

BORLAUG-RUAN INTERNSHIP

June 2010-August 2010



FROM LITTLE LONG GROVE TO BUSTLING BEIJING: MY SUMMER CONTINUING A LEGACY

MARIA CHICKERING

North Scott High School

Eldridge, Iowa

China Agricultural University

College of Agronomy

Beijing, China

Table of Contents

Acknowledgements	2
Background	4
China Agricultural University	5
My Work	5
Travels	13
Culture	17
Conclusion	17

ACKNOWLEDGEMENTS

I would like to thank the following people for all they have done.

Dr. Norman Borlaug for being my hero, for saving millions of lives and for establishing this wonderful program I was fortunate enough to participate in. This paper is dedicated to your memory.

My Parents for saying goodbye to their favorite daughter for two months so I could travel to China and always supporting me in whatever I decide to pursue. I love you so much and appreciate everything you have done for me.

Mrs. Chris Green for introducing me to Dr. Borlaug's work and the World Food Prize, for being the best History Day coach ever and for always being there for me, even at 5 in the morning.

Lisa Fleming for all the help and guidance she provided over this internship and for being available at any time of the day or night for all of us interns.

Ambassador Ken Quinn for giving me this life-changing opportunity.

My Friends for keeping me updated on everything happening in Iowa, for always being on Skype for me to talk with and for being the best friends ever.

Maria Biddick for being on Skype every afternoon and talking to me about anything and everything and for taking care of my Facebook.

Dr. Zhaohu Li for making sure I had everything I needed while in China, for allowing me to have an internship at CAU and for being a great mentor.

Lucy for taking care of my every need, for making sure I was safe, for taking me to the grocery store, for escorting me around Beijing, for treating me like a best-friend and for always being there for me to talk with. I hope one day that you'll get to come visit me in America.

Bau Ruiya (Boria) for letting me help with her project, for teaching me all sorts of lab work, for being patient when I did not understand something, for sending me articles so I could read about what we were doing and for explaining to me what we were doing when I was incredibly confused.

Margaret for letting me help with her experiment, for taking me around Beijing, and most important, for always putting a smile on my face.

Annie for taking me around Beijing and beyond, for explaining different experiments to me and for always being there to talk to.

Julie for taking care of me that first night I was at CAU, for always asking interesting questions about the US, and for being my friend.

Lucy Li for taking me all over China, for never letting me get lost in all of those places we went and for always being there to talk with.

Ariel, Fancy, Penny, Lily and all of my other friends in China for being my friends and for making CAU feel like a home away from home. I can never put into words what your friendship means to me.

BACKGROUND

A little about myself.

I first heard about the World Food Prize through a research project for National History Day. My partners and I had chosen to research Dr. Norman Borlaug for the theme that year, which was “The Individual in History: Actions and Legacies.” Our advisor, Mrs. Chris Green, had suggested we research Dr. Borlaug, and after doing a Google search we decided that he would be the perfect individual to research for this particular theme.

Through our research we discovered more about Dr. Borlaug’s work. We had never even heard of this man who had saved a billion lives, and he was born and raised in the state we had lived in our entire lives! This man, for being an international hero, was widely unknown in his own country and state. This angered me, and I was determined to learn more about this great man. Since our project needed to focus on Dr. Borlaug’s actions and legacies, we decided to look into what actions he was taking to ensure that his work in agriculture would continue well into the future. We learned how he had established the World Food Prize in 1986 to give recognition to those who were making improvements in the quality, quantity or availability of food in the world and ensure that their work would continue. We read how he had come out of retirement to join Sasakawa Global 2000 to fight hunger in widely forgotten Africa. Then we learned about the Global Youth Institute. It was established to introduce the youth of the world to the problem of world hunger, the work of Dr. Borlaug and the work still being done to fight hunger. The Borlaug-Ruan Internship was another program that had been established for youth involvement, and we soon learned that it held a special place in Dr. Borlaug’s heart. Dr. Borlaug knew that his legacy could only continue if young people had a passion for taking action to fight hunger, and this internship was designed to foster this desire. His greatest joy was in the hunger fighting youth, the youth that were Borlaug-Ruan Interns.

