_2O_2) and cytokines. Using the MTT cleavage assay, VT at concentrations of 50 ng/ml or higher was found to significantly decrease proliferation and viability of RAW 264.7 cells without stimulation or with stimulation by lipopolysaccharide (LPS) or interferon (IFN)-. In the absence of an activation agent, VT (25-250 ng/ml) had negligible effects on the production of NO, H_2O_2 and cytokines. Upon activation with LPS at concentrations of 10 to 100 ng/ml, VT at 25 to 100 ng/ml markedly enhanced production of H_2O_2 but was inhibitory at 250 ng/ml. VT enhancement of H_2O_2 production was observed as early as 12 h after LPS stimulation. When IFN- was used as the stimulant, VT (25 to 250 ng/ml) delayed peak H_2O_2 production. VT (25-250 ng/ml) also

markedly decreased NO production in cells activated with LPS or IFN-g. Interestingly, VT superinduced TNF-a and IL-6 production in LPS-stimulated cells and also elevated TNF-a in IFN- stimulated cells. These results suggest that VT can selectively and concurrently upregulate or downregulate critical functions associated with activated macrophages.

2. **Regional DON analysis** (Hart). A regional DON analytical laboratory was established to provide DON analysis for small grain researchers in eastern United States. Technical support was provided by the USDA, and a there was charge of $5.00/sample to cover the costs of the Neogen Corp analytical tests. Approximately 1350 samples were analyzed. Significantly more samples are expected in the future as the National Scab Initiative progresses. More samples would be expected in a FHB epidemic year which did not occur in this region in 1998. One-tenth of the samples submitted were from the midwest region (ie west of the Mississippi).

Table 1. Comparison of fungicide treatments on Fusarium Head Blight in three winter wheat varieties. Plots were inoculated with *Fusarium graminearum* grown on cracked corn, and spread throughout the plots. The plots were sprinkler irrigated with an overhead system.

variety	treatment	Test wt. (lbs/bu)	bu/acre	Incidence[3]	Severity[4]	Vomitoxin (ppm)
Bavaria	Ben/Man	45.9	47.7	63%	6.4	2.2
Bavaria	Folicur	49.8	48.0	64%	6.9	3.0
Bavaria	Quadris	46.1	45.8	59%	6.5	5.1
Bavaria	Tilt	46.7	42.7	60%	6.6	3.8
Bavaria	Control[1]	47.3	44.7	69%	7.3	4.0
Bavaria	Control(-Tilt)[2]	47.9	46.2	63%	6.7	3.7
Freedom	Ben/Man	48.9	41.9	42%	4.9	1.2
Freedom	Folicur	43.1	46.7	45%	5.3	1.2
Freedom	Quadris	47.9	40.4	43%	5.3	2.2
Freedom	Tilt	46.4	42.0	40%	5.0	1.0
Freedom	Control	48.0	42.5	46%	5.4	1.2
Freedom	Control(-Tilt)	42.4	43.2	48%	5.4	0.9
Ramrod	Ben/Man	47.0	44.7	38%	5.4	3.1
Ramrod	Folicur	47.5	43.9	48%	5.1	2.3
Ramrod	Quadris	47.3	44.4	36%	5.1	6.5
Ramrod	Tilt	48.0	45.6	40%	4.9	3.9
Ramrod	Control	47.8	38.8	38%	5.1	2.7
Ramrod	Control(-Tilt)	47.6	43.2	41%	5.0	4.1

[1]Control indicates replicated plots treated with Tilt at growth stage 8 to reduce the incidence of foliar diseases. [2]Control (-tilt) indicates replicated plots not treated with Tilt at growth stage 8. [3]Incidence based on percent of heads with symptoms. [4]1-10 scale, 1=no symptoms, 10=symptoms on 100% of heads.

Table 2. Average DON levels within varieties across all fungicide treatments, and within all fungicide treatments across all varieties.

Variety/treatment	*Replications*	*Average (DON ppm)*
Freedom	6	1.28
Bavaria	6	3.63
Ramrod	6	3.77
Tilt	3	2.90
Folicur	3	2.17
Quadris	3	4.60
Manzate	3	2.17
Control[1]	3	2.63
Control(-Tilt)[2]	3	2.90

[1]Control indicates replicated plots treated with Tilt at growth stage 8 to reduce the incidence of foliar diseases. [2]Control (-tilt) indicates replicated plots not treated with Tilt at growth stage 8.

