Newsletter | September 2023 | Issue no. 19

MIRRA

Methods for Irrigation and Agriculture

The AZMUD Project Symposium: Presenting the Final Results of an EU PRIMA-funded Project

Cultivating Cutting-Edge Agricultural Technologies: Highlights from AZMUD Project 2020-2023

Demonstration & Validation in Action: AZMUD Technologies in Action at MIRRA's Climate-Smart Farm in the Jordan Valley

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The AZMUD Project Symposium: Presenting the Final Results of an EU PRIMA-funded Project

By Will Thompson

The AZMUD project was an internationally led, collaborative effort to develop new climate-smart technologies to improve the performance of greenhouses in the Mediterranean region. Between 2020 and 2023, representatives from France, Spain, Egypt, Turkey, and Jordan worked together to develop relevant technologies for farmers to create a more climate-resilient agriculture sector. Over three years, the project achieved innovations in low-energy drip-irrigation, joule root-zone heating system, slow-release organic pesticide and fertilizer, transparent PVs, magnetic water treatment, and biodegradable plastic film, and well as IT solutions to digitalize the data collection process for farmers.

AZMUD Project Partners at the Final Symposium held in Amman, Jordan in September 2023.

This symposium represented the end of this project and MIRRA – the project's Jordan partner – hosted this two-day event to gather all partners and relevant stakeholders to discuss the future of these technologies, and how they may be applied across different sectors. The symposium attracted a variety of stakeholders representing many facets of the agriculture sector and natural resource management:

Maha Aqra, the National Center for Research and Development in Jordan, speaks at the AZMUD Project Symposium.

he Jordanian Ministry of Environment

The Jordanian Ministry of Agriculture

Higher Council for Science and Technology

The National Center for Research and Development

Cewas Middle East

Action Against Hunger

Current River

Jordan Forum for Business and Professional Women

MENA Hydroponics

Sustainability Excellence

International Water Management Institute

A sincere thanks is given to PRIMA and the European Union for generously supporting this project and directly contributing to a vital advancement in climate-smart technologies. Their contribution has paved the way for an important step forward towards better greenhouse technologies, as well as international collaboration and mutual understanding between stakeholders across the Mediterranean.

Several Stakeholders from Jordan and the AZMUD Project Consortium Partners at the AZMUD Project Symposium in Amman, Jordan

Cultivating Cutting-Edge Agricultural Technologies: Highlights from AZMUD Project 2020-2023

By Jane Beeler & Samer Talozi

For the first day of the symposium (September 27th, 2023), representatives of organizations from Jordan and around the world gathered in Amman, Jordan at the AZMUD symposium, hosted by MIRRA, to discuss progress made in various agricultural technologies. These technologies were developed by the AZMUD project partners, which worked from April 2020 to September 2023 on the "Improvement of Mediterranean Greenhouses Performance using Innovative Plastic Materials, Natural Additives and Novelty Irrigation Technologies. " The following is an overview of the six agri-technologies presented.

The start of soilless cultivation of cherry tomatoes at MIRRA's Climate-Smart Farm in the Jordan Valley

Joule Heating Conductive Plastic Sheets for Hydroponic Systems:

This innovative technology has been designed by AIMPLAS, based in Spain. Founded in 1999, AIMPLAS consists of over 800 associated companies and more than 240 trained professionals.

AIMPLAS focuses on thermoplastics and thermoset pilot plants, coatings, polymer and nanoparticle synthesis, clean rooms, and testing facilities.

The Joule heating system utilizes a polymeric material which exhibits properties similar to semiconductor material. When an electric current is applied, the system applies localized and homogeneous heat to plant roots, allowing for precise temperature control of the water through day and night.

One of the AZMUD project technologies, the Joule Heating Conductive Plastic Sheets, used to heat the root-zone in soilless agriculture, a technology developed by AIMPLAS

This reduces greenhouse heating needs, which saves energy previously consumed in a climate-controlled system. AIMPLAS has observed an increase in plant growth rates — especially in early growth stages — when this technology is implemented. When the technology was in use, the temperature of the water stayed between 18 and 22 degrees Celsius at both day and night. Without the technology, unregulated water temperatures frequently dropped to 0 degrees Celsius at night.

