Beijing, China

Through the Eyes of A Seventeen-year-old

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"Few are those who see with their own eyes and feel with their own hearts." – Albert Einstein

I am honored to be one of those people

Background and First Impressions

Have you ever experienced one of those moments that make you stop and think, "This is my calling"? Have you ever been so inspired that you would leave your life behind for 2 months to help a worthy cause? Have you ever ventured out of your "bubble" and entered into a new culture for the sake of impacting another's life?

This summer I traveled to Beijing, China, to work at the Chinese Academy of Agricultural Sciences. While there, I met many great challenges and overcame them. In the course of 2 months, my whole life came into perspective. I would like to share with you the good times and the bad times, the research and the culture, and most of all the impact.

It was a cool, dark night…I walked into my house around midnight as I was just arriving home from a show choir competition. I was met at the door by my mom; she held the letter from the WFP. All of the hard work and anticipation boiled down to this small moment. I reluctantly opened the letter…I DID IT! I was going to Beijing, China for the summer!

On June 5, 2005, I wearily stepped off the plane with Morgan and Mark, the other Beijing Interns. The years of hard work and anticipation had finally paid off. It was almost midnight in China, and I was exhausted. I was picked up at the airport by one of the directors of CAAS and escorted to his car. During the 45 min. drive to CAAS, I couldn't help but be pulled in by the vivid neon lights covering the city. I arrived at CAAS and immediately fell asleep. So began my 2-month venture into the Chinese culture.

Who am I???

I was born on October 11, 1987, in Spirit Lake, Iowa. I have spent most of my life being raised by my father, Ivan, and my stepmother, Judy. During my sophomore year (2003-04) I attended the World Food Prize Foundation's Youth Institute. I was strongly impacted by the research and speakers that I was introduced to, and became aware of the international internship program and decided that it was my calling. Unfortunately, I was too young to apply for an internship that summer so I had to wait until the next year. I then attended during my junior year (2004-05) and was finally accepted as a Borlaug-Ruan International Intern!

History of CAAS

Founded in 1979, CAAS is a top-ranked, national research center and graduate school. It includes 41 research institutes located throughout mainland China. Fifteen of these institutes are located in Beijing on a main campus. There are also eleven national nurseries of crop germplasms and 103,000 mu of experimental agriculture and livestock farms. The focus of these institutes is on plant research, animal husbandry, agricultural economy, environmental studies, agricultural engineering, and new agricultural technology. There are about 9,000 faculty members at CAAS and about 6,000 of these are researchers. Since 2002, the school has been honored to be listed among the *First Class Graduate Schools in China.*

My Living Conditions

I stayed in the graduate school office building, where I had my own room. My room had two beds, TV, air conditioning, and a private bathroom. I am very thankful that I was provided such great accommodations during my stay in China. I usually skipped breakfast, but I would eat lunch in the cafeteria beneath my building. I was fortunate to have a good Chinese friend, Dongping, who helped me order in the cafeteria. When dinnertime rolled around, I'd either go out with Dongping, make some ramen noodles in my room, or if I were really missing American food, I'd go to TGI Fridays.

Research

During my first week, my lab director, Dr. Zhou, and I were unsure as to what I should study. I previewed a few topics such as the yeast two-hybrid system and DNA sequencing, but finally settled on studying the Arabidopsis plant. From there, I was partnered with my friend Dongping, who mainly worked with the planting and visual evaluation aspects of the study.

- **Background of reactive oxygen species**

Many plant responses to biotic and abiotic stress include a rapid burst of production of reactive oxygen species (ROS). The generation of ROS can result both from disruption of normal metabolic processes, such as electron transport in the chloroplasts and mitochondria, and active synthesis as part of a programmed defense response. The functions of ROS in

plant biology are frequently unclear, but they can play both positive and negative roles within the plant. ROS are toxic invading microorganisms, which can promote beneficial and detrimental oxidative biochemical reactions, and can be recognized as signals to initiate wider defense responses against stress in plant.

What are they?

Reactive oxygen species are:

- Molecules like hydrogen peroxide ions and like the hypochlorite ion
- Radicals like the hydroxyl radical; the most reactive of them all
- The superoxide anion which is both an ion and radical

They are unstable and quickly react with other molecules or radicals to achieve the stable configuration of 4 pairs of electrons in their outermost shell.

Why are they important?

Strong oxidants like the various ROS can damage other molecules and the cell structures of which they are a part.

Among the most important of these are the actions of free radicals on the fatty acid side chains of lipids in the various membranes of the cell, especially mitochondrial membranes (which are directly exposed to the superoxide anions produced during cellular respiration).

