

**Progress Report to the Agricultural Research Foundation  
Oregon Wheat Commission**

**PROJECT:** Development of wheat varieties adapted to Oregon production with enhanced disease resistance, stress tolerance, and superior end-use qualities

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**FUNDING HISTORY:**

1999-2000	198,480 (requested)
2000-2001	164,992
2001-2002	164,992

**ABSTRACT:**

The goal of the OSU Wheat Breeding program is to develop varieties that can increase economic returns to Oregon growers through improved grain yield, disease resistance, and enhanced end-use qualities for marketing. The soft white winter wheat OR939526 was advanced to Foundation seed increase this past fall and has been proposed for release this coming August. OR939526 is a broadly adapted, high yield, strawbreaker footrot resistant selection from the cross 'Madsen/Malcom'. It has end-use quality attributes similar to Stephens. Four Clearfield herbicide-resistant soft white winter wheat selections were advanced to Breeder seed increase with expectation to move one or two selections to Foundation seed increase next fall. The hard white selection OR850513-19, which was on Breeder seed increase this past year, was withdrawn from release considerations due to high level of susceptibility to Stripe rust. Also, there were concerns that protein qualities of -19, along with the remaining 'Ivory' reselections -8 and -9, were inadequate for making acceptable noodle and bread products. We are carefully re-examining product quality of our other elite advanced hard white selections, while we restructure the underlying hard white wheat germplasm base. Parent lines from the Great Plains and Australia are being extensively used to improve winterhardiness, protein quality, bread-making quality, noodle color, and noodle texture. For 2002, eleven soft white winter wheat experimental lines were entered into regional and/or statewide variety trials, including the four Clearfield herbicide resistant selections. Six hard white winter wheats also were advanced to these trials. Three soft white wheats were advanced to industry evaluations through the Wheat Quality Council, while three hard wheats were entered in Asian Noodle Collaborative testing at the Wheat Marketing Center. Collaborations with the Wheat Marketing Center and ARS-WWQL are continuing to identify hard and soft wheat selections with superior-quality and critical traits, such as extra-soft kernel texture, that will improve marketability and demand for Oregon wheat.

## **OBJECTIVES:**

1. Develop and release new wheat varieties with superior disease resistance and enhanced tolerance to abiotic stresses that minimize production risks and increase economic returns to growers.
2. Increase demand and marketability of PNW wheat through development of soft and hard wheat varieties with superior end-use qualities. Identify germplasm, genes, and traits that contribute value-added or product-specific qualities and provide new marketing opportunities for wheat growers.
3. Identify germplasm, genes, and traits that will contribute to superior varietal performance and enhanced yield stability under diverse production conditions. Incorporate these new genetic resources and products of biotechnology into adapted varieties through efficient use of field and laboratory evaluation methods.
4. Identify promising lines and populations from the HybriTech / Monsanto winter wheat germplasm stocks for use in pureline variety development efforts.

## **PROCEDURES:**

Wheat breeding materials must be evaluated under a wide array of environmental and management practices to characterize performance and adaptation. Early generation breeding materials (F1 through F5) are evaluated through a shuttle between Hyslop and Pendleton (Ruggs) to identify broadly adapted, disease resistant selections. Mid-late generation materials, (preliminary and advanced lines of F6 through F9) are evaluated in replicated trials at our core nursery sites at Pendleton (Rugg-Barnett), Moro (Sherman County Experiment Station), and Corvallis (Hyslop Research Farm). In addition, five 'satellite' testing nurseries are now being used to more rapidly characterize performance of our breeding lines. Each site includes 2 replications of SW and HW Elite nurseries for grain yield comparisons and unreplicated plots or observation rows of lines in all the preliminary and advanced yield trials (F6 through F8 generations). The nurseries were planted at sites near Moro (Chris Kaseberg), Condon (Jeff Nelson), Arlington (Jim Rucker; Eric Anderson for 2002), Pilot Rock (Cliff Hoelt), and Hermiston (Kent Madison). These sites were chosen to represent a very diverse array of production conditions; from very low rainfall to full irrigation, shallow to deep soils, and low residue to high residue management practices. A winterhardness nursery site has also been established for evaluation of these same trials.

