Water harvesting monitoring at Al-Muwaqqar and Rihab

Soil moisture and pond water levels

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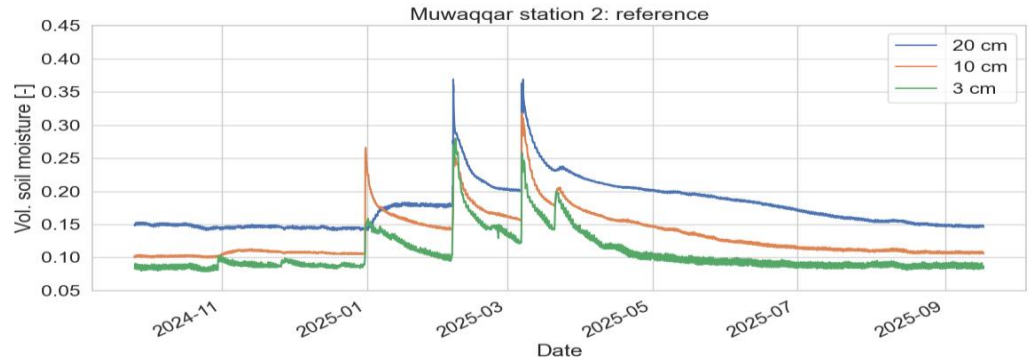
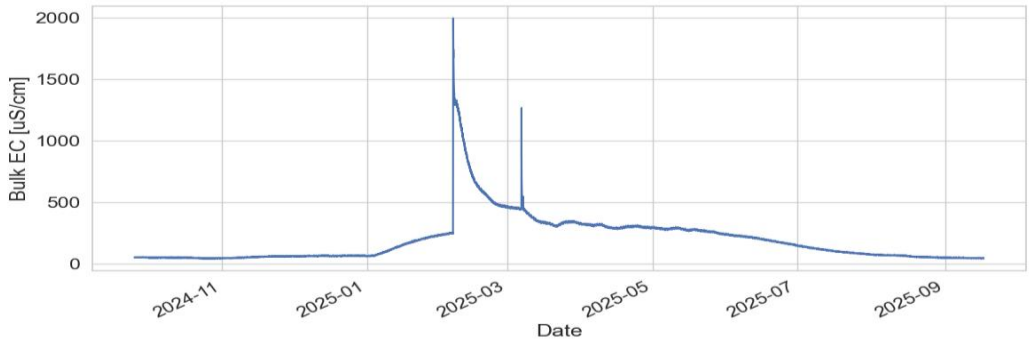
No regret water harvesting measures

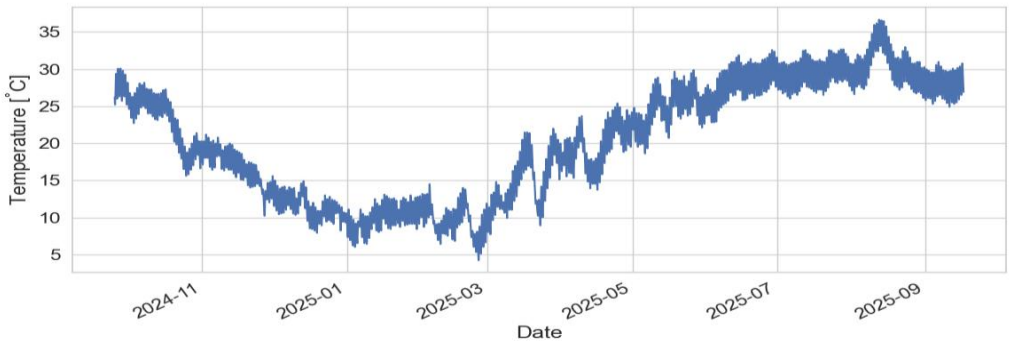
- Land surface interventions
  - Stimulating contour plowing
  - Terracing
  - Stone bunds
  - Valleranis
  - Trenches
- In-stream interventions
  - Check dams / gabions
  - Gully plugs
  - Hafirs / ponds
  - Small and large dam reservoirs
  - Subsurface dams

