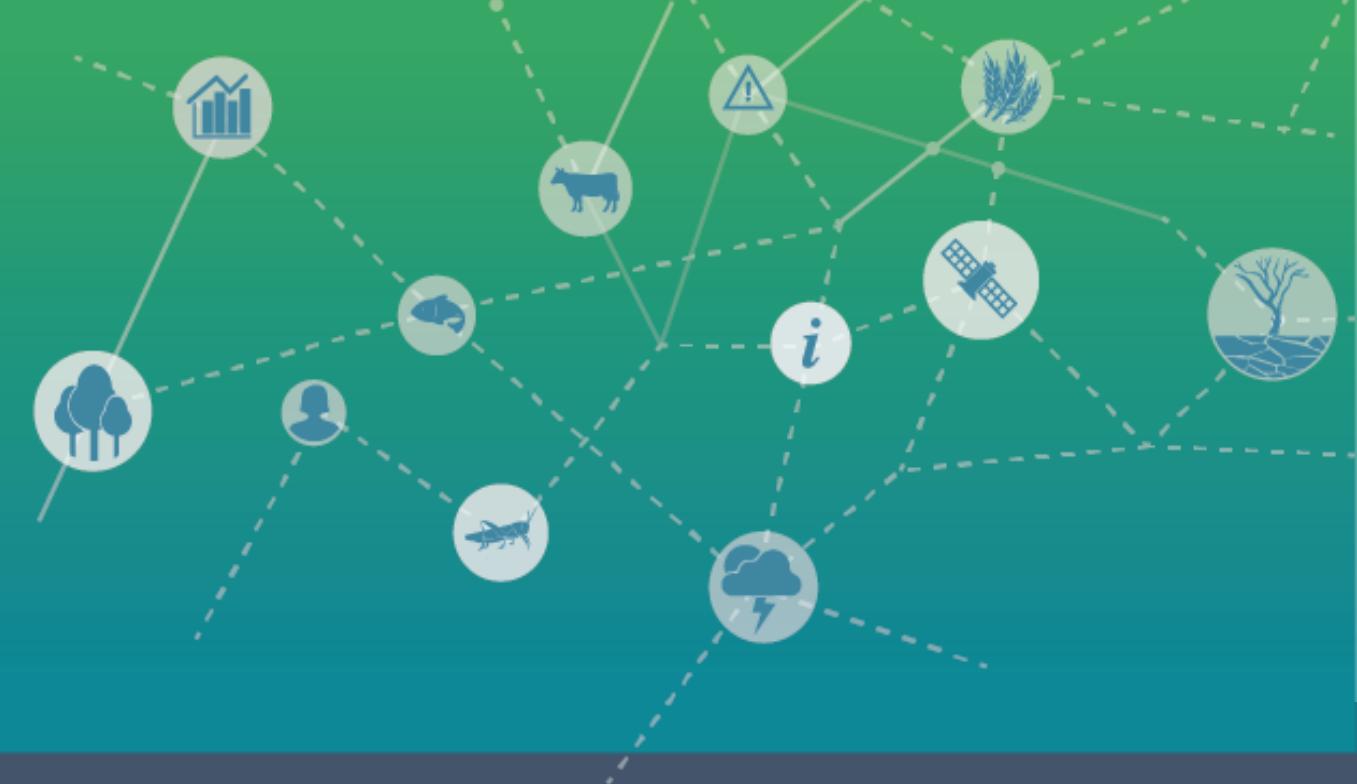




Food and Agriculture  
Organization of the  
United Nations



## Crop Module 1 Introduction to AquaCrop

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Jorge Alvar-Beltrán



# DAY 1: TABLE OF CONTENTS

- Practical applications of crop models
- AquaCrop compared to other models
- How do crop models work?
- AquaCrop: user interface

**Covered during the pre-training session**

- AquaCrop: climate module
- AquaCrop: crop module

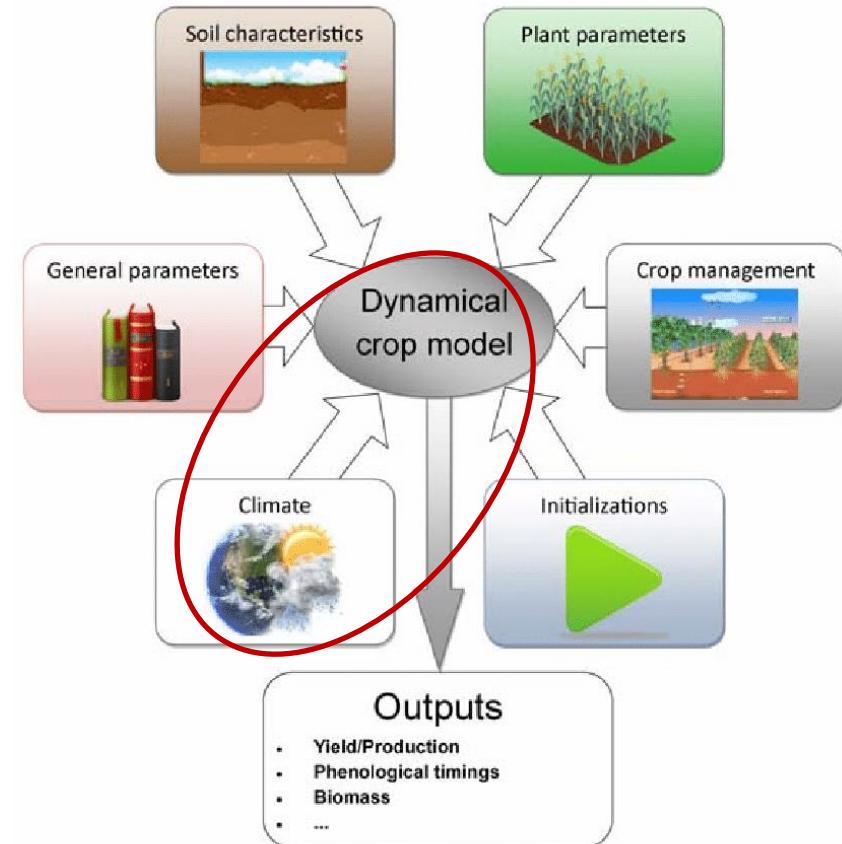
# PRE-TRAINING SESSION

# Crop models: what are they useful for?

Crop models are sets of mathematical equations that represent processes within a predefined plant system as well as the interactions between crops and its environment.

Crops models can contribute to agriculture in many ways:

- Understand crop responses to environmental changes;
- Compare attainable and actual yields;
- Identify constraints to crop production and water productivity;
- Develop irrigation schedules for maximizing production;
- Study the effect of climate change;
- Support decision-making on water allocations and water related policies;





# Some of the most widely used crop models

Model name	Main features/advantages	Link
AquaCrop	Crop-water productivity	<a href="#">link</a>
AEZ	Maximum potential yield	<a href="#">link</a>
APSIM	Crops and agricultural inputs	<a href="#">link</a>
EPIC	Focuses on soil erosion	<a href="#">link</a>
DSSAT	Crop growth and development	<a href="#">link</a>
CropSyst	Effect of management on productivity	<a href="#">link</a>

Useful overview of [crop models](#)



# AquaCrop compared to other crop models

- AquaCrop produces much finer outputs (for site-specific locations) than other models and, as a result, its spatial applications are narrower.
- AquaCrop does not consider the leaf area index (LAI) as done by many other crop simulation models (i.e., GAEZ, DSSAT and CropSyst)
- Uses a relatively low number of parameters and mostly-intuitive input variables that can be determined by simple methods.
- AquaCrop simulates one crop at the time and cannot run multiple crops for comparative economic assessments as oppose to GAEZ.
- AquaCrop considers abiotic/biotic stresses (living and non-living factors), while other models do not (WOFOST)
- AquaCrop does not take into account other reducing factors such as pests and diseases

# Limitations of crop models

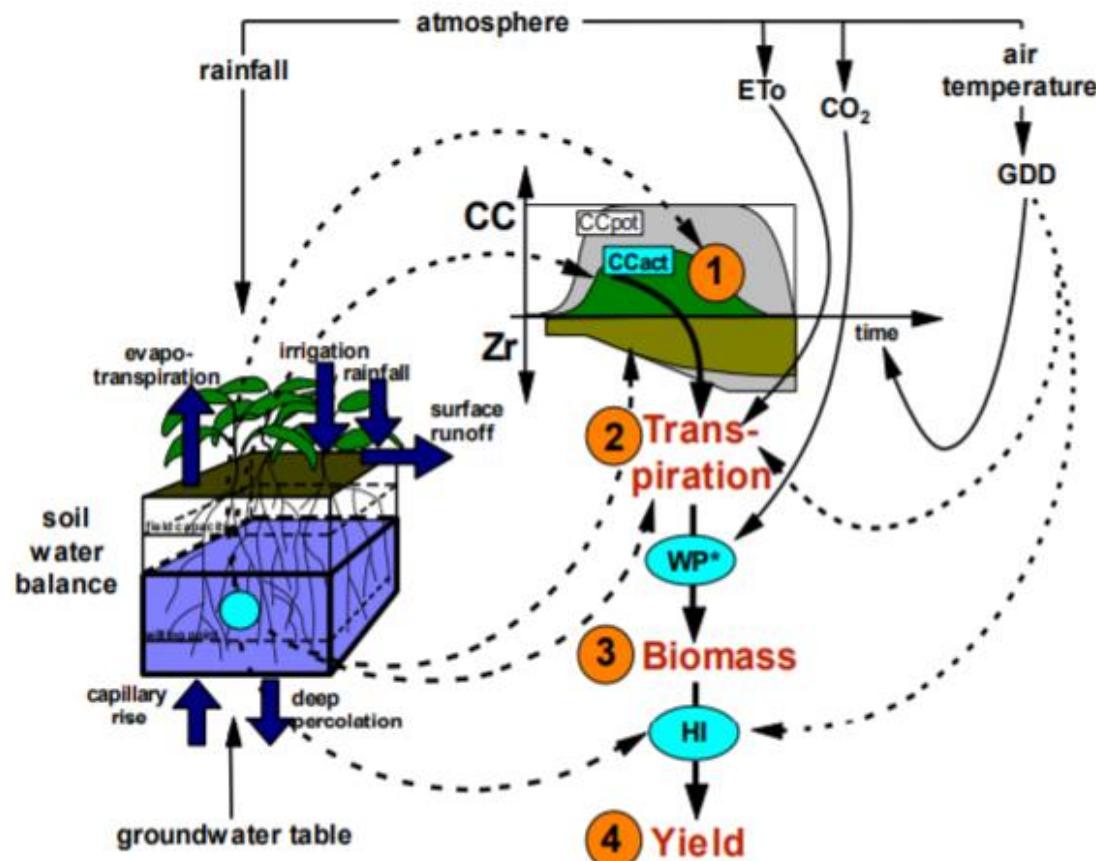
Every model has its strengths and weaknesses and, therefore, the selection process is a critical step determined by the robustness of the model, as well as on the applications, context and objective of the impact assessment.

A potential threat in crop modelling is that users are not always familiar with the intended use and limitations of each tool and, consequently, are not necessarily aware of the uncertainties associated with their outputs

- A major limitation of crop growth models is the lack of spatial information of the actual conditions of each field or region.
- Many crop-growth models require a significant amount of input data, sometimes difficult to retrieve.
- Many crop-water productivity models lack comprehensive fertilizer management and pests and diseases modules.

# AQUACROP MODEL

# AquaCrop: introduction



AquaCrop simulates crop yield in different steps:

- 1) crop development
- 2) crop transpiration
- 3) biomass production
- 4) yield formation

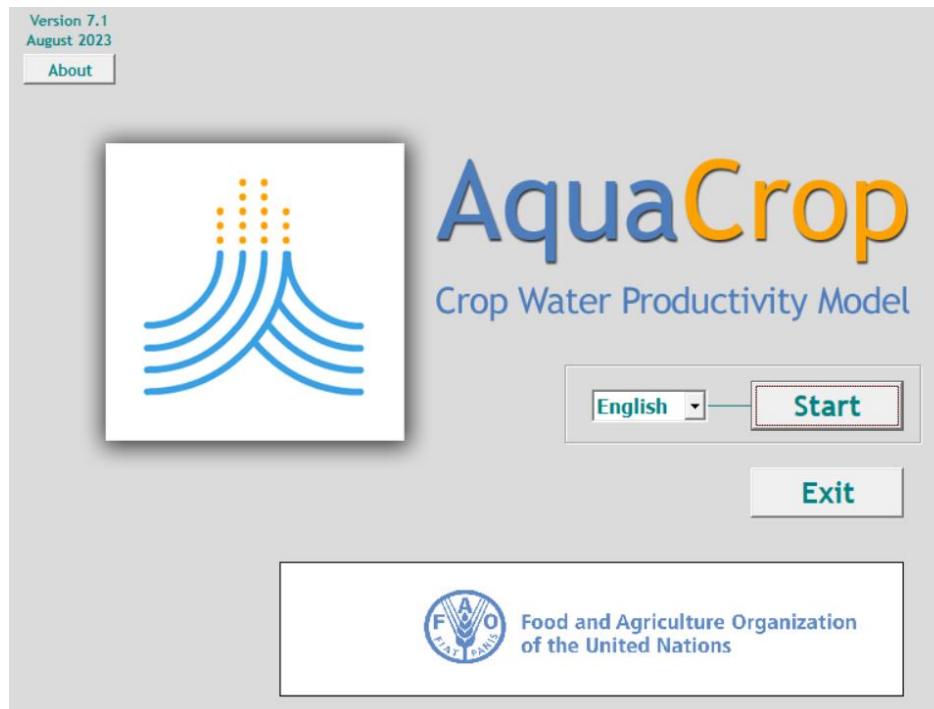
**Evapotranspiration:** location, air temperature, humidity and solar radiation...

Penman Monteith equation:

$$\lambda ET = \frac{\Delta(R_n - G) + p_a C_p \frac{(e_s - e_a)}{r_a}}{\Delta + \gamma \left( 1 + \frac{r_s}{r_a} \right)}$$

# AquaCrop interface

## Graphical User interface



## Plug-in or Standalone

 LIST	File folder
 OUTP	File folder
 PARAM	File folder
 SIMUL	File folder
 aquacrop	Application
 AUTHORS.md	MD File
 LICENSE	File



# Data used for this simulation

**Climate module:** AquaCrop default climatic files for Córdoba (south Spain) for the year 1981.

**Crop module:** AquaCrop default crop files (**daily values**) for tomato grown in Córdoba and transplanted on 1st May.

**Management module:**

- Irrigation sub-module: create our own irrigation files.
- Field sub-module: AquaCrop default field files (moderate soil fertility).

**Soil module:**

- Soil profile: AquaCrop default soil files (sandy-loam).
- Groundwater sub-module: AquaCrop default groundwater files (constant water at 2m depth).

# The core of the model

DATA	02/05/2018 10:20	Carpeta de archivos
IMPORT	02/05/2018 10:20	Carpeta de archivos
OBS	02/05/2018 10:20	Carpeta de archivos
OUTP	02/05/2018 10:20	Carpeta de archivos
SIMUL	02/05/2018 10:20	Carpeta de archivos
_DEISREG.ISR	02/05/2018 10:29	Archivo ISR 1 KB
_JSREG32.DLL	23/04/1997 1:16	Extensión de la ap... 40 KB
AquaCrop	02/05/2018 9:35	Aplicación 12.867 KB
AquaCrop	20/12/2006 9:15	Icono 2 KB
DelsL1.isu	02/05/2018 10:29	Archivo ISU 10 KB

PaddyRiceGDD.CRO	17/04/2017 16:42	Archivo CRO	7 KB
Patancheru.CLI	29/01/2009 12:12	Archivo CLI	1 KB
Patancheru.ETO	29/01/2009 12:12	Archivo ETO	3 KB
Patancheru.PLU	29/01/2009 12:12	Archivo PLU	2 KB
Patancheru.TMP	29/01/2009 12:12	Archivo TMP	4 KB
ModerateSF.MAN	17/04/2017 11:15	Archivo MAN	1 KB
Sand.SOL	17/04/2017 10:02	Archivo SOL	1 KB
RCP8-5.CO2	12/07/2015 14:12	Archivo CO2	3 KB
TR2a.IRR	31/12/2009 10:38	Archivo IRR	1 KB
WPSandLoam.SW0	24/12/2011 7:14	Archivo SW0	1 KB

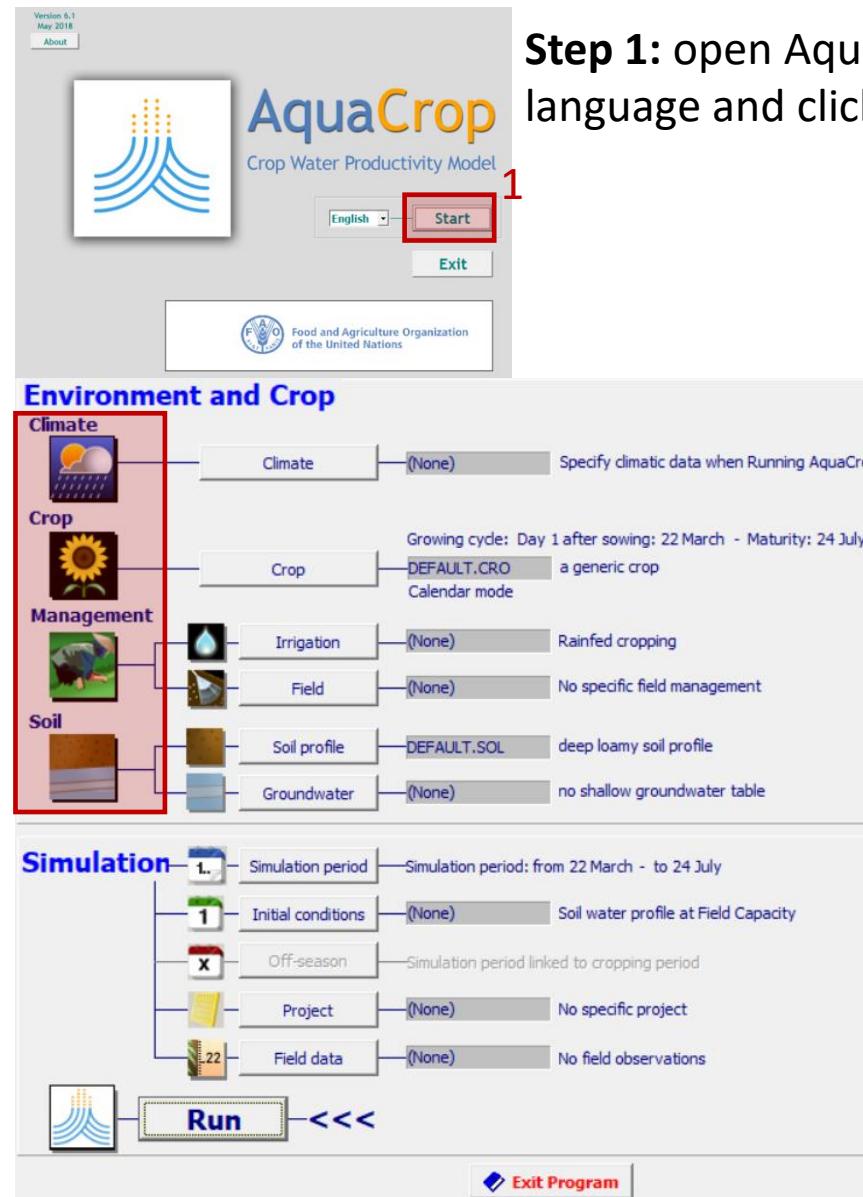
**Step 1:** open the **AquaCrop** folder in your desktop

**Step 2:** launch **AquaCrop**

*Many of these files (ETO, PLU, TMP) are automatically created by AquaCrop when preparing the climatic files.*

# CLIMATE MODULE

# AquaCrop: the interface



**Step 1:** open AquaCrop, select the language and click on **start**

Climate data collected in the field and or from gridded/point geospatial climate datasets.

