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Report on development of training materials for capacity building training 1 for staff by building capacity in plant breeding and biotechnology education and research through partnership program in africa, middle east and europe for agricultural transformation (BREEDTECH) project

Submitted by BREEDTECH Project team

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Executive Summary

The Building Capacity in Plant Breeding and Biotechnology Education and Research through Partnership Program (BREEDTECH) aims to foster cutting-edge research and innovation that addresses the challenges of sustainable agriculture and climate resilience across Africa and Middle East. This report focuses on training of staff from Higher Education Institutes (HEI's) and presents an overview of two intensive training workshops that will be delivered by the Swedish Agricultural University (SLU) in Sweden and Scuola Superiore Sant'Anna (SSSA) in Pisa, Italy. These workshops are designed to provide academic and/or research staff with essential skills and knowledge in modern breeding technologies and interdisciplinary research methods. Participants will come from six HEI's including Egerton University and Laikipia University (Kenya), Haramaya University and Oda Bultum University (Ethiopia), and An-Najah National University and Al-Quds University (Palestine).

The first workshop at SLU will be held from June 23rd to 27th, 2025, and will introduce participants to advanced techniques such as CRISPR gene editing, microbiome-assisted breeding, Spray induced gene silencing and genomic selection. The program will combine lectures, hands-on lab work, and field visits, providing participants with both theoretical knowledge and practical experience in modern crop improvement methods. The second training workshop, taking place from September 22–30, 2025, at SSSA, will adopt a multidisciplinary approach, integrating plant science, climate science, genomics, agrometeorology, and participatory methods. This workshop will focus on equipping participants with the skills to merge genetic, climatic, and socio-economic data to drive sustainable crop improvement strategies. In addition to lectures and practical sessions, the workshop will feature case studies, field visits, and management meetings to foster collaboration and establish long-term partnerships among the

participating institutions.Together, these workshops will provide participants with the technical expertise, systems approach, and collaborative skills necessary to advance research and contribute to the development of climate-resilient agricultural practices.

1.0 Introduction

Capacity building and staff retooling, often involves training and development. These are crucial for staff to enhance skills, adapt to changes, and improve overall performance. This process aims to strengthen a workforce's abilities to carry out tasks, adopt new technologies, and ensure they are equipped with the necessary knowledge and expertise. In BREEDTECH project this capacity building activity for Palestinian and African partners, two training courses will be conducted, one in Swedish University of Agricultural Sciences (SLU), the second one in The Sant'Anna School of Advanced Studies in plant breeding and biotechnology.

The courses will not only include theoretical training sessions, but also practical sessions through field visits. The aim of this activity is to provide the participants with hands-on experience and knowledge about the latest techniques and advancements in the field of plant breeding and biotechnology. The participants will be able to apply the newly acquired skills and knowledge to their respective universities, contributing to the improvement of the teaching and research programs in plant breeding. four participants from each Palestinian and African HEIS will be selected based on their experience and qualifications in the field, ensuring that they will be able to effectively utilize the training opportunity. The training sessions that will be conducted for 5 days will be designed in consultation with experts in the field to ensure that they cover the most relevant and up-to-date information. Overall, this capacity building activity will contribute to the development of the next generation of plant breeders in Palestine and

Africa, providing them with the necessary skills and knowledge to address the challenges of food security and sustainable agriculture.

2.0 Development of Training materials for capacity building training for staff

2.1 Training needs assessment

This involved profiling of target groups and identification of topics of training with an intendend outcome of content of courses that is is agreed between partners. A needs assessment was conducted to identify knowledge gaps and capacity-building requirements among university staff from African and Palestinian HEI's in plant breeding and biotechnology. Each
institution submitted documents outlining their staff's specific advanced training needs, which were reviewed to highlight key areas for further development. In response, the training institutions tailored their contributions to address these needs, ensuring a balance between their areas of expertise. This approach ensured the program provided specialized training that directly targeted the knowledge gaps while building on the existing expertise of the staff.

2.2 Profile of Target Groups

Twenty-four staff (4 staff per Higher Education Institution) will participate in the training sessions in Sweden and Italy. The selection process was designed to ensure diversity and gender inclusiveness, with participants coming from various fields including plant pathology,plant breeding, Agricultural engineering,horticulture and crop protection.

2.3 Overall Areas of Focus

The first Workshop at SLU will provide with a comprehensive introduction to cutting-edge Next generation crop breeding technologies. The training will focus on modern

techniques such as CRISPR gene editing, microbiome-assisted breeding, and genomic selection. Key topics covered include genetic markers, high-throughput phenotyping, RNA interference for pest control, and advanced data analysis using GWAS. The workshop aims to build technical capacity and foster knowledge exchange to support sustainable agriculture and innovation in academic and research programs. The second workshop at SSSA will focus on addressing the challenges of climate-resilient agriculture through a multidisciplinary approach. Participants will learn how to integrate plant science, climate science, genomics, agrometeorology, and participatory methods to improve crop adaptation to climate change. The workshop will include lectures, practical sessions, case studies, and field visits, promoting a collaborative learning environment. Key topics include the impact of climate change on agriculture, genomic tools for breeding, and integrating farmers' knowledge to support sustainable crop improvement Below is an excerpt from the schedules currently designed for the SSSA training and the SLU training. The program is subjected to adjustments where necessary.

