

Hybrid Rice in Hunan China



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Looking down this list I feel nothing but complete gratitude with the knowledge that my internship would never have been a success without each person on the list. But I would also like to say thank you to the staff at CNHRRDC who probably seldom get the thanks they deserve. Thank you to the cooking staff who prepared meals for everyone at the center every day of the week; and the people working in the hotel who go out of their way daily to make all of our experiences more comfortable.

Introduction

I stared at the rice seedling in my hand. It looked fairly insignificant; like a blade of grass. I knew that the genetic make-up of this seedling through the help of science and the right growing conditions would produce more food than ever to help feed our growing world. I moved the rice seedling to my left hand to place it in the paddy at the China National Hybrid Rice Research & Development Center, realizing that I was more similar to that rice seedling than I had ever thought. Like that seedling, with the help of scientists and the right growing conditions I was on my way to complete my life's dream of using science to help feed the poor.

I have had a special interest in science since before I can remember. My mom has always encouraged me to never give up my dream of helping the world through science. She was the one who first read the newspaper article that changed my life. Norman Borlaug visited Minnesota, my home state to attend a meeting, and he had an article in the newspaper. My mom and I both look up to him as a hero, so she was quick to show me the article. It talked about Norman Borlaug's life achievements, but it also mentioned the things he was doing at the time, including the Youth Institute and Borlaug-Ruan internships. I immediately knew that I had to try to win one of these internships. Part of doing this would be writing a paper. After looking at the website, I found the topic was on using bio-fuel to fuel the world, which is something I was already extremely interested in! I was inspired to write a paper about using native Kenyan grasses as bio-fuel for Kenya. Even though writing the paper took up most of the little free time I had in the summer and after school, I loved doing the research on my topic. It really didn't feel like a sacrifice at all.

I attended the Youth Institute in 2007 thanks to Lisa Fleming, who accepted my paper despite the fact that I didn't send in the correct paper work on time. I could not believe that I had the opportunity to meet Norman Borlaug and other distinguished people in the field that I aspire to become a part of myself. It seemed almost too good to be true. The Youth Institute was a fantastic experience for me; I made a lot of new friends that were some of the brightest and most driven young people I have ever met. It was so encouraging to be surrounded by people who have similar goals and dreams as I do. I also learned so much, especially from the hunger banquet, which has had a lasting impression on me to this day.

Though the Youth Institute was a fantastic experience that I would not trade for the world, I still had my heart set on being a Borlaug-Ruan intern. Seeing the presentations of those who had done the internship the year before further cemented my already set mind. I started applying for the internship as soon as I got home. When I got the letter saying I made it to the interview stage I was so thrilled I could hardly stand it. After the interview, I got a letter in the mail saying that I would not be a Borlaug-Ruan intern that year. I was very disappointed, but hand written underneath the letter was a note from Ambassador Kenneth Quinn urging to try again next year. It did not take me long to decide I would apply again, one last time.

Once again I made it to the interview stage; I did not let myself get my hopes up like the last time, but after the interview, I was just as excited and anxious as I had been the year before. The time came for the letters to be received; I followed my mom out to the mail box every single day until she started answering my question before I asked it. At that point I told her to check it for me, though I still asked about it every day regardless. On Thursday, I had to go into my high school to give my science fair presentation to some teachers and my principal. My principal walked into my presentation a bit late, which was odd because she is usually so punctual. She smiled at me and told me that my mom had called her, and I should call her as soon as possible. I rushed through the presentation and started dialing as soon as the last question was answered. It was my mom on the phone. She told me that she got the letter. She was crying, and pretty soon I was too when I found out I got the internship! I would be spending two months of the summer at the China National Hybrid Rice Research and Development Center in Changsha, Hunan, China.

The China National Hybrid Rice Research and Development Center (CNHRRDC) was founded in 1984 by Professor Yuan Longping. Professor Yuan is commonly known as the “Father of Hybrid Rice” because he is the founder of hybrid rice. His name is known all over China because he is responsible for feeding millions, and increasing rice yields substantially. “The CNHRRDC has had three big target

yield goals. Right now, the third and final stage is to produce 13.5 tons per ha by 2012” (Yuan, Longping). This new rice variety will be called ‘super hybrid rice’. By the time this goal is reached, I am sure that new goals will have been set to improve rice yields once again.



Figure 1: Professor Yuan Longping and me

Rice with increased yields are an extremely important output of the center, but it also has many sectors focusing on disease prevention, water saving techniques, and many other areas that are related to rice production. Professor Yuan’s two main goals are to keep increasing the yields of hybrid rice by developing new varieties and to spread the knowledge of these new techniques and varieties across the entire world. When I lived at the center, saw both these goals continually being worked toward. I myself have done some work transplanting, starting seedlings and working with tissue cultures. While I did my small part, there were many people at the center who work tirelessly to achieve the target yield goal and many other goals as well. At the hotel I lived in, there is an international program that is fulfilling Professor Yuan’s second

goal. There were three different classes speaking English, French and Portuguese during my stay. People from countries all over the world came to learn about cultivating and implementing hybrid rice in their countries. I learned so much from these people, who soon became my friends, about world hunger and the impact hybrid rice is going to have in their countries.



Figure 2: Professor Yuan and Other Workers at CNHRRDC Working to Improve Efficiency in Planting Hybrid Rice.

Though I lived and did a little bit of work in the CNHRRDC, I actually spent the most time conducting my experiment at Yuan Longping Institute which is located about 500 meters from the center. This institute's main purpose is to test seed purity for seed companies and farmers all around China. Many rice seed companies have worked with this institute because of their extremely fast and efficient method of DNA extraction and PCR. The person I worked in close association to in the lab was Mr. Chen, who has been staff at the institute for the past 6 years. I have a huge interest in hybrid rice variety protection because, though it is not cultivating new varieties, it was a great way for me to make a difference and help the cause while I stayed there. I loved this work because it was applicable and can be used by CNHRRDC in the future which let me fulfill my personal goal, which was to help the center as much as I possibly could in achieving their goals.

