Food and Agriculture Organization of the United Nations

Crop Module 3
Creating crop and irrigation files

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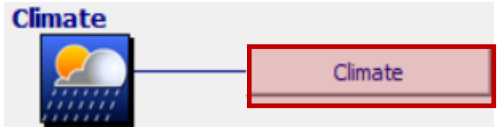
(2023)

Food and Agriculture Organization of the United Nations

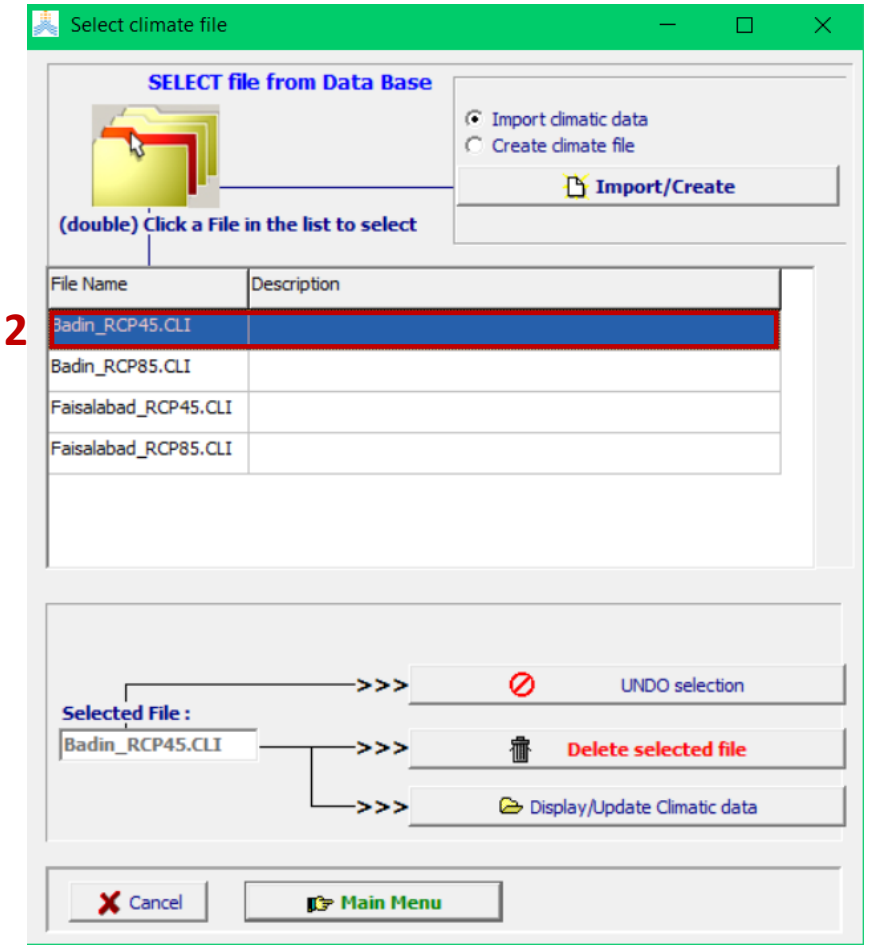
Table of Contents

Climate module: open Badin

Steps 1-2. Open the **climate** module and select the climatic file **Badin_RCP45**



1

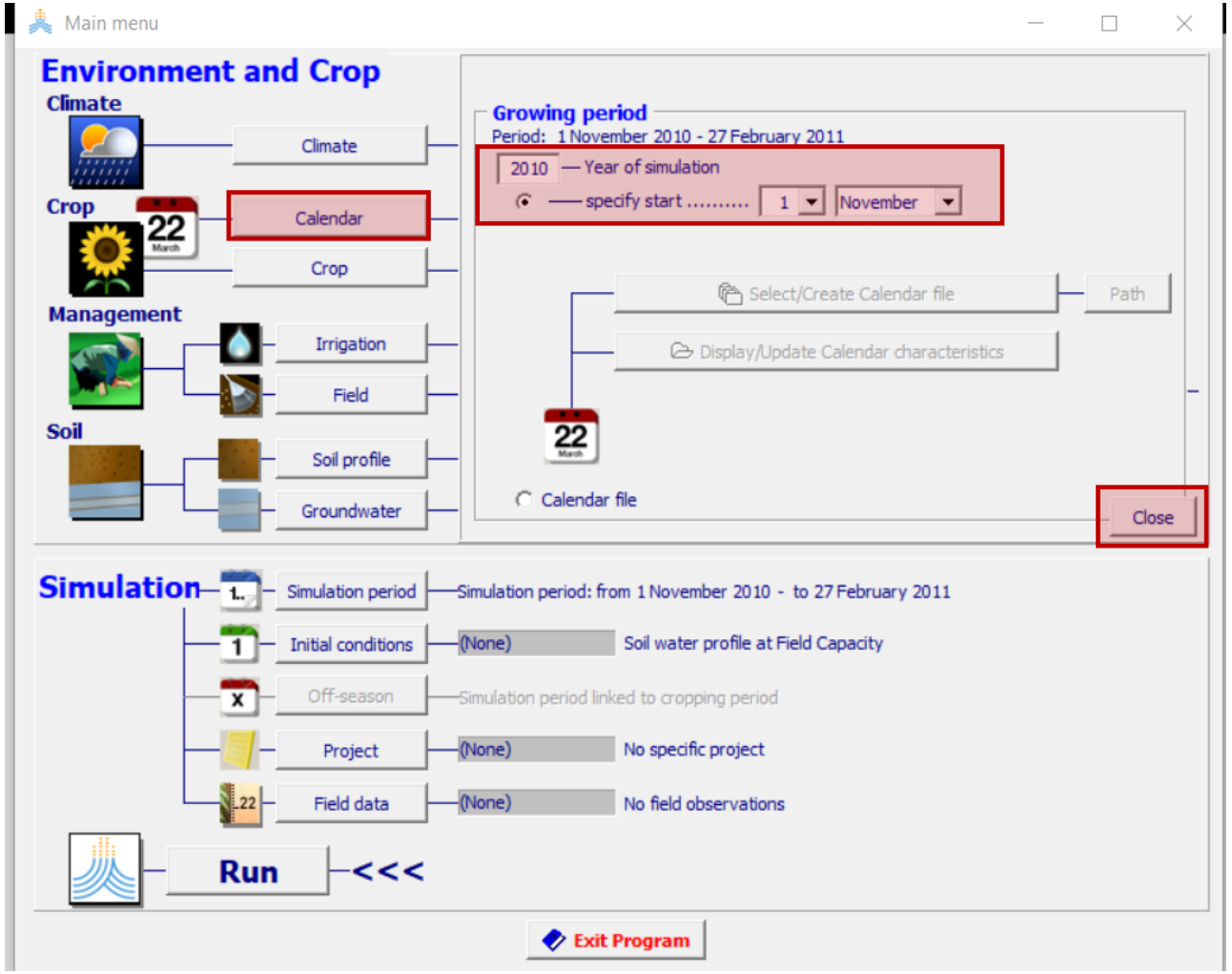


2

CREATE A CROP FILE

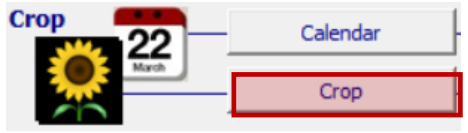
Crop calendar

Step 1: Click on **Calendar**, specify the sowing date "**1st of November**" and click on **Close**

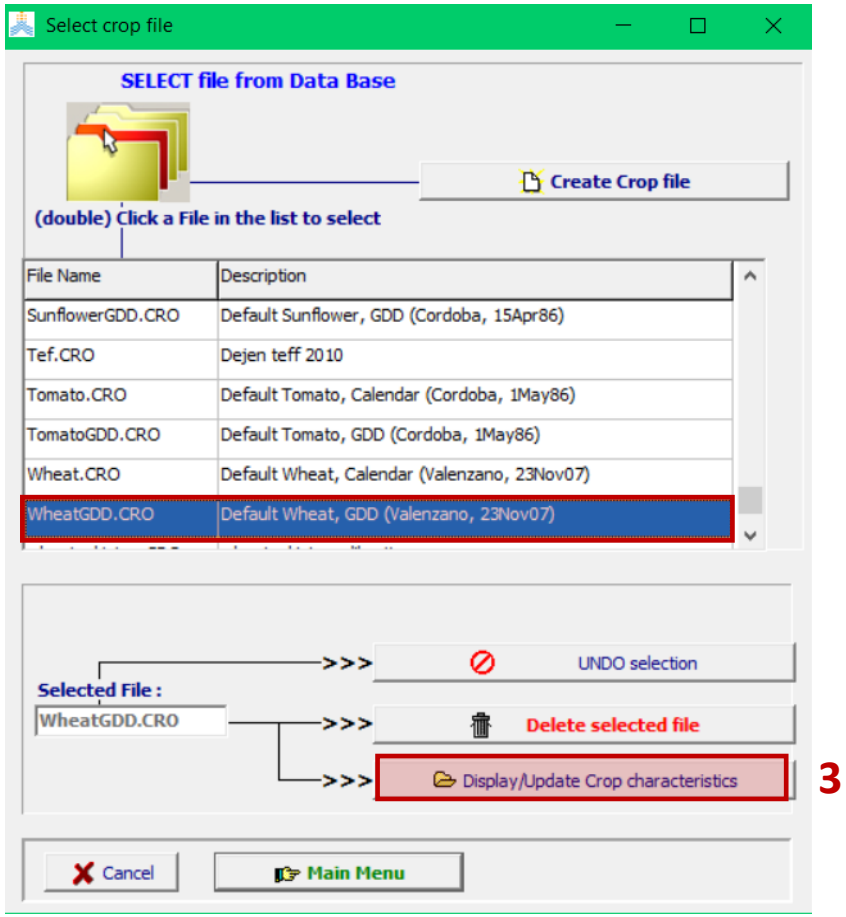


Crop module: open wheat

Steps 1-2: Open the **crop module** and select the default file **WheatGDD.CRO**



1



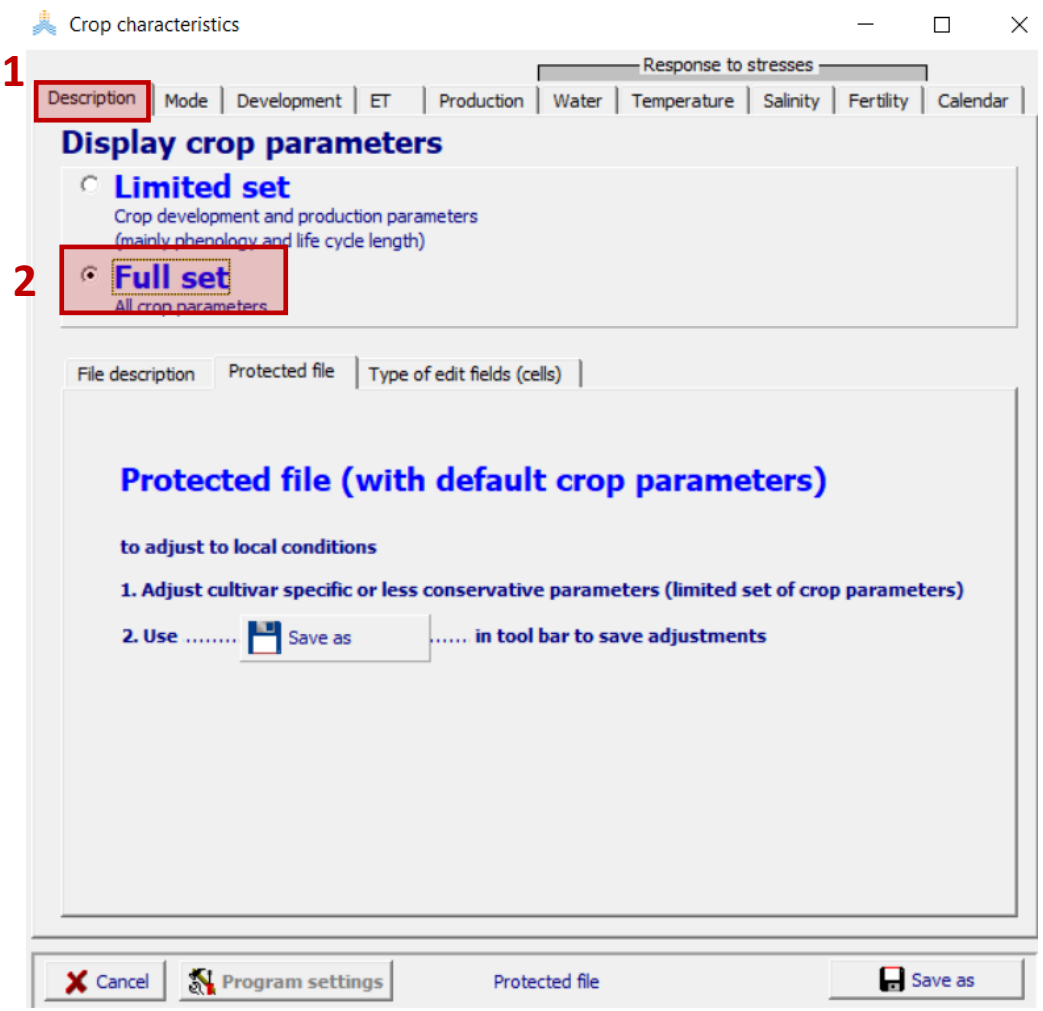
2

3

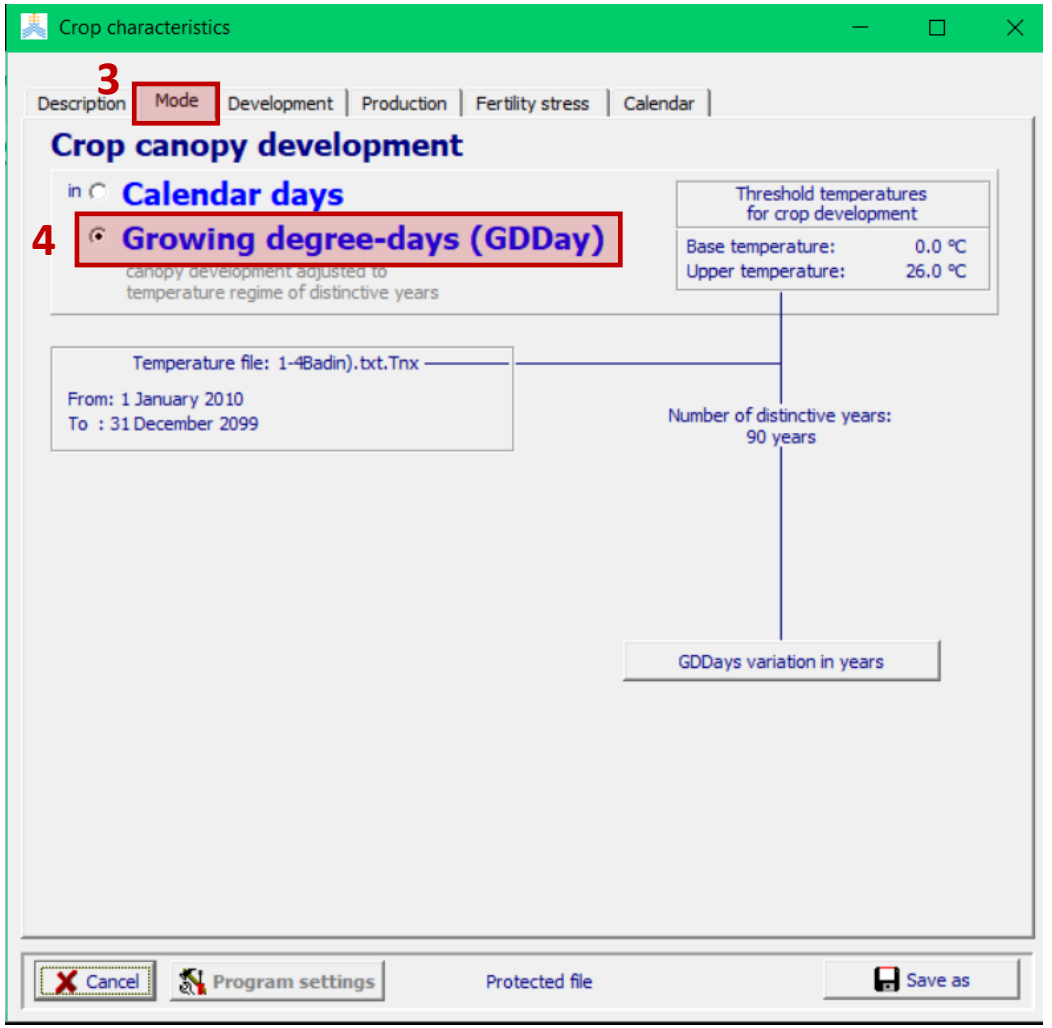
Step 3. Click on **Display/Update Crop characteristics**

