



DRIP IRRIGATION DESIGN & SCHEDULING

<https://app.agri.gov.il/didas/>

DIDAS

A USER-FRIENDLY PROGRAM FOR ASSISTING DRIP IRRIGATION DESIGN AND SCHEDULING

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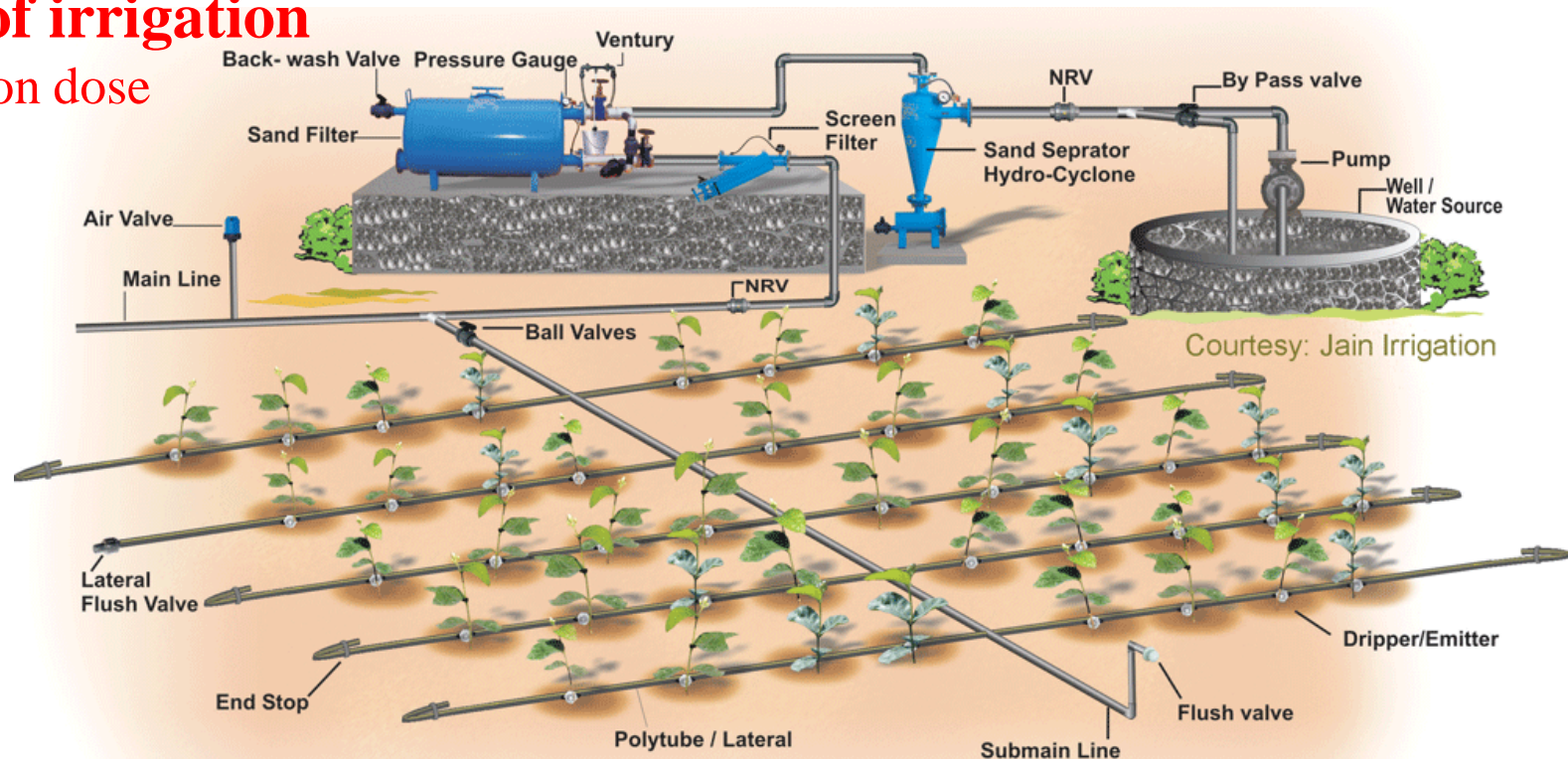
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Dahlia Greidinger Symposium, Haifa, March 6th, 2019

Design and Scheduling of Drip Irrigation Systems

- Distance between emitters along a drip line
- Distance between drip lines
- Depth of subsurface emitters
- Emitter discharge rate
- Irrigation frequency
- Starting hour
- Duration of irrigation
- Daily irrigation dose



DIDAS main window for choosing among the **steady**, **quasi-steady** and **unsteady** flow modeling for the **design** and **scheduling**



DIDAS window for choosing between the Coupled Source-Sink Systems with **On-surface** or **Sub-surface** emitters

Drip System Design

Steady Flow Evaluation of Relative Water Uptake Rate

Soil
Evaporation
Plant Resistance
Vertical Plane
Horizontal Plane
Summary

Vertical Plane Configuration

On-Surface | Sub-Surface

On-Surface Irrigation

Root Zone Depth (d_0): cm

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Evaluate

Drip System Design

Steady Flow Evaluation of Relative Water Uptake Rate

Soil
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Plant Resistance
Vertical Plane
Horizontal Plane
Summary

Vertical Plane Configuration

On-Surface | Sub-Surface

Root Zone above Emitter
(Beginning of growing season)

Root Zone below Emitter

No Emitter
 No Plant
 Shallow Groundwater

Root Zone Depth (d_0): cm

Emitter Depth (z_{s0}): cm

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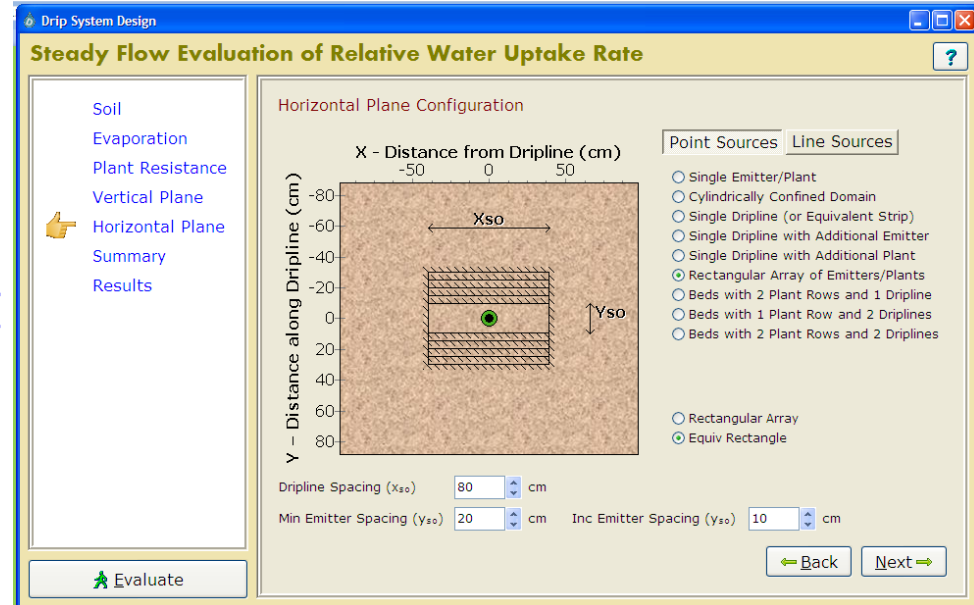
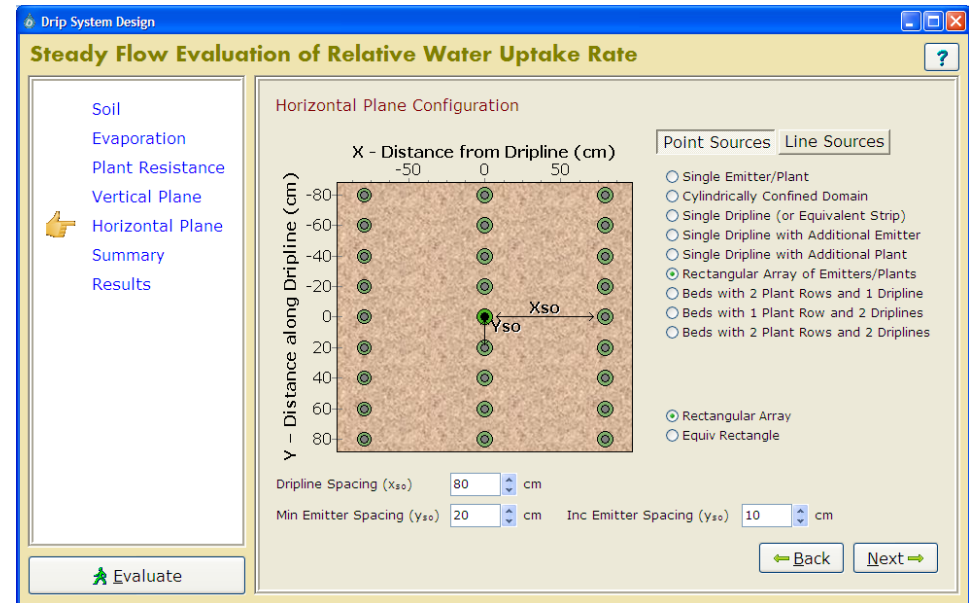
Emitter Depth (z_{s0}): cm