Through our research we were also introduced to many people affiliated with the World Food Prize and Dr. Borlaug. My history day group and our advisor were fortunate enough to attend the 2008 World Food Prize, which was the first time I had the opportunity to speak with and hear from people who were personally dealing with hunger. This was a huge shock to me. Coming from Iowa I had never seen hungry people; people who were “hungry” were those who had skipped lunch. It was an eye-opening experience and helped me understand how fortunate I was. However instead of feeling relieved, I felt a need to help these people who were starving. We also were able to talk with Dr. Borlaug’s sister Charlotte, and from that conversation I learned about his early life, his family and how his passion for growing things and learning had always been present. My group and I also arranged an interview with Ambassador Ken Quinn in Des Moines. Interviewing the President of The World Food Prize was an amazing opportunity for us and we were able to learn his perspective on the problems of world hunger, Dr. Borlaug’s actions to eradicate it and how his legacy could be continued. Before we finished the interview Ambassador Quinn told me that I should attend the Youth Institute and apply for the Borlaug-Ruan Internship. I had already been contemplating the idea, and decided I would sign up.

Soon thereafter I spoke with my Biology teacher who gave me the information and told me that I could begin working on the paper over the summer. I chose to research Ghana and how

educating subsistence farmers could have an impact on their country. It was fascinating but also devastating to read about some of the conditions Ghanaians were living in. I attended the 2009 World Food Prize and enjoyed it just as much as the previous year. Participating in the Youth Institute was an amazing experience that opened my eyes to the youth of America who have a passion for helping people. Attending the huge banquet and laureate ceremony were opportunities to understand new aspects of the hunger problem, and I enjoyed them immensely. I decided to apply for the internship immediately, though I had my doubts about leaving my friends and family for such a long amount of time. I knew that doing something to help others would be more important than a missed summer with friends. When I got news that I had been selected as one of the interns I felt extremely honored to be one of the youths chosen to carry on Dr. Borlaug's work.

CHINA AGRICULTURAL UNIVERSITY

My host University.

I was chosen to go to China Agricultural University located in Beijing, China. It was founded in 1905, and upon the founding of the People's Republic of China three major agriculture universities in Beijing merged to form Beijing Agricultural University (BAU). The China Agricultural University (CAU) we know now was founded when BAU and Beijing Agricultural Engineering University combined in 2005. CAU is one of the best Agricultural Universities in China and research done at CAU is respected throughout the world.

MY WORK

What I researched at CAU.

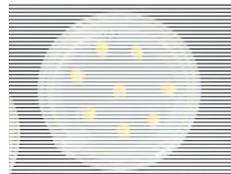
Dr. Li allowed me to decide what I wanted to work on, so after reading through previous interns' papers I decided that I would like to assist a grad student with some sort of DNA research. He assigned me to work with Bau Ruiya (Boria) who is a graduate student studying transgenic maize. She explained that we would try to incorporate a gene called Los 5 that codes for draught tolerance into a maize plant. Draught tolerance is becoming increasingly important in our world because of the lack of water we face. It is necessary for research to be done in order to keep agricultural output at the same level or higher with less water.

Normally there are six steps for creating a transgenic plant: transformation, harvesting the seed, screening the seed, grow the transgenic seedling, DNA extraction, and PCR analysis. Because the internship lasted only sixty days, I was unable to perform all the necessary steps in the correct order.

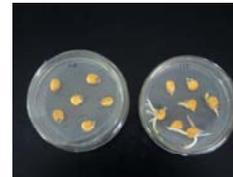
Instead we began with seeds that had already undergone transformation and had been harvested. From each plant Boria had taken the kernels and placed them in a labeled bag. There were 10 different groups, and from each group we selected 16 kernels. We only chose undamaged kernels that were of a good size. We put these kernels into a large plastic test tube and sterilized them using 75% ethanol for one minute then 2% NaClO for fifteen minutes. We moved them to the clean bench and used a bacteria free water wash three times. This ensured that the seeds would not get bacteria while growing.

To see which seeds actually had the gene Los 5 we made a selection medium. The Los 5 gene had been inserted into the genome of the corn along with a gene for Hyg resistance. Hyg is a bacteria that will kill seeds growing in media. To see which seeds were transgenic we made a Hyg medium. This medium contains Hyg so the idea is that transgenic seeds will grow, while non-transgenic ones will not. Hyg selection medium is made by combining ms (4.33 g/L) and sucrose (30 g/L). We used a 500 mL beaker. Then the pH value is tested, it needs to be at 6.5. Then agar (8 g/L) is added to the mixture and you placed it in a sterilization machine ran at 115°C for twenty minutes. We then poured the medium into petri dishes until they were approximately half full on the clean bench. After the medium cools it forms a gel.