A list of experimental trials included at each of the satellite locations for **2002** follows:

**Show and Tell:** established varieties, newly available varieties, and elite OR lines under consideration for variety release. (27 entries, one replication)

**Soft White Elite:** elite soft-seeded lines with check varieties. (40 entries, two replications)

**SWADV** – Advanced soft white selections with checks ( 40 entries, F8 generation, one replication)

**Hard White Elite:** elite hard-seeded lines with check varieties. (30 entries, two replications)

**HWADV:** Advanced hard white selections with checks (56 entries one replication)

**Durum Elite:** Elite durum lines, planted at Pilot Rock only (60 entries, 2 reps)

**OR-ID Irrigated Yield Trial:** advanced lines from OR and ID breeding programs with potential for irrigated wheat production. Planted at Hermiston, OR, and Parma, Hazelton, and Aberdeen, Idaho; conducted in cooperation with Ed Souza and Bob Zemetra, University of Idaho. (24 entries, 3 replications)

**Observation Nurseries:** a single replication of two row plots for each of the following sets of advanced lines:

IMIADV	Advanced lines carrying IMI-herbicide resistance (35 entries)
SWRPN -	Soft White Replicated Prelim Nursery (80 entries, F7 generation)
SWPYT -	Soft White Preliminary Yield Trial (300 entries, F6 generation)
HWPYT -	Hard White Preliminary Yield Trial (80 entries, F6 generation)
HTADV-1	Advanced Hybritech inbred lines (80 entries, F6-F7 generations)
HTADV-2	Advanced Hybritech inbred lines (80 entries, F6-F7 generations)
HTADV-3	Advanced Hybritech inbred lines (80 entries, F6-F7 generations)
HTADV-4	Advanced Hybritech inbred lines (80 entries, F6-F7 generations)

Other field trials for 2002 include: A set of F2 plots were planted at Moro to characterize plant type and yield potential under lower rainfall conditions and thereby facilitate selection of superior F2 populations and space plants at Hyslop. A direct-seed research nursery was established at the Sherman County Experiment Station in collaboration with Don Wysocki, Erhling Jacobsen, and Russ Karow. The nursery includes our Soft White Elite Nursery, in addition to the Statewide Variety Trial, to characterize performance of both current varieties and our most advanced breeding lines. In addition, we are evaluating a diverse set of F2 populations for their potential adaptation and selection under direct-seed conditions. A second direct-seed research trial was established by Dale Wilkins and Don Wysocki near Pendleton. This nursery will examine variation in productivity, fertilization response, and disease resistance among 8 varieties and elite experimental lines in a late-seeded no-till situation. Our goals in this diverse set of experimental locations and germplasm are to more rapidly characterize performance of our breeding lines and parent stocks for adaptation, yield potential, stress tolerance, and disease resistance.

Germplasm exchanges with the Limagrain/Nickerson companies are continuing. In 2001, over 140 varieties and germplasms from England and France were evaluated. Forty lines were advance to multilocation replicated yield trials for more detailed characterization of adaptation, yield potential, and disease resistance in 2002. A second set of lines were exchanged between our programs in late fall and the new Nickerson lines were seeded at Hyslop in early December.

## REPORT OF ACCOMPLISHMENTS:

**Status of New Varieties:** OR939526 is a soft white winter wheat being proposed for release in 2002 for its superior yield potential and broad adaptation to wheat growing areas of the Pacific Northwest. We anticipate approximately 80,000 pounds of Foundation seed will be available through the Washington Foundation Seed Service this coming August. OR939526 will be submitted for Plant Variety Protection, but without the Title 5 option.

OR939526 is a semidwarf soft white winter wheat derived from the cross 'Madsen'/'Malcom'. OR939526 carries the Pch1 gene for resistance to *Pseudocercospora* footrot from the parent variety Madsen and has a similar disease reaction. It has acceptable levels of resistance to Stripe and Leaf rust and is moderately susceptible to *Septoria*. It is susceptible to *Cephalosporium stripe*, with reaction similar to Stephens. OR939526 carries the Bt4 gene as a source of resistance to Common Bunt. OR939526 averages 2 d later in heading date than Stephens and 2 d earlier than Weatherford.

