

FIELD EVALUATION OF GLOBAL BITTER GOURD GERMPLASM FOR VARIOUS HORTICULTURAL TRAITS



AVRDC

The World Vegetable Center



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WORLD FOOD PRIZE FOUNDATION
2013 BORLAUG-RUAN INTERNATIONAL INTERNSHIP
THE WORLD VEGETABLE CENTER (AVRDC) REGIONAL CENTER FOR EAST AND
SOUTHEAST ASIA
KAMPHAENG SAEN, NAKHOM PATHOM, THAILAND

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ACKNOWLEDGMENTS

I would like to thank the late Dr. Norman Borlaug, founder of the World Food Prize Foundation and the late Mr. John Ruan, for creating the Borlaug-Ruan Internship Program. I also want to thank Dr. Norman Borlaug for impacting the world and inspiring young people like myself to follow in his footsteps.

I want to thank Ambassador Kenneth Quinn for his support in keeping the Borlaug vision alive with a commitment to utilizing science based research to address world food needs. A special thanks to Lisa Fleming for all the hard work and dedication she has given to ensuring the success of the Borlaug-Ruan Internship Program. As each intern embarks on their internship, Lisa's support is appreciated beyond words. Thank you to the World Food Prize Foundation staff for their support and dedication to the Borlaug-Ruan Internship program. Their vision ensures

I would like to thank the individuals that allowed me the opportunity to work in Thailand at the AVRDC World Vegetable Center. Thank you to Doctor Narinder Dhillon, head of the AVRDC's cucurbit breeding program, for teaching me the importance of plant genetics and to always think outside of the box. I want to thank Supunsa Phethin, assistant plant cucurbit plant breeder, for serving as a mentor both in and out of the laboratory. Thank you to Shelia de Lima and Pishayapa Thongmalai for helping me feel welcome during my internship. I would like to thank the rest of AVRDC Staff and Field workers for their continual support and help throughout my stay in Thailand.

Thank you to my former Colo-Nesco High School agriculture instructor Mr. Joshua Day and English teacher Mrs. Lisa Hill for their support and encouragement.

Finally, I would like to thank my parents Craig and Lisa McEnany, as well as my siblings Melissa, Michael, Michelle, Maria, Morgan and Mary for their love, encouragement and support throughout my internship.

INTRODUCTION

I grew up in central Iowa on a small acreage in Nevada surrounded by corn and soybean fields. Growing up in the Midwest, I was exposed to agriculture at a young age. Whether I was spending time at my grandparent's dairy farm or working with my family's vegetable garden, agriculture was always an important part of my life. My first summer job was detasseling and roguing seed corn fields and was my first experience with plant genetics. During my five years working for DuPont Pioneer, I developed a better understanding of how scientists select for desired plant genetic traits. This experience spurred my interest in global food issues and while participating in the Iowa Youth Institute, I realized the important role that plant genetics will play as different groups look for ways to feed a growing population.

The internship served as my first experience outside of the United States. My view on agriculture and food production changed when I traveled to Thailand. Not only was it a new cultural experience, but I saw the differences in agricultural practices, specifically mechanization as we hand watered plants. Working for the AVRDC made me realize that while corn and soybeans are extremely important crops in the Midwest, focusing research on food crops suited to different countries, climates and cultures is essential to empowering individuals with food independence.

BACK GROUND INFORMATION: AVRDC

My internship involved working for the East and Southeast branch of the AVRDC World Vegetable Center with Dr. Narinder Dhillon and his research assistant Supunsa Phethin who both specialize in cucurbit breeding. I was located at the research and training office located on the Kasetsart University's Kamphaeng Saen Campus in Nakhon Pathom, Thailand.

According to the AVRDC World Vegetables Research Center's website, "The Bitter Gourd Project is a not-for-profit project of AVRDC-The World Vegetable Center dedicated to improving the incomes and health of the poor in developing countries—particularly the quality of life of diabetics—through scientific research on bitter gourd (*Momordica charantia* L.)" (AVRDC, Bitter Gourd Project).