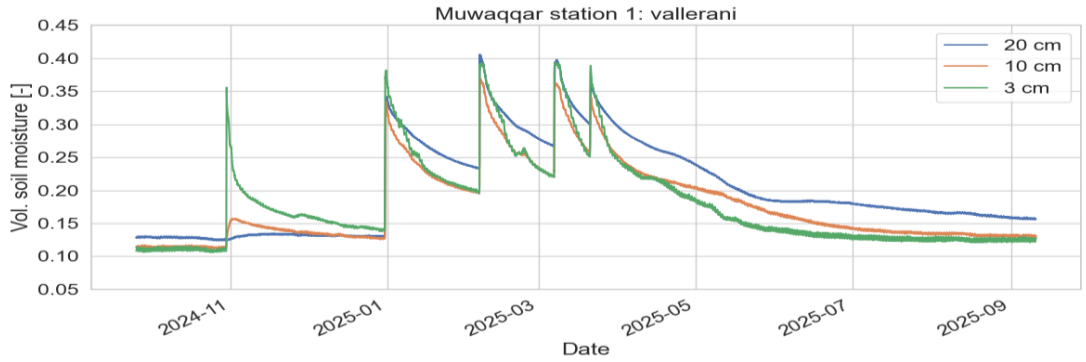
Al-Muwaqqar – vallerani water harvesting

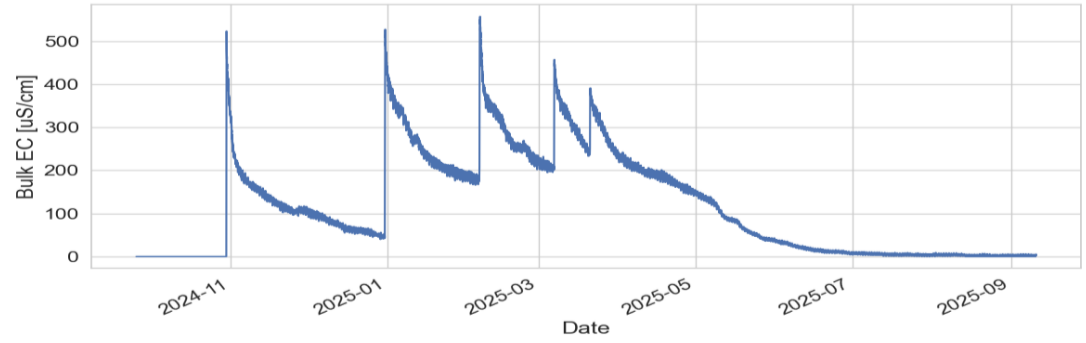
Al-Muwaqqar: Green water harvesting - reference vs vallerani soil

