My Summer At

農學的中國學院

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Chinese Academy of Agricultural Sciences

Beijing, China

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Acknowledgements

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Introduction to the World Food Prize

Mrs. Sue Duffee, one of my high school teachers, introduced me to the World Food Prize Foundation during my sophomore year of high school. She recalled a particular conversation I had with other students in the room one afternoon about the benefits of using biomass—particularly switch grass—as an alternate fuel source. Mrs. Duffee assumed I would be interested in the Youth Institute's topic of that year—Biofuels: Promises and Implications for Food Security in Developing Countries. Although I had not heard much about the World Food Prize, I immediately began researching and writing my paper.

Attending the World Food Prize Youth Institute was very influential. Before the Youth Institute, I did not have a solid grasp on my intended career plans—only a few interests. But those three days in Des Moines set a solid foundation for my projected path.

Also, the opportunity I was presented with was astounding. I was able to interact with a range of people from across the globe working to eliminate hunger and poverty. I was able to learn a great deal about agricultural advances and their affects on food security. And most importantly, I was able to apply for the Borlaug-Ruan International Internship.

"Improving the quality, quantity, and availability of food in the world." This simple phrase, the World Food Prize's mission statement, has stuck with me since the Youth Institute. After my experiences with the World Food Prize, I know that I will spend the rest of my life striving for these admirable goals in some way or another.

About Me

My name is Colin Steele Weaver, and I am an alumnus of Boone High School in Boone, Iowa. I attended the Youth Institute in 2007, my sophomore year of high school (**Figure 1**). Before the Youth Institute, I knew very little about the World Food Prize, but was willing and eager to write my research paper and attend the event. That fateful conversation about switch grass in the Excel room started off a series of events that eventually led me to Beijing, China. After attending the Youth Institute, there was no doubt that I would apply for the Borlaug-Ruan International Internship. I was enthused and wanted to submit my application right away.

Figure 1. With my Youth Institute group

In order to apply for the internship, students must either be high school juniors or seniors. Being only a sophomore, disappointment came when I realized I would have to wait an entire year to apply. Over the course of that year, I spent many nights tossing and turning, hoping and praying to one day be selected. I wanted to begin the fight to eradicate hunger and poverty right away. This internship seemed ideal.

Over a full year later, I received word that I had been accepted for an interview. The process was nerve-racking. But March 3, 2009, made all of the stress of the application process well worth it. A giant envelope from the World Food Prize (complete with infamous gold letterhead) arrived, informing me of my upcoming trip to Beijing, China. I was

overwhelmed with joy. I would be spending my summer researching as a Borlaug-Ruan Intern at the Chinese Academy of Agricultural Science in Beijing, China.

Three months later, I was finishing my excessive packing, saying last minute goodbyes, and heading to the airport to catch my flight, taking me off on the experience of a lifetime.

About the Chinese Academy of Agricultural Sciences

The Chinese Academy of Agricultural Sciences (CAAS) is China's national agriculture research organization under the Chinese Ministry of Agriculture. CAAS works to serve national agriculture as well as rural development through their research. CAAS strives to meet national agricultural development objectives established to promote agricultural sustainability, thus providing food for China's growing population.

Figure 2: With my peers at CAAS

Located in the Haidian District of Beijing, CAAS has seventeen institutes within the main campus, and twenty-two extensions across China. During my time in China, I worked in the Graduate School of the Beijing campus in the National Key Facility for Crop Gene Resources and Genetic Development (**Figure 2**).

In the lab, I worked with four graduate students: Zhang Zenglin (Jack), Xiaoya (Serena), Xiaobo, and Danmei. Jack was my overall mentor in the lab, with whom I worked on my specific project. I also worked with Serena, Xiaobo, and Danmei frequently as an assistant on their experiments doing tasks ranging from PCR to collecting plant tissue samples from the greenhouses.

Lab

Before getting to my lab write-up, a crucial explanation is first necessary. I conducted my research in the National Key Facility for Crop Gene Resources and Genetic Development of the Chinese Academy of Agricultural Sciences under the supervision of Dr. Mao Long. My project (in a similar form) was an original experiment of Dr. Mao and was published under his name in an issue of Nature in 2000. He has since created this modified version of his original experiment in order to teach his students new lab procedures and to teach basics in molecular biology. Although the results of my experiment were not officially published, the main purpose was to increase my knowledge and proficiency in the lab.