There are 285 million people in the world living with diabetes of which 80% of those are in low-income and middle-income countries (AVRDC, Bitter Gourd Project). It has been scientifically proven that bitter gourds can lower the blood glucose level. "Bitter gourd can play a role in the prevention and treatment of Type II diabetes, which is also called insulin-independent diabetes or adult onset diabetes. This form of the disease usually occurs in people who are overweight and inactive. In Type II diabetes, the liver, skeletal muscle, and fat tissues do not respond adequately to insulin—they are 'insulin resistant.'" (AVRDC, Health-Benefits).

Throughout my internship with the AVRDC, I experienced firsthand the dedication and commitment that this organization has towards creating a more sustainable product, increasing yields of bitter gourds benefiting food production and medical possibilities with type II Diabetes.

RESEARCH RESULTS:

INTRODUCTION

Momordica charantia L. also known as Bitter Gourds are rich in phytonutrients including dietary fiber, minerals, vitamins and anti-oxidants. They are also used as a folk medicine to lower the blood glucose in people with Type II Diabetes. The main goal of the bitter gourd project is to improve the yield, fruit quality, field disease resistance, and nutrients content.

The hypothesis of this study is the horticultural traits of each line of bitter gourd germplasm are different. The ages of the male and female flower anthesis, which is approximately 45 days on average, will fall below that average for each bitter gourd line.

The study will evaluate the differences in 186 bitter gourd varieties from 17 different origins. The trial was established using the completely randomized block design. Three plots were created with all 186 entries included with three replications in each test plot, totaling 1,674 plants in the trial. All three plots were in the same location and received the same management.

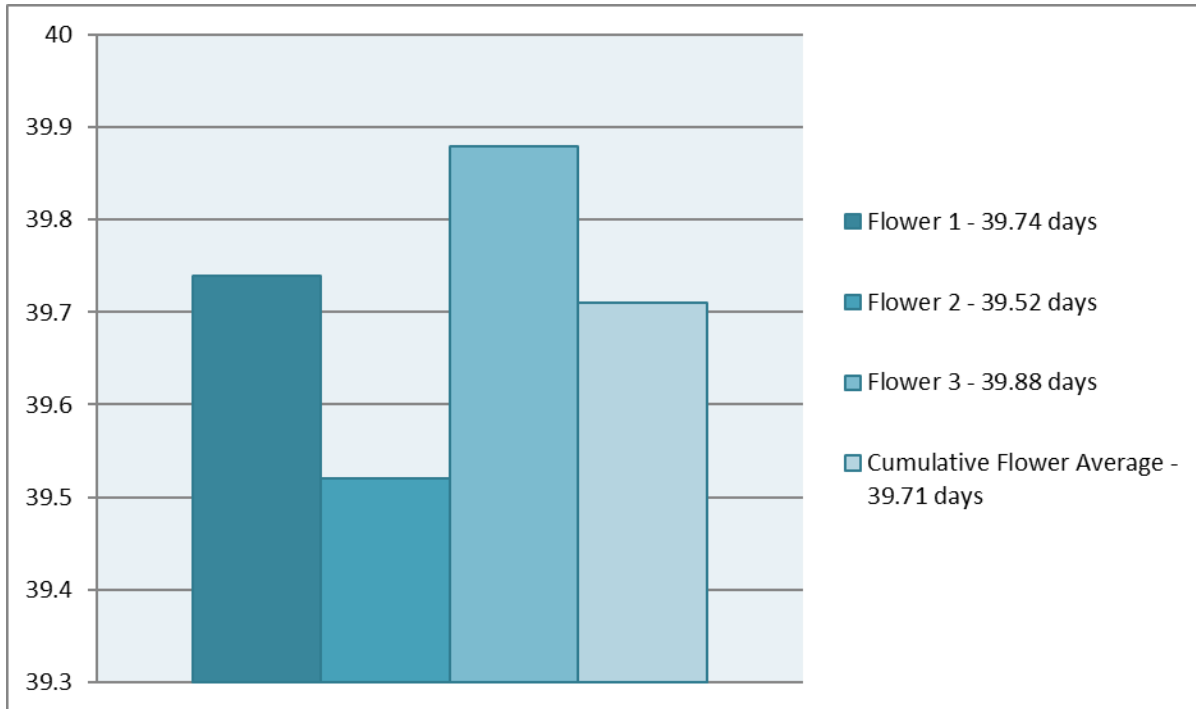
The primary goal of this project was to determine if the anthesis date for female flowers which is approximately 45 days could be improved through earlier flowering dates using selective genetic analysis. This project will determine if male anthesis can be bred earlier as well. This will allow the male flower to be used for pollinating gynoeocious lines and hybrid lines that do not produce male flowers.