Create a crop file: wheat

Steps 1-2: Click on **Description** and select **Full set**

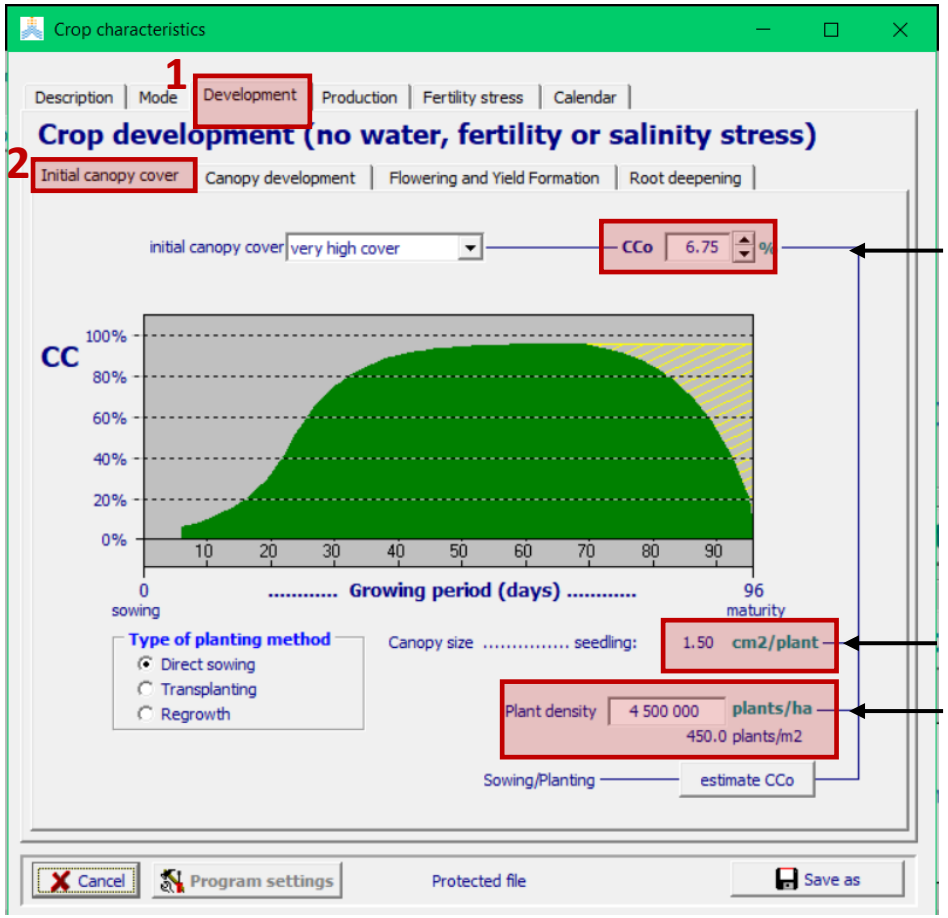


Steps 3-4: Click on **Mode** and select **Growing degree-days (GDDay)**

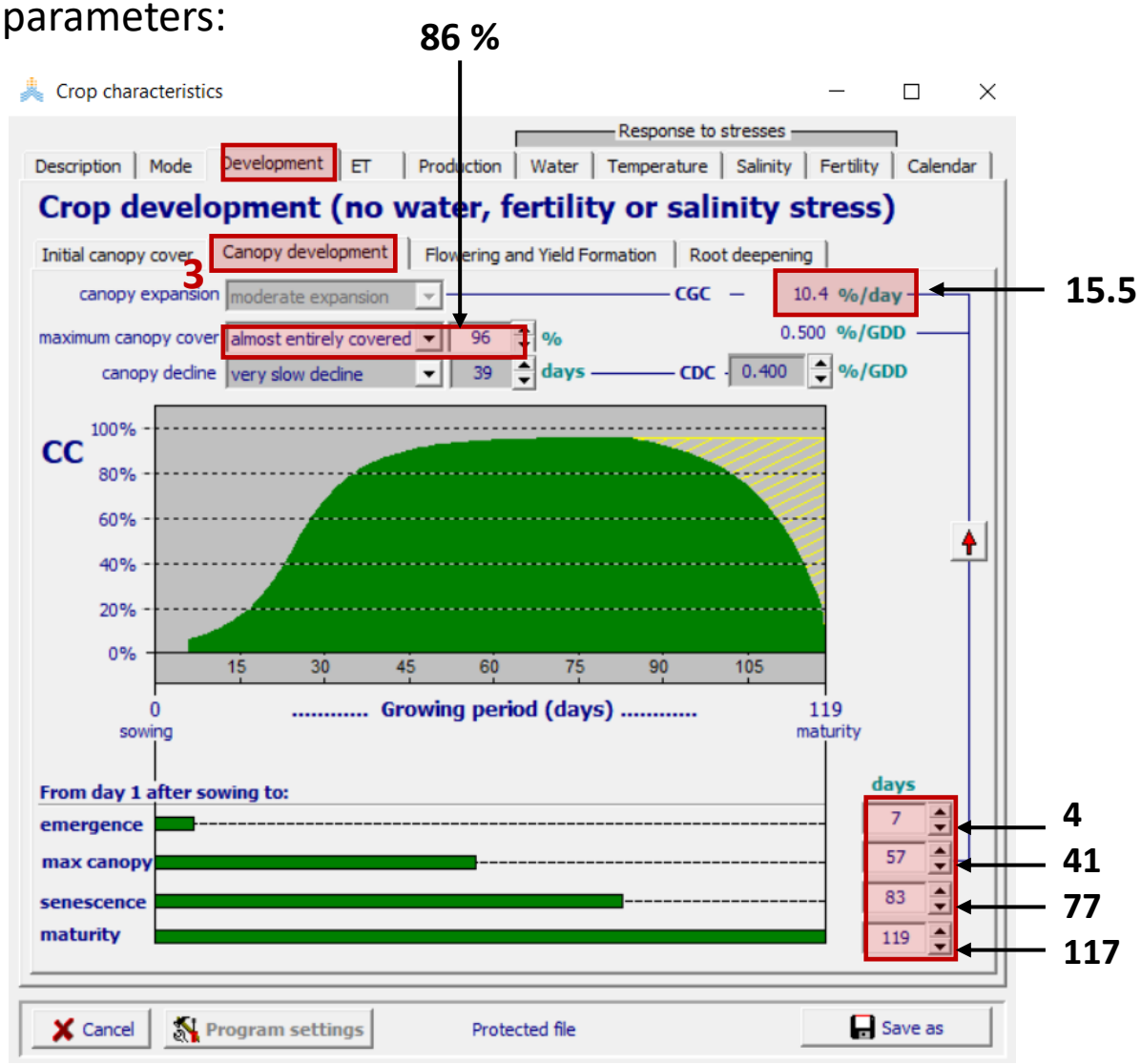


Create a crop file: development

Steps 1-2: Click on **Development** and modify the following **Initial canopy cover** parameters:

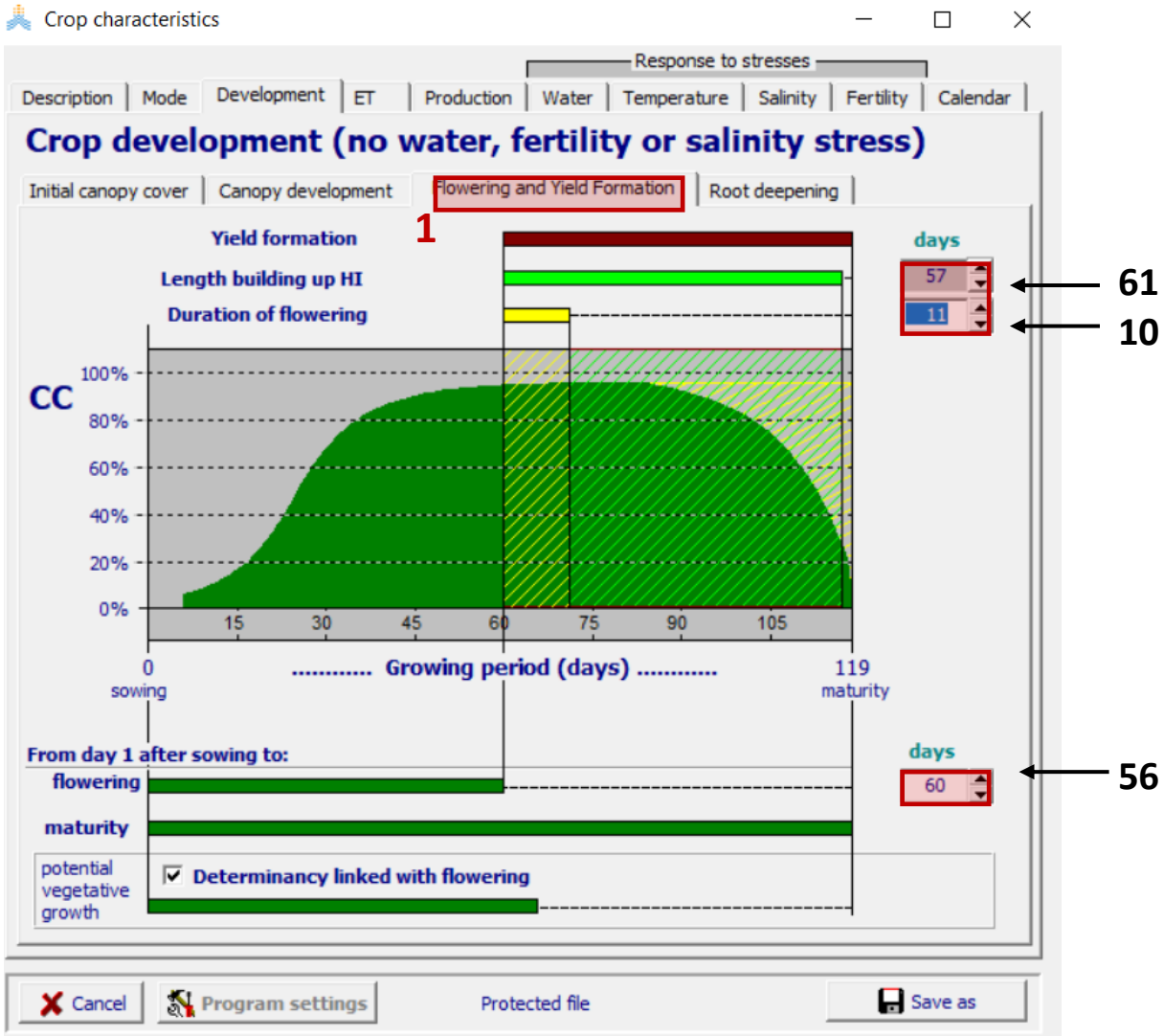


Step 3: Click on **Canopy development** and modify the following parameters:



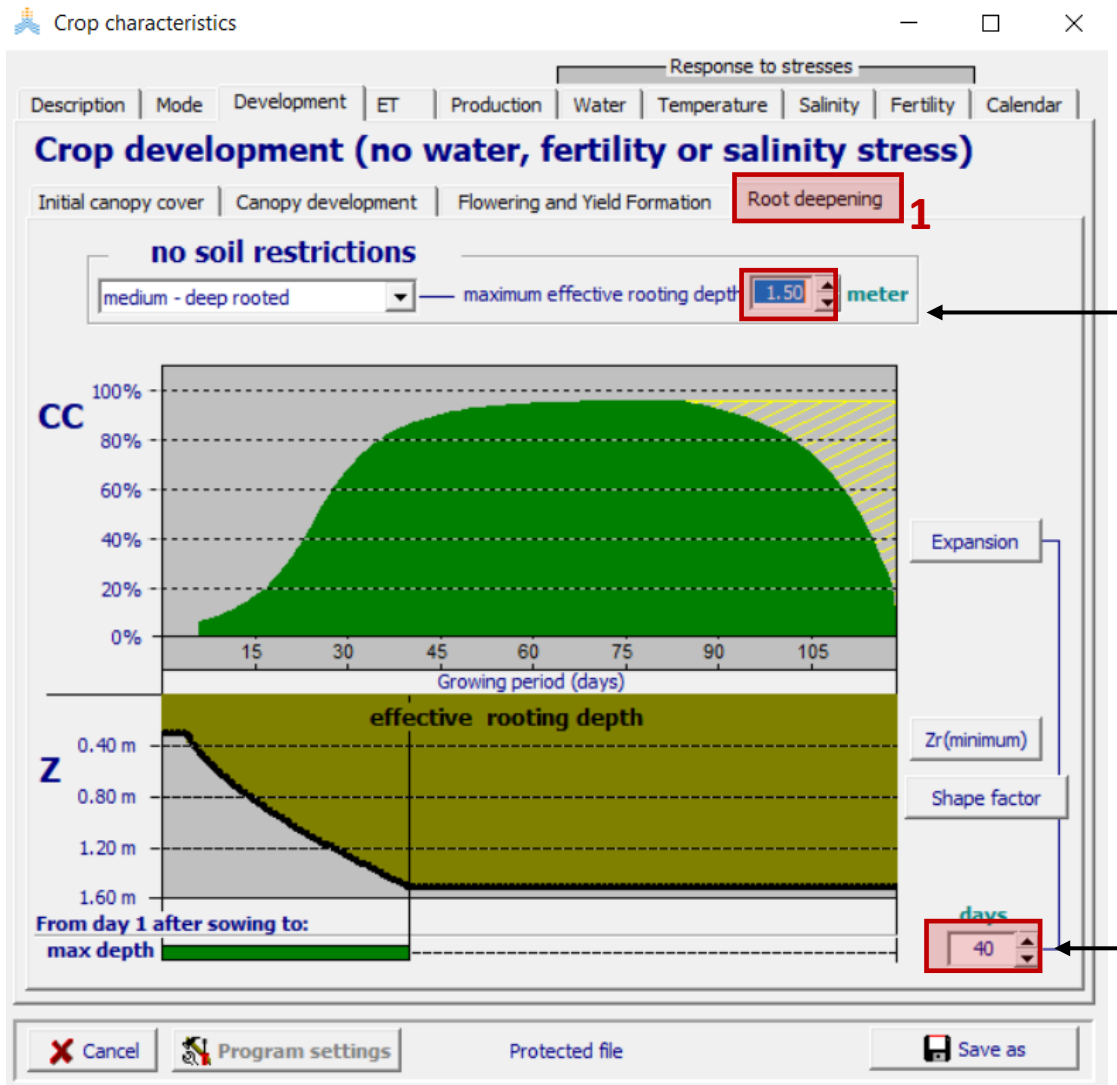
Create a crop file: flowering & yield formation

