WCC-97 (Research on Cereal Diseases)
2002 Season

Our meeting was held June 5-6 at Fort Collins, CO and Scottsbluff, NE.

June 5th. The initial field trip began with a brief tour of the barley breeding and malt testing facilities utilized by Anheuser-Bush at their Fort Collins facility.

Barley breeding and evaluation of hops at AB

This was followed by a stop at the High Plains Ag Lab north of Sydney, NE to observe the research being conducted by Dr. Gary Hehn on Wheat Streak Mosaic Virus of winter wheat.

Looking at WSM infections Effect of planting date mite movement

When moving, mites survive less that 24 hours at high temperatures and low humidity's. They can survive as long as 3-4 days under cool wet conditions. Depending on wind speed and favorable environmental factors, they can move from ¼ mile to perhaps hundreds of miles. They would not be present in large enough numbers at these great distances to cause high disease levels

Yellowfox tail is a good weed host for the mite, however not as good a host as is volunteer wheat.

There is a good correlation between degree of leaf chlorosis and yield loss.

June 6th. The meeting at the Panhandle Research and Extension Center began with a welcome by the director Chuck Hibberd. The 70K sq ft center was staffed in 1973 when the state obtained the facility from a defunct private college. Currently, all PhD level staff have 50/50 research/extension appointments and each researcher is associate with a campus department in Lincoln, NE.

The introduction was followed by a mini symposium on WSMV and included presentations by:

Drew Lyon: Talked about dryland cropping systems and the importance of maximizing water utilization on the high plains.

Gary Hehn: Talked about the biology of the wheat curl mite and the importance of WSMV to the economy of Kansas and Nebraska. The mite is common from Texas to Canada and vectors WSMV, Highplains disease and corn lethal necrosis. The green bridge in Nebraska lasts from July-September and plants need to be 100% dead before they will not longer support the mite. Corn can also serve as a bridge. Movement of the mite is directly related to population size and the generation cycle can be as short as one week at 80 degrees F.

WSMV cultivar test and Gary Hehn discussing the trial

Dallas Siefers (KSU) Talked about High Plains and yellow head disease of wheat. High Plains was first discovered in 1993, when the unidentified virus was showed to be transmitted by the wheat curl mite. The virus causes wheat streak like symptoms in wheat and a kernel red streak in corn. This virus can be mechanically transmitted by vascular puncture of the leaf tissue. Plants doubly infected with WSMV and HP disease almost always die. Plant resistance is a function of resistance to both the virus and mite.
Yellow head disease was first described in OK, KS, NE and the Dakota's in 1996. The heads of infected plants turn yellow and the leaves appear similar to WSMV. The disease will infect downy brome grass although wheat appears to be the preferred host.

Drake Stenger: Talked about the genetics of WSMV. Genetic variation has been shown between individual isolates, individual fields and mite populations in general. Mixed infections in the field are not common and usually the same virus is identified in these situations. The mite vector tends to resolve mixed infections and only pass along one strain of the virus at feeding.

Roy French: Talked about development of WSMV as a gene expression vector for cereals. MSMV is well expressed in the leaf tissue, however it has low expression in the crown. It can be found in roots, but is restricted mostly to the stele.

State Reports:

California Report-- Lee Jackson

General. Small grains in California are sown in the fall and are comprised primarily of hard red spring and durum wheat, 6-row spring feed barley, triticale and oat. A substantial acreage of spring-sown spring barley and spring wheat also is grown in the intermountain area of NE California (Tulelake/Klamath basin). Estimated acreage for the small grain crop for the 2002 season in California, according to the California Agricultural Statistics Service, included 625,000 acres of wheat (including 95,000 acres of durum), similar to last season's winter wheat acreage and 12% more durum; 110,000 acres of barley (decrease of 31% compared to 2001); and 320,000 acres of oat (increase of 27% compared to 2001). Triticale acreage wasn't estimated, but 30-50,000 acres are grown in the San Joaquin Valley. Leading wheat cultivars (non-durum) by acreage were Yecora Rojo (128,500 acres), Bonus (77,000 acres), and Express (73,800 acres). Yecora Rojo and Bonus predominated in the San Joaquin Valley while Express predominated in the Sacramento Valley. Kronos was the leading durum cultivar with 61,000 acres, accounting for two-thirds of the durum total. Between 150,000 and 200,000 acres of wheat and triticale were harvested as green-chop forage for dairies in California's Central Valley. Many rainfed wheat and barley fields in the foothills surrounding the San Joaquin Valley also were harvested as forage this season because of a drought in the region; rainfall totals were about a third of average for the year.

Conditions were favorable for grain production throughout most of the state, but severe frost injury occurred on early sown fields in the southern San Joaquin Valley. Because of very mild late-fall to early winter temperatures, wheat and triticale that had been planted for forage for dairies in November was in the jointing stage by mid-January when weather turned very cold for the rest of the month and into the 1st week of February. High tiller mortality occurred, and in some cases, entire fields were lost. Later, damage was reported on earlier sown or earlier maturing cultivars in the Sacramento Valley, where more typical freeze injury symptoms of partial spike sterility were visible. With regard to diseases, stripe rusts of wheat and barley were the most important in 2002.

Wheat stripe rust and leaf rust. We continue to see new races of wheat stripe rust. Last season's collections revealed 10 races of wheat stripe rust in California, including 6 or 7 new races. This season, the previously resistant cultivar Bonus has become susceptible. In mid-to-late April moderate to severe wheat stripe rust (up to 70% severity) was reported in commercial fields of Bonus in the Sacramento/San Joaquin Delta and other areas of the Sacramento Valley. The cultivar Dirkwin, grown as a forage crop, also had high stripe rust severity. In the second week of May, wheat leaf rust became severe (up to 100% severity) on many cultivars in the Sacramento and San Joaquin Valley. By the 4th week of May stripe rust and leaf rust had spread throughout the Central Valley. Despite the warmer, drier climate of the southern San Joaquin Valley, I easily detected stripe rust (up to 80% severity, 20% incidence) in commercial fields as far south as Kern County (southern end of the San Joaquin Valley) where the most common cultivars are Yecora Rojo and Brooks. Some durum wheat cultivars also had stripe rust infection, but at lower levels than the hard red wheat. Leaf rust levels in the southern San Joaquin Valley ranged up to 40% severity, 40% incidence. I also detected leaf rust on a few durum wheat cultivars or lines in nurseries, and in moderate severity on one triticale cultivar. The crop was in the latter stages of grain-fill (late dough) when high levels of leaf rust developed, so yield losses should be minimal.