To confirm my experiment, I chose to evaluate the number of days that occur from the first observed flowers at intervals of 5, 10, 15, 20 days. This allowed me the opportunity to determine if the Bitter Gourds produce a majority of their flowers early in their production cycle and what percentage of the plants flowered within the established time period.

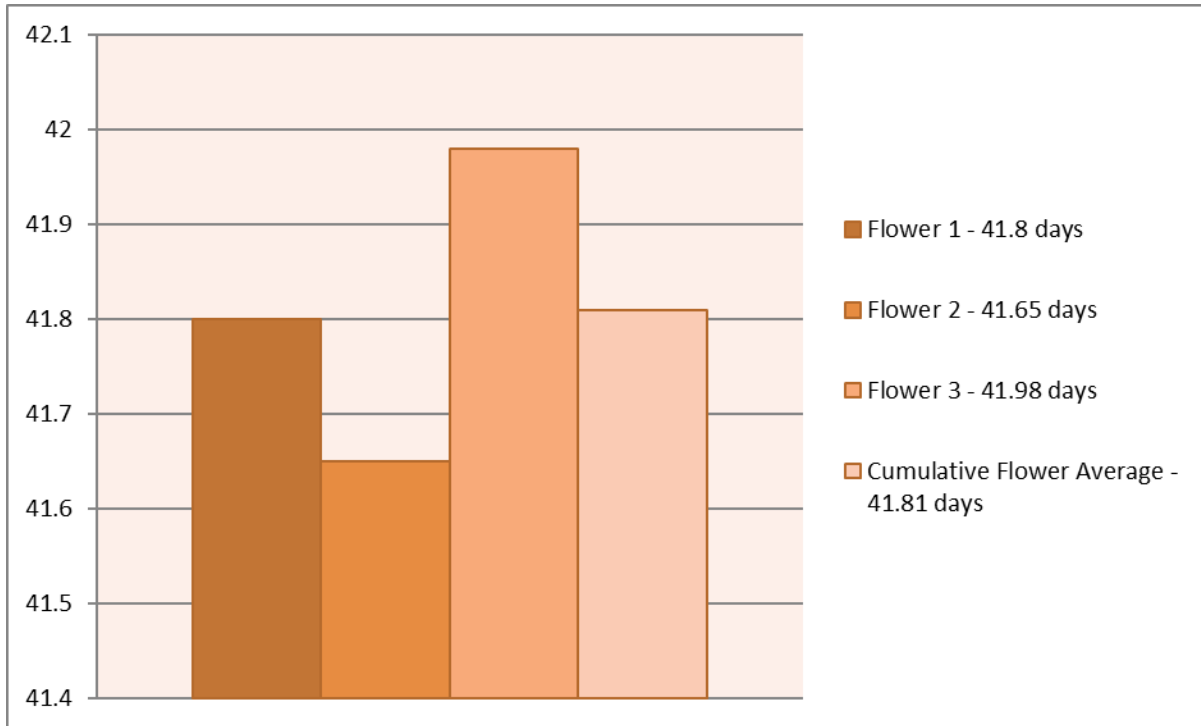
Throughout the course of the experiment, eight plants died and six did not produce a fertile male or female flower. These plants were not included in the analysis as the plant did not produce a viable product.