Grain yields of OR939526 have consistently exceeded those of the check varieties Stephens, Weatherford, and Madsen. Over 120 site/years of testing, OR939526 has averaged 107.7 bu/a grain yield compared with 99.6 bu/a for Stephens and 99.8 bu/a for Madsen. In 91 site/years of testing, OR939526 has averaged 103.3 bu/a compared with Weatherford at 99.7 bu/a. Over 60 locations in 2000 and 2001, test weight of OR939526 averaged 0.3 lb/bu lower than Stephens and 0.8 lb/bu lower than Madsen. Grain protein content of OR939526 has averaged 0.4 percentage points lower than Madsen and Stephens. Thousand kernel weight has averaged 39.4 g over 3 years of OSU Variety Trials; higher than kernel weight of Madsen at 35.4 g, but lower than Stephens at 41.9 g.

Comparisons of milling quality, flour yield, protein content, and cookie diameter suggests that OR939526 has quality very similar to Stephens, Weatherford, and Madsen and is considered as acceptable for soft wheat applications. OR939526 was evaluated in the 1999 PNW Wheat Quality Council trials and was considered as generally acceptable for major soft wheat product applications.

**Results of 2001 Breeding Trials:** Breeding materials were evaluated at a total of eight locations in 2001, including five 'satellite' sites. Severe drought conditions throughout the growing season impacted many, if not all, of our research trials. The Rugg's nursery had excellent moisture conditions at fall planting, but winter/spring rainfall was insufficient and the nursery finished under drought stress. Stands were somewhat variable at Moro and Kaseberg's due to dry and deep moisture conditions at planting. Plots at Condon were abandoned because of severe plant damage and sterility resulting from late-May frosts. The Pilot Rock nursery was abandoned due to extreme drought and frost damage. The irrigate research trial at Hermiston experienced severe drought stress in early-mid grain-fill, when irrigation water became unavailable. The trials did not fully recover from the short-duration stress and yields were compressed. Stands and early growth at Arlington were excellent and, as expected, the nursery ran out of moisture

during grain fill. Resulting yields and grain quality provided good measures of stress tolerance.

Average grain yields of the Soft White Elite Nursery ranged from lows of 32.7 and 37.1 bu/a at Kaseberg's and Arlington, to a high of 132.8 at Hyslop. There was substantial variation in genetic response to the varying stresses and yield potential among the sites. Selections that performed well under high-yield conditions did not necessarily perform well under drier conditions, and vice versa. The 2001 trials were again particularly beneficial to identify selections with resistance to *Pseudocercospora* (strawbreaker) footrot. All of our nurseries at the Hyslop Agronomy Farm, from headrows through elite yield trials, were infected with strawbreaker footrot. The infection was such that most materials that did not carry genetic resistance from VPM1 (Madsen), Rondevous, or Cerco were lodged by harvest. Some of the Hyslop trials, particularly those of hard white materials, were not harvested for grain yield because of severe lodging.

**Soft White Winter Wheat Improvement:** Seven soft white winter selections were advanced to either State-wide Variety Trials or Regional Nursery testing; including OR941904, OR941896, OR951431, OR941550, OR9900548, OR9900553, OR941611. Grain yield and performance data for these seven lines and the 50 entries evaluated in the 2001 Soft White Elite Nursery are summarized in Table 1.

OR951431 is medium height semidwarf derived from the cross 'Hill/3/Cerco//YMH/HYS/4/Cerco/YMH/HYS'. We are particularly interested in OR951431 as it carries strawbreaker footrot resistant derived from the germplasm line 'Cerco'. This resistance is genetically different than the resistance carried in Madsen or other VPM derivatives. The selection has shown high yield potential and broad adaptation under recent stress conditions. The selections 1904 and 1896 are sister lines from the spring x winter cross combination 'SPN/5/NZT/BEZ1/ALD,F1/4/F1,NAD//TMP/CI12406/3/EMU'. In addition to high grain yield potential, they have shown superior quality for use in cookie applications. Unfortunately, the lines do not carry strawbreaker footrot resistance.

OR9900553 is from the cross 'Arminda/3/VPM/MOS951//2\*Hill/5/ID#870337'. OR9900548 is from similar parentage, from the cross TJB801-1332/PRL/4/D6301/HN7//Era/3/Buc/5/ID#870337. The last parent of each, ID#870337, is a selection from complex spring x winter parentage. Both are shorter semidwarfs with high head fertility, targeted for their high yield potential under irrigated production conditions. The lines also have been noted for their soft grain texture and superior cookie quality in our preliminary quality evaluations.

