

Transforming the Agrarian Face of India

My Journey in Making Every Seed Count



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Chicago, Illinois

2015 Borlaug-Ruan International Internship

Maharashtra Hybrid Seed Company Limited (Mahyco), Jalna, India



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The Spark that Ignited the Fire- My Introduction

My name is Madeline Poole, and I currently attend the Chicago High School for Agricultural Sciences in Chicago, Illinois. My admiration for both agricultural science and foreign relations sprung from three activities: Debate, FFA, and Science Fair. These three activities along with several volunteer organizations have led to me worlds I never thought I would explore and have ultimately built my identity.

I was first introduced to Dr. Norman Borlaug when I was a sophomore in high school. I was currently enrolled in an AP Human Geography course, and we discussing the green revolution and its impact on the world. I remember this being one of my favorite units in this class. The way Mr. Harris talked about Dr. Borlaug and International Agriculture sparked an interest in me that I haven't had before. At the end of the year, I would revisit this unit when we were given our final assignment. I walked in class that day and the projector had been on and a writing rubric with several different factors of food security lied on each of the students' desk. Mr. Harris told us that each of us would be writing a paper to submit to the world food prize. He then proceeded to play videos about the organization and its goals. The last two videos he played pertained to the global youth institute and the Borlaug-Ruan International Internship. From that moment on, I knew I wanted to make an impact like my peers in the video were able to do.

After weeks of intensively researching, writing, and editing, my paper was complete. After submission, I received an email several weeks later that I had been selected as a delegate for the Global Youth Institute. Although I thought I knew what lied ahead, I was greatly mistaken.

When I first entered the World Food Prize, an aurora of excitement filled the air. Flags of every country imaginable lined the hotel hall, and people from all over the world checked in. I remember meeting my table leaders, who were both previous Borlaug interns. They were so welcoming and excited, they had qualities in them that I wanted to see in myself. Every day was a new adventure in learning, but perhaps the one that stood out to me the most was the panel of women peasant farmers from Africa. The passion of women such as Birtukan Tegegn (the 2014 female food hero) strengthened my desire to play a leading role in the battle against hunger. Bram Govaerts, the 2014 Borlaug Field Award recipient planted the seed and my head that although I was only a young girl, I could have a tremendous impact on food security. After holding a personal conversation with him, I knew that one day, I wanted to have the same sense of selflessness as Bram.

Before leaving Ambassador Kenneth Quinn gave a word a wisdom to everyone at the global youth institute. The last thing he said was “There is information on the Borlaug-Internship available. Either you take it, or you don’t. It’s your choice if you want to impact your life.” These words were a call to action for me. I must admit I was very apprehensive to take an application at first. I saw the caliber of students at the institute, and I thought to myself, “*I wasn’t capable of becoming an intern.*” The idea of spending two months away thousands away from home also filled me with a sense of fear. Despite all this, I decided that this was something I have dreamed of for years, and it was time to take action.

A couple of months after submitting my application, I received an email saying I was chosen to participate in the interview round of the selection. A few weeks later I completed my interview via Skype anxiously waited for a status update. In March, I received one of the biggest surprises ever. I opened up my email and it said, “Congratulations! At this time, I am very pleased to inform you that you have indeed successfully qualified to be one of our 2015 Borlaug-Ruan Interns” I couldn’t hold my excitement in. Just before the orientation in Des Moines, Iowa, I found out that I would be spending my internship at the Maharashtra Hybrid Seed Company in Jalna, India.

From Chicago to India

To be absolutely honest, my knowledge about India was very limited. The idea of going to a country I knew nothing about intimidated me at first, but after researching and attending the internship orientation, my excitement grew. I had so many questions for my new host families and so many cultural aspects I wanted to explore.

Before I knew it, June 18th came, and I was scheduled to leave for India. Just like Ambassador Quinn advised, my parents held a conversation with me on the way to the airport because they knew that the Maddie they knew now was not the Maddie that would return. At the airport I gave my family one last hug, and departed for my terminal.

After over two days of traveling and three sleepless plane rides, I finally landed in a small airport in Aurangabad. On the other side of the glass walls of the airport, I saw a married couple smiling and waving excitedly. I was so thrilled to meet my new family that I had forgotten one vital resource: my luggage. As my host family and I laughed at my forgetfulness, we entered back into the airport and loaded my luggage and proceeded into the vehicle. It was only five in the morning, but the streets of India were lit up with action. Farmers herded their cows across the street, women with water jugs on their head lined the roads, and children were laughing and running about. On the long car ride to Dalwadi, my host mother, Madhvi, and my host father, Bharat, explained what was happening around me and answered any questions I had.

