



From

Iowa



to



India



Hannah McAtee
2011 World Food Prize Borlaug-Ruan International Intern
Maharashtra Hybrid Seeds Company Limited
Mahyco Research Center
Dawalwadi, Jalna, Maharashtra State, India

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Personal Background

I am Hannah McAtee from Davenport, Iowa. I am a 2011 graduate of Davenport Central High School, and now a freshman at Arizona State University in Tempe, Arizona. I am a member of the Barrett Honors College at ASU, majoring in Global Health and Pre-Medicine. My dream job would be a pediatrician for Doctors Without Borders, and I recently had a life-changing experience that put me one step closer to that goal. I worked as a Borlaug-Ruan International Intern at Maharashtra Hybrid Seeds Company Limited in Dawalwadi, India for eight weeks. If not for the World Food Prize, I would never have had this incredible opportunity.

I first heard about the World Food Prize in the Spring of 2010, when my high school journalism teacher, Deb Buttleman Malcolm, told me about the Global Youth Institute in Des Moines. After writing a letter of intent to attend the Global Youth Institute, I was chosen to represent Davenport Central High School in October of 2010. In preparation for my attendance at the Global Youth Institute, I researched and wrote a paper on the problems faced by small farmers in rural Columbia. I enjoyed attending the Global Youth Institute and meeting people from all over the world who share a common goal of fighting world hunger. On the last day of the Institute, the students met in small groups to present and discuss our papers. I was interested to learn that many of the problems I had found in Colombia were also occurring in Sierra Leon, Kenya, Mexico, and other places around the world. This showed me how truly important the fight against hunger is, and how we must work together to develop ways to do something about it.

Another important aspect of the Institute was meeting with previous Borlaug-Ruan International Interns and hearing their amazing stories. I was so surprised and encouraged to hear that these high school students had researched among leading scientists and policymakers in hands-on experiences around the world. After attending the Institute and talking it over with my parents, I was so excited to apply for the chance to have a similar experience.

Going through the application and interview process was stressful for me, especially during the busiest time of my senior year. However, it all went well, which assured me that a BR Internship was a good fit for me. Throughout the entire process, Ambassador Quinn, Lisa Fleming, and the entire World Food Prize Staff were very supportive and open to answer any questions my family or I had. I did not have a preference as to where my internship (should I be lucky enough to receive one) would be. I only requested that my work have some connection to the medical field, as that is what I am planning to study in the future.

I was so excited to get the email from Lisa Fleming in April, with an attachment that said "Hannah McAtee's Letter". I excitedly opened the attachment, skimmed the letter, and found out that I would be spending the summer in India! I knew that I would be exposed to so many new experiences

during my internship, and I could not wait to pack my bags and head to Asia. I also knew I would miss my family and friends, but Lisa's advice to Skype, blog and take many pictures and videos helped a great deal. It was comforting to know that I would be able to keep in touch with people back home throughout the duration of my internship.

After graduating high school, I had just one week to prepare for my two month internship. I spoke with people who had visited India before, and even met with Lisa Cathelyn, a 2008 BR Intern who worked at the M.S. Swaminathan Foundation in Chennai, India. These meetings taught me to be cautious of the food and water I would consume, as well as safety tips for being a young visitor to a foreign country. But the general consensus was that nothing could truly prepare me for India; that I would see things I had never seen before, have experiences I had never had before, and eat things I had never eaten before.

With these thoughts in mind, and with my anti-malarial pills in tow, I set off on the 50-hour journey to Dawalwadi, India. My first flight was a 45-minute flight from Moline, IL to Chicago. I had mixed feelings on this flight: I was excited to experience a new culture and learn as much as I could, but I also knew that I would miss my life back home. Thankfully, I happened to sit next to a foreign exchange student from Israel on this flight. She was returning to her hometown after a year in the United States. She helped comfort me by telling me that the traveling is the hardest part: that once I reached India, I would become so immersed in my surroundings that it would be hard to return home in just two short months.

From Chicago, I had a 15-hour flight to New Delhi, India. I tried to sleep and relax as much as possible, while getting up every three hours or so to walk around and stretch. Immediately upon landing in New Delhi, a wave of heat came over me. I knew that it would be difficult to wear long pants in this climate, but I was ready to make the sacrifice if it meant fitting in with the Indian way of life. Because my flight to Aurangabad was not for another 24 hours, a driver came to pick me up and take me to the Sehgal Foundation for the night. While there, I met a very nice woman named Satoko, who is working at the Institute and staying in the guest house. We had a wonderful conversation and she wished me well on my journey. One thing she told me particularly stood out, and I have seen it become true in so many ways during my time in India. She said, "I hope you find an angel to help you on your trip." I don't know how Satoko knew it would happen, but every single person I met in India turned out to be an angel in some way.

One Man's Dream to Change India

India, a country with 1.3 billion people living on land roughly 1/3rd the size of the United States, gained its freedom from the British in 1947. Since then, there has been a constant debate within the government on how to feed the country's ever-growing population. Dr. Badrinarayan Ramulal Barwale recognized the importance agriculture would play in the development of this newly independent nation, and he founded Maharashtra Hybrid Seeds Company Limited (Mahyco) in 1964, originally to expand his family farm. His company offered hybrid seeds to small-scale farmers at reasonable prices, at first in the state of Maharashtra, but quickly growing to include all of India.

Dr. B.R. Barwale received the World Food Prize in 1998, and since then the company has expanded even more. Today, Mahyco employs over 100,000 self-managing contract growers and researchers specializing in seed production, processing and distribution. According to the company website, Mahyco is currently "engaged in the research, production, processing and marketing of approximately 115 products in 30 crop species." Mahyco has offices all over India, but I spent my summer at the Mahyco Research Center, located in Dawalwadi, Maharashtra State, India. Dawalwadi lies on Jalna-Aurangabad Road, in rural India. The Mahyco website describes the Research Center as one of Asia's most advanced seed industry Research and Development establishments.