RESULTS

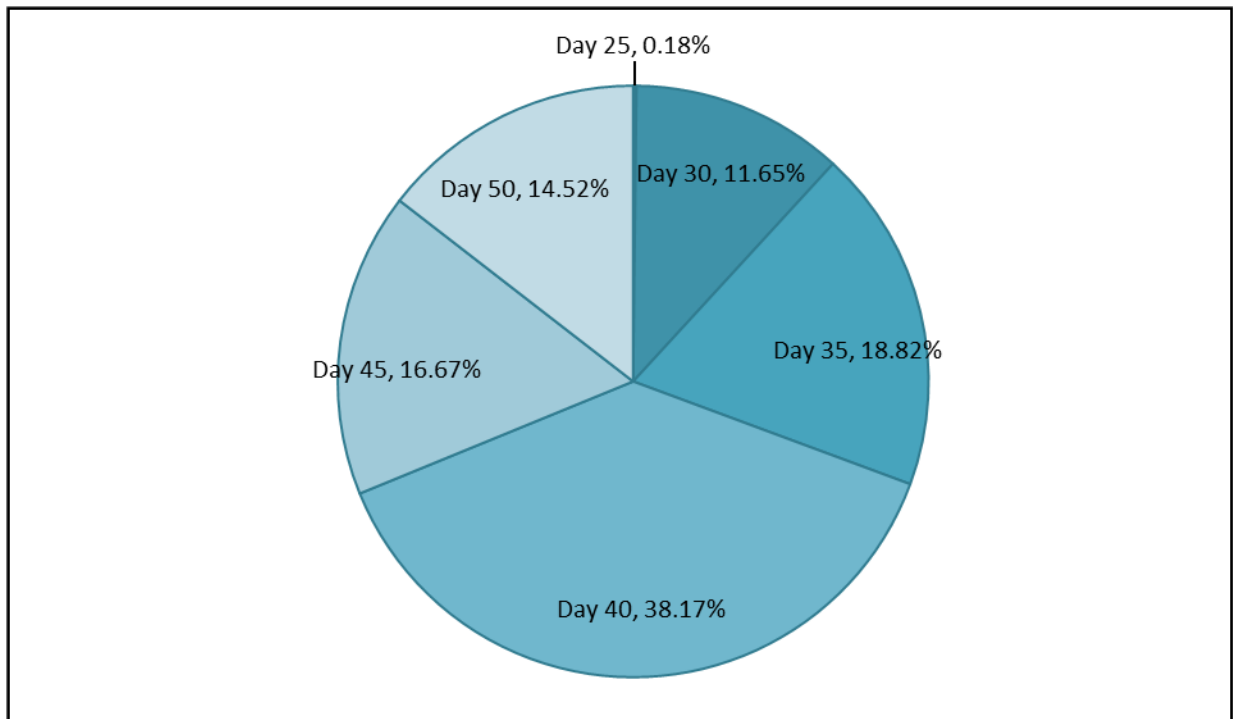
The following graphs show the data analysis that was collected throughout the course of the experiment. The three replications of data were compared to analyze the flowering average for both male and female flowers. The data will be further discussed in the analysis.



