DIDAS – A user-friendly software for Drip Irrigation Design And Scheduling

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http://app.agri.gov.il/didas

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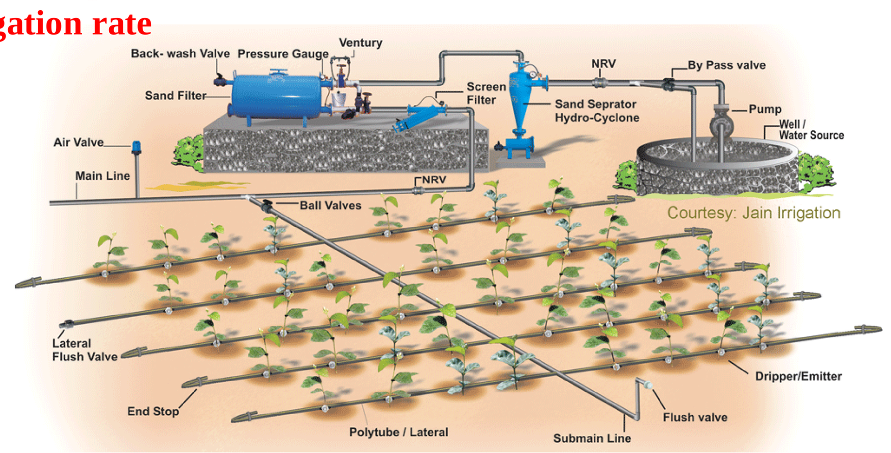
Design and Scheduling of Drip Irrigation Systems

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



What is DIDAS?

DIDAS is a software package aimed at assisting irrigators in the design of drip irrigation systems and in irrigation scheduling. The program simulates drip irrigation of various annual crops and trees at various soils and evaporation conditions. It evaluates the plant water use efficiency, but not plant growth and yields. DIDAS is comprised of **three modules**:

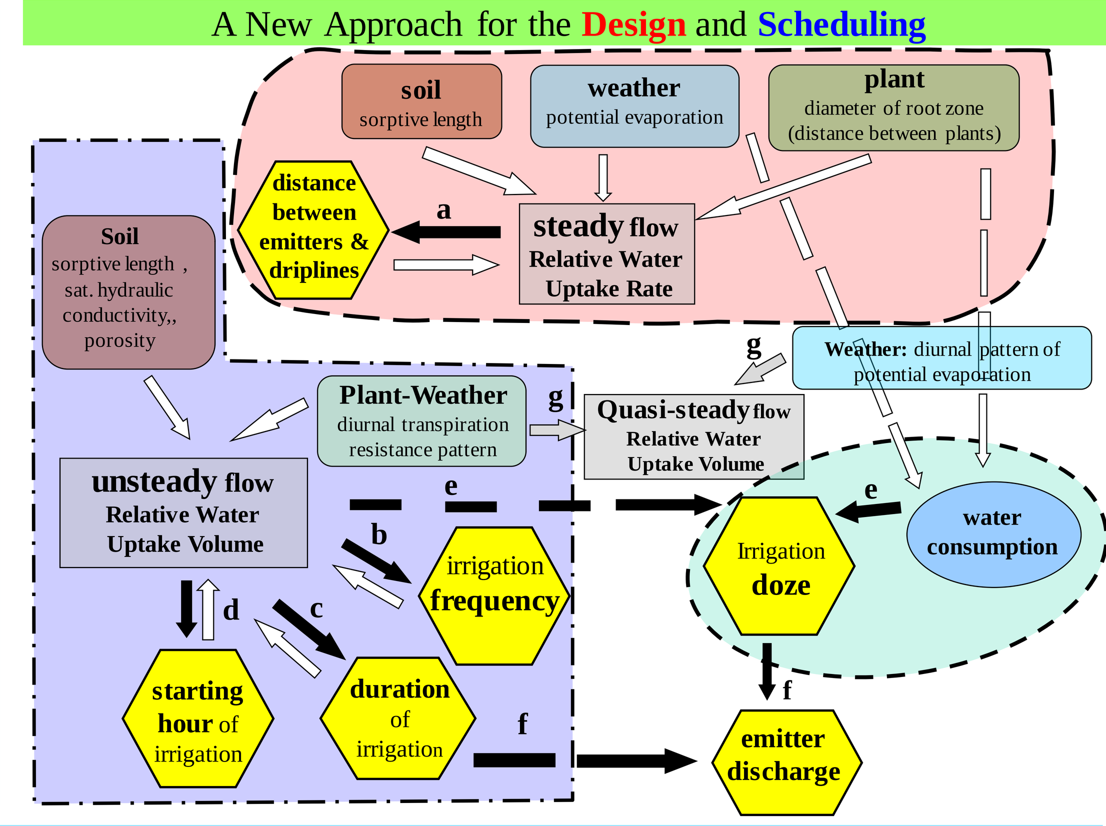
A **drip system design** tool based on steady irrigation and water uptake processes for assessing the effect of geometrical attributes on water use efficiency.

A **diurnal pattern** module, based on steady irrigation and accounting for the diurnal patterns of plant-atmosphere resistance to water uptake and evaporation, serving for fine-tuning of the irrigation system design and for preliminary evaluation of scheduling scenarios.

An **irrigation scheduling** optimizing tool, based on the actual water application schedule and on the diurnal pattern of the plant-atmosphere resistance to water uptake.

An updated version of the DIDAS package can be downloaded freely from the DIDAS web site (http://app.agri.gov.il/didas)

A New Approach for the Design and Scheduling



Who should use DIDAS?

