

International team finds new clues for improving wheat

By Kansas State University, Research & Extension

A TEAM of Kansas (US) State University wheat scientists are tapping into 10,000 years of evolution in the plant's genetic code as part of their continued efforts to understand how historic processes that shaped modern wheat can help to improve the varieties grown by today's farmers.

The exhaustive study, which is published in *Nature Genetics*, involved sequencing the genomes of nearly 1000 wheat lines collected from different parts of the world with different environments.

Agriculture Victoria involvement

The work was led by researchers from Kansas State and Agriculture Victoria, in collaboration with the University of Saskatchewan (Canada) and the University of Minnesota (US).



Kansas State University wheat geneticist and pathologist Eduard Akhunov works in the university's greenhouse. (PHOTO: K-State Research & Extension)

"We compared the genomes (in the 1000 wheat lines) against each other, and looked for nucleotide base changes, or mutations, that distinguish one wheat accession from another," said Eduard Akhunov, a Kansas State wheat geneticist.

He noted that the researchers found more than seven million differences in the genetic code of the 1000 lines.

"These differences can affect the function of genes that control various traits in wheat that helped it adapt to new growth conditions, such as withstanding drought and heat stresses; fighting off diseases; and yielding nutritious grain," Eduard said.

The changes that occurred in the genetic code can tell researchers a history of each wheat accession.

"When humans started spreading wheat from the site of its origin to other places, they brought it into contact with wild wheat, and wild ancestors accidentally began to inter-breed with bread wheat," Eduard said. "What happened then was that bread wheat inherited the genetic diversity that was present in the wild emmer wheat."

Gene flow is key

That process of one species sharing genes with another species is called gene flow, and it is key for explaining the genetic diversity of today's wheat varieties, according to Kansas State wheat breeder Allan Fritz.

"Understanding gene flow between wild emmer and common wheat is more than just academically interesting," Fritz said. "The importance of historical introgression suggests that a more strategic use of wild emmer should have value for future wheat improvement."

Fritz noted that Kansas State scientists have been using wild emmer in developing germplasm for new wheat varieties in projects funded by the Kansas Wheat Commission and the university's Wheat Genetics Resource Center.

The work by Eduard and his research team allows breeders to "evaluate the diversity in wild emmer and be intentional and strategic" in how they employ desired traits in new wheat varieties, according to Fritz.

"As we move forward, we can apply what has been learned here to also focus future efforts on traits related to health and nutrition that wouldn't have been direct targets of historical selection," he said.

Eduard adds: "For the first time, we have described how wild emmer's genetic diversity contributed to the development of bread wheat. And what it's done since humans domesticated wheat is it's helped to develop a better crop."

Kansas State's study was funded by the Agriculture and Food Research Initiative's competitive grants program, administered through the U.S. Department of Agriculture's National Institute of Food and Agriculture and part of the International Wheat Yield Partnership, which Eduard said aims at increasing the genetic yield potential of wheat using innovative approaches.

Eduard also said that Corteva Agriscience and the agriculture division of Dow/DuPont provided financial support through its collaboration with Agriculture Victoria Service. Their support, he said, allowed the researchers access to needed technologies and to develop the set of data indicating the genetic differences in wheat varieties, also called an SNP dataset.

Kansas State received additional funding from the Kansas Wheat Commission and the Bill and Melinda Gates Foundation.