Usha Zehr, the youngest daughter of Dr. BR Barwale, is the Joint Director of Research at Mahyco Dawalwadi. During my time at Mahyco, I would live with two different host families: first with Madhavi, Bharat, and Aditya Char, and later with Usha, her son Ben, and her nephew David.

Maharashtra Hybrid Seeds Company Limited, Dawalwadi

I arrived in Aurangabad, India, a city of about 1.2 million people, at 8:30 pm on June 14, 2011. It was a much smaller airport than that of New Delhi, and I walked from the airplane to the gate. I grabbed my luggage, and walked out the doors of the airport and into the adventure of a lifetime. My host mom, Madhavi, and a company driver were waiting for me with a sign that read "Miss Hannah McAtee," and I was so relieved to see them that a huge smile came across my face. I knew that my experience in India would be a once-in-a-lifetime opportunity, and I was ready to get started.

The driver took us to our home, which was about a fifty-minute drive from the airport. The entire way there, I chatted with Madhavi about my trip and about my initial impressions of India. She calmed my two initial fears almost instantly. First, she gave me her phone to call my family back home and tell them I had reached my final destination. Then, she told me that she had bought a carton of bottled water for me and even placed some in the refrigerator. Her caring attitude was apparent immediately, and I was

so grateful to have someone like her throughout the duration of my internship. Remembering what Satoko had said about angels, I was pleased to find one so early into my experience.

Madhavi lives with her husband, Bharat, and son, Aditya on the Mahyco campus in Dawalwadi, which is between Aurangabad and Jalna, in the state of Maharashtra. As we drove through the Mahyco gates, I was amazed at the beauty of the buildings and gardens, even though it was dark outside. We drove through the campus and ended up in the colony, where about 40 Mahyco employees live with their families in flats and houses. We pulled up to our house, where I was greeted by Bharat and Aditya. After a quick tour of the house and my room, Madhavi suggested I wash up before dinner. I entered my bathroom and was surprised to find a lizard on the wall! This was not something that I had encountered in the States, so I was very scared at first. I knew I did not want to leave it there, so I went and told Madhavi. She started laughing and said that they do have lizards in the home, but they would not do much. Sensing my fear of the lizard, she got a broom and swept it outside. I was thankful that she was so considerate as to understand without my asking to get rid of the lizard, and our connection only grew from that point.

After the lizard was removed, we settled down for our first meal together. Prior to this experience, I had never tasted Indian food, but I had heard that it might be a little spicy for me. From my first bite, I loved the food. I enjoyed the combination of the flavors, spices, vegetables, and roti with every bite. My host family seemed somewhat surprised that I was enjoying the food so much, but since that initial meal, I knew that I would at least try and probably enjoy everything offered in the next eight weeks. I also decided to have an open attitude in every aspect of my life in India, not just in my food choices.

That first night, Madhavi said that I could begin working the next day, or rest if I was feeling sleepy. Although I knew I was jetlagged from the travel and the time difference, I was so excited to begin working that I agreed to start the next day. After a night's sleep, Madhavi woke me up around 7:30 am and I got ready for my first day on the job. One nice aspect of living on campus is that we were able to walk to work each day in less than five minutes. So around 9:00, we headed over to the labs of Mahyco.

Because Bharat was away on a work trip for the day, Madhavi introduced me to Narendran Nair, who would be my tour guide. He took me around to all the different labs and introduced me to various people at each. I learned that each lab is composed of a group of researchers and their team leader who oversees the work. Narendran is the team leader of the Plant Transformation Lab, so he first explained to me the work that takes place there. I was fascinated to learn about the different ways Mahyco is producing transgenic crops that are more beneficial for farmers. Immediately, I knew that I would ask to do some work in this lab if I was given the choice.

Next, we visited the Molecular Breeding and Applied Genomics, Molecular Quality Assurance, Molecular Biology, Pathology, Entomology, and Molecular Virology labs. I was so excited about learning all the different research people do at Mahyco, that I barely noticed my jet lag. In fact, one piece of advice I had learned about fighting jet lag was to keep busy. If you are busy, you will not notice that you are tired. This certainly proved to be true during my first few days at Mahyco. During the days, I was so busy and excited that I felt completely awake and involved. But, when I would go home to eat and relax with my family, I immediately became sleepy. It was not that I was bored, it was simply that when I had the opportunity to rest, my body appreciated that, which made for some very early bed times that first week.

Nonetheless, I was excited to meet with Bharat and plan my program for the next eight weeks. He asked if there were any particular labs I was interested in, and I chose the Plant Transformation and Biotechnology Labs (Molecular Biology). These two seemed to complement each other throughout the entire cloning and transformation processes. In the Plant Transformation Lab, I would be working with Dr. Narendran Nair, who has been working at Mahyco for the past 12.5 years. During my time in the Biotechnology Lab, I would primarily work under Abhishek Kulkarni. Bharat also said that I could spend some time volunteering at Shri Ganapati Netralaya, a state-of-the-art eye hospital founded by the Mahyco Research Foundation. With these three prospects in mind, I was excited to work hard and make the most of my time at Mahyco.