AIMPLAS is actively working on a plan for dismantling and recycling all components of the system. The Joule system has a 5 -10 year life cycle. The main challenge faced in the production of this technology is the automation of the industrial process.

Biodegradable Films For Agriculture:

AIMPLAS is also working to develop biodegradable films designed to serve as protective coverings or mulch for soil surfaces.

Biodegradable plastic mulch piloted with the Okra crop cultivated at MIRRA's Climate Smart Farm in the Jordan Valley

This film provides an easier end-of-life procedure than standard conventional plastic mulch, as it has no adverse impact on the soil, reduces waste and labor, and requires no landfill disposal. The film's life cycle begins as its non-degradable counterpart (the soil is prepared, the film is installed, and plant growth begins). However, the end-of-life procedure only requires mixing biodegradable material into the soil to degrade the left-over film.

The development of this technology is ongoing, and there are not yet results regarding yield with the biodegradable film. The film meets biodegradable standards, such as expected germination and plant growth, and maintenance of invertebrates, microorganisms, and bacteria. 32% of the material was converted to CO2 in 160 days, and AIMPLAS anticipates that 90% will be converted within 24 months. The chemical composition of the film contains no substances of high concern. The film meets property requirements such as tensile strain and stress at break, impact resistance, light transmission, and aging.

Semi-Transparent Photovoltaic (PV) Modules

SMARTWALL, a company based in France, is developing semi-transparent PV modules, specifically for off-grid systems and applications.

The PV modules are semi-flexible, curved, light-weight, and have controlled light transmission. The PVs balance the light needs of plants and energy efficiency using adjustable transparency. The energy systems for these modules utilize recycled Li-batteries from electric vehicles, which have storage up to 24 kWh and can supply 230 VAC to 6 kVA of energy. The panels can be easily installed on greenhouses roofs or ground structures. They connect to electrical cabinets using a clear wiring diagram and standard AC and DC connections.

Semi-Transparent Solar Panels from AZMUD Partner, SmartWall in France installed at MIRRA's Climate-smart Farm in the Jordan Valley

Slow-Release Pesticides:

Idai Nature, part of the ROVENSA NEXT group based in Spain, is developing natural biocontrol products for greenhouses to reduce reliance on chemical pesticides in agriculture. These chemical pesticides negatively impact the environment,

and supermarkets are demanding the use of more natural products. Idai Nature is working in conjunction with the European Union in order to reduce pesticides in the agriculture market.

Pesticides developed by IdaiNature are being tested inside the Soilless greenhouse at MIRRA's Climate-smart Farm in the Jordan Valley

Idai nature selected four substances containing natural ingredients for testing. While conventional pesticides attack all bacteria and diseases in the soil, these substances attack specific targets depending on their composition. Currently, these substances are contained in small capsules which break down in the soil to release the solution. Idai Nature is working to protect the ingredients in these substances, to decrease required dosage, and to allow them to be included in foliar sprays like conventional pesticides.

Low-Energy Drip Irrigation System:

MIRRA is working to develop a low-energy drip irrigation system with activation pressure of ≤ 0.5 bar. The low-pressure irrigation systems reduce the hydraulic energy per volume of water by nearly 50% compared to commercial emitters with activation pressures between 0.5 and 1.0 bar.

An Automated Solar Water Pump at MIRRA's Climate-Smart Farm

This reduction in energy usage decreases greenhouse gas emissions due to electricity generation. Due to the lower energy cost, farmers may be incentivized to install off-grid solar-pumped drip systems rather than using grid electricity or diesel fuel. Furthermore, the drip irrigation system reduces water usage compared to conventional irrigation systems.