Illinois Report — NCR-184 October 1998

Frederic L. Kolb[1], Guihua Bai[2], Larry Boze[1] and Norman Smith[1]

Illinois Wheat Production:

Wheat yields were average to below average for much of Illinois in 1998 with an estimated state average yield of 49 bu/A on 1.2 million acres for a total production of 58,800,000 bushels. This was 16 % less production than in 1997. The winter was very mild in Illinois with dense stands coming out of winter dormancy. A spring freeze caused some damage to some fields and some varieties, but the damage was not widespread. Excessive soil moisture in the spring, scab (Fusarium head blight), and septoria leaf blight and glume blotch all had detrimental effects on yields. Scab damage was spotty in 1998 with severe losses in some localized areas and little damage in others.

University of Illinois Research:

A wheat variety, Kaskaskia, was released in 1998. Kaskaskia is high yielding, has excellent test weight and winter hardiness, and is moderately resistant to scab.

Development of scab resistant germplasm and varieties continues to be a major research emphasis in the wheat breeding program. The long-term objective is the development of soft red winter wheat genotypes with excellent resistance to scab combined with resistance to other diseases, high yield potential, and acceptable winter hardiness and milling and baking quality. Our short-term objectives are: 1) to combine genes for resistance to scab from diverse sources; 2) to evaluate the genotypes produced from crosses and identify those with resistance to scab; 3) to identify molecular markers associated with genes for resistance to scab; and 4) to work toward using molecular markers to assist in breeding for scab resistance.

We are evaluating scab resistance using both greenhouse and field procedures with misting systems and inoculation. We had very high incidence in the 1998 scab evaluation field nursery. We inoculated the field nursery with wheat seed on which a mixture of *Fusarium graminearum* isolates had been cultured. Infected wheat seed was scattered on the ground in the nursery several times beginning about one month before flowering. The nursery was mist irrigated each day (one hour in the morning and one hour in the afternoon) unless it rained. The mist irrigation system delivered a fine mist and applied 0.12 inch of water per hour. Mist irrigation began when the earliest plants began flowering and continued until all plants had flowered. Scab symptoms were rated in the field nursery by estimating incidence in each row and by evaluating severity on 20 random heads from each line (10 heads in each of two replications). Material evaluated included germplasm reported to be tolerant / resistant, current varieties, and experimental lines. In 1998 we evaluated about 750 experimental breeding lines and varieties in the inoculated, misted field nursery, and, based on field symptoms and evaluation of kernels, some experimental lines with scab resistance were putatively identified. We collected agronomic data on previously identified scab resistant lines, and putatively scab resistant plants were selected from 7 segregating F_4 populations. These materials will be evaluated further to determine the level of resistance.

Using a population of lines from a cross of resistant and susceptible cultivars, we conducted research on identification of molecular markers linked to scab resistance. About 300 combinations of AFLP (amplifed fragment length polymorphism) primers were screened, and eleven AFLP markers showed significant association with scab resistance. Most of these molecular markers were located in one chromosome region. A manuscript on these markers has been submitted for publication, and additional research with these markers is in progress. This research is in cooperation with Guihua Bai,USDA-NCAUR; Greg Shaner, Purdue University; and Les Domier, USDA-ARS at Urbana, Illinois.

[1] Department of Crop Sciences, University of Illinois
[2] USDA-NCAUR

Personnel:

Larry Boze joined the University of Illinois project as a Research Specialist in May, 1998. Larry holds an M.S. from the University of Minnesota and has had extensive experience in plant breeding, primarily with maize.

Fusarium Head Scab Ratings of Varieties - 1997 & 1998

	Inoculated, Misted Nursery at Urbana			
Variety	'97 Scab Index	'98 Scab Index	'97-'98 Scab Index Average	'98 Seed Rating
	(0-100)	(0-100)	(0-100)	(0-9)
Ernie	14	29	22	4.5
Patton (Agripro)	25	22	24	5.5
Foster (Agripro)	20	39	29	5.5
Cardinal	30	34	32	7.5
Pontiac (Agripro)	36	32	34	7.0
Kaskaskia	39	33	36	7.0
2571 (Pioneer)	39	37	38	6.0
2548 (Pioneer)	57	43	50	7.0
Howell	59	82	50	6.0
Clark	65	39	52	7.0
2540 (Pioneer)	53	58	55	9.0
Caldwell	58	63	60	6.0
Madison	49	82	65	8.5
Patterson	73	63	68	4.5
LSD (.05)	20	24	–	--
CV (%)	25	33	–	--

Scab Index: 0 = no symptoms; 100 = all heads infected and severe spread within every head.
Seed Rating : 0 = excellent, no scabby seeds; 9 = all seeds scabby and shriveled.