OR941611 is from the cross ID#832665/Madsen sister. It was notable for its taller stature, superior yields and overall performance under drought stress this past year. Its performance suggests it may have application to drier production areas of Oregon. In addition to strawbreaker resistance, trials conducted by Dick Smiley have suggested that OR941611 may have moderate levels of resistance to *Fusarium* dryland footrot.

Three soft white winter wheat selections, OR941550, OR 951431, and OR9900553, were evaluated through the PNW Wheat Quality Council evaluations this past January. In spite of higher protein levels in the grain samples from Pendleton last year, OR951431 and OR9900553 performed very well in milling and baking evaluations conducted by industry collaborators. OR9900553, in particular, was noted for its very soft kernel texture, higher break flour yields, and superior product qualities. OR941550, derived from soft x hard wheat parentage, was generally considered less acceptable for use in soft wheat products.

**Hard White Winter Wheat Improvement:** In fall, 2000, the hard white winter 'Ivory' reselection OR850513-19 was advanced to Foundation seed production. OR850513-19 had shown the best protein quality among all the Ivory reselections we had evaluated. It was dropped from further consideration this past summer, however, due to high levels of susceptibility to Stripe rust. The remaining Ivory reselections also have been shelved, primarily due to inadequate protein quality.

We have not lessened our commitment to hard white development; rather, we are moving new populations forward to address critical deficiencies in our hard white germplasm base. Improving protein quality and noodle color, as related to PPO activity, are critical to developing hard whites for multi-product applications. Moderate levels of bread quality also are needed to satisfy domestic expectations and product needs. Other traits of concern include winterhardiness, as much of our hard white base was derived from spring x winter crosses, and inadequate *Pseudocercospora* footrot resistance. In response, we are currently fast-tracking high-priority hard white cross combinations. We expect to have numerous F3 and F4 plant rows and populations in the field next fall from 3-way crosses of (OSU HWW's) x (Plains HRW and HWW) x OR943575. These combinations should provide us with means to simultaneously improve protein quality, winterhardiness, and noodle color, while capturing the high yield, broad adaptation, low PPO, and footrot resistance of our hard white selection OR943575.

Six hard white wheat selections were advanced to either State-wide Variety Trial or Regional Nursery testing; including OR941048, OR942496, OR953475, OR952577, OR9900384, and OR850513-8. Grain yields and performance of these lines are summarized with the Hard White Elite Nursery data (Table 2). Out of 28 experimental lines evaluated in the 2001 HW Elite, 12 were dropped due to inadequate noodle color or protein quality.

The hard white selections OR942496 and OR941048 have been entered in the Asian Products Collaborative sponsored by the Wheat Marketing Center. OR941048, from the cross 'ID 80-628/3/CER/YMH/HYS/4/CER/YMH/HYS', has shown promising yield potential, intermediate to low PPO activity, and moderate protein quality. OR942496 is a hard white selection from a spring x winter cross combination and is now in the State-wide variety trials and regional testing. It has also shown promising agronomic potential, but has questionable end-use quality attributes.

**Spring Wheat Improvement:** Our spring wheat nursery at Pendleton last year was heavily infested with Hessian fly. The infestation was such that yield and performance data was only an indication of resistance or susceptibility to the fly. Unfortunately, very few of our spring wheat selections had adequate levels of resistance. Seven elite spring wheat selections were advanced to the 2002 Statewide Spring Variety Trials, Regional Nursery trials, or Tri-state spring nurseries. The Statewide entries include the hard white spring OR4970025 (F34.70//BB/GLL/3/Crow.s /4/Tan.s/Pew.s), which was ranked 4<sup>th</sup> of 28 entries for grain yield in the 2001 Regional Hard Spring Nursery, and OR4970018, a hard red from the CIMMYT cross ‘Tan.s/Pew.s/5/Rbs/Anza /3/Kvz/Hys//Ymh/Tob /4/Bow.s’.

All of our advanced spring wheats are currently derived directly from CIMMYT germplasm. This past year we imported nearly 300 new CIMMYT spring wheat lines for evaluation and crossing purposes. These will be used for both winter and spring wheat breeding efforts. Included are 125 lines that were selected on-site last spring in Obregon. These lines are currently in our greenhouse under quarantine seed increase.

Two years ago we also initiated a crossing program to develop a small spring wheat germplasm base that is fully ‘OSU developed and owned’. These populations, now in F3 headrows, are being targeted especially for quality improvement by combining the best-adapted public spring wheats with new high-yielding CIMMYT germplasm.