Step 1: Click on **Flowering and Yield Formation** and modify the following parameters:



Create a crop file: root deepening

Step 1: Click on **Root deepening** and modify the following parameters:

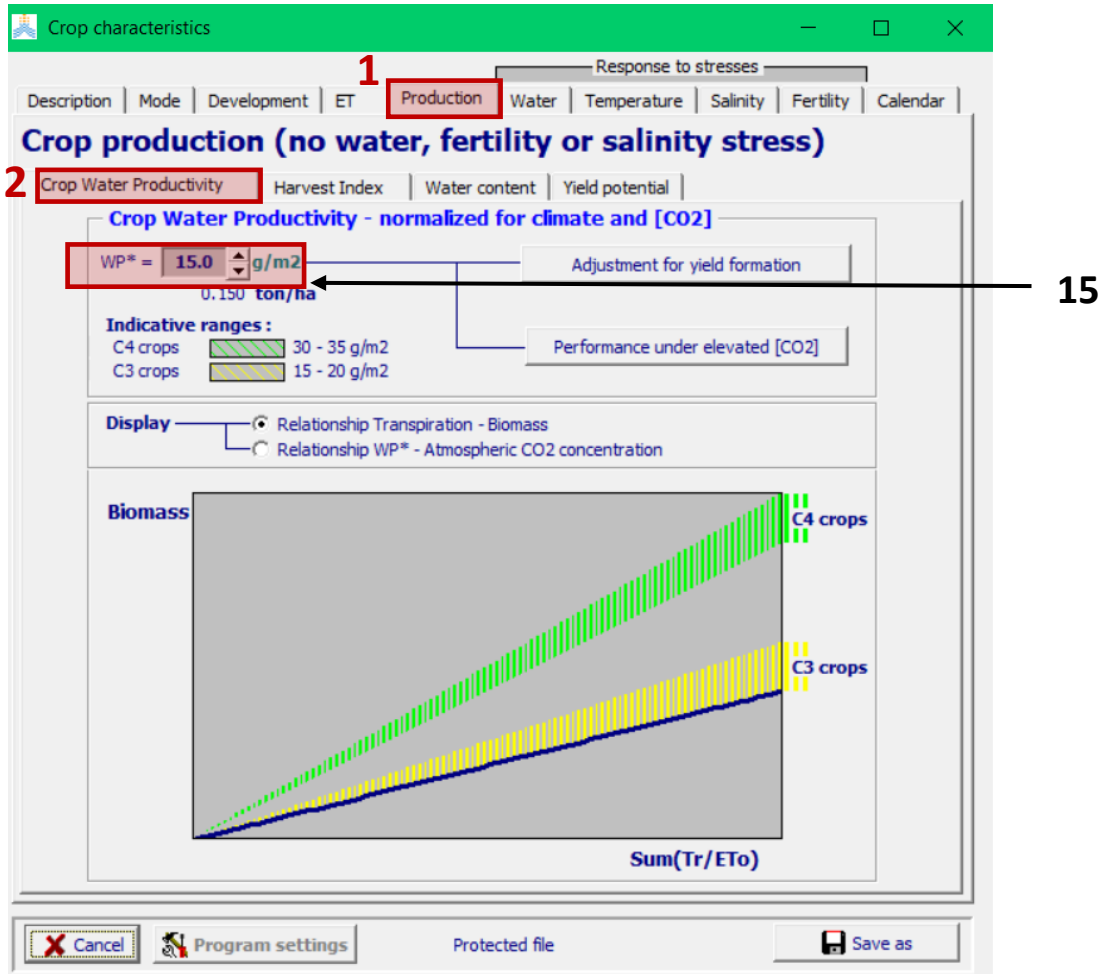


1.50 (same)

29

Create a crop file: production

Steps 1-2: Click on **Production** and modify the following **Crop Water Productivity** parameters:



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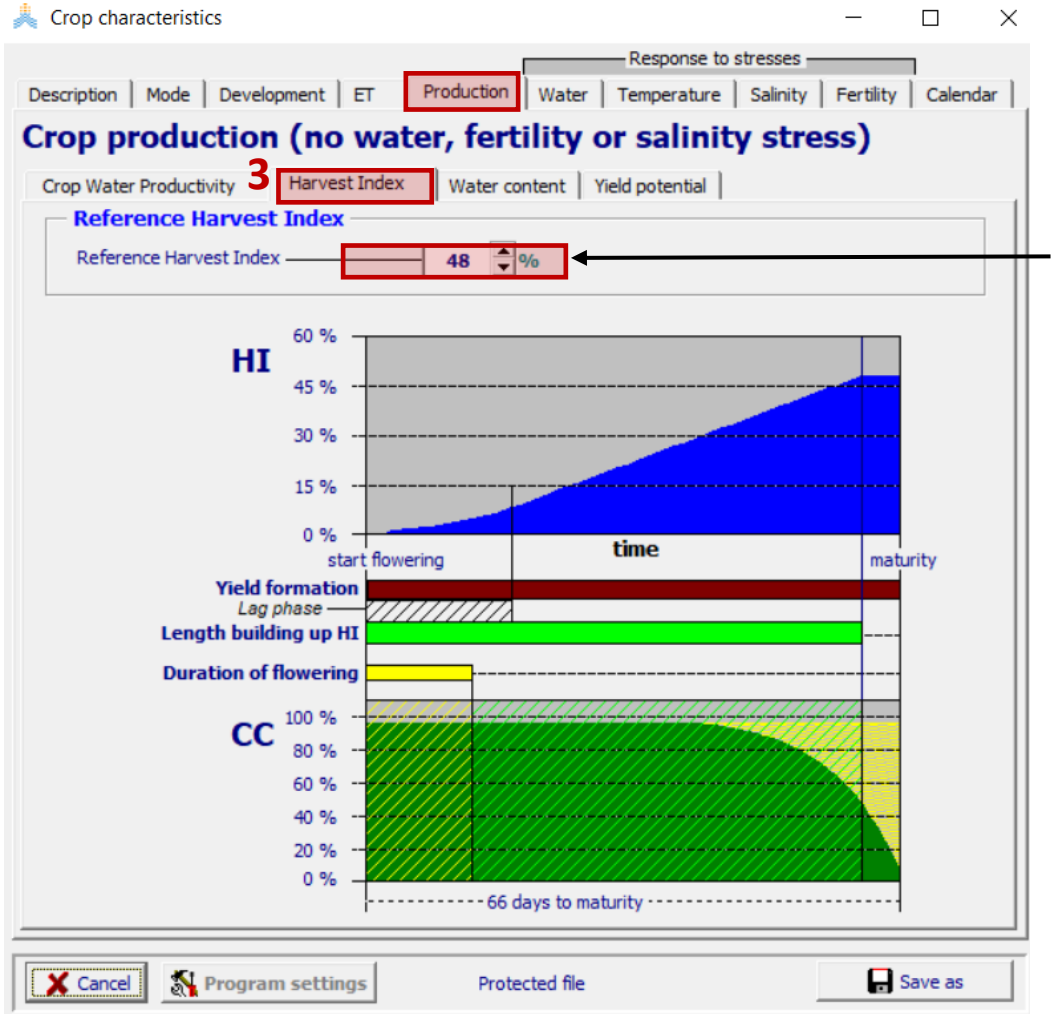
Step 3: Click on **Harvest Index** and modify the following parameters:



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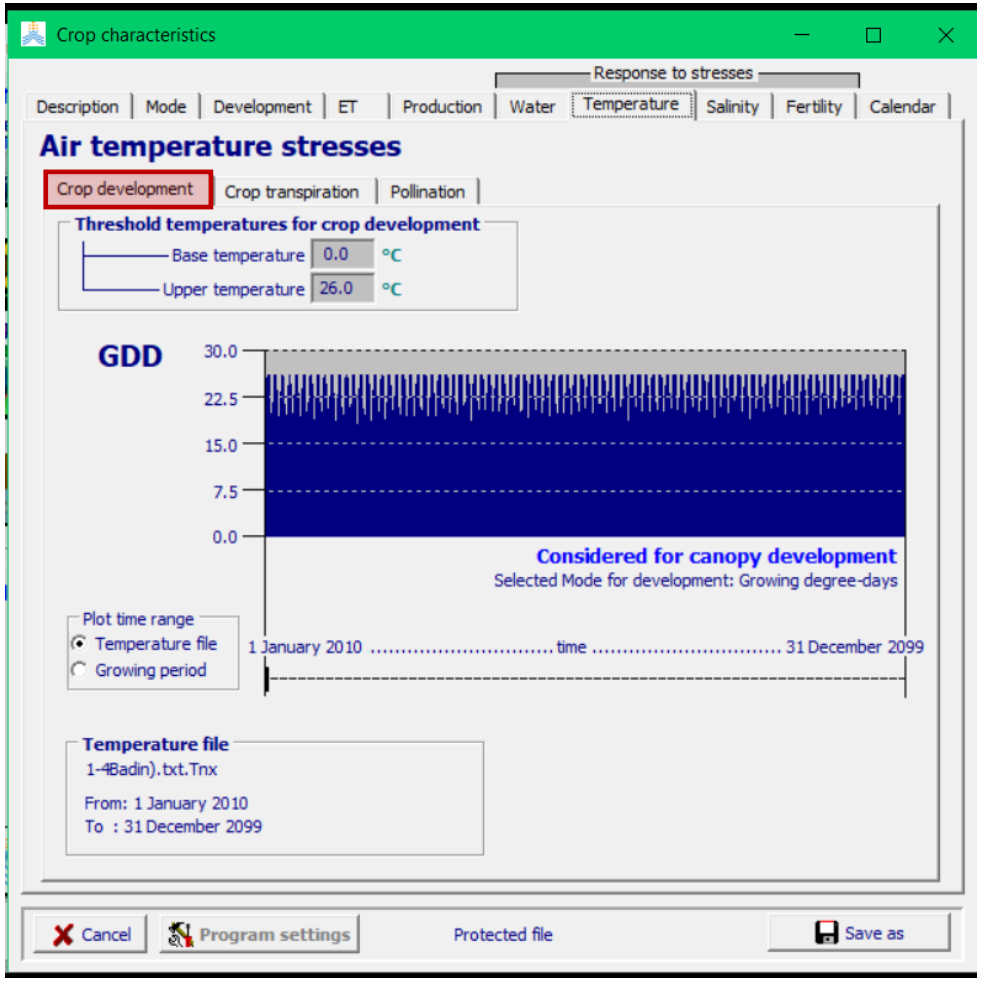
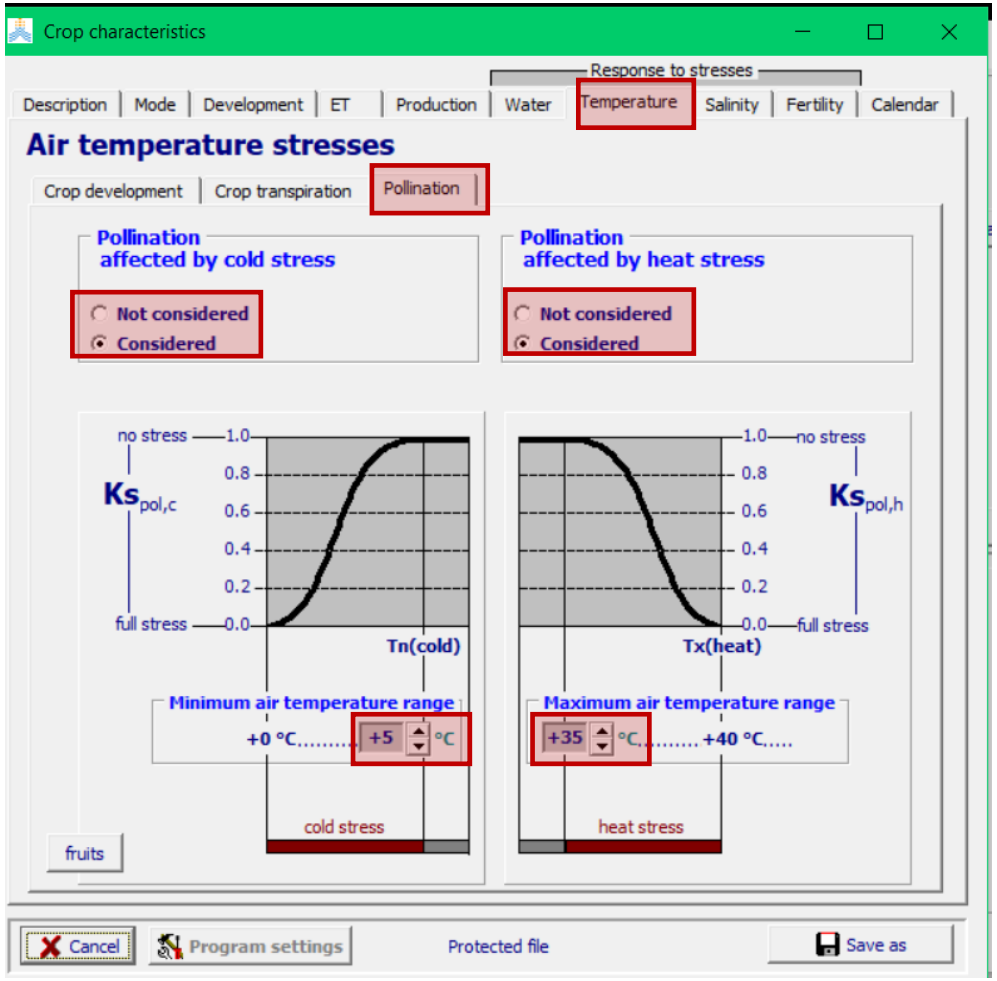
Create a crop file: air temperature stresses

Step 1: Click on **Crop development**

In this section you can modify the base and upper temperature. Keep 0°C and 26°C.