Barley stripe rust and leaf rust. We also continue to see new races of barley stripe rust (BSR). Last season's collections revealed 8 races of BSR, including 3 new races. In early May BSR was severe (up to 100% severity) on susceptible cultivars and breeding lines in nurseries at UC Davis; barley cultivars with resistance (UC 937 and UC 933) were unaffected. BSR was severe on susceptible lines and cultivars in both the Sacramento and the San Joaquin Valleys by the 3rd week of May. Plots of many susceptible cultivars and lines in nurseries had 100% severity/100% incidence and limited sporulation was seen on the resistant cultivars UC 937 and UC 933. I also observed barley leaf rust (up to 60% severity, 100% incidence) on several susceptible cultivars in nurseries in the San Joaquin Valley. In the BSR screening program at UC Davis, about 2500 lines consisting of advanced materials from many U.S. breeding programs and 1000 National Small Grains Collection accessions from all over the world were evaluated. About 40% of the NSGC accessions were highly susceptible (greater than 50% severity), as were a high proportion of breeding lines from programs in Washington, Utah, Montana, North Dakota, Texas, and from Coors and Busch.

Other diseases. Late sown (last week of January) barley and oat nurseries at UC Davis had very severe BYD. Barley scald developed to high severity in a nursery in Butte County (Chico) where stripe rust levels were low. Septoria tritici blotch developed to high severity on many wheat cultivars and lines (including those with *Stb 4* resistance) at the Butte County testing site. I observed an oat field with low incidence and low severity of crown rust in the San Joaquin Valley (Fresno Co). Oat stem rust occurred in 70% severity and 30% incidence in plots of the cultivar Swan in the Central Coast region.

Colorado Report – Joe Hill

Idaho Report – Bob Forster

General: Cereal growers in Idaho harvested about 1.2 million acres of wheat and 670 thousand acres of barley in 2001 and planted similar acreages in 2002. No severe epidemics occurred in wheat or barley last year, but prolonged snow cover this past winter contributed to considerable snow mold (*Typhula* spp. and *Fusarium nivale*) in winter wheat in southeastern Idaho. Spring wheat and barley were generally seeded 2-3 weeks later than normal in 2002 due to a colder-than-normal spring, but by June the crops were growing well with minimal disease problems reported to date.

The percentage of malting barley acreage relative to feed barley acreage continues to increase and now accounts for about 2/3 of the total barley acreage in the state. Two new malt houses are under construction in Idaho Falls. They will require in excess of 60,000 A of additional malting barley from the eastern Idaho area to supply them.

Research on the tri-state (Idaho, Oregon, and Washington) cereal root disease management project is progressing. Dr. Carl Bradley started March 1, 2001 as a post doctoral fellow and conducted a root disease survey throughout 12 counties of southeastern Idaho. He resigned in March 2002 to accept a faculty position as Extension Plant Pathologist at North Dakota State University, and Dr. Anita Koehn will replace him starting July 1. A multi-year tillage by crop rotation study was initiated this spring at two locations in southeastern Idaho. Also, a study was initiated in cooperation with Dr. Terry McGonigle of Idaho State University to evaluate the role of mycorrhyzae in wheat production in the state.

Personnel: Due to the budget crisis facing the University of Idaho, Dr. Maury Wiese and I are both retiring effective June 22, 2002. Dr. Carl Strausbaugh will take over my research and extension program here at Kimberly. Maury's program will be absorbed into remaining programs or parts will be eliminated.

Kansas Report -- William W. Bockus

Personnel news. The biggest news in Kansas State University's wheat research program is the movement of Dr. Bob Bowden from Extension Wheat Pathologist to become the USDA Research Leader for the Plant Science Unit at KSU. This not only involves him moving down the hall, but, because of a one-year hiring freeze, there is a big void in extension wheat pathology this year. In the interim, Dr. Doug Jardine, Extension State Leader for Plant Pathology, is handling as many of the wheat extension duties as he can.

Wheat crop condition. As of the writing of this report (May 20, 2002), 79% of the wheat acreage is estimated to be at the headed stage compared to 82% at this time

last year and an average of 80%. Similar to last year, the current condition of the wheat crop in Kansas is not very good and rated as follows:

Table 1. Crop conditions in Kansas

Wheat	Very Poor	Poor	Fair	Good	Excellent
5/19/02	17	23	32	26	2
4/28/02	17	23	35	23	2
5/06/01	15	26	34	23	2

Disease loss estimates for 2001. Only diseases that caused more than trace losses are reported. (Data from Jon A. Appel and Robert L. Bowden)

Table 2. Wheat disease losses in Kansas

Disease	Loss in 2001	Loss in 2000	10-year avg.
Stripe rust	7.3%	0.05%	0.74%
Tan spot	1.9	0.2	1.32
Leaf rust	0.4	2.9	4.13
Septoria complex	0.1	0.04	1.47
Root and crown rots	0.1	0.001	0.09
Soilborne, spindle streak	0.05	0.001	0.23
Bunt & loose smut	0.05	0.01	0.01

Potential wheat disease losses for 2002. Although final estimates of wheat disease losses during 2002 have not yet been produced, it is anticipated that Barley Yellow Dwarf will be the most important disease in the state this year. BYD is being seen in many parts of Kansas with many fields showing uniform high incidence. Other important diseases will be Wheat Streak Mosaic that is occurring in central and western Kansas and Leaf Rust that is occurring virtually throughout the state. The two virus diseases (BYD & WSMV) were important because of the unusually warm fall and winter that allowed the insect vectors to remain active for most of the season. Although stripe rust is present, it will probably only cause a fraction of the loss that it caused last year.

Minnesota Report – Ruth Dill-McMacky

Small Grains Crops in Minnesota
2001 season

The 2001 season was difficult for small grains production. A cold spring and near-record rainfall in April delayed planting of most cereal crops into late May and contributed to reductions in the acreage of small grains. The spring wheat crop was 1.8 million acres down 150,000A from the previous year. The durum wheat crop, at 2,000 A was similar in size to the previous year. Minnesota's barley acreage continues to fall with only 145,000 acres harvested in 2001, making it the smallest crop since 1881.