DIDAS is intended for both practitioners and scholars. Potential users include private growers and irrigators working for irrigation companies, extension services and growers associations. It is also of benefit to scientists, lecturers and students interested in the processes of two and three-dimensional water flow and uptake in soils.

What is DIDAS good for?

Irrigators of annual and perennial crops can use DIDAS as a decision support tool for assisting them in deciding upon optimal designs of drip irrigation systems and optimal irrigation schedules, in conditions where water is a key limiting factor in crop production.

The "design" does not refer to the hydraulics of the irrigation system (pumps, valves, filters, pipe diameters etc), but to the geometrical attributes of the drip irrigation system. These include: distances between emitters along driplines and between driplines, the depth of subsurface emitters and the size and depth of root systems. DIDAS assesses the effects of these attributes on the plant water use efficiency in various environmental (soil properties and atmospheric evaporative demand) conditions. DIDAS refers directly to only drip irrigation. Nevertheless, its three modules can assist in understanding and assessing also furrow irrigation ,for example, by simulating irrigation with parallel line sources on a flat soil surface.

The "scheduling" refers and assists in optimizing drip irrigation schedules of both every-few-days irrigation and multiple daily irrigation pulses. DIDAS evaluates the effect of the irrigation frequency, the daily hours of the water application and the irrigation pulse duration on the water use efficiency for a given scenario of: drip system design, soil properties, root system size and depth and atmospheric evaporative demand. DIDAS cannot be used for assessing plant water use efficiency in rainfed crop production or when applying supplemental irrigation, i.e. it refers to only regular irrigation schedules.

Researches, lecturers and students can use DIDAS for research and teaching purposes as a research or training tool for studying the effects of various boundary, engineering and environmental, conditions on the processes of two and three-dimensional water flow and uptake in variably-saturated soils. Setting scenarios of coupled on-surface or subsurface water sources and subsurface sinks and utilizing the graphical outputs of the spatial distributions and temporal patterns of the soil water potential enables methodological studies of the roles of gravity and capillarity in driving the soil water and of the effects of the soil, plant and atmospheric evaporative demand on water flow and uptake by plant roots. DIDAS allows also setting scenarios with just point or line water sources, which are relevant to other agronomic and environmental practices and to processes involving water application and leaks with no water uptake by plant roots.

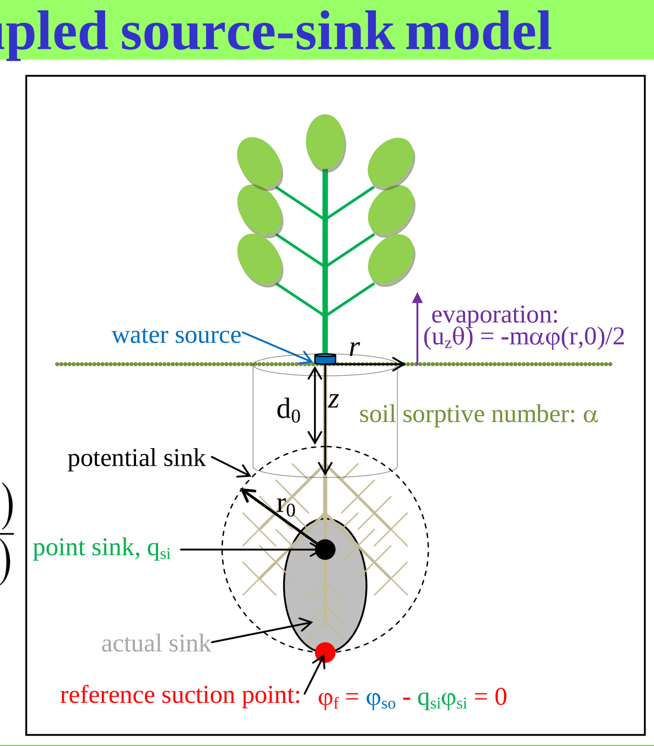
What are DIDAS' concepts and principles?

DIDAS is designed to be user-friendly and to use a minimal number of readily-available and intuitive parameters on one hand, and to be accurate, robust and relevant on the other hand.

The program performs computations based on analytical solutions of the relevant linearized water flow and uptake problems. Water flow is described by superposition of solutions for positive sources (on-surface or subsurface emitters) and negative sinks (plant root systems). Steady water flow is assumed in the design module and unsteady flow is used in the irrigation scheduling module. The **design** tool is based on a new, relative water uptake rate criterion (**RWUR**, ratio between water uptake rate and irrigation rate) suggested for assessing the effect of the geometrical attributes on water use efficiency. The recommended RWUR criterion for design purposes is evaluated assuming no plant-atmosphere resistance to water uptake. Namely, the plant roots apply maximum possible suction and the water uptake is determined just by the capability of the soil to conduct water from the sources (emitters) to the sinks (root zones). The computations of the RWUR require only a minimum number of three parameters describing the soil texture, the size of the root zone and the potential evaporation, in the few cases when it is important to account for also evaporation form the soil surface. The irrigation **scheduling** optimizing tool is based on unsteady water flow modelling and on a relative water uptake volume criterion (**RWUV**, ratio between daily water uptake volume and daily irrigation volume). An alternative optimization criterion can be to maximize the daily hours for which the evaluated (absolute) WUR is higher than a given threshold value. The computations of the diurnal patterns of the water uptake rates and the daily RWUV for a given irrigation scenario require additional information on the diurnal pattern of the plant-atmosphere resistance to water uptake and on the hydraulic conductivity of the soil.

Coupled source-sink model

$$\bar{q}_{si} = \frac{\Phi_{so}(0, Z_{bot})}{\Phi_{si}(0, Z_{bot})}$$



Unsteady (transient) water flow and uptake model for Irrigation Scheduling