Cabbage Transformation Project

Abstract

I will be using *Agrobacterium*-mediated transformation to create transgenic cabbage plants, under the guidance of Dr. Narendran M. Nair and Sunil Madan in the Plant Transformation Laboratory at Maharashtra Hybrid Seeds Company Limited (Mahyco) in Dawalwadi, Jalna, India. Our aim is that through *Agrobacterium*-mediated transformation of a *Bt* (*Bacillus thuringiensis*) gene, followed by a tissue culture based plant regeneration system, we will produce cabbage plants which express a *Bt* gene (gene of interest). In India, a major pest of cabbage plants is the larvae of Diamondback Moth, DBM (scientific name *Plutella xylostella*), of the Lepidoptera order. Cabbage is an important vegetable crop for the farmers in India, and DBM causes a devastating 20-52 percent of crop loss annually. Insecticides cost farmers more money and time than they can afford in this developing nation and also pollute the environment. If we can successfully develop transgenic cabbage carrying *Bt* gene (*cryIF*), they will become resistant to the DBM, making them more useful for farmers in India. Mahyco researchers have previously generated transgenic *Bt* cabbage successfully and they are currently in the government

regulatory process. Through a protocol designed to transform cabbage through the use of *Agrobacterium*, I will attempt to produce transgenic cabbage plants. After about a fourteen week procedure, the roots and shoots of the transformed cabbage plants will be ready for bioassays, tests which include using DBM larvae to determine the efficacy of gene and ELISA for the detection of *Bt* protein. We anticipate that many cabbage explants will die during the selection process. If the experiment works as designed, some of the cabbage should become transgenic and pass the ELISA and Bioassay test. Unfortunately, the entire process is longer than the duration of my internship here, but I will be able to complete three experiments through the selection process. I will also observe a bioassay test of another researcher's experiment. If the anticipated outcome of producing transgenic cabbage plants is achieved, it would confirm that *Agrobacterium* is an effective method in the production of transgenic cabbage plants. Once this transgenic crop is approved for sale by the government of India, it will greatly decrease the amount of cabbage crops lost to the Diamondback Moth by Indian farmers.

My Contributions

On my first few days in the Plant Transformation Lab, I tried to learn as much as possible. This was made simpler by my wonderful mentors, who were very accommodating and helpful throughout the duration of my internship. I first researched all about *Agrobacterium* mediated transformations and why they are important. The Plant Transformation Lab at Mahyco used to perform transformations using a gene gun, rather than *Agrobacterium*. But trial and error showed them that it is more beneficial to use *Agrobacterium*. I learned that during my time at Mahyco, I would be performing cabbage transformations, as they have the shortest experiment length. Mahyco is also developing transgenic vegetable (okra, brinjal/eggplant, and chilli) and field (cotton, wheat, and rice) crops.

After I had learned the basics, it was time to prepare for my experiments. I had learned that different steps of the experiment must take place in different types of media in order to be successful. After the explants are infected with the *Agrobacterium*, they must be transferred into media containing various types of antibiotics that will kill the non-transgenic tissue. Yogesh Zade is the official "media guy" in the Plant Transformation Lab, and I was able to work with him for a couple of days before starting my experiments. Basically, each researcher gives him a list of the media they need each day, and Yogesh is responsible for creating the media. During my time with Yogesh, he mixed the chemicals together, and I was in charge of checking the pH of the resulting substance. If it was too high, I added HCl to the mixture, and I added NaOH if the pH was too low. Once the media had been prepared autoclaved and poured into the correct plates, it was time to begin my experiments.

Throughout my experiments, I worked mostly with Sunil Madan. He has worked at Mahyco for 11 years, so he had a lot of insight into the procedures and techniques. My specific experiment was to infect the explants with a desired gene which is known to make cabbage resistant to the Diamondback Moth. Below is the protocol I used for three subsequent *Agrobacterium* –mediated transformations of Cabbage.

Protocol

Seed inoculation- The purpose of this step was to sterilize and inoculate the cabbage seeds in CC-O medium. One gram of cabbage seeds (Proprietary line seeds of Maharashtra Hybrid Seeds Company Ltd.) was mixed with a spoonful of Carbenzin and water. After being placed in the shaker for thirty minutes, the flask was decanted with sterile water five times. The seeds were then soaked in 0.1% Mercuric Chloride for five minutes. The flask was again decanted with sterile water five times, after which the seeds were blot dried on sterile filter paper. I then inoculated the seeds in glass bottles, at about fifteen seeds per bottle. The bottles were placed in the 28°C incubation room for a period of four days.

Growth of *Agrobacterium* culture- A loopful *Agrobacterium* culture, which contained Bt gene (gene of interest), was placed in a 150 mL flask. The flask was incubated on the rotary shaker at 175 revolutions per minute for five hours.

Explant preparation- In preparation for the transformation, I used a scalpel to remove two cotyledon leaf with petiole explants from each four-day old seedling. The explants were stored in LB liquid medium on sterile filter paper until infection time.

Transformation- This was the step where I actually infected the explants with the gene of interest. First, we calculated the amount of *Agrobacterium* culture to use with the equation $(\text{Final Optical Density})/(\text{Required Optical Density}) \times \text{Volume}$. The required optical density in each cabbage transformation is 0.3. In my experiments, five mL of *Agrobacterium* culture was added to 15 mL of LB liquid medium. This mixture was poured over the explants and allowed to sit for fifteen minutes, with occasional stirring. Prior to infection, a control group of 20 explants was placed on the CC-1 medium. After the fifteen minute period, I removed the *Agrobacterium* culture using a micropipette, and then blotted the explants with sterile filter paper. The explants were then transferred to the CC-1 co-cultivation medium and sealed with Micropore tape, where they remained for four days in the 25°C plant tissue culture incubation room.

Postculture-The explants were transferred to CC-2 medium, where they would remain for seven days postculture period. During this time, the *Agrobacterium* will die due to the antibiotic in the medium,

leaving just the desired gene in the cabbage explants. The postculture medium is meant to induce callus on the explants, which will later be used for the regeneration of transgenic plants.