Observed crop characteristics

Irrigation method, application depth & time etc.

Soil fertility & practices affecting soil-water balance

Soil profile characteristics (texture, FC, PWP, SAT)

Water depth below soil surface and soil salinity

Simulations coinciding with the growing cycle of the crop

Soil water content at the date of sowing

Aggregation of the above files into one project file

Observations from the field (CC, biomass and SWC)

CC: Canopy Cover; FC: Field Capacity; PWP: Permanent Wilting Point; SWC: Soil Water Content; SAT: Saturation

# Climate module: selecting a climatic file

## Environment and Crop

### Climate



Climate

1

Select/Create Climate file

2

Path

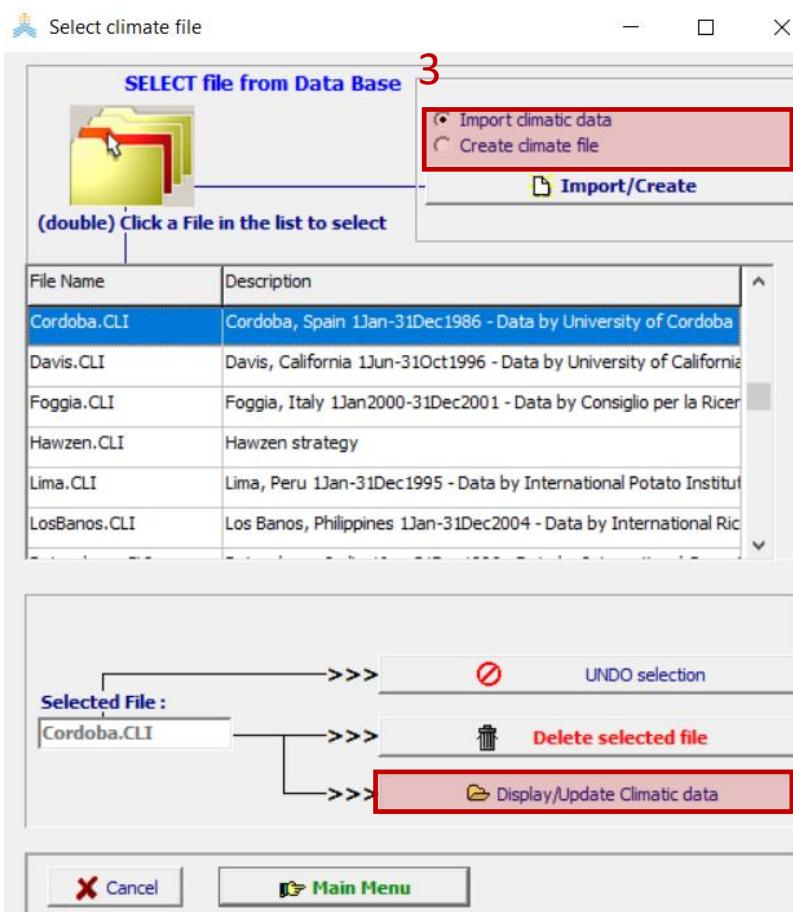
Display/Update Climate characteristics

Steps 1-2: click on the **climate** module and then click on **select/create climate file**

*Remember! We are importing default climatic files from AquaCrop, we are not creating them...*

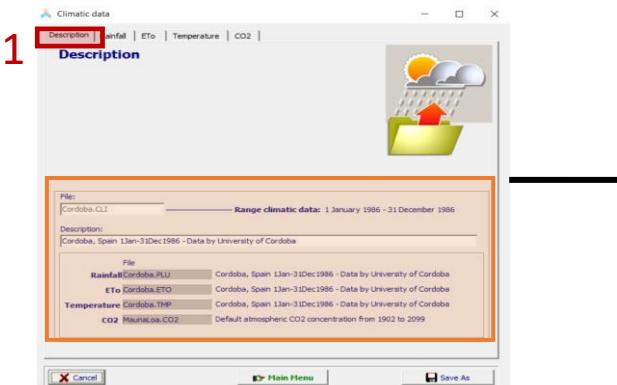
**Step 3:** click once (but not twice!) on the climatic file of **Córdoba, Spain**

*If you click twice on Córdoba, AquaCrop will bring you directly into the main interface*



**Step 4:** click on **display/update climatic data**

# Climate module: climate data

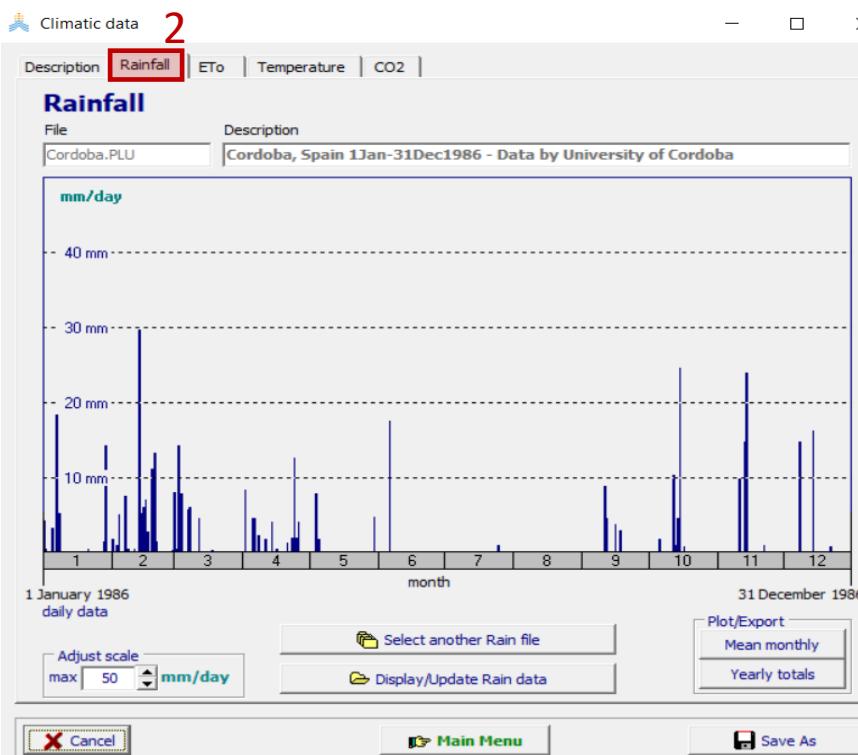


**Step 1: click on description**

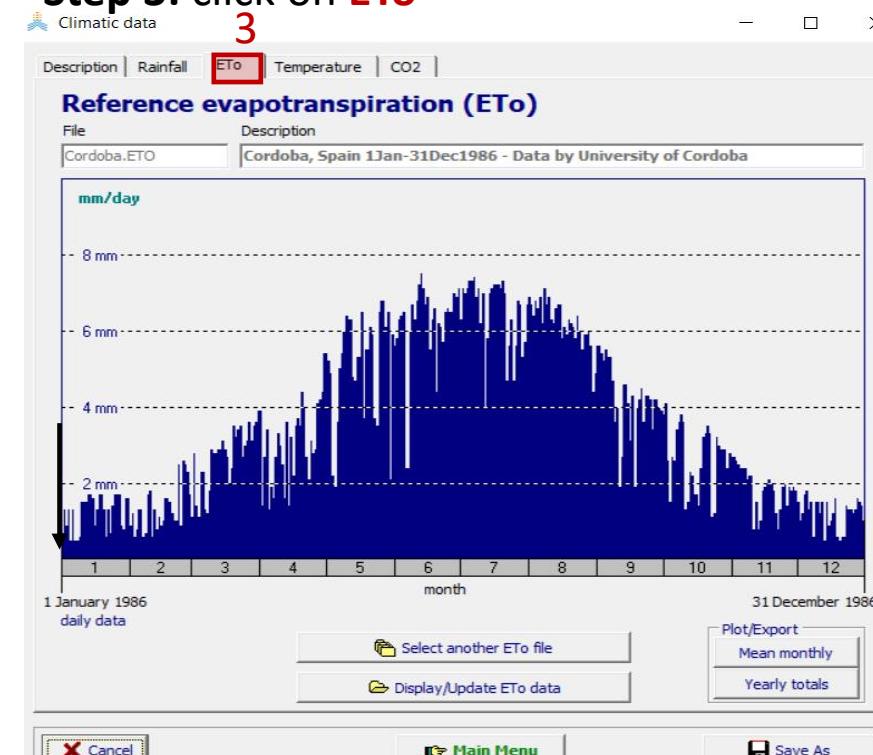
*Here you will find all the files within the selected climatic folder. Each of these files includes its respective extension: PLU, ETO, TMP, CO2...*

We will be running simulations for the summer of 1986 in Córdoba!

**Step 2: click on rainfall**



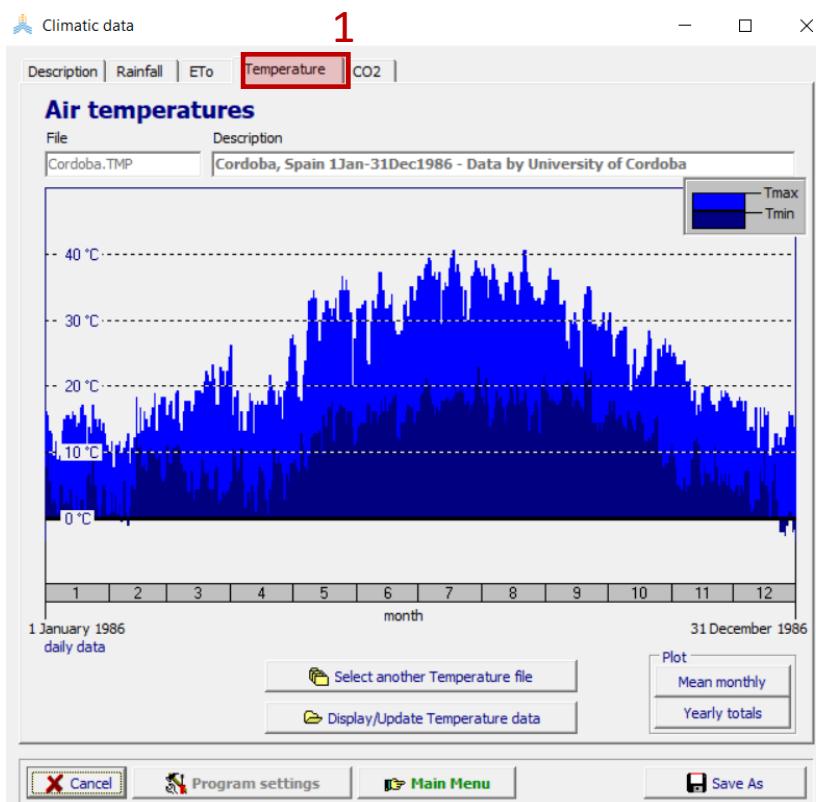
**Step 3: click on ETo**



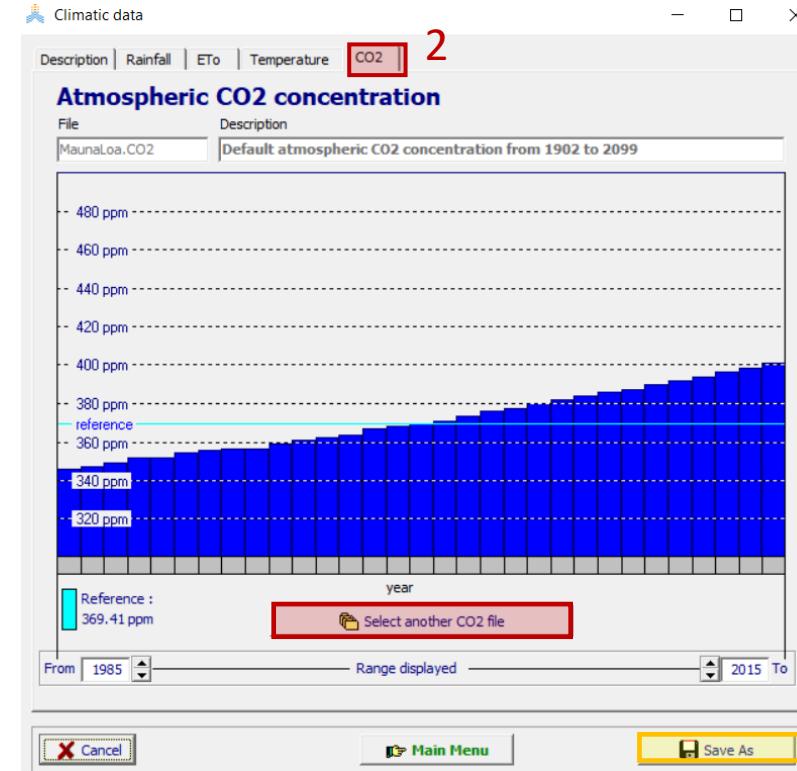
*You can display the data on daily, monthly, or yearly basis*

# Climate module: climate data

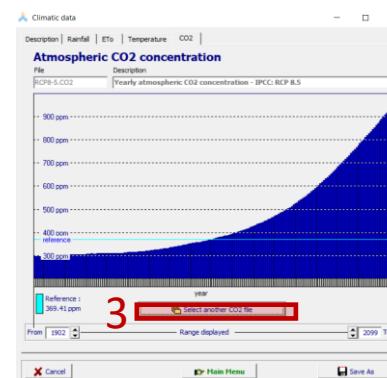
Step 1: click on temperature



Step 2: click on CO<sub>2</sub>



Step 3: test another CO<sub>2</sub> file



File Name	Description
RCP4-5.CO2	Yearly atmospheric CO2 concentration - IPCC: RCP 4.5
RCP6-0.CO2	Yearly atmospheric CO2 concentration - IPCC: RCP 6.0
RCP8-5.CO2	Yearly atmospheric CO2 concentration - IPCC: RCP 8.5
SSP1_1.9.CO2	Atmospheric CO2 concentration from 1902 to 2099 - Scenari
SSP1_2.6.CO2	Atmospheric CO2 concentration from 1902 to 2099 - Scenari
SSP2_4.5.CO2	Atmospheric CO2 concentration from 1902 to 2099 - Scenari
SSP3_7.0.CO2	Atmospheric CO2 concentration from 1902 to 2099 - Scenari
SSP5_8.5.CO2	Atmospheric CO2 concentration from 1902 to 2099 - Scenari

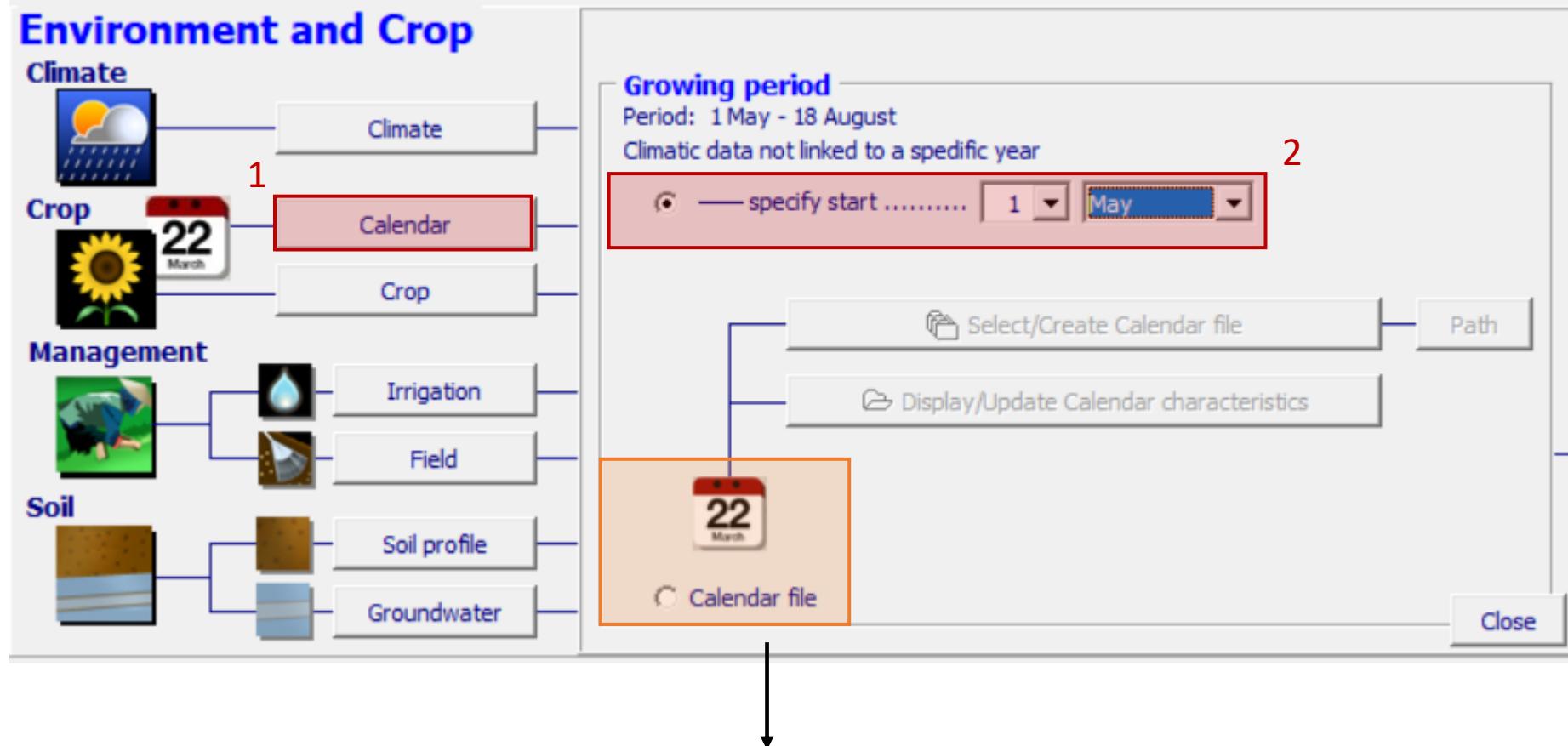
SSPs are now available on  
AquaCrop!