Working on the clean bench to prevent bacteria from infecting our seeds we placed 8 seeds in petri dishes filled with medium using sterilized tweezers. We labeled the petri dishes and sealed them with parafilm around the edge. Then we placed the petri dishes in an incubator and waited several days. When we checked them most of the seeds were healthy except for a few that had gotten bacteria despite our precautions. With the ones that had gotten bacteria we made another mixture of medium and selected new seeds from those groups to put in the medium using the same procedure.

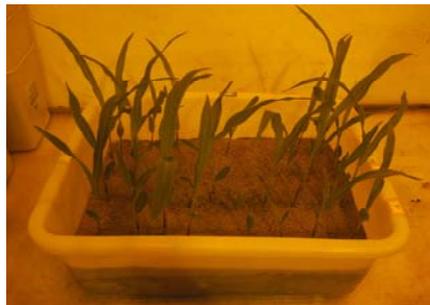


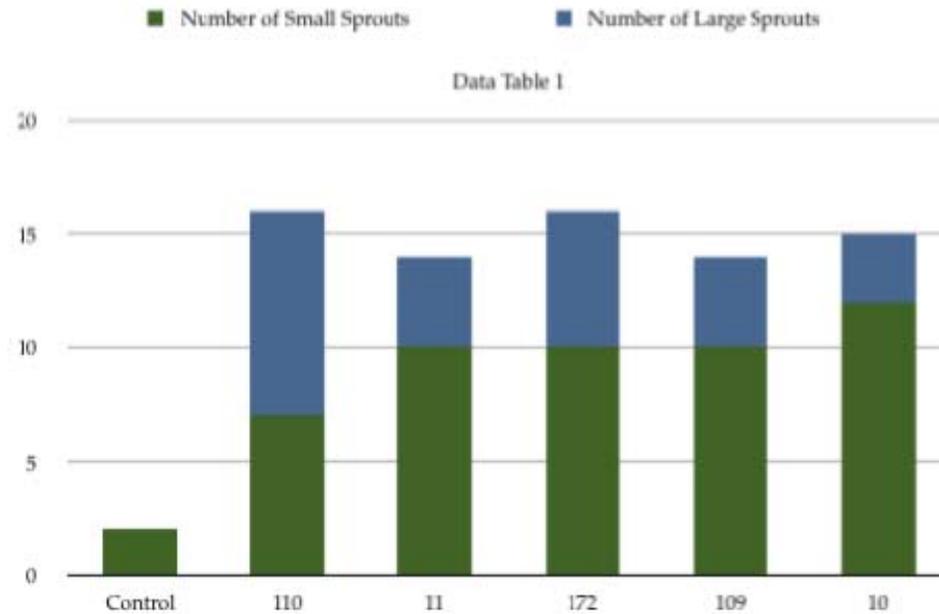
Seeds in Medium after growing



Seeds in Medium

Our next step was to take the germinated seeds and plant them. Before we did this we counted how many seeds from each group germinated and how many of those sprouts were big (see Data Table 1). Next we took the seeds to a greenhouse and prepared a tub to plant them in. We filled the tub with sand and watered it thoroughly. Then we selected the seeds from each group with the largest sprouts, carefully washed all medium from them and planted them in the tub. We planted the seeds in sand because they are supposed to be draught tolerant and sand dries quicker than soil. We allowed these seeds to grow for eleven days until seedlings appeared that were large enough to collect DNA samples from.





In the meantime the seeds we had replanted due to bacteria got bacteria again, so we decided to simply grow them on moist filter paper. After they sprouted we planted them in another tub of sand, prepared exactly like the previous one. Every day we would check the tubs to make sure the sand was still moist. It was important to keep the seeds growing in a place with steady temperature and moistness. Unfortunately, one day the greenhouse's air-conditioning unit broke down, causing it to become much warmer in there than usual. Despite this the seeds still grew, though we fear that the change in temperature may have caused some damage to our data.

Next we carried out DNA extraction. To do this we went into the greenhouse and cut off medium sized pieces of leaf from the seedlings, approximately .5 grams each. We wrapped this in tin foil, labeled it, and dropped it into liquid nitrogen. We collected two samples from each group. While we were selecting the leaves for extraction there was a beaker of CTAB Buffer preheating in a 65°C water bath. After this buffer heated up, we added 2% Mercapto Ethanol to it.