Root Zone Offset (d_0): cm

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An example of DIDAS Scenarios for Drip Irrigation

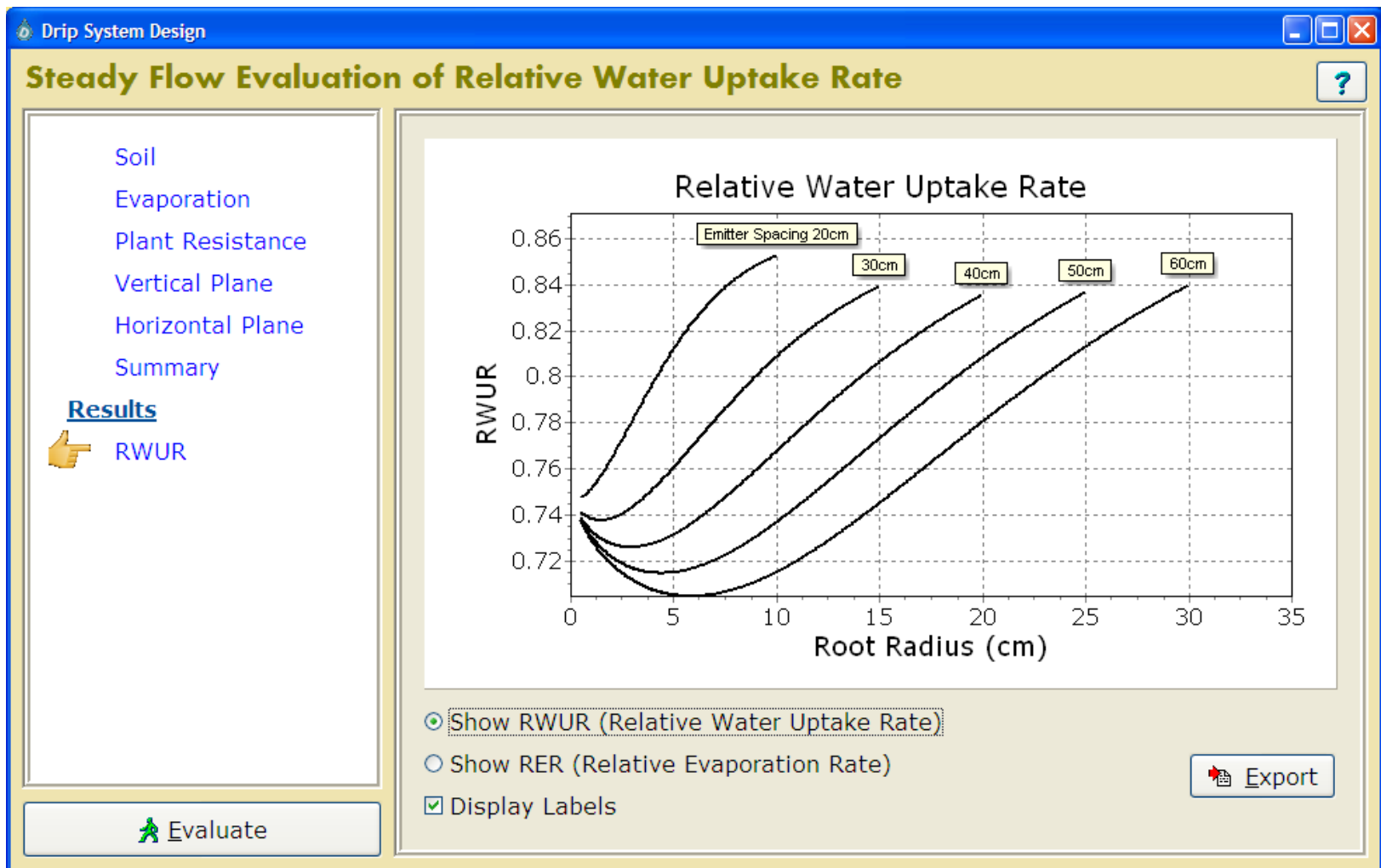


The water flow and uptake problem can be formulated in two, equivalent modes:

1. Superposition of neighboring sources and sinks

2. Flow in a laterally-confined, equivalent domain

An example of DIDAS steady flow modeling output: RWUR as function of the radius of the root zone for various distances of plants and emitters along the driplines



DIDAS window defining the **irrigation scheduling scenario**: Daily, 2h-irrigation at 6:00

Irrigation Scheduling

Unsteady Flow Evaluation of Relative Water Uptake Rate and Volume

Soil
Evaporation
Plant Resistance
Vertical Plane
Horizontal Plane
Scheduling
Summary

Results
RWUR
Tensiometers

Scheduling of Water Applications

Irrig. Frequency Every Day (Multiple Daily Irrig. Cycles)
 Every 1 Days (Few-Days Irrig. Cycles)

Water Supply Daily Water Volume 2 liter
 Emitter Discharge Rate 1 liter/hour

Irrig. Starting Hour 06:00 Ending Hour 20:00

No. of Daily Pulses 1 Pulse Duration 02:00 hour

Water Supply for Irrigation Day

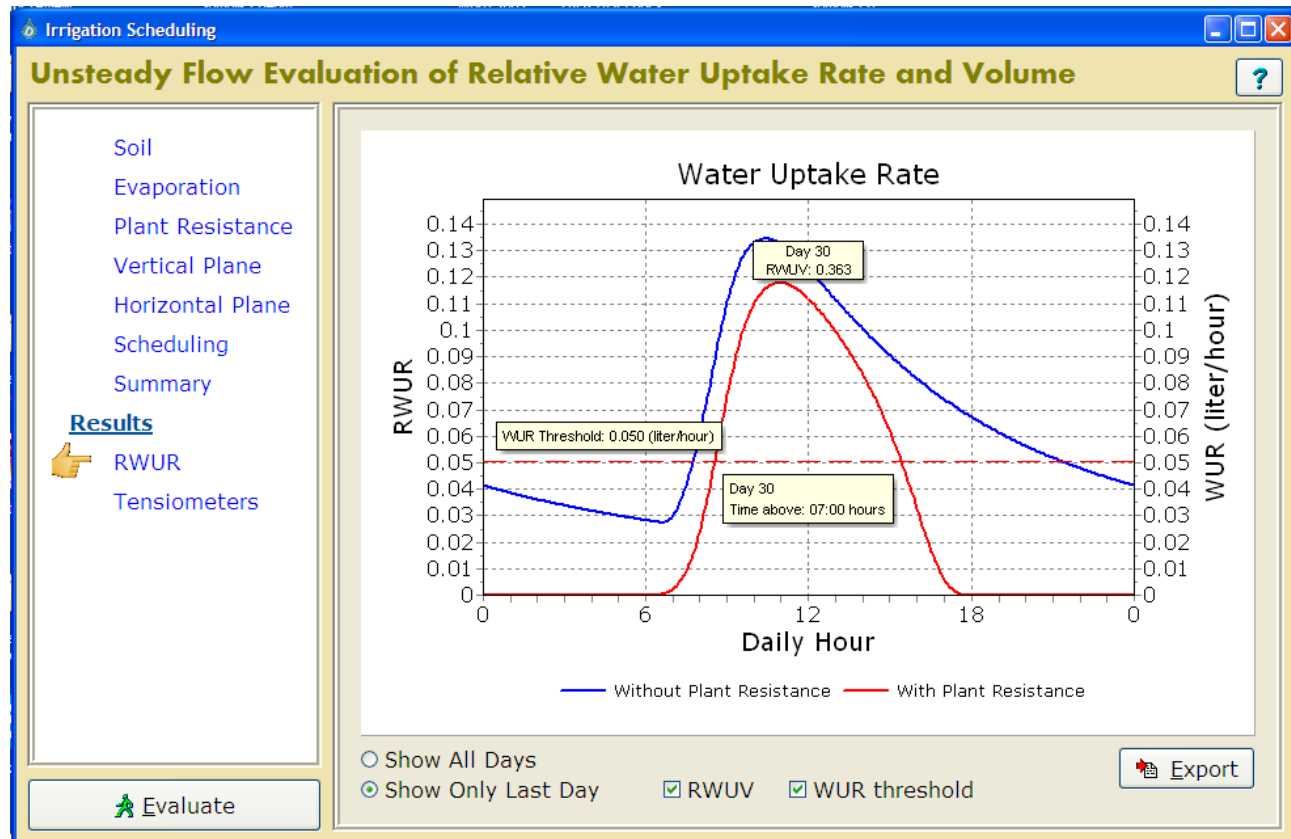
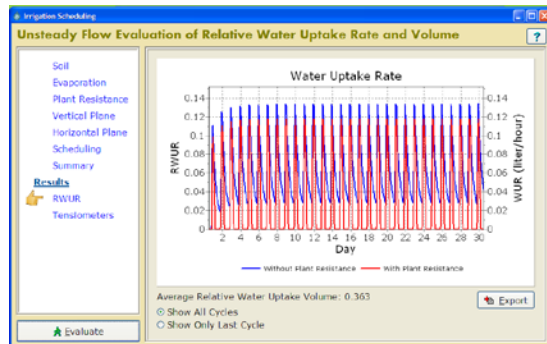
Daily Hour	Discharge Rate (liter/hour)
0	0
2	0
4	0
6	1
7	1
8	0
10	0
12	0
14	0
16	0
18	0
20	0
22	0
24	0