# CROP MODULE

# Crop module: calendar information

Steps 1-2: click on **calendar** and select a **sowing date (1<sup>st</sup> of May)**

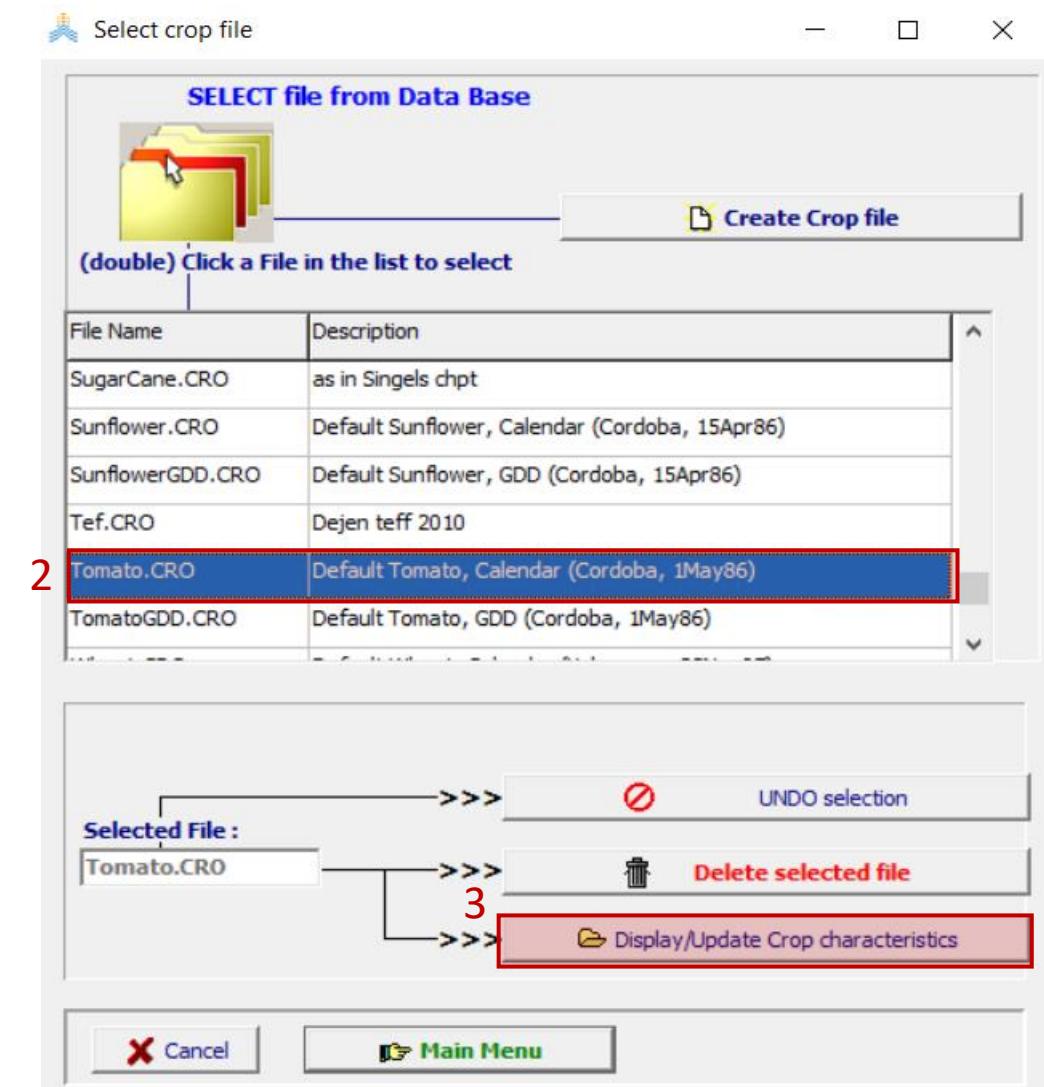
*The sowing date needs to be within the timeframe of the climatic file!*



*You can also create your own calendar file (for advanced users!)*

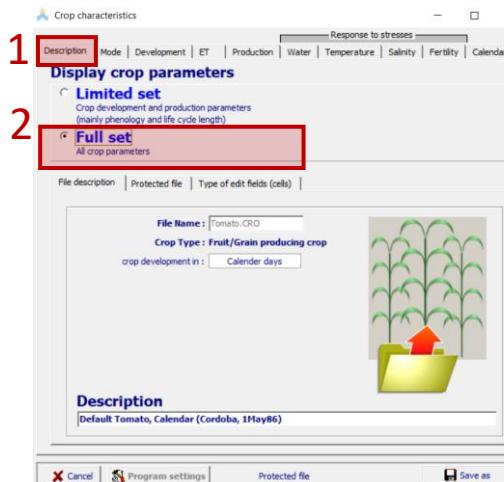
# Crop module: crop information

Steps 1-2: click on **crop** and select **default tomato days**



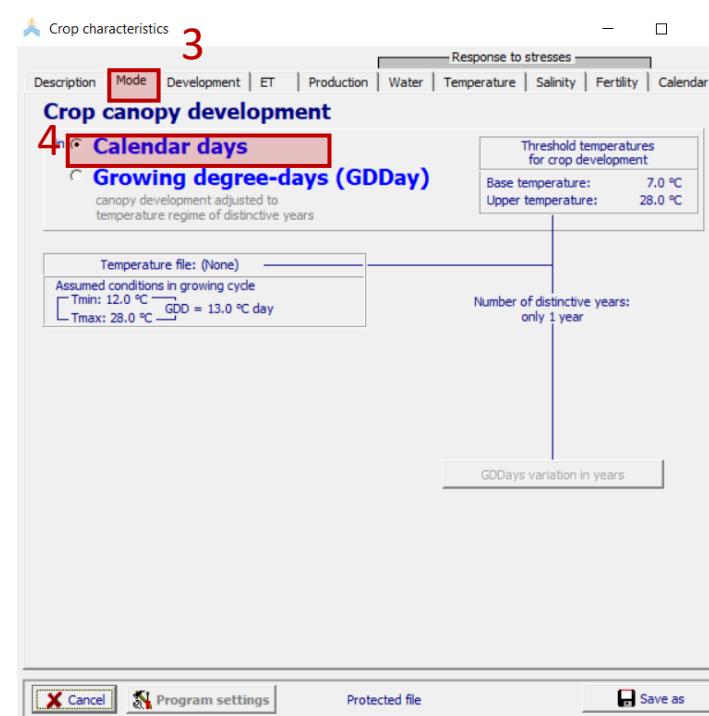
Step 3: click on **Display/Update Crop characteristics**

# Crop module: crop information



**Steps 1-2:** click on **description** and **full set**

While **limited set** does not include crop's responses to stresses (water, temperature, salinity, fertility), **full set** does.



**Steps 3-4:** click on **mode** and select **calendar days**

*The second option is to select GDD (cumulative heat units throughout the growing cycle) (for advanced users!)*

$$GDD = \left[ \frac{(\text{Max Temp} + \text{Min Temp})}{2} \right] - \text{Base Temp}$$

# Crop module: crop development

Steps 1-2: click on **development** and then **initial canopy cover**

1 Crop characteristics

Response to stresses

Description | Mode | **Development** | ET | Production | Water | Temperature | Salinity | Fertility | Calendar

**Crop development (no water, fertility or salinity stress)**

2 Initial canopy cover | Canopy development | Flowering and Yield Formation | Root deepening

initial canopy cover — CCo 0.67 %

CC

Growing period (days)

transplanting 0 15 30 45 60 75 90 105 maturity 110

Type of planting method

- Direct sowing
- Transplanting
- Regrowth

Canopy size transplanted seedling: 20.00 cm<sup>2</sup>/plant

Plant density 33 333 plants/ha  
3.3 plants/m<sup>2</sup>

Row planting estimate CCo

Cancel Program settings Protected file Save as

Steps 3-4: click on **development** and then **canopy development**

3 Crop characteristics

Response to stresses

Description | Mode | **Development** | ET | Production | Water | Temperature | Salinity | Fertility | Calendar

**Crop development (no water, fertility or salinity stress)**

4 Initial canopy cover | **Canopy development** | Flowering and Yield Formation | Root deepening

canopy expansion fast expansion CGC 12.3 %/day

maximum canopy cover fairly covered 75 %

canopy decline very slow decline CDC 7.2 days %/day

CC

Growing period (days)

transplanting 0 15 30 45 60 75 90 105 maturity 110

From day 1 after transplanting to:

- recovered
- max canopy
- senescence
- maturity

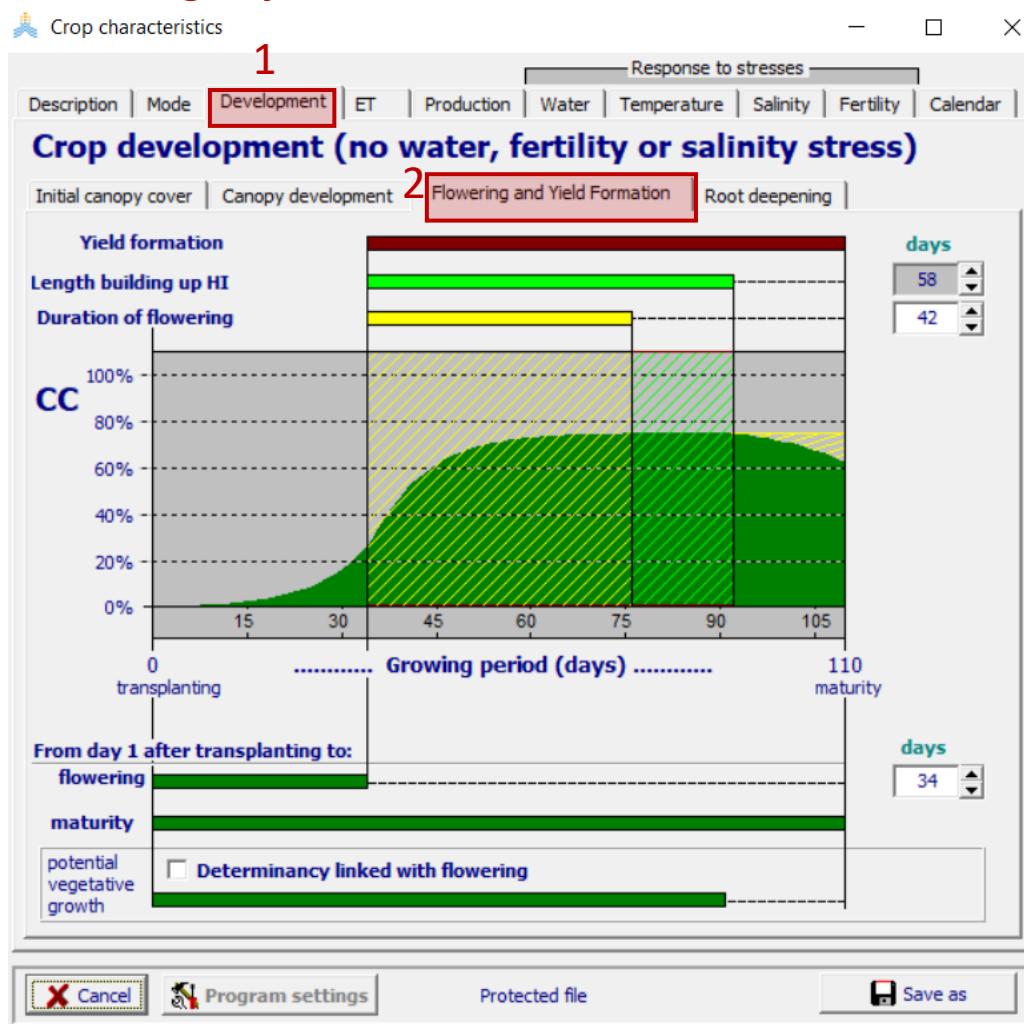
days

4
63
91
110

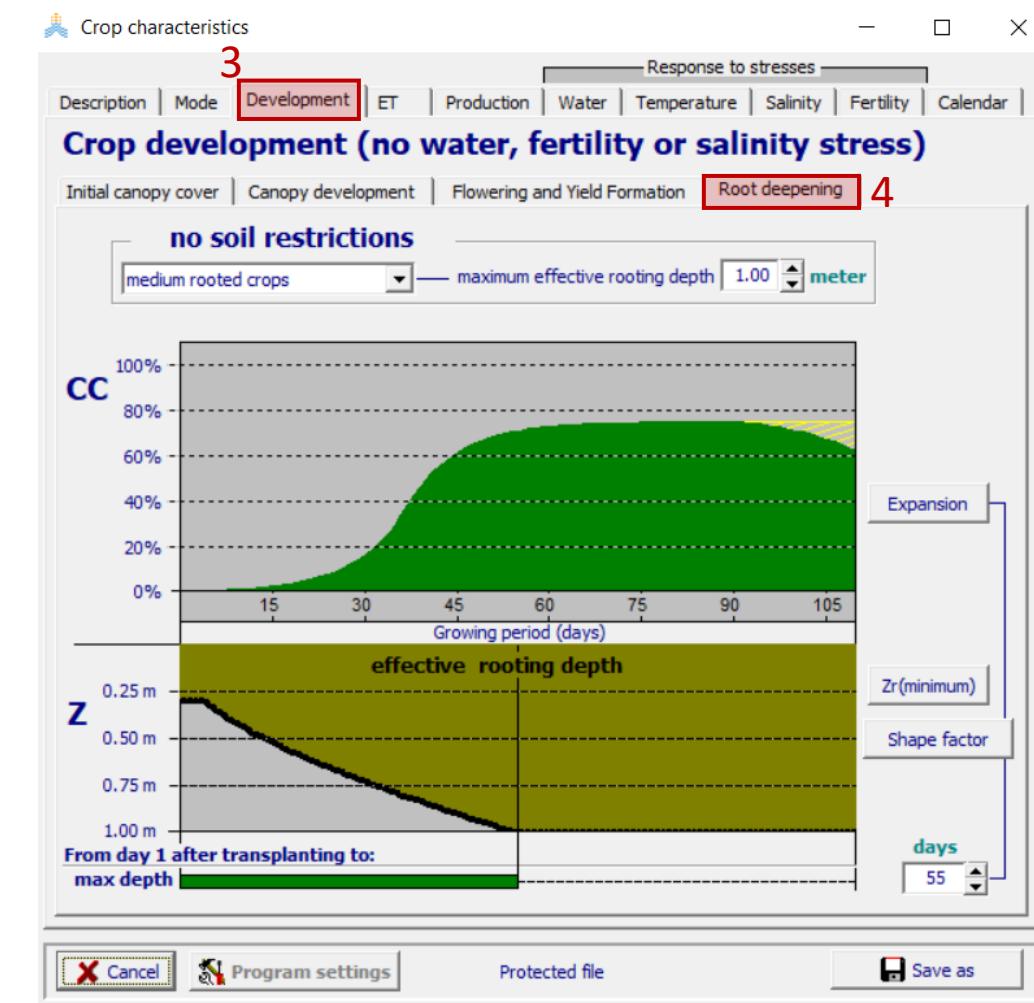
Cancel Program settings Protected file Save as

# Crop module: crop development

Steps 1-2: click on **development** and then **flowering & yield formation**



Steps 3-4: click on **development** and then **root deepening**





# Crop module: crop evapotranspiration

Crop transpiration (Tr) is calculated by multiplying the evaporating power of the atmosphere with the crop coefficient ( $KcTr$ ) and by considering water stresses ( $Ks$ ) and temperature stress ( $KsTr$ ) throughout the growing cycle:

$$Tr = Ks * KsTr * (KcTr, x CC^*) * Eto$$

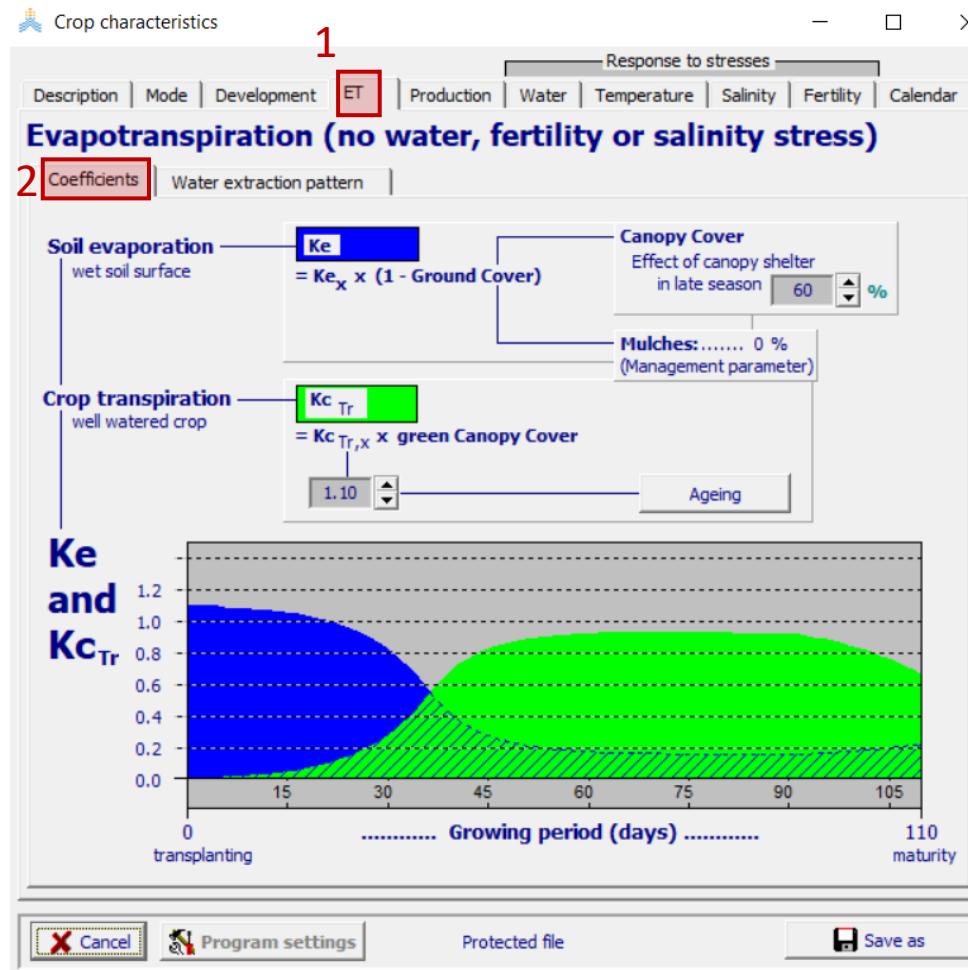
where the evaporating power (ETo) is expressed by the reference grass evapotranspiration as determined by the FAO Penman-Monteith equation. The crop transpiration coefficient ( $KcTr = KcTr,x CC^*$ ) is proportional to the fractional canopy cover (CC) and, as such, continuously adjusted to the simulated canopy development.

Penman-Monteith equation

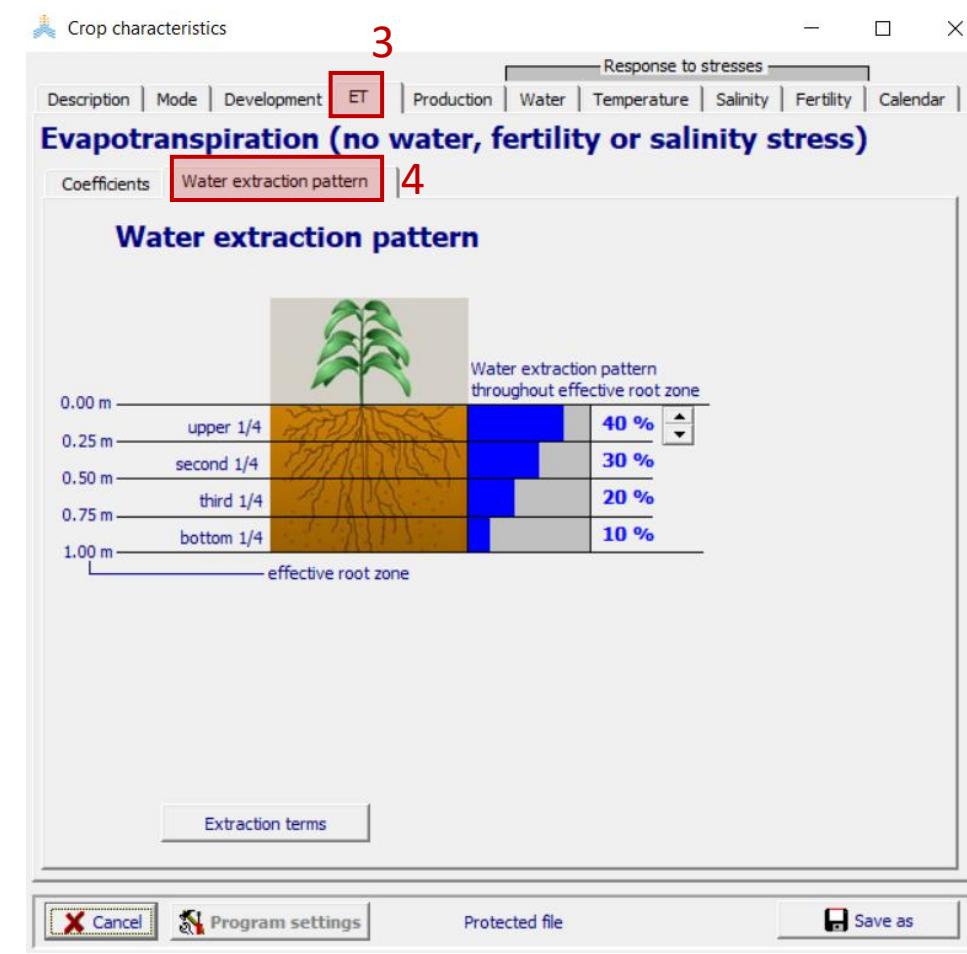
$$\lambda ET = \frac{\Delta(R_n - G) + p_a C_p \frac{(e_s - e_a)}{r_a}}{\Delta + \gamma \left( 1 + \frac{r_s}{r_a} \right)}$$

