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:

2000-2001	164,992
2001-2002	164,992
2002-2003	120,000

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 'Tubbs' was released to growers in 2002. Tubbs is a broadly adapted, high yield, strawbreaker footrot resistant selection from the cross 'Madsen/Malcom'. It has end-use quality attributes similar to Stephens and Madsen. 'ORCF-101', a CLEARFIELD* herbicide resistant soft white winter wheat variety, has been approved for release in 2003. We anticipate approximately 4,500 bushels of Foundation Seed will be available in August. ORCF-101 will be available to seed dealers through a non-exclusive licensing agreement with OSU. Restructuring of our hard white wheat breeding continues in collaboration with Dr. Andrew Ross. Improvements in protein quality, noodle color and texture, and bread-making ability are being targeted in segregating populations, as are needed to meet, and exceed, Asian market expectations. Two new Ph.D. research studies were initiated to support our hard white wheat improvement efforts. Six experimental lines were advanced to Statewide Variety Trials; including 5 soft white winter lines and 1 hard white winter selection. Three of these lines also were entered in WA and/or ID statewide trials. A total of 11 lines were entered in Regional Nursery trial, eight of which are soft winter wheat selections. Industry milling and baking evaluations were conducted on two soft white wheat selections, OR9900553 and ORCF-101, through the Wheat Quality Council. OR9900553 has very soft kernel texture and has shown superior performance in end-use quality evaluations conducted by ARS-WWQL and the Wheat Quality Council. Collaborations with the OSU Wheat Quality Lab, 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 and improved protein composition, which 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, six '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). In fall 2002, the nurseries were planted at sites near Moro (Chris Kaseberg), Condon (Jeff Nelson), Arlington (Eric Anderson), Lexington (Chris Rauch), Hermiston (Kent Madison), and Ritzville (Gary Galbraith, for winterhardiness testing). 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. With these diverse experimental locations for yield and observation nurseries, we except to more rapidly characterize performance of our breeding lines and parent stocks for adaptation, yield potential, stress tolerance, and disease resistance.

A list of experimental trials included at each of the **satellite locations for 2003** follows:

> **Soft White Elite**: Elite soft-seeded lines and check varieties. (40 entries, two replications); also substituting for the OSU Statewide Variety Trial for 2003, with inclusion of variety candidates from ID and WA.
> **HTElite:** Elite lines and selections from the Hybritech stocks (60 entries two replications)

Hard White Elite: Elite hard-seeded lines with check varieties. (25 entries, two replications)
SWADV – Advanced soft white selections with checks (50 entries, F8 generation, one replication)
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. (26 entries, 3 replications)
Nickerson Elite: OSU selections from materials provided by the Nickerson breeding program. Planted at Hermiston. (30 entries, 2 reps)
Observation Nurseries: A single replication of one- or two-row plots for each of the following sets of advanced lines:

IMIADV	Advanced lines carrying IMI-herbicide resistance (32 entries)
SWRPN-1	Soft White Replicated Prelim Nursery (50 entries, F7 generation)
SWRPN-2	Soft White Replicated Prelim Nursery (50 entries, F7 generation)
HWADV	Hard White Advanced Nursery (30 entries, F8 generation)
SWPYT -	Soft White Preliminary Yield Trial (320 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)

Germplasm exchanges and collaborations with the Limagrain/Nickerson companies also are continuing. In 2003 we will be evaluating 120 new varieties and germplasms from England and France in replicated trials. Thirty lines from Nickerson materials screened in 2001 and 2002 have been advanced to multilocation replicated yield trials for more detailed characterization of adaptation, yield potential, and disease resistance. Additionally, we have nearly 300 new spring wheat germplasms from CIMMYT that have recently cleared our greenhouse quarantine increase. These will be evaluated in field trials for the first time in 2003. Included are 125 germplasms selected on-site in Obregon during the 2001 Kronstad Symposium.

REPORT OF ACCOMPLISHMENTS:

Status of New Varieties: 'Tubbs' is a soft white winter wheat released in 2002 for its superior yield potential and broad adaptation to wheat growing areas of the Pacific Northwest. Tubbs is derived from the cross 'Madsen'/'Malcom'. Approximately 80,000 pounds of Foundation seed were available, and sold, last August through the WSCIA Foundation Seed Service. Tubbs will be submitted for Plant Variety Protection, but without the Title 5 option.