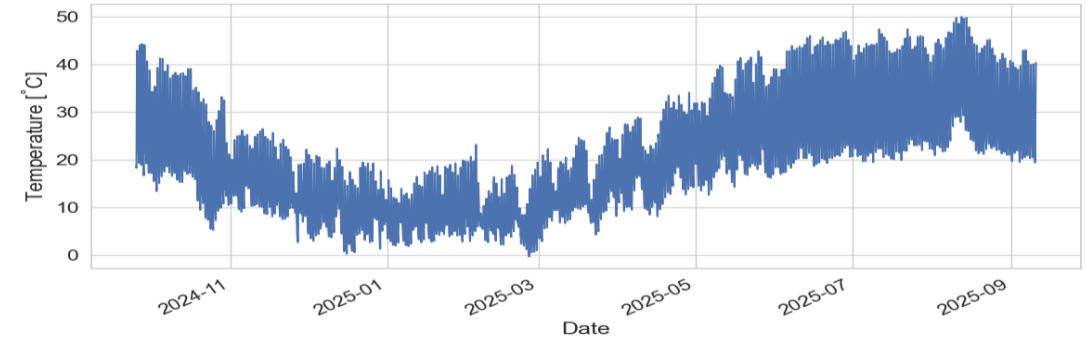










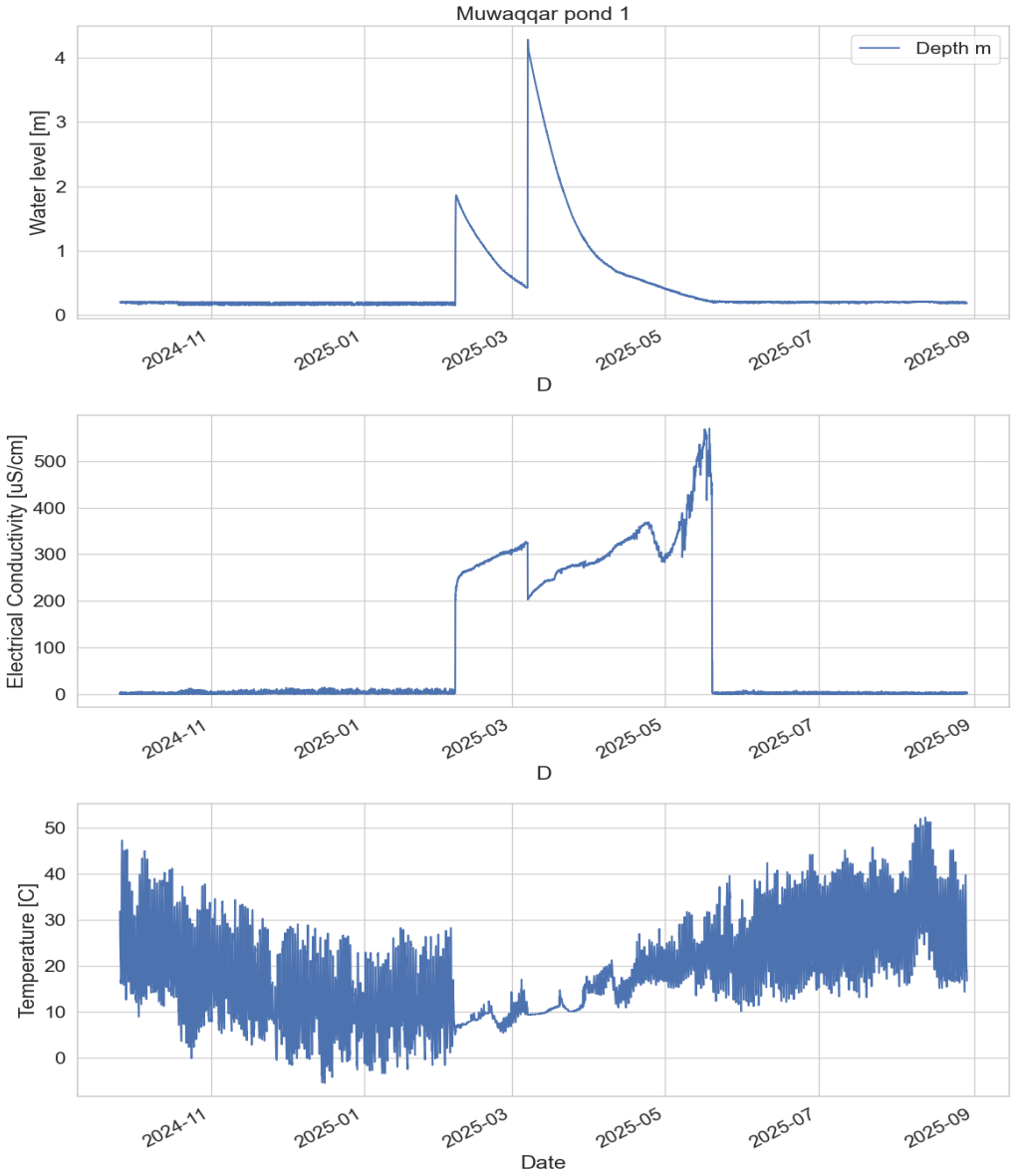


Al-Muwaqqar experiment – vallerani water harvesting

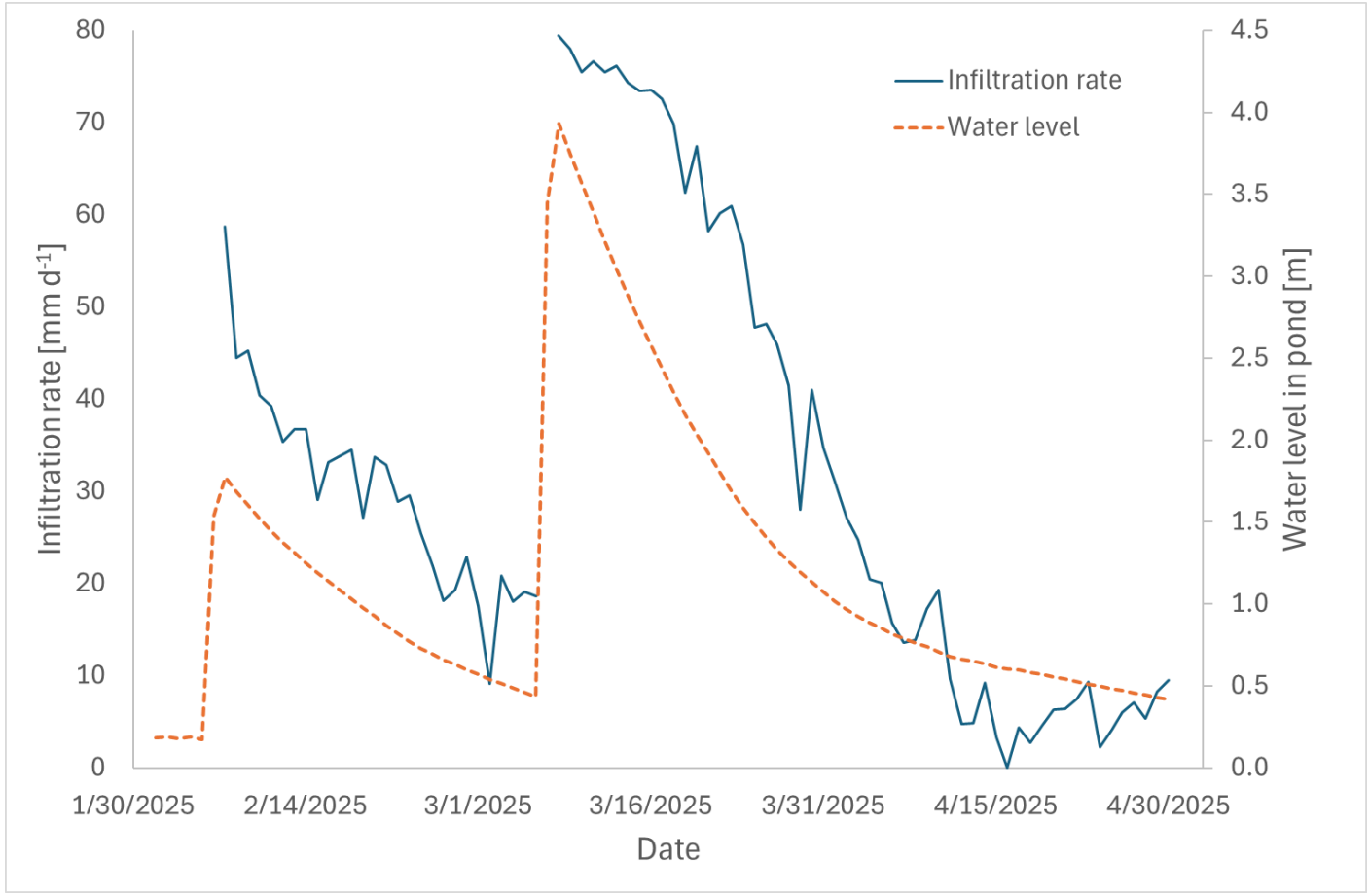
- Timelapse video made using telemetric datalogger set-up
- More vegetation growth along vallerani edge and in vicinity of vallerani than in downstream interspacing
- Water harvesting yields green water used by vegetation
  - Improves soil infiltration capacity (root activity)
  - Increases soil carbon content and soil cover
  - Reduces erosion, sediment production and transport
  - Reduces flash floods in drainage system