As we drove down the winding road filled with palm trees and exotic plants, two guards swung open the gate, and revealed the exquisiteness of the Mahyco campus. We finally reach the house that I was to call home for the next two month. I received a warm welcome from neighborhood children who pressed their faces up against the windows and waved. Later that night, I attended a pizza party at the Barwale's house with several of the families on campus. During the conversation during dinner, I learned that I had a plethora of things in common with everyone. I learned that Usha Zehr, Dr. Barwale's daughter used to be a faculty member at the University of Illinois where I conducted research the past two summers. There was one thing everyone had in common in the entire room: the desire to fight food insecurity through biotechnology. Meeting everyone on campus made me realize that there was no better place for me to spend my internship than Mahyco.

One Man with a Dream-Mahyco

The Maharashtra Hybrid Seeds Company Limited (Mahyco) was founded in 1964 by one man with a dream. This man was Dr. Badrinarayan Ramulal Barwale.

Dr. Barwale grew up in a small agricultural family in Jalna, India. When Jalna first was admitted as a part of the Indian government and away from British control, the government was faced with one gargantuan question: How will we feed the people of India? During this time, farmers

endured a very low quality of life. Debts were high, income was inadequate, and yields were not even enough to feed their own family. Dr. Barwale seemed to have the answer.

As a young farmer with the desire to better his family's life, Dr. Barwale hired extra workers and implemented innovative irrigation systems. He started to breed okra seeds that were so successful, he was able to sell to other farmers. This caught the attention of the Rockefeller foundation and the Indian Council of Agricultural Research, and Dr. Barwale began to market more seeds. Today this is what we know as "Mahyco."

Mahyco isn't your traditional seed company. Instead of marketing to wealthier farmers, it sought to provide affordable high-yielding seeds to small-scale farmers. It currently employs over 100,000 self-managing contract growers, and even more in seed production, processing, and seed distribution. Mahyco is also in a partnership with Monsanto in hopes to produce biotechnology crops that will feed the over 212 million people who are undernourished in India. Mahyco believes that it is possible to improve the lives of farmers through superior agricultural technology. With one of the most advanced research and seed development centers in Asia, Mahyco continues to feed the world with Indian Agriculture.

Not only is Mahyco helping address food security issues, they are addressing the socio-economic issues India faces through the Barwale Foundation. Under the Barwale foundation, the **Golden Jubilee School**, **Badrinarayan Barwale Mahavidyalaya College**, and **Shri Ganapati Netralaya** eye hospital were established.

Dr. Barwale believed that health and education was not just a privilege of the rich. In a region that lacks basic Metropolitan facilities, the Barwale foundation sheds a light of hope through affordable health care and education.

The MMBians and My Research

Mahyco is located in Dawalwadi on the Jalna-Aurangabad highway in rural India. In this guarded compound lies the Research and Development center for the company. There are a series of scientific research labs ranging from plant transformation to quality assurance lab. I was fortunate enough to be placed in the Molecular Microbiology lab. Although I had no background in Microbiology and a limited background in Biology, Dr. Bharat Char felt that this lab would suit me because of my interest of agricultural biotechnology. He also said that I would be exposed to a wide range of vital lab techniques in the plant and seed science industry. Not only would I be loading PCR and locating genes, I also would be collecting soil samples, isolating bacteria, and so much more.

Dr. Rajendra Marathe is a principal investigator of MMB lab, who has studied at the top universities in India, and even completed a post doctorate in plant pathology at Yale University. The Molecular Microbiology lab comprised of approximately ten researchers who work to promote and protect plant growth. Some of the projects that are currently working on include Nitrogen use efficiency, phosphate use efficiency, and plant growth promoting rhizobacteria. While I conducted my own research project concerning plant-growth promoting rhizobacteria (PGPR), I had the opportunity to shadow some amazing scientists who had very different projects. On “Lab Technique Tuesdays” I learned the protocol of a specific lab technique and followed a scientist who allowed me to replicate the procedure. I was so honored not only to be given my own individualized project, but be trusted enough to assist in other company research projects. In the lab, the scientists called themselves the “MMBians” (The Molecular and Microbiology Lab Technicians). My work was primarily independent, but I worked under Shweta Agrawal who has a background in Biotechnology, and Minal Desphande, who has a background in Microbiology.). When I started the internship, they told me that I was more than just some high school student, I was an MMBian!

My research consisted of me traveling around Jalna and taking wild plant and surrounding soil samples. I primarily wanted to see what bacteria is contained in wild plants that allows them to grow without human interaction. After isolating and screening bacteria of soil and root entophytes, I created seed coatings to test on rice and chickpea plants, and if they were successful, they would be further investigated by the country and marketed to small holder farmers.