# Crop module: crop evapotranspiration

Steps 1-2: click on **ET** and then click on **coefficients**

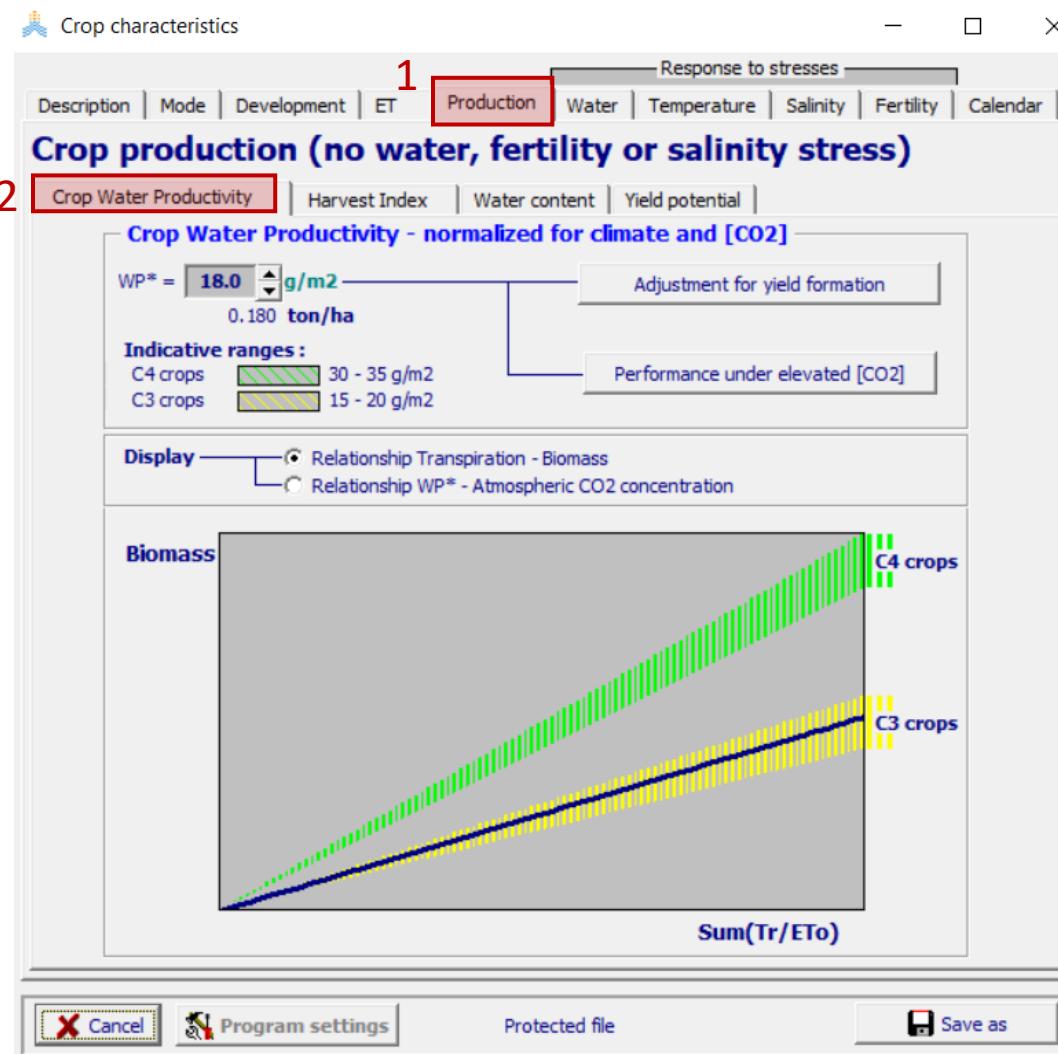


Steps 3-4: click on **ET** and then click on **water extraction pattern**

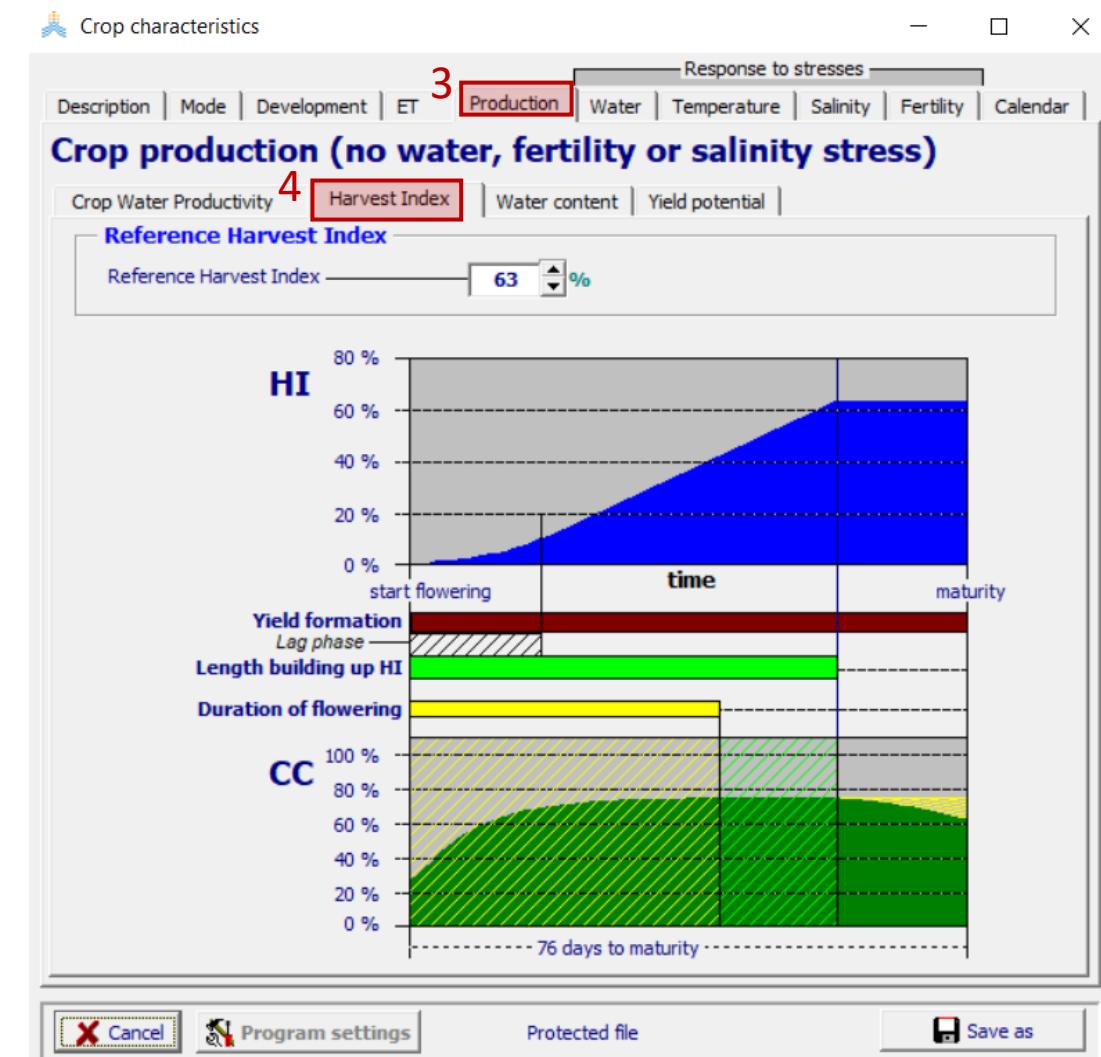


# Crop module: crop production

Steps 1-2: click on **production** and then **crop water productivity**



Steps 3-4: click on **production** and then **harvest index**



# Crop module: crop production

Steps 1-2: click on **production** and then **water content**

Crop characteristics

Response to stresses

Description | Mode | Development | ET | **Production** | Water | Temperature | Salinity | Fertility | Calendar

**Crop production (no water, fertility or salinity stress)**

Crop Water Productivity | Harvest Index | **Water content** | Yield potential

Water (or dry matter) content of fresh yield

not specified  
 specified

 95 % water

 5 % dry matter

indicative values

**Composition of fresh yield**

**Crop** 

for specified climatic conditions  
planting ..... 1 May

**Climate**   
(None)

**dry Biomass** **12.4 ton/ha**

**Yield**  
dry yield **7.8 ton/ha**  
fresh yield **155.7 ton/ha**



**Cancel** **Program settings** **Protected file** **Save as**

Steps 3-4: click on **production** and then **yield potential**

Crop characteristics

Response to stresses

Description | Mode | Development | ET | **Production** | Water | Temperature | Salinity | Fertility | Calendar

**Crop production (no water, fertility or salinity stress)**

Crop Water Productivity | Harvest Index | Water content | **Yield potential**

**potential crop production**

**Crop** 

for specified climatic conditions  
planting ..... 1 May

**Climate**   
(None)

**dry Biomass** **12.4 ton/ha**

**Yield**  
dry yield **7.8 ton/ha**  
fresh yield **155.7 ton/ha**

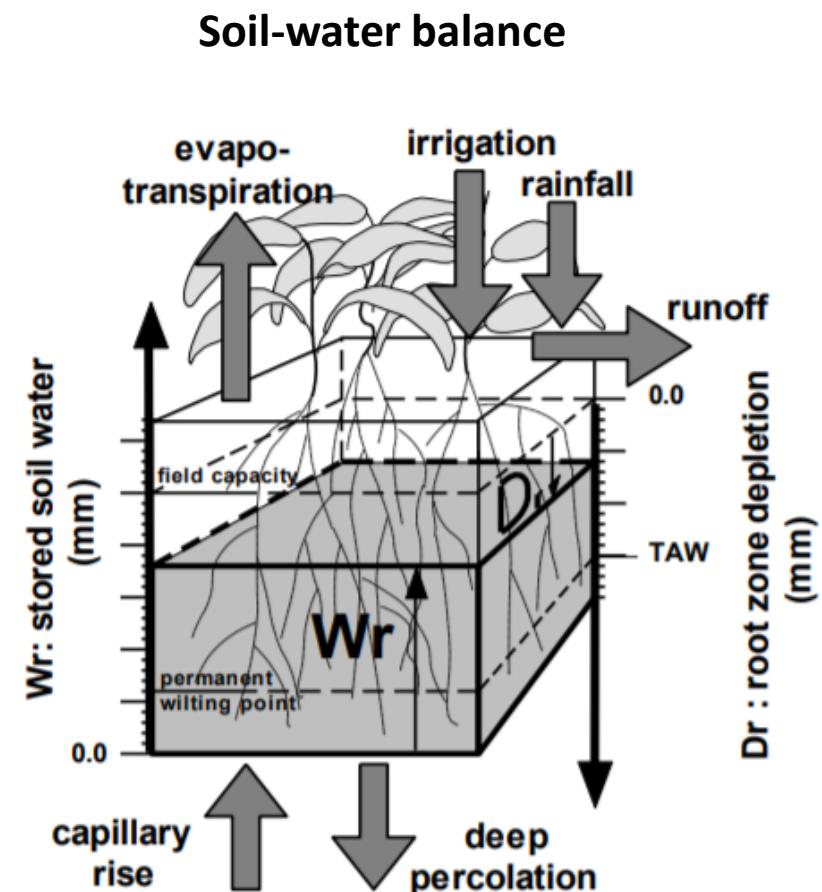
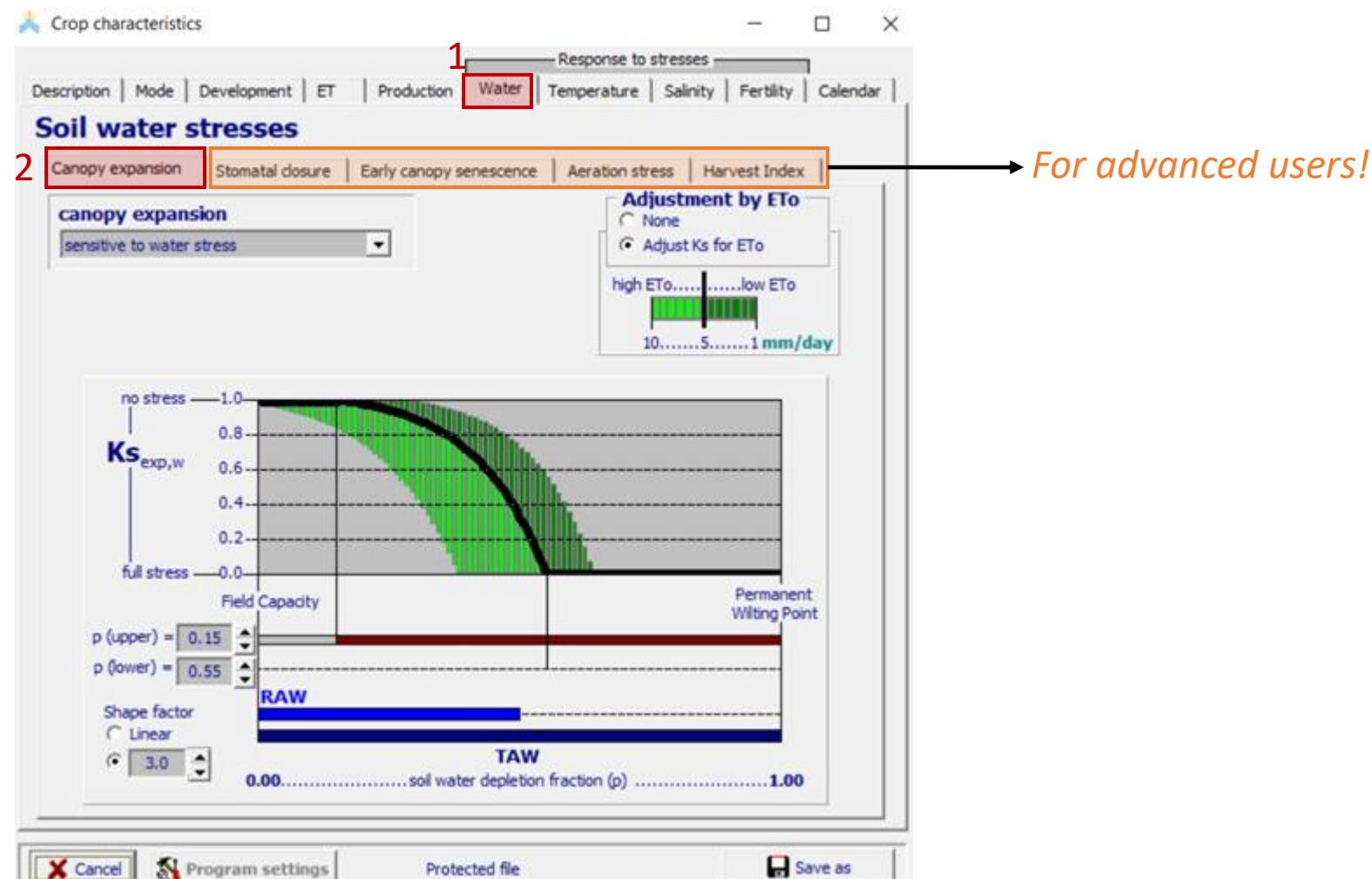


**Cancel** **Program settings** **Protected file** **Save as**

# Crop module: soil-water stress

**Soil water stress:** start to affect a particular process when the stored soil water in the root zone drops below an upper threshold level (FC and PWP)

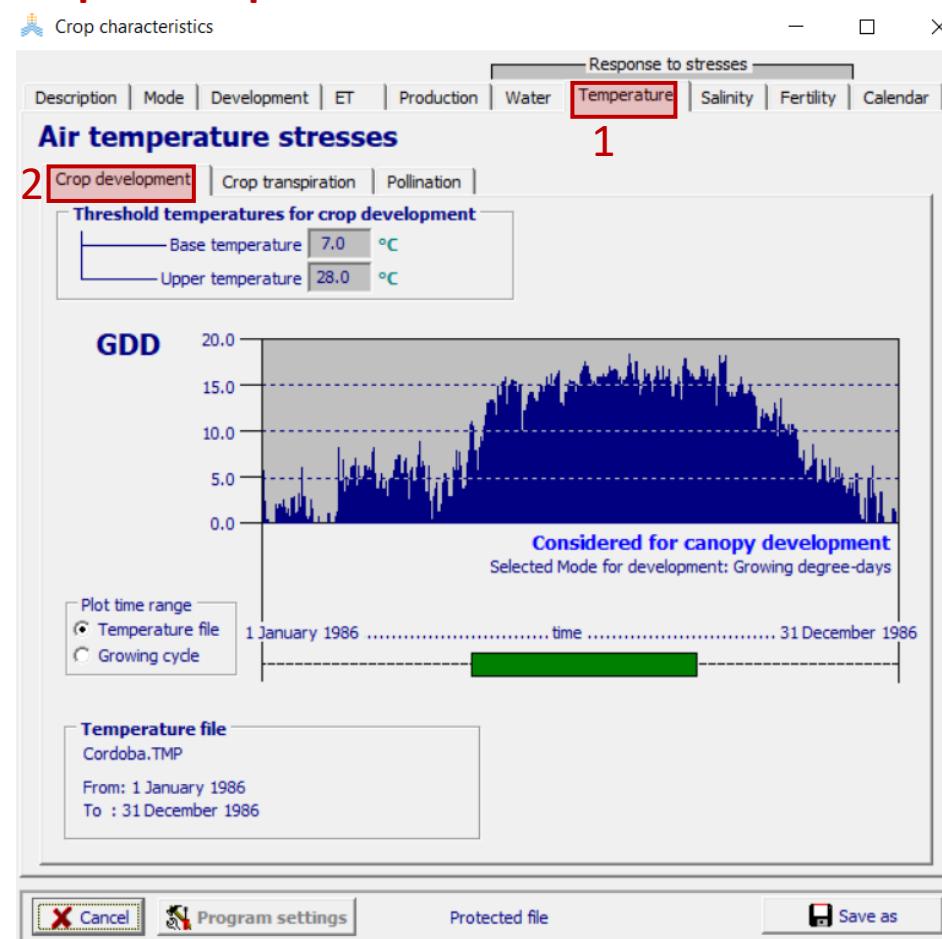
Steps 1-2: click on **water** and **canopy expansion**



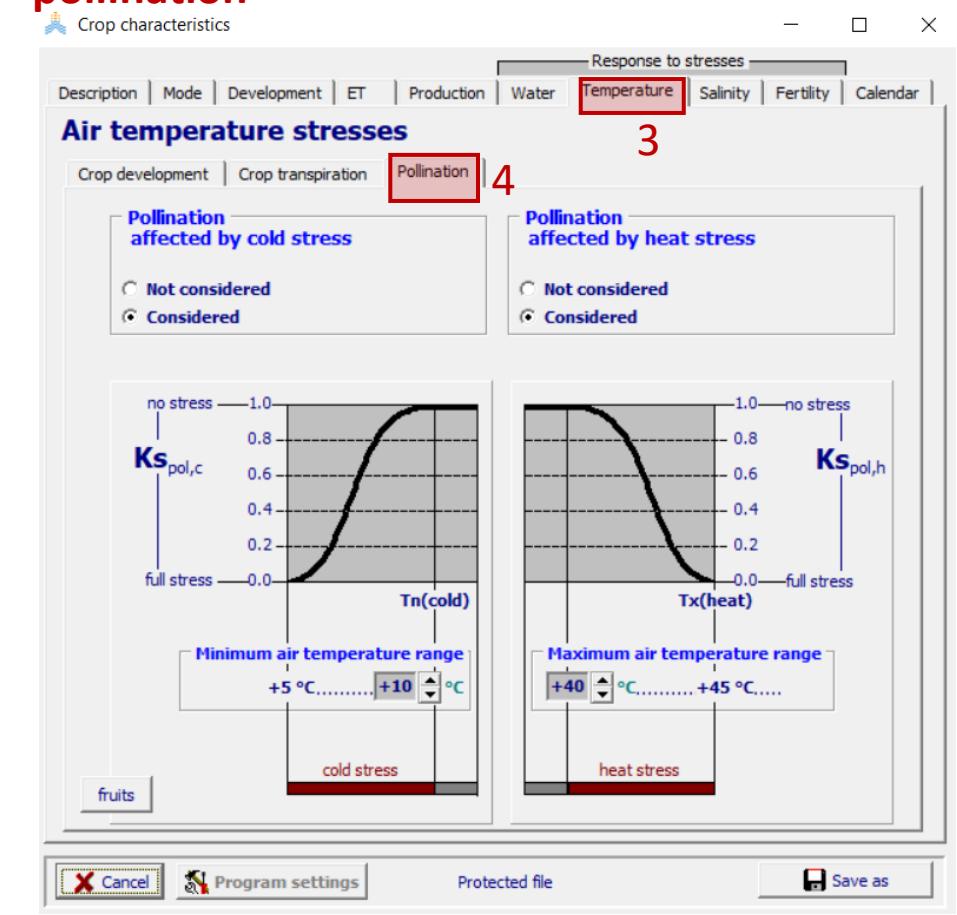
# Crop module: temperature stress

**Temperature stress:** cold temperature stress reduces crop transpiration. Hot and cold temperature stresses inhibit pollination and reduce the harvest index (HI)

