WGRC scientists showed off their work to a crowd at the Rocky Ford Experiment Station. *(photo courtesy of Haley Ahlers*

Wheat takes a walk on the wild side

By Jordan Hildebrand, Kansas Wheat

Tucked quietly away in the Kansas Wheat Innovation Center is a treasure trove of genetics from around the globe. The Wheat Genetics Resource Center (WGRC) is an internationally-recognized gene bank that curates and houses more than 247,500 seeds from 2,500 wheat and wild wheat species accessions. While maintaining the collection in a climate and humidity controlled environment is an important cornerstone of the WGRC, it is not the only function of the organization.

WGRC scientists showed off their work at the Rocky Ford Experiment Station on May 11. While the research plots did have familiar varieties in the collection, such as Everest and Jagger, attendees had the opportunity to wander and learn about a fraction of the weird and wonderful looking species housed by the WGRC.

While growing these species provides a walk on the wild side for spectators, these plants are meant for teaching and research. One trait that scientists are looking for is resistance to leaf rust. The foliar disease is one that is familiar to Kansas farmers, with the bright orange pustules causing up to 20 percent yield loss, but it is also a devastating disease found worldwide. WGRC scientists inoculate the plants with a composite of leaf rust strains and monitor the susceptibility of the plant to the disease. Useful genes like leaf rust resistance, as well as a number of others, are identified and then transferred to modern, agronomically useful breeding lines.

Included in the selection were 40 lines of diverse tauschii plants, a very close relative that crosses readily with wheat, and is a major source of genes for disease and pest resistance.

"There is valuable genetic information hidden in these plants that we're trying to explore and use," said Duane Wilson, associate scientist at the WGRC.

The genes may be diverse, many of these lines may look similar to the untrained eye, but will have differences both large and small. Traits as minute as small "hairs" on leaves or awn length could be the deciding factor between identification of two species.

"With each species there is one particular trick to identification," said Jon Raupp, senior scientist at the WGRC. "But there will be some species that you'll just never get right away."

Some some wild species thrive in the Kansas environment, but others don't fare as well. Wilson reported that last year's plots suffered from tremendous winterkill while the species planted this year handled the weather much better. Most of the species were headed and flowering at the time of the field day, but several of the wild wheat relatives were "late bloomers." While this sounds like a mundane detail to most, WGRC scientists see potential to use possible early or late maturity genes in the next big wheat variety.

"This is the most active collection of its kind in the world," said Wilson. "Lots of places just hold their collections, but we hold and evaluate these species which can be very beneficial to farmers worldwide. The WGRC is an incredible valuable genetic resource."

Engineering resistance to beat the bugs

By Malerie Strahm, Kansas Wheat Communications

Until now, resistance to the aphid-vectored virus known as barley yellow dwarf (BYD) has been limited, at best, in wheat. This serious wheat disease in Kansas has had reports of yield losses of up to 35 percent. Suggested risk management practices such as adjusted planting dates and using insecticides are effective in the short-run, but not enough to control the disease as a whole. What if there was a way to beat this disease, once and for all?

Research lead by scientist Bernd Friebe at Kansas State University and the Wheat Genetics Resource Center I/UCRC may provide a way to control BYD through fabricated genetic resistance. The objective of his current research project is to identify naturally-occurring sources for BYD resistance and transfer them into adapted Kansas winter wheat cultivars. The use of cultivars with genetic resistance to the virus or the aphid vector is the most economic and practical way of controlling BYD.

"For the environment, it's always the best solution if you can use native resistance," said Friebe. "If you have genetic resistance then it doesn't matter if the vector is floating around. They can do whatever they want to the plant, and not infect it."

The adult aphid is very small at roughly one-eighth of an inch long.

To encounter resistance, Friebe and his team start with evaluating chromosomes from wild relatives of wheat for agronomically-interesting traits and then combining modern wheat with wild wheat to produce recombinants that can be used directly in wheat improvement. A recombinant with a resistant gene to wheat streak mosaic virus, Wsm3, was derived from a wild wheat species called Thinopyrum intermedium. This recombinant also contains resistance to Triticum mosaic virus and has the potential of also containing resistance to BYD. Finding these recombinants, however, is time-intensive.

"If you already have chromosome addition lines, it can take three to four years to find recombinants with shortened chromosome segments. If you start from scratch by crossing wild relatives to wheat then it might take ten years to produce recombinants having the trait of interest," said Friebe. "It's the only way you can make the distantly-related gene pool available for wheat breeding. It's trickier and it's also a numbers game. Some chromosomes recombine easier than others."

This gene transfer process is not a simple task and the talent to apply the technique is rare. Manipulation under a microscope can be extremely difficult and time consuming, resulting in fewer people getting into the field. Friebe, and his team of scientists including Dal-Hoe Koo and Tatiana Danilova, are among a handful of people worldwide who are able to do this chromosome engineering. Resistant genes are invaluable, but perhaps more so are the dedicated scientists who can artfully extract that value.

Value, in the end, will be added back to farmers who can use the resistant wheat in their fields, eliminating the need to unsuccessfully control aphid populations or time their planting just right. The future for BYD may be bleak, but the future for farmers is bright.