Tubbs carries the Pch1 gene for resistance to *Pseudocercosporella* 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. Tubbs carries the Bt4 gene as a source of resistance to Common Bunt. Tubbs averages 2 d later in heading date than Stephens and 2 d earlier than Weatherford. Grain yields of Tubbs 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. Comparisons of milling quality, flour yield, protein content, and cookie diameter suggests that Tubbs has quality very similar to Stephens, Weatherford, and Madsen and is considered as acceptable for soft wheat applications.

The Oregon Agricultural Experiment Station has approved the release of ORCF-101, a soft white winter wheat (*Triticum aestivum L.*) that possesses Clearfield™ herbicide resistance technology. ORCF-101 is being released for its utility for grassy weed control, adaptation to wheat growing areas of the Pacific Northwest, and acceptable quality for the soft white market class. ORCF-101 is a semidwarf soft white winter wheat derived from the three-way cross 'CV-9804'/'Malcolm'//'OR939481'. CV-9804, also known as 'FS-4', is the donor of the Clearfield trait, developed through mutagenesis of the cultivar 'Fidel'. OR939481 is a selection from the cross 'Stephens'/'Madsen'.

ORCF-101 is adapted to production areas of northeast Oregon, southeast Washington, and Idaho. ORCF-101 carries resistance to strawbreaker footrot (*Pseudocercosporella herpotrichoides)* from the parent variety Madsen and has a similar reaction to this important root disease. ORCF-101 has adult-plant resistance to stripe rust (*Puccinia striiformis*) in field situations, with infection intensities similar to Stephens and Madsen and less that 'Tubbs'. It has shown susceptibility to current races of leaf rust (*Puccinia recondita*). ORCF-101 is moderately susceptibility to *Septoria tritici*, crown rot (*Fusarium pseudograminearum)* and Cephalosporium stripe (*Cephalosporium gramineum*).

ORCF-101 was evaluated in breeding trials in 2001 and 2002 and in OSU Statewide Variety Trials and Northern Idaho Variety Trials in 2002. ORCF-101 averaged 2 d later in heading than Stephens and 2 d earlier than Madsen. Plant height averaged 1.5 inches taller than Stephens and 0.4 inches shorter than Madsen. ORCF-101 has shown good straw strength under high yield conditions. Winterhardiness of ORCF-101 is expected to be no better than that of the adapted parents Malcolm, Stephens, or Madsen.

Grain yields of ORCF-101 have been very comparable to Madsen and higher than for Stephens in trials for which Beyond™ has not been applied. Over 15 site/years of trials, average yields of ORCF-101 were 95.8 as compared with 95.0 for Madsen and 88.5 for Stephens. When data from 2001 Hyslop is excluded, due to an intense Strawbreaker footrot infection, ORCF-101 averaged 2.3 bu/a higher than Stephens. Analyses conducted by the ARS- WWQL suggest that ORCF-101 has milling quality, flour yield, protein content, and baking quality very similar to Stephens, Madsen and Tubbs and is considered as acceptable for soft wheat applications. Milling quality, as indicated by test weight, flour yield, break flour yield, ash content, and water absorption suggest ORCF-101 is not significantly different from Stephens. Cookie diameters and sponge cake volumes of ORCF-101 were considered acceptable and did not differ significantly from Stephens and Madsen.

Herbicide tolerance of ORCF-101 was evaluated at two locations in 2002. At the OSU Pendleton research site, Beyond™ was spring applied at 4, 6, and 12 oz rates. There was no significant reduction in grain yield for either ORCF-101 or the herbicide resistant parent, CV-9804; rather, grain yield was increased slightly, likely due to improved weed control over the untreated plots. Plots of the check variety Stephens were effectively killed with each herbicide application. A trial near Athena, OR, conducted under contract by BASF, showed that ORCF-101 had commercially acceptable crop safety ratings and similar tolerance to CV-9804 based on fall and spring applications of Beyond™ at 4, 8, or 16 oz rates

ORCF-101 will be submitted for Plant Variety Protection with the Title 5 option. ORCF-101 will be release to seed growers only through a non-exclusive licensing agreement that grants permission to produce, sell, and promote seed of the variety.