Al-Muwaqqar infiltration ponds

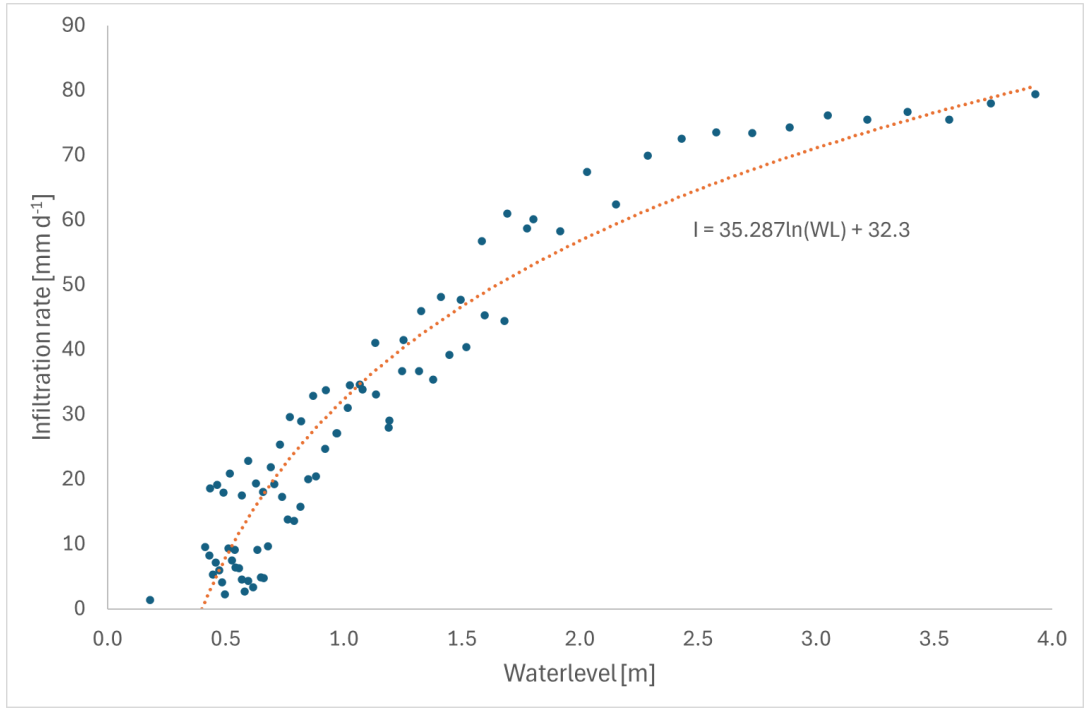
- Upland valleranis construction (green water harvesting) to diminish flow and sediment transport to wadi channel
- Sequence of ponds constructed in wadi channel
- Groundwater recharge through infiltration in pond (blue water harvesting)
- Pond water level reduction ≈1.4 m in 30 days
- Infiltration rate range 15-57 mm/d
- How much evaporation and groundwater recharge?



Al-Muwaqqar pond infiltration rates from waterlevel observations



- Total infiltration in Al-Muwaqqar pond is 2,777 mm in 89 days



Tiger bush ecohydrology

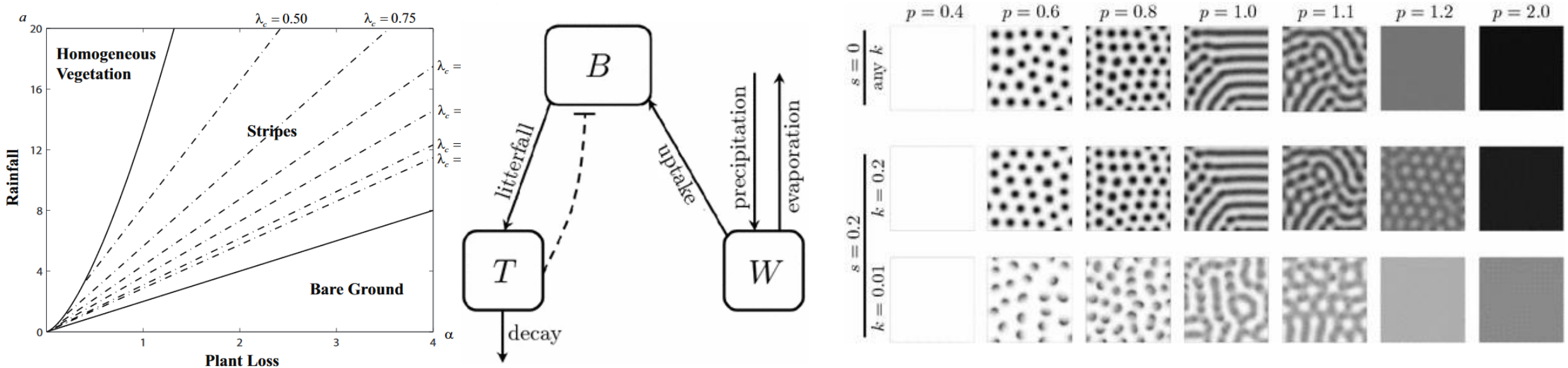
- Natural solution to water scarcity
  - Insufficient water to cover whole area with bush
  - Crusted bare areas are slightly higer in topography and produce overland flow ➔ limited soil moisture availability, no plant survival in dry periods
  - Bush growth occurs in slight depressions that are fed by rainfall, but also receive overland flow from crusted bare areas
  - Infiltration occurs in bush areas, enough soil moisture for bush survival
  - Produces wavelike striped patterns
  - Litter decay can produce toxicity in soil that may also governs pattern formation where there is sufficient rainfall
  - **Inspiration to design nature-based solutions (NBS)?**