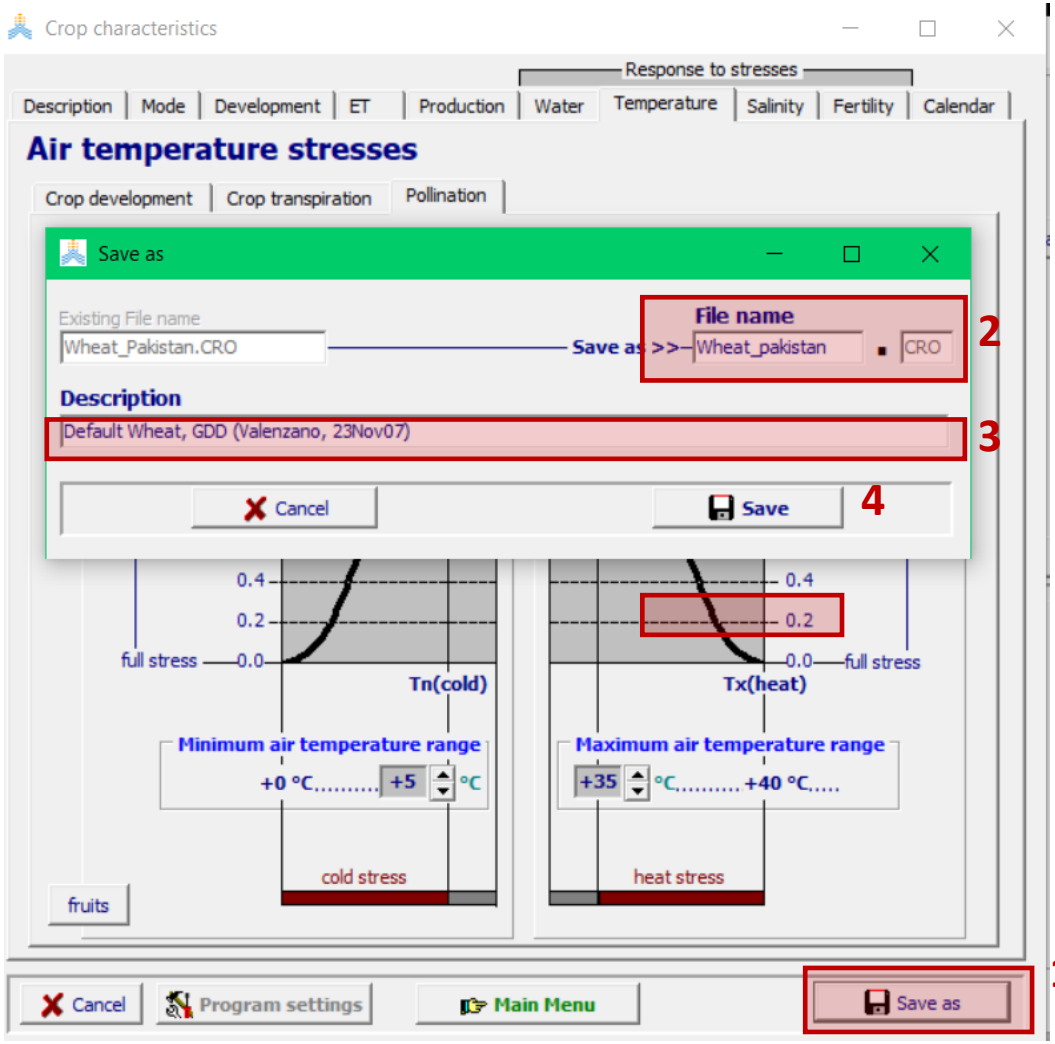


Step 2: Click on **Pollination** and select **considered** (both for cold/heat-stress) and keep min/max ranges as +5ºC and +35ºC, respectively.



Save the crop file

Steps 1-3: Click on **Save as** (bottom of the screen) and enter the following **File name: "Wheat_Pakistan"** and in **Description "Wheat_Pakistan"**

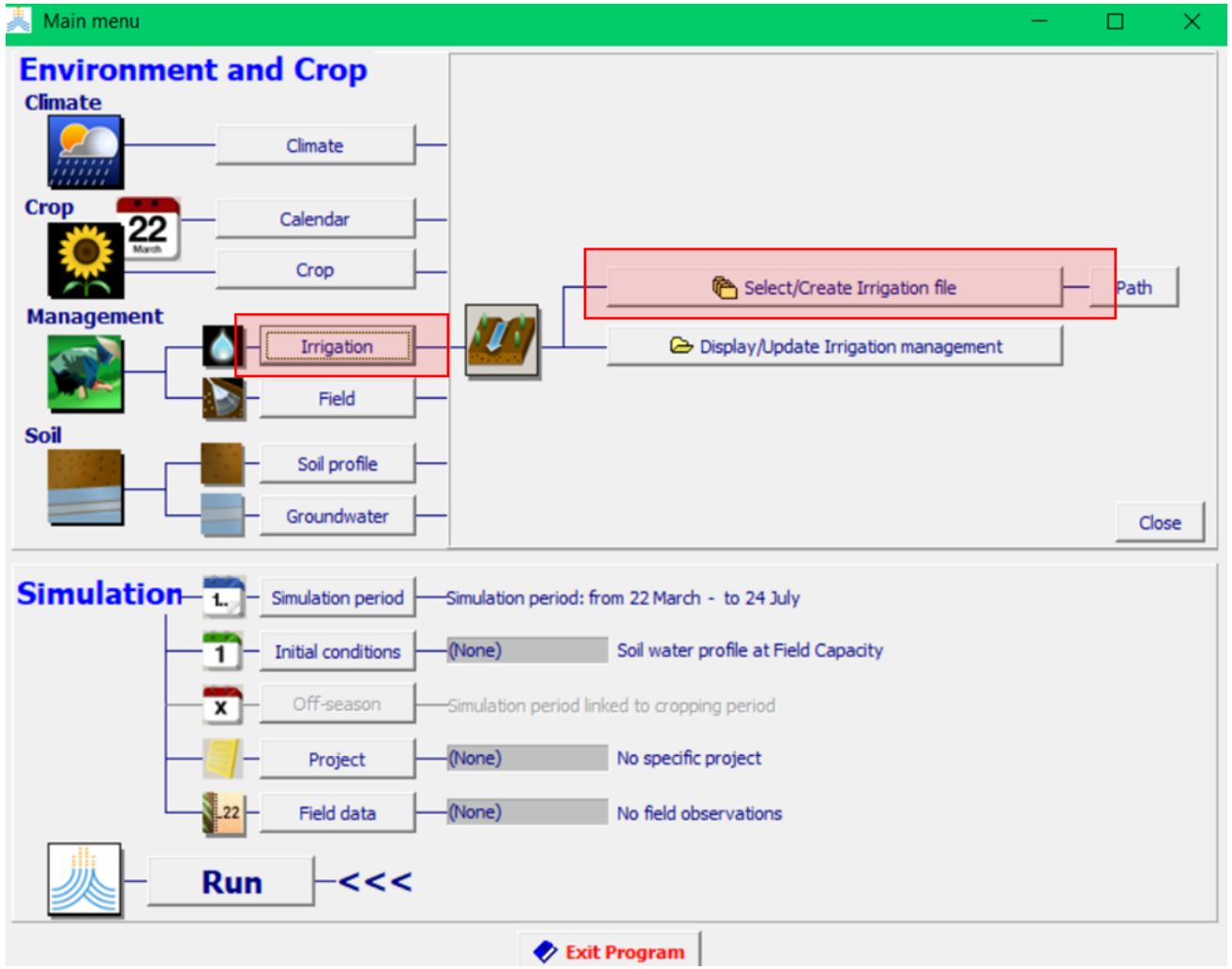


Step 4: Click on **Save**

CREATE AN IRRIGATION FILE

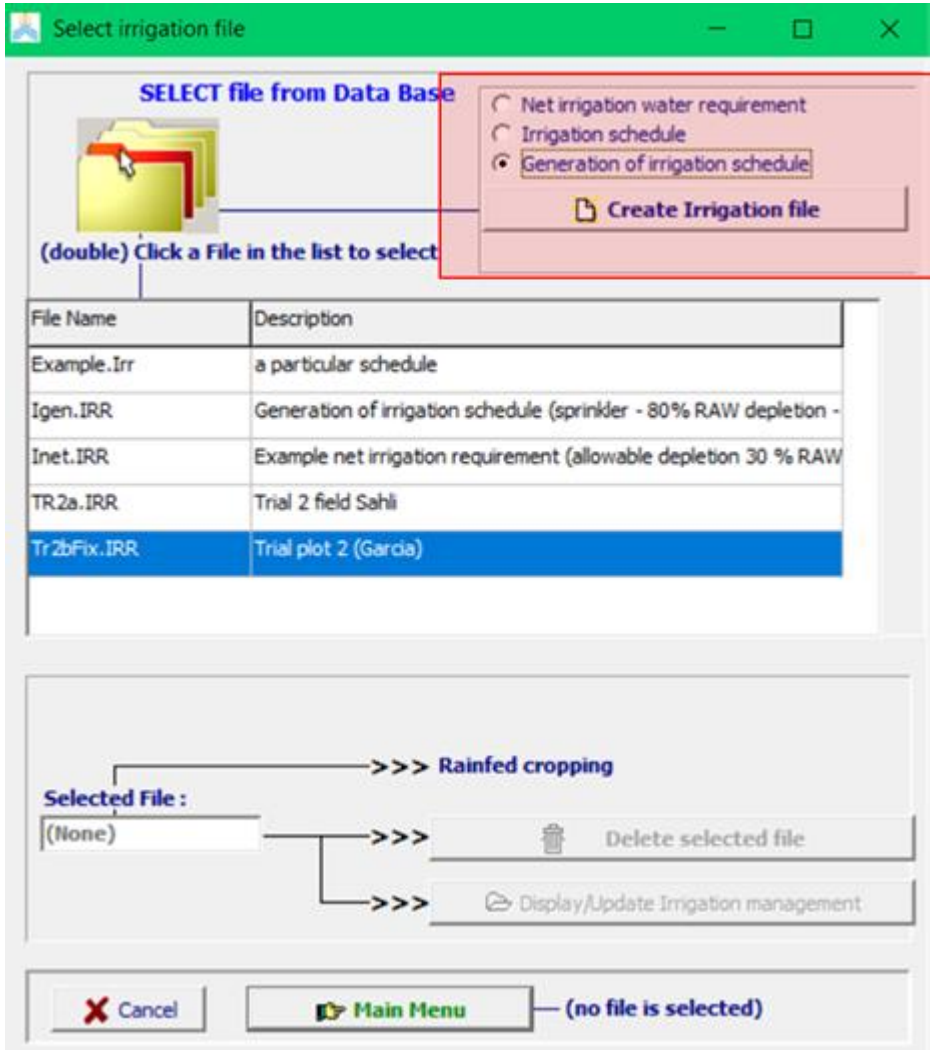
Irrigation file: fixed interval

Steps 1-2. Click on **Irrigation** and **Select/Create Irrigation file**

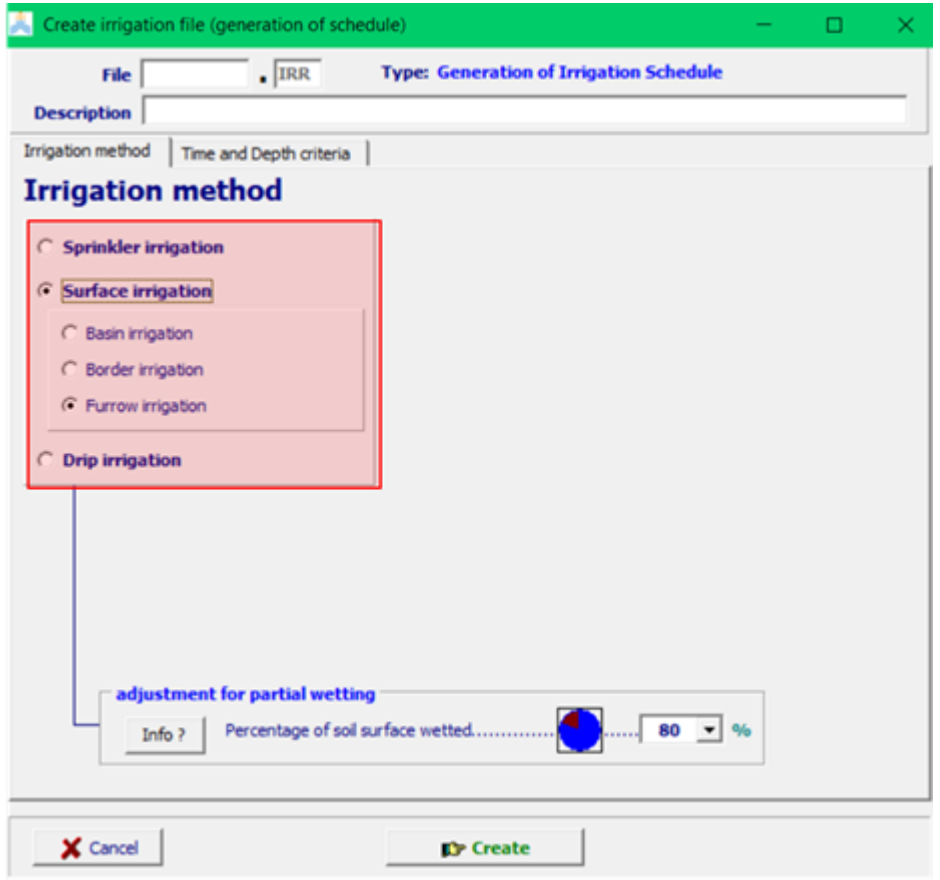


Irrigation file: fixed interval

Step 1: Click on **Generation of irrigation schedule**



Steps 2-3. Click on **Surface irrigation** and then on **Furrow irrigation**



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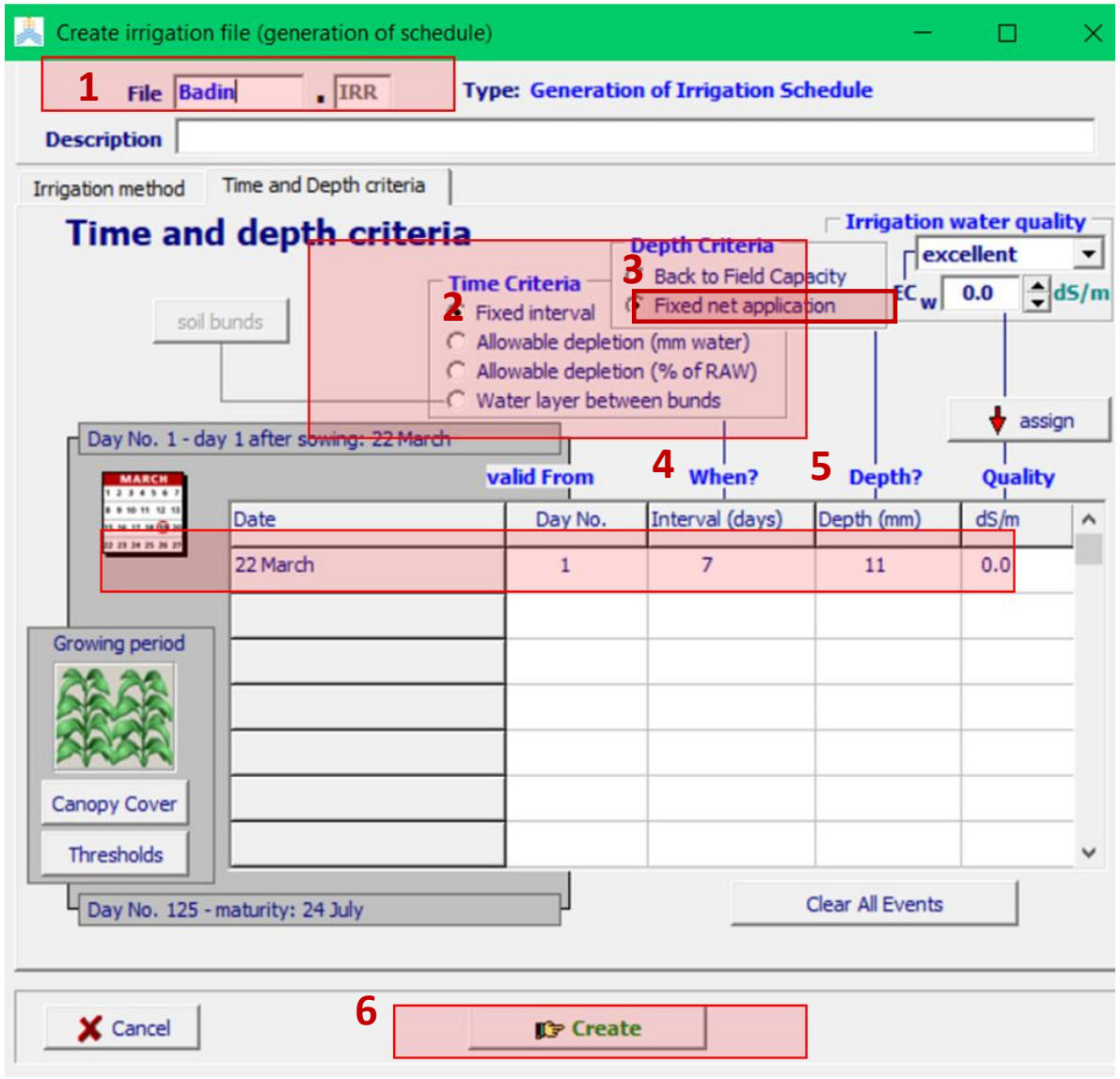
Irrigation file: fixed interval