Similarly, the oat acreage, at 210,000, was the smallest crop since 1867. As much as 250,000 acres were not planted in Minnesota in the 2001 cropping season.
Continued cold and wet weather in May slowed the establishment of crops. In June weather conditions favored small grains and crops that had gotten off to a late start developed well with few disease problems. By late June the cereal crops were looking good to excellent. In July temperatures above 85^{o}F stressed crops and hastened crop development. Harvest was completed ahead of the 5-year average and the rapid maturing of crops likely contributed to reduced yields.
State spring wheat yields averaging 44 bu/A, 5 bu/A below 2000. Barley yields averaged 55bu/A and oat yields averaged 60 bu/A, 10 bu/A and12 bu/A below the 2000 yields, respectively.
Rainfall in combination with the high temperatures in July promoted the development of some foliar diseases, including tan spot and Septoria and Fusarium head blight. The late development of disease mitigated much of their impact and losses were generally below 5%. While Fusarium levels were low and yield losses minor in 2001, levels of deoxynivalenol (DON) in barley prevented some of the crop from being sold for malt production.

2002 season
Following a mild winter, drier soil conditions allowed for crop planting to start ahead of the average for the past several years. Cold spring temperatures delayed crop emergence and freezing temperatures in mid-May (which killed some 65,000 acres of newly emerging sugarbeets requiring replanting) caused some damage to small grains although the damage appeared to be largely cosmetic and no replanting was undertaken.
Heavy storm rains that fell between June 8 and 10 dumped up to 5 inches of rain on parts of the Red River Valley. Flooding appears to be worst in Roseau County where the Roseau River has flooded 340,000 acres - 80 percent to 90 percent of the total cropland in Roseau County. Flooding has occurred on the Wild Rice River in Norman County around and south of Ada and also in Marshall County near Warren. Water damage varies from saturated soils to submerged crops.

Overview of Present Research Programs
The Fusarium head blight research in Minnesota continues as a large collaborative effort. Faculty from the four departments of the College of Agriculture, Food and Environmental Sciences, three University of Minnesota Research and Outreach Centers and two USDA-ARS units (Cereal Disease Laboratory & Plant Science Research Unit) are involved in FHB research. While many researchers in Minnesota have projects funded by the USWBSI, researchers have also been supported by state funding.
The research being conducted in Minnesota includes breeding for resistance to FHB in wheat and barley utilizing classical and molecular techniques, studies aimed at improving the efficiency of breeding methodologies and selection of resistance, investigations on the pathogenic variation in *Fusarium graminearum*, examinations into the pathways of entry by Fusarium head blight, and the chemical and cultural control of FHB.

Personnel changes in Minnesota

Departures:

Donald V. McVey, USDA-ARS Cereal Disease Laboratory, Research Plant Pathologist – retired September 2001.

Hala Toubia-Rahme, University of Minnesota, Northwest Research and Outreach Center, Crookston – resigned December 2001.

New Personnel:

David F. Garvin, USDA-ARS, Research Geneticist (wheat) – started August 2001.

Martin L.. Carson, USDA-ARS Cereal Disease Laboratory, Research Leader -started February 2002.

Charla Hollingsworth, University of Minnesota, Northwest Research and Outreach Center, Crookston – starts July 2002.

Montana report – Bob Johnston and Bill Grey

Personnel – Don Mathre

Don retired at the end of 2001 and the Dept is currently looking for a replacement. Four candidates were interviewed in April, however, the University has implemented a short term hiring freeze until budget problems are resolved. The freeze has been lifted and a offer has been made to one of the interviewees. The job description was changed somewhat by the Dean to include more teaching (30%) and at this point the position has not be accepted.

Disease problems:

Continuing drought is the primary production problem in the state. The last three years has be very dry and soil moisture reserves are at all time lows. The outlook for 2002 is bleak but probably better than in 2001. After the meeting, Montana received 2-5 inches of much needed moisture.

Fusarium root rot is foremost in grower's minds right now. This is due to many factors including:

- Reduced tillage and leaving large amounts of residue on the soil surface.
- Not matching fertility levels with usable moisture
- Changing patterns of cultivars. In some areas, spring wheats are being displaced with durum wheats. Durum wheats are more susceptible to Fusarium than are hard red spring wheats.

Production figures for Montana

Acres in CRP is 3.4 million out of a total of 18.3 million crop acres or ~ 19%

Durum wheats – dollar per acre down 32% from 1990's high

Year	Total						
	Acres		Production		Value		
	Planted (000)	Harvested (000)	Yield Per Acre Bu.	Total Bushels (000)	Price Per Bu. Dols.	Value of Production (000) Dols	Value Per Acre Dols.
2002	530						
2001	510	495	24	11,880	3.85	45,738	92
2000	480	470	28	13,160	3.52	46,323	99
1999	360	350	27	9,450	3.45	32,603	93
1998	450	430	28	12,040	3.23	38,889	90
1997	300	290	26	7,540	5.18	39,057	135
1996	290	280	25	7,000	4.65	32,550	116

Winter wheat – dollar per acre down 63% from 1990's high

Year	Total						
	Acres		Production		Value		
	Planted (000)	Harvested (000)	Yield Per Acre Bu.	Total Bushels (000)	Price Per Bu. Dols.	Value of Production (000) Dols	Value Per Acre Dols.
2002	1,400	1,000	28	28,000			
2001	1,300	870	22	19,140	3.20	61,248	70
2000	1,500	1,350	33	44,550	2.87	127,859	95
1999	1,050	970	38	36,860	2.67	98,416	101
1998	1,400	1,250	39	48,750	2.80	136,500	109
1997	1,600	1,450	38	55,100	3.40	187,340	129
1996	2,150	1,980	31	61,380	4.24	260,251	131