Rice variety protection and seed purity was the program suggested to me because I would be able to complete a whole experiment in my two month stay. In many of the other fields, I would not have had the time to bring a project from start to finish or give them new and exciting data. Both these were things I was hoping to achieve, so this program seemed to fit me perfectly. Also, because of my prior knowledge of PCR from my intern experience at the University of Minnesota, I was very confident about the procedure and my capability in regards to this area of study. Though I had many supervisors and mentors throughout the experiment, I really appreciated that the project was my own. This meant that I was allowed to do the work myself, make my own mistakes and have my own successes. Having the freedom to do this made my experience in the lab a lot more enjoyable than it would have been otherwise. It was my responsibility to prepare the rice seedlings for DNA extraction, to put together and prepare the DNA for PCR. It was also my responsibility to load the PCR products for electrophoresis and retrieve the gel pictures.

My project may seem like it does not help with food security at first glance. However, if you look more carefully you can see this is not the case. Throughout my experience in China, I learned that food security is not just about the increasing the food itself. There is so much more to it than that. Every process from seed to final product is vital for food security. This process includes variety protection. Variety protection and seed purity are very important for the breeder, the company who creates these new seeds, and the farmers who are planting these seeds. If great care is not taken with seeds, entire fields could become less productive. This is a huge problem, especially with farmable land becoming scarcer and populations growing at an alarming rate. PCR and the use of SSR markers has been a very promising solution for keeping seed purity and also for variety protection. Both these things encourage companies and breeders to continue striving toward creating the most ideal super hybrid rice possible. If there is no property protection and anyone can “steal” varieties and take others work as their own, there would be huge problems. These problems would directly affect the security of rice in China and around the entire world.

I stared down at the rice seedling I just planted in the paddy below me. Living embodiments we both were for the quest to end world hunger. The rice seedling and I are continuing links in the chain started by men like Dr. Norman Borlaug and Yuan Long Ping to help feed all who live on the earth.

Identification of Super Hybrid Rice variety Guangzhan 635/1128 Using SSR Molecular Markers

Statement of Purpose

Rice is a staple food that feeds more than half of the world's population. Rice is an especially vital food in China because it makes up about 40 percent of the total caloric intake of people there (Shi-Hua Cheng, Jie-Yun Zhuang, Progress in Research and Development on Hybrid Rice: A Super-domesticated). World population growth is about 2 percent a year. This means that the world population will double in only forty years. Norman Borlaug has stated that "food is a moral right of all who are born into the world," and hybrid rice has become a very promising way to feed the people of the great nation of China and the world. Fifteen million hectares, about half of China's total rice areas, are now under hybrid rice cultivation. Hybrid rice has increased the national average rice yields from 3.5 to 6.2 tons/ha (Tran, Dat, Hybrid Rice for Food Security). Scientific research in biotechnology to increase yields and sharing this knowledge with countries around the world is a huge step in feeding the world. The current goal is a yield target of 13.5 tons per ha by 2012 (Yuan, Longping). If this goal is achieved, it would help to alleviate hunger around the world.



Figure 3: Hybrid Rice in an Experimental Field of CNHRRDC

With all these new varieties being created and researched, there needs to be a quick and easy way to check for seed purity, which should be 95% or higher to insure optimum yield. There also needs to be a way to distinguish and protect these new varieties. China has huge problems with ideas and rice varieties being stolen. My project will help to protect a specific new and very promising super hybrid rice variety. I will be using SSR (simple sequence repeat) markers to identify and distinguish this new variety separate from its parents and other rice varieties. This information will be used for property protection. Once I find the primer that best distinguishes this variety, it can be used from then on to test seed purity, which is vital when seed is being used on a large scale setting.

Hypothesis

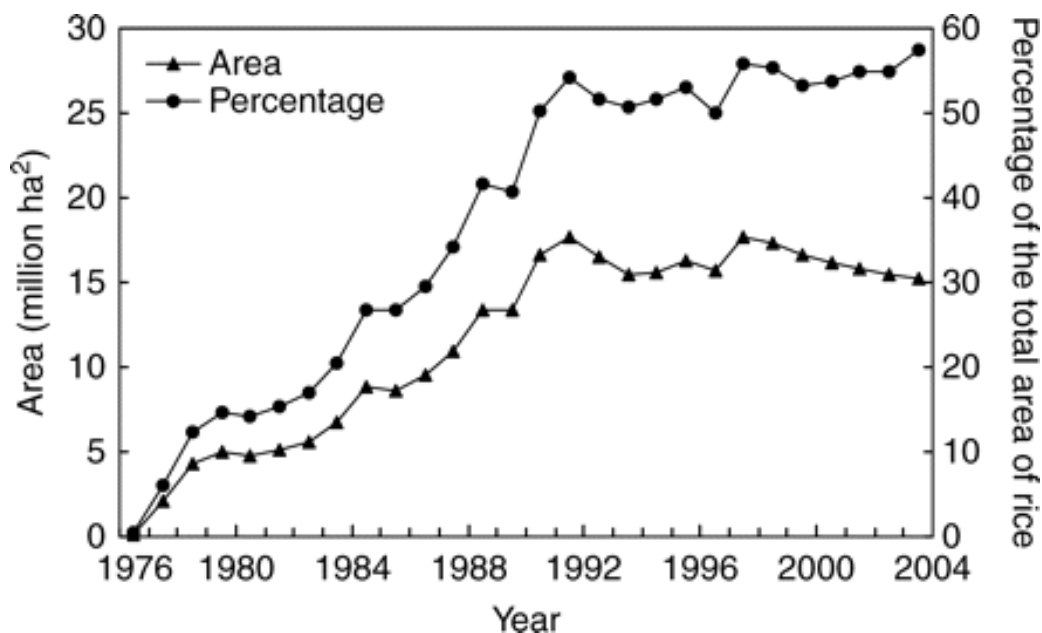
Different primers will amplify different portions of DNA, and the gel will show approximately how many base pairs were in the amplified section for each variety. What I am looking for is a PCR picture that shows the polymorphism of this new hybrid variety. The

picture should differentiate the parents and the other chosen varieties from the new hybrid variety. By looking at the picture, I should be able to easily identify this new variety. It should have a double band where the other varieties should only have a single one. Also, each parent should match up with one of the new varieties band. A good result will help to protect and to ensure the purity of this new super hybrid strain. The success of this project will help to protect hybrid varieties, which, in turn, are helping to feed a hungry world.