Abstract

Plant growth promoting rhizobacteria are the soil bacteria inhabiting around/on the root surface and are directly or indirectly involved in promoting plant growth via production and secretion of various regulatory chemicals in the vicinity of the rhizosphere. : In this independent study, soil samples will be collected from the Maharashtra Hybrid Seed Company campus in Jalna, India. Bacterial isolates will be screened for production of growth hormones like IAA, N fixation, and phosphate solubilization properties by different assay methods. To observe plant growth promotional activity, rice seeds can be treated with selected bacterial isolates and grown on germination paper. The plant growth promotional effects of these cultures can be compared with non-treated control plants. Based on the screening, selected bacterial isolate will be identified by cloning and sequencing the 16s RNA. The seeds treated with bacterial cultures containing desired characteristics produced a plant with a longer root and shoot length. To further justify the positive effects of rhizobacteria, further investigation on experimental plots must be done.

Introduction

Soil Fertility continues to be a persistent issue facing agriculture, especially in developing nations. This problem is primarily due to continuous cropping without replenishing soil nutrients. While this problem can be solved by the application of fertilizer, the availability of fertilizer is limited due to rising costs and environmental concerns. Soil erosion and groundwater contamination caused by chemical fertilizers have gathered environmentalists and agronomists to develop a better alternative.



Thousands of different bacterial colonies exist in soil. These bacteria colonies play a vital role in plant's biogeochemical cycles, soil fertility, and overall health of the plant. Maintaining a biological balance in soil. (Barea 2004). Bacteria that either 1) synthesize certain compounds for plants, 2) facilitate the uptake of certain nutrients in the soil, or 3) prevent plants from acquiring certain diseases are known as plant growth promoting rhizobacteria. (PGPR) (Hyat 2010)

Plant growth promoting rhizobacteria are the soil bacteria inhabiting around/on the root surface and are directly or indirectly involved in promoting plant growth and development via production and secretion of various regulatory chemicals in the vicinity of rhizosphere. Some examples of PGPRs are: *Pseudomonas*, *Azotobacter*, *Bacillus*, *Rhizobium*. Rhizobacteria usually promotes plant growth directly by assisting in resource acquisition such as nitrogen, phosphorous, and essential minerals. It indirectly promotes plant growth by reducing the effects of various pathogens in the form of biocontrol agents. In addition, PGPRs produce substances that protect plants against various diseases. (Ahmed and Kibret 2013).

Within the last decade, research scientists have been studying the effect of PGPR on plant growth. Plant growth promoting rhizobacteria have been recognized as efficient microbes for sustainable agriculture, holding great promise for increasing yields. Several studies have identified bacterial cultures that have used PGPRs have reported plant growth promotion, increased yields, solubilization of Phosphorous, and Nitrogen Fixation. The mechanisms of PGPR are not fully understood yet, but they have gained more importance in agriculture. Scientists today are screening several different bacterial cultures in order to find cultures that promote plant growth and increase agricultural yield. (Singh, 2013)

Bacterial cultures were In this study, bacterial cultures were tested for four different characteristics: Phosphate solubilization, Nitrogen fixation, IAA production, and anti-fungal. Phosphate and Nitrogen are two of the most important nutrients to inhibit plant growth. IAA, also known as Indole acetic acid, plays multiple roles from promotion of cell division and meristematic tissue to promotion of protein formation. Antifungal properties are important to protect the plant against fungus that can hinder plant growth.

Explanation of Materials and Methods-

Soil Sample collecting and Soil Serial Dilution- Five different wild plants were collected from the MAHYCO campus located in Dalawadi, India. Each plant was completely uprooted from the ground, and a surrounding soil sample was taken. The soil samples were then diluted. One gram of each soil sample was weighed, then placed in a vial containing 1mL of distilled water. After it was properly vortexed, 1mL of the sample mixed with water was taken and placed in a new vial that also contained 9mL of water. This process was done three times, until the sample was diluted to 10^{-3} . This gave us four different vials, all with different dilutions. Using a pipette, 20 μ l of each dilution was placed onto an LB Agar plate, then spread using a spreader. The plates were then wrapped and placed in a 37°C incubator overnight to grow the bacteria.



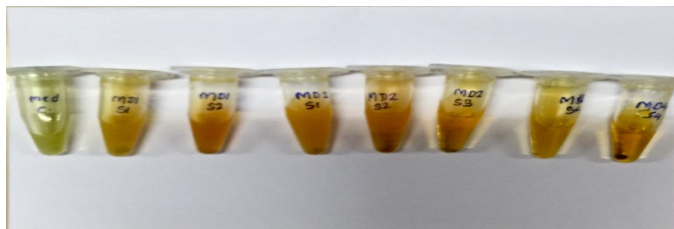
Entophytes Isolation and Root Sterilization- A small section of the root was cut off the plant. The roots were first washed in distilled water for removal of surface soil for three minutes. Then the roots were dipped in 70% ethanol for sixty seconds and given a further wash in distilled water for three minutes. After that, the roots were dipped in 2% sodium hypochlorite for three to five minutes and finally washed with distilled water for five minutes. After that, roots were chopped, then crushed into 1ml of water. Then they were place into a vortex and 100 μ L were spread on an LB Agar plate and kept at 37°C incubator for overnight. The bacteria colonies were separated on new LB Agar plate. This process ensures that only the bacteria accumulated within the roots were taken.