Spring wheat – dollar per acre down 55% from 1990's high

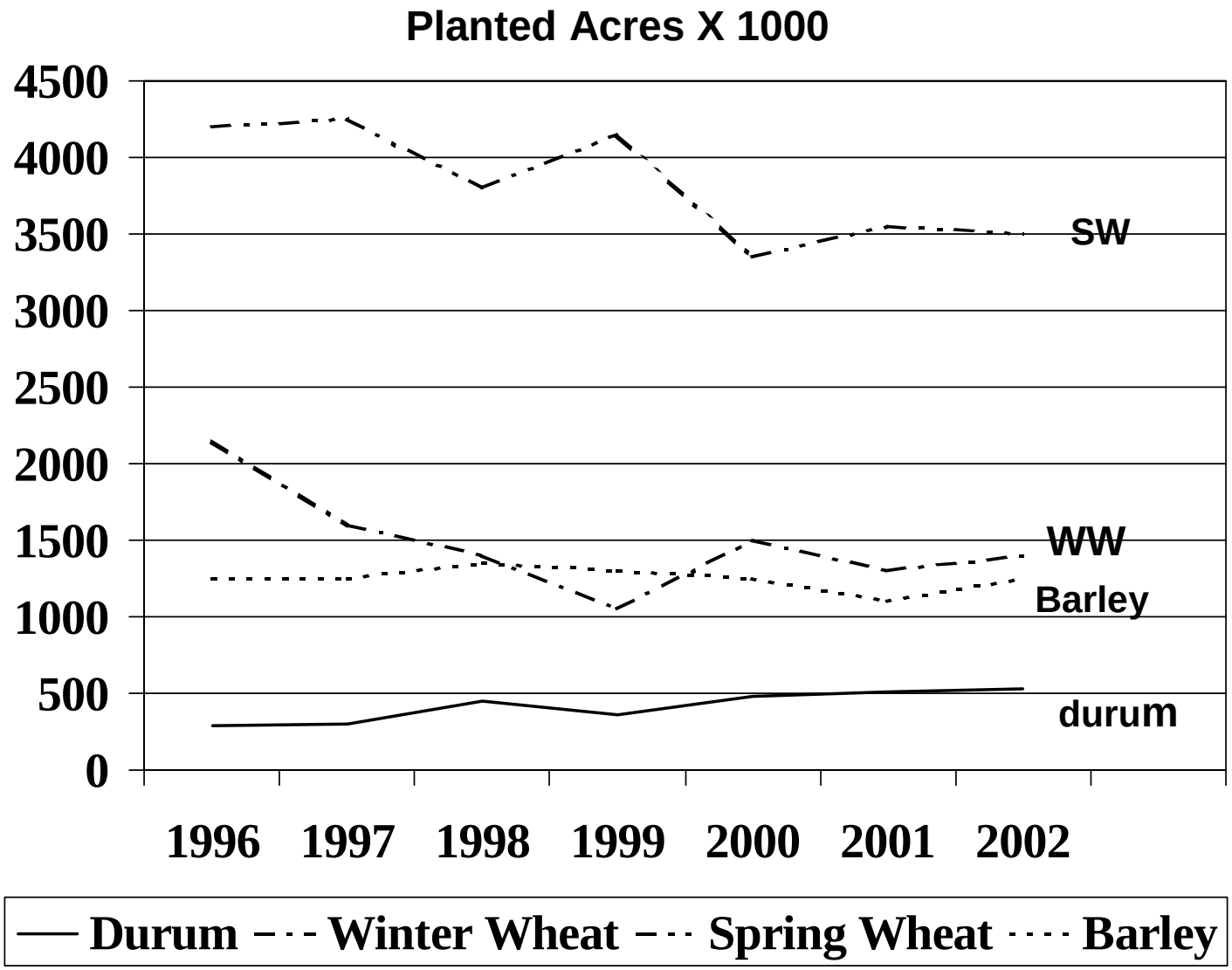
Year	Total						
	Acres		Production		Value		
	Planted (000)	Harvested (000)	Yield Per Acre Bu.	Total Bushels (000)	Price Per Bu. Dols.	Value of Production (000) Dols	Value Per Acre Dols.
2002	3,500						
2001	3,550	2,850	23	65,550	3.20	209,760	74
2000	3,350	3,100	25	77,500	3.03	234,825	76
1999	4,150	4,000	27	108,000	2.97	320,760	80

1998	3,800	3,600	30	108,000	3.13	338,040	94
1997	4,250	4,100	29	118,900	3.58	425,662	104
1996	4,200	4,100	26	106,600	4.22	449,852	110

Barley – dollar per acre down 29% from 1990's high

Year	TOTAL						
	Acres		Production		Value		
	Planted (000)	Harvested (000)	Yield Per Acre Bu.	Total Bushels (000)	Price Per Bu. Dols.	Value of Production (000) Dols.	Value Per Acre Dols.
2002	1,250						
2001	1,100	720	41	29,520	2.70	79,704	111
2000	1,250	950	40	38,000	2.38	90,440	95
1999	1,300	1,150	50	57,500	2.32	133,400	116
1998	1,350	1,200	48	57,600	2.27	130,752	109
1997	1,250	1,150	53	60,950	2.83	172,489	150
1996	1,250	1,150	43	49,450	3.07	151,812	132

Production figures are from the Montana Agricultural Statistics service.



2001 disease picture: Fusarium root rot was widespread through out the central wheat producing area of Montana. Durum production was particularly hard hit by this disease. As an interesting sidelight, some of our durum cultivars have black awn which turn white when the plant is stressed ie. Fusarium. This make for an interesting marker which is noticeable by growers, even passing by the field at 60 mph!

The was some development of Septoria Leaf blotch in the eastern corner of the state (this was the one area that did receive more that normal moisture levels.)

So far in 2002 some wheat streak has been showing up in central Montana. Does not appear as though it will be a problem at the present time.

Montana's growing season is just getting underway by early June, so it is much to early for us to speculate on what the summer might bring.

Bill Grey is involved in a research project looking at colonization of saw fly larvae by various Fusarium species. Field research first observed dead larvae covered with a pinkish growth. Investigative work has shown that a number of Fusaria are involved. Additional work is underway to determine if these Fusaria are pathogenic on wheat, barley and durum wheats.

Nebraska Report – John Watkins

Stripe Rust Incidence (John Watkins, Extension Plant Pathologist)

The 2001 Nebraska winter wheat crop was estimated at 59,200, 000 bu with a 37 bu/a average yield on 1,600, 000 harvested acres. Statewide stripe rust, *Puccinia striiformis*, was the major disease causing economic loss on susceptible varieties. Varieties in trials in Keith and Perkins Counties were evaluated for stripe rust severity. Stripe rust was severe on the varieties 2137 and Lakin. Approximately 10.4% of the winter wheat acreage in Nebraska was planted to 2137. Alliance, Arapahoe and Pronghorn, showing only light rust severity, were planted on approximately 40% of the Nebraska acreage. Of the more recent Nebraska-released varieties, Millenium, Wesley and Wahoo showed light severities where Culver and Cougar showed moderate severity.