Next it was important that we pre-cooled the mortar and pestle by pouring liquid nitrogen into it. After it became sufficiently cool we added one packet and ground the leaf until it became a fine powder. It is easiest to grind the leaves when the liquid nitrogen is nearly completely evaporated. Then we filled two microfuge tubes with powder, making sure to label them and that they are pre-cooled. We replaced the tubes in a liquid nitrogen bath. Then we repeated this until all the packets were ground into powder. To each tube we added 700µL CTAB Buffer, mixed it through inversion, and incubated them for forty minutes at 60°C. After incubation the tubes were spun at 12,000 rpm for ten minutes, then we put the upper aqueous solution into a different tube and discarded the bottom.

Our next step was to add 600 μ L of Chloroform: Iso Amyl Alcohol (24:1) to the tubes and mix them through inversion. We added 600 μ L of solution because you have to add an equal amount of solution as there is upper solution. After it is mixed in we allowed it to sit for three to five minutes. Next we spun the tubes again, this time at 12,000 rpm's for ten minutes. We then transferred 300 μ L of the upper aqueous phase only to a clean microfuge tube. Our next step was to add 200 μ L of Isopropanol to the tube, we added 200 μ L because you add $\frac{2}{3}$ the volume of the upper aqueous solution. We mixed the tubes then iced them for thirty minutes or longer. Our next step was to spin the tubes at 8,000 rpm for five minutes. We again removed the upper aqueous phase and disposed of it. In the bottom the DNA pellet had become visible, we added 1 mL of 70% Ethanol and slowly inverted it to suspend the pellet, then spun it for three minutes at 6,000 rpm. We repeated the last step of removing the upper phase, adding ethanol and spinning.

After this our next stop was to put off the upper phase one last time. We added 1 mL of absolute ethanol and spun the tube at 6000 rpm for three minutes. Next we carefully removed all supernatant and allowed the DNA pellet to dry. We resuspended the pellet in sterile DNase free water and incubated the tubes at 65°C for twenty minutes. For long amounts of time we stored the DNA at -20°C, for short times we stored it at 4°C.

The procedure we used to extract DNA is a common one used by many Universities and research facilities. Although it is very long and sometimes repetitive it works well and preserves DNA structure well. My experience with it was fun and it was amazing to me when the DNA pellet appeared from seemingly nowhere.

The next step of our work was to run PCR on the DNA. PCR stands for Polymerase Chain Reaction. It's main purpose is to make a huge number of copies of a gene. This is done through a series of heating and cooling that are at prime temperatures for DNA replication in a closed environment. There are three main steps: Denaturation at 94°C, Annealing at 54°C and Extension at 72°C. These steps produce a huge number of gene copies that are necessary during



PCR Preparation

DNA analysis.

The procedure for PCR began with having 4 μ L of H₂O for each tube of DNA. Since we had 12 tubes, 9 of DNA, 1 of H₂O and 1 of Los 5/Hyg, we needed 48 μ L. We needed 5 μ L of "Mix" for each tube, which consisted of Buffer, dNTP and Taq Enzyme. We also needed .5 μ L of

Primer, we used Los 5 and Hyg 1 & 2 primers, for each tube; along with .5 μL of DNA in each tube. It was important that we kept the mix and primers on ice.

We used a pipette to place 48 μL of H₂O, 60 μL of mix and 6 μL of primer into a large test tube. We had 3 different primers to test, so we had to repeat this procedure three times, since only one primer can be used at a time. Primers are what select the section of gene to be copied, and we used Los 5, Hyg 1 and Hyg 2 primers. In the case of the Los 5 Primer, there were two that had to be mixed together, so we used 3 μL of each. Once all the components had been added to the large test tube we mixed it using a shaker machine. We then spun the tube using a centrifuge very briefly.

The next step required much organization. This is important because we want to ensure that the different samples of DNA are kept separate and organized so our results are accurate. We layed out 11 PCR tubes and labeled them 1-11. We pipetted 9.5 μL of our mixture into each PCR tube. We then put .5 μL of DNA sample into each PCR tube, changing pipette heads with each new sample. We repeated this step for each primer. It was arranged from 1 to 11 as follows:

TUBE #	1	2	3	4	5	6	7	8	9	10	11
DNA Sample	10	11	110-1	110-2	110-3	109	109-2	CK-1	CK-2	Los 5/Hyg	H ₂ O

After the PCR tubes were filled with a total of 10 μL of mixture, we labeled their tops then placed them in a PCR machine. The program we ran consisted of the following steps:

- 1) 5 minutes at 94°C
- 2) 30 seconds at 94°C
- 3) 30 seconds at 55°C
- 4) 30 seconds at 72°C
- 5) 10 minutes at 72°C

We ran the middle steps (2-4) 30 cycles.