Simulation Time 30 Days

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Evaluate

Sample of DIDAS **unsteady** flow model output: Diurnal patterns of the **RWUR**

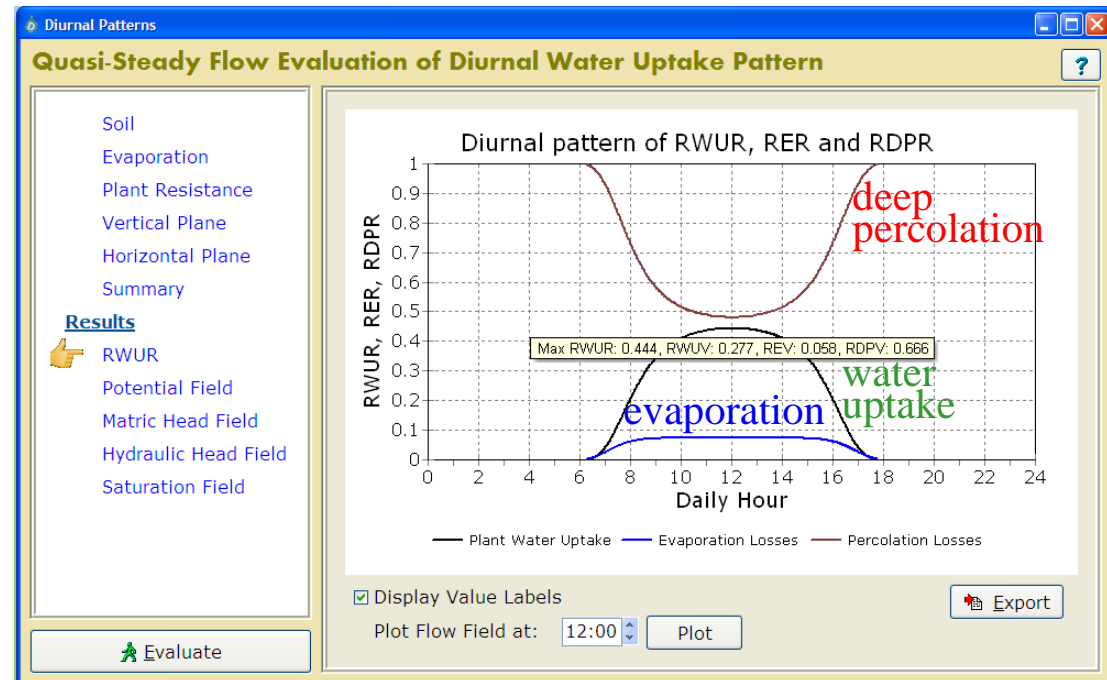
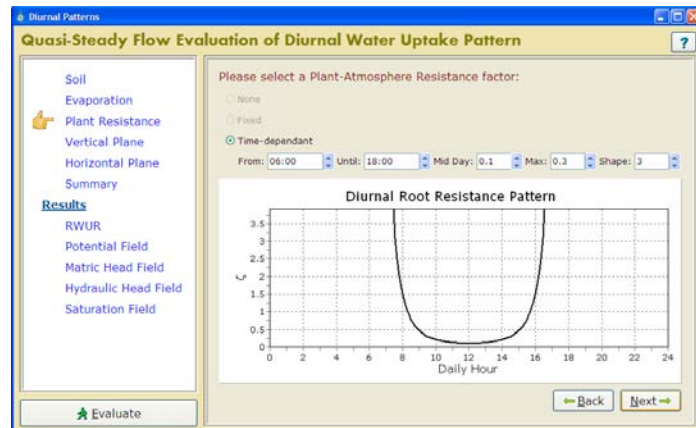
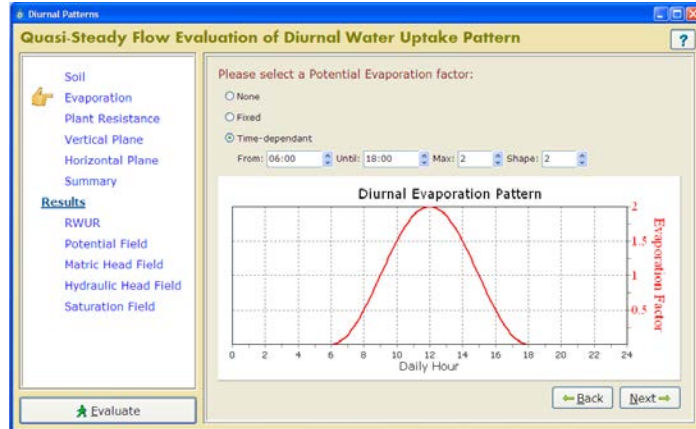


An example of DIDAS quasi-steady flow modeling output: Diurnal pattern of the RWUR

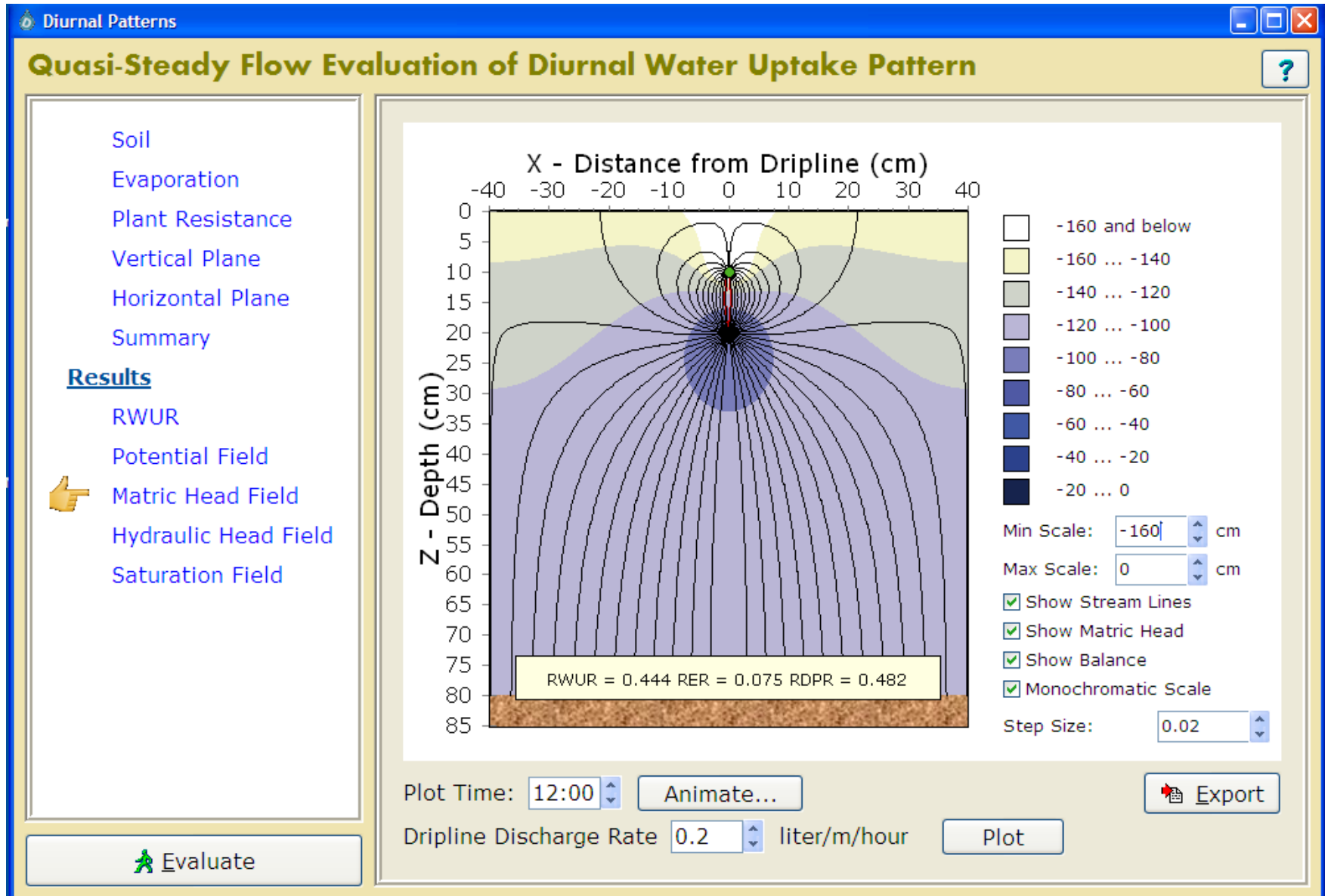
Plants of radius of root zones of 10 cm and emitters at distances of 30 cm along a single drip line