**Steps 1-2:** click on **temperature** and then click on **crop development**



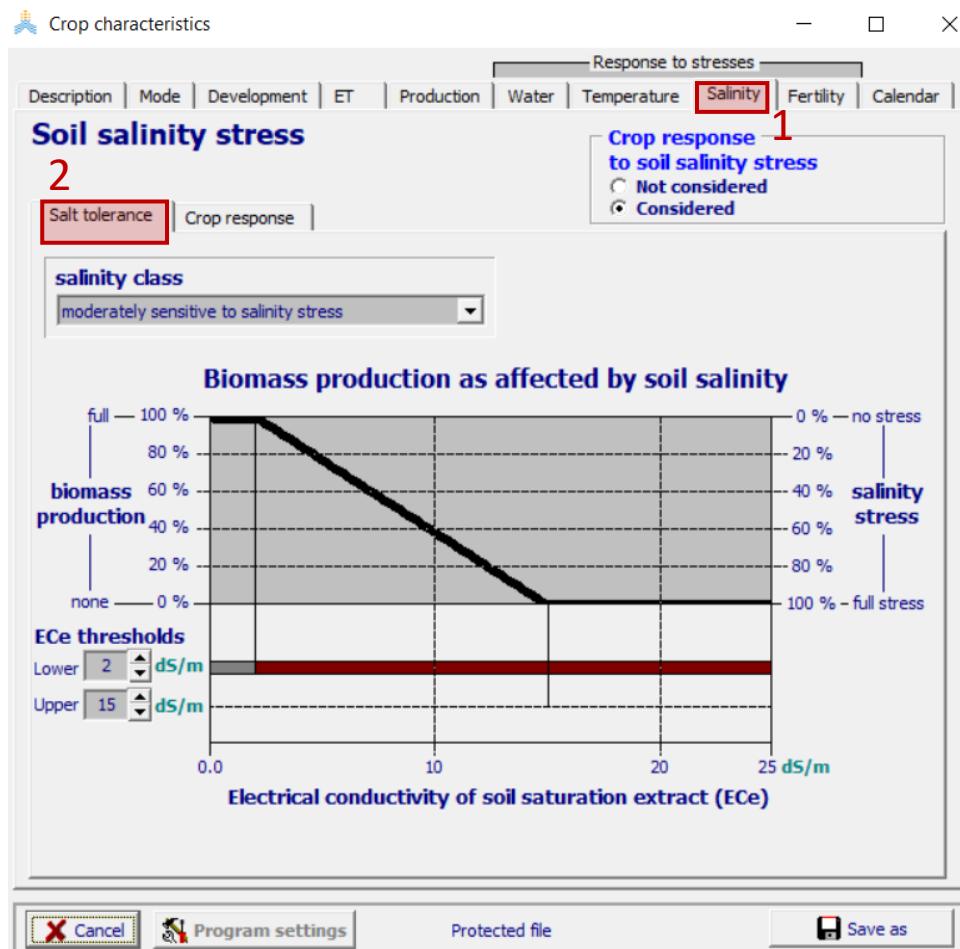
**Steps 3-4:** click on **temperature** and then **pollination**



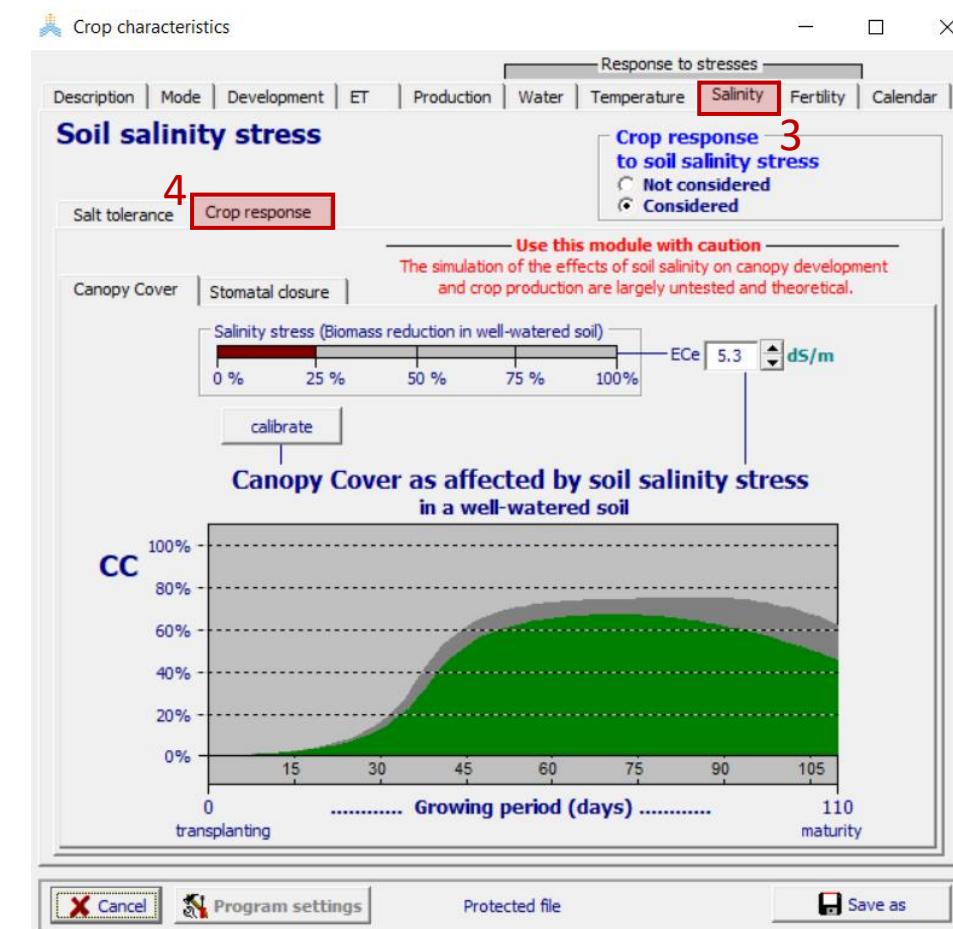
# Crop module: salinity stress

**Salinity stress:** since soil salinity reduces the availability of the water in the root zone reservoir, the presence of dissolved salts increases the effect of soil water stress.

**Steps 1-2:** click on **salinity** and then click on **salt tolerance**



**Steps 3-4:** click on **salinity** and then click on **crop response**



# Crop module: soil fertility stress

Steps 1-2: click on **fertility** and then on **considered**

Crop characteristics

Description | Mode | Development | ET | Production | Water | Temperature | Salinity | **Fertility** | Calendar |

Response to stresses 1

**Soil fertility stress**

Crop response to soil fertility stress

Not considered

Considered (by local calibration) Calibrate

2

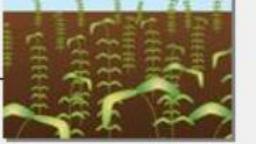
adjustment not considered  
(no correction for soil fertility stress)

Cancel Program settings Protected file Save as

Step 3: click on **Start**

Calibration soil fertility stress

Field observations

 no water stress 

**Reference field** not stressed

**Stressed field** soil fertility stress

**observations**

1 Biomass production ..... about half relative biomass 50 %

2 Maximum Canopy Cover ..... strongly reduced CCx 45 %

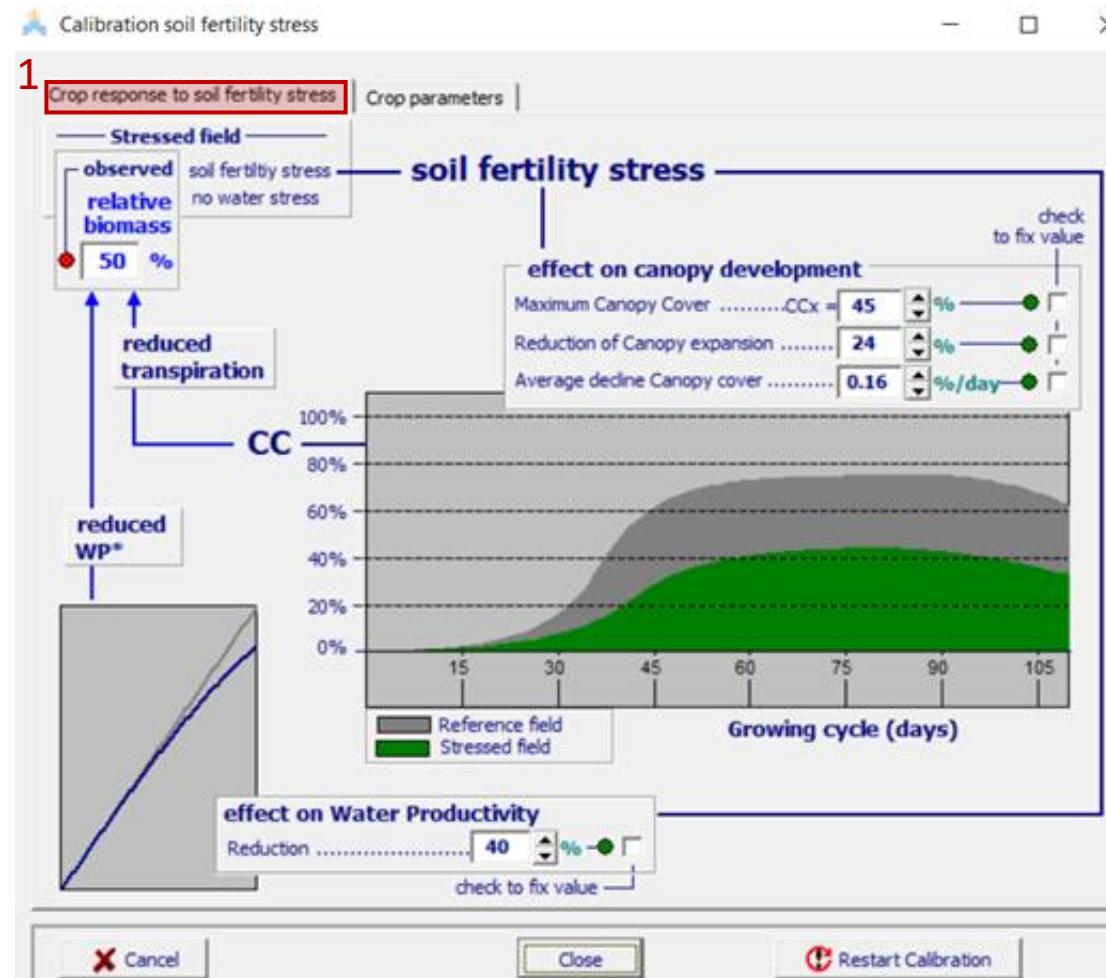
3 Canopy decline in season ..... medium

**calibration** 3 Start

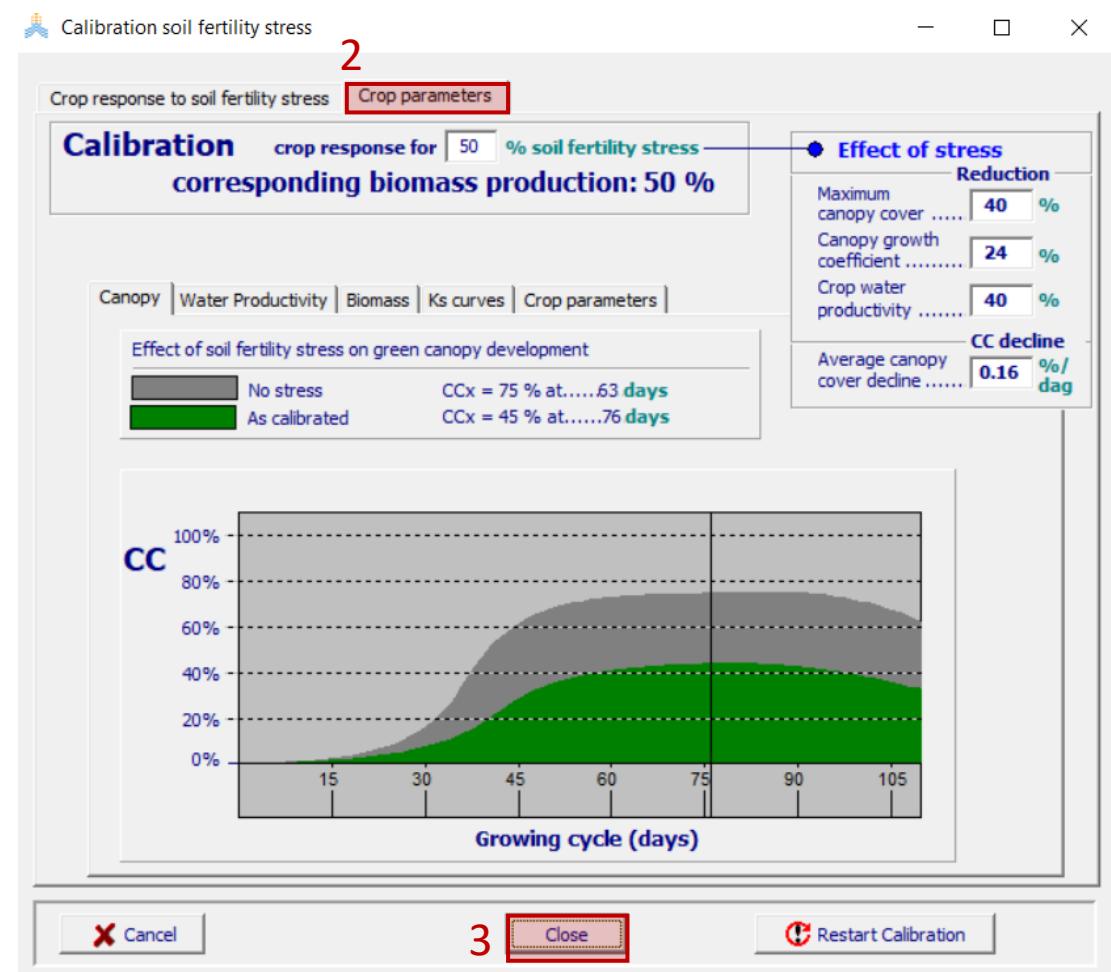
Cancel Close

# Crop module: soil fertility stress

Step 1: click on **crop response to soil fertility stress**



Steps 2-3: click on **crop parameters** and then **close**



# Crop module: calendar information

## Step 1: click on **calendar**

Crop characteristics

Response to stresses

Description | Mode | Development | ET | Production | Water | **Temperature** | Salinity | Fertility | Calendar

**Crop calendar (no water, fertility or salinity stress)**

  growing period

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
day 1 after transplanting											
maturity											

**Growth Stages**

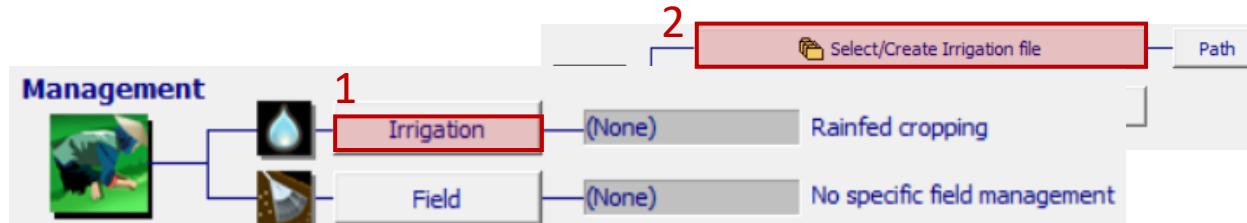
From day 1 after transplanting:	Length days	Date
to recovered transplant	4	1 May
to maximum canopy cover	63	5 May
to maximum rooting depth	55	3 July
to start of canopy senesence	91	25 June
to maturity	110	31 July
to flowering	34	18 August
Length building up HI	58	4 June
Duration of flowering	42	end 1 August

**Buttons:** Cancel | Program settings | Protected file | Save as

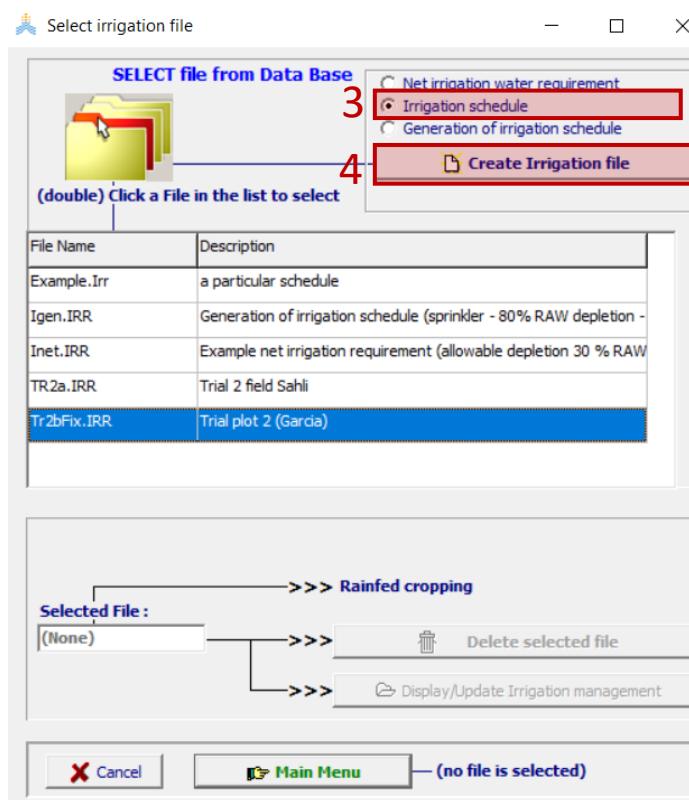
*Summary of all the phenological phases based on the selected transplanting date*