Once we were finished we stored the samples in water at 4°C. This completed how we replicated DNA using the process of PCR.

Next we were ready for the final step in creating a transgenic crop, DNA analysis. For this we used Gel Electrophoresis. The way Gel Electrophoresis works involves the size of DNA. The electrophoresis machine runs a charge from one side of the plate to the other. The DNA goes away from the negative charge towards the positive side, and the smaller strands are able to travel further. The gel is then looked at under ultraviolet light and compared with a sample with

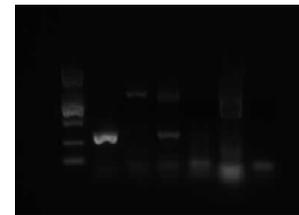
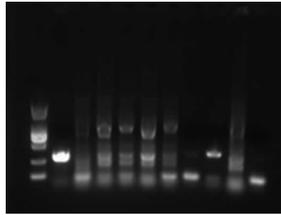
known genes. If the genes match up, then they are present, but if there is nothing then the genes are not present in the DNA sample.

The first step in this process is to create a 1% agarose gel by combining 40mL TAE Buffer with .4 g of agarose. TAE buffer contains Tris base, acetic acid and EDTA. We then microwaved the beaker containing the agarose gel mixture until it is completely combined, which was approximately five minutes.

We readied the electrophoresis stand by placing the plate in it and sealing it tightly. Then we added 3 μ L of dye to the agarose gel mix and shook it well to disperse it completely. Then once the gel mixture was warm, but not hot, we slowly and evenly poured it into the electrophoresis plate. We then carefully placed the combs in the plate. We allowed the gel mixture to cool for about twenty minutes; when the liquid cools it forms a solid gel. We next removed the combs from the plate, and the plate from the stand. Small wells formed where the comb was, which is where we insert the DNA samples later. We take the plate with gel and place it completely submerged under TAE in the electrophoresis machine, with the pores closest to the negative side.

Next we used a pipette to insert 8 μ L of each DNA sample into their own pore. It is important to carefully insert the DNA, avoiding poking a hole in it or else the DNA sample will spread and produce inaccurate results. Also put 8 μ L of Gene Marker in one pore. Examples of Gene Marker include Los 5 and Hyg. They are samples in which the desired gene is present, and we use it to compare our samples to. We then ran electrophoresis; 110 volts for 30 minutes. After that was done we removed the plate from the machine and slid the gel off of the plate and onto the base of the tri-purpose ultraviolet analyzer, which uses ultraviolet light to capture a photograph of the gel so the different genes are visible. We ran the program using white light first, then ultraviolet light, and were able to compare our DNA samples with the Gene Marker samples.

The results of our experiment were revealed after we analyzed our DNA using gel electrophoresis. We tested for both Los 5 and Hyg genes in our transgenic maize. Hyg 1 was present in all the samples, including the control sample, which was what we were trying to *not* have happen, so that transformation was unsuccessful. Los 5 was somewhat successful. The first time we ran it, several of the samples showed evidence of its presence, so we ran it again. The second time it was revealed that incorporating Los 5 was unsuccessful. The gene is supposed to be present at 250 bp, but on our samples there was a marker at 300 bp, rendering it useless. Boria's had three samples that did show the Los 5 gene at the correct place; 109, 109-2 and H2O.



However, H2O should not have shown the gene, so later samples will have to look further into this. I was unable to continue researching because it was time for me to leave.

Gel Electrophoresis Results

Boria and I were able to draw conclusions from our work. Our transformation of maize to include the Los 5 gene for draught tolerance was unsuccessful except for the possibility of one sample. Because the genes did not show up in our gel electrophoresis tests we know that the desired gene was not incorporated into the existing DNA except for the possibility of our 109 sample. Another transformation would help to make sure that our attempt was accurate, as human error could have had some effect on the plants. We also saw that our maize was non-transgenic because of experimenting with the plants themselves. Once we had removed a few leaves for DNA extraction we stopped watering the maize while still observing it. After a few days the leaves began curling inward, showing the lack of water and proving it was not draught tolerant. More research will have to be done to produce a maize variety that is draught-resistant because the need is so great for one. With the changing climate and increasing presence of draught a variety of maize that can survive harsher conditions is needed immensely.

