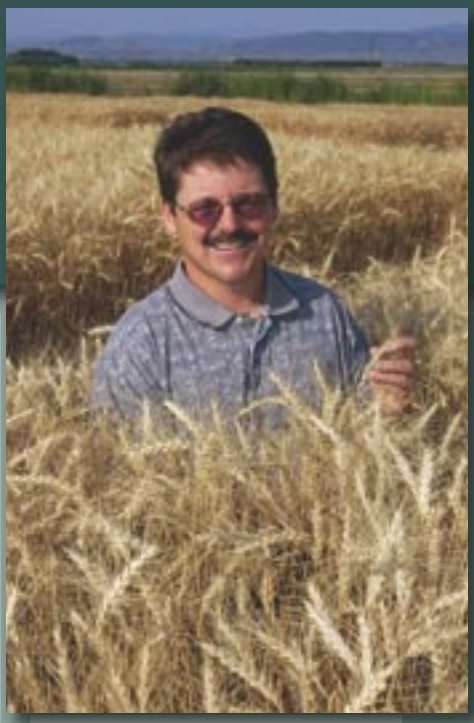

Forty Years of Experience

Wheat Breeding and Genetics Program Celebrates 40 Years of Service

Wheat is the backbone of dryland farming in eastern Colorado.

Scott Haley, associate professor of soil and crop sciences, is far too young to have 40 years of personal experience in the business of wheat breeding. As the fourth wheat breeder to direct Colorado State University's Wheat Breeding and Genetics Program, however, Haley knows that the foundation of his program was laid by the hard work, perseverance, and creativity of the breeders and researchers that went before him. Established in 1963, Colorado State's Wheat Breeding and Genetics Program conducts basic and applied research on the development of improved wheat cultivars with specific adaptation to the difficult growing conditions in the central High Plains region.

Since its inception, the Wheat Breeding and Genetics Program has released more than 20 improved wheat cultivars, and University-bred wheat cultivars now account for roughly 60 percent of Colorado's 2.6 million acres of wheat. This figure is drastically different from the mid- to late-1990s, when a single cultivar from Texas (known as TAM 107) dominated the landscape in eastern Colorado.

Wheat is the backbone of dryland farming in eastern Colorado. More Colorado acres are planted with wheat than any other crop, but wheat is traditionally a crop with low economic returns. Development of improved wheat cultivars serves a vital function for the wheat industry in Colorado by reducing costs of wheat production, minimizing or eliminating the need for chemical pesticides, and providing improved wheat marketing options. In partnership with the Agricultural Experiment Station, Colorado wheat farmers enthusiastically support the wheat breeding research at Colorado State University.

Colorado wheat must be able to withstand stresses that are somewhat different from those found in other areas of the Great Plains. Colorado is located on the western edge of the nation's great winter wheat breadbasket, and the state's dry conditions and high temperatures often reduce yields and adversely affect processing quality. At the same time, the lack of moisture makes Colorado winter wheat less prone to certain diseases and pests.

However, the Russian wheat aphid has been a persistent pest of Colorado wheat since 1986. The small, pale green, spindle-shaped insect damages wheat by sucking sap from and injecting toxic saliva into the leaves. The aphids prevent young wheat leaves from flattening out, and the insects live within the tightly curled leaves, protecting them from the weather and insecticides. Since the original strain of Russian wheat aphid arrived in Colorado, it has cost wheat growers in the state more than $132 million in crop losses.

A large component of Colorado State University's wheat breeding effort in recent years has been directed toward rapid deployment of genetic resistance to Russian wheat aphid. At the time of the pest's arrival, no wheat cultivars in the Great Plains (or the entire United States, for that matter) had resistance to Russian wheat aphid. Since 1994, however, several improved cultivars carrying resistance to Russian wheat aphid have been released by Colorado State University through a partnership with the Colorado Wheat Administrative Committee and the Colorado Wheat Research Foundation. Funding from the Agricultural Experiment Station has been instrumental in identifying, developing, and investigating strains of wheat resistant to Russian wheat aphid. Development of Russian wheat aphid-resistant cultivars provides wheat

Colorado State University

Knowledge to Go Places

producers in Colorado and the west-central Great Plains with an effective, economical, and environmentally-sound means of mitigating economic losses from Russian wheat aphid.

Resistance to Russian wheat aphid is only one component in producing a quality superior wheat cultivar. Wheat breeding is a team effort requiring the expertise of many people from many diverse disciplines. Wheat breeding research at Colorado State University relies on an impressive network of field, greenhouse, and laboratory facilities. In the field, Haley and his team of researchers identify plants with desirable traits. Crosses are made and growth is studied in greenhouses. Insect resistance also is evaluated in greenhouse environments under the supervision of Frank Peairs in the Department of Bioagricultural Sciences and Pest Management. In Colorado State's newly-renovated Wheat Quality Laboratory, milling, dough mixing, and test baking of bread and noodles is done. A multitude of different criteria are important to wheat processors and the end-use industry, and the Wheat Quality Laboratory houses a variety of highly specialized equipment to evaluate experimental wheat cultivars for these criteria.

All this effort is directed towards the dream of producing a perfect wheat cultivar. "Although I can readily envision the ideal wheat cultivar, I expect that I will never find it. Compromise is definitely the name of the game," Haley says. Wheat producers are looking for cultivars that emerge well in the fall, don't fall over or shatter before harvest, tolerate multiple climatic stresses, and produce high yields with superior processing quality.

"There are so many traits that are desirable to producers, as well as to the processing industry – and an immense number and combination of genes control these traits. The wheat genome is incredibly complex, and combining all the necessary genes into a single package is virtually impossible with current technologies. Fortunately, I am part of a great community of wheat researchers, and we will continue to work toward these goals."

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The DNA of Wheat

Wheat has an incredibly large genome. Wheat is polyploid, which means that, hundreds of years ago, two species found in nature crossed and produced what is now known as Durham wheat; then, a third species hybridized with the first two to produce bread wheat. As the wheat genome is so complex and wheat is a public sector crop that tends to be a low-value crop, sequencing the wheat genome probably is not going to happen soon, but DNA markers have been identified for a few characteristics such as Russian wheat aphid resistance.

However, researchers are facing a new challenge. A new biotype or strain of the Russian wheat aphid was discovered in Colorado fields this year. As yet, genetic resistance against this biotype has not been identified in wheat plants.