

Building on a Tradition of Excellence



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Grant Title: Development of wheat varieties that are more cost efficient to grow and which have superior end-use properties

1998-99 OWC Project Funding Level: \$195,248

Project Summary:

Investments in wheat breeding and genetics research are cost-effective means to increase productivity, decrease production risks, and increase demand through production of varieties with superior disease resistance, enhanced yield potential, and superior end-use quality. The OSU Agricultural Experiment Station's 'Oregon Invests' program estimates that variety improvement efforts contribute an additional 7 to 8 million dollars annually to the state economy through increased grain yield and enhanced yield stability. Research efforts to develop value-added, superior quality varieties will further increase demand for Oregon wheat and provide new marketing opportunities for Oregon growers.

Foundation seed of three new winter wheat varieties developed by the OSU Wheat Breeding program will be available to growers this coming fall. 'Weatherford' is a high yielding, soft white winter wheat for production in eastern Oregon with resistance to cephalosporium stripe and strawbreaker foot rot. 'Foote', is a soft white winter wheat for western Oregon with resistance to *Septoria tritici*. 'Temple' is a new club wheat for eastern Oregon dryland areas. 'Ivory', a new hard white winter wheat with superior Asian noodle quality, is anticipated for release in fall 2000 or 2001. 'Winsome', a hard white spring, will be available to growers for planting in spring of 2000. Two new soft white winter wheats, OR939515 and OR939528, sister selections from the cross of 'Madsen/Malcom', are under consideration for breeder seed increase this fall. These varieties and experimental lines represent significant improvements in yield, disease resistance, and milling and baking qualities and will provide additional economic returns to Oregon wheat growers.

This Month's Article: The article reviews changes, new directions, and priorities for the OSU Wheat Breeding and Genetics program.

Dr. Warren Kronstad, with the support of the Oregon Wheat Commission and Oregon Wheat Growers, has built an outstanding program over the last 35 years and established a tradition of excellence in wheat breeding and genetics research. Through Warren's leadership in international research, germplasm development and exchange, and graduate student training, the Oregon wheat program has been a major contributor to wheat improvement worldwide. The benefits to Oregon producers of the combined international and domestic efforts are evident in the superior germplasm and outstanding wheat varieties developed by the breeding program; varieties that have provided continued increases in grain yield, superior disease resistance, and excellent end-use quality.

Dr. Kronstad's retirement this last December brought a period of transition to the OSU wheat breeding and genetics research programs. The OSU International Winter x Spring Wheat enhancement program, conducted in collaboration with CIMMYT, is closing after 20 years of funding from the U.S.-Agency for International Development. Dr. Oscar Riera-Lizarazu joined OSU last year in a new position as Cereal Biotechnologist, bringing new cytogenetic expertise and molecular tools to the wheat genetics research effort. Dr. Karim Ammar joined OSU to lead a grant-funded effort in Durum wheat breeding. And, after spending nearly 15 years in wheat research with the USDA-ARS in Lincoln, Nebraska, I joined OSU last September, to succeed Dr. Kronstad as Project Leader for the OSU Wheat Breeding and Genetics program.

In joining the OSU Wheat Breeding program, I recognized that the immediate challenge is not how to replace or succeed Warren Kronstad, which is an inherently impossible task. Rather, the challenge is how to build upon the existing program strengths and traditions, through use of new technologies, new breeding strategies, use of novel genetic resources, and through building multidisciplinary and public-private research collaborations.

Even with the many contributions of OSU variety development efforts to date, tremendous challenges still confront our growers. Production costs and risks continue to escalate. Management practices are evolving in attempts to improve sustainability and profitability of production. Drought and temperature stresses continue to limit grain yields and we are experiencing increasingly erratic weather patterns. Disease and insect pressures are increasing and evolving in response to both changing management and environmental conditions. The world grain market is increasingly sophisticated and competitive, placing increased demands on wheat end-use quality.

Wheat breeding remains the critical link that provides direct economic return to growers from public investments in biotechnology, molecular genetics, cereal chemistry, pathology, entomology, and agronomic research. Oregon wheat varieties have been highly successful due to their broad adaptation and performance stability over a wide array of environments and production conditions. The challenge now is to build on the broadly adapted genetic base of the program to address more specific constraints. To do so, the breeding program will start by increasing the number of test sites and expand evaluations of early generation materials. Breeding sites under higher residue conditions, lower rainfall, and with early seeding dates will be established this fall to characterize genetic response to localized disease complexes and stresses and develop varieties for more specific production conditions.

