Post-award Report on the Diversity in Science Grant 2024

Project title	**Training Course for Female Plant Pathologists to Learn Molecular Diagnosis of Plant Diseases**
Donor	**Biochemical Society (UK)**
Recipient	**Prof. Manal Eid, Professor of Genetics** Faculty of Agriculture-Suez Canal University. Ismailia- Egypt
Start/End Day of the activity	**From 2 to 4 February 2025**
Location	**Plant Clinic**- Faculty of Agriculture-Suez Canal University. Ismailia- Egypt
Organizers	**Prof. Waleed Shaban** **Prof. Manal Eid**
Submitted Date	**26 February 2025**

List of Trainers and Speakers

Name	Specialization	Institution
Prof. Mahmoud Rifaat	Molecular Genetics	Faculty of Agriculture Suez Canal University, Ismailia. Egypt
Prof. Waleed Shaban	Plant Pathology	
Prof. Manal Eid	Plant Genetics & Bioinformatics	
Prof. Ahmed Ryan and **his group**	Biotechnology	
Mrs. Nira Mohamed	Plant Pathology	
Dr. Abeer Abouelwafa	Plant Virology	Plant Pathology Research Institute (PPATHRI), Agricultural Research Center (ARC). Giza. Egypt

*The report was presented by **Prof. Manal Eid**, a genetics professor at Suez Canal University's Faculty of Agriculture in Ismailia, **Egypt,** who received the award.

*This report highlights the objectives, structure, content, and outcomes of the project, underscoring its relevance in modern agricultural practices.

Title: Training Course for Female Plant Pathologists to learn Molecular Diagnosis of Plant Diseases

I-Introduction:

Plant diseases significantly impact agricultural productivity and global food security. Traditional diagnostic methods, while effective to a degree, often fall short in terms of speed, accuracy, and sensitivity. In response to these issues, the Plant Clinic at the Faculty of Agriculture—Suez Canal University (SCU) in Egypt arranged a three-day technical program and training course from **February 2–4, 2025**, with the goal of providing plant pathology specialists with sophisticated skills in biotechnology and molecular diagnostics.

A significant training course was successfully held to teach on biotechnology and molecular diagnostics as more effective techniques of detecting plant diseases. This course aimed to equip researchers with the skills to shift from traditional diagnostic methods to modern molecular approaches, which offer higher accuracy, speed, and reliability. The training focused particularly on empowering female researchers specializing in plant pathology, reinforcing their roles in advancing agricultural research.

The Biochemical Society's Diversity in Science grant **(2024),** combined with additional support from SCU, enabled us to involve twenty-four female early-career researchers: MSc students conducting research, PhD students, and postdocs working in plant disease research fields. This initiative aligns with international initiatives such as WISTAN (Women in Science and Technology in Africa Network) and OWSD (Organization for Women in Science for the Developing World), which aim to increase flexibility for women with families and to improve research collaboration between individual women scientists by creating research groups of women who can contribute collectively. It also supports the UN SDG (2016-2030) Goal 5, which is to empower women and girls.

II-Background and Objectives:

The Plant Clinic at SCU aims to serve the local agricultural and scientific communities by developing competent and influential future scientists and leaders to meet current and future essential agricultural needs. The most important of these needs is to increase plant production in order to feed Egypt's rising population while employing economically and environmentally sustainable approaches. The training of plant pathologists is essential because there is high demand in the plant protection industries and research institutions for their expertise and scientific innovation to increase food availability and security and improve quality of life.

Traditional plant disease diagnosis frequently relies on visual signs, microscopy, and standard laboratory procedures. While these methods have been used in agricultural research for decades, they are limited by their sensitivity to human error, reliance on subjective analysis, and time consumption. In contrast, biotechnology and molecular diagnostics make use of polymerase chain reaction (PCR), DNA sequencing, and bioinformatics. These approaches are accurate, sensitive, and can detect pathogens at the genetic level, even before symptoms appear.

As a result, one of the primary purposes of the Plant Clinic at SUC was to help plant pathologists improve their practical skills and update their own higher education institutions. The planned project held training at this clinic in Ismailia, Egypt, with the goal of exposing female pathologists to the essential principles and theories of molecular diagnostics over three days, supervised by highly experienced SCU specialists who assisted the training sessions.

The objectives of the training course were:

1. To empower female plant pathology researchers with cutting-edge technological abilities.
2. To introduce participants to the fundamentals of molecular diagnostics.
3. To provide hands-on experience in using techniques like **ELISA, PCR** and gel electrophoresis.
4. To establish a network of trained professionals who can apply these methods to mitigate plant disease outbreaks effectively.

III-The Training Course Structure and Content:

The three-day training course was intended to be intense and conducted in a cutting-edge biotechnology facility. The course was divided into theoretical lectures and practical exercises to guarantee a thorough understanding of molecular diagnostics. Each theoretical lecture was conducted and delivered in person for 60 minutes to ensure maximum effectiveness and was assigned to the course's teaching team, who participated in the lecturing process based on the topics determined in the program's agenda, using the most appropriate method for the materials presented. Participants were encouraged to participate in group discussions, which were structured to give them more opportunities to participate in the learning process. During the practical exercises, the molecular tool is integrated with the use of ELISA and PCR analysis for verification.

Day 1: Molecular Diagnosis of Plant Diseases Using ELISA

The first day began with an inauguration session under the auspices of the dean of the Faculty of Agriculture, which set the stage for the training. The dean welcomed participants and underlined how biotechnology may transform ways to fight against plant diseases.