As of early June 2002, stripe rust is just beginning to make its way into Nebraska. Warm temperatures may slow its development.

Leaf Rust Incidence(John Watkins, Extension Plant Pathologist)

Leaf rust, *Puccinia triticina*, was not a production factor in Nebraska in 2001 because of dry weather that was not conducive to its development. As of early June 2002, with the wheat in the flowering stage, leaf rust severities are light on the flag-2 leaves.

Results of the 2001 Puccinia triticina Race Survey

Sixty nine different rust races were identified in 2001 as compared to 43 in 2000. Virulence phenotype TDB made up approximately 16% of races in 2001. From 2000 to 2001 there were no changes in virulence to host genes *Lr1, 3, 10, 16* and *21*; virulence increased to genes *Lr2a, 2c, 11, 17, 18* and *26*; and decreased to genes *Lr3ka, 9, 23, 24* and *30*, although with many of the genes the increase or decrease in virulence frequency was not statistically significant. None of the 69 rust races found in 2001 were virulent to host gene *Lr16* which is the gene that conditions leaf rust resistance in many of Nebraska varieties.

Wheat Viruses in 2002 (John Watkins, Extension Plant Pathologist)

Due to the cool, wet April and May in eastern Nebraska, the symptoms of soil-borne wheat mosaic persisted into early June. The incidence of soil-borne wheat mosaic was high in eastern and south central Nebraska this spring. Loss estimates to soil-borne are difficult because of varying levels of resistance in the varieties grown. One sample received by the diagnostic clinic in mid-May had both soil-borne mosaic and wheat streak mosaic. Symptoms were severe with high yield loss anticipated.

An early May survey of the Nebraska Panhandle and southeast Wyoming by specialists from Colorado State, Wyoming, Nebraska=s Panhandle Research & Extension Center and Lincoln revealed more wheat streak mosaic than was expected. Pockets of wheat streak were found in both the northern and southern Panhandle with the incidence and severity high in several fields. In all cases there was evidence of volunteer wheat in last year=s stubble fields adjacent to the affected fields. The long, mild fall exacerbated mite and disease development. We observed one field where volunteer wheat had developed in a sunflower field last summer, and the adjacent wheat field was severely infected with virus this spring. Observations in other sunflower fields and dryland corn fields have show that volunteer wheat can be a significant summer green bridge in these fields.

Advanced Screening for Evaluating Wheat Streak Mosaic (Gary Hein, Entomologist, Panhandle Research & Extension Center)

In the summer of 2001, we were able to establish heavy populations of wheat curl mite in the planted volunteer used as a virus source for the screen. This year three trials were planted within the screen area at the Panhandle Res. and Ext. Center at Scottsbluff. The first trial was planted on Sept. 7 and includes 18 varieties with resistance sources from Colorado, Kansas and the best commercial and upcoming lines from Nebraska. These entries were planted in single row plots, 12 feet long and replicated four times. The second trial includes 39 numbered entries from Dr. Baenziger that have been crossed to WSMV resistant material, and it was planted on Sept. 13. Only enough seed was available to plant short (6 feet), single row plots for screening of these lines. The third trial, planted on Sept. 14, includes 32 commercial varieties or lines nearing release that were entered in the statewide testing program. This trial was replicated three times.

Mite populations in the volunteer built up to heavy levels and transferred readily to the emerging wheat. Because of the extended warm fall, mite populations have become extreme and virus presence is severe. Much of the wheat is showing severe yellowing and obvious virus symptoms. The Tomahawk currently looks severely stressed and a significant number of plants will likely die before spring. Several lines in Dr. Baenziger's screen are showing what appears to be good resistance at this time.

Plots have been evaluated this spring and virus ratings have been taken of the severity of the wheat streak mosaic. We are currently summarizing these data. Virus symptoms have been extreme with the susceptible check Tomahawk being killed in

several of the plots it was planted. The inclusion of the increased number of varieties will allow us to begin to establish wheat streak ratings for nearly all of the commercial varieties available to Nebraska growers and evaluate upcoming releases for their response to wheat steak mosaic.

The extreme virus pressure this year has given us a chance to see how the resistant sources have performed. The Kansas lines and some of the Nebraska sources look good however, even these are showing symptomology of the virus under the severe conditions. The presence of the screen is allowing us to observe how this resistance performs under varying conditions and how it is impacted by field conditions.

Results from the 2001 trials are shown in Table 1. Few differences were seen between varieties in number of mites on the plants, and mite numbers never did build to large levels in the fall. Yellowing was rated on a 0-4 scale with the susceptible Tomahawk rating a 3.5 and showing extreme yellowing. Stunting was rated as a percentage of the most vigorously growing lines in each replicate. The resistant lines all rated near 100% in this rating while Tomahawk showed a 35% reduction in overall size. The chlorophyll readings fro the SPAD meter shows numerically the impact of the virus as well. These values have related well with yield reduction in all of our screen trials and this method shows promise as a way to numerically estimate the impact of the virus in our screen trials. Yields of the resistant lines all were very good compared to the commercial standards except the two KS95H103 entries. This line is an earlier selection from Kansas that has since been discarded because of low yields. Again in 2001 the screen provided a very good comparison of lines in their potential in resisting wheat streak mosaic. The success in the trial again this year indicates that the screen can be repeated with regularity. This screening process should become an integral part of the wheat breeding efforts at UNL so that resistant lines can be more effectively identified and developed for Nebraska wheats.

Table 1. Number of mites counted per plant, yellowing ratings, stunting ratings (0-100), and chlorophyll readings (SPAD) for wheat streak mosaic virus infected plots at Panhandle Research and Extension Center, Scottsbluff, 2001.

