

\$1 Million Grant to Help University Researchers

A nationally funded project by Kansas State University wheat researchers could help determine more quickly which new candidate varieties of wheat will produce superior yields and baking quality.

A team of wheat breeders and geneticists at the university has received a nearly \$1 million grant from the U.S. Department of Agriculture's National Institute of Food and Agriculture, or NIFA, and the Kansas Wheat Commission for "An Integrated Omics Approach to Accelerating Wheat Quality Improvement."

"NIFA and the Kansas Wheat Commission, in response to the commodity board provision in the 2014 Farm Bill, are co-funding Kansas State University researchers to increase understanding of the genes responsible for wheat quality as well as improve selection strategies that will speed the delivery of superior varieties to wheat farmers," said Justin Gilpin, CEO of the Kansas Wheat Commission. "Kansas wheat farmers, through the Kansas Wheat Commission, are proud to sponsor this important work along with NIFA to help enhance quality and add value to winter wheat in the southern Plains."

The university's team is led by Jesse Poland, associate professor of plant pathology and a wheat geneticist, and includes Allan Fritz, professor of agronomy; Guorong Zhang, associate professor of plant pathology at the university's Agricultural Research Center in Hays; Eduard Akhunov, professor of plant pathology and wheat genomics; and Rebecca Miller, research associate professor of grain science and industry and director of the university's Wheat Quality Lab. Fritz and Zhang are wheat breeders, while Akhunov is a wheat geneticist. Miller specializes in wheat and flour quality and in baking and cereal chemistry.

With the world's population estimated to reach 9.6 billion by 2050, more food — and more nutritious food — will be needed, making wheat even more important to feed a hungry world, according to Poland. But developing new wheat breeds is an expensive and time-consuming process that often produces candidate varieties that may be high-yielding but of poor quality. The new project aims to develop prediction models to better determine which new wheat breeds have the best potential for yield combined with good baking quality.

"New DNA sequencing technology has enabled the determination of genetic differences between candidate wheat varieties as well as the development of genomic prediction models for important traits such as milling and baking," Poland said. "These prediction models can then be used for selection of superior

candidate varieties."

To speed up the process of determining which new varieties of winter wheat are best, Poland's research team will take an integrated approach to develop profiles on each breed's genomics and other "omics": proteomics for proteins; metabolomics for metabolites; and ionomics for minerals. These factors will be evaluated as determinants of wheat quality, and the information will be combined to develop improved models for yield and quality.

"Such integrative genomics' approaches hold great promise to identify genes and biological pathways that underlie complex agronomic traits in wheat and develop novel strategies for accelerating wheat improvement," Akhunov said.

For the project, advanced breeding lines in Kansas State University's wheat program will be profiled for milling and baking quality. Proteomic, metabolomic and ionic profiles of the parental and advanced breeding lines, as well as genomic profiles of all breeding lines, will be generated. Then the researchers will develop, test and implement novel prediction models using the genomic profiles combined with the other "omics" data as predictor variables and phenotypes, or characteristics.

"We will test and implement the integrated models in new breeding lines to accelerate the wheat breeding process for improving quality," Poland said. "Overall, this project will lead to an increased understanding of the genetic determinants of wheat quality as well as improved selection strategies that can result in accelerating the delivery of superior varieties to wheat farmers."

The new project follows up on previous projects Poland's lab has conducted involving high-throughput genotyping and work involving the wheat genome. Poland's research has been honored with the National Association of Plant Breeders' 2016 Early Career Scientist Award, which recognizes a young scientist who is active in the field of plant breeding.

Poland also serves as director of the university's Feed the Future Innovation Lab in Applied Wheat Genomics. The lab, supported through the U.S. government's Feed the Future initiative to reduce global hunger and improve food security, uses research, education and outreach to advance solutions to hunger, poverty and undernutrition in low-income countries. The lab is conducting research at Kansas State University and in Mexico and southern Asia.