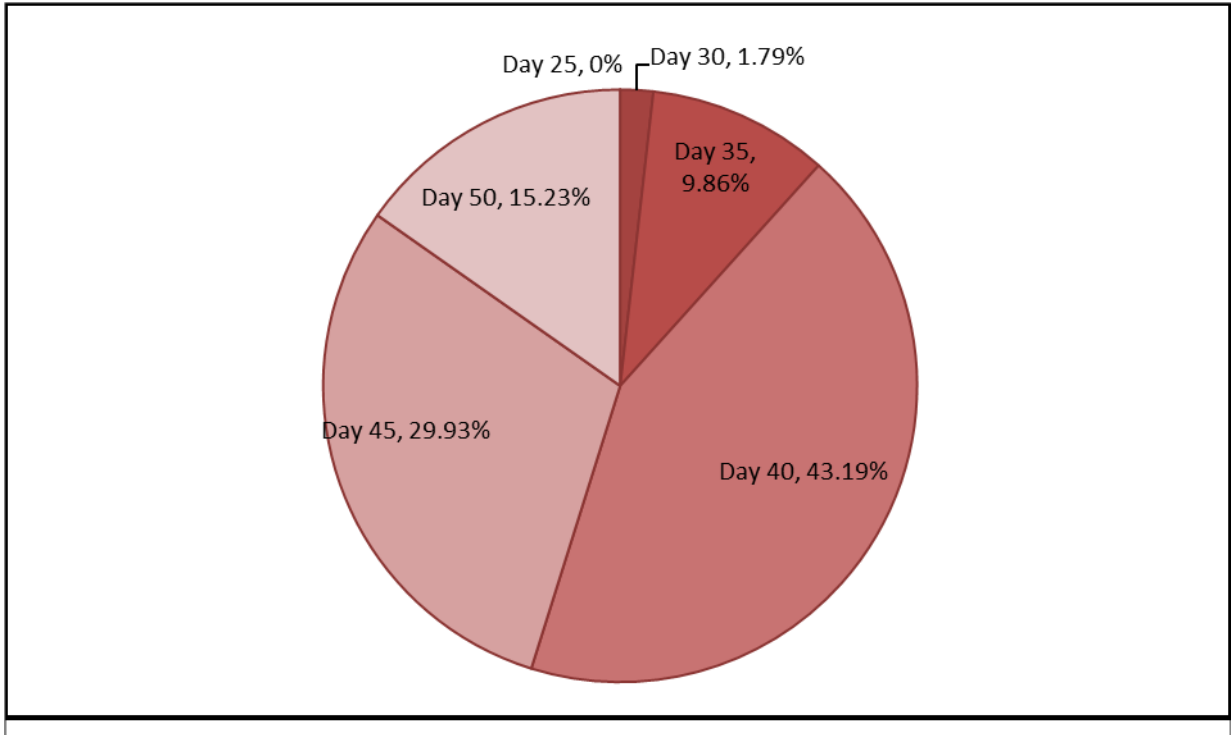
Graph 1-Male Flower Anthesis



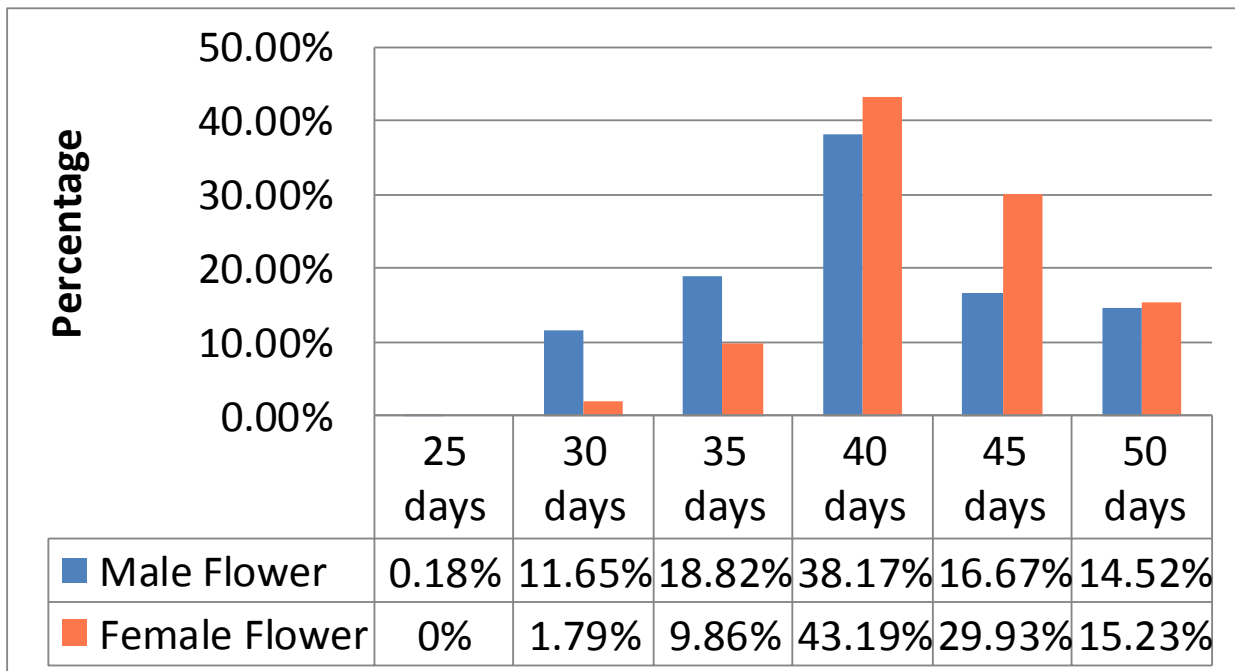
Graph 2- Female Flower Anthesis



Graph 3- Male Five Day Interval



Graph 4- Female Five Day Interval



Graph 5- Comparison of Male and Female Five Day Intervals

ANALYSIS

The male flower anthesis chart in graph 1 represents that the first male flower from all three replications corresponded with the hypothesis and flowered before the 45 days. In Graph 2 the female flower anthesis on average produced flowers prior to 45 days. This proves the hypothesis was accurate in that both male and female flowers can be bred to flower before 45 days. This is significant because if the male flower is bred to flower earlier it can be used to pollinate gynocious lines. This will lead to producing more bitter gourds at a faster rate.