**Early Generations and Crossing:** Over 600 soft and hard wheat crosses were made to introgress new genetic stocks and develop new breeding populations for variety development and genetics research. Approximately ½ the crosses were intended for soft wheat improvement and ½ for hard white improvement. High priority single crosses were advanced through the greenhouse for topcrossing, for production of F3 seed, and F3 single-seed decent derived lines prior to fall planting. These include crosses with French lines that have shown superior yield potential and disease resistance, both for *Cephalosporium* stripe and *Fusarium* dryland footrot; crosses with Plains hard wheats; CIMMYT synthetic wheats; and with our new soft white IMI resistant selections.

Over 8,000 plots, 20,000 headrows, 220 space plant populations, and 500 entries in observation trials were evaluated for plant type, winter survival, disease resistance, grain yield, grain quality, and end-use quality over 8 locations in Oregon; these in addition to the HybriTech stocks evaluated in 2001.

**Proprietary Research:** Four Clearfield herbicide resistant breeding lines were advanced to breeder seed increase this past fall. Approximately 1,800 heads of each line were selected and individually threshed. Half of the headrows were seeded at Moses Lake, WA, and the remaining ½ at Yuma, AZ. The goal was to provide opportunities for further reselection and purification while obtaining maximum possible seed increase. BASF agreed to cover costs for these Breeder seed increases.

Lines under breeder seed increase include:

OR201007	‘Madsen/FS-4//Weatherford seln’
OR201008	‘Madsen/FS-4//Weatherford seln’
OR2010010	‘FS-4//Spn/Madsen/3/Spn/Madsen’
OR2010051	‘FS-4/Spn//63-189-66-7/Bez/4/Spn/Madsen’

OR2010010 and OR2010051 were advanced to the Oregon Statewide Variety trials, while OR201007 and 8 were entered in Regional Nursery Trials. Yield and performance data from 2001 is summarized in Table 3. Although data is limited, these Clearfield selections had competitive grain yields and acceptable plant type and disease resistance. Preliminary quality evaluations suggest they have acceptable soft wheat quality, although more extensive testing is needed. The ‘next generation’ Clearfield populations are being moved through greenhouse single-seed descent to further improve adaptation and performance.

Material Transfer or Research and Development Agreements were formalized and signed with Monsanto for donation of HybriTech stocks, with Monsanto for development of roundup-ready wheats for Oregon, and with BASF/AmCy for development of IMI herbicide resistant wheat varieties. These agreements had undergone many revisions, with help of Bill Hostetler and others, and were brought to the OWC and OWGL for their input and support. The collaborative research effort and germplasm exchange program with the Limagrain/Nickerson companies of France and England continues. We are in the final stages of drafting a formal R & D agreement with Limagrain.

Discussions with OWC, OWGL, growers, and wheat industry representatives were initiated in August to develop commercialization strategies and support for release of OSU-developed Clearfield wheat varieties. Now formalized as an ‘executive advisory committee’, industry representatives will work with OSU to address policy issues, license and enforcement, develop release and commercialization strategies.

In December, BASF provided an unrestricted grant-in-aid of \$20,000 to support our breeding and research efforts. This follows the purchase of growth chambers and past funding support for single seed descent of IMI breeding materials.

**End-use Quality:** End-use quality research and development efforts involve collaborations with OSU researchers, the Wheat Marketing Center, USDA-ARS-Western Wheat Quality Lab, USDA-GIPSA-FGIS, and commercial companies.

Results from a second year of Asian product evaluations with the Wheat Marketing Center generated more questions than answers. Lines in the 2000 Hard White Elite Nursery were evaluated for Chinese raw noodles, steam bread, and pan breads using grain samples from multiple locations and varying protein contents. For the 2000 grain samples, there was little consistency in results or varietal ranks over locations for product attributes. Product color was generally less than acceptable, possibly related to high ash or bran contamination during milling. Samples from the 2001 HW-Elite will be milled and submitted for product testing this spring. Additional biochemical analyses are anticipated as we try to understand basis for variations in product quality.