Phosphate Solubilization Assay- Each bacterial culture underwent a series a test, one including its ability to solubilize phosphate. Each culture were point inoculated on paper disks on Tri-Calcium Phosphate Plates. These plates were then wrapped in placed in a 25°C incubator for three days. After three days, the plates were observed to see if there was a “zone of clearance”

around the respective cultures. This zone would indicate the culture did in fact solubilize the phosphate contained in the plate.

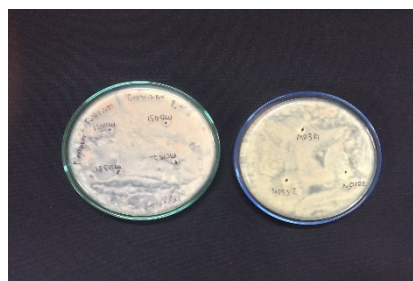
Nessler's test for Screening of Nitrogen-Fixing Bacteria- Bacterial cultures were inoculated in peptone water media and kept at 37°C, 180 RPM shaker. After 24 hours and 48 hours of growth 1ml of culture is taken in a vial and centrifuged at 10,000 RPM for 10 minutes. This supernatants

were collected in a new vial and 50 µL of Nessler's reagent was added. Vials were shaken well and kept in a dark condition for 30 minutes. After the incubation time of 30 minutes, vials were observed for the development of brown precipitate which is the positive indication of Nitrogen fixing bacteria.



Salkowski test for estimation of IAA production- Bacterial cultures were inoculated in LB Media added with Tryptophan in 2 mg/L. 500 µL of culture was taken at 24 and 48 hours' time point and centrifuged at 10,000 RPM for 10 minutes. The supernatant was collected in a new vial and 1ml of Salkowski reagent was added. It was mixed well then incubated at room temperature for thirty minutes. Positive cultures show pink color development. To calculate the amount of IAA produced, the optical density was taken at 530 nm against media control. The concentration of IAA can be calculated with the help of a standard graph.

Antifungal Assay- Fusarium graminearum was inoculated in 5mL of potato dextrose broth and grown at 25°C, 180 RPM for 3 days. Using a pipette and a spreader, the fungus was spread on a potato dextrose agar plate. After it was dry, paper disks were placed on the plate and then saturated with the respective culture. Plates were kept in a 25°C incubator. Once grown, the plates were observed for a “zone of inhibition.” This zone indicates that the culture has antifungal characteristics.



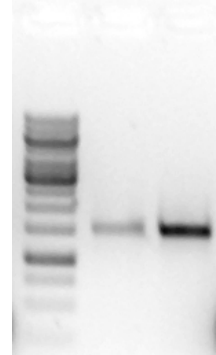
Germination Experiment- Bacterial cultures were inoculated in LB and Tryptophan media and grown for 24 hours at 37°C and 180 RPM. Twenty rice seeds were then soaked in each respective culture for one hour. A media and water control were added for comparison. After incubation, the seeds were placed on pre-moistened germination paper and kept in a controlled condition



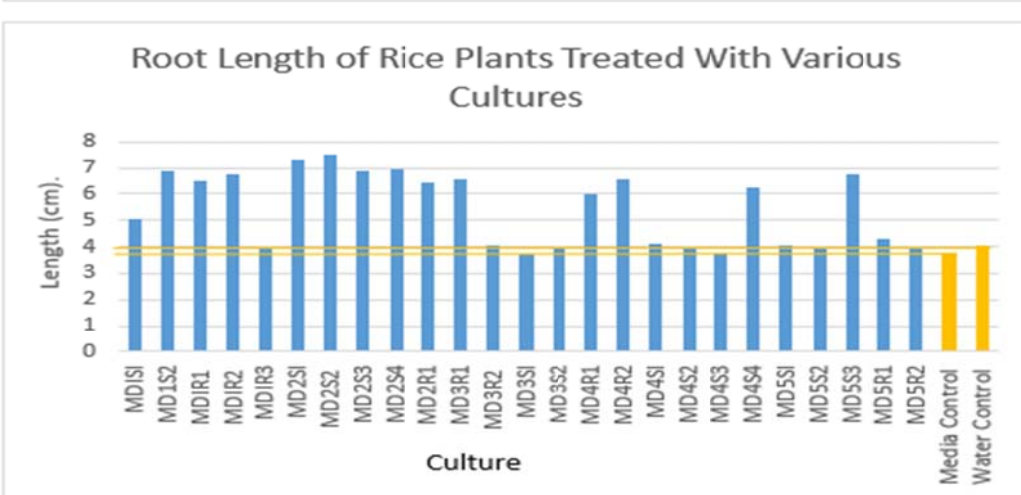
chamber. On the seventh day, plants' root and shoot length were measured and compared to the two controls.