Selection I-After seven days in the postculture medium, the explants were again transferred to a new medium. This time, the medium contained antibiotics which would be helpful in killing the nontransgenic explants. A positive control group was moved to a new CC-2 medium, and a negative control group was placed on Selection I medium. The freshly sealed glass plates were incubated at 25°C for a period of five weeks.

Selection II-After five weeks, many explants had bleached and died, meaning that they were not transgenic. But a few had produced callus and started to regenerate shoots. I cut the regenerated shoots individually and transferred them to the Selection II medium, where they were then stored for an additional four week period.

I was only able to complete my experiments up to the Selection-II phase during my time at Mahyco, but Sunil promised that he will finish my experiments even after I return to the United States.

On days when I did not have a procedure to complete for my own experiment, I enjoyed helping and learning from the other researchers in the Plant Transformation Lab. I became very comfortable with all the steps of the cabbage transformation protocol. It seemed the Sunil had a new experiment each day, and I was happy to help in whatever capacity I could. Although my individual experiments focused on cabbage, I was also able to learn about okra, rice, and tomato transformations during this time. Many of the other workers in the lab were willing to show me their work, and if I felt comfortable, they even let me complete some of their experiments. I worked alongside Truptee Deshmukh, Varsha Pawar, Smita Kaptan, Swati Pawar, and Vrushali Gawade. I was thankful to learn the techniques they use each day from a first-person point of view, and they said they were thankful to have me help them and keep them company during their busy work days.

Conclusions and Future Planning

Once the regenerated shoots have undergone many rounds of selections, rooting, and hardening, they are grown in stable conditions in the Mahyco greenhouses. The Indian government has not yet given Mahyco permission to grow *Bt* crops in the ground. The shoots of these explants can be checked for the presence of the desired gene, through procedures such as ELISA (Enzyme Linked Immuno Sorbant Assay), GUS marker detection, PCR (Polymerize Chain Reaction) and Bioassay. The most commonly

used process to check for *Bt* cabbage is Bioassay, which involves infesting both the transgenic and non-transgenic leaves with Diamondback Moth larvae to see the effects of the desired gene.

During my time at Mahyco, I learned a lot about producing transgenic crops with desirable traits, such as drought tolerance, insect resistance, high yield, etc. I also learned that Mahyco was the first company in India to commercialize the sale of *Bt* Cotton in 2002. Initially, 50,000 hectares of *Bt* cotton were grown in India. In 2010, 9.4 million hectares of *Bt* cotton were grown, comprising 86% of the total cotton crop land area.

Mahyco is currently in the regulatory stages for the rest of their *Bt* crops. Every day, the Mahyco workers in the Plant Transformation Lab are busy trying to perfect their protocols in the hopes of receiving this approval sooner rather than later. They know that *Bt* products can dramatically improve the lives of Indian farmers, and they are willing to fight for their right to sell. The Plant Transformation Lab is intensely focused on the future of Indian agriculture, and I am very grateful to have had the opportunity to work with them in this effort.

Recombinant DNA sub-cloning project

Abstract

I will be experimentally building a DNA construct, which will be ultimately transformed into various field and vegetable crops using *Agrobacterium*, under the guidance of Abhishek Kulkarni and Madhumita Dutta in the Biotechnology Laboratory at Mahyco. Through restriction digestion and ligation reactions, we will be able to clone DNA which will be used in producing transgenic crops. DNA cloning is an integral process in agricultural biotechnology because it is required for the production of transgenic crops. The experiment will include "cutting" the desired gene through digestion reactions, using restriction enzymes. The DNA insert will be transferred into a specific vector via ligation. The ligated product is then transformed into the bacteria, which is then grown on the specific medium, which will result in the formation of isolated colonies containing the desired gene. The desired recombinants can be identified by isolating the DNA and digesting it with the same restriction enzymes as used in the earlier steps of the experiment. Once this is confirmed, the cloned DNA will be transformed into *Agrobacterium* for later use in the Plant Transformation Laboratory.

My Contributions

During my time in the Biotechnology Lab, I mostly observed the different experiments which took place each day. I was grateful for Abhishek and Madhumita, who answered all of my questions and

explained to me the various procedures. For the first few days, I read texts about cloning, DNA, and why biotechnology is important. Then, I got to observe a recombinant DNA sub-cloning procedure, including restriction digestion and ligation reactions.

Future Applications

If the experiment results with successful cloning of the desired gene, it will be used for plant transformation. Transgenic crops may contain genes for pest resistance, higher yield, or abiotic stress tolerance, which will help farmers get better yields even in unfavorable conditions. DNA cloning has wide applications, in the fields of agriculture, health, and medicine, which can better the lives of all.

Shri Ganpati Netralaya-Home of the Eyes

Keeping with Mahyco's mission to help the less fortunate, Dr. B.R. Barwale constructed the Shri Ganpati Netralaya in 1992. This charitable eye hospital provides 24-hour eye care to the rural population of Maharashtra state. Many of the patients who visit this hospital are poor farmers or housewives, who would not be able to afford eyecare at other institutions. People travel from all over the state to receive eye care from the elite doctors at Netralaya. If a patient is unable to afford care, the fees are simply waived, giving anyone and everyone access to quality eye care.

At Netralaya, I observed the work in the Retina Department. I worked with Dr. Girish Rao, Dr. Rushikesh Naigaonkar, Dr. Pravin Patil, Dr. Abhijeet Gore, and Vaibhavi Agashe. Most of my days were spent in the outpatient department, where about 50 patients are seen each day. The most common cases were trauma, infections and retina detachments. Although most of the patients speak only Hindi or Marathi, the doctors explained to me what they were doing in English. I learned how to examine the retina of a patient using a slit lamp, as well as take photos of the fundus and retina with state-of-the-art machinery.