184 —Management of Head Scab of Small Grains 1998 Ohio Report

Patrick E. Lipps, Department of Plant Pathology
Kim Garland Campbell, Department of Horticulture and Crop Science
The Ohio State University, OARDC, Wooster

NCR-State Report:

1)There was very little damage from FHB in Ohio in 1998. Warm temperatures in April and May advanced the heading of the crop by about 7 to 14 days. The early wheat varieties went into bloom during the second week of May in southern Ohio during a 2-3 day rain period, but most of the crop flowered during the third week of May throughout he rest of the state. Most of the wheat flowered during a 10-day dry period. FHB severity ranged from 0 to 25% of heads affected in individual fields in the early maturing varieties in southern Ohio. However, fields with over 5% of the heads affected were rare.

2) Wheat production, market class and yield loss estimate: 1,160,000 million acres of soft red winter wheat were planted in Ohio in 1997 for the 1998 growing season. The state average yield was 64 bu/A. Yield loss to FHB was probably less than 0.2%.

3) Research: Research efforts at OARDC were focused on evaluating wheat breeding lines and varieties for resistance to scab. Infested corn kernels were used to inoculate plots and mist irrigation was used to maintain moisture during the early morning and late evening hours. Scab symptoms developed by three weeks post anthesis, permitting only a five day period for disease evaluations before senescence.

One of four locations where the Ohio Wheat Performance Trial was planted had sufficient disease to permit evaluation of commercial varieties under natural conditions. Over 60 lines were assessed for scab severity. Scab severity was assessed as the percentage of heads affected in plots. Severity ranged from 0 to 33% of the heads affected across the varieties (See Table 1). The average percentage heads affected was 3% across all varieties in the test. Only five varieties had over 10% heads affected (Pioneer 25R57, Coker 9543, Corn Belt X-15, Styer's Gregory, and Seed Consultants SC 1308).

4) Personnel and physical resources directed at FHB research:

FHB research is conducted as part of the wheat breeding program in cooperation with Dr. Kim Campbell in wheat breeding and Dr. Pat Lipps in plant pathology. Physical resources includes those necessary for greenhouse and field screening. Depending on the level of funding, future research will focus on genetics of resistance, developing lines with improved resistance, epidemiology and chemical control.

Table 1. Reaction of soft red winter wheat varieites to moderatley low levels of head scab near Circleville, Ohio, 1998

Brand	Cultivar	Yield	% Scab*	Brand	Cultivar	Yield	%Scab*
AGI	540	83.8	1	LG Seeds	LG1388	88.5	0
	550	86.1	1		LG1433	81.6	0
AGRA	GR962	93.1	6	NK	Coker 9474	79.8	1
	GR983	72.8	0		Coker 9543	67.3	33
Agripro	Bradley	61.5	3				
	Foster	83.9	2	NOSCO	RW151	81.4	2
	Patton	92.1	1		RW1517	79.3	1
	Beck 107	73.8	0	Pioneer	2540	90.7	1
	109	82.0	1		25R26	89.0	1
Certified	Cardinal	93.3	1				
	Clark	74.2	7	Rupp	RS901	74.8	8
	Dynasty	80.4	4		RS927	83.2	1
	Freedom	87.5	0				
	Glory	91.6	2	Seed Consultant	SC1308	82.4	12
	Hopewell	96.2	1		SC 1358	72.1	0
	Patterson	77.6	5		SC1365	79.5	1
Countrymark	529W	76.7	0	Shur Grow	SG1545	78.9	1
	539W	87.4	3		SG1550	83.0	1
	558W	86.8	4		SG1555	70.6	0
	569W	90.8	0				
Corn Belt	X-15	73.4	12		Benjamin	83.6	2
Dyna - Grow	DG-411	87.9	4		Magers	66.7	0
	DG-422	89.3	8		Podach	86.4	2
	DG-424	90.9	0		Reino	82.2	1
	DG-426	88.4	1				
Hybritech	Q708	94.4	1		480	87.8	2
	Q7203	87.7	6		481	88.4	2
Terra	SR204	84.1	1				
Thompson	TS4020	76.2	2		W9710	80.2	1
	TS5020	81.7	3		W9830	77.2	0
	TS8040	71.0	0				

*Scab rating based on visual estimate of percentage heads affected.