Research

Feeding the World

Feeding the world is becoming a larger and larger problem as the years go by. “Rice (*Oryza sativa* L.) is one of the most important food crops in the world. It is the main staple food for heavily populated Asian countries as well as many African countries in which overpopulation is becoming a critical issue” (Yamamoto, Toshio. *Towards the Understanding of Complex Traits in Rice: Substantially or Superficially?*). For this reason, rice research is quickly becoming one of the most popular and essential crops to study. Rice research has become a very exciting and fast-changing field ever since the implementation of hybrid rice, which increased the crop yield in rice fields exponentially. Hybrid rice techniques were discovered by Professor Yuan Longping and started being used commercially in 1976. Ever since this discovery, new varieties are constantly being bred to increase both quality and quantity. Thanks to continuing research, hybrid rice has increased the amount of rice China, and other countries around the world have been able to harvest on a large scale.



(Progress in Research and Development on Hybrid Rice: A Super-domesticate in China)

China's Food Security

China is the most populated country in the world; it has over 1.3 billion people. It is also the third largest country in the world. Population is still on the rise, despite the strict government population control. Food security is becoming a larger and larger issue, as China begins to make the transition from being a rural farming country to a hugely industrial one. Because of the cheap labor available in China, many companies have flooded in to save money on production. China's economy is booming, but the amount of people left on the farms has diminished substantially. There is very little money involved in farming today. People continue to flood into the city to make a better life for themselves and their families. The fact is, there is less farm land, more people to feed and less farmers to produce this food. Using science is a great way to continue to feed the growing populations all over the world. Hybrid rice technology has greatly improved food stability, and it will continue to do so.

China Property Protection

New varieties of rice create new solutions and progress toward the ultimate goal of feeding the world. "A major challenge in this technology, however, resides in the development of methodology" (Yamamoto, Toshio, *Towards the Understanding of Complex Traits in Rice: Substantially or Superficially?*). Since so many new varieties are being created and modified, methodology is becoming more and more essential. Though new varieties are hugely advantageous, keeping the old intact and well documented is extremely important as well. "8 types of CMS have been used commercially for rice production" (*Progress in Research and Development on Hybrid Rice: A Super-domesticated in China*). To keep the parent lines of these varieties intact is important in order to guard the future of rice production and allow for new rice variety discovery, which will continue to increase quality and yield substantially over time.

What is Hybrid Rice?

"Hybrid rice breeding is based on using cytoplasmic male sterility (CMS) or photo-thermo genetic male sterility (P-TGMS). This uses 3 lines (CMS line, CMS maintainer, CMS restorer). Hybrid rice has yield advantage of 10-20% over conventional varieties" (Cheng, Shi-Hua, *Progress in Research and Development on Hybrid Rice: A Super-domesticated in China*). These techniques have revolutionized the rice production industry by increasing yields and adding many new facets to research. "New male sterile germplasm and inter-subspecies (*indica* x *japonica*) crosses were used to broaden the genetic base of parental lines. During the last decade, great attention has been paid to broaden the genetic diversity of hybrid rice" (Cheng, Shi-Hua, *Progress in Research and Development on Hybrid Rice: A Super-domesticated in China*).

With new possibilities come new challenges. Because the variety and potential for new rice hybrids are increasing rapidly, protection of the parental lines and of each new variety are increasingly important in this field of research. Though this field is changing rapidly, there is still much more to be discovered about the genetics of rice, and the science behind the changes

being made to increase yields in hybrid varieties. “Genetic control of quantitative traits like crop yield is poorly understood” (Yamamoto, Toshio, *Towards the Understanding of Complex Traits in Rice: Substantially or Superficially?*). The more understanding a scientist has for the simple ramifications of each change, the more they can manipulate rice genetics to get the ideal result. “Rice breeding is based on information derived from various quantitative trait loci (QTL). QTL’s can be organized into 9 categories containing 237 characters. QTL’s and associated with other complex traits have given crucial information to the understanding of natural variation. Traits like high yield performance and stress tolerance are controlled by minor QTL” (Yamamoto, Toshio, *Towards the Understanding of Complex Traits in Rice: Substantially or Superficially?*). QTL’s give vital information, and are very important when working with rice genetics. Once the base of fundamental information about rice genetics is understood, that is when true progress can be made and positive results can be anticipated.

Hybrid Rice History

Rice is a very important staple food crop. “Hybrid rice has yield advantage of 10-20% over conventional varieties” (Cheng, Shi-Hua, *Progress in Research and Development on Hybrid Rice: A Super-domesticated in China*). This increase has caused over 50% of farmers in China to grow hybrid rice, and this number is continually increasing. Throughout the world changes are being made to increase farm productivity. Hybrid rice is the leading and most effective innovation that has brought about a rapid change and increase in rice production. “With development of indica inclined and japonica inclined parental lines; new hybrid rice with super high yield potential have been developed” (Cheng, Shi-Hua, *Progress in Research and Development on Hybrid Rice: A Super-domesticated in China*). Professor Yuan Longping was the original creator of hybrid rice which has made him a hero throughout all of China. He has saved countless lives through his work and continues to work to bring about changes to improve the lives of the people of China and those around the world as well, through international programs that teach people about hybrid rice cultivation. Though the history of hybrid rice has been a short one of about 30 years, the changes and innovations it has brought about are significant and continually growing.

Materials list

9 selected rice seedling varieties
 Microwell plates
 Silicon Microwell plate covers
 Scissors
 Pen
 Permanent marker
 Notebook
 Buffer solution 1
 Buffers solution 2
 Freezer
 Icebox
 Pan

Water
 Deionized water
 Hot plate (Electric Magnetic Cooker)
 Ice tray
 96 various primers
 dNTP
 Taq polymerase
 10x Buffer
 Distilled water
 PCR machine
 4% agarose gel
 Gel mold
 Electrophoresis machine
 1x TAE
 BIORAD gel imaging system

Procedure

This experiment will be conducted using PCR. 48 primers were selected and 9 varieties (1 hybrid, 2 parents, 2 relatives and 4 non related rice varieties) were tested with each of these primers. After trial 1, I will assess which primers were promising for identifying this strain. From there I will conduct trial 2 and 3.