Over 150 hard white wheat samples from the 2000 Hard White Elite Nursery were submitted to USDA-GIPSA-FGIS in January of 2001 for visual classification. The majority of samples graded 'soft white' for visual kernel attributes such as color and shape. The results confirm the serious nature of classification and segregation problems in the PNW; problems that will only increase as hard white wheat production increases. Samples from the 2001 trials have now been submitted to FGIS for further evaluation and classification. As new hard white varieties are readied for release, it will be important that either FGIS can visually identify the variety, or that we work with FGIS to develop more objective tests for the industry.

Support from Craig Morris and the USDA-ARS Western Wheat Quality Lab in evaluating our preliminary and advanced breeding lines is gratefully acknowledged. Through their testing efforts, we have begun to partition our soft white selections into 'quality subclasses' to target specific market needs and opportunities.

With recent arrival of Andrew Ross, OSU Cereal Chemist, we are reevaluating our quality research program and market development efforts. We anticipate several new end-use quality research thrusts to be established, in addition to redefining and reinvigorating our hard white wheat variety development program.

**Genetic studies and collaborative basic research:** Population development continues for application of molecular marker technologies in collaboration with Oscar Riera-Lizarazu. A collaborative graduate student project is underway to examine molecular markers and gene flow in historically important PNW wheats. Single seed descent populations for enhanced protein quality and Cephalosporium stripe resistance are being developed as part of our trait improvement efforts and investigations into 'association mapping' applications.

**General program activities:** With loss of Karim Ammar due to visa complications in 2000, we assumed all responsibilities for winter durum breeding and genetics research. This included a two-year Multilocation Trial for study of N response and pasta quality of elite OSU durum lines. The second year of MLT field trials were completed in 2001 and grain samples are now being processed for Pasta quality testing. Due to changing business priorities and ongoing concerns regarding winterhardiness and quality, grant funding for the winter durum project was discontinued as of July 1. We completed the field season and processing of the durum germplasm, shelved the early generation stocks,

and moved a limited number of lines into advanced trials. We are currently packaging samples of the durum germplasm to be distributed to colleagues as CIMMYT, Mexico; Martonvasar, Hungary; and Odessa, Ukraine.

In collaborations with the CIMMYT winter wheat program in Turkey, our program supports the quarantine increase, packaging, and distribution of seed stocks for the Facultative and Winter Wheat Observation Nursery (FAWWON) and EEWWRYT Eastern Europe Winter Wheat Regional Yield Trials. The stocks are an important source of new parents for our program and are provided to breeding programs throughout the US and North and South America.

### **IMPACTS:**

The hard white spring wheat 'Winsome' was released to growers in February, 2000. Winsome is the first hard white variety released by OSU for Asian noodle applications and will provide new marketing opportunities for Oregon growers. The soft white selection 'OR929526' was advanced to Foundation seed increase for potential release to growers in 2002. Four Clearfield herbicide resistant selections were advanced to Breeder seed increase. These varieties and selections represent significant improvements in yield, disease resistance, and milling and baking qualities and will provide direct economic returns to Oregon wheat growers. Investments in wheat breeding continue to contribute to the state agricultural economy through increased grain yield, enhanced yield stability, and superior end-use quality for marketing.

### **RELATION TO OTHER RESEARCH:**

The satellite locations of HW and SW elite trials will provide a total of eight locations of grain samples. The samples are being used for studies on end-use quality stability, end-product applications, genotype x environment influences on quality, and hard white wheat classification in collaboration with Wheat Marketing Center, ARS-WWQL, and USDA-GIPSA. Numerous crosses were made to develop stocks needed for genetic studies on end-use quality, disease resistance, adaptation and stress tolerance.

Several collaborative research studies are underway: with Andrew Ross on end-use quality improvement for Asian markets; Oscar Riera-Lizarazu to develop molecular markers for identification of disease resistance and quality traits using mapping populations, varieties, and segregating populations; Dick Smiley on evaluation of germplasm for *Fusarium* foot rot resistance; Wheat Marketing Center on multipurpose end-use evaluations of hard white wheats; and with Chris Mundt on laboratory and field evaluations of *Cephalosporium* stripe and *Pseudocercospora* footrot resistance. Herbicide resistant wheat cultivar development continues with Dan Ball and Carol Mallory-Smith. Strategies for N management and genetic control of protein content in hard white germplasm are being pursued in collaboration with Neil Christensen and Don Wysocki. Variety development for direct-seeding applications will be pursued in collaboration with Wysocki, Smiley, Mundt, Ron Rickman, and others.