- **Morning Session:**
- **Lecture1:** Traditional methods of diagnosing plant diseases and the important of the plant clinic in plant pathology field
- **Lecture2**: Immunological diagnostic methods
- **Lecture3**: Branch Chain DNA Technology (bDNA); Micro-plate based automated system
- **Afternoon Session:**

Laboratory-1: Fundamentals of ELISA (Enzyme-Linked Immunosorbent Assay) Technique

- Participants were introduced to **ELISA** procedures and taught the fundamentals, such as detecting and measuring proteins (antibodies, antigens, and hormones) with enzyme-linked antibodies that cause a visible color shift.
- They learnt the ELISA technique through hands-on exercises, using potato virus samples as a positive control (***Datura metel***) and a negative control (**Potato virus Y**), and

followed the practice instructions, which included covering the plate with an antigen to block the reaction and reading absorbance with a microplate reader.

Day 2: Foundations of Biotechnology in Plant Pathology

- **Morning Session:**

❖ **Lecture 4**: Introduction to Biotechnology and Its Role in Plant Pathology

- This session provided an overview of biotechnology, explaining its fundamental principles and how it complements traditional diagnostic methods.
- Topics included:
  - Understanding DNA, RNA, and proteins in plant-pathogen interactions.
  - Key advancements in biotechnology relevant to plant pathology.

- **Afternoon Session**

Laboratory-2: Fundamentals of Molecular Biology Techniques

- Participants were taught laboratory methods such as DNA extraction, gel electrophoresis, and PCR.
- Participants were able to extract DNA from strawberry plant samples infected with pathogens and healthy plants as controls, as well as DNA from fungi and bacteria, through hands-on exercises. These tests were carried out with the bacteria *Xanthomonas fragariae* and two significant fungal diseases (*Colletotrichum acutatum* and *Phytophthorafragariae*) which were thought to be the most likely to infect strawberry plants in the field.

Day 3: Advanced Molecular Diagnostics:

The final day was dedicated to providing participants with the skills required to undertake molecular diagnostics independently.

- **Morning Session:**

Laboratory-3: Practical Instruction in PCR Amplification and Interpretation

- Participants performed PCR on plant samples to detect pathogens.
- Gel electrophoresis was used to visualize amplified DNA fragments.

- **Afternoon Session:**

Laboratory-4: Hands-On Training

- After being split up into groups, participants received plant samples contaminated with unidentified diseases. Each group diagnosed the infections using the techniques they learnt and presented their findings.

❖ **Panel Discussion and close session:**

- The trainers and participants engaged in an interactive session to evaluate the sensitivity, accuracy, and efficiency of molecular diagnostics compared to older methods such as visual inspections and culture techniques. Furthermore, the trainers talked about upcoming technologies like CRISPR-based diagnostics and metagenomics and how they have the potential to transform the field.

- By the end of the session, the participants had received their certificates from the Vice Dean for Post-Graduate & Research, and they expressed their gratitude for attending this training course, which provided them with valuable knowledge and increased their skills and confidence in plant disease diagnosis.

IV- Participants and Their Achievements:

- The course attracted 24 female researchers from various agricultural research institutions.
- The participants were carefully selected based on their expertise in plant pathology and their motivation to adopt modern diagnostic tools.
- Participants demonstrated remarkable progress by completing **a questionnaire** during the course:

➢ All researchers successfully performed DNA extraction and PCR independently.
➢ They gained confidence in interpreting molecular diagnostic results.
➢ Participants proposed strategies for implementing these techniques in their respective institutions.

V-Key Outcomes and Impacts

1. **Enhanced Research Capacity:**
   The course significantly improved the technical capabilities of participants, enabling them to conduct advanced diagnostics in their laboratories.
2. **Empowerment of Female Researchers:**
   By focusing on female researchers, the course promoted gender equality and highlighted the potential of women in leading scientific advancements.
3. **Improved Plant Disease Management:**
   The adoption of molecular diagnostics will lead to earlier and more accurate detection of plant diseases, reducing crop losses and enhancing food security.
4. **Knowledge Dissemination:**
   Participants pledged to train their colleagues, ensuring the widespread adoption of molecular techniques across research institutions.

VI-Challenges and Lessons Learned:

While the training course was a success, a few challenges were encountered:

- **Resource Limitations:** Access to advanced equipment was initially a hurdle for some participants.
- **Skill Gaps:** Participants had varying levels of familiarity with molecular biology, requiring additional effort to bring everyone up to speed.

To mitigate some of these obstacles, participants were given additional help and online tools, such as instructions for easy hands-on tasks and access to the course materials.

Conclusion and Future Direction:

The training course on biotechnology and molecular diagnosis of plant diseases was a resounding success. It equipped female researchers with cutting-edge skills, empowered them to tackle plant health challenges effectively, and laid the foundation for a paradigm shift in plant disease diagnostics. The participants were pleased with their full engagement in the training and requested that the event be repeated with a larger number of registrations. This initiative represents a significant step towards modernizing agricultural research and fostering sustainable development in agriculture. By embracing molecular diagnostics, the agricultural sector will be better prepared to address emerging plant disease threats, ensuring food security for future generations.

Given the popularity of this course, preparations are ongoing to make "Empower early career researchers through biotechnology and green chemistry as well as biochemistry" an annual program to engage more female scientists and offer opportunities in this sector in other cities around the country. Future courses will aim to increase outreach efforts by integrating more institutes and colleges in order to sustain participation and inspire Egypt's next generation of female scientists.

We are grateful for **the Biochemical Society's** tremendously valuable help in making this course possible through **the Diversity in Science Grant**, and we look forward to sharing our future successes as we work to empower scientists of the future.

* This report includes photos that show the event and participants in action. We obtained the relevant permits for their use.

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