# Lecture 5: Modeling of agricultural water demand
# CropWat Model

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## WHAT DATA DO I NEED FOR CALCULATIONS?

**For Crop Water Requirements (CWR) , you need**

**1. Reference Crop Evapotranspiration (ETo) values** calculated from:

- either Your own measured values entered directly from the keyboard using **InputData,ETo**

- or Estimates of ETo calculated using the Penman-Monteith equation. ETo is automatically calculated when you enter monthly climatic data (temperatures, humidity, windspeed, sunshine).

The data can be input from the keyboard using **InputData, Climate, Enter/Modify** or from a data file using **InputData, Climate, Retrieve**.

You can use the old *.PEN data files in the CLIMWAT database but to do this you must change the **File Type** from *.PEM to *.PEN when retrieving these files.

**2. A Cropping Pattern** consisting of
-one or more crop file names and the planting date(s). To do this, use the menu options **InputData,Crops, CroppingPattern**.

Note: the option **InputData,Crops,CropCoefficeints** is provided only to enter or edit crop coefficient files (*.CRO). A set of typical crop coefficient data files are provided in C:\CROPWATW\CROPS.

**3. Monthly Rainfall data**

- rainfall data is not absolutely necessary (e.g. many areas of Egypt have no rain), but it should be used if rain falls in the growing season. Use **InputData,Rainfall** to do this.

You can use the old *.CLI data files in the CLIMWAT database but to do this you must change the **File Type** from *.CRM to *.CLI when retrieving these files.

**For Irrigation Scheduling you will need the data listed above and -**

**4. Soil Type information**

-soil data is entered using **InputData, Soil**. A set of typical soil types are provided in C:\CROPWATW\SOILS.

**5. Your Scheduling Criteria -** the basis on which schedules will be calculated

- you must specify the basis on which the scheduling is to be carried out (e.g. 100mm every 14 days, or irrigate to return the soil back to field capacity when all the easily available moisture has been used). This is done with menu option **Schedule,Criteria.**

Once all the data is entered, CropWat for Windows will carry out the necessary calculations. You do not need to click on a "calculate" or "run" command. If you change any data, the program will automatically recalculate the results.

## How do I see the results ?

On screen - The menu options **Tables** will show tables of input data and results

-The menu option **Graphs** allows you to plot data and results

To file - Use the **SaveReport** option to create ASCII (text) and .CSV (export) files

To printer - Use the **Text Editor** to print ASCII files created with SaveReport

- Graphs can be rotated to Landscape or Portrait using the Print Manager.

## The Tool Bar

You can access the data entry windows using the icons in the Tool Bar.
These are grouped into sets of related icons across the top of the
screen.
As you work with the program, you will often find that there are several
ways of getting to the same menu option.
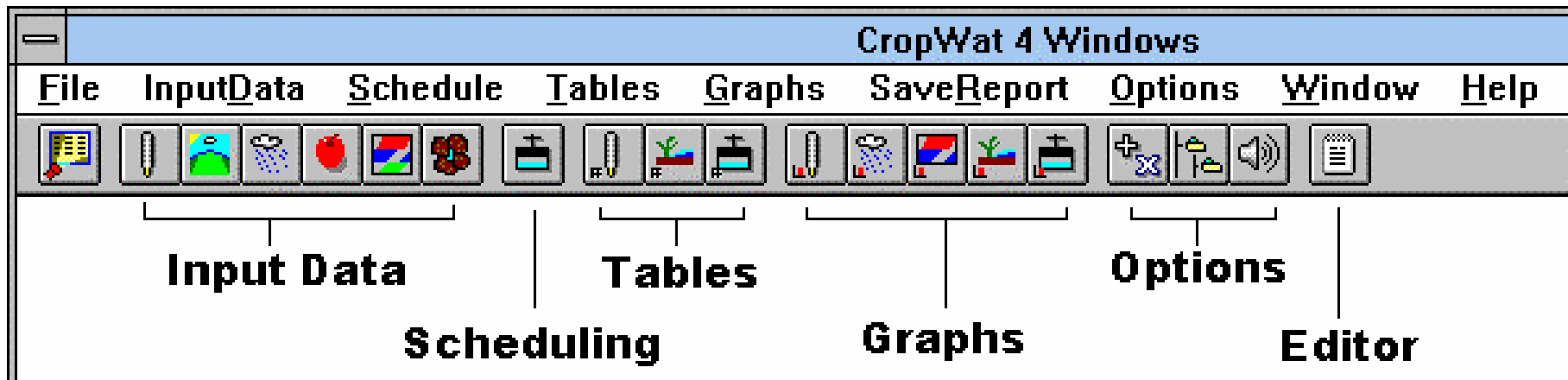
# The DATA STATUS Window

To help you know what data has been entered into the program a
"**DATA STATUS WINDOW** " is provided . This is a table summarizing
the current data in use and also shows if you have entered enough data
to calculate crop water requirements or an irrigation schedule.

| Data Item | File Name | CWR | Scheduling |
|---|---|---|---|
| Climate | [No Data] | Optional | Optional |
| ETo | [No Data] | Yes | Yes |
| Rainfall | [No Data] | Optional | Optional |
| Crop | [No Data] | Optional | Optional |
| Cropping Pattern | [No Data] | Yes | Yes |
| Soil | [No Data] | No | Yes |
| Scheduling Criteria | [Not Set] | No | Yes |
| Can Calculate Now? | | No | No |

CLIMATE - enter monthly climate data to calculate ETo

ETo - enter your own monthly ETo estimates

RAINFALL - enter monthly rainfall data

CROPS - enter cropping patterns and crop coefficient data

SOIL - enter data for your soil type

These options permit you to enter new data using a "data entry window" or to load/save data to/from files.
The load/save options duplicate the **File,Retrieve** and **File,Save** options in the **File** menu. For example, a set of climate data could be read in from a data file using **InputData,Climate,Retrieve** *or* using **File,Retrieve,Climate Data** .