Diurnal patterns of:
Potential evaporation
Plant resistance to water uptake

Diurnal patterns of:
Relative Water Uptake Rate
Relative Evaporation Rate
Relative Deep Percolation Rate

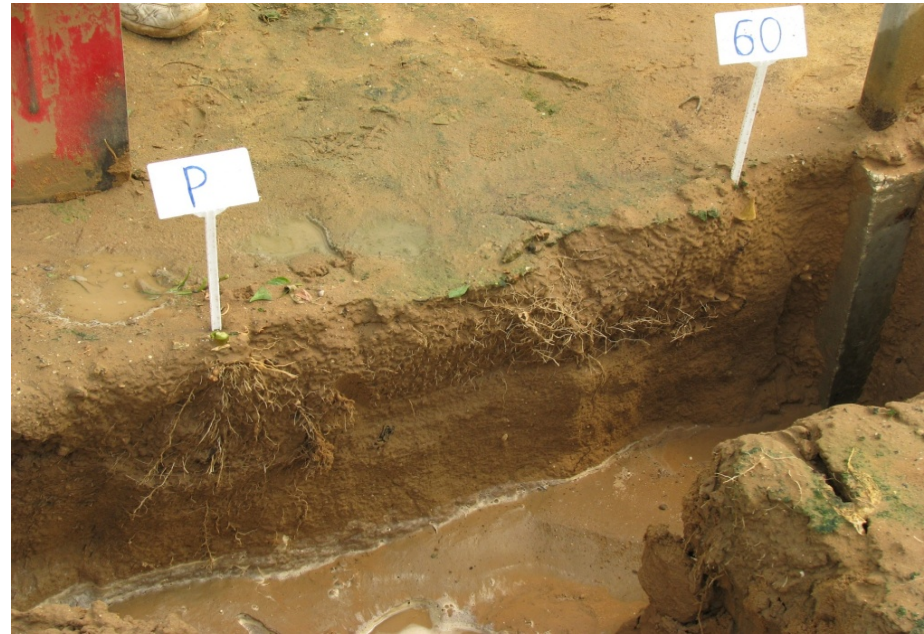
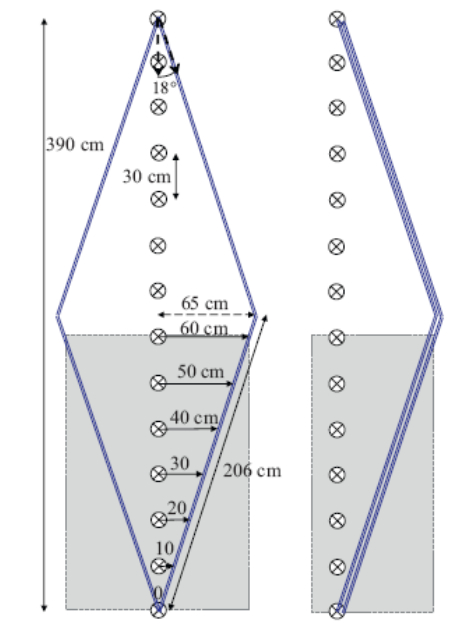


An example a flow field depicted in DIDAS diurnal patterns module



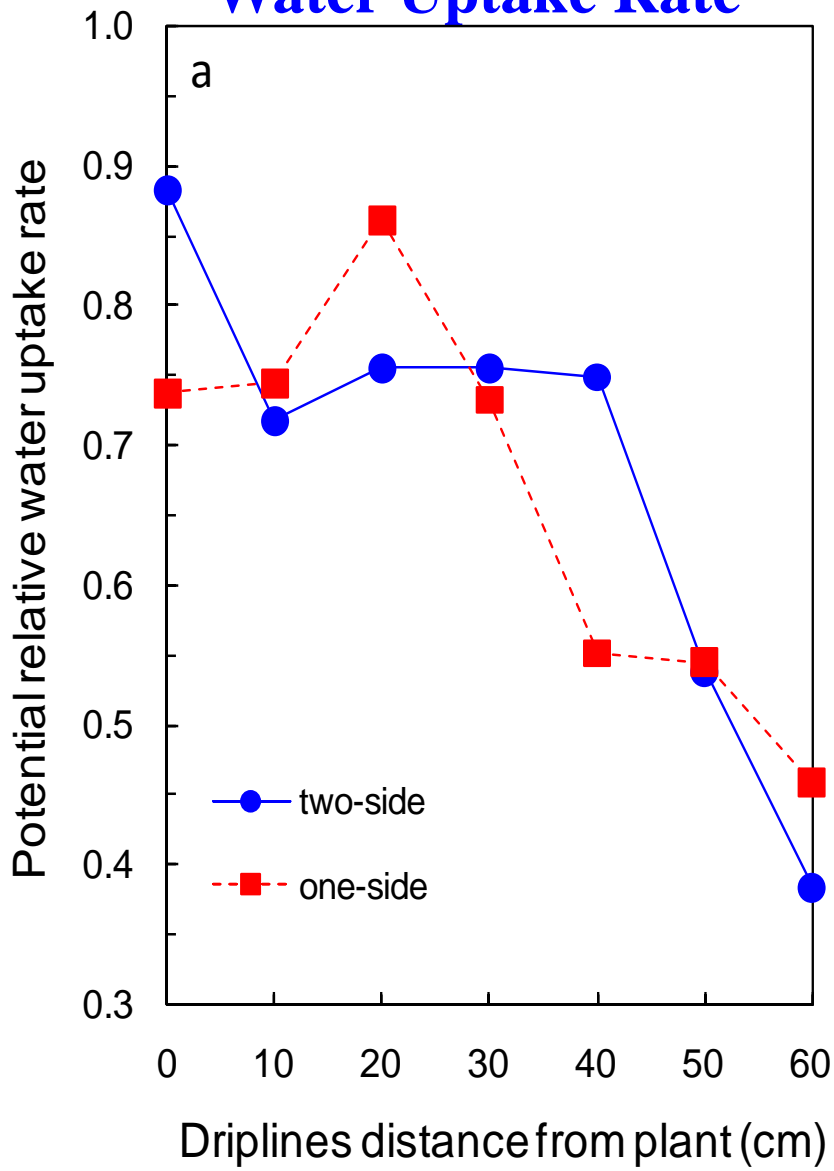
Watering a plant row with **one or two drip lines** at different distances

(Bell pepper, sandy soil, Besor experimental station, Meiri et al., 2011)