Tuesdays and Thursdays were OT days, meaning I spent them in the Operation Theater. It was exciting to put on a gown, mask, and cap in preparation for entering the OT. Netralaya has five theaters, and I was able to spend some time in all of them. I observed retina detachment, cataracts, and squint surgeries, and I was fascinated by all of them. It was incredible to see the connection between the lab technicians and the doctors, as a doctor would simply hold out her hand, and the technician would know which tool to give her. The doctors set up the microscope so I could directly observe the procedures. It surprised me that most of the patients were awake during the surgeries. When I asked Dr. Uday Naik, a pediatric ophthalmology specialist, about this, he said that similar procedures would be performed under general anesthesia in the United States. He explained that this difference occurs because, "Americans

have extremely low pain tolerance, while Indians can handle a certain amount of pain if they know it will be beneficial to them in the end.”

When the patient load would slow down, I spent time helping the receptionist in the Retina Department. Part of her job includes typing case summaries which the doctors have handwritten in English. Because she speaks little English, this is a difficult task for her. I volunteered to help her type the case summaries, and I was thankful to be able to physically give back to a hospital where I had already learned so much. Instead of accepting my gratitude for letting me help her, the receptionist thanked me for being a blessing. Her duties also included answering phones and setting up appointments for all of the patients, so when I typed the case summaries, she had more time to complete her work.

Training Program at Garudmachi

From July 15-17, I was invited to attend an Outbound Management Program with about 25 members of the Research and Development Department at Mahyco. I was not sure what to expect, as all I knew about the trip was that we were going to Lonavala, a hill station about eight hours away. My first thought was, "What is a hill station?" My second, "What should I pack to wear?" Thankfully, Madhavi, being the angel that she is, knew how to help. She told me that a hill station is sort of like a resort town in the United States, with pretty mountains, valleys and hills everywhere. She also said that because we were in the middle of monsoon season, it would be very rainy and wet where we were going. Madhavi helped me pack and gave me a couple of rain jackets to borrow, which would come in very handy at the hill station.

After about an eight hour bus drive (with several food and tea stops), we reached Garudmachi, the place where we would stay for the next three days. My initial reaction was that it reminded me of summer camp for adults: we had scheduled meal times, participated in team-building activities, and stayed in "luxury tents". The tents were quite nice because they had attached bathrooms, beds instead of sleeping bags, and cement floors rather than grass. In my tent, there were four other women: Usha, Shusma, Leela, and Kiranmayee. Although I was the youngest, they were very friendly and helpful in making me feel comfortable in a new environment. The major advantage of these tents was that they were water proof, so no monsoon would get in our way from enjoying the weekend. I was very happy to be spending time with such important scientists and researchers who made me feel accepted.

One morning, we went on a trek through the mountain. Although it was foggy from the monsoons, the clouds split when we reached the top, and we had a beautiful view of the valley and dam below us. Throughout the weekend, we played many leadership and team-building games, and I enjoyed participating. One game began with two single file lines of nine people facing each other. All 18 people

stood in a ladder on the ground, with one empty box in between the two rows of nine. The objective was to move all of the people to the opposite side of the ladder; so that the two groups would face out rather than in. One leader was chosen from our team to stand on the outside of the ladder and instruct the 18 people how to move. After several attempts, a new leader was chosen. Again, it seemed almost impossible to move all of the people without having two stand in the same box. After a few more tries by different leaders, I was chosen to be the leader. I was a little timid at first, because I had no idea how I would be able to solve a puzzle that people with Doctorates of Philosophy could not complete. But I remained calm and gave it a shot. I decided to try an approach that involved alternating the people who move from one side to the other. To my surprise, this worked and I was able to successfully complete the puzzle! The other members of the team applauded my work, and I will always remember that moment. I felt accepted by my Indian colleagues; although I was younger and less experienced than them, they treated me as an equal.

After this experience, while I was still on cloud nine from solving the puzzle, I was soon brought back to reality when we split into two groups. The trainer of my group only spoke Marathi, and I struggled to learn from him the correct technique of pacing, which he was teaching to the group. Thankfully, my Indian friends sensed my unease, and translated what he was saying to me. I am lucky that I had these angels watching out for me, because that night we participated in a treasure hunt, and I needed to use pacing as a way to help find the treasure. Again, we were separated into small groups, and I was the only one in my group who had had the pacing education. Another member of the group had learned navigational skills, so we set off with our compass and "torches" (flashlights) to find the treasure. We had a great time on our treasure hunt, and we soon learned that each small group had to help each other in order for the large group to find the treasure.

While we were celebrating our successful treasure hunt, we relaxed around a campfire. At this point, I felt completely comfortable and at ease, as if I had known these people my whole life, rather than just a few weeks. After dinner, they decided to play a game called "Antakshari", in which two teams sit opposite each other. One group sings in Hindi, and can stop singing at any time. At that point, the opposing team must come up with a song that begins with the sound the first group had just finished singing. Although I could hardly understand any of the songs, I enjoyed the dynamic and excitement of the group as they hurried to pick a song. It surprised me how involved all the members were; nobody was NOT singing, and nobody seemed to care whether you hit the right note or not. We played late into the night, and around 11:15 pm, people started to get tired. But, rather than call it a night and go to sleep, they decided to order tea and coffee for everyone in order to continue the game. It is amazing the amount of comfort and satisfaction Indians get from their tea.