Graph 3 and 4 show the five day intervals of plant flowering dates. The goal of the study was to observe the flower dates using five day intervals to support my experiment. The five day intervals for both male flowering and female flowering dates do show that the majority of bitter gourd plants flowered before or by the forty-fifth day. There were some plants for both the male and female that did not flower until approximately fifty days. The data in Graph 5 compares the male and female flowering rates. Both male and female flowers reached their peak flowering rate around day 40.

OTHER WORK

During my internship I had the opportunity to participate and observe the different aspects of producing bitter gourds. I learned the importance of mulching or using a sheet of plastic tarp to cover the ground around the plant to help prevent weeds and pest from affecting the plant. Trellising is used to help support the plant to grow upwards and to keep the plant off the ground. Plants in the plot were pruned up to about the 8th node. This helped to stimulate the upper branches to help produce a higher yield. I learned the process of pollinating bitter gourd plants. This consists of clipping the male flower closed and covering the female flower. To pollinate you unclip the male flower and remove it from the plant, then you uncover the female flower and rub the pollen on the stigma. After completing this process you recover the female flower.

Strength of the bitter gourd skin surface was tested by rubbing the surface of the bitter gourd. By rubbing the surface you could observe the strength of the bitter gourd because if the several pieces of the bitter gourd fell off it meant it was too weak. What you want for each bitter gourd is to be able to do the skin surface test and lose little to no pieces of the bitter gourd. Strength of the skin was important because if the bitter gourd has a stronger skin surface it will have a longer shelf life. Additionally, it will be better able to be transported from the farm to market without damaging the vegetable.

CONCLUSIONS AND FUTURE WORK

My research was reflected upon the data that I collect during my time working for the AVRDC. The data collected proved that the male and female anthesis can occur in 45 days. From the two trials the greatest bitter gourd varieties will be selected. Bitter gourd research is beneficial to people's health since it is considered a type of folk medicine for people with Type II diabetes. The results from my research will contribute to helping select the most effective genetic lines. Next year, the same trial will be completed, conducted and compared with my results, so the top genetic lines can be selected. The data from both trials collected will also contain the bitter gourds shelf life, skin surface and bitterness which were completed after my departure.

PERSONAL EXPERIENCE

On the morning of June 14 I boarded a plane to leave the United States for the first time and traveled almost halfway around the world. When I left home to embark on this journey, I never imagined I would find another place I could call home. Working in Nakhon Pathom, Thailand for the AVRDC World Vegetable Research Center was absolutely amazing experience.

Traveling internationally was a new experience, as it was the first time I left the country. It was also the first time I left home for such an extended period of time. As a very quiet person, this experience forced me out of my comfort zone and I learned to ask people for help when needed. As one of seven children, it was a new experience to live alone in an apartment. The staff at the AVRDC did an amazing job making me feel welcome during my time in Thailand. I am glad I had the opportunity to work with all of them; they are truly an amazing group of individuals.

I was fortunate that during my internship I was located in Nakhon Pathom, which is famous for its Buddhist temples. I had the opportunity to visit several temples and learn about Buddhism. My favorite temple that I visited was Phra Pathom Chedi which has the largest pagoda or tiered tower in Thailand. I learned Phra Pathom Chedi temple is the official provincial symbol of Nakhon Pathom.

While in Thailand I had the opportunity to travel and see some amazing historical and cultural sites. Thailand has beautiful scenery and architecture. I was able to visit the historical city of Ayutthaya where I saw the UNESCO Heritage Archeological Site and learned about the Burmese invasion around 1767. One of my favorite places that I got to visit was the Grand Palace in Bangkok. It was amazing to be able to travel and experience another countries culture and history.