NCR-184
ARKANSAS STATE REPORT — 1998

Gene Milus, Department of Plant Pathology, University of Arkansas, Fayetteville

In 1998, Arkansas farmers harvested 900,000 acres of soft red winter wheat with an average yield of 51 bushels per acre. Less than 1% of the acreage had visual symptoms of Fusarium head blight due in large part to cool and relatively dry weather immediately before, during and after flowering. Most of the affected acreage had only trace amounts of head blight, and the most severely affected fields had symptoms on about 1% of the heads. Losses due to head blight were negligible.

Backcross F_1, topcross F_1, and F_2, populations from crosses designed to transfer FHB resistance to the southern soft red winter wheats were selected in the field for heading date, plant height, yield potential, and resistance to leaf rust, stripe rust, and Septoria tritici leaf blotch. One or two heads from 83 to 165 plants from each of 78 populations were kept for advancement. To advance the populations, one or two seeds per head were sprouted, and 165 seedlings per population were vernalized and grown in a growth chamber. After 2 months, plants were moved to a greenhouse to make room for more populations. This past summer was one of the hottest on record, and populations moved to the greenhouse in July had poor seed set. Populations moved to greenhouse in September had good seed set. Head rows or bulks of these advanced populations as well as bulks of the non-advanced populations will be planted to the field this fall and will be selected for FHB resistance as well as the traits described above. See the report in the Proceedings of the Scab Forum for additional details.

Quadris and Benlate alone and in combination were evaluated for efficacy against FHB. Fungicides were applied once at 50% heading. Each treatment was evaluated in low and high disease pressure environments. The low disease pressure environment received less inoculum and lower volume of misting than the high disease pressure environment. Plots were inoculated with a conidial suspension of *Fusarium graminearum* at 10% and 50% flowering and were misted for approximately 16 15-minute intervals per day for 15 days following the first inoculation. No disease except scab affected the experiment. Treatments in the low and high disease pressure environments averaged approximately 10 and 50% blighted florets, respectively. The treatment effect for incidence was significant at $P = 0.056$ under low disease pressure and nonsignificant (0.75) under high disease pressure. Depending on how one interprets a P value of 0.056, all treatments with Quadris could be considered to reduce incidence under low disease pressure. None of the treatments had any effect on yield or level of DON in the grain. All treatments were above the desired level of 2 ppm DON. Three of the Quadris treatments significantly increased test weight at low disease pressure. None of the treatments provided an economic level of protection against head blight. See the report in the Proceedings of the Scab Forum for additional details.

The uniform winter wheat scab nursery was planted at Fayetteville but was not inoculated because of a shortage of help and because the wide difference in heading dates among the entries seemed to preclude a valid test.

NCR-184 Committee - Management of Head Scab in Small Grains 1998 Iowa Report

Dr. Gary Munkvold, Dept. of Plant Pathology, Dr. Jim Holland, Dept. of Agronomy, Ms. Paula Flynn, Plant Disease Clinic, Mr. John Shriver, Dept. of Plant Pathology

Winter wheat production in 1998: The October 1 estimate for the Iowa winter wheat crop in 1998 was 32,000 acres harvested, an increase of 18% over 1997. Average yield for 1998 is estimated at 40.0 bu/acre, down from 42.0 bu/acre last year. Total production for 1998 is estimated at 1,128,000 bu. Weather was not conducive for scab development during anthesis, but rainfall was very high in June and some scab developed. Overall, the prevalence of scab was low. Foliar diseases were a major problem in some fields, limiting yields considerably.

Scab research: Currently, Iowa State University does not have a research program on scab. Variety tests are conducted by Dr. James Holland in the Dept. of Agronomy, but scab ratings are not taken and only a small number of entries are included each year. Iowa State University does not have an active wheat breeding program.