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Improving Disease Resistance and Stress Tolerance

Genetic resistance to disease and insects, when available, remains the most environmentally sound and cost effective means of control. However, this requires an on-going supply of new and more effective resistance genes to keep up with evolution of the pathogen. The OSU Wheat Breeding program has established a tremendous germplasm base through its international program and close interactions with breeding programs at CIMMYT, in France, Hungary, Romania, Turkey, and many other countries. In addition to this valuable genetic base, there is an exciting array of new genetic stocks being developed through wide-hybridization with wild, weedy ancestors of wheat. Preliminary research has suggested that genes from *Triticum tauschii*, *monococcum*, and *timopheevii* will be a powerful source of new disease resistance genes, including genes for Cephalosporium stripe, Septoria, and rust resistance.

However, while genes from these wild species have great potential to reduce disease losses, their introgression into adapted, productive varieties is inherently difficult. Applications of molecular marker technology and modern cytogenetic tools, in collaboration with Dr. Oscar Reira-Lizarazu, will be needed to efficiently transfer these alien genes into new varieties.

Market Development and Improvement of End-use Quality

Improving end-use quality of our wheat is critical if we are to successfully compete and gain a share in the increasingly competitive international marketplace. This means going beyond issues of grain cleanliness, test weight, and protein content to aggressively develop a premium-customer focus for end-product quality. Our customers are demanding wheats that have improved milling efficiency, improved processing tolerance and stability, that require fewer chemical additives, provide superior product color and textural properties, and meet consumer expectations and for end-product quality. A renewed commitment to genetic enhancement of quality through breeding is the first step in market development. Our breeding program is in an excellent position to address quality needs of both domestic and export industries through ongoing collaborations with the Wheat Marketing Center and USDA-ARS Western Wheat Quality Lab. However, commitment from the entire wheat industry will be needed to effectively produce, segregate, market, and capture value from wheats with novel and product-specific qualities.

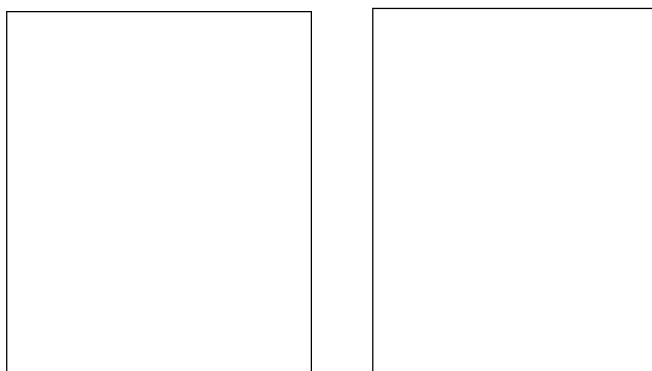
A wide array of new genes and technologies are now available for modification of wheat end-use quality. These tools give us the opportunity to design wheats for specific end-product quality needs and to develop new markets with value-added quality traits. New genetic modifications of protein quality are possible through novel glutenin and gliadin alleles developed via wide-hybridization and transformation. Genetic modification of starch quality has only recently become possible through identification of novel genes which control the ratio of amylose

and amylopectin starches. These genes will be key to meeting the subtle, yet demanding, flour properties required for processing of Asian noodle products.

Building Ties for the Future

These are changing times for public breeding programs as industry investments in life sciences and genetics continue to grow. The long history of free germplasm exchange, the fundamental life-blood of our breeding program, can no longer be taken for granted. Genetic ownership, plant variety protection, material transfer agreements, technology licenses, and plant patenting issues now confront public institutions on a regular basis. The OSU Wheat Breeding program will continue to be an open program, freely exchange germplasm, and collaborate with both public institutions and private companies. However, it is also important for Oregon growers that we are able to develop effective research partnerships with private industry. It will not necessarily be easy to develop a more 'business like' attitude in the public sector, but it will be necessary to ensure our growers have access to new proprietary genes and technologies that can improve their profitability.

Future breakthroughs in disease resistance, stress tolerance, end-use quality, or grain yield will require expertise and commitment from many diverse research disciplines. Public research programs that are successful will be those that are well focused, multidisciplinary, and vertically integrated to address economically critical problems; combining tools of molecular genetics, pathology, cereal chemistry, physiology, classical genetics and breeding through systems management on-farm. For the OSU Wheat Breeding program, that means promoting research collaborations that culminate in the release, production, and marketing of superior wheat varieties. The support and guidance of the Oregon Wheat Commission, the Oregon Wheat Growers League, and Oregon producers is critical to our efforts, so that we can continue to bring exciting new wheat varieties and new technologies to the farm.



Photos: Crossing wheat plants in the OSU Wheat Breeding and Genetics greenhouse.