Results of 2002 Breeding Trials: Breeding materials were evaluated at a total of nine locations in 2002, including five 'satellite' sites. Severe drought conditions throughout the growing season impacted many, if not all, of our research trials. Fortunately, the Pendleton Rugg's nursery site was summer fallowed the previous year and had sufficient moisture for the crop to finish under only moderate drought stress. However, due to a fertilizer overlap and apparent interaction of growth stage with frost, several yield trials were severely damaged and had high CV's. Plots at Kaseberg's and Pilot Rock were abandoned due to extreme drought and frost. Stands were variable at Moro due to dry and deep moisture conditions at planting. Trials that were late-seeded at Moro under no-till conditions, including the SW and HW Elite, had more uniform stands, lower CV's, and better grain quality. Plots at Condon were low tillering and experienced severe drought stress. The Arlington nursery had uniform stands and fairly good early growth. As expected, the nursery ran out of moisture during grain fill and finished under significant stress. The Arlington nursery had a uniform infection of Fusarium dryland crown rot. The infection helped differentiate the lines for disease response, with white-head ratings ranging from 0 to 40%. Yields averaging 130 bu/a were obtained under irrigation at Hermiston. The high yield conditions are important to evaluate plant type, head fertility, and lodging resistance. A collaborative yield trial under a center pivot near Ritzville evaluated 320 of our Hybritech advanced lines. Intended primarily for winterhardiness screening, the trial instead provided a good measure of yield potential and heat stress tolerance during grain fill. An intense stripe rust infection at Hyslop farm was very beneficial in identifying and eliminating susceptible selections and populations.

Average grain yields of the Soft White Elite Nursery ranged from lows of 28.1 bu/a at Condon to a high of 130.5 at Hermiston. There was substantial variation in genetic response to the varying stresses and yield potential among the sites.

Soft White Winter Wheat Improvement: Seven soft white winter selections were advanced to either State-wide Variety Trials or Regional Nursery testing; including OR941550, OR9900548, OR9900553, OR941611, OR9900549, OR9900598, and OR9900513. Grain yield and performance data for these seven lines and the 40 entries evaluated in the 2002 Soft White Elite Nursery are summarized in Table 1.

OR9900553 is from the cross 'Arminda/3/VPM/MOS951//2*Hill/5/ID#870337'. OR9900548 and OR9900549 are 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. These 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. The soft white winter wheat selection OR9900553 was evaluated through the PNW Wheat Quality Council evaluations in 2002 and 2003. OR9900553 was noted for its very soft kernel texture, higher break flour yields, and superior product qualities.

OR941611 is from the cross ID#832665/Madsen sister. It was notable for its taller stature, superior yields and overall performance under drought stress the past two years. Its performance suggests it may have application to drier production areas of Oregon. In addition to strawbreaker resistance, trials conducted by Dick Smiley in 2001 have suggested that OR941611 may have moderate levels of resistance to Fusarium dryland footrot.

OR9900598 is from the cross ROD/ID#870337 and performed particularly well at higher yield sites such as Hermiston, Hyslop, and Pendleton. Its parent, Rod, continues to top Oregon and Washington variety trials, but is not widely grown due to weak straw and lodging susceptibility. OR9900513, from the complex cross SPN//MCD/CAMA/3/CVA/4/YMHDW//942-13/SPN/5/YMHDW//942-13/SPN, performed well over sites, and also was notable for its performance at drier locations such as Arlington and Moro.

Hard White Winter Wheat Improvement: There were a relatively small number of hard white lines evaluated in yield trials for 2002, and fewer retained for 2003. This is, in part, due to increased selection pressure on our HW germplasm to meet higher quality standards, particularly for noodle color and bread-making criteria. Behind the advanced lines, we are currently fast-tracking high-priority hard white cross combinations. Numerous F3 and F4 populations are in the field and greenhouse 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.