NEW YORK REPORT — 1998
NCR-184 Management of Scab of Small Grains— New York (Cornell University)

Project Leaders:
Gary C. Bergstrom, Professor, Plant Pathology (NCR-184 representative)
Mark E. Sorrells, Professor, Plant Breeding
Cooperators:
Ellen M. Chirco, New York Seed Testing Lab
William J. Cox, Professor, Soil, Crop, and Atmospheric Sciences
Stanley O. Kawamoto, Research Support Specialist, Plant Pathology
Wilmar C. da Luz, Research Plant Pathologist, EMBRAPA, Passo Fundo, Brazil
Donald Shardlow, New York Seed Improvement Project, Plant Breeding
Elson Shields, Associate Professor, Entomology
Larry Thompson, Director of Biosafety, Veterinary Diagnostic Laboratory

State Report:

Small Grain Production: Approximately 150,000 acres of soft winter wheat and 110,000 acres of spring oats.
Disease Occurrence: Scab occurred only at low incidence and very low severity in 1998 winter wheat produced in New York. All but the very late-planted winter wheat flowered during a generally dry period in May. No problems with vomitoxin contamination in grain were reported by elevators or flour mills in 1998.

Wheat Breeding/Evaluation: An irrigated scab nursery has been established in Ithaca. We are participating in the cooperative winter wheat scab nursery (results reported in Proceedings). An additional 50 regionally-adapted varieties and lines are also being evaluated. Also, scab reaction of over 75 lines derived from crosses of New York-adapted winter wheat cultivars with Chinese sources of resistance is being assessed.

Biocontrol: In cooperation with Dr. Wilmar Luz of Brazil we are continuing to assess potential biocontrol strains of bacteria and yeasts from Brazil and New York for control of scab (spike treatment) and scab seedling blight (seed treatment). We have also begun assessment of strains for suppression of development and sporulation of *F. graminearum* on corn stalks. Commercial-type formulations of bacterial antagonists were applied to winter wheat seed for field evaluation of microbial seed treatments in September 1998. Strains commercially formulated for aerial application will be applied to wheat spikes in field plots in May 1999.

Aerobiology Research: Graduate student Sandra Maldonado has begun Ph.D. studies on the aerobiology and epidemiology of *Gibberella zeae* relative to ascospore production and dispersal from sources on overwintered corn stubble. One of the objectives of the research is to measure vertical atmospheric gradients of ascospore dispersal relative to area sources of marked inocula in corn stubble. Radio-controlled model airplanes outfitted with remote-controlled spore traps will be utilized to collect *Gibberella zeae* ascospores in air currents.

Publications:

Bergstrom, G. C., S.O. Kawamoto, E.M. Chirco, and M.E. Sorrells. 1998. Effects of seed treatment on laboratory warm germination and field emergence of scabby winter wheat seed, 1997. Fungicide and Nematicide Tests 53:409-410.

Bergstrom, G. C., S.O. Kawamoto, and W.J. Cox. 1998. Effects of seed treatment seedborne Stagonospora nodorum blotch and yield of winter wheat from scabby seed,1997. Fungicide and Nematicide Tests 53:411.

NCR-184 Report 1998
North Dakota

This brief summary is condensed from the report "Current Research on Fusarium Head Blight at North Dakota State University 1998." References in the summaries below are to the individual items compiled there. The full report will be distributed at the 1998 NCR-184 annual meeting. Additional copies are available from the Office of the Director, North Dakota Agricultural Experiment Station, NDSU, Fargo 58105.

The FHB situation in North Dakota in 1998 and its impact on small grain crops.

In 1998, Fusarium Head Blight (FHB) was less severe than in 1997, but individual severely affected fields could be found throughout a large area of eastern and northern ND. According to Marcia McMullen, extension plant pathologist, and counties most affected were those in the Northcentral and Northeast crop reporting districts. Several of these counties are the same ones, which have seen severe FHB problems each year since 1993. Losses to FHB in 1998 were less overall than in previous years but loss in durum in 1998 was particularly severe, greater than in 1997.

Overview of present research programs.

As presented in the full report, the research described involves contributions by scientists representing six NDSU departments, NDSU Research - Extension Centers, NDSU Extension, and the USDA-ARS Northern Crop Sciences Laboratory. Most of the reports have multiple authors, attesting to the collaboration among individual scientists and between departments and other units in these research efforts.

While the principal research emphasis at North Dakota State Univ. continues to be on breeding for, and genetics of resistance to FHB, there is also active research in several other areas including epidemiology , physiology and biochemistry, cereal science, disease surveys, and chemical control.