Step 1: Name the file **Badin**

Step 2. Click on **Fixed interval**

Step 3. Click on **Fixed net application**

Step 4. Select **7** under **Interval (days)**

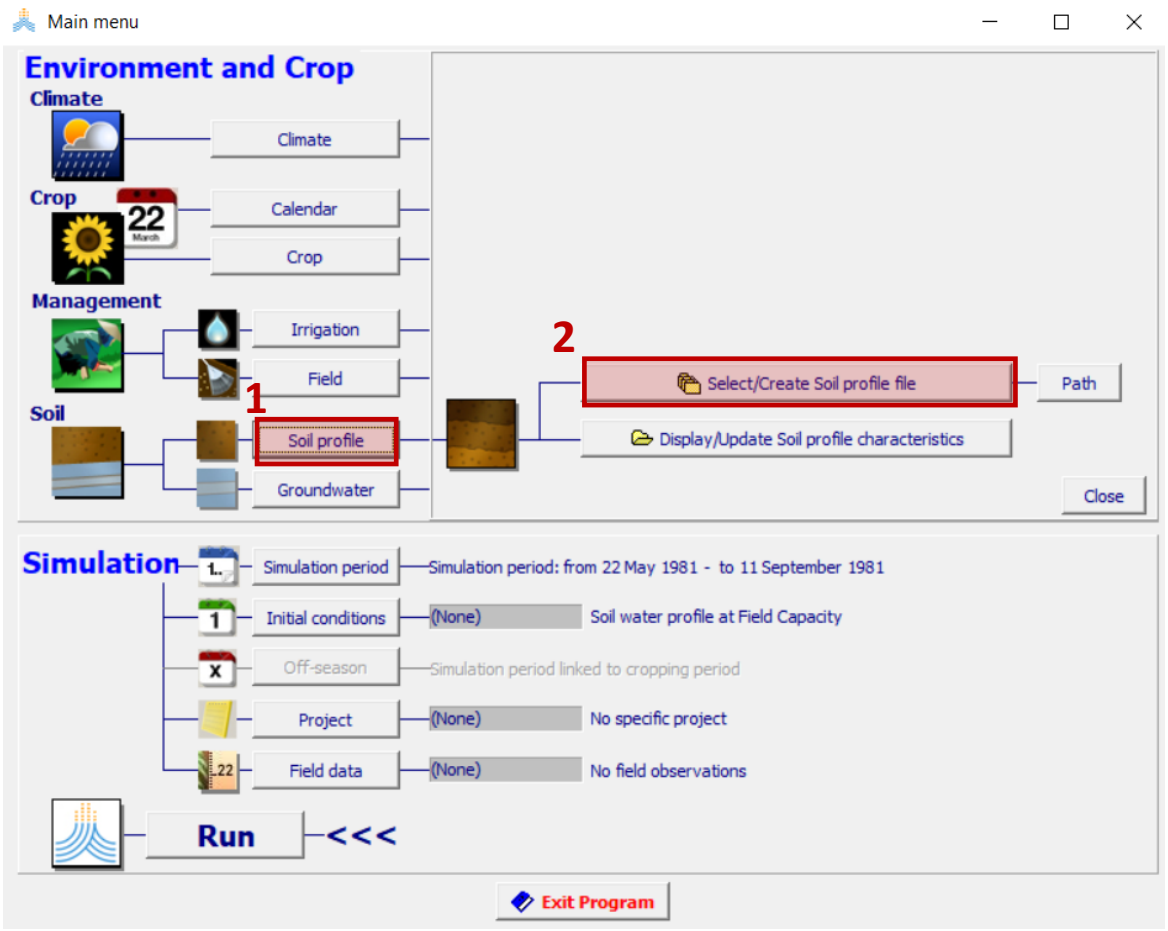
Step 5. Select **11** under **Depth (mm)**

Step 6. Click on **Create**

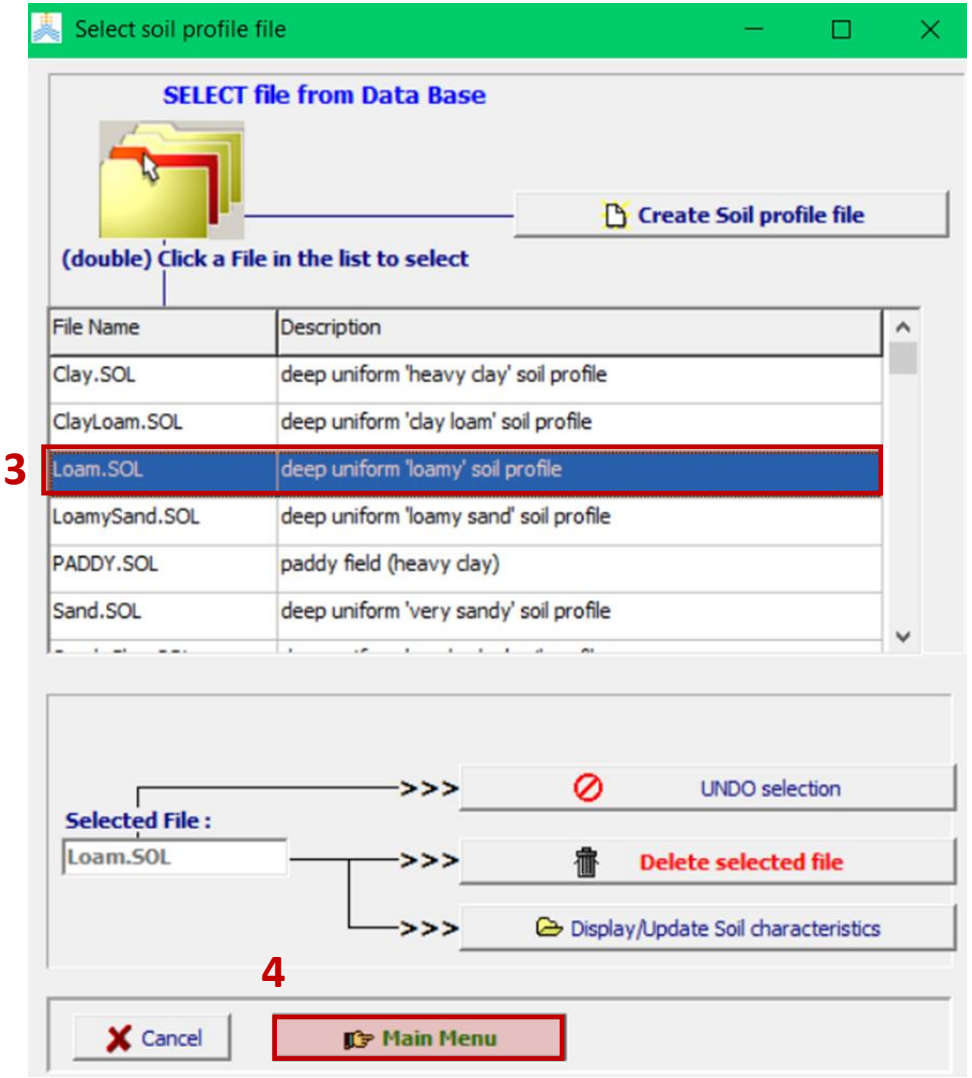
UPLOAD A SOIL FILE

Soil: upload a soil file for Badin

Steps 1-2: Click on **Soil profile** and on **Select/Create Soil profile**



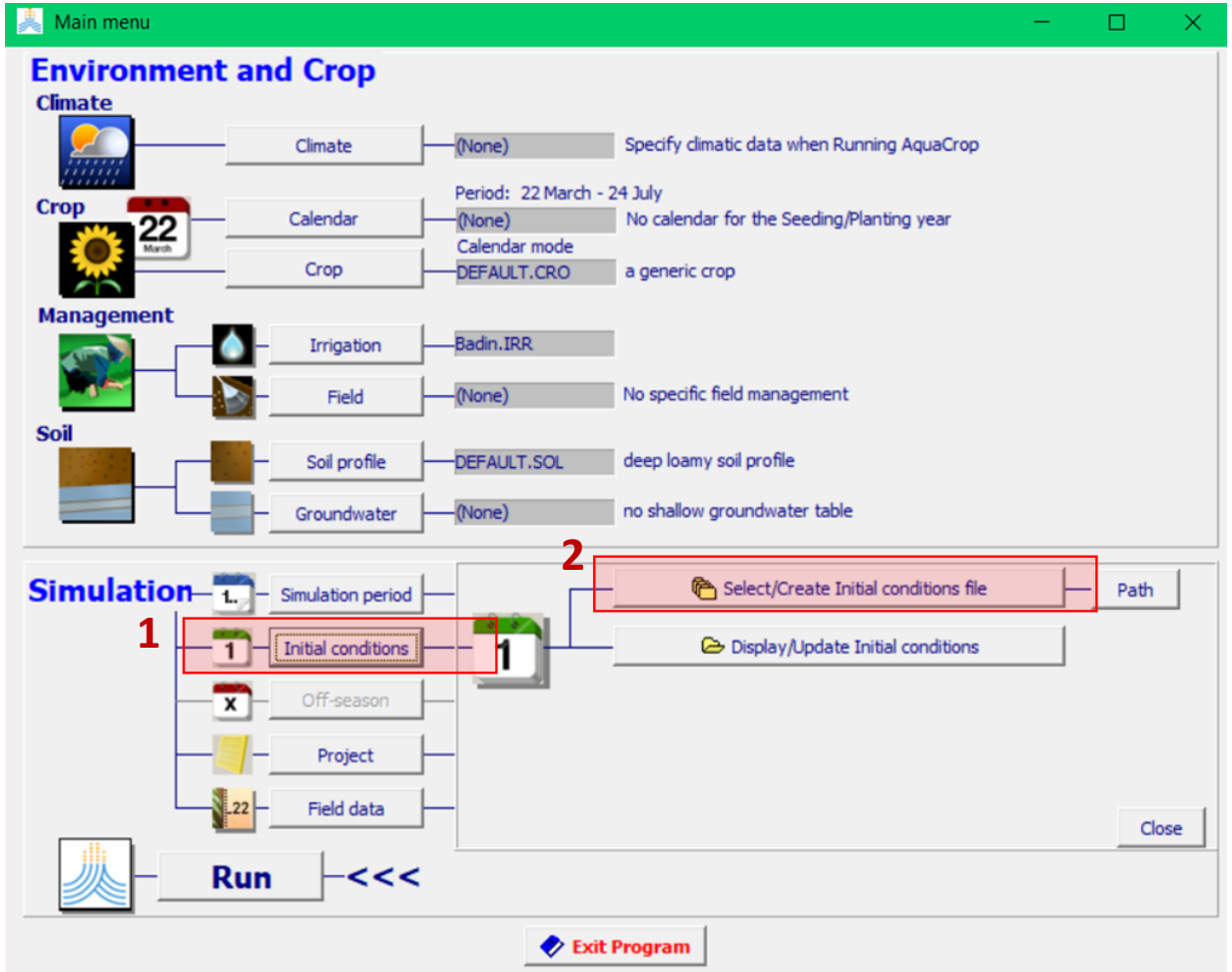
Steps 3-4: Click on **Loam** and on **Main Menu**



