

Small Grains Breeding at Purdue University

The first project approved by the Purdue Board of Trustees in 1880 was for testing wheat varieties. In 1900, in the 12th *Annual Report of the Indiana Agriculture Experiment Station* (W.C. Latta) summarized 19 years of testing wheat cultivars in Indiana.

Fred Patterson, leader of small grains breeding program at Purdue from 1950 to 1986, provided much of the information in this summary from his research and memory. He had learned that Purdue sent Martin L. Fisher and another person, we are not sure who, to Minnesota in 1904 to learn the techniques for making wheat crosses from W.M. Hays. Fisher likely started making crosses soon thereafter and was appointed the Purdue Agriculture Experiment Station's plant breeder in 1915. When he left Agronomy to become Dean of Men in 1926 he was replaced by Dr. G.H. Cutler, who released cultivars of clover and soybeans as well as wheat.

It became apparent that plant breeding would be of little value unless some means were provided to protect the purity of newly developed cultivars. In 1919, the International Crop Improvement Association was created at the International Hay and Grain Show where G.I. Christie, Purdue's first director of Extension, was superintendent. G.H. Cutler, later to be associate head of Agronomy at Purdue, was elected first vice president of the association. According to Keller Beeson, M.L. Fisher became a moving spirit in the organization and a missionary to get the seed certification program widely accepted and was instrumental in Beeson's election as secretary-treasurer in 1929 and as president in 1930. Seed certification was introduced in 1920 by the Indiana Corn Growers Association in cooperation with Purdue. Under Beeson's tutelage and leadership, with help from M.O. Pence and other agronomists, certification rapidly took hold in Indiana and farmers began to place more and more faith in experiment station varieties. Beeson was secretary-treasurer of the Indiana Crop Improvement Association, which superseded the Indiana Corn Growers Association, from 1928 until his retirement in 1962.

Early emphasis in wheat breeding, encouraged by several severe winters, was placed on winter hardiness. The winter of 1928, for example, resulted in the loss of 66 percent of the planted wheat acreage in Indiana. Fisher's work produced Michikof (1920) and Purkof (1924), cultivars with excellent winter hardiness, but with gluten contents too high to be suitable for use in pastry flour blends. Resistance to Hessian fly was a concern from the beginning and was the subject of the first report of the experiment station. E.B. Mains and H.S. Jackson at Purdue began developing cultivars resistant to leaf rust, caused by the fungus *Puccinia recondita*, in 1926. From their genetic studies, Mains, C.E. Leighty, and C.O. Johnston determined how leaf rust resistance was inherited. Identifying sources of leaf rust resistance became a major part of the Purdue wheat program. Cutler was brought to Purdue in 1926 to concentrate on the gluten problem. With the support of Igleheart Mills, the Southwestern Indiana Wheat Improvement Association was established in the late 1930s to support a special Extension effort that continued into the 1960s. Igleheart worked with Purdue to produce the cultivar, Newstar, which gave a strong yield of high quality flour.

Paralleling the Agronomy wheat program aimed at lodging resistance, cold resistance and baking quality, a program of breeding for disease resistance was conducted by Ralph Caldwell and LeRoy Compton (USDA-ARS) in the department of Botany and Plant Pathology. As Cutler approached retirement, Agronomy considered dropping out of the cereal breeding program, and concentrating on forage crops. When Associate Director Norman Volk, gave J. B. Peterson, head of Agronomy, permission to screen for a small-grains geneticist, Peterson approached Caldwell, head of Botany and Plant Pathology, who was also screening for a small grains breeder, about the possibility of pooling resources in a joint program. The plan was accepted and put into effect with Peterson hiring F.L. Patterson in 1950, and Caldwell hiring J.F. Schafer in 1952. Caldwell, Compton, Patterson and Schafer developed extensive research collaborations, and the Small Grains Research Program became eminently successful, especially in the area of soft red winter wheat where it dominated in the eastern United States from the 1950s through the 1980s. In the 1970s, more than 80 percent of the soft red winter wheat acreage in the United States were planted to wheat developed at Purdue.

Beginning in the 1940s and early 1950s, research expanded to winter barley, and winter and spring oats. Winter oat research was discontinued after the release of cultivar Norline in 1960. Winter barley research was discontinued after the release of cultivar Pike in 1976. Although several successful cultivars were released, winter barley and oat production moved to areas south of Indiana due to limited winter hardiness. Research on improvement of spring oats was expanded beginning in the late 1960s due to the continuing threat of crown rust and stem rust and the emerging threat of barley yellow dwarf virus.

In the 1950s, the average yield of soft winter wheat in Indiana was 28 bushels per acre at a time when the nursery plots yielded about 50 bushels, with several selections going higher than 65 bushels. A majority of the new strains were resistant to leaf rust, loose smut, soilborne mosaic, and Hessian fly. Examples are Knox (1953) and Vermillion (1955), the first of the early maturing wheats for the Ohio River valley area. Knox provided about a 25 percent advance in yield, a new level of excellence in quality, and was a widely-used parent line for developing early-maturing wheat cultivars, and resistance to leaf rust. In 1959, 96 percent of the oats and 88 percent of the wheat grown in Indiana were of varieties developed in the Purdue-USDA cooperative small grains research program. In 1961, Knox was the most widely grown soft winter wheat in the United States.

An oat program begun in 1940 by this same interdepartmental team resulted in outstanding improvements in lodging resistance, disease resistance, and adaptation to the warm temperature conditions in Indiana. After 1954, six spring oat varieties were distributed, including Clintland, Bentland, Newton, Putnam, Clintland 60, and Putnam 61. These varieties made up a substantial part of the oats grown in the North Central region.

After Caldwell retired in 1970, the cooperative program continued under the leadership of Patterson (who retired in 1986), Herb Ohm (started in 1970), and D. M. Huber and

G.E. Shaner in Botany and Plant Pathology. Huber concentrated on root and crown rot diseases and their interactions with nitrogen form and level, and Shaner focused on foliar diseases. Hari Sharma, cytogeneticist, was added to the team in the eighties to focus on the transfer of resistance to barley yellow dwarf virus from wheatgrass into wheat.

Recent history of the Small Grains Program will be continued in a future article. Excellent soft winter wheat and spring oat cultivars continue to be developed, and there has been a transition to releasing wheat cultivars under licensing agreements by Ag Alumni Seed. There is increased emphasis on genetics research, DNA marker development for specific genes and traits, and marker-assisted selection. Also, the USDA-ARS component of the collaborative research program has been significantly strengthened.

Ohm & McFee