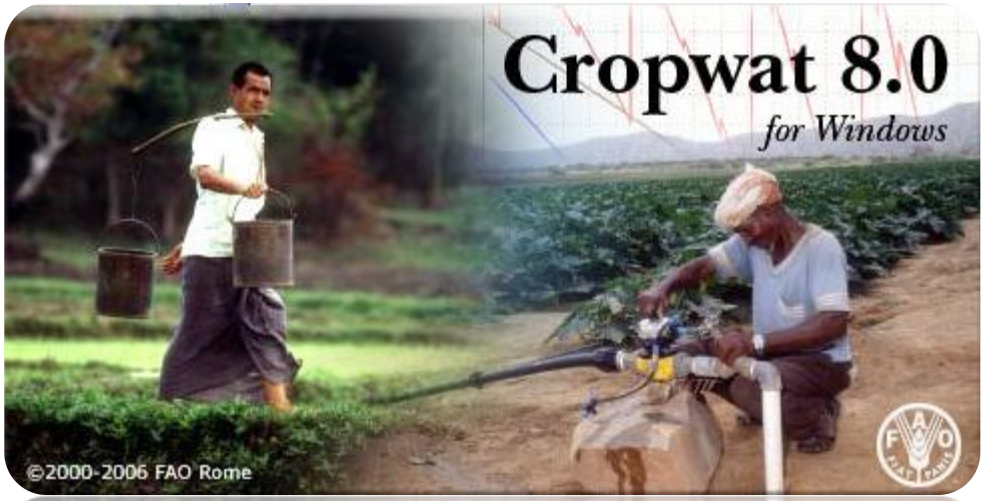


CROPWAT 8.0

THE FUNDAMENTAL QUESTIONS OF IRRIGATION

How to irrigate

How much to irrigate

When to irrigate

The designer's point of view

The operator's point of view

IRRIGATION POBLEMS CORRESPONDING SOFTWARE

How to irrigate

Ve.Pro.L.G. s

EPANET

the designer's point of view

IRRIGATION POBLEMS CORRESPONDING SOFTWARE

How much to irrigate

When to irrigate

DAILYET
Version 3.0.1

CROPWAT
version 8.0

CLIMWAT 2.0

New_LocClim
Local climate estimator

SPAW
Soil - Plant - Air - Water
Field & Pond Hydrology
Version 6.02.75

the designer's point of view

the operator's point of view

DailyET

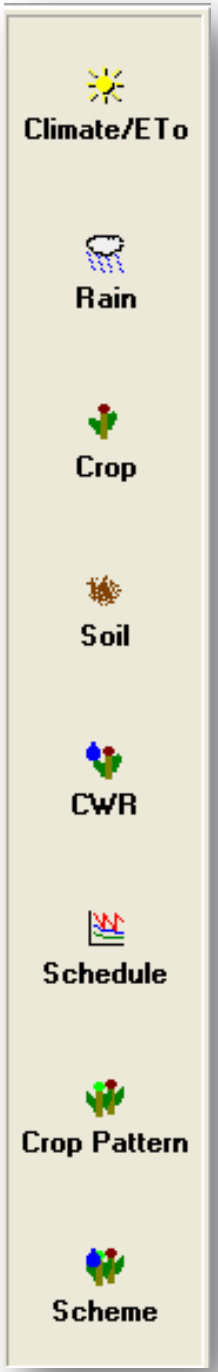
- Singole point estimation of ET0

CropWat is a decision support system developed by FAO, having as main functions

- to calculate: reference evapotranspiration, crop water requirements, crop irrigation requirements;
- to develop: irrigation schedules under various management conditions, Scheme water supply;