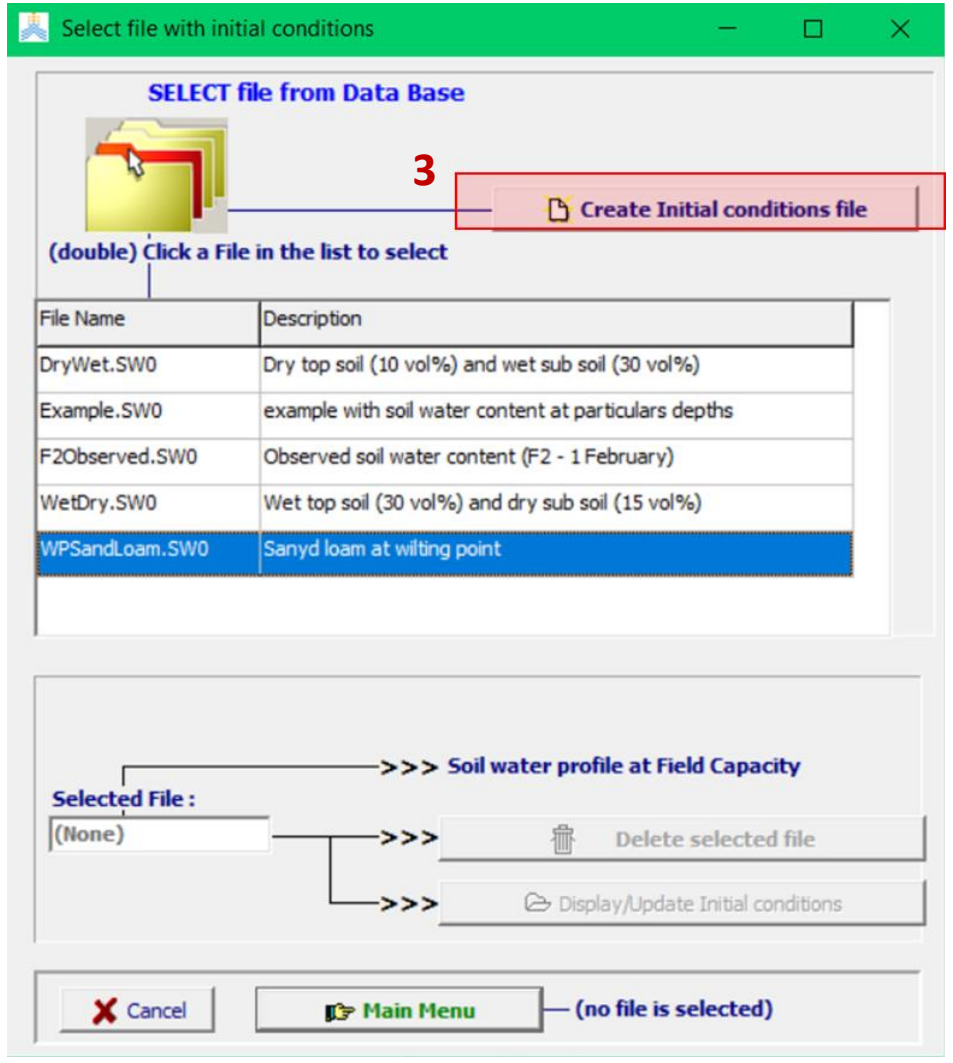
INITIAL SOIL CONDITIONS

Soil water initial condition: create a SW0 file

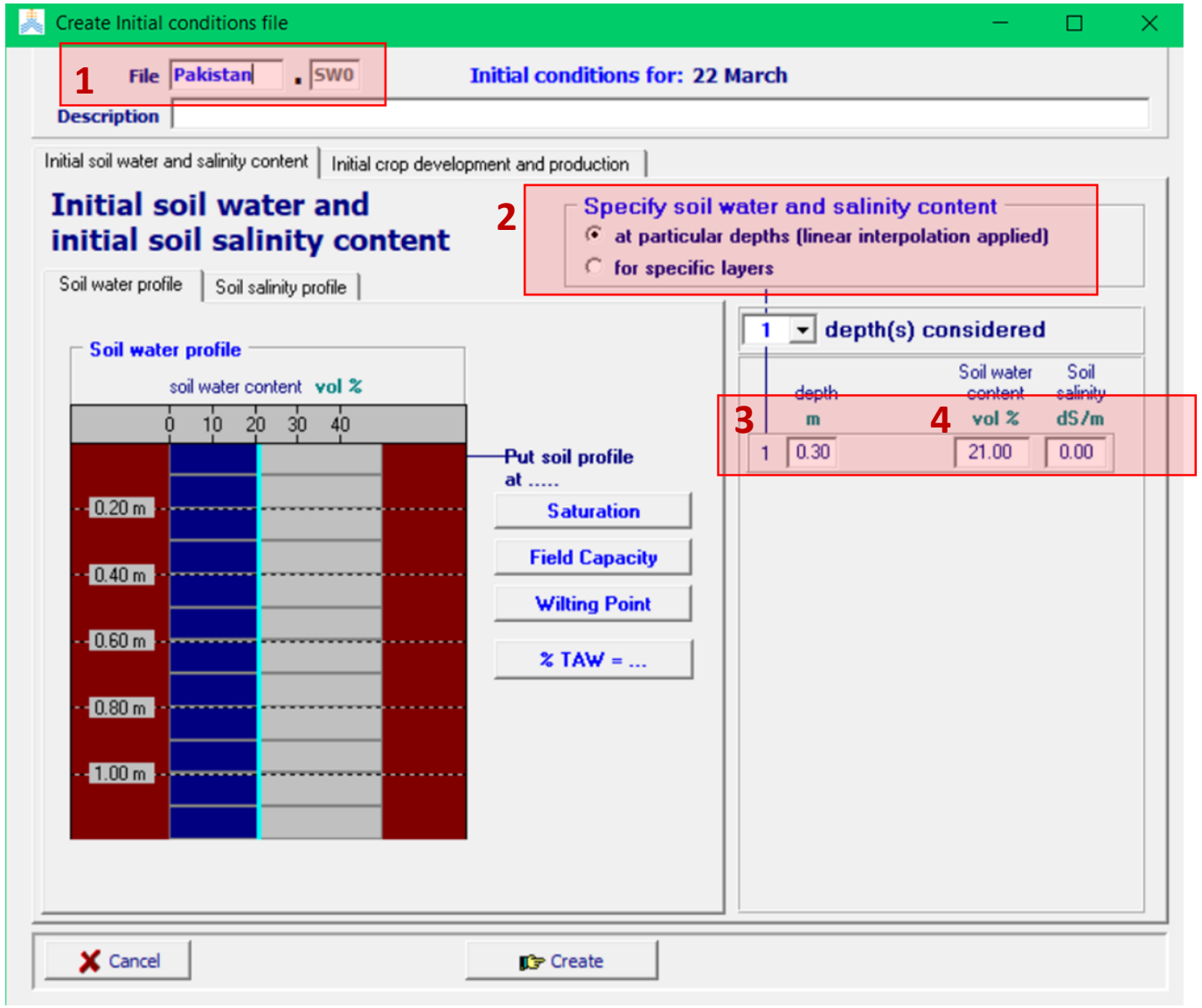
Steps 1-2: Click on **Initial conditions** and on **Select/Create Initial condition file**



Steps 3: Click on **Create Initial condition file**



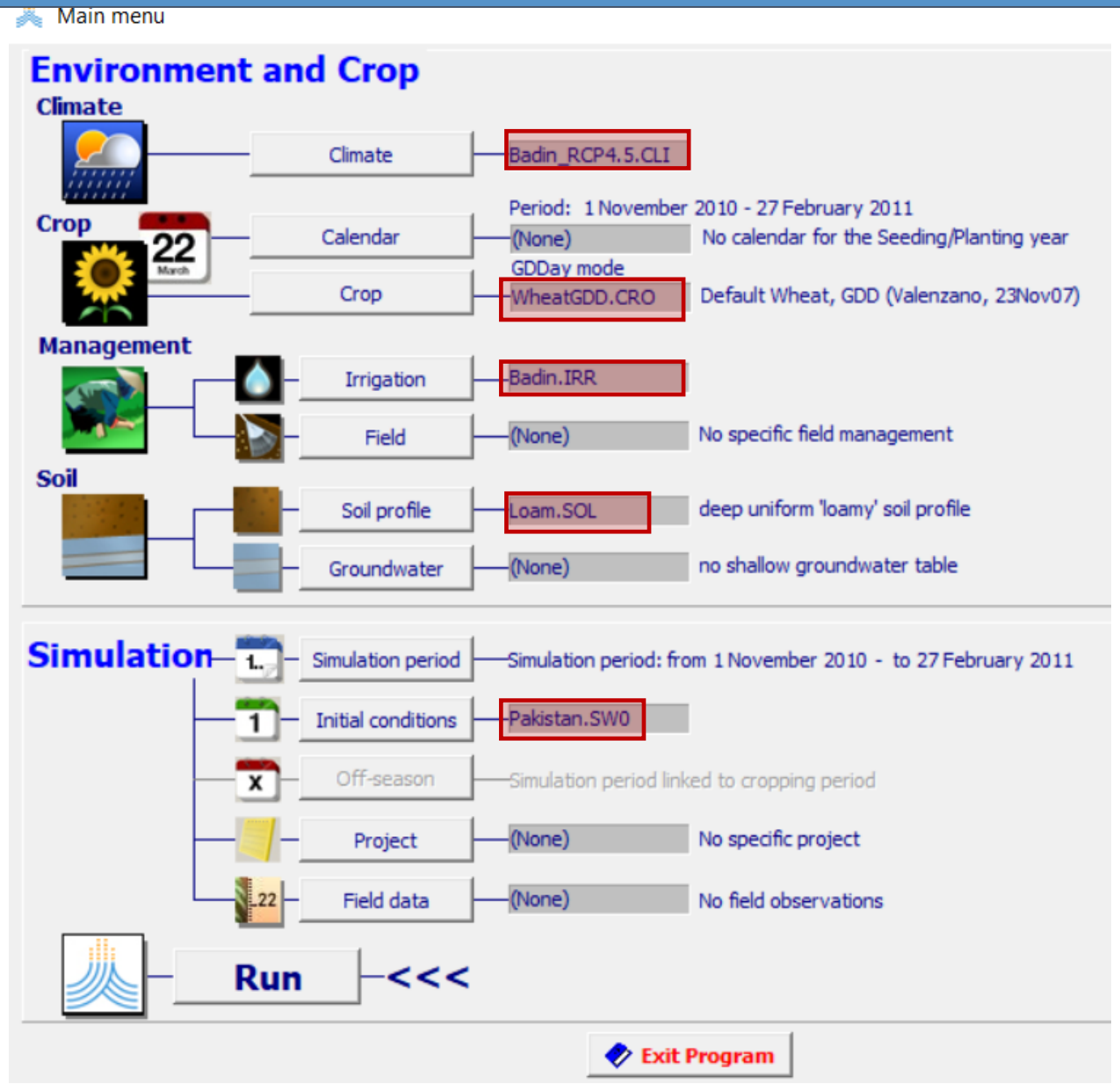
Soil water initial condition: create a SW0 file



Step 1: Name the file **Pakistan**
Step 2: Click on **At particular depths**
Step 3: Specify **0.30** under depth (m)
Step 4: Specify **21.0** under Soil water content (vol%)"

SIMULATIONS

Status: progress made so far



We now have:

-Climatic file: **Badin_RCP45**

-Calendar date: **1st November**

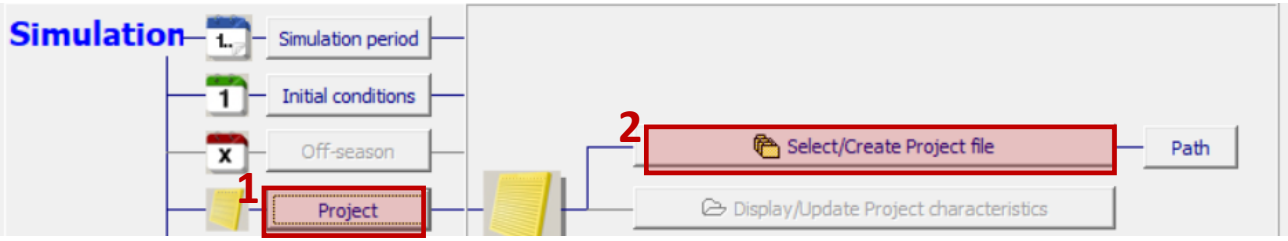
-Crop file: **Wheat_Pakistan**

-Irrigation file: **Badin**

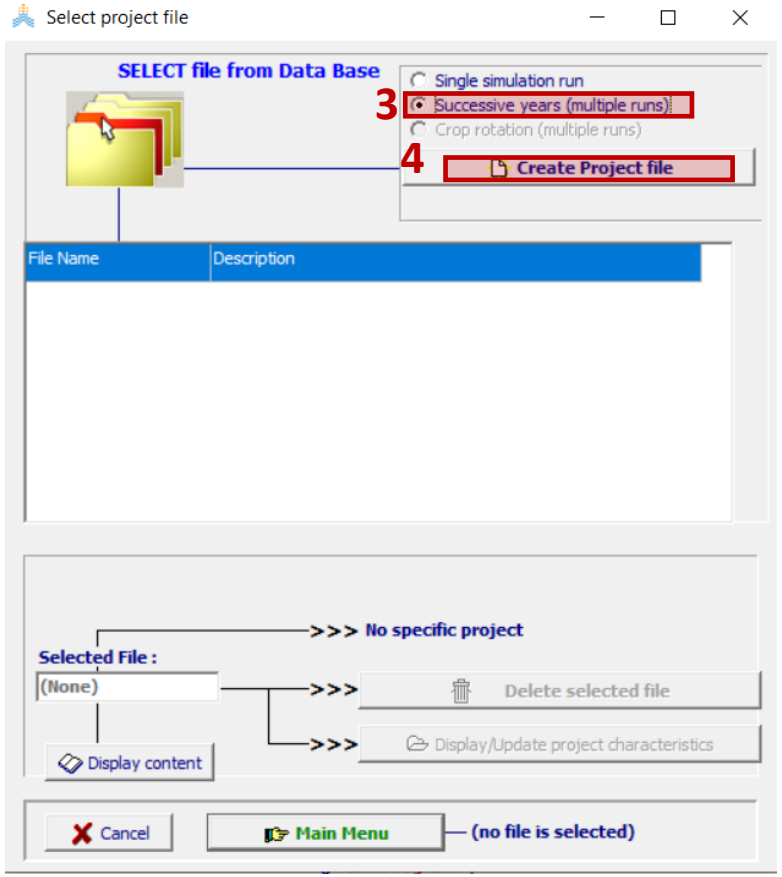
-soil profile file: **Loam**

-soil water condition: **Pakistan**

Project file for multiple years

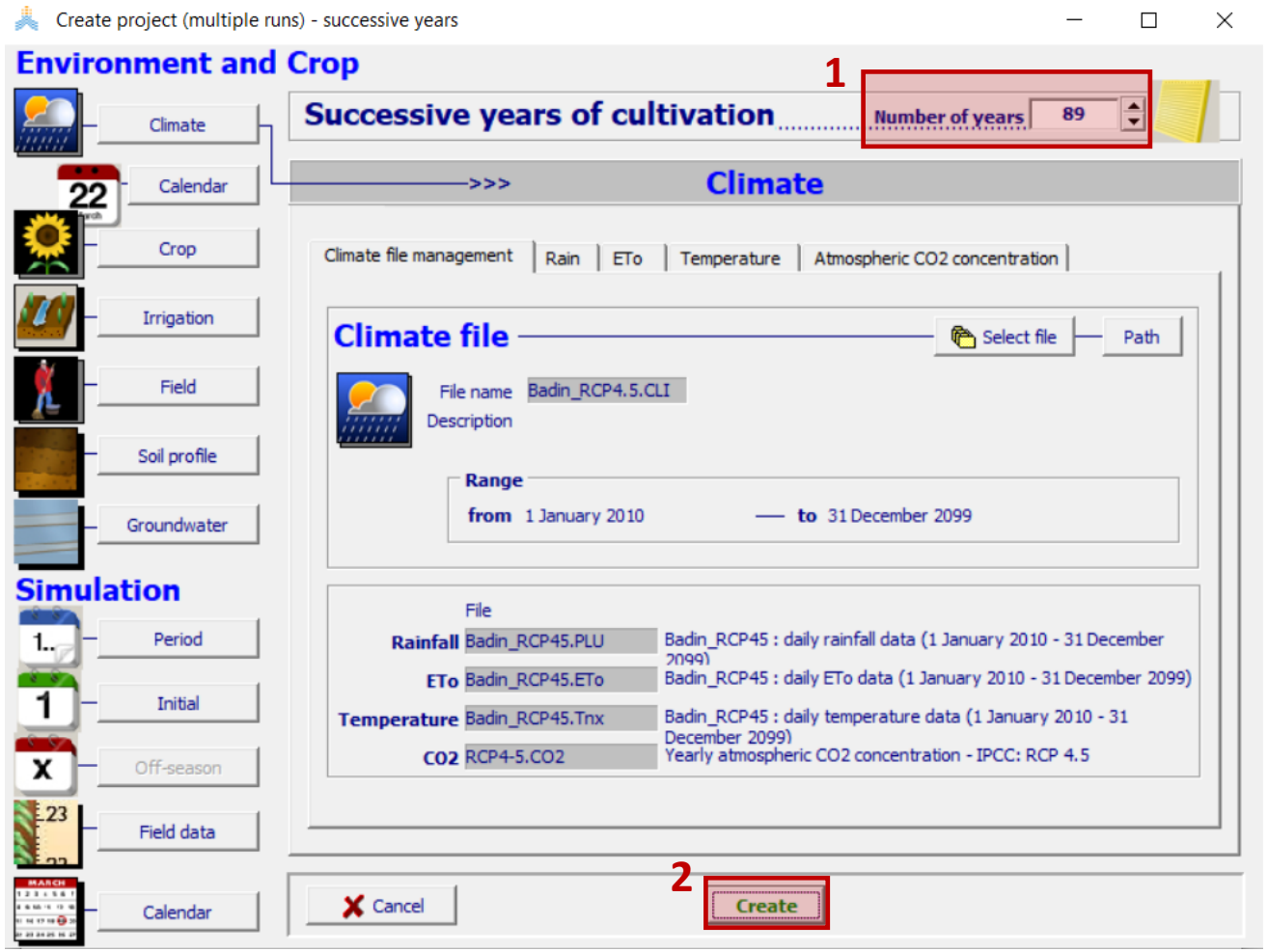


Steps 1-2: Click on **Project** and on **Select/Create Project File**



Steps 3-4: Click on **Successive years (multiple runs)** and on **Create Project File**