Introduction

Abscission is a naturally occurring process in flowering plants by which leaves, fruit, and other organs are shed. Graham (2006) explains that abscission occurs after the plant forms an abscission zone (AZ) at the base of each leaf petiole. According to Mao (2000), plants containing the *JOINTLESS* gene do not develop AZs, thus the plant's leaves or fruit are not shed normally. Therefore, studying the process of abscission is relevant to food security. If plants used for sustenance are grown to contain this *JOINTLESS* mutation and do not shed their fruit, overall spoiled product can be decreased and overall crop yield increased.

In this study, the transcription factor BP(KNAT1) was used to over-express the downstream regulator gene *JOINTLESS*. *JOINTLESS* is a candidate gene that affects development of the pedicel in flowering plants. For the purposes of this experiment, a common tobacco, Nicotiana rustica, was used.

As was stated previously, over-expression of *JOINTLESS* has significance to exponentially increase the yields of many crops. Specifically, the resultant tobacco plants will have considerably fewer AZs formed on the pedicels and will shed considerably less plant material.

Methods and Materials

First, because of the purpose of this project—to further learn lab procedure and understand gene expression—we did not have to worry much about our control group or additional contributing variables. Had sufficient data needed to be collected and true results observed, and also had this project not already been published, much more emphasis would have been put on controlling all variables.

Most of the project data and observations come directly from the phenotype of the resultant tobacco plant compared to the wild-type control. For our concerns, project success is simply a yes or no answer. Yes, there are only a few AZs on the resultant plant, or no, there are nearly or as many AZs on resultant plant as there are on control. Put simply, if there are significantly fewer AZs, the gene expression has worked. If there are not, it has failed.

Transformation of the *JOINTLESS* gene into the tobacco plant was done through an RNAi vector by means of a T-vector (**Figure 3**). Our transformed samples, along with the control samples, were then given several weeks to grow before the phenotypes were assessed.

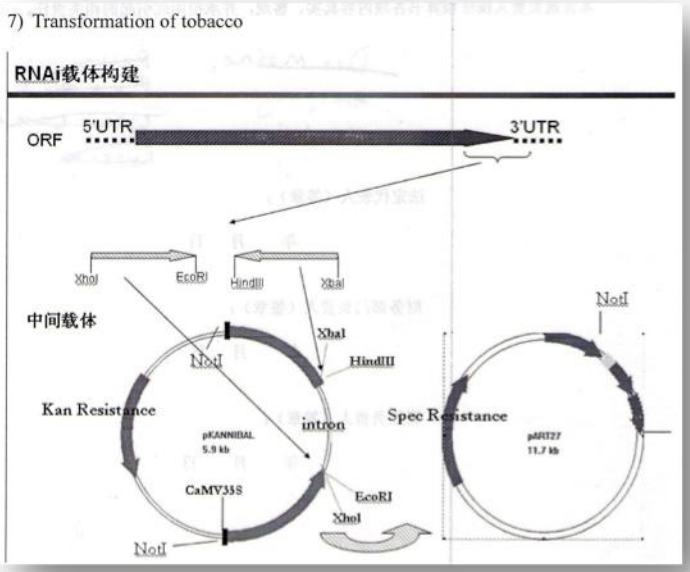

Figure 3 Transformation of tobacco

Results

The first attempt at the experiment failed when the transformed tobacco tissue was contaminated, so gathering data or determining results was not possible. On the second attempt, I had to leave my research in order to return home to the U.S. far before the resultant plants were grown and ready to be phenotypically examined. As mentioned earlier, however, this project has been completed and published. Actual results were not as important as my education of lab procedures and materials. If project results were measured by the amount I learned and my increased lab competence, the project would have been a success.

Discussion

It is difficult to interpret data because there was not much information collected from the experiment. In addition, it is difficult to discuss the implications that the results have on the original hypothesis, because this experiment has already been completed and published. Nonetheless, it is clear that overexpression of *JOINTLESS* does in fact result in the formation of fewer AZ's, thus resulting in a less plant material lost.