3.0 The program of the courses and Structure of the lectures

3.1 First Staff Training workshop in Swedish Agricultural University (SLU), Sweden

This training is scheduled to be done between June 23rd- 27th 2025. The training will involve 24 staff drawn from Kenya, Ethiopia and Palestine. The trainers will be drawn from the different departments with SLU with expertise ranging from plant breeding, biotechnology and microbiome. The participants will also have a field visit and a reflection session. The participants will network and create partnerships with the training thereby creating opportunities for future engagements. The participants

will also have an opportunity to engage in a trade fare hence have a chance to interact and engage with the industries within Sweden.

Table 1: Saff Training Schedule at SLU

Next-Generation Crop Improvement: CRISPR, Microbiomes, and Advanced Breeding Techniques

1st StaffTraining workshop -SLU(Sweden): June 23rd- 27th 2025
Participants: STAFF (24)

Day 1 – Plant Breeding, Genetic Markers, and Phenotyping

Time	Session	Format
08:30–09:00	Registration & Welcome Remarks	Opening Session
09:00–10:30	Introduction to Plant Breeding & Genetic Markers	Lecture
10:30–11:00	Coffee Break	Break
11:00–12:30	Marker-Assisted Selection & Use of Genetic Markers	Lecture
12:30–14:00	Lunch Break	Break
14:00–16:00	High-Throughput Phenotyping	Hands-On Lab
16:00–16:30	Coffee Break	Break
16:30–17:30	High-Throughput Phenotyping (continued)	Hands-On Lab

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Day 2 – CRISPR Theory and Practice with Oilseed Rape

Time	Session	Format
09:00–10:30	CRISPR Technology in Crop Improvement	Lecture
10:30–11:00	Coffee Break	Break
11:00–12:30	Design of CRISPR Gene-Editing Experiments	Lecture
12:30–14:00	Lunch Break	Break
14:00–17:30	CRISPR Editing in Oilseed Rape	Hands-On Lab

Day 3 – Microbiome-Assisted Breeding

Time	Session	Format
09:00–10:30	Microbiome Interactions and Crop Improvement	Lecture
10:30–11:00	Coffee Break	Break
11:00–12:30	Demonstration: Microbiome Data Sets & Analysis	Demo
12:30–14:00	Lunch Break	Break
14:00–17:30	CRISPR Editing in Oilseed Rape (continued)	Hands-On Lab

Day 4 – RNAi & SIGS Technologies

Time	Session	Format
09:00–10:30	Introduction to RNAi for Pest & Pathogen Management	Lecture
10:30–11:00	Coffee Break	Break
11:00–12:30	Design & Application of RNA Molecules	Lecture
12:30–14:00	Lunch Break	Break
14:00–17:30	SIGS Hands-On Testing	Hands-On Lab

Day 5 – GWAS, Genomic Selection, and Data Analysis

Time	Session	Format
09:00–10:30	Principles of GWAS and Genomic Selection	Lecture
10:30–11:00	Coffee Break	Break
11:00–12:30	Data Analysis in GWAS	Limited Hands-On
12:30–14:00	Lunch Break	Break
14:00–17:30	CRISPR Editing in Oilseed Rape (wrap-up)	Hands-On Lab

Day 6 – Field Visits and Reflection

Time	Session	Format
09:00–12:30	Field Visit: Application of Breeding Technologies	Visit

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Time	Session	Format
12:30–14:00	Lunch Break	Break
14:00–16:00	Reflection & Q&A Session	Group Discussion

3.2 Second Staff Training Workshop Sant'Anna School of Advanced Studies (SSSA), Italy

This training is scheduled September 22nd to 26th 2025. It will involve 24 staff members from Kenya, Ethiopia and Palestine.The trainers will me experts from SSA who will covers aspects of climate change and its impact on agriculture, agrobiodiversity in breeding, genomics and data driven breeding among other topics. The training will engage hands-on sessions and and case studies to bring out the local contexts into perspective. The traing will have team bonding and networking session with an execurision in the learning tower of Pisa and the Botanic garden. This will not only create a learning workshop but a nerworking and collaborative environment for future engagements.