Genomic DNA Isolation and Sequencing- 1mL of culture was centrifuged at 3,000g for 10 minutes, forming a pellet at the bottom. The pellet was then re-suspended in 250 μ l of SET buffer. Lysozyme was then added to a concentration of 1mg/mL (5 μ l) and incubated at 37°C for 30 minutes. Then, 25 μ l of 10% SDS and 20 μ l of 10mg/ml Postnasal K was added. Tubes were then incubated at 55°C for one hour with occasional invert. One-third of the volume of NaCl was added and incubated at room temperature with frequent invert. After that, it was spun at 4500g for fifteen minutes. The separated supernatant had 1 vial of isopropanol added and gently inverted for DNA. Then tubes were kept at -20°C for 1hour. Directly after incubation, tubes were spun at 10,000 rpm for 15 minutes at 4°C. It was then air dried overnight in the laminar and the pellet (DNA) was re-suspended in Water.

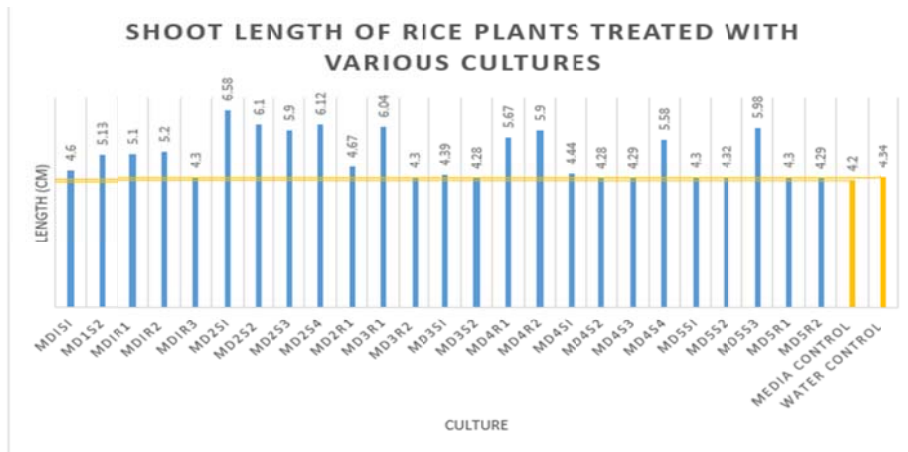
PCR and DNA Sequencing- For PCR, 3 μ L of Genomic DNA, 0.5 μ L of deoxy-nucleotide-tri phosphate, 1 μ L of forward and reverse primer, 0.3 μ L of Taq polymerase, 2 μ L of the Taq buffer, and 12.2 μ L of distilled water was placed into a DNA vial. The vial was put on a temperature 35 temperature cycles (94, 52, and 72 degrees). At 94 degrees, the DNA strands separate as the hydrogen bonds holding them together break down. Once the mixture is cooled down at 52 degrees, the temperature of the primers bind to the single DNA strands. The primers are short sequences of nucleotides which must join to the front of the separated DNA for the copying process to start. Lastly, at 72 degrees, the enzyme adds bases to the primers segments to build up complementary strands of DNA exactly like the original molecule. The final DNA sample was then loaded on a 0.8% agarose gel. Using gel electrophoresis, the DNA was separated and analyzed based on its size and charge. The DNA was then examined using an ultra violet image viewer. The DNA sample was sent to the sequencing lab. Once the sequencing lab forwarded back the sequence, it was placed into the BLAST program and the bacteria was identified.



Results



This graph represents the root length of rice plants treated with various cultures. The length on the graph represents the average of ten rice plants.



This graph represents the shoot length of rice plants treated with various cultures. The length on the graph represents the average of ten rice plants.