Three hard white wheat selections were advanced to either State-wide Variety Trial or Regional Nursery testing; including OR942496, OR953475, and HWE02-27 (a Hybritech

selection). Grain yields and performance of these lines are summarized with the Hard White Elite Nursery data (Table 2). Out of 30 experimental lines evaluated in the 2001 HW Elite, >13 were dropped due to inadequate noodle color or protein quality.

The hard white selections OR942496 and OR941048 were evaluated in the Asian Products Collaborative sponsored by the Wheat Marketing Center in 2002. OR941048, from the cross 'ID 80-628/3/CER/YMH/HYS/4/CER/YMH/HYS', had relatively poor noodle color and has been dropped from further testing. OR942496 is a hard white selection from a spring x winter cross combination and has performed satisfactorily, although soft texture related to slightly weak gluten characteristics may be a concern.

Hybritech germplasm: The Hybritech stocks have been managed as a parallel breeding effort to our core program. The stocks are providing us with unique genetic diversity and have shown high yield potential. Most of the advanced lines (F5 through F8) are soft white wheat class. A high proportion of early generations (F2 through F4) populations, however, are intended for hard white wheat development. Due to high land costs at Hyslop farm, the early generation stocks (F2 bulks, F3 bulks, and F4 headrows) are all being grown and evaluated at the Rugg's site. In 2002, selection efforts were facilitated by a severe infection of Stripe rust at Hyslop and differential response to Fusarium crown rot at the Arlington satellite site.

Three hundred and eight Hybritech lines were evaluated in advanced replicated yield trials in 2002, selected from among over 2100 lines grown in 2001. Of these, 57 lines were retained for elite multilocation testing in 2003 (Table 4). We anticipate several lines may move into Regional nursery testing next fall. Relatively high selection intensities have been used in attempting to capture the most promising material, while reducing the total number of stocks. A summary of stocks and management to date are as follows:

Hybritech seed stocks evaluated in 2001 and advanced to trials for 2003.

Evaluated - 2001		Retained - 2002		Retained - 2003	
Generation	# Lines/ Popn's	Gen.	# Lines/ Popns	Gen.	# Lines / Popns
F1's	676	F2 bulk	118	F3 bulk	54
				F2 bulk	119
F2 bulk	635	F3 bulk	194	F4 headrows	8,000
F3 bulk	696	F4 Hdrws	14,000	F5 PYT inbreds	833
F4-F5 Headrows	24,800	F5/F6 PYT Inbreds	688	Adv. Inbreds	150
F5-F6 Inbreds	1705	Adv. Inbreds	280	Elite inbreds	53
Hybrids (Genesis)	920	F2 bulk	200	F3 bulk	98
				F2 bulk	197
Advanced Inbreds	295	Adv. Inbreds	28	Elite inbred	4

Spring Wheat Improvement: In 2001, our spring wheat nursery at Pendleton was heavily infested with Hessian fly. Few of our selections had adequate levels of resistance. In 2002, there was a severe stripe rust epidemic at Hyslop Farm and a change in rust races. Few varieties or selections had adequate levels of resistance to the new rust

race; including those from OSU, WSU, or U of I. As such, the number of viable spring wheat selections in our program has been significantly reduced.

Two hard white wheat selections with good resistance to both stripe rust and Hessian fly will be entered in the 2003 Regional trials. They are OR4930230 (chil/wuh3) and OR4201106 (Weaver/3/Sapi/Teal//Hui). Preliminary quality tests have suggested that both have acceptable Asian noodle quality. Four soft white spring selections from the cross 'Milan/Sha7' will be entered in Tri-state spring variety trials. These are mid-late maturing selections (later than Penawawa, earlier than Alpowa) with good stripe rust resistance and quality similar to Whitebird. Unfortunately, these are susceptible to the Hessian fly. Six hard red spring selections from CIMMYT germplasm have been identified that have promising bread-making quality and good disease resistance. These will be in advanced yield trials for 2003, considered for entry in the Tri-state nurseries, and used for crossing with both spring and winter materials.

In 2003, we are concentrating on evaluation of 300 new CIMMYT spring wheat lines that were imported in 2002 and have cleared greenhouse quarantine. These stocks will be used for both winter and spring variety development efforts.

