Using Weather Stations to Improve Irrigation Scheduling

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What is today's most important rule for irrigators?

- **THE RULE OF THUMB**

- Why do farmers irrigate the way they irrigate?
  - „because it looks dry“
  - „because that’s how I always did it“
  - „because it feels right“

*The average irrigation decision is pure guesswork!*
What does a farmer need to know when taking an irrigation decision?

- His crop - pheno phase, root development, fruit stages…
- His soil types
- His irrigation system’s distribution uniformity
- His pipeline pressure
- His canal flow
- WEATHER = HIS MICRO-CLIMATE!
- SOIL MOISTURE

Plenty of Monitoring requirements!
» Water - the resource of the future

- Monitoring needs in the cycle of water
  - Precipitation
  - Quantity and quality of ground / surface water
  - Pumping Water for irrigation purposes
    - Quantity of uptake - meter reading
    - Pump runtime
    - Pump activation / deactivation and monitoring
    - Pump error
  - Irrigating
    - Evapotranspiration
    - Soil moisture (at various levels)
    - Wind speed and direction
» Water - the resource of the future

- Monitoring needs in the cycle of water (ctd.)
  - Irrigation systems
    - Canal flow
    - Canal level
    - Pipeline pressure
    - Pivot position
    - Valve status (open/closed/error)
    - System yield
  - Fertilizing
    - Soil conductivity
    - Water conductivity
    - Run-Off
A Weather Station’s Sensors

Data collection - the Sensors

- Sufficient Accuracy
- Robust
- Operate in wide temperature range
- Low Power Consumption
- Little drift over time
- Simple Installation, low maintenance
A Weather Stations‘s Components: Logger and Com‘s

- Compact and simple to use
- Extremely Robust
- Easy to Install
- Integrated Units
- Options: GSM, GPRS, UHF
- Low Power Consumption
- Remote Configuration
An Automatic Weather station - Sensor Requirements

You need at least the sensors required by the ETo Formula according to Penman-Monteith.

- Rain Gauge
- Wind Speed and Direction
- Temperature & Relative Humidity
- Solar Radiation
Weather Stations for Irrigation Improvements

Which mounting is required?

- According to the model's requirements!
- DO NOT mount any sensor on metal plates!
- Observe WMO regulations, if possible!
Weather Stations for Irrigation Improvements

- Which quality / accuracy is required?
  - Sufficient accuracy for the task!
  - Low Drift at least within the first five years
  - Low maintenance requirements
  - *But it wont work without maintenance!*
Data Collection: Option 1 - GPRS

Measure once per minute, transmit averages every 15 minutes

GSM Provider

Internet

Users

addPro 5.4

Web Server
Data Collection: Option 2 - UHF radio

Measure once per minute, transmit averages every 15 minutes

Direct UHF Radio Connection to Base Station

Internet

Users

Web Server

addPro

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Evapotranspiration
Statistics
There is a wide Variety of sensors:

- Sentek EasyAGs and EnviroSMARTs
- AquaSpy AquaSpy probes
- Stevens HydraProbes
- Decagon Echo2
- Streats Aquaflex
- Irrometer Watermarks
- ………
Because „One fits all“ doesn’t work

- There are different crops
- There are different soils
- There are different budgets
- There are different irrigation systems
Soil moisture curves can be displayed in individual settings. To better separate depths of multilevel probes, each sensor can be assigned a display offset. To better recognize Full and Refill points, lines can be drawn and the area in between coloured.
It is important to assign to each sensor its proper soil type and calculation method: averaging or summing.
Irrigation Improvements

Just about all farmers over-irrigate - with rather detrimental consequences:

• Wash out of nutrients = increased need of fertilizers
• Too much water in the soil > too little oxygen! This largely affects the plants „metabolism“, reduces growth, harms micro-organisms, reduces yield.
• Pollution of ground- and surface water (nitrates!!)
• Unnecessary wear and maintenance of equipment
• Waste of energy (electricity, fuel) to run the pumps
WATER LOGGING
Temporary slow down of daily crop water use and growth caused by water logging after an irrigation.
### Table 1. Water Savings

<table>
<thead>
<tr>
<th>Water Applied</th>
<th>Before EnviroSCAN</th>
<th>After EnviroSCAN</th>
<th>Savings</th>
</tr>
</thead>
<tbody>
<tr>
<td>ML/Ha</td>
<td>9</td>
<td>7,5</td>
<td>1,5</td>
</tr>
<tr>
<td>Total ML</td>
<td>3.150</td>
<td>2.625</td>
<td>525</td>
</tr>
<tr>
<td>Total Water Cost</td>
<td>$33.075</td>
<td>$27.562</td>
<td>$5.512</td>
</tr>
</tbody>
</table>

### Table 2. Yield Results

<table>
<thead>
<tr>
<th>Yield Increase</th>
<th>Before EnviroSCAN</th>
<th>After EnviroSCAN</th>
<th>Yield Increase</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bales/Ha</td>
<td>8</td>
<td>9,8</td>
<td>1,8</td>
</tr>
<tr>
<td>Total Bales</td>
<td>2.800</td>
<td>3.430</td>
<td>630</td>
</tr>
<tr>
<td>Total Value in $</td>
<td>$1,271.200</td>
<td>$1,557.220</td>
<td>$286.020</td>
</tr>
</tbody>
</table>

(Assuming 1999/2000 average of $454/bale)
WASTE OF WATER AND ENERGY!
Cost savings

If you manage to reduce irrigation by only 10% the savings in gasoline alone can be tremendous:

Example:

John Deere 4045T 99hp Diesel Engine
Consumption: 15l/hr @ 2500rpm
If irrigation ON for 3 hrs./day from May 1st to August 31st:
Total Consumption: 5587l @ € 1.2 = € 6.700

Annual Saving: € 670 per pump per season!
Irrigation Improvements

Some farmers **under-irrigate** - with consequences as fatal:

- The plant suffers excessive dry stress = reduced yield, lesser quality crops
- Water and fertilizers do not reach the active root zone = reduced yields, lesser quality crops
- Water and fertilizers that do NOT reach the active rootzone are **100% lost** for this crop! And so is the energy invested for their application!
Plant water stress

Stress days

Probes: EB1 | Sensor Depth (cm): 20 + 30 + 50 + 70 + 90
» Plant Water Stress in Corn

Corn Yield vs. Stress Days

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WHY WEATHER STATIONS?

✓ To get real-time micro-climatic information
✓ To compute Evapotranspiration
✓ To use the same data for disease models
✓ To monitor soil moisture
✓ To correlate irrigation with ETo, soil moisture, soil salinity, precipitatin, ground water level, etc.

TO UNDERSTAND WHAT’S GOING ON

AND TAKE BETTER IRRIGATION DECISIONS!
Thank you for your attention!