Sr.No.	Culture name	Phosphate solubilization assay	Nitrogen fixation assay		Antifungal assay
			24 Hours	48 Hours	
1	MD1S1	Negative	Negative	Positive	Negative
2	MD1S2	Negative	Positive	Positive	Negative
3	MD1R1	Negative	Positive	Positive	Negative
4	MD1R2	Negative	Positive	Positive	Negative
5	MD1R3	Negative	Negative	Negative	Negative
6	MD2S1	Negative	Positive	Positive	Negative
7	MD2S2	Positive	Positive	Positive	Negative
8	MD2S3	Positive	Positive	Positive	Negative
9	MD2S4	Positive	Negative	Positive	Negative
10	MD2R1	Negative	Positive	Positive	Negative
11	MD3R1	Negative	Negative	Positive	Positive
12	MD3R2	Negative	Negative	Negative	Negative
13	MD3S1	Negative	Negative	Negative	Negative
14	MD3S2	Negative	Negative	Negative	Negative
15	MD4R1	Negative	Positive	Positive	Negative
16	MD4R2	Negative	Positive	Positive	Negative
17	MD4S1	Negative	Negative	Negative	Negative
18	MD4S2	Negative	Negative	Negative	Negative
19	MD4S3	Negative	Negative	Negative	Negative
20	MD4S4	Negative	Negative	Negative	Negative
21	MD5S1	Negative	Negative	Negative	Negative
22	MD5S2	Negative	Negative	Negative	Negative
23	MD5S3	Negative	Positive	Positive	Negative
24	MD5R1	Negative	Negative	Negative	Negative
25	MD5R2	Negative	Negative	Negative	Negative
26	Control	Negative	Negative	Negative	Negative

This graph portrays the results of the phosphate solubilization, Nitrogen fixation assay, and antifungal assay results for 25 different bacteria and one control.

Sr.no.	Culture name	O.D./ml at 530nm	O.D.- Blank	Conc. (µg/ml)
6	MD2S1	0.26	0.207	3.25
7	MD2S2	0.215	0.162	2.125
8	MD2S3	0.15	0.097	0.5
9	MD2S4	0.164	0.111	0.85
16	MD4R2	0.154	0.101	0.6
20	MD4S4	0.2	0.147	1.75
26	Control	0.053	0	-1.925

This chart shows the result of cultures showing positive for IAA production and the control. O.D is optical density.

Sequencing results for MD2S1 Primer Used : 16s rRNA Reverse

ATCTTTCTTGGGGGGGGGGGGGGGGGGGATGGGACAGGGGGGGGGGGGAA
GAGACGCATTAGAGCGGCCCGCGCTGATTAGCTAGTGGGAGGAAAAAAGG
GGGGGACGATCAGAGCTGGCGAGAGGATGACCAGCCGGCTGGGACTGAGAC
ACGGGCCAGACTCCTACGGGAGGCAGCAGGGGGGAATCTTGCGCAATGGGCG
AAAGCCTGACGCAGCCATGCCGCGTGAATGATGAAGGTCTTAGGATTGTTAAA
TTCTTTCACCGGGGACGATAATGACGGTACCCGGAGAAGAAGCCCGGCTAACC
CCTGCCAGCAGCCGCGGCATACGAATGGACAGCTCGCTCGGATTACTGGGCGA
AAGGGCGCGAGCCGACGGAGGGCTGAGGGGGGAGCCAGCCCCCCCCGAACT
GCCTTGAAGTGCGACTTGATATGAGAGAGGAGTGGAACTCCCAGGTAGAGGGA
ATCTTAATTTGGAAGAACCCTGGCAAGGCACTTCTGGTCTTCTGACCCTAGG
CCGAAGCGGGGAGCACAGATAATACCTGTACCCCCCTAACACATCCTATTTC
GGTGTTCCTTCGTACCACTACATAACTTCCCCGGAGTCGTGCATTTAATCACG
GTTGCGGGCCCCAACCTGACATGGTATTGACCCCAAACTCCCCTTTTGATGT
TGACCCCCGAAACGGTTCTTTTGGAATGAAAAGGGTATGGTTC

Blast Results: *Brevundimonas sp.*

One culture, MD2SI, underwent DNA sequencing.

Implication of Food Security

Based on this study, it is quite evident that plant growth promoting bacteria with desirable properties can greatly enhance plant growth and development. These rhizobacteria are a key tool in promoting sustainable agriculture and promoting food security. In order to meet environmental challenges will ensuring food for the growing population, something must be done to increase crop production.

As of now, farmers are enhancing crop production through the excess use of chemical fertilizer and pesticides. While these methods are increasing crop production in the present, they will have detrimental effects on the environment and soil fertility. The excess fertilizer in fields are killing off beneficial microorganisms and making pathogens resistant to pesticides. Another huge problem the application of these chemicals may cause is water and ground water contamination. In developing countries where water is scarce, water contamination is devastating. It also can majorly harm any livestock that access drinking water from nearby water sources.