DNA Extraction

1. Cut up rice leaf sample into small pieces in a 1.5ml tube until it is about half way full.
2. Turn on the heater with a pot of water on top and wait until it boils.
3. Then add 500ul of solution 1 into the tube.
4. Place the tube into the boiling water for 30 seconds.
5. Take the tube out of the water, then add 750ul of solution 2 (the numbers for the amount of solution do not matter as long as the ratio of **2** solution 1 **to** **3** solution 2 is maintained)
6. Place the tube into the boiling water again, this time for exactly 120 seconds.
7. Put the samples on ice. The DNA will then be extracted and ready for PCR.

PCR

Here is a list of ingredients; listed in the order they should be added to the tube. To increase accuracy, the master mix and primer for all 9 samples will be added together then added to the 96 microwell plate.

1	Tube	12	Tubes
10x Buffer	2ul	24ul	

dNTP(2Mm)	1ul	12ul
Taq gold (2.5U)	0.24ul	2.88ul
Primer(5uM)	0.8ul	9.6ul
Water	13.96ul	167.52

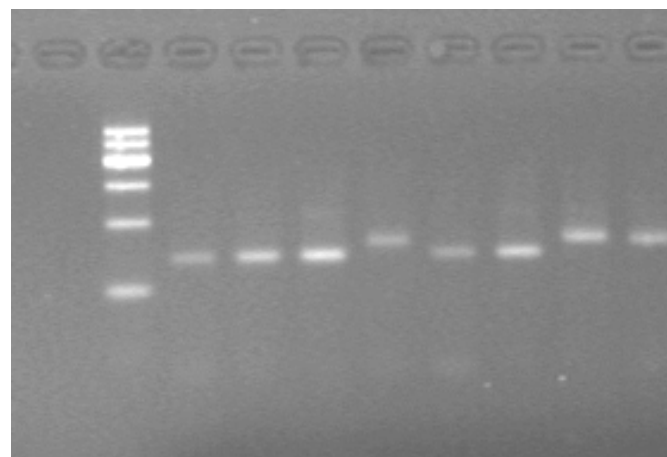
1. Combine all these ingredients together, in this order in a 0.5ml tube. Vortex this tube. The entire procedure should be done on an ice tray to insure that Taq, which extremely temperature sensitive, will not get too warm.
2. In a 96 well plate add 2ul of the DNA. The sample should be the same down the line of the plate. There are 8 lines, which means 8 primers can be tested on each plate.
3. Once the plate is filled, secure a latex cover which seals each well closed. The samples are then ready to be put into the PCR machine.
4. Open the lid and place the 96 microwell plate inside. Then securely close the lid.
5. The cycle goes as follows: 94 degrees C for 4 minutes, then 35 cycles of 94 degrees for 15 seconds, 55 degrees C for 15 seconds, and 72 degrees C for 30 seconds. The final step is 5 minutes at 72 degrees C.

Gel Electrophoresis

1. Prepare a 4% agarose gel with ethidium bromide. Place the gel into the electrophoresis machine using gloves.
2. Fill the tub with 1x TAE buffer high enough so as to cover the agarose gel.
3. Add loading dye to each of the samples in the 96 microwell plate.
4. Load 5ul of ladder, and then add 16ul of sample into each of the wells leaving 3 spaces in between each new primer on the gel. Generally 2 primers can fit on 1 gel.
5. Put on the lid of the electrophoresis machine, then run the gel at 130 volts for 30 to 45 minutes. The gel will then be ready to have a picture taken.
6. Take the gel out of the electrophoresis machine using gloves, and bring it to the BIORAD gel imaging system which contains a camera and UV light.
7. Take the picture which will be projected on the computer screen.

Observations and Results

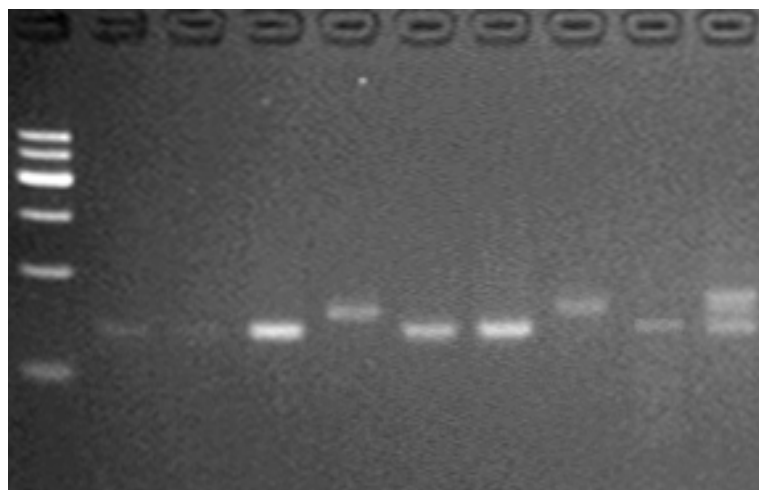
Below are gel pictures for the 4 successful SSR markers. I ran each successful primer 3 times. All 3 trials are shown one after another.