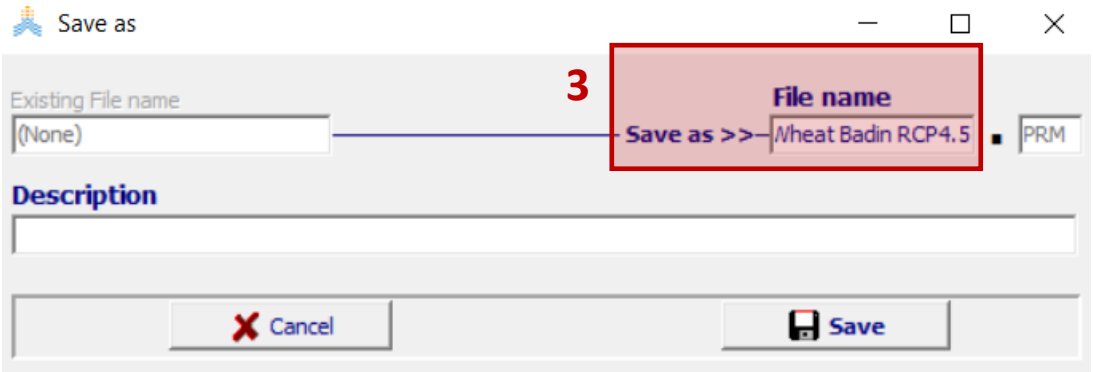
Project file for multiple years



Step 1: Make sure number of years is set as 89 (2010-2099)

Step 2: Click on **Create**

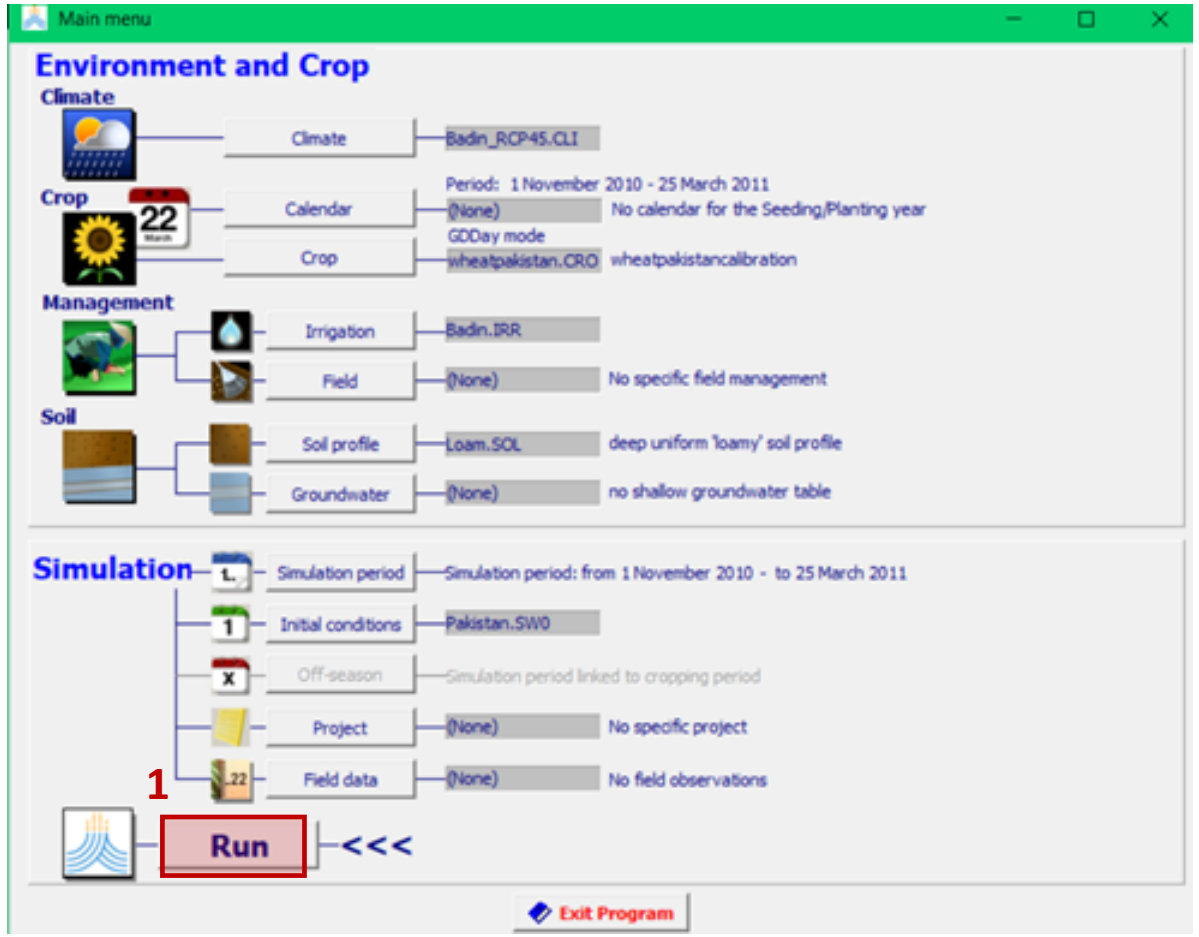
Step 3: Save as **Wheat Badin RCP 4.5**

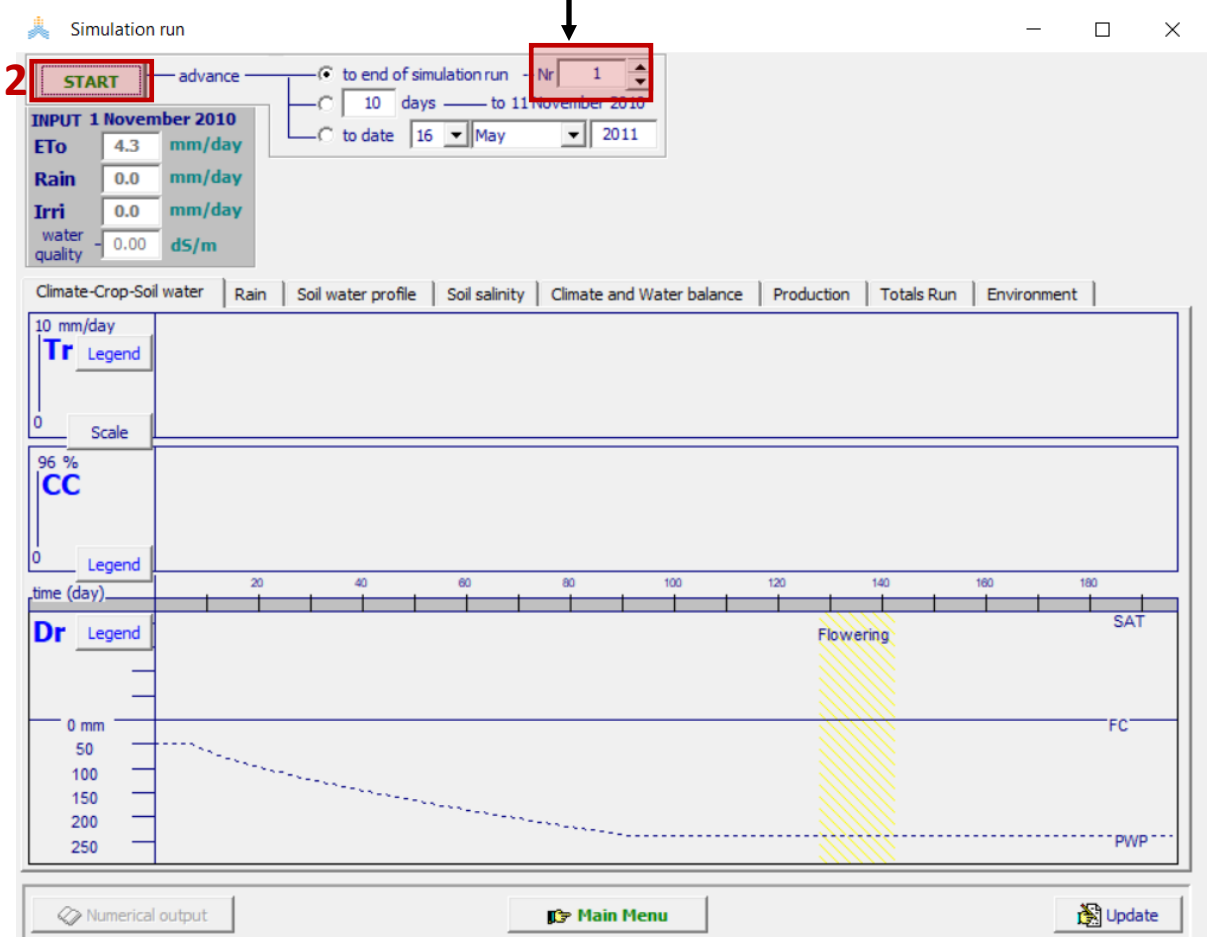


Run the Simulations

Steps 1-2: Click on **Run** and then click on **START**

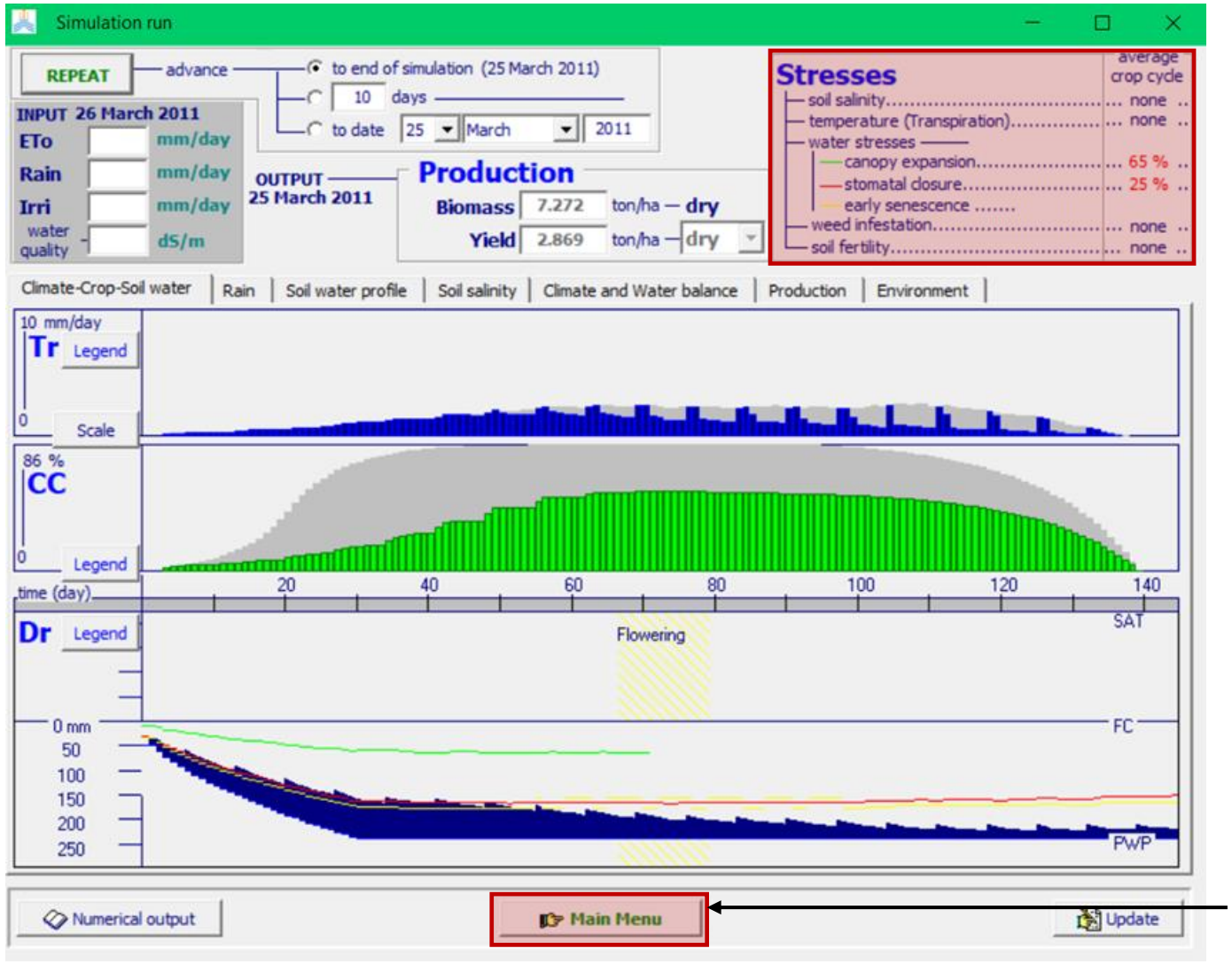
Nr 1 corresponds to the year 2010-2011





Results visualization

In this section, we will look at the yield results emerging for Badin in 2010/2011, particularly water and temperature stresses