This study also concluded that antifungal properties, phosphate solubilization, nitrogen fixation, and IAA production are essential to ensure a healthy plant. Nitrogen is considered as one of limiting nutrients in plant growth. It is a crucial component in chlorophyll and is the most important pigment for photosynthesis and amino acids. However, plants are not able to utilize it because plants can only take up nitrogen in its elemental state. The plant growth promoting bacteria that tested positive for nitrogen fixation can fix atmospheric N₂ and enhance crop yield. Indole Acetic Acid, or IAA, influences cell enlargement, bud formation, and root initiation. It also increases root hairs and lateral roots. When seeds are coated with these respective bacterial cultures, they are exposed to this crop enhancing hormone. Phosphorous is the second most plant nutrient available in soil after nitrogen. It is present in high amount in soil, however, most of the P is present in an insoluble form. Globally, it is the major yield-limiting nutrient, and it is estimated that the world's phosphorous reserve will end by 2050. Rhizobacteria can help solubilize P so it is available to the plants.

If positive cultures are found and seem to have a positive effect on plant growth, seeds can be coated with this respective cultures. In this study, several crop-enhancing bacteria cultures were found and identified. These cultures will be further replicated and this ultimately will make farming more cost effective and sustainable for farmers everywhere. Today PGPRs serve as excellent model systems which can provide biotechnologists with novel genetic constituents and bioactive chemicals having diverse uses in agriculture. The closer scientists are to understanding the mechanisms and applications of these plant growth promoting bacteria, the closer we are to food security.

Self-Reflection

“A nation's culture resides in the hearts and in the soul of its people.”

-Mahatma Gandhi

My internship experience was more than just eight weeks of research. It was a journey that allowed me to explore Indian culture and agriculture through the eyes of its people and develop as a young woman.

Growing as a Scientist

I remember the first day of work in the Molecular and Microbiology Lab. I had planned for everything to be absolutely *perfect*. I woke up two hours earlier than I was scheduled to, I dressed professional, and even researched more about the lab and the company. I had taken the most rigorous science classes my school had to offer, worked in a lab for the past two summers, and prepared myself for months for this trip. As I first entered the lab, I became a bundle of nerves. Everyone was at least ten years older than me, and the room was so quiet you could hear a pin drop. After a tour of the campus and some friendly introductions, the lab workers wanted an idea of what I knew. I received so many questions and a lot of them included words I have never even heard of before. The more times I answered “I’m sorry, I don’t know,” the more I felt defeated. Although I was upset, Dr. Pritesh was excited to teach me and handed me three large text books. From 10:00am to 5:30pm, I read the literature I was given and was determined to do better the next day.

The next day rolled around, and I was finally introduced to Shweta, the woman who would serve as my teacher for the next two months. When she told me today we were learning lab techniques, I was overwhelmed with joy. As she handed me a lab coat and rubber gloves, I finally felt like a real scientist. Unfortunately, day two of working in my lab would be another series of failures. My nerves took over, and I could not complete simple tasks such as using a pipette. Every mistake I could have possibly made, I made.

The entire week was a series of trial and error. On Friday of that week, Shweta gave me my very own lab book. She told me to write the protocol’s we had done throughout the entire week, and memorize them over the weekend. I did as told, and came in Monday ready to go. That Monday Shweta told me something that paralyzed me with fear. She said that all my work this week was independent, but everything I needed to know was in my lab notebook. If I was incapable of doing these tasks with her, how would I manage without her next to me?

This was my time to prove myself. I disposed of my “I can’t attitude” and told myself that I was going to follow the protocol’s and do them well. Although it took triple the time it took Shweta to do it, *I did it*. After I did, Shweta told me something that would forever serve as a lesson. She said, “If I were to stay with you for another week, you would just keep making the same mistakes. The best way to learn sometimes is to struggle through things on your own.”

From that point forward, things began to change. I was no longer viewed as a seventeen year old girl, but a scientific researcher. Everyone in the lab allowed me to assist with their work and taught me complicated lab techniques. Although I still sometimes put the wrong amount of chemicals in the buffer, broke through the gel during electrophoresis, and made numerous other errors, I did not consider them mistakes. They were rather valuable learning experiences that would teach me patience and the skills needed to be a successful scientist.

Growing as a Person

The first week and a half of the internship experience, I was known as the “very polite, but *quiet* girl.” When I first heard this I was a little surprised, because despite my shy nature, I tried to initiate conversations as much as I could. There was just a sense of openness that Indian culture had that American Culture did not; No one shut their bedroom doors, people left their front doors wide open, and everyone treated each other like family. The importance on family-value was evident through family game nights, sports tournaments, and shared meals. Indian culture has taught me to be more open. The more I immersed myself within the culture, the more I fell in love with it. Within the lab, I went from a shy working student to a social butterfly. Not a day went by when me and my lab mates were not swapping American and Indian food, engaging in riveting conversation, and yes, even pranking each other with insects. Although the people within my lab were significantly older than me, I never noticed any barriers between us; it was as if we had known each other for years.