# MANAGEMENT MODULE

# Management module: irrigation

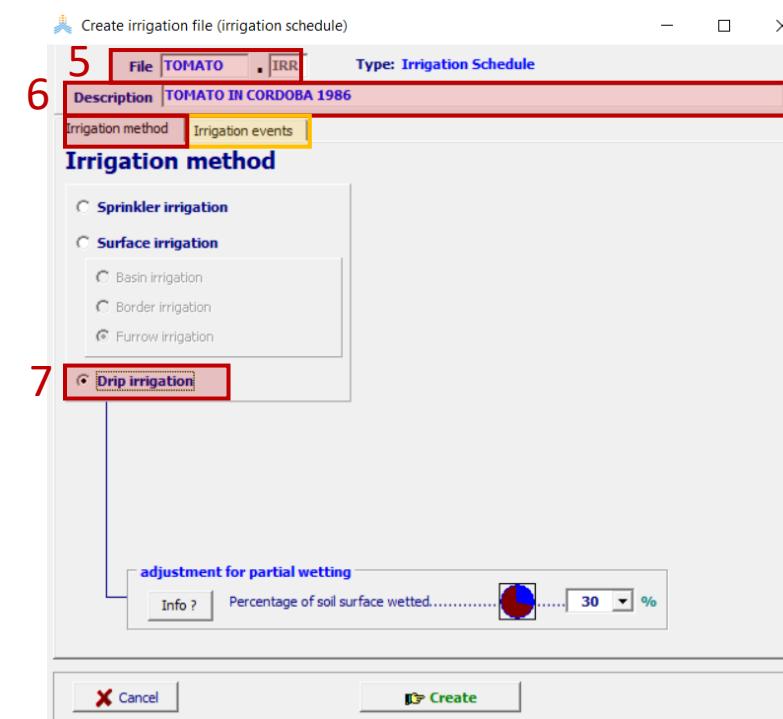


**Steps 3-4:** click on **irrigation** schedule and then **create irrigation file**



**Steps 1-2:** click on **irrigation** and then **select/create irrigation file**

**Steps 5-7:** name your file “**tomato**” and provide a description “**tomato in Córdoba 1986**” and select the irrigation method, in our case, **drip irrigation**. Then click on **irrigation events**



# Management module: irrigation

**Step 1:** click on **add events** and add **10**. **REPEAT STEP 1** to have a total of 20 irrigation events

Create irrigation file (irrigation schedule)

File **TOMATO** IRR Type: Irrigation Schedule

Description TOMATO CORDOBA 1986

Irrigation method Irrigation events

**Irrigation events**

1 **Add** 1 **events**

Day No. 1 - day 1 after planting: 1 May 1986

When? Depth? Quality

assign

Event Date Day No. Net application (mm) ds/m

2

1			
2			
3			
4			
5			
6			
7			
8			

Growing cycle

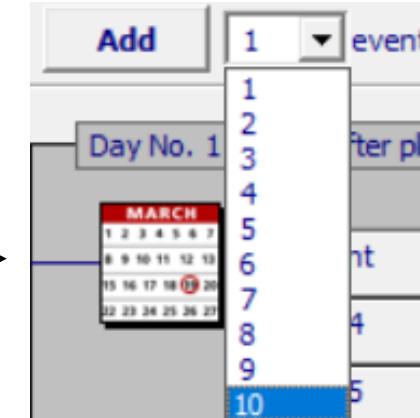
Canopy Cover

Plot events

Day No. 130 - maturity: 7 September 1986

Clear All Events

3 **Create**



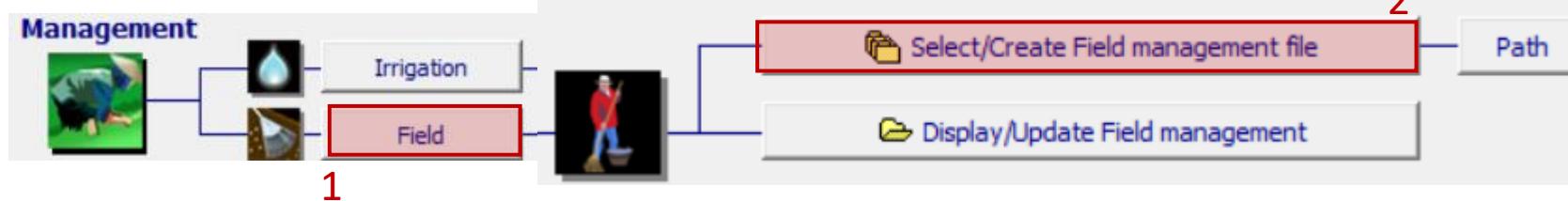
**Step 2:** type the frequency of irrigation (**5** days) and the net application of water (**10** mm). In total, you should have 20 irrigation events each with 10mm (total net application during the growing cycle: **200mm**)

Event	Date	Day No.	Net application (mm)	ds/m
1	5 May 1986	5	10	0.0
2	10 May 1986	10	10	0.0
3	15 May 1986	15	10	0.0
4	20 May 1986	20	10	0.0
5	25 May 1986	25	10	0.0
6	30 May 1986	30	10	0.0
7	4 June 1986	35	10	0.0
8	9 June 1986	40	10	0.0

**Step 3:** click on **create**. AquaCrop should have created the irrigation file with the frequency and the irrigation amount specified!

# Management module: field management

Steps 1-2: click on **field** and **select/create field management file**



Steps 3-4: click once on **moderate soil fertility** and **display/update field management**

**Select field management file**

**SELECT file from Data Base**

(double) Click a File in the list to select

File Name	Description
ExampleBunds.MAN	Soil bunds, 0.25 m height
ExampleMulch.MAN	100 % surface organic mulches
ExampleWeeds.MAN	presence of weeds (moderate weed management - decrease of RC)
<b>ModerateSF.MAN</b>	<b>moderate soil fertility</b>

**3**

**Selected File :** ModerateSF.MAN

>>> UNDO selection

>>> Delete selected file

>>> **Display/Update Field management**

**4**

**Field management**

**Description**

**File**: ModerateSF.MAN

**Description**: moderate soil fertility

**2**

**Path**

**1**

**Display/Update Field management**

**Main Menu**

**Save as**

This section contains two screenshots. The left screenshot shows the 'Select field management file' window with a list of files. The 'ModerateSF.MAN' file is selected and highlighted with a blue border. The right screenshot shows the 'Field management' window, which displays a description of 'moderate soil fertility' and includes a small illustration of a person working in a field. A red arrow points from the 'ModerateSF.MAN' entry in the first window to the 'Description' field in the second window.

# Management module: field management

Field management practices are choices of soil fertility levels, weed management, and practices that affect the soil water balance such as mulching to reduce soil evaporation, soil bunds to store water in the field, and tillage practices such as soil ridging or contours reducing run-off of rainwater.

## Step 1: click on **soil fertility**

1

Field management

Description Soil fertility | Mulches | Field surface practices | Weed management | Multiple harvests |

**Soil fertility**

Biomass production: moderate (dropdown menu) | relative biomass: 57 %

Corresponding soil fertility stress: 44 %

effect

Info | Canopy | Water Productivity | Biomass | Biomass - Stress |

Biomass production: 100 % | Green canopy development: CCx = 80.0 % at....50 days | CCx = 52.0 % at....58 days

CC (%) vs Growing period (days): A graph showing canopy cover (CC) increasing from 0% at day 15 to approximately 55% at day 60, then slightly decreasing to about 45% by day 120.

Cancel | Program settings | Main Menu | Save as

## Step 2: click on **mulches**

2

Field management

Description | Soil fertility | **Mulches** | Field surface practices | Weed management |

**Mulches**

Soil cover by mulches: none (dropdown menu) | Total Reduction in Soil evaporation .... 0 %

Soil Evaporation: An arrow pointing upwards from the soil surface.

no mulches

Plot: Relative soil evaporation (radio button selected) | Coefficients Ke and Kc(Tr) (radio button)

reference (100 %) = non covered, bare, wet soil surface | CC (100 % biomass production)

Erel and CC: A graph showing relative soil evaporation (Erel) decreasing from 100% at day 15 to about 20% by day 60, while canopy cover (CC) increases from 0% at day 15 to approximately 80% by day 60, remaining relatively stable thereafter.

Cancel | Program settings | Main Menu | Save as

# Management module: field management

## Step 1: click on **field surface practices**

Field management

1

Description | Soil fertility | Mulches | **Field surface practices** | Weed management

### Field surface practices

do NOT affect surface runoff  
Estimation of surface runoff is based on soil profile characteristic (valid for crop type: 'small grain')

affect surface runoff

prevent surface runoff

soil bunds

**surface runoff**

soil profile characteristic CN = 61

not affected by management CN = 61

surface runoff inhibited CN = N/A

storage of excess water CN = N/A

Cancel Program settings Main Menu Save as

## Step 2: click on **weed management**

Field management

2

Description | Soil fertility | Mulches | Field surface practices | **Weed management** | Management perfect

### Weed management

Relative cover (RC) of weeds in season 0 %

Canopy cover | Biomass

CC

100%  
80%  
60%  
40%  
20%

15 30 45 60 75 90 105

..... Growing cycle (days) .....

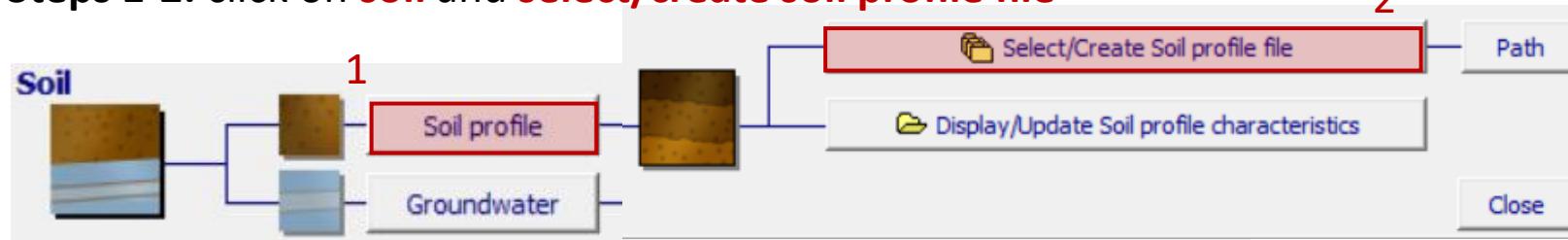
Canopy Cover (CC)  
crop and weeds  
unlimited soil fertility  
weeds  
crop

Cancel Program settings Main Menu Save as

# SOIL MODULE

# Soil module: soil profile & texture classes

Steps 1-2: click on **soil** and **select/create soil profile file**



Steps 3-4: click once on **sandy-loam** and then click on **display soil characteristics**

The image contains two side-by-side windows. The left window is titled 'Select soil profile file' and shows a list of soil profiles. A file named 'SandyLoam.SOL' is selected and highlighted with a red box, labeled '3'. The right window is titled 'Soil profile characteristics' and displays the selected profile's details. It has tabs for 'Description', 'Characteristics of soil horizons', 'Soil surface', and 'Capillary rise'. The 'Description' tab is active, showing the text 'deep uniform 'sandy loam' soil profile'. An arrow points from the 'SandyLoam.SOL' entry in the left window to the 'Description' tab in the right window, labeled '4'. Both windows have standard operating system window controls (minimize, maximize, close) and a 'Main Menu' button at the bottom.

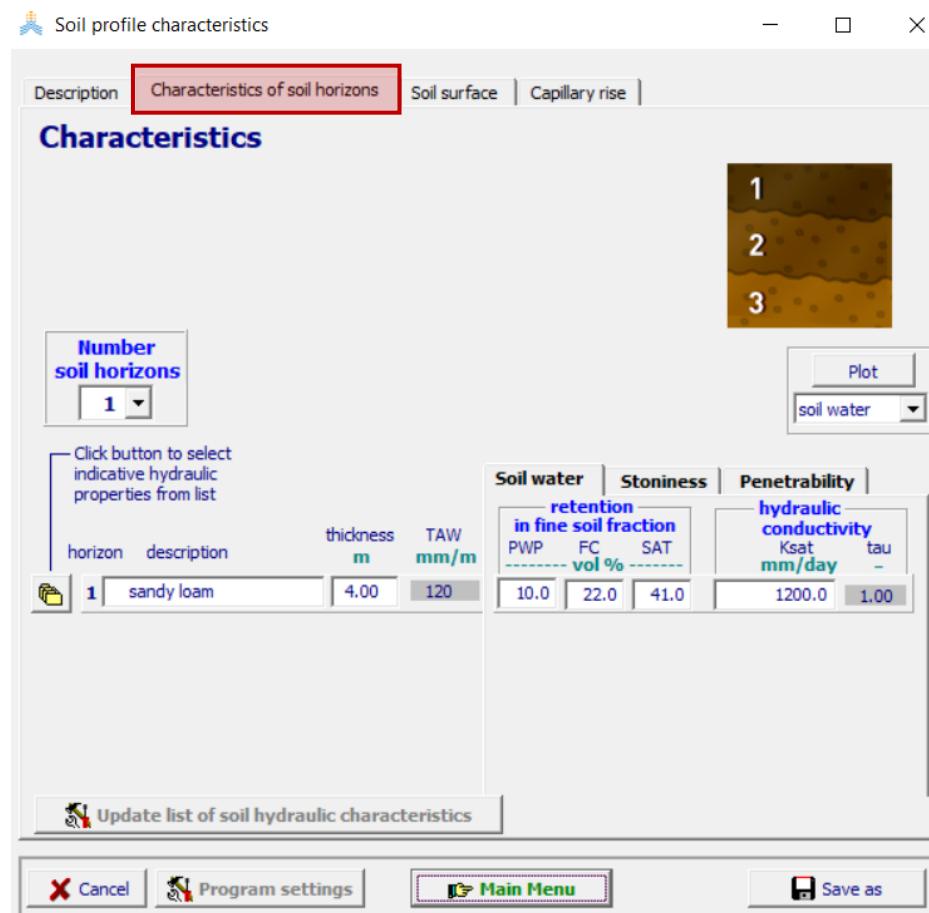
3

4

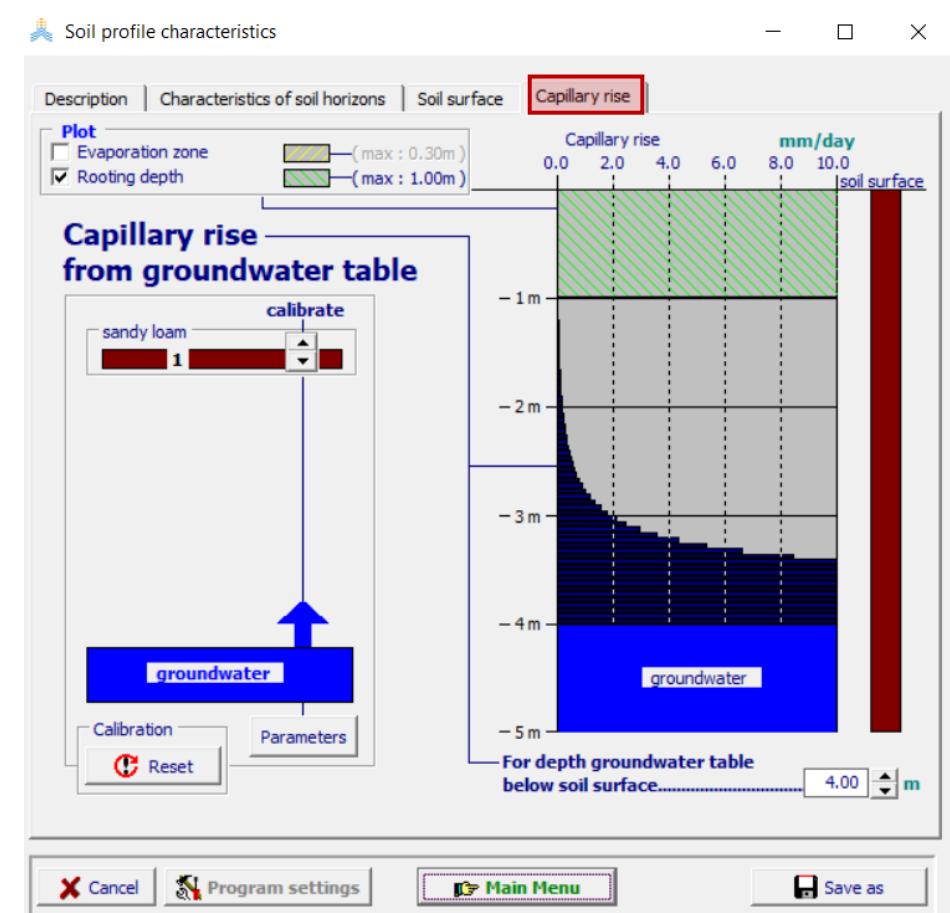
# Soil module: soil profile & texture classes

The soil profile can be composed of up to five different horizons of variable depth, each with their own physical characteristics. The characteristics are the water retention in the fine soil fraction at saturation (SAT), field capacity (FC), and at permanent wilting point (PWP), and the hydraulic conductivity of the soil at saturation (Ksat).

## Step 1: click on **characteristics of soil horizons**

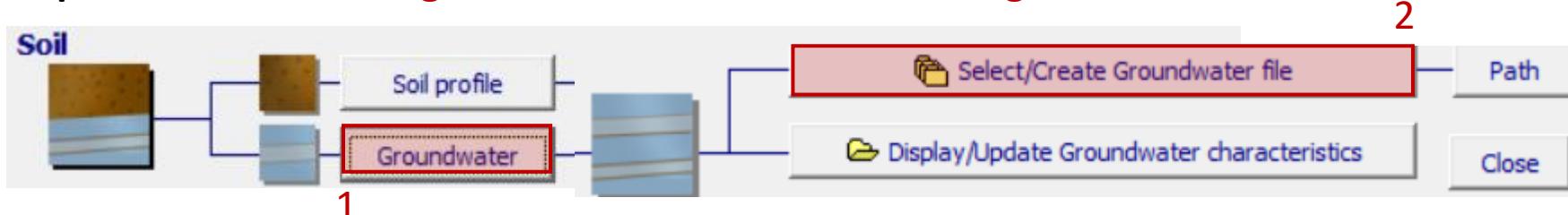


## Step 2: click on **capillary rise**

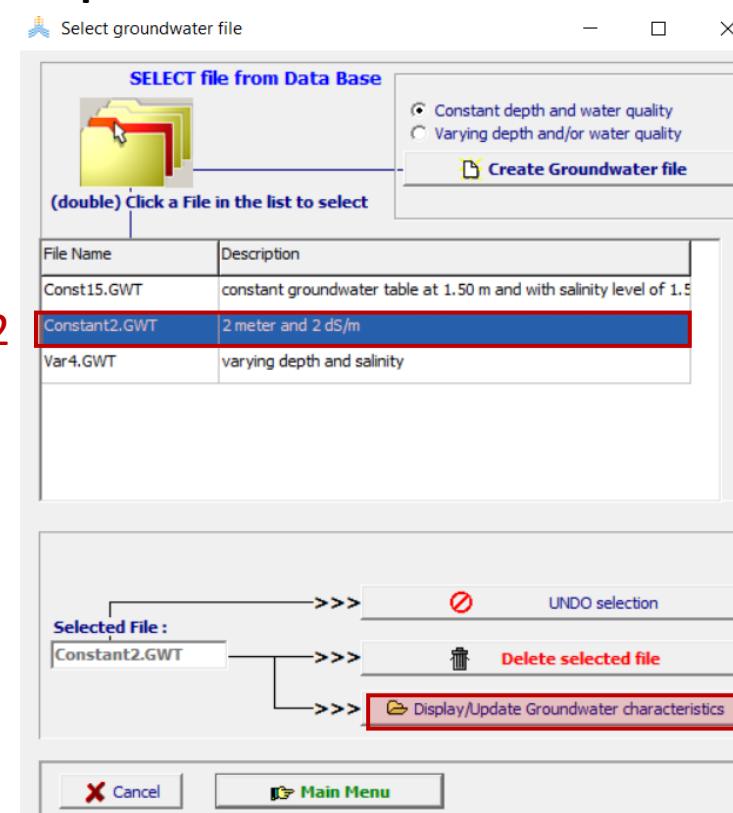


# Soil module: groundwater

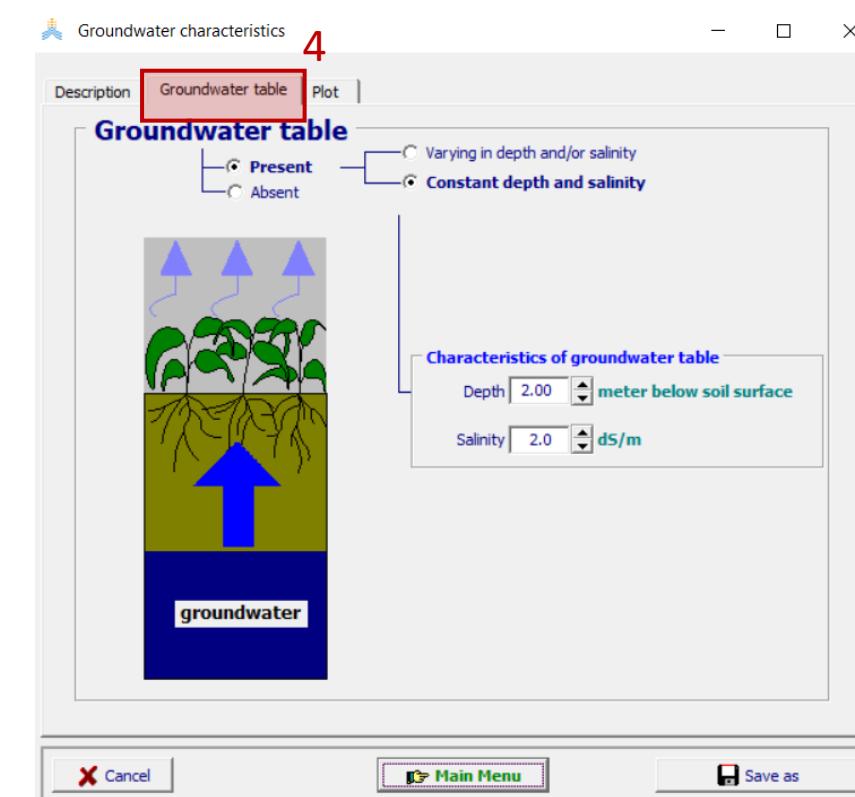
**Step 1:** click on **soil** and **groundwater**, then **select/create groundwater file**