My Contributions

Overall, I worked diligently on my lab project, but ran into issues with the language barrier. In many situations, I was unable to comprehend the implications my specific work had towards the overall experiment. As an example, I constantly amplified DNA fragments from the tobacco using PCR (polymerase chain reaction) methods. I enjoyed following protocol in order to perform such procedures, but I usually had no idea what the consequential amplified DNA was used for once it left my hands due to some technical terminology that was lost in translation.

Lab Procedures and Other Lab Work

As well as working with Jack on my project, I also worked as a lab assistant to many of the other graduate students in the lab. Doing so allowed me to learn many other procedures that were not used in my specific experiment.

Procedures learned:

- PCR (polymerase chain reaction)
- DNA extraction
- Plasmid extraction
- Plant tissue cultures
- Gel Electrophoresis
- Bacterial colony preparation
- Micro and refrigerated centrifuge
- Vector transformation
- Enzymatic treatments of DNA and RNA

as well as many others.

Lab Experience and Food Security

I went to Beijing expecting to spend the summer working on my own lab project that would help combat global food insecurity. I was given a great project and was able to learn a lot during the experience,

but I still felt as if I had not fulfilled my expectations of personally increasing global food security.

I was not able to enter the lab until nearly my second week in Beijing. Coming from the United States, CAAS administrators were afraid that I was potentially carrying the H1N1 virus. Because of this, I was quarantined to my room for several days and unable to start my lab work right away.

When I was allowed into the lab, I learned that my project had already been completed and the results had already been implemented to further food security. What I was hoping to do was already done. I was slightly disappointed at first that my work wouldn't make a direct impact. I came to realize the most crucial objective of the internship. The program was established to grow people, not food. All of the fourteen interns lacked the skills and knowledge we needed to make adequate contributions to eradicating hunger and poverty. Our work didn't compare to that of the top researchers. The real purpose for sending us abroad was to whet our appetites for what lies beyond and to grow us as people. We were immersed in international research facilities where we worked alongside world-renowned scientists. By doing so, the World Food Prize truly followed out its purpose for the internship; to inspire us to spend our lives as did Dr. Norman Borlaug—fighting global food insecurity. I did learn, however, that although my work in China was a small contribution to the cause, my work in the future will hopefully have a greater impact.

Culture

Although I prepared for my summer abroad as best I could, I was still not ready for the huge initial culture shock that hit once I arrived. Beijing was much different from what I had expected. I had heard so much about how "Americanized" the city had become due to the 2008 Olympic Games hosted in Beijing. The Olympics contributed to the

much-needed updates of the decaying infrastructure, but the city was still slightly beneath the standards I had come to expect. At first, I saw this as a factor that would greatly deter the enjoyment of my summer. It took time to grasp, however, that I had been immersed in a completely different culture from my own. I came to realize that just because things were different, didn't mean they were inferior. Once I was able to look past these initial disappointing factors, I was able to see Beijing for what it truly was: a beautiful, culturally and historically rich, international city. Adjusting to Chinese culture took time, but by the end of the summer, I wanted to stay for another eight weeks or longer.

One aspect of the culture that was a major issue in the culture shock was Chinese food. Food consumed in China is much different from the "Chinese" food we eat in the U.S. Most of the dishes were so unlike anything I had ever had. But, after several weeks of adjustment, I learned to truly love the different but delicious cuisine.

Another issue that factored into my culture shock was the lower standard of living. During my time on campus, I stayed in one of the student housing buildings for the graduate students—one of the nicest dormitories at CAAS. Although it lacked air conditioning, a shower, a mattress and other typically sought after amenities, it became my home. I got to live as the Chinese students do. I'm thankful I had the opportunity to truly live like my colleagues and friends for the summer. It felt a little primitive at first compared to the nice hotel on campus where other international students stayed, but it made the experience much more fulfilling.

Although there were differences in culture, there were also many similarities. Like Americans, the Chinese love music and sports. The most common sport of the country is table tennis, which I played often. There were ping-pong tables on nearly every floor of my lab building, so Jack, Serena and I would constantly play during down time. Another well-loved activity is KTV (karaoke). A unified adoration for karaoke is common throughout Asia, so on several occasions, I went to a KTV lounge with everyone from my lab (**Figure 4**). It was a blast. I'm not much of a singer, but I still had a great time with my friends experiencing an important part of current Chinese pop-culture.

