Innovative irrigation technology towards improving irrigation efficiency in the field

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ARO, is the research arm of the Israeli Ministry of Agriculture, covering over 70% of the agricultural research in Israel
Irrigation

• Irrigated agriculture is using increasing quantities of water and fertilizers to supply the growing food demand.
• However, the uptake by various plants is only 30 to 50% of the water applied.
• Even, drip irrigation efficiency is about 50-70%
• The remaining water flows to surface water and groundwater.

Irrigation management measures

• Decision on irrigation amounts/scheduling
• Sensor-based
• Remote-sensing
• Continuous in time
• In-field variability
Evaporation, evapotranspiration

- Pan evaporation
- Penman–Monteith (net evapotranspiration (ET))
- Remote-sensing
- Mostly assist with decisions on irrigation amounts
- Crop coefficients – fixed tables
- Whole field

Soil measures

- Soil moisture
- Soil water potential
- Continuous measurements
- Mostly assist with decisions on irrigation amounts
- Detection of water stress
- Requires calibration to soil type
- Whole-field
Plant measures

- Leaf/stem water potential
- Dendromets
- Continuous measurements
- Mostly assist with decisions on irrigation amounts
- Detection of water stress
- Requires calibration to crop type
- Whole-field

Remote-sensing

- Plant temperature
- ET
- Mostly assist with decisions on irrigation amounts
- Detection of water stress in space
- Requires calibration to crop type
- In-field variability
Towards sensor-based precise irrigation

- Drip irrigation increased irrigation efficiency
- Auxiliary technologies should be used to support decisions on irrigation amounts and scheduling
- Plant and soil sensors exist for continuous monitoring
- Mainly used for manual decision on irrigation amounts and better irrigation efficiency is obtained
- Recent developments introduced close-loop irrigation systems
  - Amounts and scheduling

Sensor-based irrigation

- Plant: Plant water potential, temperature
- Soil: moisture, water potential
- Assist with decisions on both irrigation scheduling and amounts – close loop
- Requires calibration
- Whole-field
- Requires more research for commercial use
Sensor-based irrigation

- Reductions in water use range as high as 70% compared to farmer practices with no negative impact on crop yields (Muñoz-Carpena and Dukes).

Shani et al., Sensor Development and Positioning for Efficient irrigation in the Inherently Variable Agricultural Field
**Future research**

- Due to the soil’s natural variability, location and number of soil water sensors may be crucial and future work should include optimization of sensor placement (Muñoz-Carpena and Dukes).

- Additional research should also include techniques to overcome the limitation of requiring a soil specific calibration (Muñoz-Carpena and Dukes).

**Spatially variable rate**

- Single measurements are made for a whole-field decision

- Remote-sensing with VRI enables to address the in-field variability

- VRI systems are already commercial for pivot and linear move irrigation systems

- Initial non-commercial systems were developed for drip irrigation
Future developments

• Combination of sensor-based systems with remotely-sensed maps
  – Where to put the sensors
  – Close-loop variable-rate irrigation

But...

• The use of current knowledge like evaporation measurements and crop coefficients can significantly improve irrigation efficiency.
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The main objectives of the fellowships is to avail excellent and promising scientists with the opportunity to become proficient in advanced technologies present in the Agriculture Research Organization and to establish future collaborations with Israeli scientists.
Thank you for your attention

Questions?

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