**Steps 2-3:** click once on **Constant 2** and then click **display**



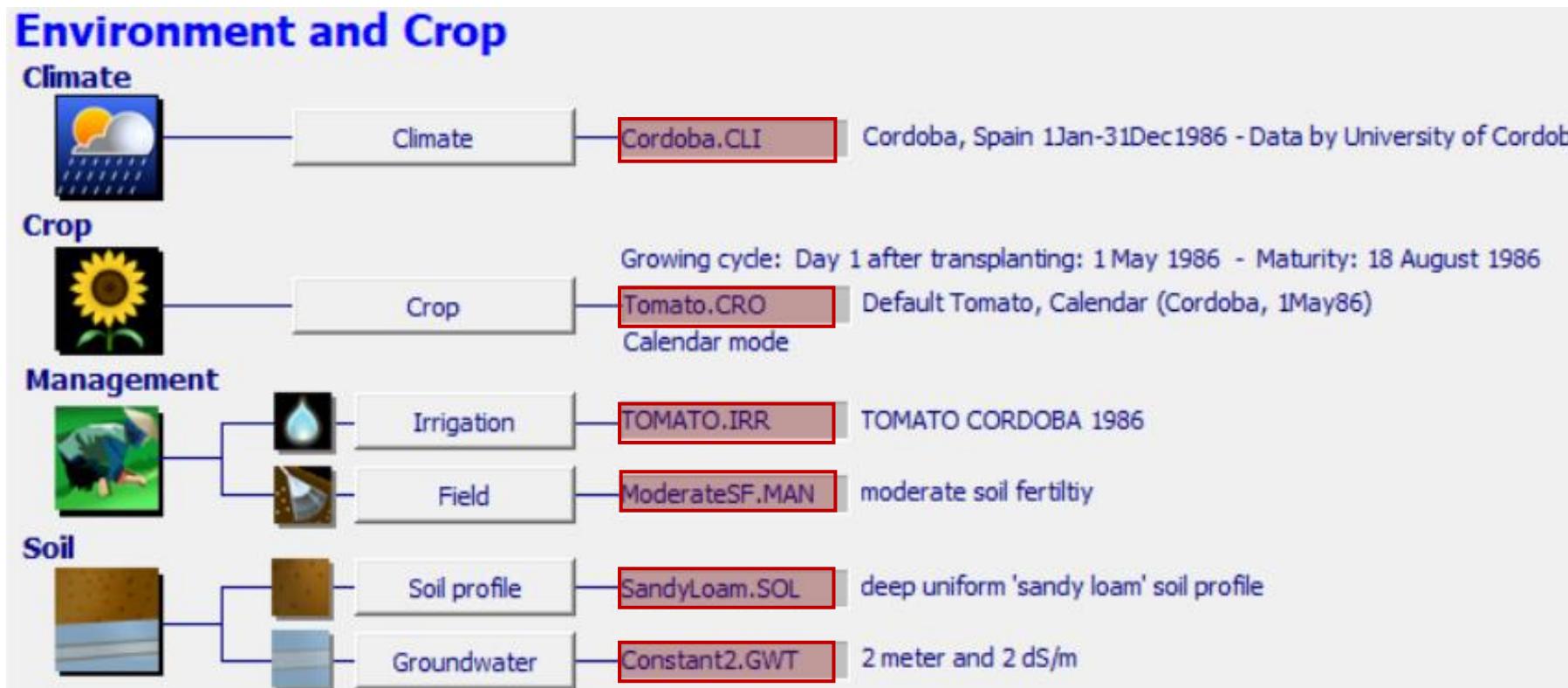
**Step 4:** click on **Groundwater table**



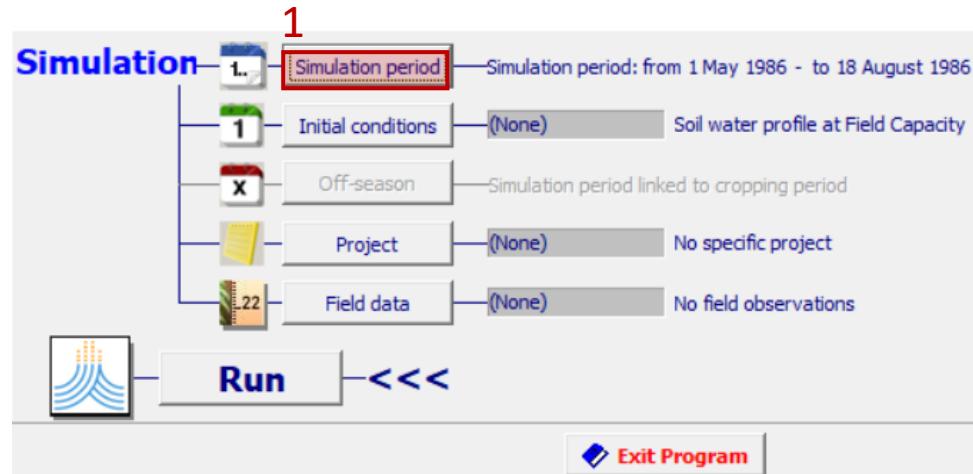
# SIMULATION

# Summary of input files

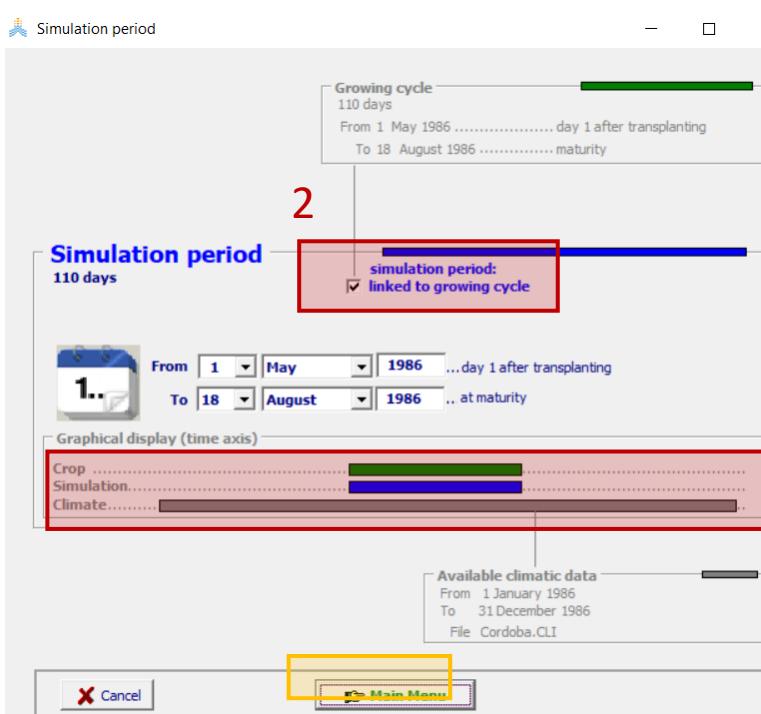
Below you will find a summary of selected files to run the simulations, including climate file (**Cordoba**), crop file (**tomato**), irrigation schedule (**tomato**), field management (**moderate**), soil profile (**sandy-loam**), and groundwater (**constant**)



# Simulation period



**Step 1:** click on simulation period



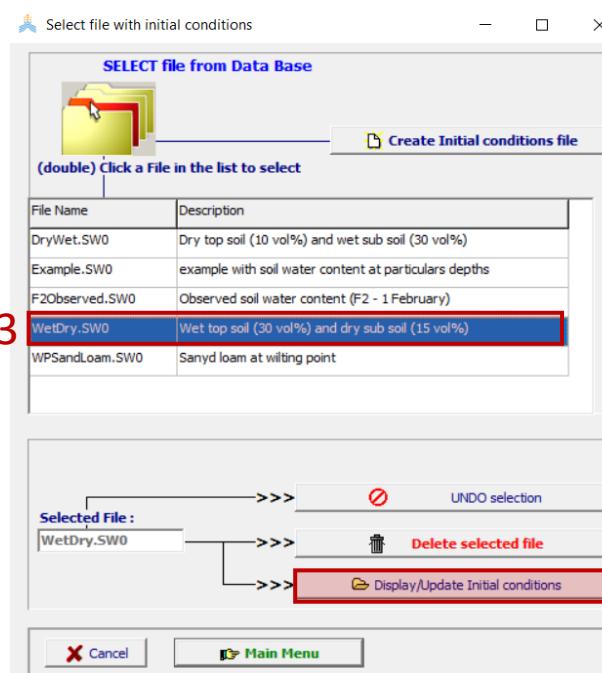
**Step 2:** double-check that the **simulation period** coincides or its within the timeframe of the climatic file

# Initial conditions

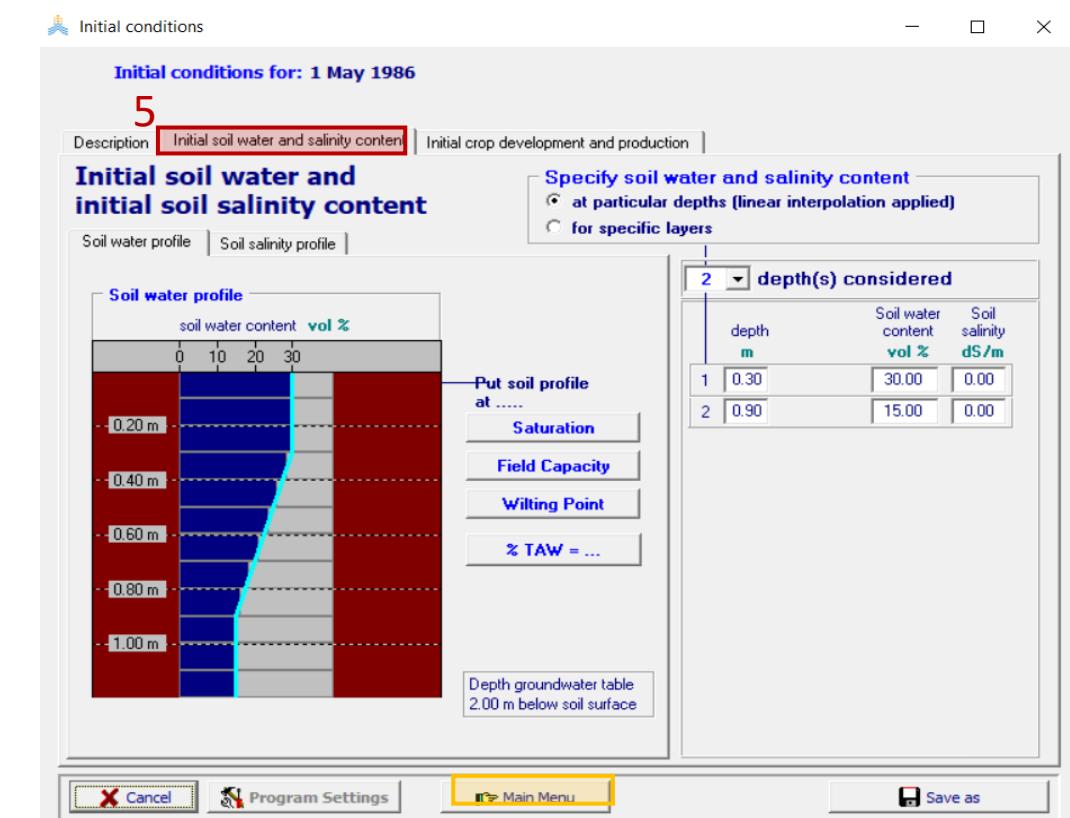


Steps 1-2: click on **initial conditions** and then **select/create initial conditions file**

Steps 3-4: click once on **wet/dry** and click on **display/update initial conditions**

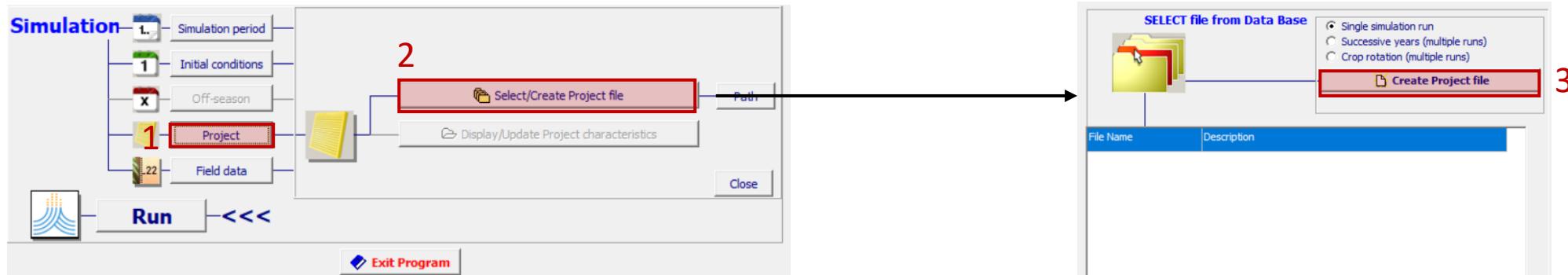


Step 5: click on **initial soil water and salinity content**

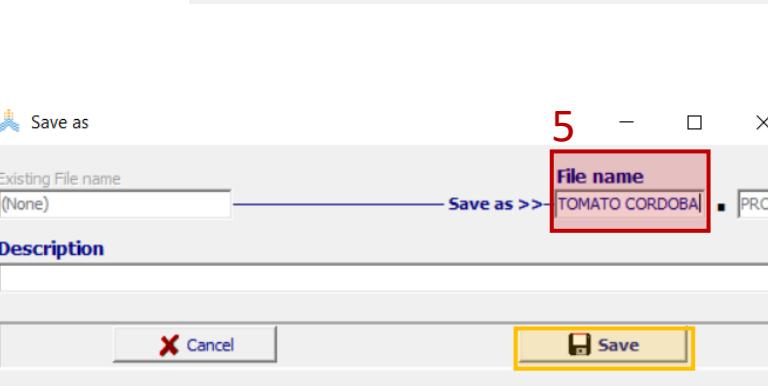
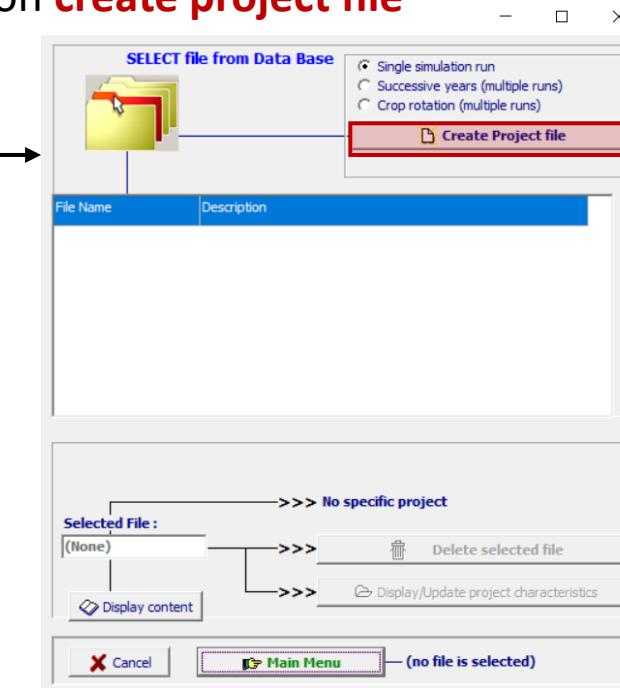
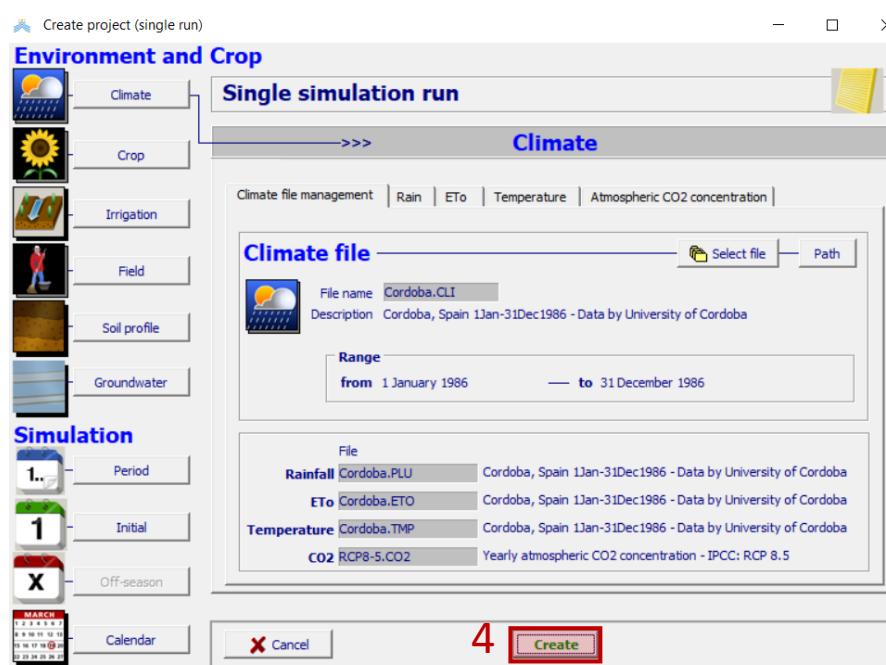


# Create project file

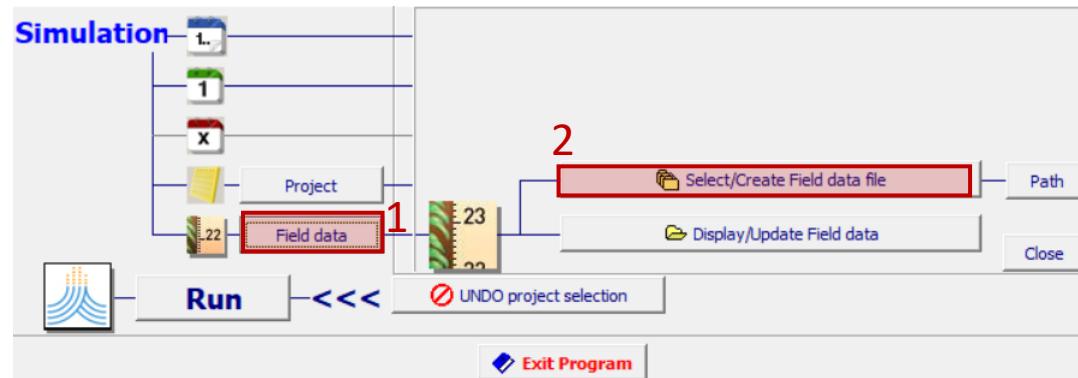
Steps 1-3: click on **project**, then **select/create project file** and click on **create project file**