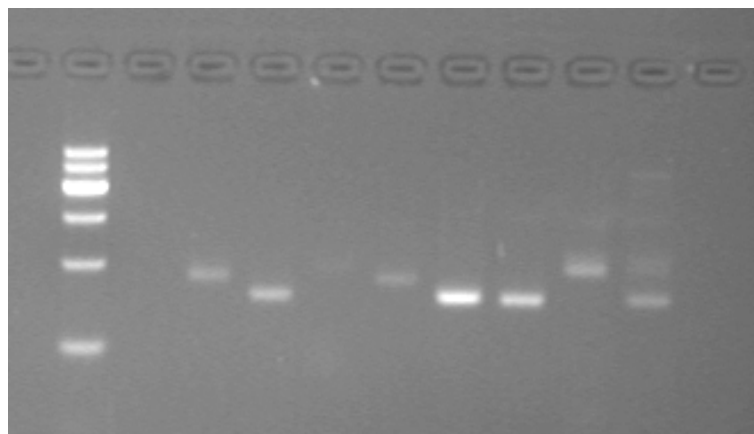
RM110 Trial 1



RM110 Trial 2



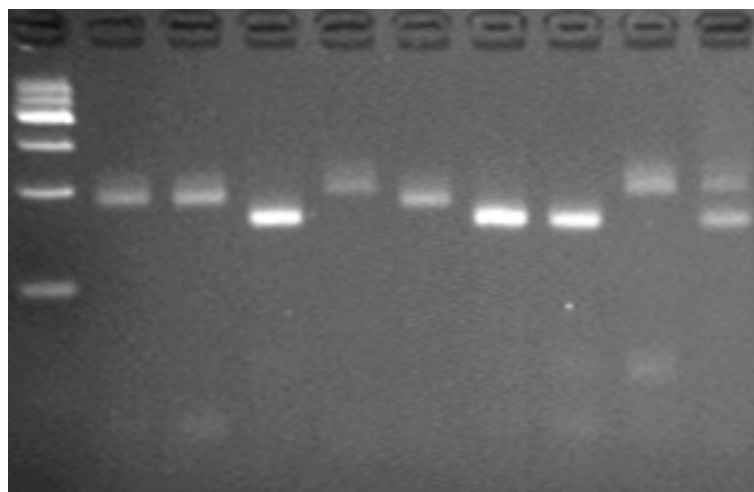
RM110 Trial 3



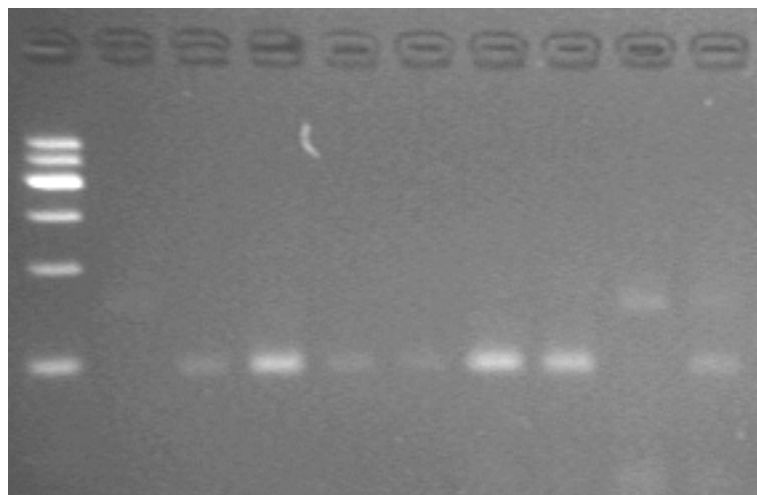
RM263 Trial 1



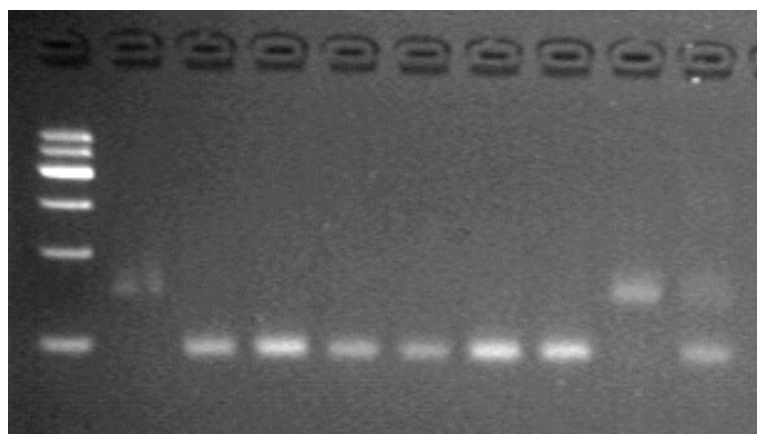
RM263 Trial 2



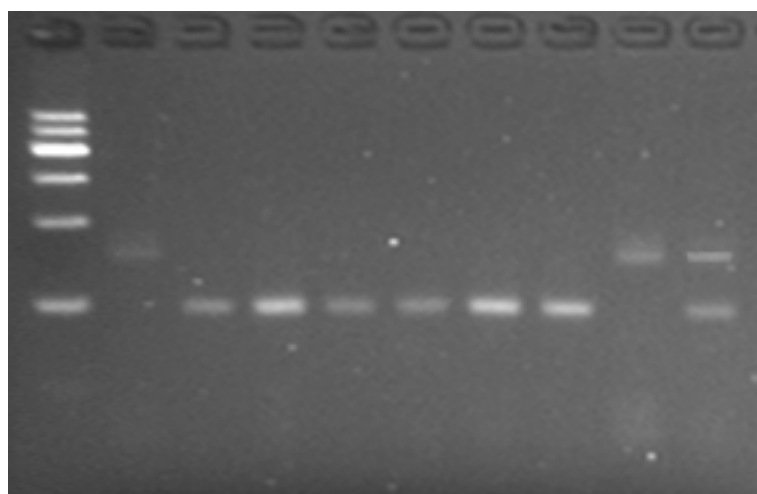
RM263 Trial 3



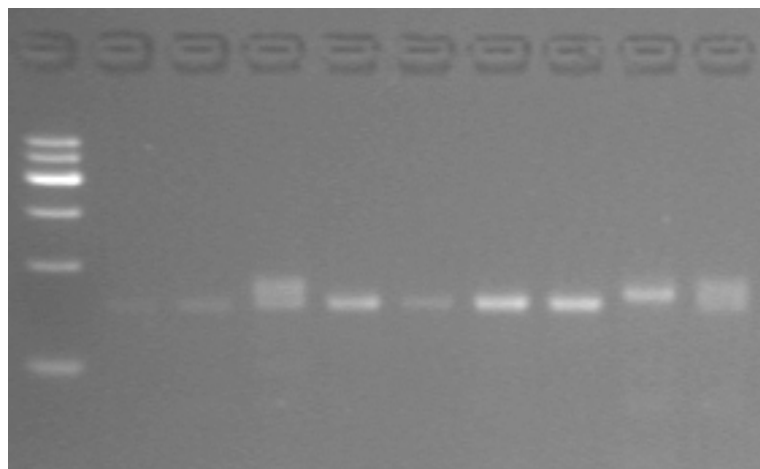
RM276 Trial 1



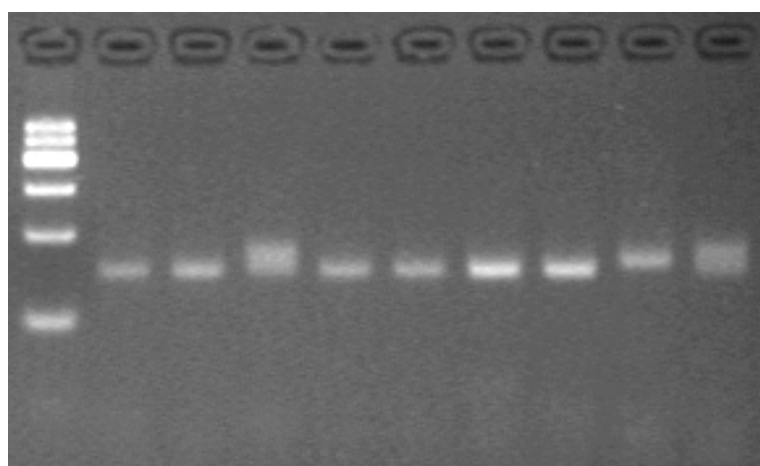
RM276 Trial 2



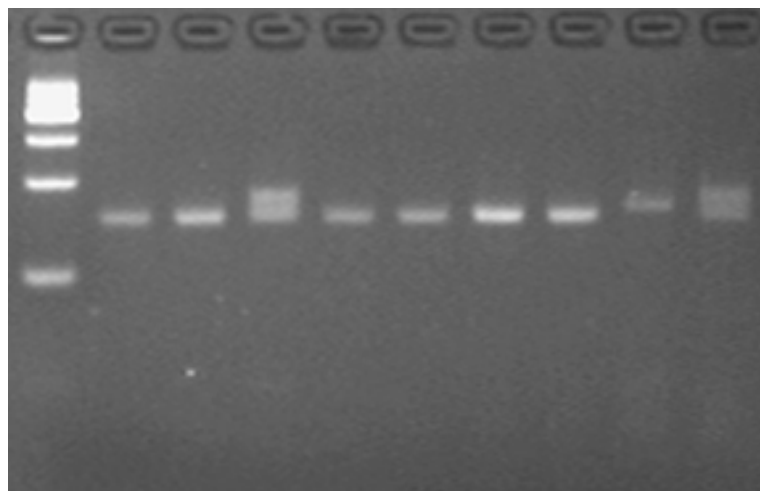
RM276 Trial 3



RM297 Trial 1



RM297 Trial 2



RM297 Trail 3

Conclusion

In the end, after using many different primers and combinations, I finally found some primers that showed polymorphism for this new rice variety. RM110, RM263, RM276 and RM297 all show polymorphism for the new hybrid variety. Because four primers were found that differentiate the hybrid from the other varieties, scientists will have the flexibility to use any one they choose. However, I would suggest they use RM110 or RM276 to identify this variety because they both showed up the most clearly in all three trials, and they also don't have excess bars to distract the purpose of the picture

Experiences of People and Culture

My two month internship at the China National Hybrid Rice Research and Development Center was life changing; through culture, research and new friendships. I learned not only about the fantastic people of China but myself as well.

Chinese Culture

When my plane landed in the Beijing airport, it was not what I had expected. Of course it was huge, but I soon found it was not the building, or even the language that came as a shock to me while walking through the airport. It was the culture that was so clearly and drastically different that made it clear to me that I was far from home. For example, a woman working in the airport spotted me and started talking to me in Chinese, pointing at my hair, then at the water machine (which is like a high tech version of a drinking fountain). She smiled and talked, then filled up a cup of water for me. Even though I didn't understand a single word she said, I could hear the kindness and concern in her voice; something I had never experienced at an airport before in my life. I continued walking until I got to a long line that was formed in order for the health inspectors to check us for H1N1. Our temperatures were already checked before we even got off the plane, but every precaution was being taken. There were sensors monitoring for H1N1 throughout the airport and about half of the Chinese people on the plane were wearing masks. I was very lucky I did not get quarantined because several of the other interns in China were.