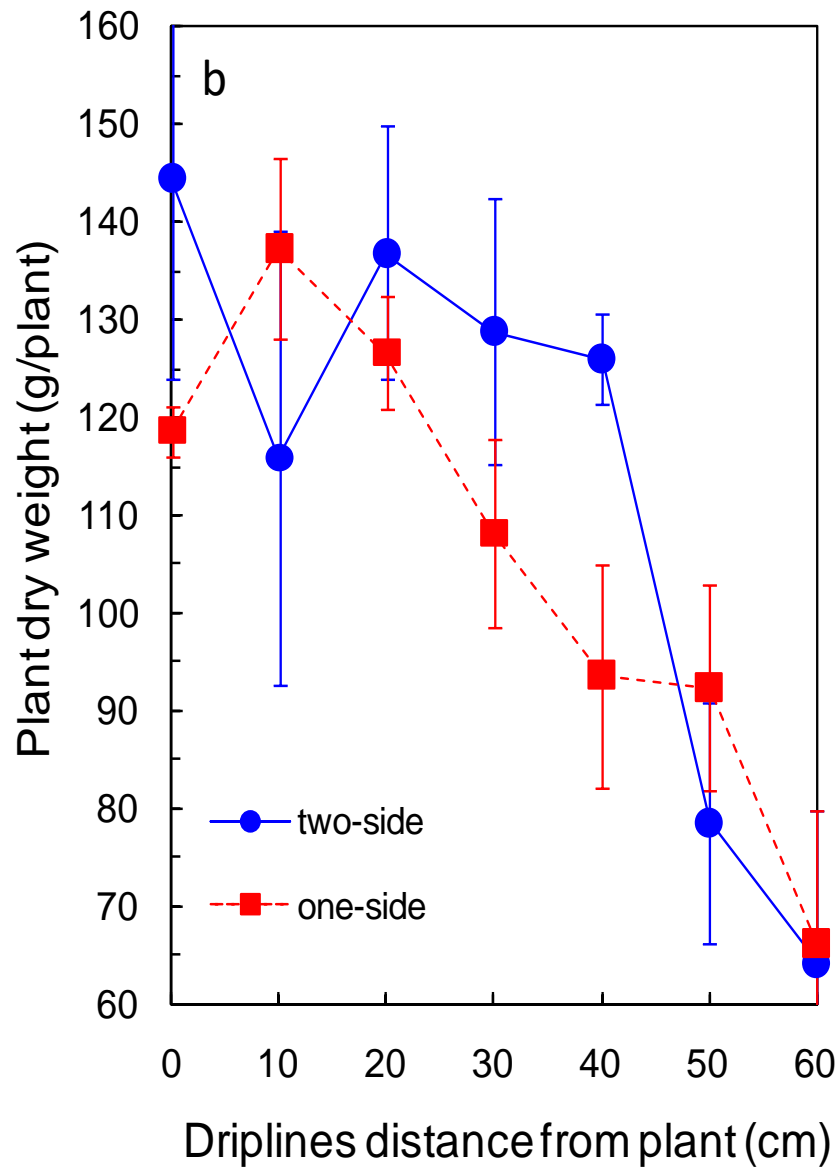


Comparison of measured plant growth and predicted RWUR

Evaluated Relative Water Uptake Rate



Measured plant growth



One or Two drip lines per plant row

Bell pepper, Besor Experimental Station, 2010

June

2DL 1DL

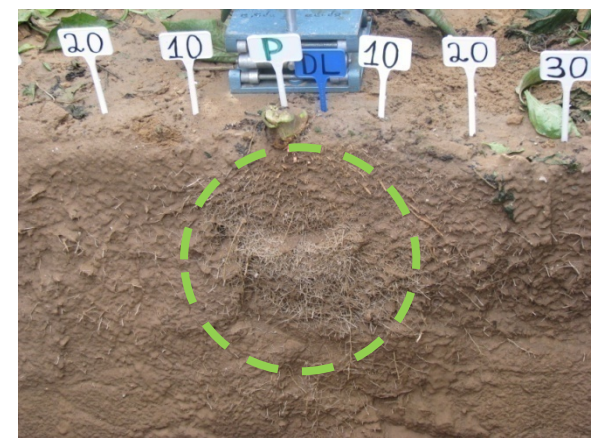
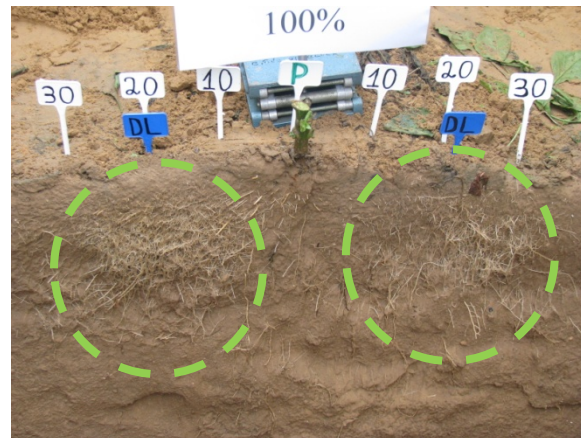


September

2DL



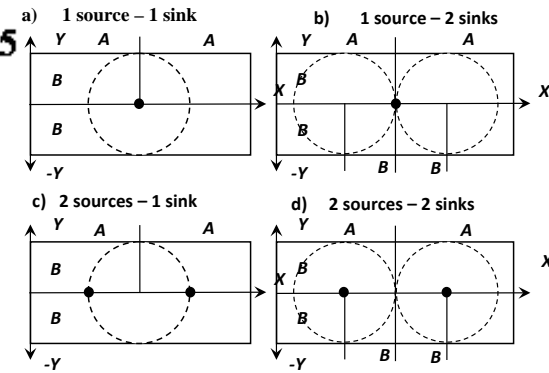
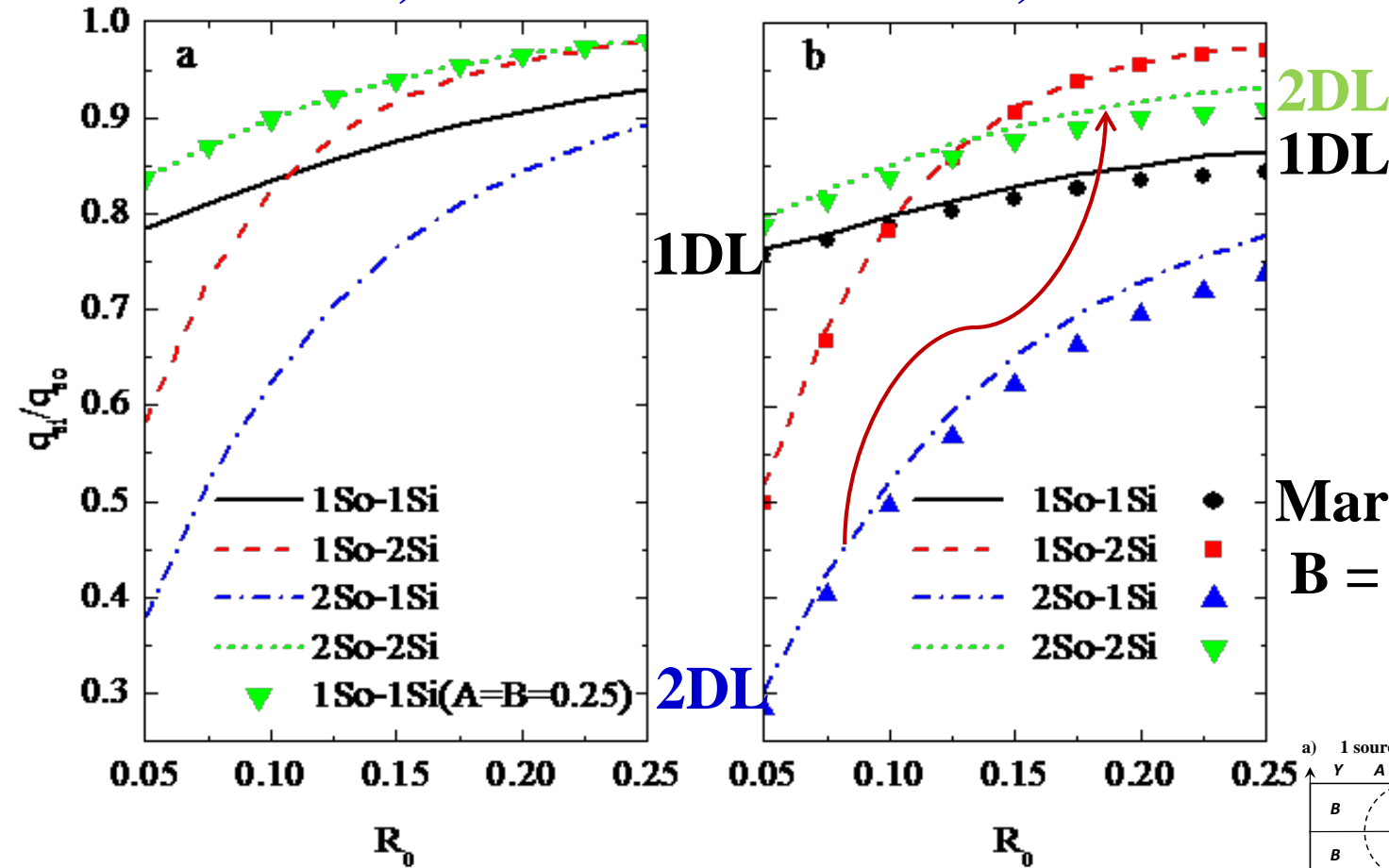
1DL