Runoff strips for Barley cultivation (Syria)

Oweis, T. and Haddad, M. 2024. Rainwater Harvesting Design Manual: Micro-catchment Systems for Drylands Agriculture. Lebanon, Beirut: International Center for Agricultural Research in the Dry Areas (ICARDA).

Mathematics and ecology

- Left image: prediction of occurrence by two parameter model (rainfall and plant loss factors)
- Right: Patterns formed by interdependence between water availability (W), toxicity decay rate (T) and plant sensitivity to toxic compounds (B)



Source: Marasco, A., Luorio, A., Cartení, F., Bonanomi, G., Tartakovsky, D.M., Mazzoleni, S., Giannino, F., 2014. Vegetation Pattern Formation Due to Interactions Between Water Availability and Toxicity in Plant–Soil Feedback. Bull Math Biol 76, 2866–2883. https://doi.org/10.1007/s11538-014-0036-6

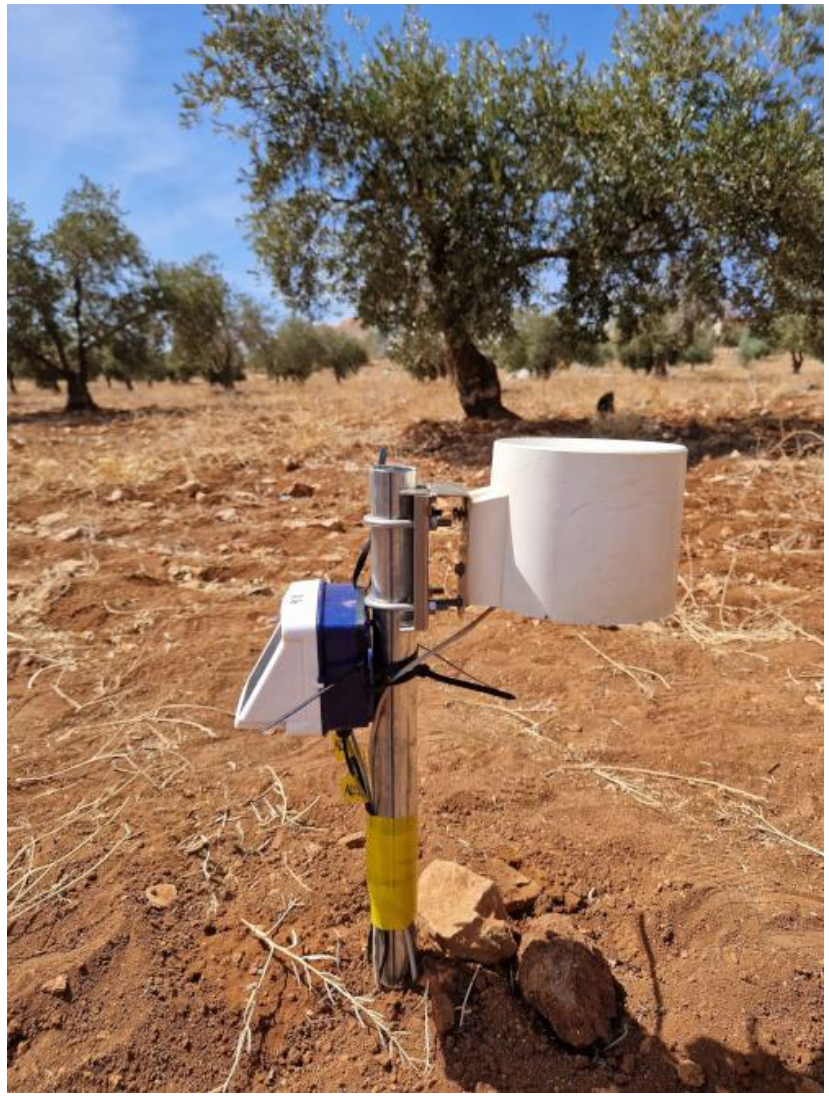
Rihab – olive orchard

- Orchards resemble tiger bush pattern with bare areas and olive trees in row pattern
- But water is allowed to flow downhill and does not infiltrate at tree lines
- Water harvesting can provide better moisture conditions at tree lines - capture of upland surface runoff
- Terracing? Semi-circular bunds?

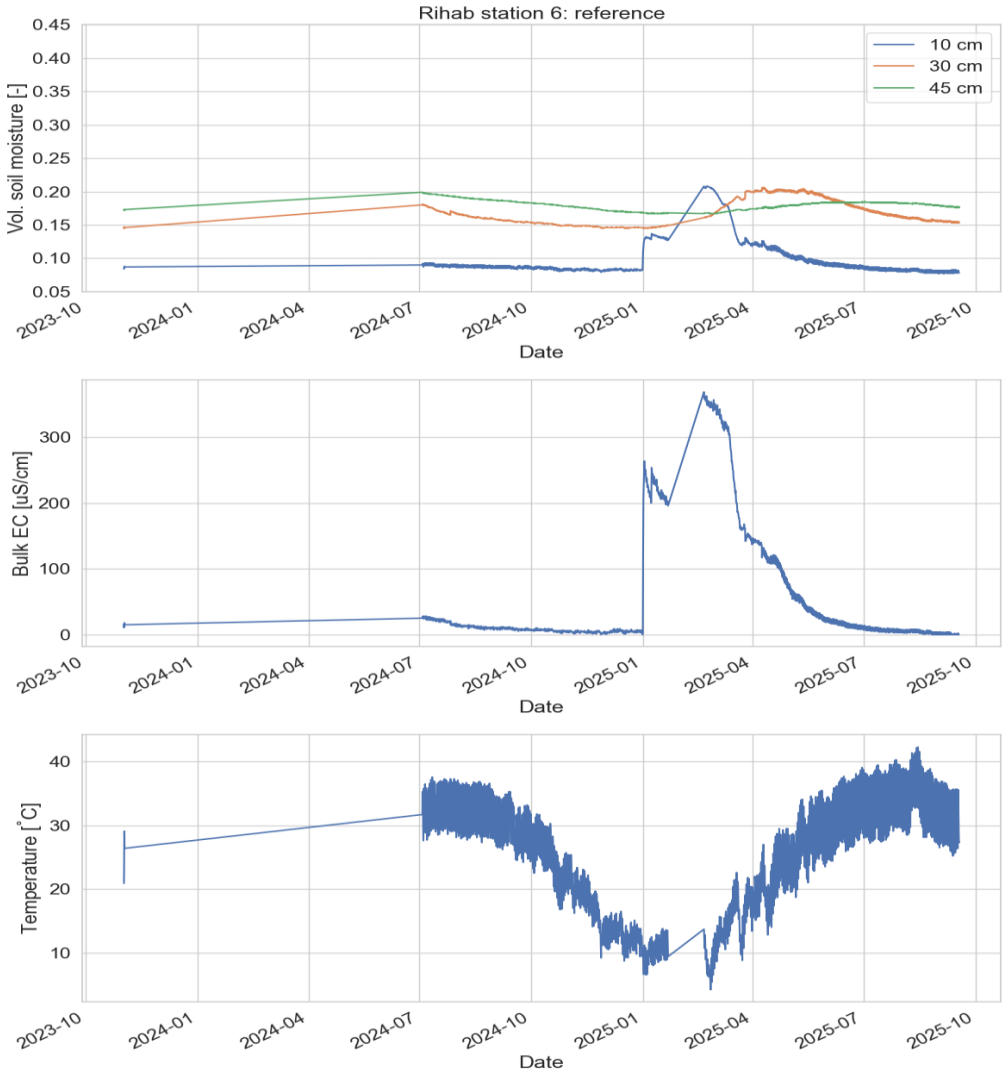
Rihab water harvesting for olive orchard