Table 2: Staff Training Schedule at SSSA

Day	Time	Activity	Facilitator(s)
Monday-22/9/25	**African and mediterranean agriculture in the climate crisis**		
	8:30-9:30am	• Registration • Welcome, introductions of ISP/SSSA • Round table introductions • Course Orientation	Institute of Plant Scienze (ISP) Director: Prof. Matteo Dell'Acqua
	9:30 – 10:15am	Topic: The State of the Climate	Prof. Roberto Buizza
	10:15-10:30am	Questions and Discussion	
	10:30-10:40 am	**Group photo**	
	10:40-11.10am	**Coffee Break**	
	11:10-12:00 pm	Climate crisis impact on Agriculture	Prof. Matteo Dell'Acqua
	12:00-1:00pm	**Questions and Discussion**	
	1:00 - 2.00pm	**Lunch break**	
	2.00-3.00pm	Topic: Agrometeorology tools and crop models for decision making	Robel Takele/Roberto Buizza

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	3.00-4:00pm	Case study: Focus Africa (prototype)	Matteo Dell'Acqua/Robel Takele
	4:00-4:30pm	Questions and Discussion	
Tuesday-23/9/25	**The value of agrobiodiversity for breeding**		
	9:00 - 10:00 am	Topic: Understanding Agrobiodiversity: Origins, Conservation, and Access	Prof. Paolo Barberi
	10:00-10:30am	Questions and Discussion	
	10:30-11:00am	**Coffee break**	
	11:00-11:45pm	Topic: DNA sequencing methods and genebank genomics	Mercy Macharia/Svenja Mager
	11:45-12:30pm	Questions and Discussion	
	12:30-1:30pm	**Lunch break**	
	2:00-4:30pm	Laboratory Facility visit (Students to present 3 minute oral /slides presentation of their projects)	Leonardo/Afwerki
Wednesday-24/9/25	**Genomics-driven breeding**		
	9:00 -10:00am	GWAS and QTL mapping methods	Prof. Matteo Dell'Acqua

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	10:00 - 10:30am	Questions and Discussion	
	10:30-11:00am	**Coffee Break**	
	11:00-12:00 pm	Genomic selection methods	Leonardo Caproni
	12.00-12:30pm	Questions and Discussion (practical applications of GS in research and teaching)	
	1:00-2:00pm	**Lunch break**	
	2:00-4:30pm	Practical session: GUI platform for Genomic Selection and introduction to R tools	Matteo/Leo/Svenja/Ettore
	Day 4		
Thursday-25/9/25	**Genomics of local adaptation**		
	9:00 – 10:00am	Climatic information to genomic data to drive breeding innovation Case study 1:	Simone Castellana
	10:00-10:30am	**Coffee break**	
	10:30-11:30pm	Climatic information to genomic data to drive breeding innovation Case study 2:	Leonardo Caproni

	11:30-1:00pm	Questions and Discussion	
	1:00-2.00pm	**Lunch break**	
	2:00-3:00pm	Sustainable cropping sytems	Camilla Moonen
	3:00-4:00pm	Accessing farmers' traditional knowledge to support adaptation	Valentina D'Amico
	4:00-4:30pm	Questions and Discussion	
	5:30 - onwards	**Dinner /Pizza / networking**	
Friday-26/9/25	**A data-driven framework for crop breeding**		
	9:00-10:00am	Combining genomics, farmers' knowledge, and climate data to accelerate crop improvement	Prof. Matteo Dell'Acqua
	10:00-10:30am	**Coffee break**	
	10:30-12:30pm	Challenges and opportunities of Designing Multidisciplinary studies(combining climate and breeding)	Prof. Matteo Dell'Acqua
	12:30-1:00pm	**Questions and Discussion**	
	1:00-2:00pm	**Lunch**	
	2:00-4:00pm	Course wrap up and assessment	
	4.00pm - onwards	Excursion – Leaning Tower of Pisa, Botanical gardens, and an Aperitivo afterwards	

3.3 Training Resource materials

The workshop were interactive and multidisciplinary, combining theoretical lectures with practical sessions to provide university teaching and research staff with a comprehensive learning experience. The content integrated the latest research to ensure it is evidence-based and aligned with current developments in the field. All lectures, training manuals, and datasets have been made available to participants and beyond. The full set of learning resources including presentations, protocols, example datasets, reference articles, and other supporting materials are accessible on Figshare (DOI: **https://doi.org/10.6084/m9.figshare.30811823**), where it is permanently stored, openly accessible, and easy for any user to follow. A complete backup is also maintained on the Al-Quds University Teams platform, which is used collaboratively by all institutions in the program.

The uploaded materials include:

1.Training programmes, providing a detailed overview of daily activities, learning objectives, session topics, and practical components.

2. Lecture presentations covering all theoretical modules, including introductory concepts, methodological guidance, analytical workflows, and applied examples.

3.Laboratory and field protocols, outlining step-by-step procedures used during practical sessions; these are provided as stand-alone documents to facilitate replication and independent use.

4.Training materials and datasets, including all files used during hands-on exercises, enabling participants to repeat analyses, follow demonstrations, and further practice independently.

5.Peer-reviewed papers and reference articles, which formed the scientific foundation for lectures and practical activities. These documents provide additional background reading, methodological justification, and context, supporting deeper learning and encouraging further exploration by participants.

All resources are clearly organised, labelled, the user can readily navigate the content, understand the procedures, and apply the same methods in their own research or teaching environments.

The Staff Training materials are open access and available on the BREEDTECH project webpage on this link

https://breedtech.edu.ps/training-for-staff/