The next morning, the Garudmachi staff told us that we would be doing rappelling that day. I immediately felt nervous, as I had seen the 40-foot rock wall and had little desire to lean back and fall from the top. But after listening to the instructions and receiving encouragement from all my Indian friends, I decided to give it a try. As I was getting the harness on, I was so nervous that I was almost shaking. But the worker calmed me down by saying I might regret it if I did not participate. He also said to make sure to look down from the top so I could remember the great view. Once I climbed to the top of the tower, I was content to wait up there and watch others rappel before me. But a worker immediately grabbed my harness and started hooking it up to the ropes. I stepped out from the gate, leaned back, and before I knew it, I was rappelling down the wall! I could hear my Indian friends cheering and yelling encouraging words from the ground. Once I started, I realized that I had to continue rappelling as that was the only way down. Right when my feet landed on solid ground, the worker told me to go back up and do it again. I eagerly went up, came down, and even went a third time. My friend Sushma accurately described my rappelling experience as, "You were nervous the first time, comfortable the second, and jumping down on the third." Through the rappelling experience, I was able to learn more about myself and how I handle fear in difficult situations. I also learned that Indians can be very persuasive and encouraging, especially in a safe and supportive environment.

When our experience at Garudmachi was nearly over, we met for one last discussion. After we all shared what we had enjoyed and learned during the weekend, Usha said that we should nominate the people who had overcome the most barriers during the trip. Leela held up my hand and said, "Let's clap for Hannah," and everyone did! This gave me a wonderful feeling. I knew that I had worked hard and learned a lot over the weekend, but it was amazing that the others could see the change in me. Although the weekend was mostly for the Mahyco workers to bond and learn more about each other and themselves, I had gotten a lot out of the experience. I am so grateful that Usha made it possible for me to attend the program, as it is one of the highlights of my entire time in India.

Living in Mahyco Colony

I firmly believe that I would not have enjoyed my internship as much as I did if I had not been surrounded by such great people. From my host family, to my colleagues, to people I met during various trips, I was constantly amazed at how kind and welcoming the Indian people were. It did not matter if I was a complete stranger, anyone would offer anything they could to me. In fact, I sometimes felt overwhelmed by the graciousness of my companions. Wasn't I supposed to be the one thanking them for giving me this great experience? Instead, they seemed to be thanking me for coming, and they were not afraid to show their gratitude.

The people at Mahyco seemed so focused on improving and enriching the lives of others, which was made evident when a group of science students from a local high school came to visit. The students listened to a presentation on Mahyco and the importance of Biotechnology, and then they toured the different labs to understand what the scientists are currently researching. Their entire day on campus showed me how focused the Mahyco team members are on the future; they realize that these students and their generation will soon be in charge of India, so they need to be aware of all the benefits of biotechnology in agriculture.

Another testament to Mahyco's mission is the Golden Jubilee School, which was started by the Golden Jubilee Educational Society in 1998. One Sunday, I was invited to go with a neighbor and her classmates to an orphanage. We rode a bus from their school to the orphanage, and the ride was so fun! All of the students were telling stories, singing songs in Hindi, and laughing, until one of them said, "Wait, Hannah can't understand us." Then they started singing one of the American songs they know, "Love Story" by Taylor Swift. At the orphanage, there were about fifty children, between the ages of four and fourteen, living in just two rooms. We played and interacted with the children, and gave them a snack and some water. Then came my favorite part...a dance party! The children's enthusiasm for life was contagious, and we had a great time. Most of the children spoke Hindi or Marathi, but I was able to count to ten in Hindi for them, and they counted to ten in English for me. Although I could not have extensive conversations with the children, we were able to communicate through smiles, laughter, and body language, and I loved every minute of it! It was at the orphanage where I truly learned how important a smile can be to make somebody's day. Each child who smiled at me made my day, and I can only hope that I offered them enough smiles to make their days brighter as well.

Living in the Mahyco Colony was a wonderful experience. Every day, kids would run around playing cricket, while adults chatted about the day's events. As Anindya, having lived in the United States during his post-graduate studies, described to me, "The difference between living in India and the U.S. is that here, you can just go over to your neighbor's house after a long day at the office. They will be so happy to see you, and insist that you stay for tea or dinner, depending on what time you visit." I certainly found this to be true many different times during my life in India.

One day, after work, three of my colleagues, Vrushali, Madhumita, and Manesha, invited me to their flat on campus. Upon entering, I immediately felt honored to be in their home. They offered me juice and biscuits (which I learned is the term used for crackers and cookies in India). Earlier that week, I had said something to Vrushali about missing Oreo cookies from back in the United States, as I had not yet encountered them in India. She had then gone into town, found Oreo cookies, and bought them, just so I would be able to enjoy them should I visit her house. Vrushali said that all Indians will offer you

something when you visit, even if they do not have much to give. She said that, "No one leaves our house without eating," which I later learned is true for most houses in India. After our snack, we had a dance party, where I showed the young women some of my dances from back home, and they showed me some Bollywood moves. I had a great time exchanging dance steps with them, and before I knew it, it was time for me to go home for dinner. But before I left, they showed me a beautiful pair of earrings that happened to match the outfit I was wearing. I tried them on, we took some photos, and then I began to take them off to return them. They were surprised, and they told me to keep the earrings! They were a gift! I could not believe these women had invited me to their home, fed me, and given me a gift, all within just a few days of knowing me. I soon learned that this was a very important aspect of Indian life.