While there was not enough time for me to do the first step of creating a transgenic maize plant, transformation, Boria arranged for me to sit in and watch while transformation was carried out on soybeans in another lab at CAU. This was an interesting process, and Boria explained to me that the process is much the same on soybeans as it is on maize, so while I never got to carry it out I understand the process.

Transformation has four main steps; preparation, infection, co-culturing, and selection. Transformation is a long process that lasts about fifty days. The goal of transformation is to

begin with seeds and a desired gene in a bacteria, and end with a plant seed, in this case soybeans, containing that desired gene.

Preparation begins with growing soybeans in a $\frac{1}{2}$ MS, agar and sucrose (pH 5.8) medium until a root appears. Once the root has emerged from the seed it is removed from the medium, placed in $\frac{1}{2}$ MS and sucrose, the root is removed and the seed is cut in half, producing a cotyledon.

The second step, selection, is done by placing agrobacterium that contains the desired gene and two large, sterilized test tube under a clean bench and pouring 100 mL of agrobacterium into each tube. Next the two large tubes are placed in a centrifuge and spun at 6,000 rpm for ten minutes. The $\frac{1}{2}$ MS and sucrose is drained from the cotyledons using a pipette while this is being done, and after the agrobacterium is done spinning we poured it out and what we used was left in a pellet at the bottom of the tubes. We added some more $\frac{1}{2}$ MS and sucrose solution to the tubes along with 15 μ L of AS and shook the tube to suspend the agrobacterium. We poured that mixture over the cotyledons, ensuring that all were covered and waited 25 minutes, then drained the agrobacterium solution from the cotyledons. This should infect the cotyledons with the bacteria containing the desired gene. We then placed filter paper on co-culture medium filled petri dishes, and placed the cotyledons on the filter paper, cut side down, sealing the petri dishes with parafilm to ensure sterility.



Soybeans in Agrobacterium

Co-culturing takes three days, during which the cotyledons are allowed to sit and grow. In the co-culture medium both the cotyledons and agrobacterium can grown, and hopefully the agrobacterium infects the cotyledon.

The last step, selection takes the longest time to complete; during this step we use a selection medium to choose cotyledons that have acquired the desired gene from the agrobacterium. The ones that are successful will not die in this medium. First we remove the parafilm seal and sterilize the petri dishes' edges using a flame. Next we move the cotyledons from the co-culture medium to the Hyg selection medium, placing five cotyledons in each petri dish. The petri dishes are sealed with parafilm and allowed to grow for fifteen days. After fifteen

days the healthy seeds are placed on a new Hyg selection medium and allowed to grow for another fifteen days. This is repeated twice more for a total of four different selections. By the end of this time the seeds remaining should be transgenic.

Working in the lab was an interesting experience that I thoroughly enjoyed. I would love for my career to involve lab work similar to what I did during my internship, and learning so much about lab procedures in a different country was a unique experience. So much of lab procedure is similar to the United States, such as the importance placed upon sanitation, yet much is different, such as no one wearing safety goggles while working. The experiences I had in the lab have positively affected my life, and though Boria and I's experiment was unsuccessful I was able to learn a great amount about the process behind producing a transgenic plant.

In addition to my work with transgenic maize several other graduate students allowed me to help with their projects. I helped one student with their cotton; small insects had invaded the plants and were under the cotton leaves. We went into the greenhouse and put up sticky paper to catch the insects because it would have harmed the experiment to use pesticides on the cotton. This showed me the importance of keeping experiments free of outside forces, like pesticides. I was also able to help another student extract DNA from various vegetables, which was interesting to compare with maize DNA extraction; the process is much the same. I even assisted one student with her experiment with wheat. I helped her plant the seeds and then while she was visiting her family I watered the plants every day. Helping her showed me how important consistency is when working with plants, they prevent you from leaving whenever you want because they still need looking after when you are not present. Helping these other students helped me learn even more about agriculture and widened my understanding of many different kinds of lab work.