Variety	Number curlmites/plant (12-4-00)	Yellowing (5-25-01)	Stunting (5-25-01)	Spad (6-1-01)	Bushels/acre
CO960293	3.37	1.00	96.67	39.43	59.9
KS99HW2-4	4.77	0.50	99.17	41.95	56.9
KS99HW1-3	4.90	0.33	96.67	41.07	47.5
KS99HW3-1	3.97	0.67	95.00	39.18	46.5
KS96HW103	5.27	1.00	85.83	40.00	45.8
Pronghorn	6.57	2.50	71.67	32.12	35.0
2137	4.97	1.67	74.17	33.98	34.6
Millennium	7.0	2.17	68.33	34.53	34.3
KS95H103+ Furadan	1.73	0.17	81.67	44.67	33.0
KS95H103	2.73	0.83	81.67	42.57	32.8
Tam107	2.47	2.50	67.50	34.72	30.1
Tomahawk+ Furadan	3.40	3.00	77.50	31.18	26.0
Alliance	4.37	3.00	59.17	32.57	24.2
Tomahawk	5.53	3.50	65.00	31.20	21.4
LSD	2.34	0.64	13.77	2.49	7.61

North Dakota Report – Marcia McMullen

Faculty working on small grains:

Dr. Mike Edwards, USDA/ARS Adjunct, Virologist
Dr. Marcia McMullen, Extension Plant Pathologist, Cereals
Dr. Jim Miller, USDA/ARS Adjunct Wheat Stem Rust and FHB
Dr. Stephen Neate, Barley Pathologist
Dr. Jack Rasmussen, Wheat leaf rust, molecular biology
Dr. Bob Stack, FHB and Cereal root rots
Dr. Glen Statler, Dept. Chair and Wheat leaf rust

Faculty changes: Stephen Neate is the department's new barley pathologist, in the position that Brian Steffenson formerly held. Stephen hails from the University of Adelaide and the CSIRO program in Australia and brings to the department a wealth of experience with small grains and soil-borne diseases. A new Extension Plant Pathologist for broadleaf crops, Carl Bradley, was hired in the position formerly held by Art Lamey, who retired in June 2001. Carl, a graduate of the Univ. of Illinois, working with Wayne Pedersen, had subsequently worked on small grain root diseases as a post-doctorate fellow at the Univ. of Idaho, Kimberly Research Extension Center, in Bob Forster's program. Len Francl has accepted a position as Dept. Chair at Penn State University, and will be leaving NDSU in August.

Crops: Wheat and barley acreage have declined slightly in recent years in North Dakota, in part due to Fusarium head blight epidemics and low prices. ND wheat acreage for 2002 is estimated at 8.6 million, barley acreage at 1.5 million, and oats at 0.8 million acres. Broadleaf crops with increased acreage include canola, estimated to increase to 1.3 million acres, and soybean, estimated to increase to 2.6 million acres.

The following are brief summaries provided by several of the cereal pathologists:

Len Francl – Summary of Research, 2002

This was the third year of operation for the NDSU Small Grains Disease Forecasting System. The system provided timely, regionally specific information to Minnesota and North Dakota wheat and barley producers for management of Fusarium head blight (scab). Advice was also given for management of tan spot, leaf blotch, and leaf rust of wheat.

Successes in 2001 included the following:

* A user guide was developed and widely distributed before the growing season. Contacts were made with about 700 farmers at winter meetings to explain how to use

the system.

* The system correctly predicted leaf and head epidemics for most regions. There was an excellent overall correspondence between Fusarium spore counts at flowering and Fusarium head blight severity from surveys later in the season.
* Fusarium spore counts were provided at Berthold, ND for the first time. Wheat leaf diseases were forecasted in nine additional regions (Jamestown, Dickinson, Kenmare, Crary, Harvey, St. Thomas, Sabin, Grand Forks, and Williston) for a total of 34 sites.
* During a rainy week in July, the forecaster web page received 285 requests per day. Overall, web page usage increased from about 6,500 hits in 2000 to 19,000 in 2001.
* Based on a lack of yield response in a replicated fungicide field trial at Fargo in 2001, wheat head and leaf diseases were not severe enough to warrant control. The disease management procedure detailed on the web site gave a no-spray recommendation, which was excellent advice.

Plans for 2002 include:

* A system expansion to 50 sites with new models that assess the risk of a scab epidemic.
* Provision of disease forecast contour maps so that users can have an overview rather than merely a prediction for single site.

Marcia McMullen, Summary of Research/Extension Efforts

Disease survey: A statewide small grain disease survey on 1500 wheat and barley fields in 2002 indicated that wheat leaf rust was observed in 22% of the spring wheat fields surveyed and the average severity in infected fields was 8.5%. Leaf rust was not detected in the state until July 5 and did not have significant impact on yield. The survey indicated that tan spot was the most common disease observed in wheat prior to heading with severity on the flag leaf in headed crops averaging 6.9% on spring wheat and 7.5% in durum wheat.

After head emergence, Stagonospora infections were frequently observed in wheats and barley and flag leaf severity averaged 13% in spring wheat, 18% in durum, and 7% in barley. Fusarium head blight (FHB) was observed in 70% of spring wheat and durum wheat fields surveyed and 42.1% of post-flowering barley fields surveyed. Average field severity in spring wheat was 4.0%, in durum 7.2%, and in barley 1%. Some severe levels of FHB were found in durum in the north central and northwest districts of the state, causing yield, quality, and market problems.

NDSU IPM field scouts recorded survey data using handheld computers and GPS units. Our Extension Entomologist, Phil Glogoza, plotted survey results using ARC View software. Survey results were distributed using the weekly Crop and Pest Report, County Ag Alerts, and several listserves. A five-crop survey across the state is in place for 2002.

Fungicide efficacy studies: Cooperative efforts have been established among research extension centers and the Fargo Exp. Station to evaluate uniform fungicide treatments for control of FHB and leaf diseases in wheat and barley. Results provided information on efficacy of registered, special exemption, and experimental products. Folicur fungicide and an experimental from Bayer (AMS21619) and an experimental from BASF (BAS505) resulted in the greatest reductions of FHB and leaf diseases, and economic improvements in yield. Application methods, such as timing of application, use of adjutants, and sprayer types, are examined to determine if improvements in fungicide coverage can be made. Part of this work is in cooperation with the US Wheat and Barley Scab Initiative and will continue in 2002.

Stephen Neate – Summary of Research

The objectives of the new Barley Pathology Project at North Dakota State University are to develop timely, practical methods for disease control in barley to ensure that the quantity and quality of barley available to industry is not limited by disease. We aim to achieve this goal through support to breeders in the development of cultivars with multiple
disease resistance, as well as development of cultural and chemical management strategies. To most efficiently achieve this goal we will also investigate the population biology and basic ecology of pathogens that cause disease on barley.