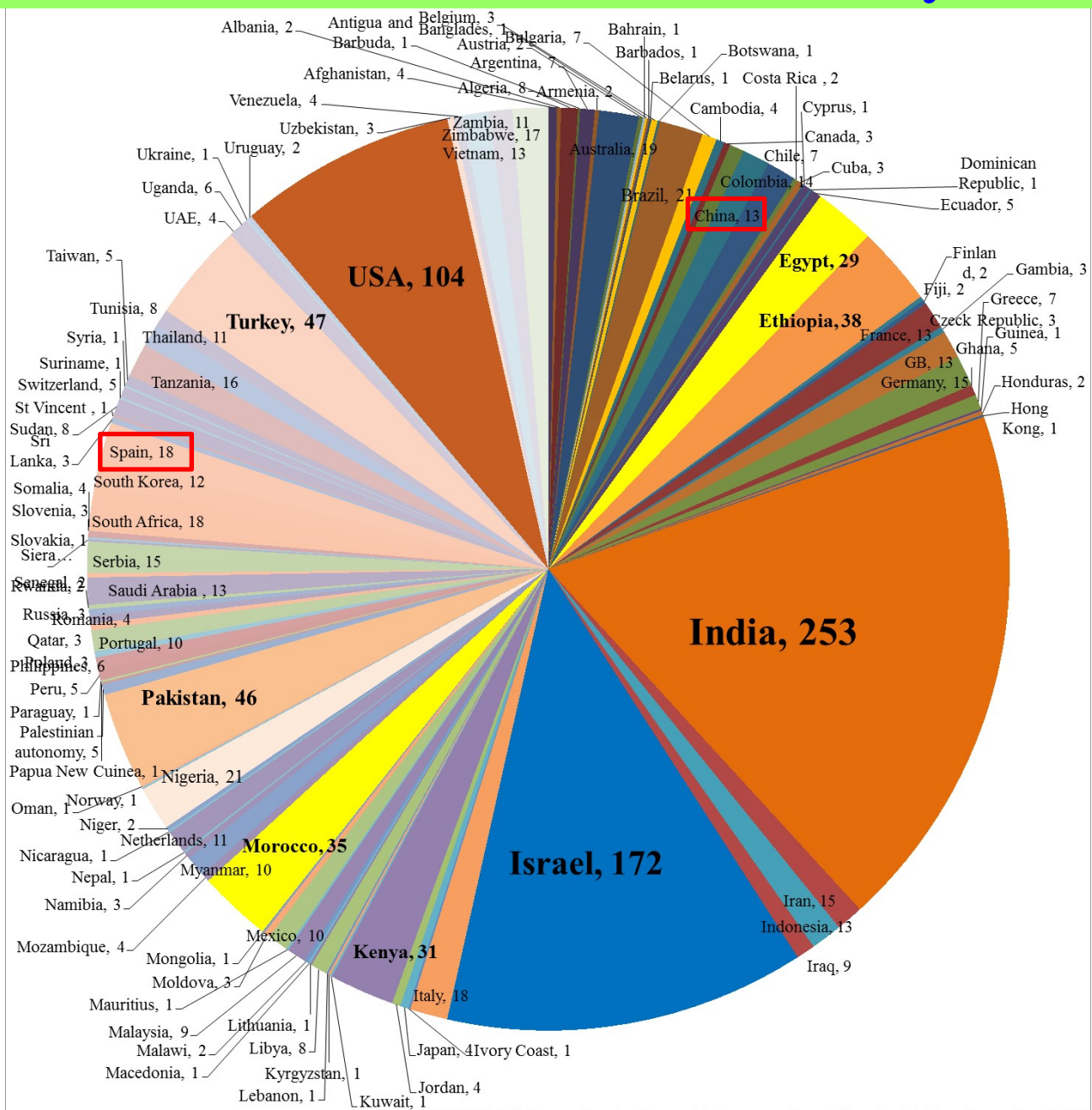
RWUR as a function of root system size for the various scenarios