The Magnetic Water device, developed by NRC, Egypt, is being validated at MIRRA's Climate-smart Farm in the Jordan Valley

Magnetic Water Treatments:

The National Research Center (NRC), the largest multidisciplinary R&D Centre in Egypt, researches major areas of industry, health, environment, agriculture, basic sciences and engineering. NRC is developing a magnetized water treatment system for irrigation. In this system, saline irrigation water passes through a magnetic field, or seeds are soaked in the magnetized water for better germination rates. This process has numerous benefits, including enhanced plant growth and yield, protection against disease and insects, and improved water-use efficiency.

NRC's trials yielded positive results, such as enhanced germination, increased growth, stronger root systems, and less bacterial growth in water sources.

NRC leads workshops, training sessions, and symposiums, in addition to providing policy recommendations, in order to promote the widespread adoption of this technology, and the other AZMUD project developed technologies, in common agricultural practice.

The first part of the symposium's first day concluded with a complete review of all developed technologies, their progress, as well as their market readiness level for commercialization. After the presentations, MIRRA opened the floor to a Q&A discussion where local stakeholders could ask questions about the applicability and capabilities of these new technologies. A lively and fruitful discussion highlighted critical issues in Jordan's agriculture sector, how these technologies could impact farmers, as well as other segments of Jordanian society demonstrating the wide-ranging influence of climate-smart technologies on society as a whole. The second day of the symposium dealt with the realities of implementing these technologies on the ground.

Demonstration & Validation in Action: AZMUD Technologies in Action at MIRRA's Climate-Smart Farm in the Jordan Valley

By Emma Failmezger & Will Thompson

During the second day of the AZMUD symposium, MIRRA took the project's partners to the Jordan Valley to see MIRRA's Climate-Smart Farm and witness first-hand the developed technologies in action.

The AZMUD Project's Partners at MIRRA's Climate-Smart Farm in the Jordan Valley

Over the course of the project, MIRRA's team has installed and field-tested each partners' developed technology to evaluate its performance in the northern Jordan Valley Mediterranean climate and farming conditions. Representatives from each partner gathered at the farm to see MIRRA present field results of how each technology has performed, as well as the operational reality of each technology on a sample farm in the Jordan Valley.

Each of the developed technologies – low-energy drip irrigation, joule root-zone heating system, slow-release organic pesticide and fertilizer, transparent PVs, magnetic water treatment, and biodegradable plastic film – target different sources of energy consumption and inefficiency. When implemented together as a cohesive system, these technologies reduce energy and water consumption thereby reducing greenhouse gas emissions expelled from operating greenhouses therefore making them a superior alternative to comparable conventional greenhouses.

A Highly Controlled Environment for Soilless Agriculture in the Jordan Valley

Low-energy drip irrigation systems that requires an activation pressure of 0.5 bars or less were adapted by MIRRA for greenhouse irrigation. These systems activation pressure is significantly lower than the 1 bar threshold used by most conventional drip-irrigation systems. When combined with soilless agriculture, this new low-pressure drip-irrigation can reduce energy needs for pumping irrigation water by 50%. Moreover, the low-activation pressure still achieved an excellent irrigation uniformity allowing for a reduction in energy without sacrificing water use efficiency.

Solar power and semi-transparent PVs can further reduce the energy needs for greenhouse cooling/heating and irrigation. A life cycle assessment (LCA) of these technologies, conducted by MIRRA, demonstrated that all tested products in the AZMUD project attained a sufficient quality index for carbon methane, chloride, and arsenic emissions according to OSHA standards, NIOSH standards, and the US Environmental Protection Agency.

Low-energy Drip Irrigation Systems is Piloted in Jordan along with temperature and humidity sensors as part of the AZMUD project

Welcome!

Hello there, my name is Jane Beeler and I'll be joining MIRRA as an intern for the upcoming fall semester. I am currently a student at Georgetown University's School of Foreign Service (SFS), and I'm passionate about studying Arabic and delving into Middle Eastern culture. With this being my first time in Jordan, I am excited to acquire experience of life in the Middle East, and gain first-hand insight into the water and agricultural challenges within Jordan. I am excited about an enriching semester ahead!

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