About one week into my internship, Madhavi suggested going over to the house across the street after work. The family over there had two daughters around my age, and I was eager to get to know them. So, after work, I decided to give it a try. I walked up to the door, and before I could even knock, Dr. Prashar happily greeted me with a "Hello, Hannah. Come on in!" I was so surprised to be welcomed in this fashion, by a family I had not even formally met. We had a nice conversation about their life in Shimla, which is in Northern India, along the Himalayan mountains. Their daughters, Somya and Akanksha, were very sweet and I became very good friends with them during my stay in India. Their mother even called me her "third daughter." Akanksha and I enjoyed many bike rides and walks on the jogging path around campus, until she left for her graduate school in New Delhi in July. Before leaving, she gave me a gift of earrings and a key chain, and I was very thankful to be her friend, even for such a short period of time. We promised each other that we would meet again sometime, and that she would take me to see Mount Everest, which I am very excited about.

Another time, Narendran invited me to his home to meet his wife, Smita, and his four year old son, Chinmay. I was excited to see him outside of the office, as I had become so accustomed to working with him, that I was curious to see his home life. Smita and Chinmay were immediately friendly, and I felt very comfortable in their home. They offered apples, which they had peeled off the skin especially for me, cake, and juice. After a nice conversation about their life in Kerala, a South Indian state, it was time for me to go home. Before I left, they gave me a present, with a tag that said, "To Hannah, With love from Narendran, Smita, and Chinmay." The tag itself was nice enough for me, as I had recently met them, and they were already so kind. But when I opened the present, I was so excited to see a wooden Shri Ganpati statue. Ganpati, also known as Lord Ganesha or the Elephant God, is a symbol of luck in the Hindu faith. Hindus believe that if you pray to Ganpati before embarking on a new journey, he will remove any obstacles that might come your way.

When I remarked to Madhavi about how much people were accepting me into their homes, she explained an important Hindu concept. She said that Indians treat anyone who enters their homes as God, because they believe it could be God in disguise trying to test them. I am not sure what I did to be treated like God, but I greatly appreciated the Indian hospitality, and it is something I will greatly miss when I return to the United States. Along with seeing God in every person comes a different aspect of the Hindu faith. Many Indians talk to each other at a close distance, without the "personal space" most Americans enjoy. But if someone gets too close and accidentally brushes your leg, they will immediately touch your leg and then touch their own heart or forehead. It took me a few instances to notice this, but once I did, I asked Madhumita about it. She said that because God is in every person, she does not feel appropriate bumping in to God. So if that happens, she must say sorry and ask for forgiveness by touching her own heart.

Another concept I found fascinating about their faith is that feet are sacred to Indian people. Whenever someone meets an elder person, they touch the feet of the elder to bless them. Children are supposed to touch the feet of their parents at least once a day, both as a sign of respect for their parents, but also as a blessing for many happy, healthy years. I loved learning different Hindu beliefs, and I was grateful that people were so willing to explain their faith to me. It seemed to me that Hinduism is more a way of life than a religion. The people are content with living their life in a certain fashion, and they are not caught up with proclaiming themselves as Hindu. This is different than in the United States, where it seems people feel almost compelled to state a religion, though they may not always put their faith into action throughout their lives.

Because I wanted to fully immerse myself in the Indian culture, I requested to learn Hindi from my Mahyco coworkers. During the fifteen-minute tea breaks at work (which occurred at 10:30 am and 3:30 pm), we had our lessons. They were very willing to teach me different phrases, and I enjoyed trying to have conversations with them solely in Hindi. I started off learning the basics, but I slowly grew to understand a great amount of conversation. Even if I could not translate word for word, I was able to understand the topics being discussed, and my friends were very excited about this achievement. In return for teaching me Hindi, they asked that I teach them some Spanish. In Indian schools, students do not have the opportunity to learn Spanish like they do in the United States. They enjoyed learning Spanish, and we had basic conversations with each other in this format: I would ask them questions in Hindi, and they would answer in Spanish. They seemed so happy when I would master a certain word or phrase, and their enthusiasm inspired me to keep learning Hindi. Before I left, I was able to count to ten, greet people, and hold conversations with them.

I learned that India has about 22 different official languages. Most people nation-wide know at least a little bit of English and Hindi. But each individual state also has its own language, which varies greatly between the North and the South. In the state of Maharashtra, which is where Mahyco is located, the mother tongue is Marathi. Many Mahyco workers know Marathi, especially if they have grown up in this area. It was amazing to listen to the conversations in the labs and in the office, because people would start a sentence in English, throw in a Hindi word here or there, and then finish the sentence in Marathi. The way they were able to switch between languages so seemingly effortlessly was amazing, and I constantly had to be on my toes to catch the different languages being used.

Living in a 5000 year old civilization definitely had its benefits. During my time in India, I was fortunate to be able to travel on historical sightseeing trips. I traveled to Agra to see the Taj Mahal and Agra Fort; Delhi to see India Gate, Parliament, Ministry, President's House, Rajghat, Humayun's Tomb, and Qutub Minar; Aurangabad to see Ellora Caves, Aurangabad Caves, Bibikamakbura, and Daulatabad Fort; and Goa to visit the Arabian Sea. After these amazing experiences, I completely understood what Dr. Uday Nair from Netralaya meant when he said, "Even though India might not be the most developed country in the world, you won't find a country with more history and culture than India." At each tourist destination, I received stares from a lot of the locals. Many times, young children would come up to me to say hello and shake my hand. A couple of times, parents even gave me their babies and asked to take a picture of us together. These acts reminded me that I was not only representing the World Food Prize, but also the United States of America, to some people who may never see another American in person.

One difference between Indians and Americans is the perception of beauty. In the United States, we hear so much about tanning beds and people wanting to be as dark as they can get. But in India, I saw advertisements on the television for creams to make your skin lighter. People here, especially women, crave light skin. My friend Seema explained this feeling as, "The grass is always greener on the other side." Another aspect of Indian fashion is wearing accessories with every outfit. Madhavi and Usha had great fun choosing bangles, earrings, necklaces, bindis, and ankle bracelets to match my outfits each morning. Madhavi said, "By the time you leave, you will be a good little Indian."

