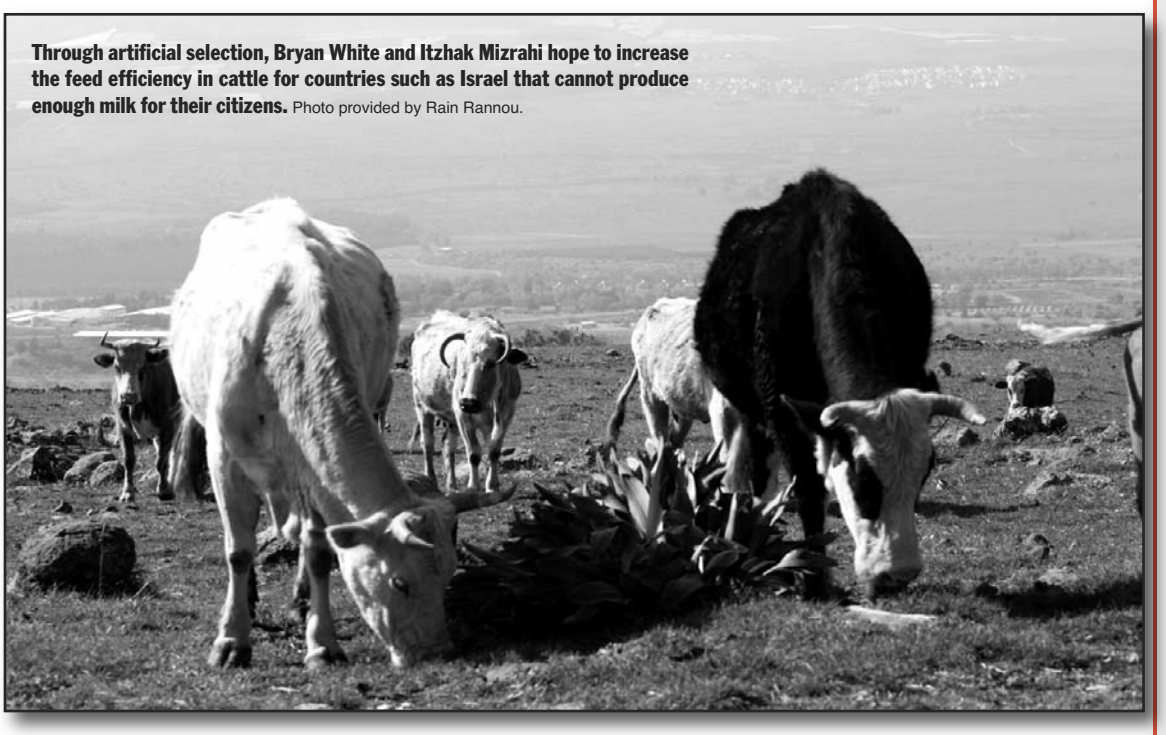
Illinois Professor Adds Value To Agriculture Through Israeli Partnership

URBANA, ILL.

Grocery stores across the United States have at least one thing in common: milk. However, other countries are not so lucky, said Bryan White, University of Illinois professor of animal sciences and researcher at the Institute for Genomic Biology.



Through artificial selection, Bryan White and Itzhak Mizrahi hope to increase the feed efficiency in cattle for countries such as Israel that cannot produce enough milk for their citizens. Photo provided by Rain Rannou.

"If you walk into any U.S. grocery store on any given day, you will find milk," White said. "But the rest of the world doesn't have that luxury. Sometimes they don't get any milk."

This reality was the foundation for a grant from the United States – Israel Binational Agricultural Research and Development (BARD) fund. BARD grants are awarded to American and Israeli scientists for jointly conducted and mutually beneficial research of agricultural problems.

White said the dairy industry is one of the biggest animal agricultural sectors in Israel. Milk is a large part of the Jewish diet and they want to meet that need, provide for themselves and be more independent. However, the country is small, and they are concerned about efficiency and the environment.

Itzhak Mizrahi, a researcher for the Agricultural Research Organization, approached White with the idea to find ways to increase feed efficiency in dairy cattle and to decrease methane gas emissions.

"If you increase feed efficiency, then you need fewer cows to make the same amount of milk. If you need fewer cows, then you release less gas. It's simple math," White said.

White and Mizrahi will receive $320,000 over a three-year period to fund this research.

"This grant helps create and maintain an important, international relationship," White said. "I believe it's important to foster this relationship in order to help Israel maintain its independence".

In addition, White has already received two similar grants through the United States – Israel Binational Science Foundation (BSF).

White received his first BSF grant two years ago to study cellulosome metagenomics in the rumen microbiome with Raphael Lamed, a professor of molecular microbiology and biotechnology at Tel Aviv University in Israel.

"Bacteria that live in the rumen, or stomach of the cow, have an organizational system called cellulosomes to break down plant cell walls," White said. "We think cellulosomes ream out the insides of plant cell walls like a bottle brush."

White and Lamed are studying the diversity, organization and adaptability of the Ruminococcus flavefaciens bacterial strains of the rumen and their cellulosomes. They are also evaluating their functional diversity.

"Our hypothesis is that the cow rumen has the most diverse set of plant-cell-wall-breaking enzymes in nature," White said. "Cattle have been evolving for a long time. During that period, they have probably eaten every type of plant cell wall on the planet."

The researchers believe cattle developed a system that is adaptable to different cell wall types, using the numerous bacterial species found in the rumen of cattle.

"For example, we think each bacterium might have a different arsenal of enzymes that break down plant cell wall. So you might have a bacteria that uses machine guns to break down one cell wall type, another that uses grenade launchers for a different type of wall, and some that use cannons for yet another wall," he said.

Learning how to increase feed efficiency is vital worldwide for those who cannot afford to feed grains to their livestock and where high-quality growth substrates are not abundant, White said.

"Increasing the efficiency for growth on forages, grasses and non-grain sources is not a big priority for much of the United States, but in the rest of the world it is," he said. "It is a big deal to people where there are limited resources. Corn is not fed to cows when people are starving. You feed that corn to the people."

Still, the research of White and Lamed is valuable to the United States. Plant cell walls are a rich source of carbohydrates for fermentation and many value-added products, he said.

Their research may improve how plant cell walls are broken down into usable products such as biofuels, the foundation of White's second BSF.

Generally, scientists receive only one BSF at a time. However, the second BSF grant's request for application to study an aspect of biofuels had a provision that one could have a current BSF and still submit to this program, which is very unusual, White said.

White and Edward A. Bayer, professor in the Department of Biological Chemistry at the Weizmann Institute of Science in Rehovot, Israel, were awarded a BSF to study bacterial conversion of biomass to biofuels, and the artificial creation of cellulosomes for specific plant cell walls and fermentation facilities.

"We take the bacteria from a cow stomach and their enzyme components to make a designer cellulosome, using a scaffold that is similar to a Legos set, with specific locations where we can place enzymes," White said. "We make designer cocktails based on what we believe to be the most efficient mixtures to degrade a type of plant cell wall."

This technology could be used to create biofuels more efficiently from regional dedicated energy crops such as miscanthus, sorghum and poplar trees. White said this science is significant for a world facing depleting fossil fuels and limited energy sources.

"It has always been my nature to collaborate internationally to try to advance science, especially in countries that are not as well off as we are," he said. "There is scientific merit in addressing the world's issues of providing fuel, value-added products and food efficiently and cheaply with minimal environmental impact." Δ