Early Generations and Crossing: Over 500 soft and hard wheat crosses were made in the field and greenhouse in 2002. These are intended to introduce new genetic stocks and develop breeding populations for variety development and genetics research. A larger proportion of topcrosses were last year made to facilitate introgression of quality traits and disease resistance from red-seeded or unadapted parent lines. Priority parents include French lines that have shown superior yield potential and disease resistance, Plains hard wheats; and crosses for development of CLEARFIELD* selections. The highest priority F1's are being advanced through the greenhouse using modified single seed descent. The goal is to obtain two generations per year and have F3-derived lines ready for planting in fall 2003.

In total, over 12,000 plots, 35,000+ headrows, 220 space plant populations, 400+ bulk F2 and F3 populations, and 740 entries in observation trials were evaluated in 2002 for plant type, winter survival, disease resistance, grain yield, grain quality, and end-use quality over 9 locations in Oregon.

Proprietary Research: Four CLEARFIELD* herbicide resistant breeding lines were under Breeder seed increase this past year with WSCIA Foundation Seed. Of the four lines, OR2010051 was proposed for release under the name 'ORCF-101'. OR2010007, from the cross 'Madsen/FS-4//Weatherford seln', has been entered in OR, WA, and ID statewide testing for 2003 and was retained for a second year of breeder seed purification. The remaining two lines, OR2010008 and OR2010010, were discarded. Yield and performance data from our 2002 CLEARFIELD* Yield Trial is summarized in Table 3. Response of nine CLEARFIELD* selections to varying herbicide rates were evaluated in collaboration with Dan Ball. Data from the efficacy trial at Pendleton are available on request. Additional herbicide tolerance evaluations are underway for 2003 with efficacy trials established at Pendleton and Moro.

End-use Quality: End-use quality research and development efforts involve collaborations with Dr. Andrew Ross and the OSU Quality Lab, with the Wheat Marketing Center, USDA-ARS-Western Wheat Quality Lab, USDA-GIPSA-FGIS, and commercial companies. Support from Craig Morris and the USDA-ARS Western Wheat Quality Lab in evaluating our preliminary and advanced breeding lines is gratefully acknowledged.

A third year of Asian product evaluations was conducted in collaboration with the Wheat Marketing Center. Lines in the 2001 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. Inconsistencies among variety ranks for product performance remain a concern, particularly when examined over growing environments. Marginal product color and relatively soft noodle texture are recurring problems in our advanced hard white lines. Rather than continue with a fourth year of Hard White testing with the WMC, we will delay until our new hard white materials become available. Over-years data analyses will be conducted to look for trends and relationships among key traits, products, and varieties. Understanding and manipulating quality traits will require a more complete biochemical analysis of protein and starch properties, while continuing end-product evaluations.

Two Ph.D. graduate student research projects have been initiated in collaboration with Andrew Ross to support our hard white wheat development efforts. The first study will investigate relationship of protein composition, as determined by electrophoresis and HP-LC, to Asian noodle quality. The second study, conducted by a Fulbright-supported student, will examine impact of drought and moisture stress on protein content, quality, and end-product quality of hard white wheat. The study uses line-source irrigation as means to apply a moisture gradient across eight HW selections.

Genetic studies and collaborative basic research: Molecular markers were used to explore nuclear and cytoplasmic diversity and genetic relationships among major PNW varieties and breeding stocks. The research was the basis of a two-year M.S. research project and was conducted in collaboration with Oscar Riera-Lizarazu. Genetic relationships among over 180 varieties and parents stocks were examined using 24 nuclear and 15 cytoplasmic PCR markers. Similarity measures have provided important

insights into managing parental diversity and suggest targets for future crossing and improvement efforts.

Genetic stocks are continuing to be developed for application to molecular marker technologies. Priorities at this time are applications to end-use quality improvement, specifically hard white wheat, and improving resistance to Cephalosporium stripe.

Other program activities: 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. Grant funds through the US AID-supported Central Asian Caucuses program have been identified to cover our costs for managing the nurseries in 2002-03.