Step 4: click on **create**, name the file as “**tomato Cordoba**” and **save** the file

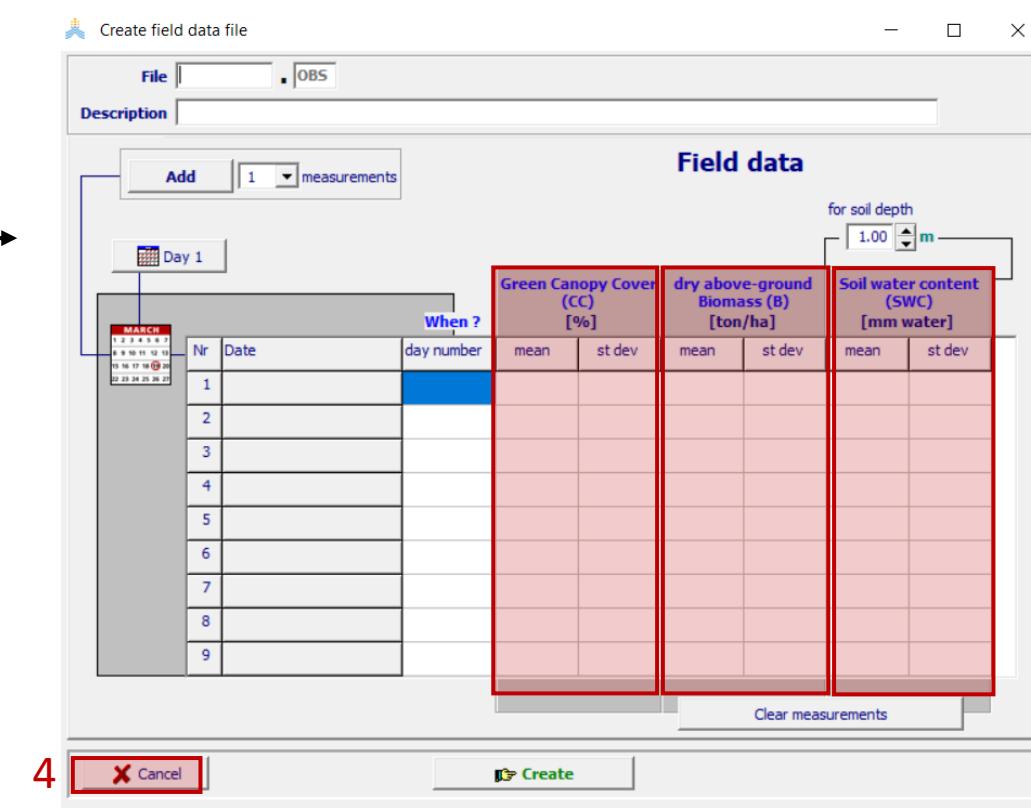
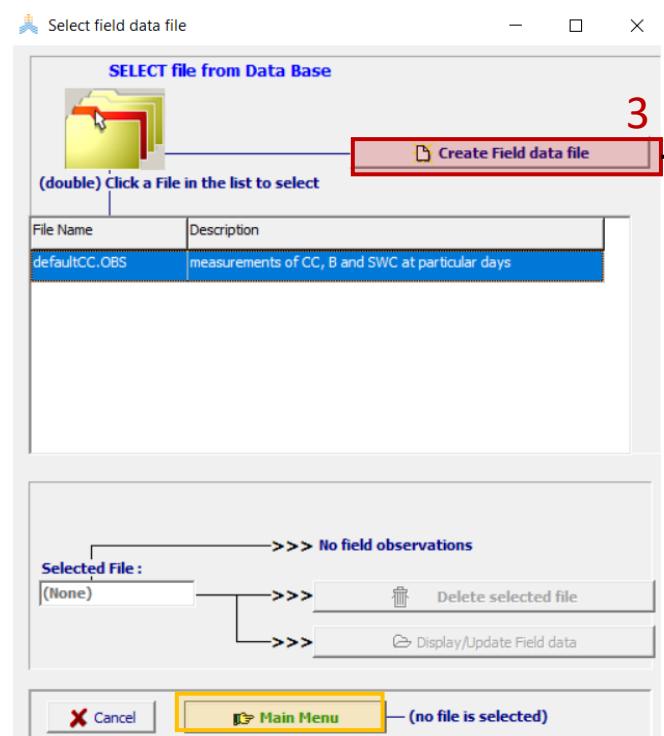


# Field data: CC, biomass and SWC observations



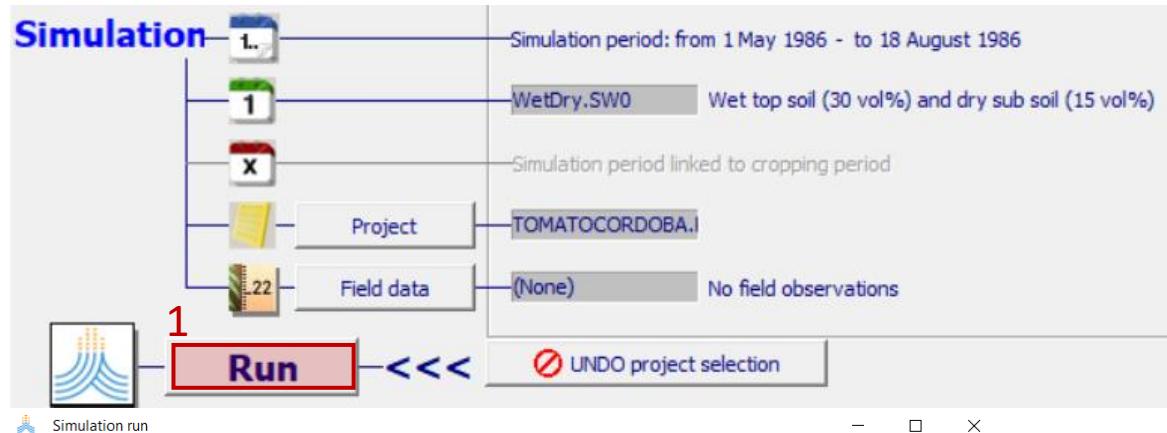
Steps 1-2: click on **field data**, then **select/create project file**

Steps 3-4: click on **create field data file**, but then click on **cancel**

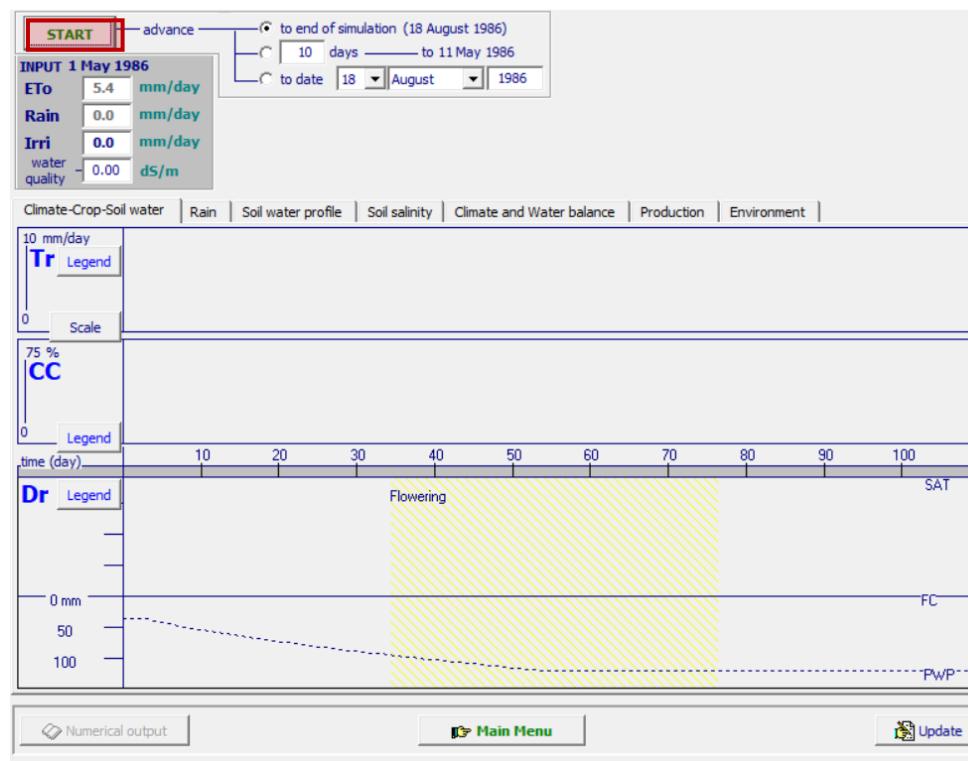


You can introduce field observations  
(CC, biomass and SWC) to better  
calibrate the model

# Run the simulations



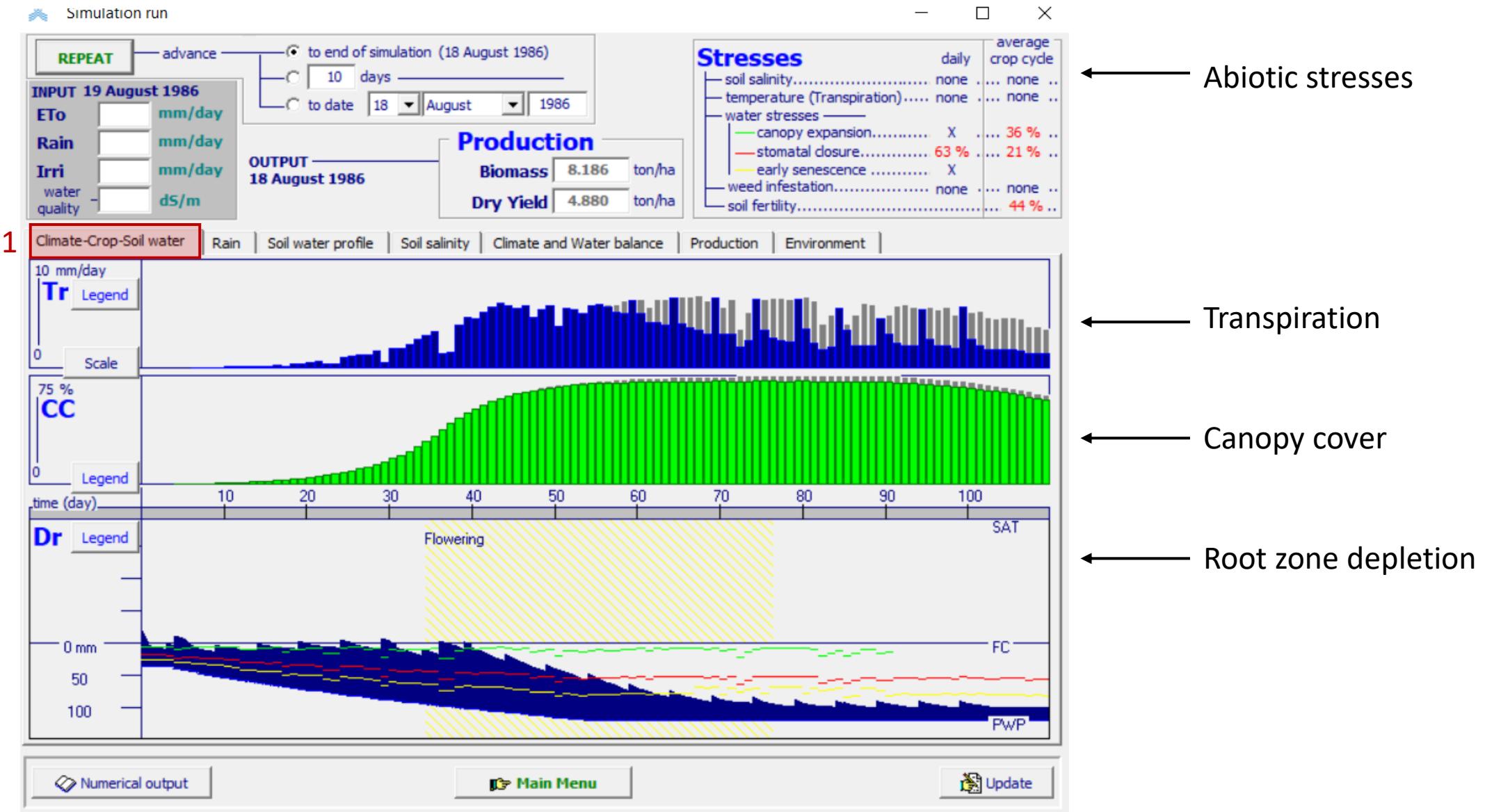
Step 1: click on **Run**



Step 2: click on **START**

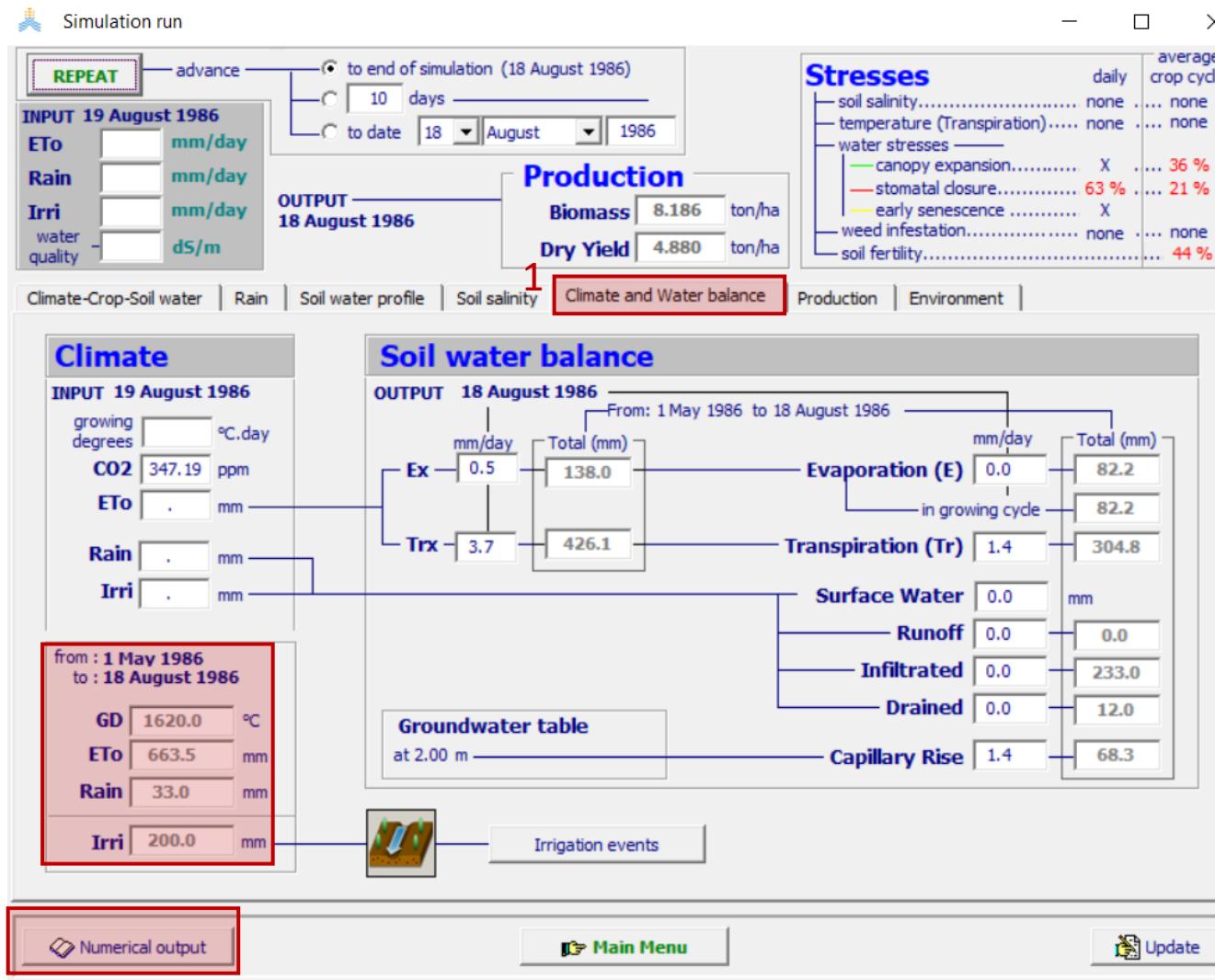
# Simulation outputs: production & stresses

Step 1: click on **climate-crop-soil water**



# Simulation outputs: climate and water balance

## Step 1: click on Climate and Water Balance



# Simulation outputs: crop development & production

## Step 1: click on Numerical output

1

Numerical output

Daily -----  
Crop development and production

Time Aggregate: Day (selected), 10-day, Month, Year

Range: From 1 May 1986 To 18 August 1986

Select Output File: Crop development and production (selected), Profile/Root zone ..., Soil water balance, Climate input data, Compartments ..., Net irrigation requirement

Day	Month	Year	DAP	Stage	Kc(Tr)	Trx	Tr	TrW	Tr/Trx	WP	Biomass
1	5	1986	1	1	-	mm	mm	mm	%	g/m <sup>2</sup>	ton/ha
2	5	1986	2	1	-	0.0	0.0	0.0	100	17.0	0.000
3	5	1986	3	1	-	0.0	0.0	0.0	100	17.0	0.000
4	5	1986	4	1	-	0.0	0.0	0.0	100	17.0	0.000
5	5	1986	5	2	0.01	0.0	0.0	0.0	100	17.0	0.002
6	5	1986	6	2	0.02	0.1	0.1	0.1	100	17.0	0.005
7	5	1986	7	2	0.02	0.1	0.1	0.1	100	17.0	0.008
8	5	1986	8	2	0.02	0.1	0.1	0.1	100	17.0	0.012
9	5	1986	9	2	0.02	0.1	0.1	0.1	100	17.0	0.016
10	5	1986	10	2	0.03	0.2	0.2	0.2	100	17.0	0.020

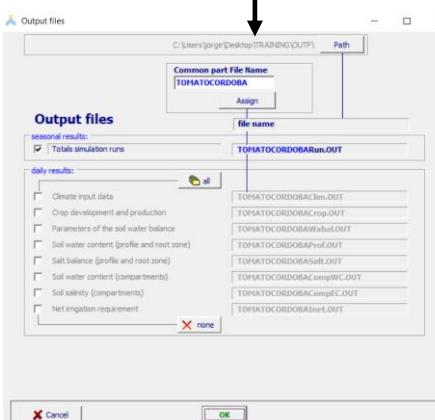
Scroll up down Scroll to date OK



Step 2: click on Main Menu, click on Yes and save seasonal results

Step 3: click on Output files and verify the output file. Name the file "FIRST SIMULATION"

Step 4: click on Exit run





## Take away messages

- Crop models are essential tools for improving field management and, thus, key for climate change adaptation.
- Crop models are a simplified representation of the reality.
- The higher the inputs the better the outputs. However, it is more time consuming and a higher processing power is required.
- AquaCrop calculates crop ET in four steps: (i) crop development, (ii) crop transpiration, (iii) biomass production, and (iv) yield formation.
- AquaCrop is divided into 4 modules of input requirements: climate, crop, management and soil



- AquaCrop training handbook: [link](#)
- Reference manual version 7:
  - Chapter 1: [link](#)
  - Chapter 2: [link](#)
  - Chapter 3: [link](#)
  - Chapter 4: [link](#)
  - Chapter 5: [link](#)
  - Annexes: [link](#)
- 43 YouTube tutorials on how to use the model: [link](#)
- The AquaCrop model – 10 years of enhancing crop water productivity: [link](#)