Our plans are to,
1. Evaluate in the glasshouse or field, breeding populations for resistance to Fusarium Head Blight, Spot Blotch and Net Blotch.

2. Conduct detailed field surveys to determine the incidence and severity of barley diseases in Western North Dakota, an emerging malting barley growing area.

3. Field and glasshouse screening of transgenic barley with genes for resistance to fungal pathogens and their metabolic products.

4. Testing chemicals and biocontrol agents for their effects on disease and pathogen survival.

Jack Rasmussen – Summary of Research on Cereals

Wheat leaf rust. The race composition of the natural population of the wheat leaf rust fungus has changed in recent years. The “T” races of the fungus have become predominant in collections made in North Dakota, replacing the “M” races. In greenhouse trials, most wheat varieties developed by the ND AES, including the recently-released, scab-tolerant ‘Alsen’, were moderately susceptible to the T races at the seedling and adult stage. It is likely that the T races pose more of a threat to North

Dakota wheat production than the M races. New Lr genes should be deployed in future cultivar releases.

Tan spot of wheat. Tan spot, caused by *Pyrenophora tritici-repentis*, is a serious foliar disease of wheat in North Dakota. The fungus produces Ptr ToxA, a host-selective toxin described by other labs as being required for disease. Laboratory experiments conducted in collaboration with Steven Meinhardt, Department of Biochemistry, demonstrated that the RGD amino acid motif in Ptr ToxA is required for toxin action in wheat. The data suggest that the receptor for toxin may have characteristics of animal integrin proteins. Greenhouse tests were used to demonstrate that wheat mutants insensitive to Ptr ToxA were still susceptible to races 1 and 2 of the fungus. However, lesion type and severity were different on the mutants, relative to the wild type parent cv. Kulm. The data suggest that Ptr ToxA may be a virulence factor that affects disease severity rather than a pathogenicity factor required for disease. The analysis of a population of 108 F6 generation recombinant inbred wheat lines derived from a cross of Erik (tan spot resistant) and Kulm (susceptible) was completed. Segregation data suggest up to five genes for resistance exist in this population. One new locus for tan spot resistance was identified on chromosome 6BS. Together, this locus and reaction to Ptr ToxA accounted for just 38% of the disease reaction, so other pathogenicity/resistance determinants probably exist in this pathosystem. A laboratory-based protocol was developed for the rapid production of ascospores of *P. tritici-repentis*.

R. W. Stack – Summary of Research on Cereals

Since the emphasis in my project is on cultivar evaluation, resistance breeding, and genetics, nearly all activities are collaborative with one or another of the several wheat breeders, or geneticists in the region. Research concerns two main diseases: Fusarium head blight, caused by (mainly) *F. graminearum*, and Common root rot, caused (mainly) by *C. sativus*.

FHB: In cooperation with the hrs wheat breeder and the durum breeder, we evaluate new accessions from several sources, and screen breeding lines and advanced materials for FHB resistance. Stack's part in the interdisciplinary effort includes improving methods for FHB testing, quality control of testing. Our procedure plays against each other use of intensive tests in the greenhouse and extensive trials in an inoculated, field nursery.

The intense collaboration since 1991 between Stack and Frohberg paid off in year 2000 with the release of a FHB resistant wheat 'Alsen', which combines good grain quality, agronomics, and yield, with moderately high FHB resistance derived from Chinese germplasm. In spring 2001, just a year after release, Alsen was planted on over 400,000 acres, one of the fastest acceptances ever for a new variety, due in part to an accelerated pre-release seed increase in New Zealand. Estimates are that Alsen will likely occupy 25-30% of the wheat acreage in ND in 2002. There is also substantial acreage in MN based on the amount of seed licensed in 2001. Alsen has been given

preliminary acceptance in Canada and will be grown on considerable acres there as well.

Several additional hrsw advanced lines showing still higher levels of FHB resistance combined with better tolerance to foliar diseases are at various stages in the evaluation process and may come up for consideration for release in 2003 and beyond.

In 3-way collaborations between pathologist, breeder, and geneticist, several studies on molecular markers for FHB resistance have been established (See refs: Anderson et al. 2001, Frohberg, Stack & Maan 2001.)

In collaboration with James Miller, USDA-ARS, we have been evaluating accessions of the world collection of *T. dicoccoides* for possible FHB resistance and testing them as parents when crossed into durum germplasm (see Stack et al. 2002).

CRR: Root rot studies on small grains were curtailed from1995 to 1998 to concentrate on the immediacy of FHB. Since 1998, root rot field trials in spring wheat and durum have been planted in Williston, ND, in cooperation with the Williston Research Center (see Tobias et al 2002a, b). There is no active breeding effort for root rot resistance; the testing is to detect highly susceptible lines before release and to provide information for cultivar recommendations.

Oregon report --Chris Mundt

The factor most limiting to wheat yield during the last two years has been drought. Three years of low rainfall caught up with us last year, and reduced state wheat yields by at least 25%. The soil profile is currently very depleted, and I expect substantial losses due to drought again this year.

Cool temperatures this year have been highly conducive for stripe rust. This has provided an excellent opportunity for the breeding program to screen material. Fortunately, nearly all of the Oregon winter wheat acreage is planted to cultivars with high-temperature adult plant resistance. Thus, little rust is expected commercially, except perhaps at higher elevations. Spring wheat, however, is being hit and is being sprayed in some cases. Barley stripe rust has come in very heavily in the Willamette Valley, though there is very little commercial production here. It is too early to evaluate the impact of stripe rust in our main spring barley area in the Klamath Basin.

It is a little early to evaluate the impacts of wheat leaf rust, though there was some that developed in June of last year.

The Septorias continue to be a significant factor in the Willamette Valley, though wheat acreage is down in this area owing to low wheat prices and higher grass seed prices. The cultivar 'Foote' has shown a nice level of quantitative resistance to *Septoria tritici*, and is increasing in popularity with growers.

Thus far, it seems as if it may be a moderate to heavy year for Cephalosporium stripe, which is a major limiting factor to wheat production in several areas of the state. Increasing effort is being devoted to breeding for resistance to this disease.

Barley yellow dwarf seems to have become a perennial problem, and we are strategizing about how to deal with this disease.