Introducing resistance to FHB into adapted genotypes remains a major effort in the breeding programs for hard red spring wheat, durum wheat and barley. Several advanced FHB-resistant hrsw lines have been through two years of yield and quality trials and are candidates for release in the near future. In durum wheat, which is tetraploid, efforts to introduce resistance from hexaploid wheat are being renewed. To date, several hundred exotic durums have been screened for FHB response and a few used in experimental crosses. Other resistance sources being explored for durum include chromosome substitution lines and a wild tetraploid wheat, T. dicoccoides. Numerous barley accessions have been screened for FHB and for DON in nurseries in North Dakota and in China and these are being used as parents in an accelerated breeding program. The conventional breeding efforts are being enhanced by basic and molecular genetics studies on barley and spring wheat

Units involved in FHB Research.

NDSU:
*Dept. of Plant Pathology:
*Dept. of Plant Sciences.
*Dept. of Soil Science.
*Dept. of Cereal Science.
*Dept. of Food Science.
*Dept. of Veterinary Science and Microbiology.
*NDSU Extension Service
*NDAES Research-Extension Centers at Langdon, ND, Carrington, ND, Minot, ND.

USDA

USDA-ARS Northern Crop Sciences Laboratory, Fargo

NCR-184, Management of Head Scab of Small Grains 1998 SOUTH DAKOTA STATE REPORT

1998 Scab Development in South Dakota

Scab incidence ranged from 0 to 60%, and severity from 5 to 100% in the spring wheat region (northeast) of South Dakota. A higher than normal level of scab infection was observed on winter wheat in the eastern part of the state with incidence ranged from 5 to 30% and severity from 10 to 80%. Estimated yield loss due to scab is 3% for spring wheat and winter wheat grown in eastern South Dakota. (M. Draper and Y. Jin).

Current Research Projects
Breeding for scab resistance in spring wheat.

The incorporation of scab resistance has become one of the main objectives in the spring wheat breeding program. Breeding materials are evaluated for scab resistance using three generations per year: two generations in the greenhouse and one generation in the field nursery. Scab nurseries are inoculated with infected grains (corn and wheat) and conidial suspensions, and mist-irrigated to provide a favorable environment for infection. Spikes are evaluated for disease severity and the harvested grain is also evaluated. In 1998, twelve lines with Sumai 3 background were evaluated in advanced yield trials (7 locations with 3 replicates). Two of these lines are being increased this winter and next summer for possible release in 2000. The scab resistance of these two lines appears to be similar to Sumai 3 with better kernel retention characteristics. The grain yield is approximately 10% lower than 'Russ' and 'Oxen'. (J. Rudd)

Breeding for scab resistance in winter wheat

Breeding efforts for improved head scab resistance in winter wheat are currently focused to address: i) characterization of scab resistance or tolerance among commercially grown cultivars and elite and preliminary lines from the breeding program and ii) identification of winter wheat germplasm sources that show a high level of scab resistance. To meet these objectives, we have been conducting both greenhouse and field evaluation for scab resistance. During the winter 1997-98, 150 entries of released cultivars, advanced experimental lines, and materials from nurseries were evaluated for scab resistance under artificial inoculation in the greenhouse. The field evaluation in Brookings in 1998 included a standard-plot planting of the winter wheat cooperative scab nursery and a replicated, spring-transplanted hill-plot evaluation (under artificial inoculation and mist-irrigation) of the same set of materials tested in the greenhouse. A high level of infection was observed in the spring-transplanted hill-plots and several promising genotypes were retained for further evaluation. In addition to these activities, two international nurseries (7th FAWWON and 21st IWSWSN, 285 entries) and the Regional Germplasm Observation Nursery (450 entries) were grown at the Watertown location where a moderately high level of natural scab infection was observed. From these three nurseries, several genotypes combining good winterhardiness, good scab resistance, and acceptable grain filling characteristics were identified. These genotypes have been included in the winter crossing block and will be re-evaluated for scab resistance during the 1998-99 field season. (S. Haley)

Germplasm introduction and evaluation.

Selected accessions (425) of hexiploid wheat with spring habit, 124 accessions of *Triticum monococcum* and 491 accessions of wheat derived from crosses with *Aegilops*, *Agropyron* and *Secale* spp. from the National Small Grains Germplasm Research Facility (Aberdeen, ID) were evaluated for resistance to scab in a field nursery in 1998. Wheat accessions with origins from Brazil, eastern China, Italy, and Japan were targeted. The nursery was artificially inoculated and mist-irrigated. Useful levels of resistance have been identified, and further evaluations will be conducted to verify these putative sources of resistance. An international scab evaluation nursery for spring wheat is being developed to facilitate germplasm introduction and exchange. (Y. Jin and J. Rudd)

Epidemiology

Research on several aspects of scab epidemiology has been initiated. Inoculum potentials from weedy grasses

are being investigated by field surveys of natural infection, isolating the pathogen from seed, and assessing perithecia production under laboratory and field conditions. Greenhouse and field experiments are conducted to investigate the effects of moisture in inoculum production vs. infection. Ascospore survival and accumulation on plant surface are also being investigated. (Y. Jin)

Fungicide efficacy studies.

