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Academy for International Agricultural Research for Development

Junior Scientists Tandems

Final Report

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Supervisor at German Research Institution: Prof. Dr. Folkard Asch

National University (Country): ---

Supervisor at National University: ---

International Agricultural Research Center (Country): International Maize and Wheat Improvement Center (CIMMYT, Mexico)

Supervisor at International Agricultural Research Center: Dr. Matthew Reynolds

Start and end date of career exploration stay: 26 Jan 2024 – 25 July 2024

Title: Effect of drought stress conditions on leaf pigment composition in spring wheat

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Master's thesis

The internship has lasted six months, from 26th January 2024 to 25th July 2024. My classmate and I traveled together to Mexico, and after a long journey, we safely arrived in Ciudad Obregón. I would like to express my sincere gratitude to CIMMYT and Dr. Jacinta for arranging transportation from the airport and providing accommodation. The first three and half months were spent at the CIMMYT research station of Ciudad Obregon, Sonora, where the field experiments were conducted. The remaining period was at CIMMYT headquarters in El Batan, Texcoco, Mexico City, where I mainly worked on data processing and analysis.

At the CIMMYT Ciudad Obregon research station, I primarily focused on field measurements using handheld devices and remote sensing in the experimental trials of water deficit (drought) and well-watered (yield potential) treatments every week. The seeds are sowing in mid-November, and the measurements were taken until the plants reached the physiological maturity stage at the end of March. A total of 12 genotypes of both treated environments will be the objective of my final master's thesis.

Initially, we collected leaf samples in aluminum foil for lab analysis of leaf pigment composition in both trials. After completing all stages of sample collection, the samples were properly packed and stored in a refrigerator. Once preserved, the samples were dried, carefully repacked and sent to the university for further analysis. During that time, I got hands-on experience with different equipment, such as a Ceptometer, ASD field spectroradiometer, Porometer Licor-600, SPAD, PRI Plant Pen, and FDR soil moisture sensor, and the leaf sampling procedure for pigment composition analysis. The primary challenge was the limited availability and restricted accessibility of the ASD machine due to its high cost. As the pre-breeding department frequently uses it, we had limited opportunities to access it. Additionally, it took me a significant amount of time to take measurements with the machine, so we sought assistance from an engineer to ensure proper use.

The hyperspectral reflectance spectra or spectral reflectance indices were measured using the ASD field spectroradiometer on both canopy and leaf levels with a full range of spectroradiometers (350nm to 2500nm). For the canopy level, the Spectroradiometer was calibrated against a white reference plate (BaSO₄) covered tripod after collecting spectral reflectance readings from every 10th to 15th plot. And, for the leaf level is attached to a leaf clip (Analytical Spectral Devices, Boulder, CO, USA) with a fiber optic cable. The leaf clip had an internal calibrated light source and two external panels i.e. a white panel to calibrate the instrument and a black panel used when measuring leaf reflectance. Due to weekly measurements and the size of panels, we were supported by several assistants who worked at the research station for leaf sampling Dr. Carlos and Dr. Jacinta, CIMMYT, organized the help.

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Spectral Reflectance Indices were collected at both the canopy and leaf levels using the ASD machine



Installing soil tubes and taking soil moisture data by using the FDR soil moisture sensor



PRI and leaf greenness data were measured by using plant pen PRI and SPAD meters, respectively

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Photosynthetically Active Radiation (PAR) and Stomatal Conductance data were collected by using Ceptometer and Porometer, respectively

The research station was lively and bustling, even though a lot of hard work was happening in the fields, which made for an energetic environment. In addition to collecting data for my master's thesis, I had the privilege of participating in CIMMYT's field day on March 12th, where I participated in field visits and attended seminars alongside scientists from various countries. On this special occasion, I had the honor of speaking with and taking a picture with the daughter of Dr. Norman E. Borlaug, and I also received an annual CIMMYT field day photo gallery. Additionally, during available moments alongside the pre-breeding team, I was able to familiarize myself with additional tasks, such as assessing rust damage percentages and measuring yield components.



CIMMYT field day picture

A month after my arrival in Obregón, my initial supervisor, Dr. Carlos Robles, received a job opportunity in Germany and subsequently relocated there. The physiology team organized a wonderful farewell party for him, featuring Spanish music. I thoroughly enjoyed the event, trying various Mexican dishes and meeting new people. It also provided valuable opportunities for scientific discussions and knowledge sharing with esteemed individuals such as Dr. Carlos Robles, and Dr. Matthew Reynold, head of



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CIMMYT's Physiology Department, as well as engineers and visiting scientists. These interactions greatly enriched my learning experience and contributed significantly to my professional development. Throughout the period, my supervisors from the University of Hohenheim, Prof. Dr. Folkard Asch, Dr. Alejandro Pieters, and Geckem, provided continuous and efficient support. We held online meetings every 15 days for updates and to address any doubts.

Stay at El Batán

Before relocating to El Batán, we spent nearly a month downloading the complete datasets from all instruments and Meta-R software with the assistance of CIMMYT engineers. After three months, we moved to El Batán, where my work became less dynamic and more independent. I would like to express my gratitude to Eloisa for her continuous support in logistics, transportation, and housing arrangements. The workspace at El Batán was ideal for focused work, allowing me to begin arranging and analyzing my data. Additionally, I had the opportunity to engage with experts from other departments, such as breeding and seed quality, which further enriched my experience. With the guidance of a post-doctoral researcher, I also learned new analytical techniques, such as conducting principal component analysis (PCA) using R software.

During my time in El Batán, I had the opportunity to meet several Indian scientists and students. One of the CIMMYT employees organized a wonderful trip to Mexico City for visitors, which I thoroughly enjoyed. The day included visits to various museums and ended with a delightful lunch at an Indian restaurant. The primary challenge during my stay was the language barrier. To cope with this, I learned some basic Spanish words; however, I still faced difficulties communicating with my landlord and using public transportation. After completing a six-month stay in Mexico, I arrived safely in Germany. Shortly afterward, I had an in-person meeting with Prof. Dr. Folkard Asch and Dr. Alejandro to discuss the finalization and necessary changes to the data. I am currently focusing on data analysis.



In front of Dr. Norman E. Borlaug statute at El Batán, CIMMYT



Conclusion

I gained valuable experience and knowledge from my supervisors, Dr. Matthew Reynolds and Dr. Carlos Robles at CIMMYT, as well as Prof. Dr. Folkard Asch and Dr. Alejandro Pieters from the University of Hohenheim. I am sincerely grateful for the opportunity to conduct research under their guidance, which effectively addressed the goals and objectives, resulting in the expected outcomes. Being part of the ATSAF-CGIAR++ Junior Scientists Tandems has been a transformative experience, enabling me to develop new skills and contribute valuable insights to my master's thesis research. This program has established a strong foundation for my future in applied research and provided essential financial support for my thesis work, alleviating my financial concerns and enhancing my research opportunities. I would like to extend my heartfelt thanks to ATSAF for their support and for facilitating my pursuit of academic goals.

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