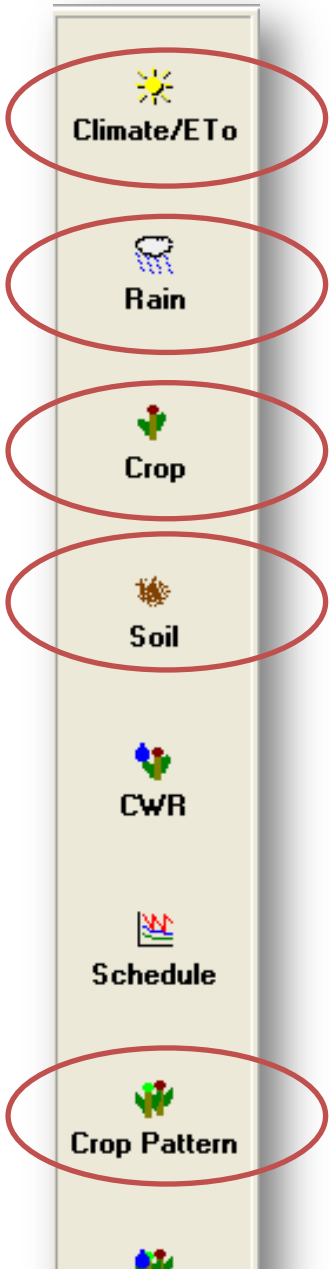
Programme structure

- 5 are data input modules
- 3 are calculation modules



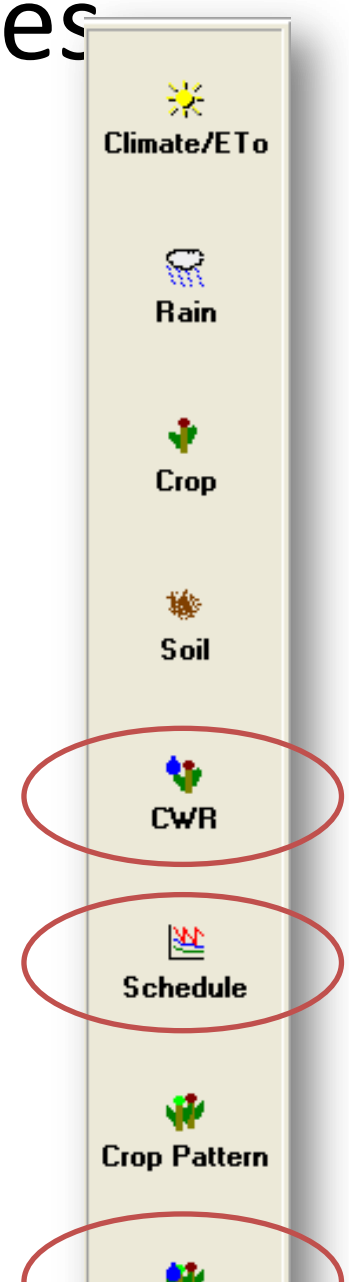
The input modules

1. Climate/ETo:
2. Rain:
3. Crop
4. Soil
5. Crop pattern



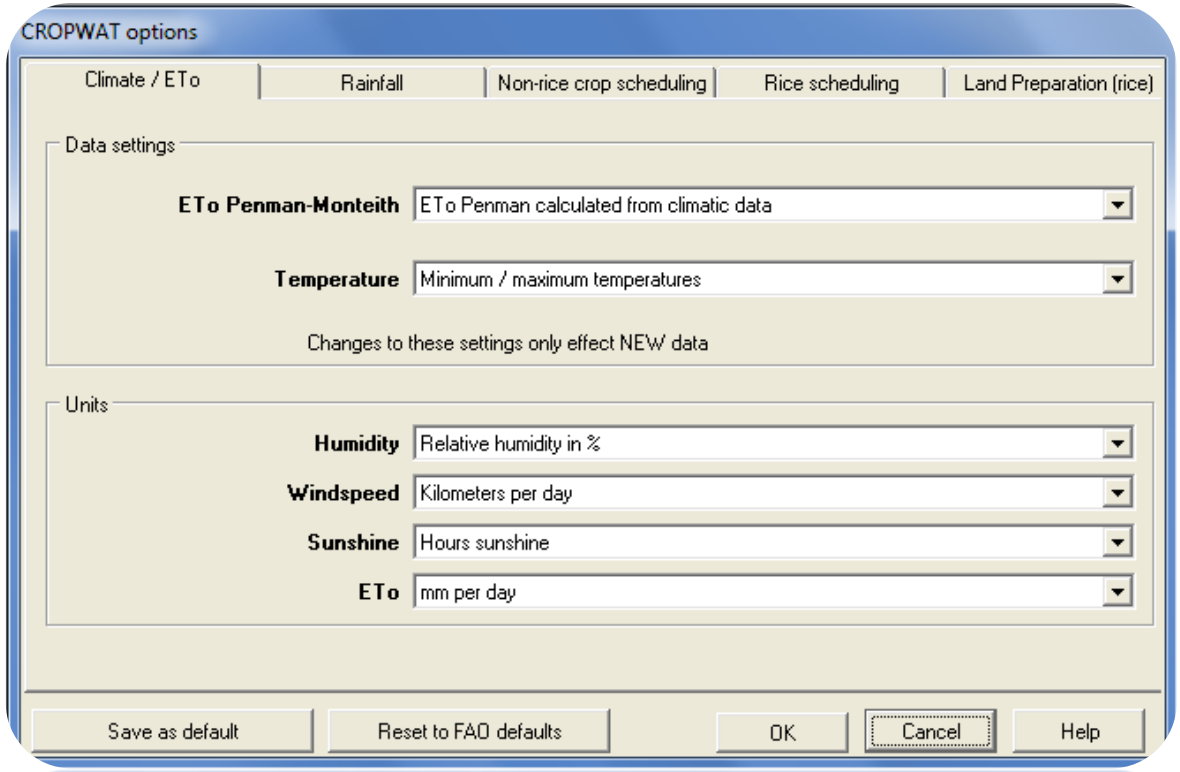
The calculation modules

6. CWR
7. Schedules
8. Scheme



Settings menu

- - Options
- - File locations



First Step – **Insert all required inputs**

- Climate (Et0, rain)
- Crop
- Soil
- Crop Pattern

INPUT

- The water balance method is used for calculation of irrigation schedules in CROP WAT, which means that the incoming and outgoing water flows from the soil profile are monitored.

Data	Input	Output
Climatic	▪ Monthly means of min. and max. temperature, relative humidity, sunshine duration, wind speed ▪ Rainfall data Monthly	✓Reference Evapotranspiration ✓ crop water requirement irrigation requirement ✓ Actual crop Evapotranspiration ✓ Soil moisture deficit ✓ Estimated yield reduction due to crop Stress ✓ Irrigation scheduling
Crop	▪ Kc, crop description, max. rooting depth, % area covered by plant	
Soil	▪ Initial soil moisture condition and available soil moisture	
Irrigation	▪ Irrigation scheduling Criteria	

The Soil module is essentially data input, requiring the following general soil data:

- Total Available Water (TAW)
- Maximum infiltration rate
- Maximum rooting depth
- Initial soil moisture depletion

Soil data

- The soil parameters important for irrigation scheduling and required for irrigation scheduling using the FAO CROPWAT program are described below:
  - Total available soil moisture content (SMta), defined as the difference in soil moisture content between field capacity (FC) and wilting point (PWP). This is the total amount of water available to the crop and depends on texture, structure and organic matter content ;
  - Initial soil moisture depletion indicates the dryness of the soil at the start of irrigation. This is expressed as a depletion percentage from FC;
  - Maximum rooting depth will in most cases be determined by the genetic characteristics of the plant. In some cases the root depth can be restricted by limiting layers ;
  - Maximum rain infiltration rate allows for an estimate of the surface runoff for the effective rain calculation. This is a function of rain intensity, soil type and slope class.

Effective rainfall

- To account for the losses due to runoff or percolation, a choice can be made of one of the four methods given in CROPWAT 8.0 (Fixed percentage, Dependable rain, Empirical formula, USDA Soil Conservation Service).
- In general, the efficiency of rainfall will decrease with increasing rainfall. For most rainfall values below 100 mm/month, the efficiency will be approximately 80%. Unless more detailed information is available for local conditions, it is suggested to select the Option “Fixed percentage” and give 80% as requested value.
- In the water balance calculations included in the irrigation scheduling part of CROPWAT, a possibility exists to evaluate actual Efficiency values for different crops and soil conditions.