## **ACKNOWLEDGEMENTS:**

Our appreciation is extended to the Oregon Wheat Commission and the OWGL for their ongoing support and commitment to the wheat breeding and variety development effort. We also wish to thank Larry Williams, Chris Kaseberg, Jeff Nelson, Jim Rucker, Eric Anderson, Kent Madison, and Cliff Hoeft for providing land and support for our field trials. Appreciation for contributing protein and farinograph analyses is extended to Pendleton Flour Mills. Special accolades go out to Mary Verhoeven, Barb Matson, Bruce Hoefer, Mark Larson, and Susan Wheeler for their extra efforts and contributions in managing the HybriTech germplasm in 2001.

## **RELATED PUBLICATIONS AND PRESENTATIONS:**

### **Publications:**

Peterson, C.J. Wheat research at Oregon State University: History and transition. Proceedings of the Warren E. Kronstad Memorial Symposium. March 15-16, 2001, Obregon, Mexico. In Press.

Peterson, C.J., R.E. Allan, and C. J. Peterson. 2001. The Pacific Northwest Region. In: Bonjean and Angus (eds.), *The World Wheat Book. Limagrain Agro-genetics and* Lavoisier Publishing, Paris, France. Pgs 407-429.

Peterson, C.J, D.R. Shelton, T.J. Martin, R.G. Sears, E. Williams, and R. A. Graybosch. 2001. Grain color stability and classification of hard white wheat in the U.S. *Euphytica* 119:101-106.

Peterson, C.J, D.R. Shelton, T.J. Martin, R.G. Sears, E. Williams, and R. A. Graybosch. 2001. Grain color stability and classification of hard white wheat in the U.S. *Wheat in a Global Environment: Proceedings of the 6<sup>th</sup> International Wheat Conference*, June 5-9, 2000, Budapest, Hungary. Z. Bedo and L. Lang (eds.). Kluwer Academic Publishers, The Netherlands. Pg 219-228.

### **Reports and Popular Publications:**

Peterson, C.J. Durum Wheat for Oregon and the Northwest. *Oregon Wheat*. March, 2001.

Peterson, C.J. The donation of HybriTech wheat germplasm to OSU. *Oregon Wheat*, July, 2001. Pg 12-13.

### **Variety Releases:**

Application for U.S. Plant Variety Protection: Winsome hard white spring wheat. Verhoeven, M., W. E. Kronstad, S. Rajaram, C. J. Peterson, C. Morris, and M. Kruk. February, 2001.

**Graduate Theses:**

Marina Castro Derenyi. M.S. Influence of nitrogen fertilization management on the bread making quality of different wheat cultivars. January, 2001.

**Presentations:**

Profits, pitfalls, and public breeding with private technologies. Hard Winter Wheat Workers Workshop, February 19-21, 2001, Kansas City, MO.

Improving wheat quality and market competitiveness: OSU Wheat breeding and end-use quality research. Oregon Wheat Growers League Summer Board Meeting, September 5, 2001, The Dalles, OR.

OSU Wheat breeding and end-use quality research for market development. CBARC Fall Research Review, September 6, 2001, Boardman, OR.

New directions in OSU wheat breeding and genetics research. Union County Wheat Growers Meeting. February 22, 2001, Ontario, OR.

The public role in development and marketing of the products of biotechnology. OSU Environmental Science and Philosophy Issues lecture series, May 17, 2001.

Wheat research at Oregon State University: History, Transition, and Future. Warren E. Kronstad Memorial Wheat Research Symposium. March 15-16, 2001, Obregon, Mexico.

Clearfield wheat development at Oregon State University. Washington State Crop Improvement Association Annual Meeting, November 14-15, Kennewick, Washington.

OSU Wheat breeding update: Research and Production Committee Meeting. Oregon Wheat Growers League Annual Convention, December 3-5, 2001, Tigard, OR,

Clearfield wheat development options for Washington. Washington Wheat Commission Meeting, March 21, 2001, Spokane, WA.

**Misc presentations:**

WCC-81 Coordinating Committee – Update of OSU end-use quality research, January 24, 2001, Seattle, WA.

Field day presentations:

OSU Sponsored: CBARC Field Day; OSU Breeding update at Rugg's nursery site; Sherman County Experiment Station, Moro; Gilliam County Crop Tour.

BASF Sponsored: OSU Clearfield breeding at Rugg's nursery site. Grower sponsored: Madison Farms.