**Tables menu** - examine input data and results

CLIMATE & ETo : Input data & calculated ETo

RAINFALL : Input data & calculated effective rain

CWR : Crop Water Requirements

IRRIGATION SCHEDULE : irrigation & soil moisture

## CLIMATE Table

The calculated values of Reference Crop Evapotranspiration (ETo) using the 1992 FAO recommended Penman Monteith equation are shown in the right hand column together with the calculated solar radiation. The units of ETo are millimetres of water per day.

## RAINFALL Table

This table is shown by selecting Tables, Rainfall. It lists the monthly total rainfall and the calculated effective rainfall. It is the same as the data entry form used to input the raw data

# CROP WATER REQUIREMENTS TABLE

This table lists information about the ETo, rainfall and crop coefficient data for each crop in the cropping pattern. To show it select Tables,CWR.
You can change the time step and the assumed in field Irrigation Efficiency, which affects the calculated the Field Water Supply in litres per second per hectare (FWS l/s/ha).

## Crop Water Requirements Table

MAIZE (Grain)    Time Step (Days): 10    **Update**    **Report...**

[All Blocks]    Irrigation Efficiency (%): 70    **Close**

| Date | ETo (mm/period) | Crop Area (%) | Crop Kc | CWR (ETm) (mm/period) | Total Rain (mm/period) | Effect. Rain (mm/period) | Irrig. Req. (mm/period) | FWS (l/s/ha) |
|------|-----------------|---------------|---------|-----------------------|------------------------|--------------------------|-------------------------|--------------|
| 23/3 | 66.05 | 100.00 | 0.33 | 22.07 | 2.45 | 2.40 | 19.67 | 0.33 |
| 2/4 | 68.20 | 100.00 | 0.54 | 36.61 | 4.05 | 4.05 | 32.56 | 0.54 |
| 12/4 | 69.92 | 100.00 | 0.76 | 53.25 | 6.25 | 6.18 | 47.07 | 0.78 |
| 22/4 | 71.19 | 100.00 | 0.99 | 70.23 | 9.51 | 9.15 | 61.08 | 1.01 |
| 2/5 | 71.99 | 100.00 | 1.18 | 84.77 | 13.31 | 12.46 | 72.31 | 1.20 |
| 12/5 | 72.31 | 100.00 | 1.20 | 86.77 | 17.33 | 15.82 | 70.95 | 1.17 |
| 22/5 | 72.16 | 100.00 | 1.20 | 86.59 | 21.38 | 19.04 | 67.55 | 1.12 |
| 1/6 | 71.55 | 100.00 | 1.20 | 85.86 | 25.34 | 22.04 | 63.82 | 1.06 |
| 11/6 | 70.50 | 100.00 | 1.16 | 82.15 | 29.17 | 24.79 | 57.36 | 0.95 |
| 21/6 | 69.05 | 100.00 | 0.96 | 65.97 | 32.80 | 27.30 | 38.67 | 0.64 |
| 1/7 | 67.23 | 100.00 | 0.72 | 48.55 | 36.20 | 29.56 | 18.99 | 0.31 |
| 11/7 | 32.83 | 100.00 | 0.55 | 17.95 | 19.28 | 15.55 | 2.40 | 0.08 |
| Total | 927.14 | | | 778.02 | 217.06 | 188.34 | 589.69 | [ 0.72 ] |

# Cultivated area and water requirement of each crop in the Gaza Strip. (Adopted from MOA, 2004, Arial satellite images and CROPWAT model)

| Crop Type | Area cultivated (dunam) | Water requirement | | |
|---|---|---|---|---|
| | | m³/dunam | $10^6$ m³/year | % of total |
| Citrus | 12,600 | 900 | 11.34 | 14.0 |
| Olives | 22,897 | 700 | 16.00 | 20.0 |
| Date Palm | Only small area remaining | | | |
| Almonds | 3,163 | 400 | 1.35 | 1.7 |
| Fruits | 10,333 | 400 | 4.13 | 5.0 |
| Vegetables (Protected) | 21,382 | 650 | 13.89 | 17.3 |
| Vegetables (Unprotected) | 47,044 | 700 | 32.93 | 41.0 |
| Flowers | 514 | 1500 | 0.77 | 1.0 |
| Ornamental | 132 | 500 | 0.07 | 0.1 |
| Field crops | 36,562 | Rain fed | 0.00 | 0.0 |
| Total | 154,627 | - | 80.48 | 100 |