Finally I arrived in Changsha my destination, the last stop. I was heading to pick up my luggage when two girls in front of me looked back. One of the girls said, "My friend thinks you are very pretty, will you take a picture with us?" I had to laugh. I had just been traveling for the past 24 hours; let's just say it was not a shining moment for me. Still, I was eager to meet new people, so I agreed. After they took at least 10 pictures of me with various people from their group, they then walked with me to pick up my luggage. We chatted about this and that. One of the girls asked me if I have skype and a phone number saying, "If there is anything you need help with or if you have any questions at all please contact me!" She wrote down all her contact

information on a small piece of paper, then the group wished me goodbye. From that time on, many other people from the center did the same thing. Everyone seemed so ready to help me, which was very comforting in a land where everything was foreign.



Figure 4: Meeting New People at the Changsha Airport.

I was very well taken care of at the International Student Center, which was located inside of the China National Hybrid Rice Research and Development Center. People living there usually just referred to it as “The Center”. I had a room all to myself, that reminded me of a regular motel room found in the United States. I loved my “real” toilet and didn’t like the mosquitoes who were pests I could never seem to get rid of. I guess it’s the price to pay for such beautiful weather all year round. Even so, after applying about 20 squirt of bug spray every day, I did have hopes for a little bit better results.

Chinese culture is very similar to American culture in many ways, but one thing that Chinese people do very well is hospitality. People would walk up to me on the street on a regular basis just to welcome me to China. Whenever anyone took me out, they treated me like an honored guest. Not letting me pay became a common theme; no matter how much I offered and tried to convince them to let me pay, they did not budge. I appreciated their kind generosity so much; I hope to extend the same kindness to those around me.