TRAVELS

Places I visited in China

My internship experience was much more than just lab work. I was fortunate enough to be in China, a place rich in historic places and beautiful landscapes. Professor Li explained that he wanted me to see and experience China during my internship, and to do this he had me travel to several different cities and all around Beijing. Seeing so many new places was overwhelming but also impressive, I feel as though I got the true "China Experience" from my internship by visiting so many places of such great importance and now understand China's rich past more than I ever thought I would.

CAU's Beijing Test Field

On two occasions I was able to visit CAU's test field just outside Beijing, which is devoted to vegetables. The first time Dr. Li and three other professors took me there to simply look at what was there. We walked in the greenhouses and through the fields to see the various plants growing there and the professors explained to me what had been done genetically to enhance them. Some enhancements included pest resistance, larger productions, hardiness and many others. The second time I visited the field was with several other grad students. They went to check on their experiments and decided to take me along. Boria showed me transgenic maize like that which we were trying to create and we went into the fields to check on some cotton

plants and soybeans. We watered and measured the heights of one student's cotton plants and to collect data we counted the number of flowers on each cotton plant too. I enjoyed going to the test field because it helped me see in person the results lab work produces. Being around plants that may someday be the next "miracle wheat" was a very neat feeling and helped inspire me to do my part to contribute to the work being done in fields around the world.

HeJian and Wuqiao

One weekend I got to travel south of Beijing to two test fields, one in the city of HeJian and one in Wuqiao. This trip had perhaps the biggest impact on me of all the places I went during my internship. At the HeJian test field we looked at student's projects, mostly with cotton. One of my friends had her cotton planted there and showed me what was different with her variety and it's importance to cotton production. Her cotton had larger bolls so it could produce larger yields and it also had draught tolerance. At the Wuqiao test field we saw more cotton and maize that had been genetically modified; the modifications mostly were for yield, pest resistance and draught tolerance. Going to these test fields helped me see research being done that had true potential.

However the more important aspect of this trip to me was the realization of how advanced American agriculture is compared with China's. At these two stations there was no mechanized farm machinery, except for several old rusted out two-cylinder tractors. There were many workers in the fields hoeing between the rows of cotton and corn where plows could not reach. To plow the fields mules were used, and if there was only one mule, then people pulled the plows themselves, having one person attached to the plow and another guiding. Though I had heard Dr. Borlaug's story of when he hitched himself to a plow to get work done when no machinery was available, I never thought I would see it in person, I thought that in a world as technologically advanced as ours that we had moved beyond this sort of labor. What made this even more difficult for me to see was that it was not young people out working, but rather older men and women- people who would be considered retirement age in America. This was such a culture shock to me living in Iowa that I wanted to go help the workers but knew that Dr. Li would never allow me to because I was a guest. This really opened my eyes to agricultural



differences between the United States and China, and the world.

While in these towns I was able to experience another side of China. I could tell that this region of China did not see many tourists because when I went to the restaurants and around town residents stared much more than in Beijing. Another interesting experience I had in Wuqiao was visiting the Acrobatic World Headquarters. Wuqiao prides itself on being the home of acrobatics and has created an entire park devoted to acrobatics. Seeing how much pride the residents took in their home was really neat and seeing the acrobatics performed there was extremely impressive.

Changchun & Yanbian

I was given the opportunity to travel to the northern city of Yanbian to attend a cotton conference in early August. To get there we took a train from Beijing to Changchun and then from Changchun to Yanbian. Changchun was a test field city but had a ton of development occurring. We were able to explore it for a couple of hours while waiting for our next train. We visited a beautiful park that showed me how very beautiful China is in its own way. Yanbian is only ten miles north of North Korea and the culture there is heavily influenced by Korea. Many of the residents are Korean and they continue the traditions of their culture. The cotton conference itself was very difficult for me to understand because it was all in Chinese, but I did have the amazing opportunity to experience the very unique city of Yanbian. It is a very pretty city, with a nice park that we went to one day that once again showcased China's beauty. We were able to visit some small shops and street vendors which was interesting and allowed me to see the different cultural items and foods they were selling. My trip to Changchun and Yanbian really opened my eyes to the differences between China's many ethnicities. I began to realize that each was very unique and had their own special practices, appearances and quirks, just like American ethnicities.

Places Around Beijing

During my two months in Beijing I was able to visit a plethora of sites around the city. Beijing is such an interesting city because of all the history it holds and the history that will still be made there. It is a bustling city that is full of contradictions; playgrounds next to dumps, skyscrapers next to slums. It is advanced, while still primitive. The city of Beijing showed me a different culture so important that its influences are felt worldwide.