B = 0.25 ; A/B = 2

B = 0.25 ; A/B = 4

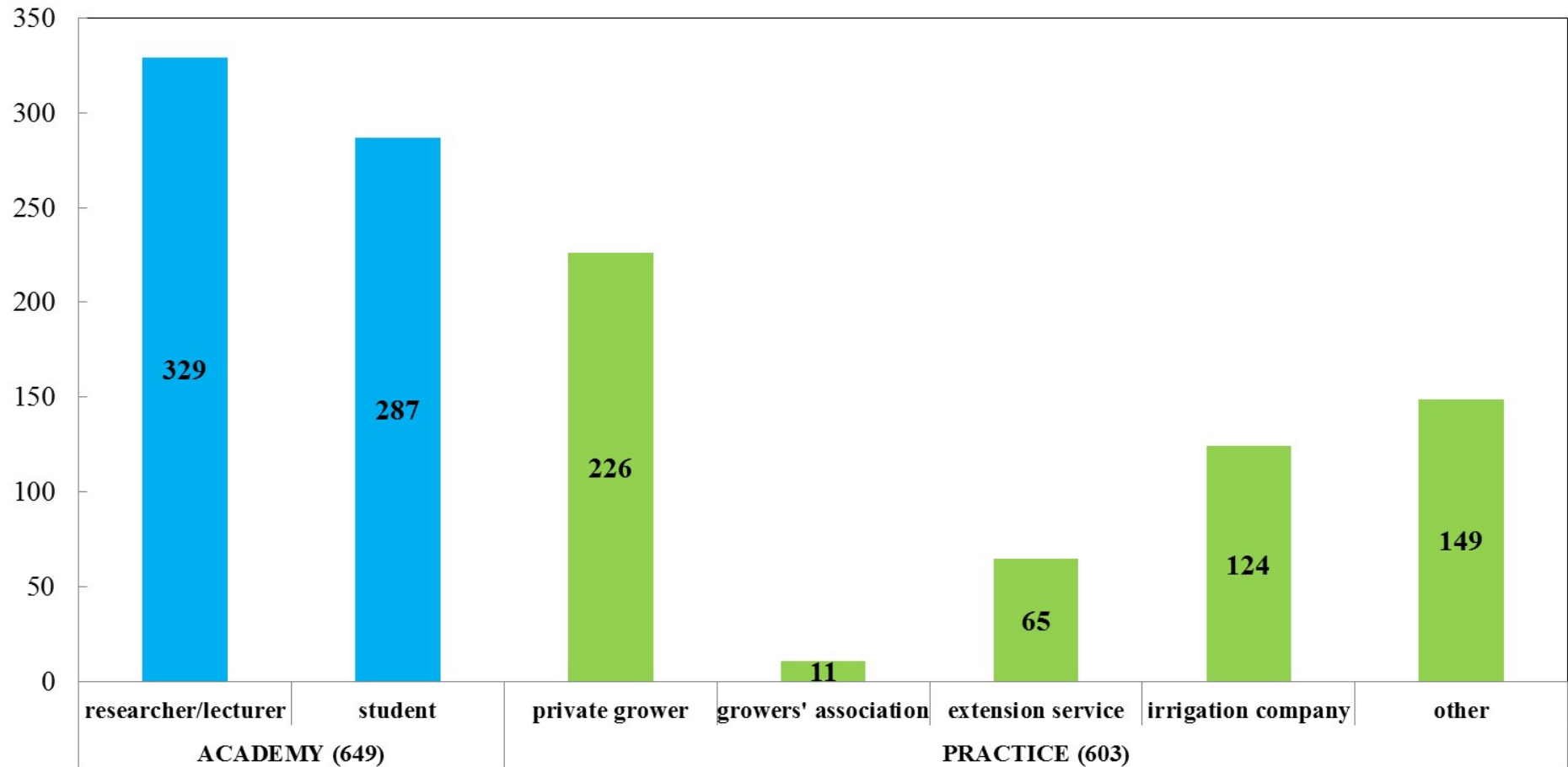


1397 DIDAS downloads sorted by country

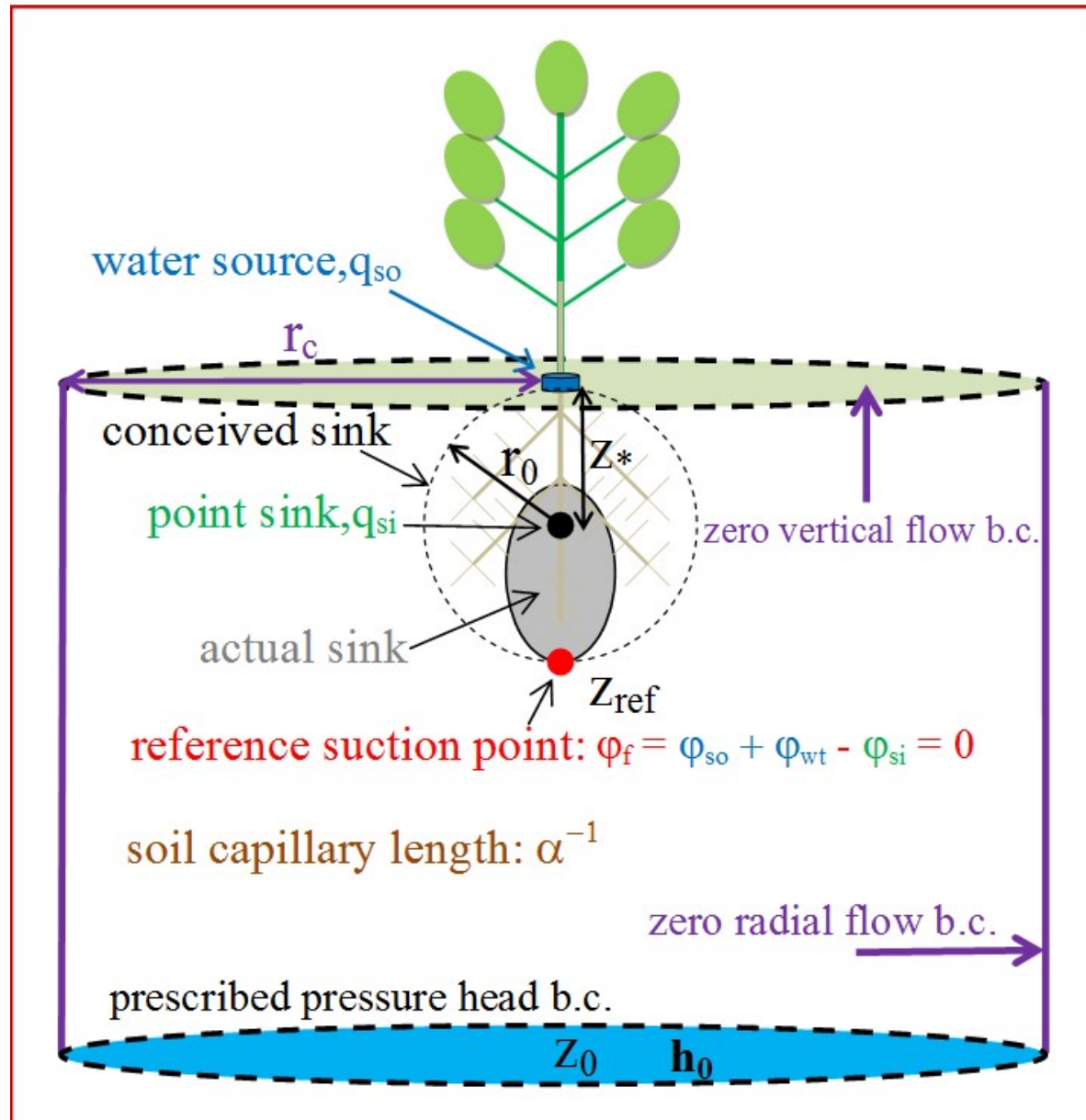


1397 DIDAS Downloads from 126 countries, March 2014 - October 2018

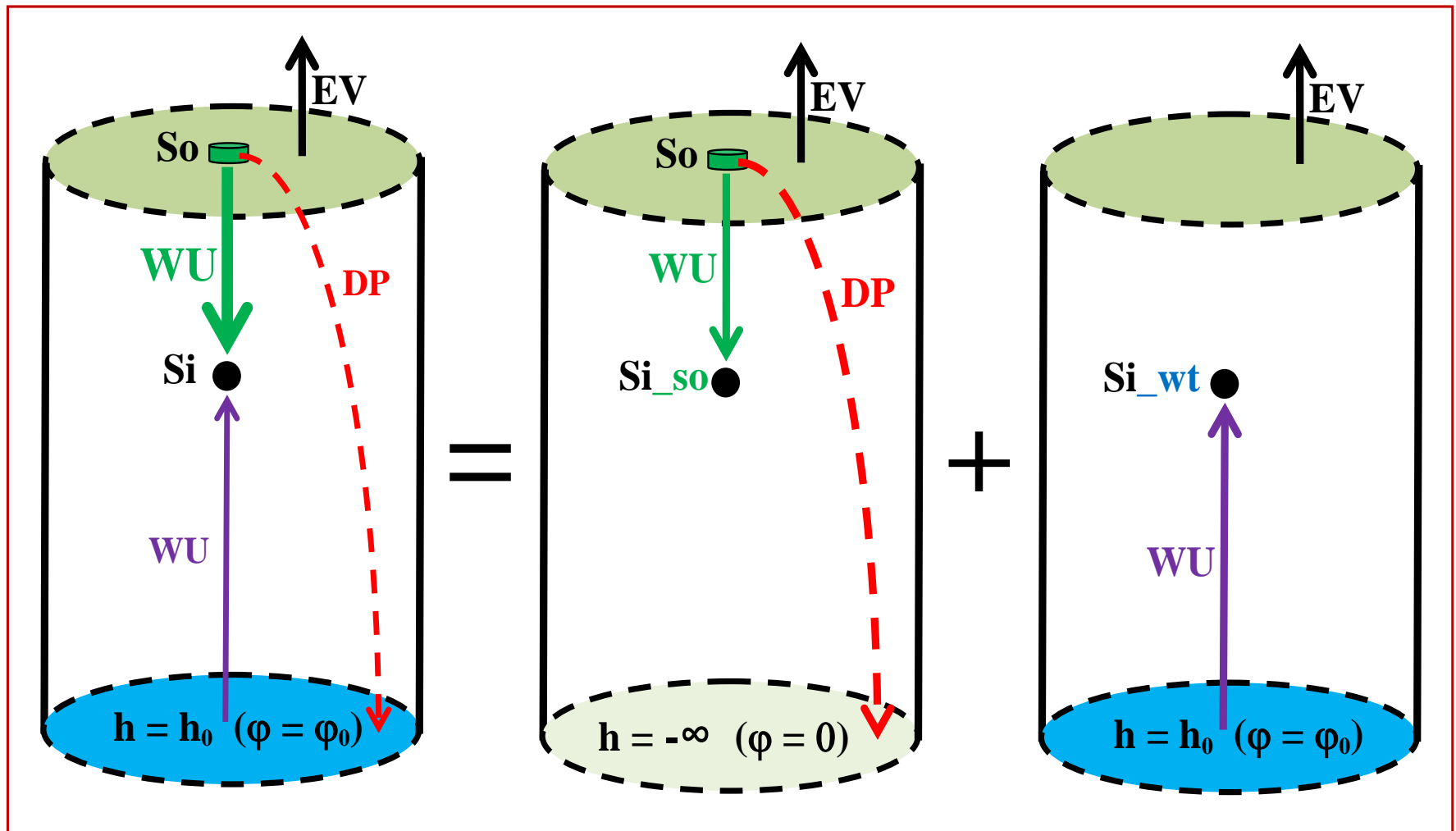
Sorted by Academy/Practice and sub-groups



Supplemental drip irrigation over shallow groundwater



Decomposition of the overall **So-Si-WT** problem to two independent **So-Si** and **Si-WT** problems