One of my favorite places to go was the market, which had a lot of different foods that I was not used to seeing. The atmosphere was bustling and rather pushy, but the food looked delicious and fresh; all except for the live frogs, snakes and piles of pig fat. The food in general was very good. I got to try a lot of new things. Even though it was quite spicy, it was also extremely flavorful. The only thing I really missed from home was raw vegetables; all the vegetables I ate in China were either fried or boiled in some type of sauce. In fact, almost everything I ate was fried, steamed or boiled in a sauce, including all meat and bread. Steamed bread is something I had never had before I went to China, but I have been missing it ever since. They also had delicious noodles, which are incomparable to any noodles I have found here in the United States. Chinese people eat almost every type of meat you can imagine. They have different ways of preparing things that Americans would generally not consider food. With animals like chickens and cows, little is wasted. They eat almost every part. While in China, I tried chicken feet, snake, the small intestines of a cow, pig blood, and turtle just to name a few. They were all very delicious. I rarely disliked anything set in front of me unless it was too spicy.

I did try to build up a tolerance to hot peppers, but I do not think they are an acquired taste. My eyes continuously watered every single time.

It was not just the food in China that was so different from home; the style in which they ate food was drastically different. I learned to use chop sticks very quickly after I arrived in China because many dishes were put on a lazy susan in the center of the table. I had to be quick to snatch up the food that wasn't swimming in a sea of hot peppers. It was a challenge to find non-spicy foods in a nice restaurant because to them, the spicier the food the better. Instead of a big room with many tables, usually nice restaurants would have separate rooms for each customer. Also, after everyone was finished eating, the food would be left behind. It was extremely wasteful, but it's a tradition that used to show class and is still used today. When I attended family gatherings, food was not wasted this way in general, but for business dinners I would often see entire dishes left untouched.

Communication was a huge barrier, for the duration of the trip. On my return home, it felt so strange to be able to understand what the person next to me was saying. Most people knew a few words in English, but I only spoke with four people who spoke English fluently. Many educated people knew a lot of English vocabulary, even if they felt uncomfortable speaking it. There are standardized English tests that every student has to pass into order to pass high school, college and even to get into graduate school. Some brave people were very excited to practice English with me. Even so, I quickly learned to take full advantage of other forms of communication. Gestures, body language, especially facial expressions became my biggest opening into the minds of many people I met. I lost track of the amount of times they told me that I need to learn Chinese and quick! I do not think they realized how hard this language was for me to learn. All the words meshed together into a big sticky blob, and I seemed to forget words as soon as I finished saying them. I did pick up on a number of essential phrases, and people were constantly surprised by how much I understood despite the language barrier.

I have to mention the driving in Changsha briefly because it was shockingly different than driving in the United States. The drivers drove with one hand on the horn at all times. I tried to count the number of times one driver would honk his horn in a trip, but I lost count after 40. He honked at cars, motorcycles, mopeds, busses and even pedestrians! I spent several Saturday afternoons walking and riding around Changsha, which is the capitol of Hunan province and only a 20 minute drive from the center. It takes about an hour by bus; still it is very worth it because it costs only 2 Yuan (1 dollar= 6.8 Yuan). The bus system was very convenient and very cheap. However, it could be quite dangerous at times. I was once standing the front of a crowded bus and in just one trip we ran two red lights, cut off at least 15 motorcycles and vehicles, went over 80 mph, and almost hit a pedestrian. Needless to say my mom would have had a heart attack.

One thing that I noticed about the Chinese culture that I really treasured was how connected to the past they were. China has a deep, rich history and many traditions. I never really thought about how new everything in the United States was until I went to China where history has been preserved for thousands of years. Our nation is so young and diverse. I never had experienced a culture where people all share the same history and traditions. While touring around Hunan, I quickly learned that every landmark had a story behind it. This was the true reason I found sightseeing so fascinating. Just by the stories I was told, I could tell you so much about what is important to the people of China. The most important thing is family. Each family only has one child, so extended family such as grandparents and cousins often live together. I would often be confused when someone told me about their sister or brother because they had none, I soon learned what they really meant was cousin. Close friends were also commonly called brother and included as part of the family. Where I lived, elders were a very well respected part of society, as I believe they should be. Grandparents lived with their children, my friend Jane's grandmother is 90 years old and still lives a happy life with her family. I hope my Grandparents can call my home, their home when the time comes that they need assistance in everyday living.



Figure 5: Zhang Jia Jie, Maiden and Guardian of the Water

I am an avid learner, and spend much of my time studying. This is what every student I met in China was like. They all seemed to take their education very seriously, but they also balanced school with family, exercise and personal health. I learned a lot about what it means to be well rounded during my stay. I tend to get so carried away with the immediate stresses in life; things like homework, deadlines and social obligations. I sometimes would never stop to catch up on sleep or work some physical activity into my day. Many of the workers at the center were masters at balancing all four aspects, and while I stayed in China, I began to pick up on these habits.

I worked in the laboratory every weekday from about 9 to 5:30, but in the noon time everyone would go home and take an hour rest. It was very hard for me to get used to this at first. I was always itching to get back to work, but that is not the Chinese way. Even in high school, students would take naps at noon. And though I never could get used to it, I believe it really did improve the health and stress levels of the people there. I soon started to get enough sleep and exercise. I have become a more balanced person because of this internship.

Forming Friendships

While I was in China I met many new people. One place where I met students was at the Hunan Agricultural University, which was very close to the center. I visited an English class early in my stay. The classroom was large, but not as huge as I imagined it would be. The students seemed very similar to those in my classes at home. The teacher wanted me to speak to the students, saying I could ask and answer any question I wanted too. The students asked me questions about myself, my family, and the culture in America. They all seemed very interested to hear everything I had to say even though the teacher had to translate most of what I said, so the students could understand. One of the most surprising things I learned there was parents pick their child's major. They were all shocked when I told them I decided for myself and that my parents are happy with whatever I choose. Afterwards many students flocked around me; I am the only American most of them had ever spoken too. Hunan does not get many foreigners, so Caucasians stick out like a sore thumb. I was very pleasantly surprised with the way others received me. I didn't get a single angry look. Most people were curious about me and very friendly. Many people who spoke a little English would start conversations with me; I have never made friends so quickly in my entire life.