I enjoyed shopping at the Chatuchak Weekend Market in Bangkok which is full of food, clothing, and people. I also traveled to Talad Thai, the largest vegetable market in

Thailand. The thing that intrigued me the most about Talad Thai is the different types of vegetables including bitter gourds, pumpkins and chili peppers that were available in massive quantities. At these markets I enjoyed trying the different foods available in Thailand, including the extremely spicy dishes that the country is known for serving. I also had the experience of trying coconut ice cream and bitter gourds.

While I enjoyed visiting the markets, one of the biggest shocks I had in Thailand was food safety was not what I was accustomed to in the United States. As I walked through the markets and I would see cartons of eggs sitting outside on the tables. I saw cooked meat and cooked fish sitting on tables that were for sale by street vendors. The majority of the table were located under a canopy. As a customer you would have no idea of how long the food had been sitting out.

I was also surprised the dogs that would roam free on the Kasetsart University's Kamphaeng Saen Campus. This surprised me because in the United States it is not common for dogs to be roaming freely. It was not uncommon for me to wake up in the middle of the night to the sounds of dogs barking.

In Thailand I had the chance to visit a beach for the first time. I visited the Ao Manao Beach where I got to go boating in the Gulf of Thailand. Of all my experiences in Thailand, my favorite was attending an elephant show. While at the show I was able to ride an elephant, which was an exciting experience for a small town Iowa girl.

REFLECTIONS

I was very lucky to work with such amazing people who helped guide me along the way. This experience helped me to broaden my knowledge of human health and food security. This fall I began my first semester at Iowa State University majoring in Agronomy with an interest in continuing to work in plant breeding.

This was my first summer away from home and this experience allowed me to become more independent and responsible. I had to live on my own and learn how to better manage my finances as well as time management.

I have the utmost respect for the men and women who work in the fields in Thailand. They work in extreme heat, but they always have a smile on their face and are laughing. They make the job at hand seem so easy. After spending five summers working in seed corn fields in Iowa roguing and detasseling corn I could sympathize with the workers that spent their days in the extreme heat.

Thailand's average temperatures during the summer months are in the nineties with the heat index in the hundreds, making outdoor working conditions more challenging. I never drank so much water in my life. I'm used to wearing shorts, t-shirt, tennis shoes and a baseball cap while working in the field. In Thailand they wear long pants, long sleeve shirts, scarves wrapped around their heads, big hats and rubber boots while working in the fields to protect them from the sun and they are more modestly dressed. This shows some of the basic cultural differences between the two countries.

After attending the World Food Prize Global Youth institute last fall I knew I wanted to experience the scientific side of food insecurity while having the opportunity to see hunger issues first handed. Through the Borlaug-Ruan Internship I was part of research that could increase the availability of bitter gourds in Thailand.

I was also able to experience the cultural difference and traditions that are celebrated in Thailand, such as riding an elephant. I was also able to visit many historical and cultural sites. One of my favorites was Death Railway Bridge, over river Kwai in Kanchanaburi.

This bridge served as a transport during WWII. It was a beautiful site, but has a significant role in Thailand history and honors the labor of the men who built it.

I thought I had an understanding of world hunger, to fully realize the impact it has on people. One image that will remain with me for the rest of my life was seeing a mother and her malnourished children begging for help in Bangkok when I was shopping in the market. Being able to see how hunger affects people makes it more personal. Having an experience like this gave me a new perspective on hunger and how big of an issue it is really is.

This internship has really taught me to be thankful for what I have. I believe I learned a lot about myself this past summer. One of the most important things I learned from Dr. Dhillon was the importance of thinking outside of the box and to never limiting yourself. I learned that working in research takes a lot of hard work and dedication because it can take years before you see the end results.

My experience this past summer opened my eyes to world hunger issues and the discoveries scientists need to work towards. This summer I realized I want to be a part of the fight against hunger. It is not enough to simply say we have a problem with hunger; we need people to stand up and make a difference continuing to raise awareness. My favorite quote from Dr. Borlaug is, "Food is the moral right of all who are born into this world". Dr. Borlaug was absolutely right when he made this remark because every person no matter where they come from deserves food. Though I never had the opportunity to meet Dr. Norman Borlaug, my life has been impacted by him because I too am pursuing a career working with plants. This internship made me want to pursue a career as an agronomist and explore the options of becoming a plant breeder. By becoming an agronomist and working with soil and plants I hope to further Dr. Borlaug's belief that food is a moral right.

PHOTOS





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