Eyespot has become almost a non-issue, as cultivars with the VPM resistance are being used in conditions where this disease is likely to be a problem. We are working to diversify sources of resistance to eyespot such that this disease will remain a non-issue. Sharp eyespot is sometimes found to be a problem on the cultivar 'Madsen", which has the VPM gene for resistance to eyespot.

Fusarium stem rot is a continuing problem in our drier production areas, and recent droughts have likely exacerbated this disease. Dick Smiley in Pendleton is doing some very nice work in an attempt to quantify levels of resistance against this complex.

About half of the winter wheat area is still sown to Stephens, followed by Madsen. The third most popular winter wheat "cultivar" is cultivar mixtures, which currently constitute about 15% of the Oregon winter wheat area. A 1:1 blend of Madsen:Rod has become a very popular combination in both Oregon and Washington.

South Dakota – Yue Jin

South Dakota State Report to WCC-97, 2002

Reported by Yue Jin

General. In 2001, total acreage of small grains was 3.5 million acres, ranked behind corn (3.8) and soybean (4.3). Among the small grains, spring wheat was 1,700,000 acres, winter wheat 1,300,000, oats 350,000, barley 90,000, and durum 25,000. Over 70% of the winter wheat acreage was not harvested due to a severe winter kill. Estimated acreage planted for small grains in 2002 was similar to 2001, with some increase in spring wheat and oats and decrease in winter wheat (1,150,000). A cool spring in 2002 delayed crop development and spring planted crops were 2 to 3 weeks behind.

Root rot in winter wheat. Common root rot was the most widespread disease in winter wheat in 2001. Root rot was also common in spring wheat.

Leaf spots. Tan spot was the primary pathogen causing leaf spots in winter wheat fields where winter wheat was planted into spring wheat stubble under no-till. This

cropping system is common in the winter wheat region, and leaf spots and root rots have been problematic in the past. A low level of septoria leaf blotch was observed on winter or spring wheat in 2001.

Leaf rust. Severe leaf rust was developed on spring wheat in 2001. Based on fungicide spray trials, Up to 10% yield loss was observed in some very popular cultivars. Although most of the winter wheat cultivars planted in South Dakota are moderate susceptible to susceptible to leaf rust, crop development earlier than normal escaped damage by leaf rust.

Stem rust. Trace amount of stem rust was observed on susceptible winter wheat cultivars. All commercial cultivars of spring wheat are resistant to stem rust, thus stem rust was observed only in experimental plants.

Stripe rust. Stripe rust does not occur frequently in SD. In 2001, a trace amount of stripe rust was observed in winter and spring wheat, considerably less than 2000.

Crown rust. Crown rust was widespread and severe.

Scab. Scab was less than 3% averaged across the state in spring wheat although 30-40% scab was observed in some isolated fields. Yield losses to scab were minimal.

Viruses: Barley yellow dwarf and wheat streak mosaic were not significant.

The spring crops of 2002 are still at the early stage of development at the time of this report.

Washington – Tim Murry and Xianming Chen

Acreage estimates.

Total - nearly 3.0 million acres

Winter wheat - 1.70 million acres (-0.05 over 2001); 66 bu/ac in 2002 (+6 over 2001)

Spring wheat - to be released 7/11/02

Spring barley - to be released 7/11/02

Oats - to be released 7/11/02

Growing Conditions

Fall 2001. Early autumn seedbed moisture in the high rainfall producing area was marginal and seeding dates were later than normal. Much of the winter wheat crop was small entering winter. Seeding conditions in the moderate to low-rainfall areas were likewise marginal and seeding and emergence was early in many areas.

Autumn and winter temperatures were average to above average, although snow fell in mid-November and persisted into February. In north-central Washington, snow cover

persisted for about 100 days. Adequate snow cover and moderate temperatures resulted in good winter survival throughout the state.

Spring 2002. Spring weather was cool and dry with relatively few days of warm, dry weather.
Rainfall is running behind long-term averages in most areas. Abnormally low temperatures in early May have damaged winter wheat in central Washington, but the extent of damage is not known. Overall the winter wheat crop is in good condition and yields are expected to be higher than last year, but well below records. The dry spring weather with moderate temperatures provided good conditions for seeding and establishment of spring crops.

Disease problems

Overall it's still too early to determine which diseases will have the greatest impact on wheat production.

Soilborne pathogens

Cephalosporium stripe is beginning to appear in some areas, and is expected to be serious in some area due to significant winter soil freezing and the continued planting of susceptible cultivars.

Eyespot is present in fields that were sown and emerged early in the low- and intermediate-rainfall areas. Widespread planting of resistant varieties in the high-rainfall areas is expected to limit disease development.

Pink snow mold was present in many fields, but not severe enough to cause significant damage. Likewise, Speckled snow mold was moderate to severe in the northern wheat production areas, but likely won't cause significant damage. The new club winter wheat Bruehl, was sown widely in the snow mold areas and is expected to minimize losses.

Foliar pathogens

Stripe rust (wheat and barley): Winter and spring weather has been very favorable to stripe rust, and it will be severe rust on susceptible varieties if the weather continues to be favorable. Wheat stripe rust severity reached 60% on susceptible varieties in our experimental plots and over 15% in commercial fields, barley stripe rust severity ranged from 10 to 30% on winter barley plots in the Mt. Vernon area in late April. Trace wheat stripe rust was found in commercial fields east of Othello in Adams County in late April.

On May 24, up to 20% wheat stripe rust occurred on susceptible varieties in experimental plots at Central Ferry (Garfield County). Severe wheat stripe rust (up to 30% severity and 60% prevalence) occurred in commercial fields planted with susceptible cultivars near Kahlotus (Franklin County). Near Walla Walla (Walla Walla County), wheat stripe rust just started to show up on susceptible varieties in disease nurseries (not inoculated).

Severe barley stripe rust is present in experimental plots in northwestern Washington.

Physiological leaf spot has not been reported as a widespread problem yet this year. Chloride applications to reduce this problem are used routinely by many growers.

Barley yellow dwarf has been reported in central Washington where wheat is sown very early in the fall

Personnel.
Ekaterini Riga was hired to replace Gerry Santo in January 2002.
Steve Wyatt, WSU virologist, retired from WSU in June 2001 and moved to Manhattan,Kansas, where his wife Carol has a position with Kansas State University. The search for his replacement is underway
Weidong Chen joined the USDA-ARS Grain Legume Genetics unit in February 2002.