Figure 6: After Class with Students from the Hunan Agricultural University



Figure 7: Some of my Friends from the Center at a Local Convenience Store

The place where I lived had a large number of people from Africa. There were three different classes studying at the center during my stay: English, Portuguese and French. These classes were taught to help these people develop hybrid rice in their native countries. I very much appreciated a little diversity. I was the only Caucasian person, by far the youngest, and one of few females in the program. Needless to say, I stood out quite a bit. People were very friendly and welcoming. They asked many questions and were very caring towards me. It was fun to be able to learn about so many different cultures from all

around the world in one place. I had some great conversations with people from Sri Lanka, Bangladesh, Vietnam and the Congo. I learned so much from the people at the center. Some became mother and father figures, others brother and sister figures. All of them had a lot of knowledge and real life experiences. Learning about all the different countries these people came from and seeing how passionate about helping to relieve world hunger they were inspirational and really great to be around.

Many people at the center were very athletic, no matter what age they are. This is one thing lacking in the United States. Many older people I know will no longer join in the games, but here they play more than young people do. This made it very hard for me to tell how old people are. I do not feel too bad though, because many people here had problems figuring out my age and where I came from as well. Actually, I was asked if am from

Russia at least a dozen times, and people guessed that I was anywhere between 18 and 25 years old. I got very involved in everyday life at the center. After my work day, I would swim, play volleyball with Professor Yuan and many others, or play badminton with my friend Jane. We would play doubles with several others till dinner on a regular basis because the badminton court was conveniently

located inside the office building in the center.



**Figure 8: Top: Volleyball in the Center
Bottom: Badminton Players**



Figure 9: Jane and me Eating Squid and Pork at Hunan Agriculture University

I met some very memorable people during my internship, but none were more memorable than Jane. Jane lives in the center with her parents who both work for the CNHRRDC. Her goal is to attend graduate school in the United States. She was very happy to speak English with me, and she had an extremely extensive vocabulary. From the time I arrived, she took me to different places all around Changsha. Her family treated me like their other daughter. They showed a lot of kindness by including me in all of their family activities. For the whole second month I was in China, I spent most evenings at Jane's house. She was very busy studying for the TOEFL exam, and I had to keep up on my blog, e-mails to my family and Lisa, and starting to write my World Food Prize

paper. We had a great set-up in Jane's room complete with rose tea, watermelon and an air conditioner. Though there was a computer room at the center, it was only open at very specific times, and the internet would crash quite regularly for varying amounts of time. Sometimes it would go out for just an hour, other times it wouldn't come back on for five days. Jane's internet was far more consistent, which was very helpful when I needed to correspond with people back home. The poor girl ended up translating for me quite often. She helped me to understand the people who wanted to have a conversation with me but didn't know enough English to do so. When someone said something, I would tell her what I thought they said. She would then tell me what they actually said. It was very fun because as time went on, I got better and better at guessing. She became one of my best friends. I learned more about Chinese culture from her than almost anyone else. She took me to a lot of different restaurants, shops and landmarks around Changsha and the center.



Figure 10: My Chinese Family.

Research

During my stay, I got to hear a speech given by Professor Yuan (the Father of Hybrid Rice). He talked about the improvements hybrid rice has brought about around the world. He also spoke of his life mission, which is simply to help feed the world through the continual improvement of hybrid rice; through breeding and other methods. I feel so blessed to have met amazing people such as Norman Borlaug and Yuan Longping in my young life. They are so hugely inspirational. I will always look up to them, and try to follow their example as I go about choosing my future career, and life mission. They are brilliant; they worked very hard and are passionate about helping others. Though their success is huge, they never became corrupted or selfish because of their fame. The world would be a much better place if more people lived like they do.



Figure 11: Transplanting Hybrid Rice into an Experimental Field

While in China, I got a very small taste of what a rural rice farmer in China does. I spent the morning planting different varieties of seedlings in groups of 100. Rice is grown in about 2 feet of muck. I started out wearing boots but because they did not carry my size at the market, within the first 5 minutes my boots were so stuck in the muck I could not move a single inch. So, I ditched the boots and went bare-foot, which was not so bad after all. I could then move more freely. The seedlings were surprisingly easy to plant, though it really was back breaking work, bending and reaching to slide them into the loose muck. I really enjoyed the experience. Afterward, I was covered in muck, but I felt like I accomplished something and that I helped in a small way, which was a very good feeling. Even though I think the feeling was even better after I had the chance to shower off! I feel like I can sympathize much more with the hard work Chinese farmers do after this firsthand experience.

Working in the laboratory, I started out being very closely supervised. It took a while before I got all the independence I was looking for. When this happened, I felt very accomplished and proud. The procedure of PCR was very familiar to me thanks to my work at the University of Minnesota the previous year. It was really interesting to compare and contrast the two labs; though the procedure was basically identical they had totally different styles of doing things. The only thing that didn't change at all was the friendly nature I found in both labs, which I was extremely grateful for.



Figure 12: Mr. Chen my Supervisor and me

Since I was extremely familiar with the PCR process before I arrived, I was very confident I would breeze through my first day, no problem. However, this was not the case. I made two huge mistakes right away in the morning. Both were extremely obvious and even more so embarrassing! The first mistake I made was not adjusting the pipette when adding primers and the second was adding the master mix in the wrong sequence. Even though I messed up big time, my mentor and the other lab workers were kind and understanding. It was hard to admit my mistakes, which I realized I was making about half way through both times. I was so concerned they would watch me like hawks after I messed up a run. I was paranoid for the next hour or so. Yet instead, when I



Figure 13: Working in the Laboratory

asked for confirmation my mentor just said “trust yourself; you will not mess up again”. That made me feel much better, and I did not mess up again; at least not for the rest of the day. I did learn a lesson that day though. I learned that there was always room for improvement and that mistakes happen. What was most important was learning from them and that was what I did. My goal was simply to perform just a little better every day I worked. I slowly became quicker and more efficient at the work I was doing, which made working very gratifying.

Conclusion

I have wanted to use science to help with world hunger issues since fifth grade. As a senior, I am seeking to get my degree in international agriculture or applied plant science. My internship in China and the World Food Prize has really helped to cement my dreams, making them seem more feasible than they ever had before. I have acknowledgements, but I do not know if they really show how grateful I am to have had this opportunity. I got to see a whole new culture, and experience something I never would have been able to have without this organization. This internship almost felt surreal because I cannot think of a single other way I would have wanted to spend this summer.

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