Figure 4 Singing Karaoke

During the summer, I fell in love with China. Despite the inevitable culture shock, I adapted to their way of life and even brought back some Chinese customs to the U.S. Upon my return home, I was asked if I would ever return to China. I came to the conclusion that the matter isn't if I will go back or not. It's when I will go back.

Travel

I was very fortunate with my sightseeing opportunities during my summer in China. During my time at CAAS, a study abroad group from

The Ohio State University (OSU) was on campus studying as well. The group was very small—only eight students as well as the group chaperone. I got to know all nine of them very well and was lucky to have been able to go on excursions with them. I, of course, visited all of Beijing's main tourist destinations, such as the Forbidden City, Tian'anmen Square, the Great Wall of China, etc. In addition, I was able to see first-hand what rural Chinese agriculture is like during my trip with the OSU group to Inner Mongolia.

Inner Mongolia is an autonomous region of the People's Republic of China, located north of Beijing. Upon arrival in Chifeng City of Inner Mongolia, we were given a tour of a typical modern farm complex. The single complex contained over 3,000 greenhouses, all tended by hand by the thousands of workers living on the farm (**Figure 5**).

Many of the crops used for food grown in Inner Mongolia are grown in greenhouses in order to control growing conditions. Usually the weather in the region is too arid and unpredictable. With a large portion of the country depending on the food production of this region, numerous greenhouses and thousands of kilometers of underground irrigation are a must. The specific complex we toured grew tomatoes—and only tomatoes. The Chinese government has heavy regulations

Figure 5 Inner Mongolia Farm/Greenhouses

on agriculture and specifies which single crop certain regions may grow. In addition, many farmers must plant government-approved seed. These

strict regulations result in better commerce and marketing as well as standard crop production and quality rate. After spending time in the southern portion of Inner Mongolia, where cultivation of the land similar to this tomato complex is common, we traveled farther north and farther away from familiar civilization.

After a nearly ten hour bus ride, we came close to the border where China, Mongolia, and Russia all meet. I became aware of how difficult it would be to find a more remote, far off place from home than where we were. Being able to experience such a drastically different culture definitely opened my eyes. Many of the people of the northern region are nomadic. The herds of cattle and sheep were free to roam and graze the vast rolling hills of meadows and prairies. In other areas, mountain chains bulged across the landscape with primitive villages of semi-permanent yurts dotting the valleys. The most profound sight was that in a large, mountainous geo-park (**Figure 6**). The landscape was breathtaking.

The entire experience in Inner Mongolia was incredible. It was a time to not only experience a different culture, but also an entirely different civilization. Spending several days in the remote northern territory of China, sleeping in yurts and eating beef with audible "moo's" from grazing cattle just outside was far different from anything I had ever done before. I was very fortunate to

have been able to have both a strong urban and rural experience during my time in China.

Impact

The Borlaug-Ruan International Internship has impacted my life in countless ways. I had the extraordinary opportunity to work in a leading research facility alongside world-renowned scientists. From there, my summer research established a concrete field of interest for post-secondary education and beyond. I know that I want to spend the rest of my life helping those without adequate food across the globe, as the World Food Prize has inspired me to do.

In addition, the internship led me to a higher level of maturity. I learned a lot about food security, but also about myself. When I returned to the U.S., I had grown in up countless ways and was much more independent. The entire experience was the best thing I ever could have asked for.

Dr. Borlaug's Influence

"As saddened as we are to lose this great friend and humanitarian hero, we can find solace in the fact that we were fortunate enough to have had our paths cross his. He made so many lives better, ours included!" said Lisa Fleming. When I received the email from her, informing me that Dr. Norman Borlaug had passed away, I was flooded with emotions. September 12, 2009 was a very sad day for the world. It was also a time to celebrate the life and accomplishments of a remarkable and outstanding man. The quotation above from Ms. Fleming's email has stuck with me since I initially read it. I truly am fortunate for my path to have crossed his. Dr. Borlaug was one of my biggest heroes. He instilled in me a passion for wanting to help those stricken with hunger and poverty. I am eternally grateful to Dr. Borlaug for sending me to Beijing, China, through a truly incredible program, but most importantly for his inspiration.

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