



Breeding successes with spring wheat germplasm

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University of California and U.S. Department of Agriculture scientists have been conducting a wheat breeding program at Davis since the 1920s. In the early years, germplasm resources came from the old California cultivars, with their characteristic white grain. The situation changed dramatically in 1961 when a previously unimportant disease, stripe rust (*Puccinia striiformis*), devastated much of the crop in the Sacramento Valley. During that year, varieties from Mexico proved resistant and replaced the original cultivars in California commercial production.

The character of the California wheat breeding program also changed drastically during this period. Although breeding of California varieties for disease resistance continued, the International Maize and Wheat Improvement Center (CIMMYT) in Mexico became an extremely important source of germplasm materials. New materials were systematically introduced for evaluation in California, and a CIMMYT subcenter at Davis studied spring-winter wheat hybridization from 1968 to 1972.

Meanwhile, the germplasm developed during this period from the original California cultivars provided a reserve of disease-resistant varieties adapted to California, but of a different genetic background from the Mexican CIMMYT materials.

New varieties

Since the first wheats from Mexico were introduced to California, a steady stream of new varieties released from Mexico have been tested here. Varieties released in Mexico that have gained acceptance here include Pitic 62 (a short statured wheat which quickly became the dominant variety in the Sacramento Valley), and INIA 66. Germplasm devel-

oped in Mexico and released as varieties in California include INIA 66R, Anza (which comprised approximately one-half of California's wheat acreage in 1976), Yecora Rojo, Portola, and Bluebird 2.

All varieties released have been spring bread-wheats for use in fall and winter planting. A program to develop durum wheats in California was started in 1966; the first variety, Modoc, was released in 1975. Workers at the University of Bari in Italy have systematically collected durum wheats in Sicily, Ethiopia, and Algeria. Studies of genetic variation in the populations sampled are being done in Italy and at Davis and Tulalake, California. From these studies we hope to locate valuable germplasm for the durum wheat breeding program and to recommend optimum sampling strategies for conserving germplasm.

We are now interested in developing winter wheats that require little vernalization (cold temperature to hasten flowering), and that do not require days of long duration for heading. Other goals of the research program include improvement of grain yield, milling and baking quality, shatter resistance, and resistance to disease.

The wheat breeding program has had many successes, and is an example of the possibilities in using germplasm. For example, the release of resistant varieties eliminated yield losses caused by the hessian fly in the Montezuma Hills area. The resistance was obtained from a Canadian variety.

High yield

The commercial variety Anza was the result of selection for high yield grain combined with selection for disease resistance and short stature. Improvements in grain quality have been attempted by crossing Anza with higher quality varieties, with moderate success. Shasta, obtained from the cross of INIA 66 x Anza, was released by the University in 1976.

UC 44-111, UC 113-412, UC 5176, and UC 6191 are other high-yielding lines that were developed, and that are now used extensively in the breeding program.

Efficiency of nitrogen use appears to be an important aspect of wheat productivity. Anza has high concentrations of nitrate in the leaves at heading time; UC 44-111 has low concentrations. Since both varieties have high grain yielding ability, it may be possible to exploit their physiological differences to increase both yield and nitrogen use efficiency.

Disease resistance

The development of stem rust resistant varieties is another success of the wheat breeding program. This most serious disease of wheat has not been reported from commercial fields for about 15 years. However, new varieties must be resistant to stem rust. Northern Mexico, where stem rust is still prevalent, could be a source of stem rust spores in California. To combat this problem, only resistant materials are obtained from Mexico, and materials developed at Davis are sent to Mexico for observation. We are hopeful that the same genes for resistance that are effective in northern Mexico will also be effective in California.

The most damaging disease in recent years has been stripe rust. In 1974, a new race attacked the previously immune variety Pitic 62, and caused severe yield losses (100 percent in some fields) in the Sacramento Valley. Fortunately, INIA 66 remained tolerant and Anza was resistant, so that a variety shift was possible in one year. To anticipate such problems in the future, each year we send rust samples to Pullman, Washington for analysis by the U.S. Department of Agriculture. By testing the spores against known wheat varieties, any new race of rust can be detected.

If a new race of stripe rust built up rapidly to damaging levels, it would be necessary to introduce a new variety rather quickly to avoid losses. The problem is that it is not possible to anticipate which genes for resistance will be needed, if indeed a gene is available. In a limited way, we are attempting to be prepared for future race shifts by identifying resistant germplasm, and introducing genes from several sources into the presently

resistant varieties, such as INIA 66, Cajeme 71, and Anza. The sources of resistance come from throughout the world and are known through international stripe rust trials. To obtain disease reaction data we expect to distribute breeding materials to several areas where stripe rust is important and the races are different from those in California. For example, several Middle Eastern countries have similar problems and could provide the needed observations. Seedling tests to newly found races will also be used. Since the seriousness of this problem was only recently demonstrated, this program needs increased attention.

During the course of breeding studies, many varieties are developed that are not for immediate commercial production. They are still important in our attempt to further improve commercial varieties and to anticipate problems that might arise. Similar materials are obtained in many wheat improvement programs, and breeders should be encouraged to share them.

U.S. Department of Agriculture germplasm collections and introductions from plant breeders throughout the world are now being screened for resistance to septoria and barley yellow dwarf and for other useful characteristics. Selected germplasm is maintained as a part of the breeding program collection at Davis.

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(Editor's note: John D. Prato passed away August 5, 1977 at age 47.)

Examples of Spring Wheat Varieties (*Triticum aestivum* L.) Developed at the University of California, Davis, But Not Released for Commercial Production*

Designation	CI no.	Parentage	Year developed
White Federation 59	17579	(Gabo x White Federation ⁵) x White Federation 38 ²	1958
White Federation 60	17580	(White Federation ³ x Onas 53) x White Federation 54	1960
Ramona 64	17581	CI 12633 x Ramona ⁷	1964
Ramona 65	17582	Onas 53 x Ramona ⁸	1964
Ramona 70W	17583	Nainari 60 x Ramona 50 ⁹	1969
Ramona 70R	17584	Nainari 60 x Ramona 50 ⁹	1969
UC 5176	17585	D6301† x Ramona 50 (from second cycle of recurrent selection)	1969
UC 6191	17586	D6301 x Ramona 50 (from second cycle of recurrent selection)	1969
Lerma Blanco 70	17587	White-grained selection from Lerma Rojo 64	1968
UC 44-111	17588	D6301 x Nainari 60	1970
UC 113-412	17589	D6301 x Nainari 60	1970

*Breeders responsible for the development of the germplasm listed here: C.W. Schaller, 1950-1961; J.C. Williams, 1961-66; C.O. Qualset and H.E. Vogt, 1967-present. Seed stocks of these lines are available in the USDA World Wheat Collection.

†D6301 is a short statured line received by C.W. Schaller from N.E. Borlaug in 1959, extensively used in genetic and breeding studies at Davis. It was derived by crossing the Mexican variety Mayo 54 to a short statured line from Norin 10 x Brevor developed in Washington by D.A. Vogel.