IMPACTS:

The soft white winter wheat 'Tubbs' was released to growers in 2002. Tubbs represents a significant improvement in grain yield and will provide direct economic returns to Oregon wheat growers through increased productivity and production efficiency. Availability of ORCF-101, a broadly adapted CLEARFIELD* herbicide resistant variety, will reduce economic losses from grassy weeds and increase production efficiency. Selections with enhanced end-use quality, such as OR9900553, are expected to increase market demand for Oregon wheat. 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:

Nine locations of grain samples will be obtained from HW and SW field trials. These samples, in varying stages of development, are being used for studies on end-use quality in collaboration with the OSU Wheat Quality Lab, the Wheat Marketing Center, ARS-WWQL, and USDA-GIPSA. For example, samples from HT Advanced nurseries are being used in an M.S. thesis study under supervision of Andrew Ross. The study will evaluate application of solvent retention capacity tests as predictors of end-use quality using grain from the 2002 Hybritech Advanced nurseries. Numerous crosses and populations were developed for collaborative 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 *Pseudocercosporella* footrot resistance. Herbicide resistant wheat cultivar development continues with Dan Ball and Carol Mallory-Smith. New studies of N management interactions with drought stress and genetic control of protein content in hard white germplasm are being pursued in collaboration with Neil Christensen and Stephen Machado. Trials under direct-seed conditions have been conducted in collaboration with Don Wysocki and Erling Jacobsen.

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RELATED PUBLICATIONS AND PRESENTATIONS:

Publications:

Lopez, C.G., G.M. Banowetz, C.J. Peterson, and W.E. Kronstad. 2002. Wheat dehydrin accumulation in response to drought stress during anthesis. Funct. Plant. Biol. 29:1417-1425.

Peterson, C.J. Wheat research at Oregon State University: History and transition. 2002. Proceedings of the Warren E. Kronstad Memorial Symposium. March 15-16, 2001, Obregon, Mexico. Invited.

Peterson, C.J. and A. Ross. 2002. Wheat Quality Team to Asia, April 2002. Trip report to the US Wheat Associates and Oregon Wheat Commission. 22 p. http://www.css.orst.edu/wheat/Reports/Asia_report.pdf

Graybosch, R.A., N. Ames, P.S. Baenziger, and C.J. Peterson. White salted noodle quality of winter wheats: genotype by environment interactions and relationships to early generation testing procedures. Submitted to Cereal Chemistry.

Peterson, C.J. Variety development at OSU: delivering technologies, market opportunities, and choices. Oregon Wheat, March, 2002. Pg 10-11.

Melanie Edwards, M.S. Thesis. Nuclear and chloroplast diversity of Pacific Northwest wheat (*Triticum aestivum*) breeding germplasm.
December 18, 2002. Advisors: O. Riera-Lizarazu and C.J. Peterson.

Presentations:

Profits, pitfalls, and public breeding with private technologies. Jim Peterson and Mike Burke. Issues Matter Lecture Series - Biotechnology: Philosophical perplexities, ethical enigmas. OSU, May 21, 2002.

Breeding varieties for the milling and baking industry. Hard White Wheat Quality Targets Meeting. February 29, 2002, Portland, OR. Sponsored by the Wheat Marketing Center.

Update on OSU Clearfield wheat variety development. CBARC Fall Research Review, September 4, 2002, Boardman, OR.

OSU Clearfield wheat variety release and commercialization strategies. Oregon Wheat Growers League Annual Convention, November 25, 2002, Tigard, OR.

Adding value to wheat through breeding at OSU. Washington Association of Wheat Growers Annual Convention. December 8, 2002, Spokane, WA.

SWW quality and breeding in the PNW. Wheat Quality Team to Asia, sponsored by U.S. Wheat Associates. Tokyo, Japan; Seoul, South Korea; Kuala Lumpur, Malaysia; Manila, Philippines; Tai Chung, Taiwan. Invited.

WCC-81 Coordinating Committee – Update of OSU end-use quality research, January 24, 2002, Carson City, NV.

Dedication of the W.E. Kronstad Memorial Conference Room. November 2, 2002.

Field day presentations

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