CROPWAT - Session: untitled

File Edit Calculations Charts Settings Window Language Help

New Open Save Close Print Chart Options

Climate/ETo

Rain

Crop

Soil

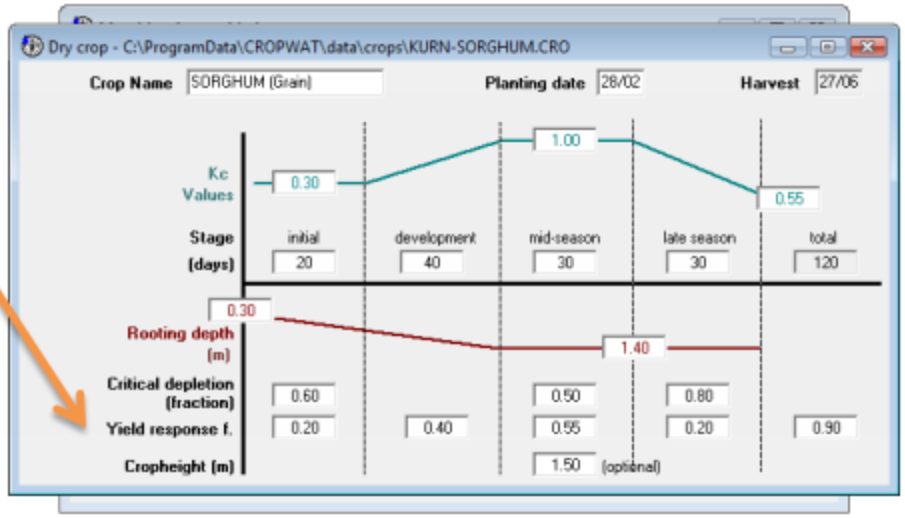
CWR

Schedule

Crop Pattern

Scheme

$$1 - Ya / Ym = Ky \times (1 - ETc / Etc)$$



CROPWAT 8.0 has crop data for several common crops taken from selected FAO publications. However, the most reliable crop data remain the data obtained from local agricultural research stations.

ETo file

Schedule file

Yield response factor (Ky)

- The response of yield to water supply is quantified through the Yield response factor (Ky) which relates relative yield decrease to relative evapotranspiration deficit. Water deficit of a given magnitude, expressed in the ratio Crop evapotranspiration under non standard conditions (ETc adj) and Crop evapotranspiration under standard conditions (ETc), may either occur continuously over the total growing period of the crop or it may occur during any one of the individual growth stages.
-
- In general, for the total growing period, the decrease in yield is proportionally less with the increase in water deficit (Ky < 1) for crops such as alfalfa, groundnut, safflower and sugar beet while it is proportionally greater (Ky >1) for crops such as banana, maize and sugarcane. For the individual growth periods the decrease in yield due to water deficit during that growth period is relatively small for the vegetative and ripening period and relatively large for the flowering and yield formation period. Water deficit during a particular growth period can also be expressed as a water deficit over the total growing period when the relationship between ETc of that growth period and ETc of the total growing period is known. The figure below provides an example of the relationship between relative evapotranspiration and yield.

Critical depletion fraction (p)

- The Critical depletion fraction (p) represents the critical soil moisture level where first drought stress occurs affecting crop evapotranspiration and crop production. Values are expressed as a fraction of Total Available Water (TAW) and normally vary between 0.4 and 0.6, with lower values taken for sensitive crops with limited rooting systems under high evaporative conditions, and higher values for deep and densely rooting crops and low evaporation rates. In addition, the fraction p is a function of the evapotranspiration power of the atmosphere.
- At lower rates of ETc, the value of fraction p are higher than at high rates of ETc. The influence of ETc on p is summarised in the following figure.
- For a list of values of p for different crops, users are invited to consult the publication No. 56 of the Irrigation and Drainage Series of FAO, entitled "Crop evapotranspiration - Guidelines for computing crop water requirements". Click here to see this publication on-line. (This link requires connection to Internet)

Initial soil moisture depletion

- The Initial soil moisture depletion indicates the dryness of the soil at the start of the growing season, that is at seeding in case of non-rice crops, or at the beginning of land preparation, in case of rice.
-
- The Initial soil moisture depletion is expressed as a percentage of the Total Available Water (TAW), in terms of depletion from Field Capacity (FC). Default value of 0 % represents a fully wetted soil profile at FC, 100 % is a soil at Wilting Point (WP).
-
- In most cases only an estimate can be made of the initial soil moisture condi-tion, depending on previous crop and periods of a preceding fallow or dry season period.

Water stress coefficient (Ks)

- The Water stress coefficient (Ks) allows to describe the effect of soil water deficit on crop evapotranspiration, which is assumed to decrease linearly in proportion to the reduction of water available in the root zone.

- Ks is given by:

- Ks = (TAW - Dr) / (TAW - RAW)
- where:
- TAW = Total Available Water Dr = Root zone depletion RAW = Readily Available Water
- Crop evapotranspiration under non-standard conditions (ETc adj) is computed from Crop evapotranspiration under-standard conditions (ETc) by means of equation:
- ETc adj = ETc * Ks
- The estimation of Ks requires a daily water balance computation for the root zone
- For a detailed description of the water stress coefficient, users are invited to consult the publication No. 56 of the Irrigation and Drainage Series of FAO, entitled "Crop evapotranspiration - Guidelines for computing crop water requirements". Click here to see this publication on-line. (This link requires connection to Internet)