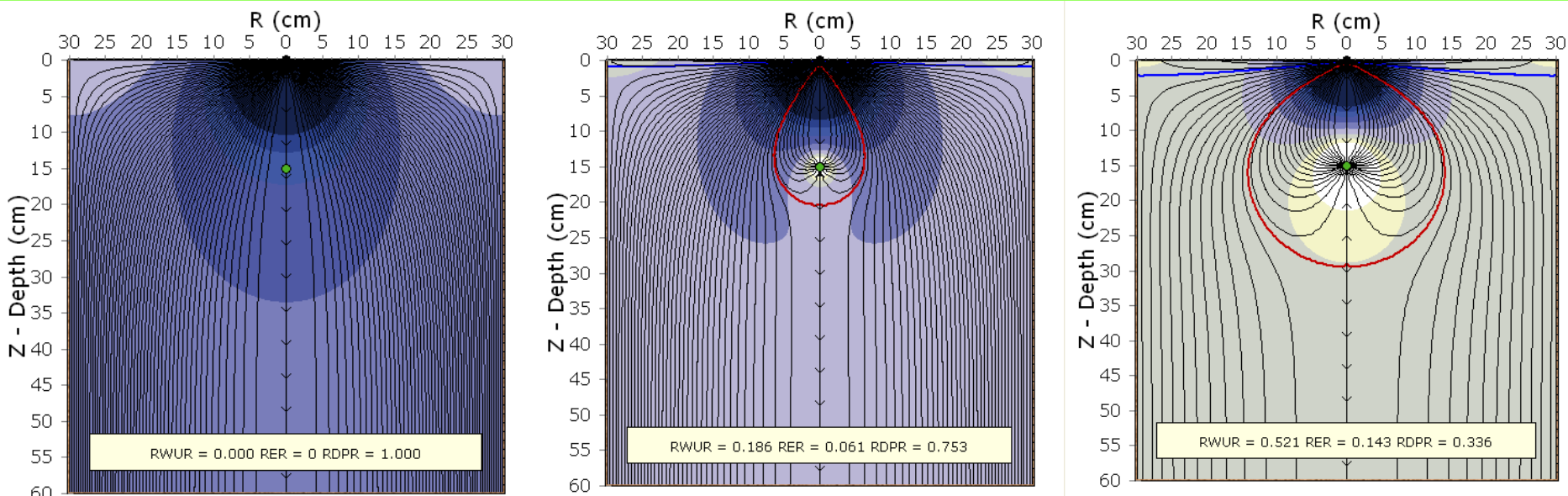


$$\nabla^2 \varphi - \alpha \frac{\partial \varphi}{\partial z} = 0 \quad \varphi = \int_{-\infty}^h K(h) dh = \frac{K_s \exp(\alpha h)}{\alpha}$$

A module for **salinity management** in drip irrigation



Diurnal pattern of water flow and uptake



06:00



07:30



09:00



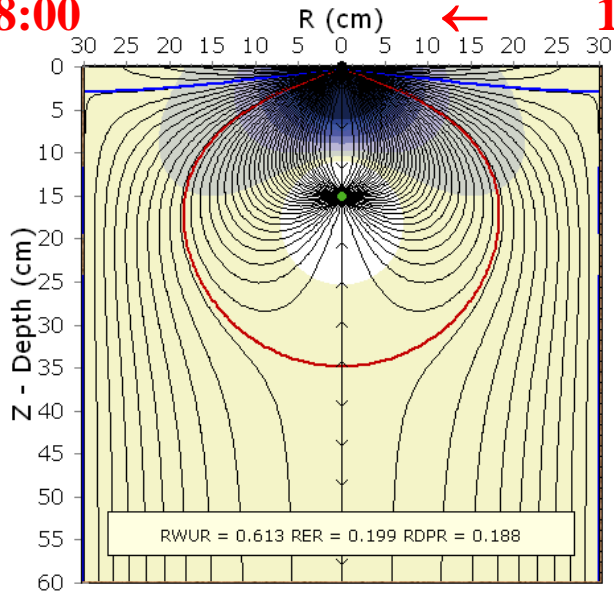
18:00



16:30



15:00



10:30



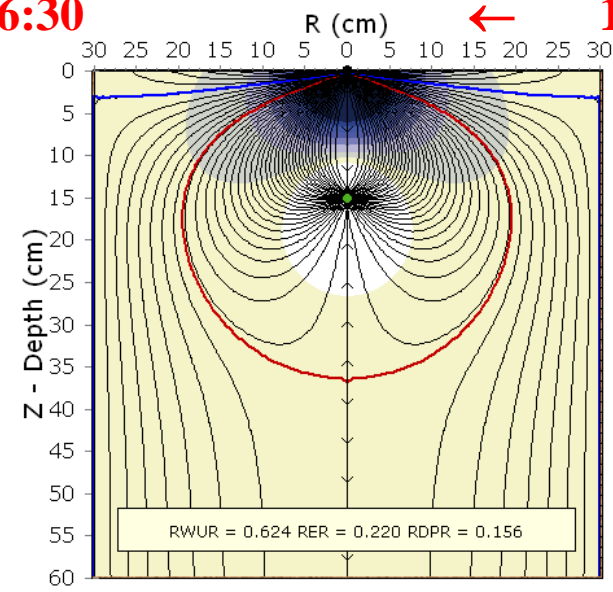
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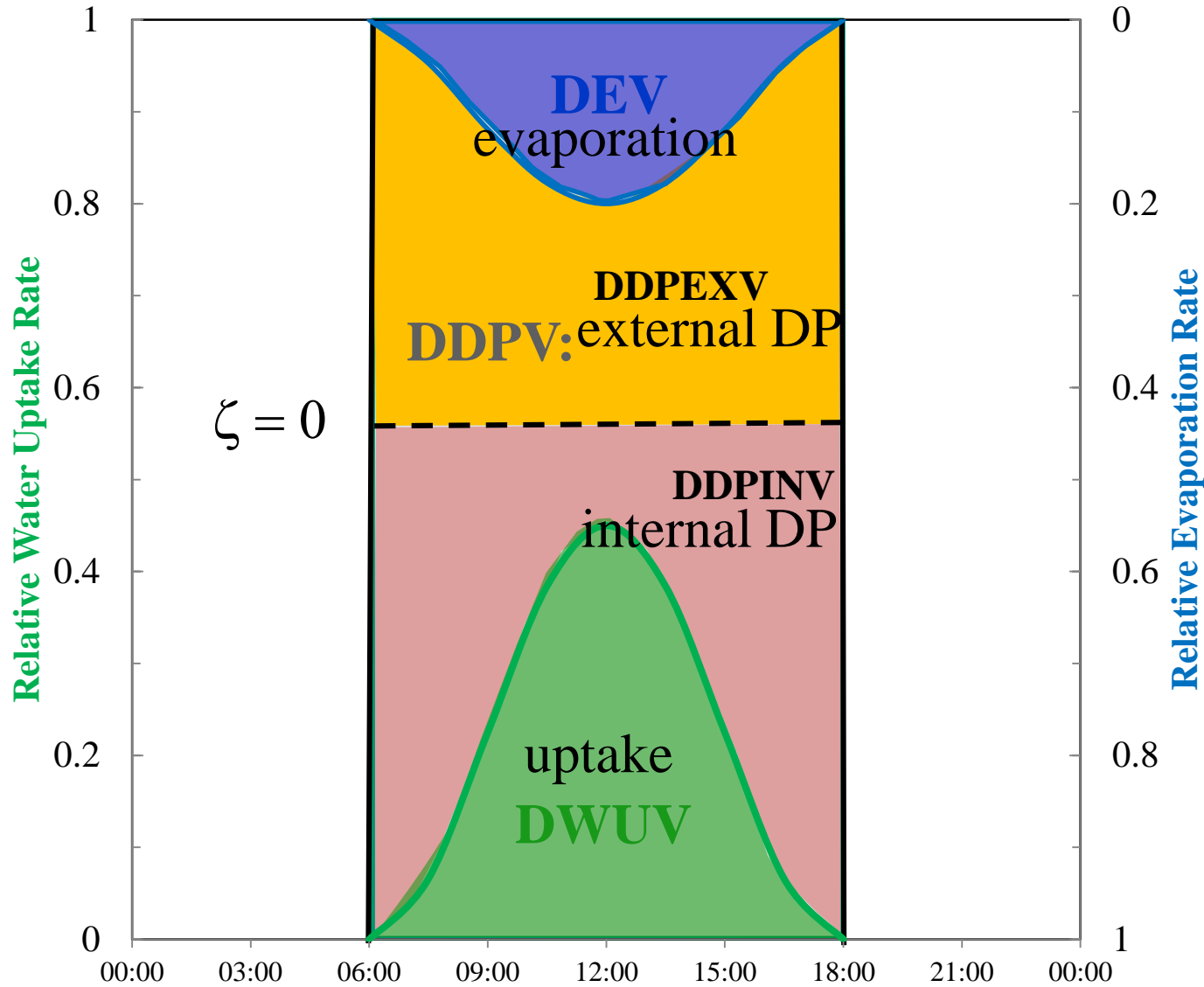
12:00



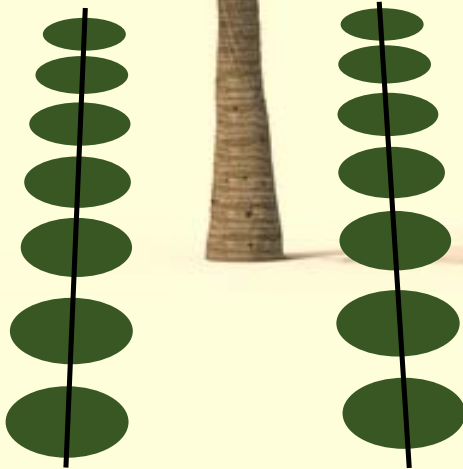
12:00



Components of (daily) water balance



Additional configurations: **Ring source**



Sprinkler irrigation of row crops with 2D or 3D root zones