Living in the Mahyco Colony was great fun. About two weeks into my internship, I began to miss dancing, which was a big part of my life in the United States. Dr. Prashar suggested that I teach a dance class for colony members a couple of nights a week. I was excited about the idea, and decided to have classes for one hour each Monday and Tuesday evening. These classes turned out to be a hit. Between ten and twenty students, ages 3 and up, attended each class, and I had great fun teaching them jazz and pom dance steps. I requested that they also teach me some Bollywood steps, so the classes turned into exciting cultural exchanges. On July 24, there was a music show in the colony. Many colony members played

instruments such as the tabala and harmonium, and sang Hindi songs. At the end of the show, they asked me to come onstage and perform a dance routine. I danced to “Jai Ho”, with the audience members cheering for me throughout the entire performance. As soon as I left the stage, I was surrounded by colony members shaking my hand and congratulating on my dance. They were so sweet and energetic about the dance that we decided to have another show on August 6, where students who had taken my dance class would perform what they had learned. Dr. Radhamni Marathe said that my Jai Ho performance was so excellent that it guaranteed a full house for the later show.

The colony members are all very close to each other, so when one of our neighbor’s daughters turned nine, she invited everybody to her birthday party. I was surprised that the first thing at the party was the cutting of the cake. Then we ate dinner and visited for a while. After that, I played a game called Dark Room with the kids. While one person stands in the hall, everybody else hides in one room and then turn off the lights. The person then comes into the room and tries to find everybody, essentially like Hide and Seek in the dark. I had a great time, and the young children started calling me Dee Dee, which means “big sister.” Bharat and Madhavi told me that it is very common for Indians to call each other Auntie, Uncle, Sister, and Brother, rather than just by their names.

Although I spent two months in a foreign country, I did not feel isolated from Western culture in the least. While watching Hindi movies with my host family, I was surprised at how many English words and phrases were used. Bharat explained that Indians find it trendy to use English. I also had the opportunity to see Harry Potter and the Deathly Hallows, Part 2, in 3D in Aurangabad with Madhavi, Usha, Bharat, David, Ben, Aditya, and Nikita. They found a theater that was showing it in English (with English subtitles) and we were all excited to watch the final movie in the series. The theater felt just like a movie theater in the United States, except halfway through the program, the film stopped and all the lights came on. I assumed that there was a technical problem with the theater, but Madhavi explained that it was just intermission. She said that all Hindi movies have intermissions, mostly because they are usually 3+ hours long.

Reflections

When I look back on my Borlaug-Ruan Internship at Mahyco, the thing that stands out the most is the people of India. Every single person I met was welcoming, and I enjoyed speaking with and learning from everyone around me. From the people at Mahyco, to the people at Netralaya, to the kids in the orphanage, to the people I passed in the street, they all seemed content with their place in life. I saw a lot of poverty and hunger up close in the streets of Jalna and other cities of India, and it was much more vivid and real than what I had heard about in the United States. But rather than being disheartened by the

struggles of the rural folk, I was inspired and encouraged by the work of Dr. B.R. Barwale . It is because of his vision that Mahyco and the Barwale Foundation have been able to achieve greatness, and I know that India is in good hands under Dr. Barwale and his organization.

One event in particular made me realize the great importance of the World Food Prize and its mission. The housekeeper at the Char house, Saraswati, although she speaks no English, greeted me with a smile and "Namaste!" each afternoon when I would come home for lunch. Madhavi and Bharat usually arrived a little later than me, so I would go online while I waited for them. On July 1, both housekeepers stood by my side watching me check my email. Then I remembered an application I had purchased before even coming to India: an English-Hindi dictionary that actually says the Hindi words aloud. I clicked on an easy word, "Hello." The iPad loudly proclaimed "Namaste!" and the housekeepers giggled. I tried another phrase, "How are you?" More laughter after my tablet said, "Aap kaise ho?" We had fun with the serious greetings and questions, and then I decided to try some funny phrases. "When does the next boat leave?" "Want to go to the movies?" and even "Happy birthday!" At this point, we were all laughing, nearly hysterical; we were excited to see which phrase the monotone voice would spit out next. I had never felt so close to people whose lives were so drastically different than mine.

But as I thought about it, were these two sari-wearing Indian women really that much different from me? We all had families who loved us, and we all need food and water to survive. We go to work in the mornings, and enjoy spending time with relatives and friends. Even though we were born and raised on opposite sides of the world, our similarities greatly outweigh our differences. If more people realize this, great things can happen. And then I realized, that is what the World Food Prize is all about: educating and feeding people, near or far, man or woman, sibling or stranger...it doesn't matter! At that moment I realized that I want to continue in this line of work for the rest of my life. And I cannot thank the World Food Prize Foundation enough for this eye-opening, inspiring, empowering experience.

Every person I encountered left an imprint on my heart, and I will forever remember the times I spent learning, speaking, and laughing with my colleagues. It may be nearly impossible to express my sincere gratitude and appreciation to all the people who made my time in India so great, especially because some of my colleagues told me that you are not allowed to say thank you to your friends in India. So instead of thanking my new friends, I decided to promise that I will join them in the fight for food security. My time in India has inspired me to take Hindi courses and join Indian student groups at Arizona State University. I hope to come back to India during my college years and beyond. As Usha commented, "Once you are an ophthalmologist, you can come back and work here at Netralaya." As I continue down the path toward a career in global health, I now realize that it is not my duty, but my honor to join the fight against world hunger.

Photos



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