Best practices on irrigation

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Best practices in improving the sustainability of agriculture

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Global agriculture and water use (ha x 10^6)

- Cultivated area (rainfed + irrigated) = 1,500
- Irrigated area = 300 (20%)
- Irrigated area for food production = 40%
- Irrigated area with salinity = 40%

Water use efficiency (WUE)

- Seasonal/annual irrigation water use:
  - Field crops: 300 (e.g. beans) to 1200 mm (e.g. cotton)
  - Protected crops (per year): 600 (e.g. leafy vegs.) to 1500 (fruit vegs.)
  - Higher in soilless culture (open-loop hydroponics) than in soil

- Tendency to over-irrigate (+10 to +50%) results in:
  - water loss
  - nutrient loss (with drainage water) and pollution (e.g. nitrates)
  - increased production costs (energy for pumping, fertilisers, …)
  - crop water stress (due to waterlogging and hypoxia in the root zone)
  - increased susceptibility to root diseases

1 mm = 1 L m^-2 = 1 kg m^-2 = 10 m^3 ha^-1
Key elements of the BEMPs on irrigation

- Crop selection (species and cultivars)
- Soil management (tillage, amendments, etc.)
- Water treatment and storage (desalinization, etc.)
- Deficit irrigation (partial root drying, regulated d.i.)
- Closed-loop irrigation systems (substrate culture)
- Irrigation scheduling (ET models vs soil moisture sensors)
- Irrigation systems (drip vs overhead irrigation)

Approaches to efficient irrigation: Deficit irrigation

Deficit irrigation

Deficit irrigation

Deficit irrigation

Deficit irrigation
Approaches to efficient irrigation
Open vs closed irrigation systems

Soilless-grown tomato: water and N balance)
(Tuscany; 2 crops/year; yield ≈ 25 kg/m²)

- Water = 6,950 m³/ha
- N = 1,330 kg/ha (N)

- Water = 8,630 m³/ha
- N = 1,600 kg/ha (N)

- Water = 0 m³/ha
- N= 0 kg/ha N

Source: Incrocci, 2011

Approaches to efficient irrigation
Irrigation scheduling

- Irrigation timers (the standard method?)
- Determination of soil water balance (called ET-based method in greenhouse and nursery crops)
- Direct measurement of moisture content in the root zone with soil moisture sensors (SMS)
- Integration of methods 2 and 3
- Speaking-plant
Irrigation scheduling (dose and frequency)

1) Determination of available water in the root zone

2) Determination of the evapotranspiration rate

2.1) ET model: FAO equation.

\[ ET = k_c \cdot ET_0 \]

- \( k_c \): crop coefficient (ET/ETP). It incorporates crop characteristics and averaged effects of soil evaporation.
- \( ET_0 \): reference or potential ET. It is assessed with evaporation pan or based on weather conditions.
2) Determination of the evapotranspiration rate

2.2) ET model: plant transpiration under greenhouse.

- ET is mostly determined by leaf transpiration (T)
- T depends basically on leaf area (LAI), the intercepted radiation \( I_c \), air temperature and relative humidity, which both determine the vapour pressure deficit (VPD)
- Stomata regulation of leaf T is often limited (due to poor gh. ventilation)

\[
T = A \cdot \frac{I_c}{\lambda} + B \cdot \text{LAI} \cdot \text{VPD}
\]

3) Direct measurement of water-related parameters in the root zone

- TDR (Time Domain Reflectometry)
- FDR (Frequency Domain Reflectometry)
Approaches to efficient irrigation

Irrigation systems: drip vs overhead irrigation

Up to \( \approx 100\% \) distribution efficiency

Conclusions on BEMPs

Why?
- Irrigation is generally inefficient due to: empiricism in irrigation scheduling, use of saline water (large leaching fraction), etc.
- Over-irrigation causes pollution due to the leaching of agrochemicals (e.g. nitrates, phosphates, plant protection products), soil erosion, etc.

What?
- Advanced irrigation management (application of crop modelling and/or sensing technology, deficit irrigation)
- Reuse of drainage water (closed system)
- Use of drip irrigation
- Other measures (crop selection, water treatment)

How?
- Regulations
- Dissemination of best practices
- Education and training

Thank you!

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