South Dakota participated in the Fungicide Network with six other states, examining the efficacy of several fungicides used to suppress scab. Two hard-red spring wheat cultivars were planted at three locations and treated with several foliar fungicides at anthesis. Treatments were evaluated for protection of the flag leaf against foliar disease as well as for incidence of scab infected heads, average plot severity, average infected head severity, yield, test weight, and severity of black point and scab in harvested grain. The heaviest disease pressure was found at the South Shore, SD. At this site, scab severity was significantly decreased with tebuconizole (4 fl. oz./A), azoxystrobin (0.15# a.i./A or 0.2# a.i./A), or azoxystrobin tank mixed with benomyl (0.125# a.i./A + 0.5# a.i./A) (0.125# a.i./A + 0.125# a.i./A). Yields were increased up to 10.2% with the best treatment, the high rate of azoxystrobin + benomyl (0.125# a.i./A + 0.5# a.i./A). Scab severity was decreased significantly with propiconizole (4 fl. oz./A), tebuconizole, mancozeb tank mixed with benomyl (1#/A + 0.5#/A), azoxystrobin (0.15# a.i./A), and azoxystrobin tank mixed with benomyl (0.125# a.i./A + 0.125# a.i./A). Leaf disease on the flag leaf, primarily tan spot, was significantly reduced with all fungicide treatments. (M. Draper)

Biological control

Our biocontrol studies for control of head scab have focused on use of different strains of the genus *Bacillus* as biocontrol agents. Both whole cells and cell-free concentrated extracts of supernatants of broth cultures have demonstrated antagonism against *Fusarium graminearum* in laboratory assays. During the summer of 1998, cell-free concentrated extracts of supernatants of broth cultures of selected *Bacillus* strains were applied in a disease nursery to see if they could protect wheat against head scab. It did not appear that much or any protection against head scab was afforded by the spray treatment with cell-free concentrated extracts. It may be difficult to find a predictable temporal treatment window in which to effectively apply such cell-free extracts to wheat plants. Thin layer chromatography (TLC) of the cell-free concentrated extracts from *Bacillus* culture supernatants which have activity against *F. graminearum* in laboratory assays reveals one or more ninhydrin-positive spots. We plan on extracting and concentrating broth supernatants in at least one other way, to see if the same or different compounds are obtained in TLC, and whether any of the spots have activity directed against *F. graminearum*. (B. Bleakley)

Development of molecular markers

A project is in the planning stage with the objective of identifying closely-linked DNA markers for the scab resistance genes. Currently, we are working on two sources of scab resistance that are likely different from known sources. Parents and segregating populations will be screened for polymorphic DNA markers (i.e. RFLP, SSR, AFLP, STS-PCR, etc.). Polymorphic markers will be screened against segregating populations to identify closely linked markers. If necessary, mRNA will be isolated from scab-inoculated spikes of the scab resistance materials. The cDNA libraries will then be constructed and used as probes in our screening. If the resistance materials contain alien species in their pedigrees, genomic in situ hybridization will be applied. The DNA markers identified in the proposed project will be directly applied to our scab disease evaluation and to our spring and winter wheat breeding program (Y. Yen).

Personnel

Researchers/Project: Y. Jin/Small Grain Pathology; M. Draper/Extension Plant Pathology; J. Rudd/Spring Wheat Breeding; S. Haley/Winter Wheat Breeding; B. Bleakley/Soil Microbiology; Y. Yen/Cytogenetics-Molecular Biology.

Supporting staff: X. Zhang (Research Associate, Pathology); R. Rudd (Research Assistant, Pathology/Breeding); M. Thompson (Research Assistant, Extension Pathology/Research).