One of the interesting things about free radicals is that in interacting with other molecules to gain a stable configuration of electrons, they convert that target molecule into a radical. So a chain reaction begins that will continue until two radicals meet each other and each contributes its unpaired electron to form a covalent bond linking the two.

Example:

The peroxyl radical may interact with:

- Another peroxyl radical on a nearby side chain cross-linking them with a covalent bond.
- Another nearby carbon-centered radical cross-linking them covalently.

In both these cases, the radical formation comes to an end but with the result that the fatty acid side chains of membrane lipids may have become so deformed as to damage the membrane.

One must also realize that ROS have important functions to perform in the cell also. These include manufacturing hydrogen peroxide, catalyzing reactions, and killing harmful bacteria.

My Contributions

I studied the Arabidopsis plant and how it reacts to reactive oxygen species (ROS). In Arabidopsis, a network of at least 152 genes is involved in managing the level of the ROS. The levels are increased by an increase in abiotic stress (drought, salinity, flood, etc) on the plants. The hypothesis is that an increase in ROS will lead to hypersensitive response (HR) and rapid cell death in the plant.

This topic is significant because the plants that we used were “model plants” meaning that they exhibited many of the same characteristics as corn, beans, wheat, etc. In general, the way the model plant handles stress is very similar to important crops. The Arabidopsis has a fairly small genome making it an ideal research plant. If we can create a transgenic line of the model plant, then in theory, the same procedure should be able to work on vital crops. If we know that a line of transgenic Arabidopsis can handle drought well, we can then isolate the mutated gene and determine what needs to be modified in a crop such as corn so that it will also be drought resistant.

We grew wild type (WT) and transgenic lines of the Arabidopsis plant in the greenhouse. When they reached maturity we ran them through stress tests. The stress tests included, watering them with salt water, not watering them at all, over watering them, not fertilizing them, and injecting them with bacteria. Over the following days we observed the plants and

compared the WT and transgenic lines. It was common to see ROS characteristics like changes in leaves, health, and maturity. If a certain transgenic line has smaller plants than the WT line after a stress test, then we can infer that the transgenic line can't handle the stress as well as the WT. The mutated gene can then be studied to see how it regulates ROS.

The expected outcome is that by modifying the mutated genes in the Arabidopsis, one can create transgenic lines that will have resistance to abiotic (environmental) stress. I helped identify a few phenotypes that have never been seen before in certain lines of this plant. These require further study as to why the ROS regulation mechanism works the way it does in these lines.

By modifying genes in plants, scientists are able to visibly see how stress affects them. The results are proving the hypothesis, which will enable scientists to create new lines of crops exhibiting better yields and responses to environmental stress.

1.Green house for Arabidopsis thaliana

2.Tray of Arabidopsis during stress testing

3. Arabidopsis after stress test
Plants on left (WT) are healthier than plants on right (transgenic)
This constitutes a phenotype for this particular gene

Final Impressions

This program has changed me in more ways than I'll even ever realize. I went into this program as a naive seventeen-year-old girl from small-town Iowa, and left a whole new person. Throughout this experience I have learned that every problem, no matter how small, affects everyone in this world. Therefore, it takes help from all walks of life to come together to solve these problems. I was the only American student on campus for the two months of my internship, but in so many ways, I felt like I belonged there. So many people graciously went out of their way to extend to me hospitality and comfort, and for that, I am eternally grateful.

As I read the papers of last year's interns, I notice that a majority of their reports are research…then, I look at my measly two pages and think to myself, "My paper doesn't look very good!" But, even though I didn't get a full-blown research project like I had hoped, I am still able to walk away with knowledge and experiences that so many others would love to have, but probably never will get to. The research I did, though minute and more visually based, is the key step in allowing other researchers to make advancements. Without people like Dongping and me planting the plants and visually monitoring their progress, there could be no further testing.

Being able to be immersed in a new culture for two months has allowed me to not only gain a better understanding of different peoples, but it has also allowed me to educate my peers and breakdown many cultural stereotypes. Thank you to everyone that helped me along the way during my internship, I am ready to go into the future and make a difference!

Acknowledgments

I would like to extend special thanks to the following:

The World Food Prize Foundation
The Chinese Academy of Agricultural Sciences
Lisa Fleming
Ambassador Quinn
Dr. Borlaug
The Ruan Family
Dr. Fan Yunliu
Dr. Zhao Jun
Wang Dongping
Wang Hanqian
Dr. Luo
Louisa
Xiwen Jiang
My Parents

Sources

www.ag.unr.edu/ROS/files/Trends paper.pdf
www.plantphysiol.org/cgi/content/full/135/2/702
www.gscaas.net.cn
www.biologicalprocedures.com/bpo/arts/1/16/m16.htm