Dr. Li, Lucy, Lucy Li, Ariel, Annie, Margaret and other grad students took turns taking me to different places around Beijing, so many places that I will choose to share only those I feel were the most important in this paper.

One of the first places I visited was the Forbidden City and Tiananmen Square. The Forbidden City's massiveness and history was fascinating, and because I had just arrived in Beijing I was still shocked at the massive amounts of people. So much of China's history took place at the Forbidden City, where the Emperor and his family lived and governed. We then travelled to Tiananmen Square, where so much of the modern government acts. The largeness of this square and knowing all of the history that happened there was impressive, but even more-so was the military presence there. China's government was really shown to me that day.

I was able to visit the Great Wall of China during my stay, which is one of the most impressive structures in the world. Climbing it truly showed me how mighty it is, and I still can not believe that it was built with no modern machinery but simply man power. Walking where Chinese soldiers had guarded their border for years was a very neat feeling. China's most well known attraction is the Great Wall, and in my opinion rightfully so; it showcases China's beauty



with its history and power and was a fantastic place to visit.

The place we visited the most was Olympic Park- it seemed like everywhere we went we ended up back at this impressive stretch of land where the 2008 Olympics were held. After trying to get in the Bird's Nest several times, Lucy's uncle invited us to a dinner at the Bird's Nest Restaurant, a new very prestigious dining center located inside of the building. That night we were even able to walk on the track of the Bird's Nest, where Olympic history happened. We also got to go into the Water Cube, which itself is an impressive and unique structure. The Olympic Park was truly an interesting place to visit and one that I will never forget.

The Summer Palace and Temple of Heaven were very interesting places to visit to me for their cultural and historic value. The Summer Palace is where the ruling family would go to relax, and its beauty was simply breathtaking. The gardens and pavilions were so beautiful, it takes visitors right back to when the Empresses would have strolled through them. The Temple of Heaven was beautiful and its spiritual significance interested me. The people of China would go to this temple to pray for different things, the most well-known being for good harvests. This belief in praying to their God's for help in their lives seemed very similar to America's religious



beliefs. These two sites showed me a lot about China's history and culture.

The most interesting place I visited during my stay in China was the China Cultural Museum and Park. This site had representations of all of China's 60 ethnic groups. The groups each had people in native dress and had native homes, some of them even showed ethnicity specific traditions. Each of them was so unique and fascinating in their own way that I could have spent days there. China has such a rich blend of cultures that it is unbelievable. Each of these different ethnicities has contributed something to the culture of China and has led it to the powerful country it is today.

CULTURE

China's Unique Culture

China's culture is very different from America's, and especially Iowa's. At many times I was homesick and simply wanted to find something familiar, like a home-cooked meal. But the experience of living in a completely different culture than your own was a life-changing experience that I will never forget. I was surprised by the people of China- though there are so many, most of them were friendly to me and tried to help out as best they could. The city of Beijing is so impressive, the amounts of cars and bicycles amazed me up until the day I left. People live on top of each other, and the city needs work. But effort is being put into developing Beijing, all of Beijing, into a functional, respectable city. Visiting this ancient but still finding-its-way city was an experience I will never regret.

CONCLUSION

What I Came Back With

I came into this internship not knowing what to expect but knowing that I did want to do everything in my power to continue Dr. Borlaug's legacy. Learning how to work with transgenic maize in a foreign country with foreign teachers was a difficult but rewarding experience and though our experiment was unsuccessful I feel as though I contributed to the war on hunger if even by a small margin. Working in the lab also assured me on the direction I want to go in my career, I enjoyed my work immensely and would love to find a job working in biotechnology. It showed me how advanced our agriculture is in the United States and how other countries are trying to match us so as to not be left behind in the agricultural field.

However, even more so than the lab work, I will take away from my internship a better understanding on how to be a citizen of the world. Living in China's unique culture showed me how different another country can be from your own, and that is a frightening feeling. But by the end of my internship I was no longer as intimidated by Beijing and felt like I could survive there fine. I learned from making friends at the lab and by seeing people everywhere that people are people no matter where they are from. Friendship holds importance no matter where you are and I am certain that my friendships with the grad students at CAU will continue long into the future. My experience at CAU in Beijing was one that changed me from a narrow-minded person to a person more open and willing to embrace new situations. My internship was a life changing experience that I will never forget.