Reducing Hunger with Genetics

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Senior Negar Kahen majors in Biological Sciences conducts genetic research to help mitigate hunger

Negar Kahen has applied her interest in genetics to reduce acute hunger. The overall purpose of her study is to address the condition of hunger to formulate prevention strategies to correct hunger and thirst. One of the reasons behind her motives is that water is a scarce necessity while soil salinity, is one of the most serious threats to agriculture. Many crops are damaged or destroyed due to high levels of salinity in the environment. Most plants are unable to grow to their highest potential or bear fruits in saline environments.

Kahen directed her motivation to reduce hunger by formulating an interesting and compelling research topic. With the help of Professor Sergey Nuzhdin, graduate, and post-doctorate students, Kahen has been successful in carrying out her study. Ever since her freshman year, Kahen has been working in Professor Nuzhdin's laboratory and took his genetics course her sophomore year.

"I was always curious about genetics and that is why I started working at professor Nuzhdin's lab. After Working on my first project and hearing about the other projects that were taking place in the lab, I was sure that I am interested in genetics," Kahen said.

She started working on this particular research project during summer 2009. Kahen presented her initial results at the Undergraduate Research Symposium last April, and was reward with an honorable mention, motivating her to continue working extensively on her research project. She presented her final results at the 5th International Congress on Legume Genetics and Genomics (ICLGG) where she received praise and constructive instruction.

Kahen focused on unraveling mechanisms underlying adaptive differentiation of plants in high salinity habitats by introducing different strains of rhizobia, a nitrogen fixing bacterium, instead of water. In fall 2009, she harvested the plants, *Medicago truncatula* (*Mtr*), and again at the end of the summer. In the research project's first series, she inoculated 6 different Mtr genotype (2 salt-tolerant, 2 salt-sensitive and 2 salt-independent) with two different strains of *Rhizobia* and planted them in three different salt concentrations. Each were in individual test tubes filled with agar and placed in an incubator with a set temperature, humidity, and light cycle. Controlling the environment ensured outside influences would not impact the results, giving more accurate and precise results.

Kahen visually observed the plants' growth in the different salt environments to check if salt level and the strain of *Rhizobia* altered the results. She took measurements of the plants changes in shoot height, root length, number of leaves, flower growth and aerial weight. Additionally, Kahen kept a journal of all the exhibited growth. Since Kahen recently finished the second trial, she is still in the process of analyzing her final results. Furthermore, she is focusing on the molecular aspect of the data to come.

Kahen hypothesizes that *Rhizobia* genotype and salt concentration will both affect the plants growth. With a particular strain of *Rhizobia,* no salt will allow for optimal growth while the highest amount of salt will result in a dead plant. If there is an apparent interaction, Kahen will extract DNA of the *Rhizobia* and Mtr from the plant root.

"Even after working and waiting for a long time, when you find data supporting previous research, it's a pleasurable feeling," Kahen said.

Plant Growth in Saline Environment

Her experiment tests the genetic interaction between *Rhizobia* and Mtr. By doing this, Kahen is closer to discovering which particular plant and rhizobial interaction are best adaptive in high salt conditions and why. This is where Kahen's interest and knowledge in genetics surfaces. By finding how the genome of the *Rhizobia* affects the genome of the plant, she can prove an interaction between the plant and bacterium's genomes. Kahen chose *Rhizobia* above other bacterium because the genome was previously sequenced and prior research shows this bacterium to interact. This is one of the known bacteria that have symbiotic interaction with plants. This conveniently allows her to look at what genes in particular were involved.

Kahen found evidence of growth variability of *Mtr* in different salt concentrations, suggesting that that plant's salt tolerance depends on the combination of plants genotype and rhizobial genotype. Thus, selected plant-rhizobium symbioses could provide an advantage for some plants to better adapt to saline conditions.

There is still more work to be done. Once Kahen finishes extracting DNA, she hopes to reveal many unanswered questions: How did the *Rhizobia* interact with the plant? Does it interact with certain genes? Does mRNA play a role? Now that Kahen has successfully acquired all the data, it is just a matter of time before correlations and causations are uncovered.

Significance

Though there is more work to be done, Kahen has always enjoyed learning about genetics and seeing how her research applies the knowledge gained from her textbooks. By working in Professor Nuzhdin's lab, she has learned all the skills and knowledge required to start and continue this research project.

Once she has compiled all her data, including the DNA extractions, Kahen hopes to see which genes interacted and thereby finding more research on these particular genes. This can continue to more research on those particular genes. Even more importantly, it can lead to Kahen's overall goal of reducing acute hunger. Kahen has already identified one of this issue's barriers and is working toward overcoming it. In other parts of the world, such as Tunisia, salinity is a big issue and field experiments are currently being done there.

Kahen hopes to contribute as much as she can to developing research skills. Although her research had its share of obstacle including the long time is took for the plants to harvest, Kahen is content with the way her research is progressing.

"All these hardships helped me to learn the knowledge required to be successful in my research," Kahen said.