One crucial lesson I learned was that everyone has a story. From talking to some of the most profound research scientists in India, to talking to the local village women, I learned we are more alike than different. One moment that resonated me was when I came home for lunch from my lab and the house maid was making fresh chappatis. Although she could not speak English, she motioned for me to come try and make the chapatti and stir the vegetables. We both laughed at my foolish attempt to flip the bread, and I began asking her questions via google translate. I found out how many family members she had, what her favorite food was, and of course, her favorite music. When I found out we both had a passion for music, she turned on the house radio and began to sing in Hindi. If I hadn’t stepped in the kitchen to observe her, I would have never gotten to know what an interesting lady she was. From that point forward, I made it my goal to not only meet as many people as I possibly could, but share stories.

Fortunately, I had a multifold of opportunities to interact with people and India culture. I had the opportunity to travel to temples and observe Hindu’s pray, partake in a Hindu fast, and even attend a wedding ceremony. Saying that everyone in India treated me like family, was an understatement. When I went to a wedding ceremony for my host family’s cousin, they insisted I enter the family photo. At first I politely refused, because I knew I was not family, but then my host family insisted that I was a part of the family. The wedding taught me more than how to dance, it taught me how to love. The way everyone in India was so welcoming towards me was truly heart-warming. My host families never failed to include me into their family parties, sports tournaments, and weekend adventures.

When I got home, I definitely wasn’t the same person as I was before. Before my internship, I was scheduled to go to Japan for two weeks with my school the day I got back from India. At first, I was fully convinced there was no way I would be able to be abroad for that long. A few weeks before my internship ended, my teacher called me to make sure I was for sure not attending. In India, I developed a love for cultural immersion and exploring new places; the thought of leaving India brought tears to my eyes. Without hesitation, I told her to place my name back on that list. I was fulfilling the promise to myself to learn the story of as many people as I could. I was no longer afraid to dance in public or make spark meaningful conversation with people. Esha and Shanayu taught me the importance of a sibling bond. When I go home, I made

sure I strengthened the relationships between my siblings and parents. Overall I was transformed from a young shy girl to a cultured, open woman.

From High School Student to Global Hunger Fighter

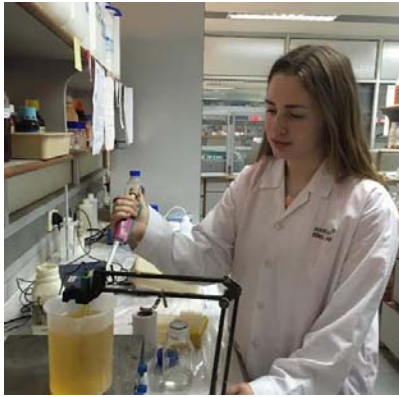
Growing up on the Southside of Chicago, I see hunger and poverty every day. I have spent time in the homeless shelters and soup kitchens in some of the lowest socioeconomic areas in the country. Because of my experiences, I thought I knew hunger and poverty. Unfortunately, I was greatly mistaken.

My first time experiencing hunger in India was simply driving down the streets with my host families. One of the most heartbreaking things I saw was a young boy digging through a pile of garbage and eating. In the streets of Aurangabad I saw a mother with her two daughters living in the streets under a bridge. In this case, the only thing keeping her and her family alive was her pure willingness to survive. There was no homeless shelter or soup kitchen; there was just the three of them in a populated city.

It was not until I volunteered at the Shri Ganapati Netralaya eye hospital that I came face to face with poverty. The eye-hospital serves people of all kind, no matter their income. I saw everything from fungal eye infections, to cataracts in young people, to even farming accidents. Most of the patients were from rural farming communities, so farming accidents filled the trauma center. Normally, I wouldn't associate malnutrition with eye problems. It was not until a young girl walked in with an eye disease resulting from malnutrition that I truly saw how hunger affects every aspect of a person's life. As the mother walked in, I could see the distress in her eyes. The room drew quiet as the mother and doctor exchanged a few words in Marathi then exited out. When I asked what happened, the Dr. told me that because of her disease, she will slowly become blind. The family did not take her to the hospital immediately, because they did not think they could afford it, and now, the mother is concerned who will marry and provide for her daughter. The next day, a middle-aged man walked in who was going blind. He too, did not think he could afford care and waited. Unfortunately this man was a farmer, who won't be able to farm anymore, further, he will not be able to provide for his family.

On the very last day of my internship, I received a call to action. I was walking down the dusty roads in the market place of Jalna when a young boy ran up to me crying and held on to my pant-leg. His rib cage stuck out through his ripped flannel shirt, and his eyes cried for help. He spoke to me in Marathi saying, "Sister, I am hungry. Please help." After my friend and I gave him some rupees, he nodded his head with gratitude and walked down the road. From that day forward, I made a promise to not only that boy, but to myself and the millions of people that go hungry each year. I was going to pursue a career that would allow me to help fight world hunger. I will follow Dr. Borlaug's legacy, and will be a fighter in the battle against global food insecurity.

Pictures



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