NCR-184 Committee— Management of Head Scab in Small Grains 1998 Missouri Report

Laura E. Sweets and Anne L. McKendry

Winter Wheat Production in Missouri and the 1998 FHB Situation in Missouri

Winter wheat is grown on all of the Missouri wheat acreage. Most of the acreage is soft red winter wheat with a minimal number of hard red winter wheat acres. Missouri wheat production in 1998 totaled 57.5 million bushels, up fractionally from last year's production of 57.2 million bushels. Of the 1.35 million acres planted, farmers harvested 1.25 million acres for grain. Missouri yields averaged 46 bushels per acre, 9 bushels below last year's record high yield of 55 bushels per acre.

1998 was a fairly good year for wheat production and a fairly poor year for Fusarium head blight in most of Missouri. The early part of the season was cool and wet but most of the state was dry as the wheat crop was flowering resulting in very low levels of scab. The exception was the northeast part of the state. There wet conditions coincided with wheat flowering and scab was a problem. The northeast site for the wheat performance test was rated for scab (see Winter Wheat 1998 Missouri Crop Performance Special Report 512).

Winter survival was a problem in the southeastern part of the state. Aphid levels and barley yellow dwarf virus were also unusually high in this area of Missouri. Leaf rust and Septoria leaf blotch came in late in the season and didn't move up to the flag leaves until well past heading. Losses from foliage diseases were minimal for most of Missouri. Missouri did have a Special Local Need Registration (Section 24c Registration) for Tilt which extended the time of application to Feeke's Growth Stage 10.5. Some growers took advantage of this label change but fungicide use was not widespread this season.

Of more concern were reports from the central and northeast portions of the state that growers were destroying wheat prior to harvest in an attempt to plant double crop soybeans earlier. In these areas the decisions to destroy wheat seemed to be based on low wheat prices and not disease problems or projected low yields.

Quality of wheat seed tested by the Missouri Seed Improvement Association was very good this season. Light infections of scab were present in many seed lots but not at levels to cause problems. Levels of black point were down compared to the last few years. There were sporadic lots with extensive damage from kernels sprouting in the head. This problem was most common in early maturing varieties in the southwest and southeast parts of the state. The wheat crop matured earlier than normal but wet conditions delayed harvest so sprouting in the head occurred.

There are no official estimates of number of acres to be planted to wheat this fall. The Missouri Seed Improvement Association did report that in both 1996 and 1997 between 1.0-1.1 million units of seed were tagged. This year only 450,000 units were tagged. The assumption is that acres seeded will not decline by 50% but that more acres will be planted with bin run seed. The best guess estimate is a 30-40% reduction in acres planted to wheat this fall.

Overview of Present Scab Research Programs

The University of Missouri did cooperate in the Uniform Scab Fungicide Trial coordinated by Dr. Marcia McMullen, NDSU. Six treatments were applied to two varieties, Ernie and NK Coker 9464. Both scab levels and foliage disease levels were extremely low. Results of this trial are included in the report for this initiative project.

Scab research within the wheat breeding program

Fusarium head blight is a major focus of the research within the soft red winter wheat breeding program led by Dr. Anne L. McKendry. Currently, our scab research involves the following general areas.

1. Greenhouse screening of all preliminary and advanced breeding lines for scab resistance. Sources of resistance being introgressed into Missouri lines include

Sumai 3, Ning 7840, and Ernie.
2. Participation in the Eastern Soft Red Winter Wheat Scab Nursery.
3. A PhD student (Shuyu Liu) working conventional and molecular genetic analysis of scab resistance in Ernie.
4. A MS student (Aerin Heitz) researching the effects of scab isolates on stability of resistance in a number of genetic backgrounds.

Winter Wheat Germplasm Introduction and Introgression

As part of the National Fusarium Head Blight Initiative, we are evaluating winter wheat germplasm for scab resistance. Our objectives in this effort include:

1. An aggressive, world-wide search for resistance in winter wheat germplasm. Priority will initially be given to evaluation of hexaploid germplasm from geographical regions where resistance has been identified or where environmental conditions are conducive to scab development.
2. Evaluation of that germplasm for associated agronomic traits important for the soft red winter wheat region.
3. Contribution to a national scab resistance information database including dissemination of data through the GRIN and/or GrainGenes and the Wheat Genetics Newsletter.

Work in 1998/99 will include the evaluation of approximately 1000 winter wheat accessions from the USDA collection at Aberdeen Idaho including accessions from China, South Korea, Japan, Brazil and Italy. A 40% research specialist and a student research assistant (30% FTE) (supported by scab initiative funds) have responsibility for evaluating resistance in winter wheat germplasm