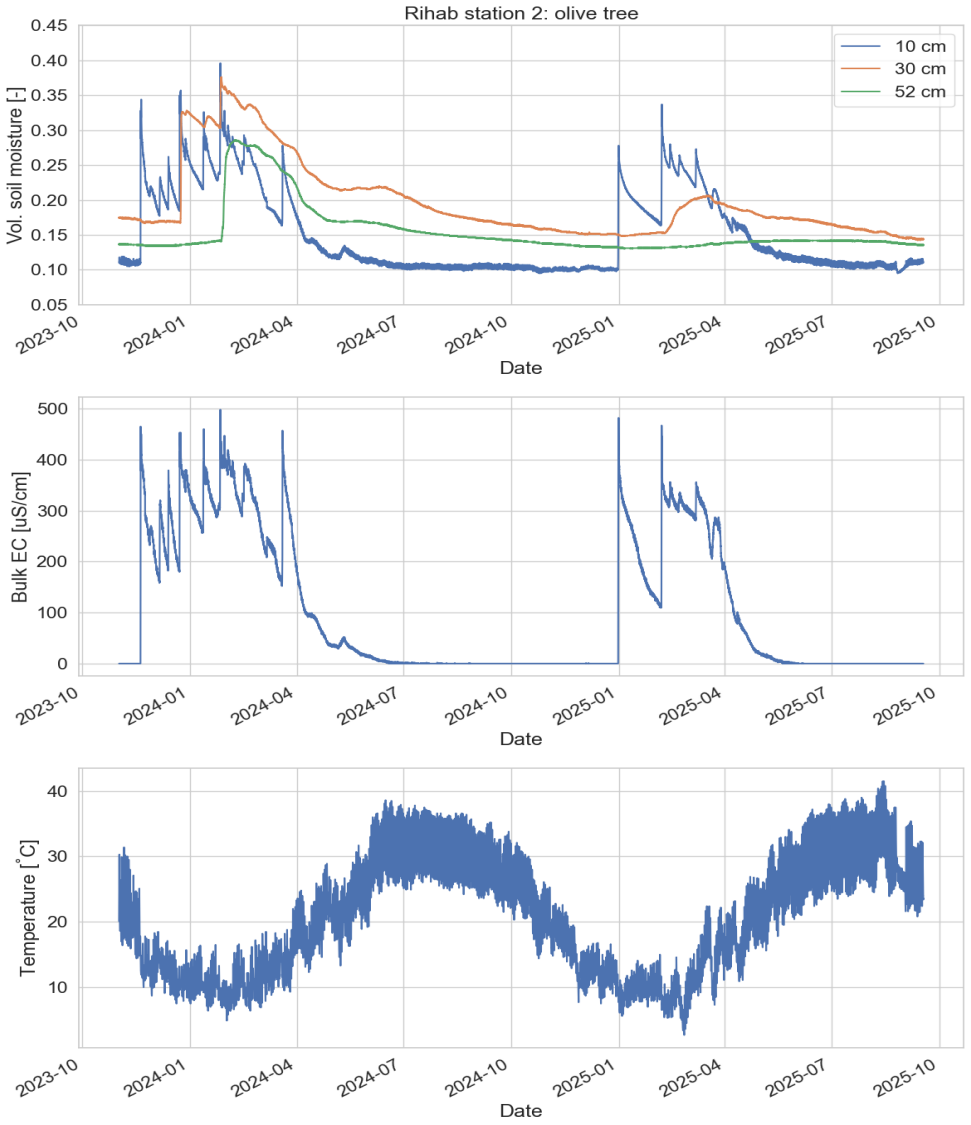
Rihab olive orchard soil moisture and EC

- Telemetric stations, soil moisture, bulk EC, T and rainfall
- Green water harvesting
- Moisture being provided from 30 cm and greater depth
- Increase in soil depth around tree due to sediment deposition
- Reference not always functional, comparison difficult



Rihab olive orchard





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