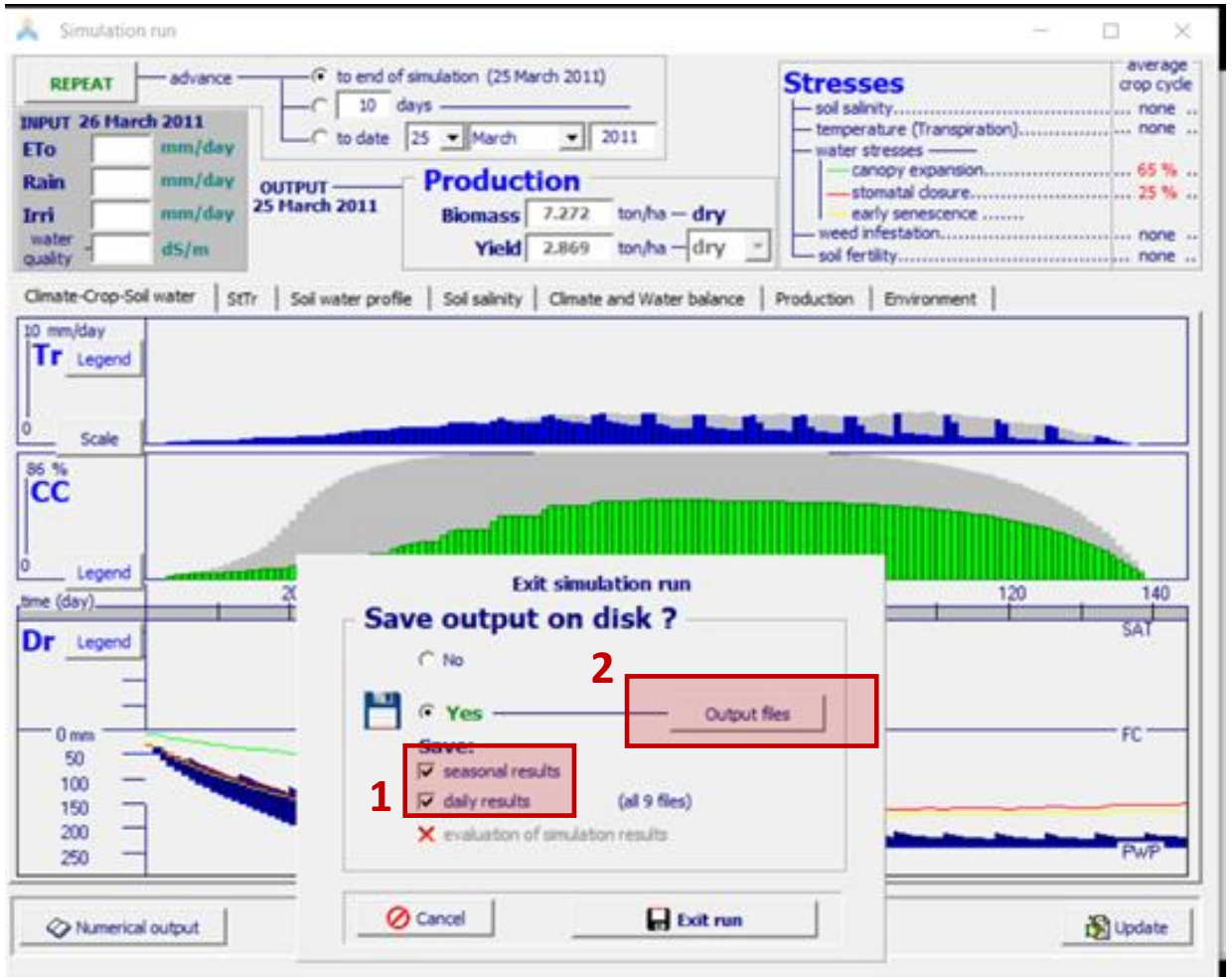


Step 1. Click on **Main Menu** to save the results

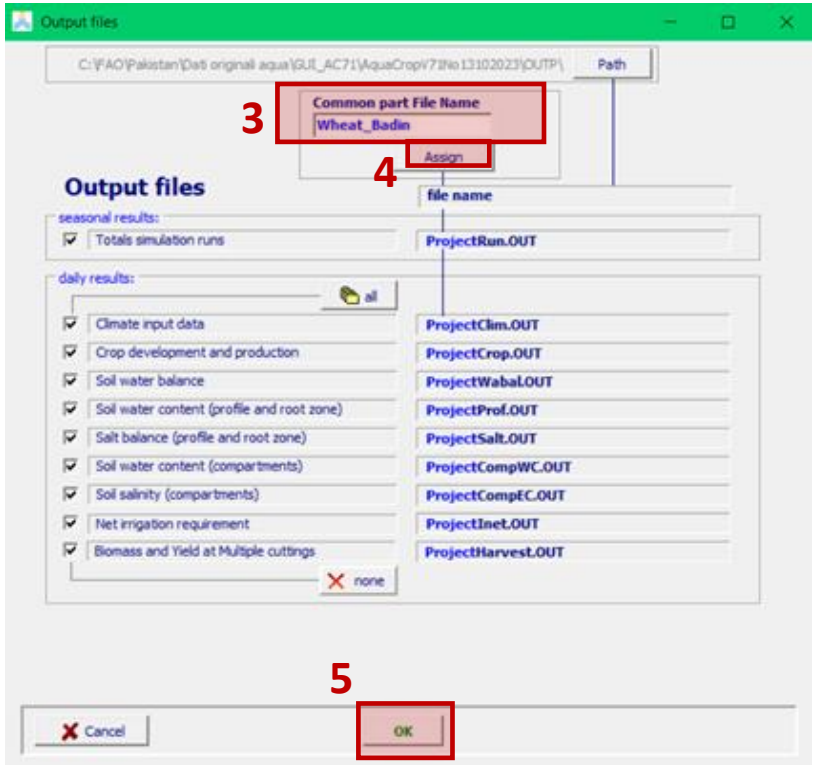
Save the simulation results

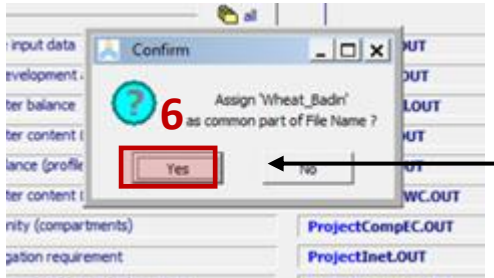
Step 1. Click on **Yes** (make sure that seasonal and daily results are ticked).

Step 2. Click on **Output files**



Steps 3-5: Under **Common part File Name** save the file as **"Wheat_Badin"** (make sure that all the output files are ticked) and then click on **Assign** and **OK**





Step 6: Click on **Yes**

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Crop Module 4
Creating/Running files for multiple years

Jorge Alvar-Beltrán

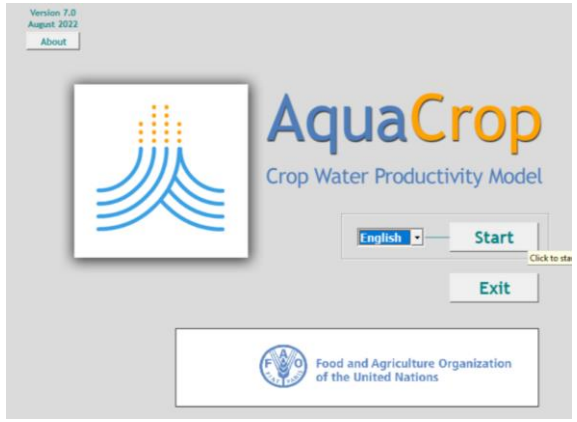
(2023)

RUNNING PRM FILES ON AQUACROP PLUGIN

Objective

- Create project files to run simulations for multiple years (2010-2099).

- You will use the plug-in to run simulations for wheat in two locations (Multan and Badin) under 2 RCPs scenarios (RCP 4.5 and 8.5) for the 2010-2099 period.



Project files
(.PRMs or .PROs)

Output files (daily or seasonal)

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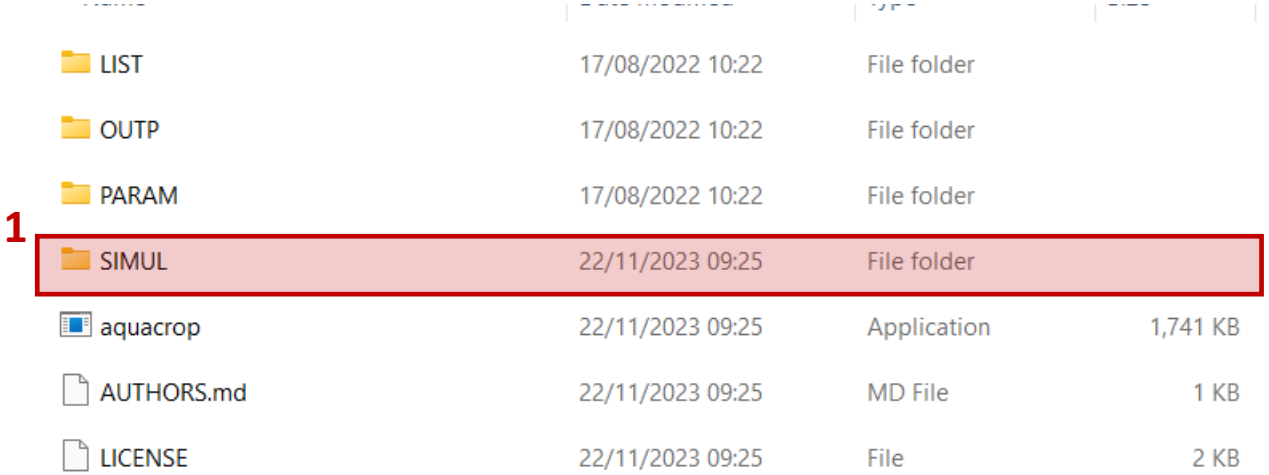
Instruction-AquaCrop plug-in

Step 1: Paste this file into AquaCrop plug-in, folder **SIMUL**



Project file scheme

Crop_Location_SowingDate_Irrigation_RCP

- Wheat_Badin_1Nov_7d11mm_45
- Wheat_Badin_1Nov_7d11mm_85

- Wheat_Multan_1Nov_7d13mm_45
- Wheat_Multan_1Nov_7d13mm_85

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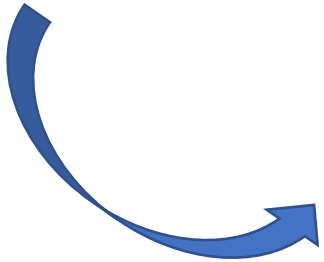
Copy paste raw datasets

Step 1: Download the DATA folder from here (https://www.dropbox.com/scl/fo/c8vmi4zoe023ikajzobkh/h?rlkey=gz3i2gl7ux5yxcms6yvjuokzf&dl=0)

Step 2: Copy and paste the DATA folder content to your personal DATA folder



CTRL + C and CTRL + V

Personal DATA folder

OS (C:) › FAO › Pakistan › GUI_AC71 › AquaCropV71No13102023 › DATA

Nome	Ultima modifica	Tipo	Dimensione
1stNov.CAL	20/11/2023 15:26	File CAL	1 KB
Badin_RCP45.CLI	29/11/2023 10:56	File CLI	1 KB
Badin_RCP85.CLI	29/11/2023 10:57	File CLI	1 KB
Multan_RCP45.CLI	29/11/2023 10:58	File CLI	1 KB
Multan_RCP85.CLI	29/11/2023 10:59	File CLI	1 KB
RCP4-5.CO2	21/10/2022 16:02	File CO2	3 KB
RCP8-5.CO2	21/10/2022 16:02	File CO2	3 KB
wheatpakistan.CRO	24/11/2023 15:17	File CRO	7 KB
Badin_7d11mm.IRR	01/12/2023 17:55	File IRR	1 KB
Multan_7d13mm.IRR	01/12/2023 17:58	File IRR	1 KB
Bad85.PLU	08/11/2023 12:41	File PLU	386 KB
Badin_RCP45.PLU	20/11/2023 18:14	File PLU	386 KB
Multan_RCP45.PLU	21/11/2023 17:26	File PLU	386 KB
Multan_RCP85.PLU	21/11/2023 17:28	File PLU	386 KB
ClayLoam_Multan.SOL	21/11/2023 17:33	File SOL	1 KB
Loam_Badin.SOL	20/11/2023 18:43	File SOL	1 KB
Pakistan.SW0	24/11/2023 14:28	File SW0	1 KB
Bad85.Tnx	08/11/2023 12:41	File TNX	707 KB
Badin_RCP45.Tnx	20/11/2023 18:14	File TNX	707 KB
Multan_RCP45.Tnx	21/11/2023 17:26	File TNX	707 KB
Multan_RCP85.Tnx	21/11/2023 17:28	File TNX	707 KB
Bad85.ETo	08/11/2023 12:41	WPS Spreadsheets...	386 KB
Badin_RCP45.ETo	20/11/2023 18:14	WPS Spreadsheets...	386 KB
Multan_RCP45.ETo	21/11/2023 17:26	WPS Spreadsheets...	386 KB
Multan_RCP85.ETo	21/11/2023 17:28	WPS Spreadsheets...	386 KB

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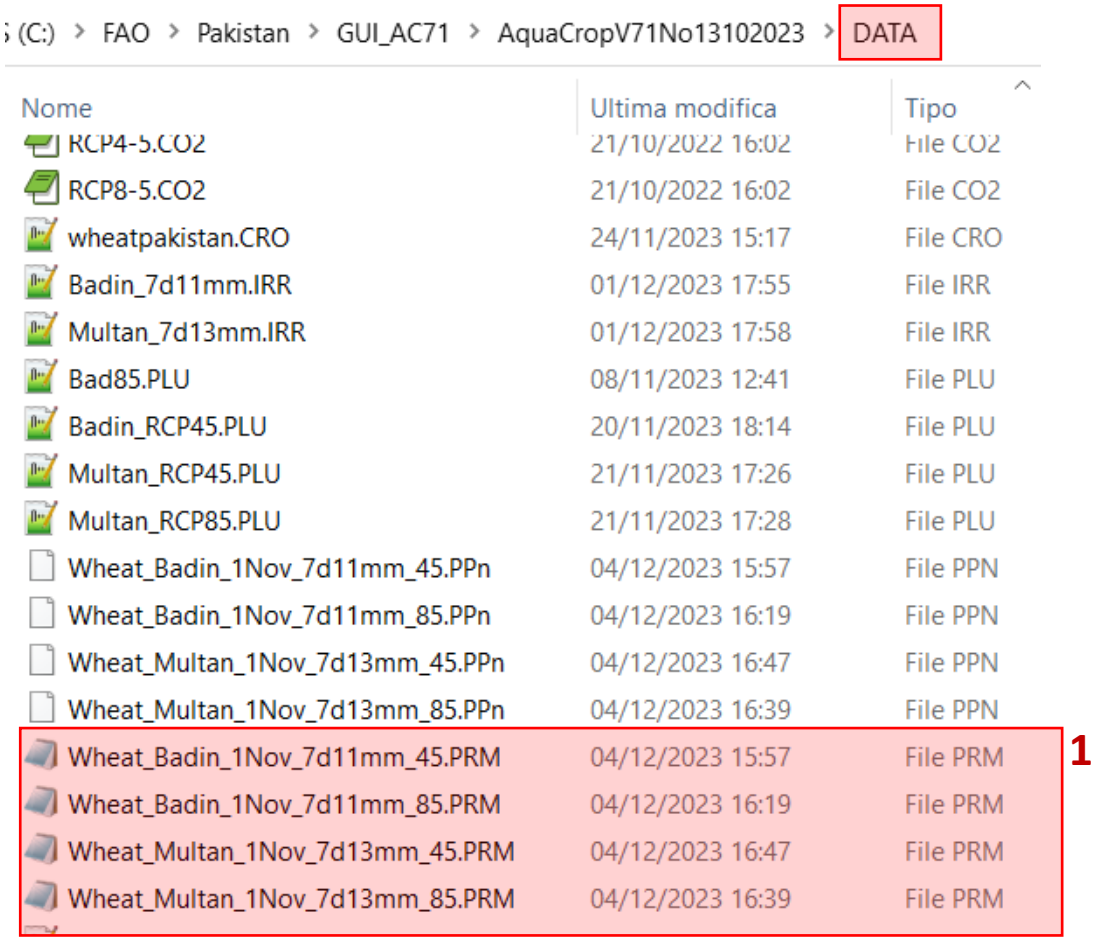
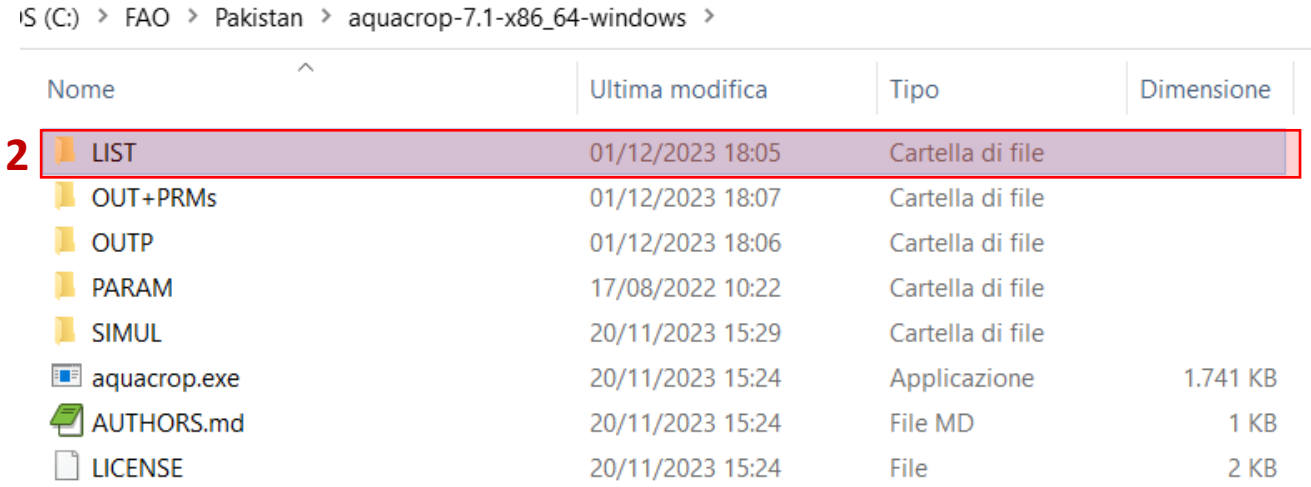
Copy paste PRM files

Step 1: Copy and **paste** the PRM files from the **DATA** folder of GUI_AC71 to the **LIST** folder of the PLUGIN

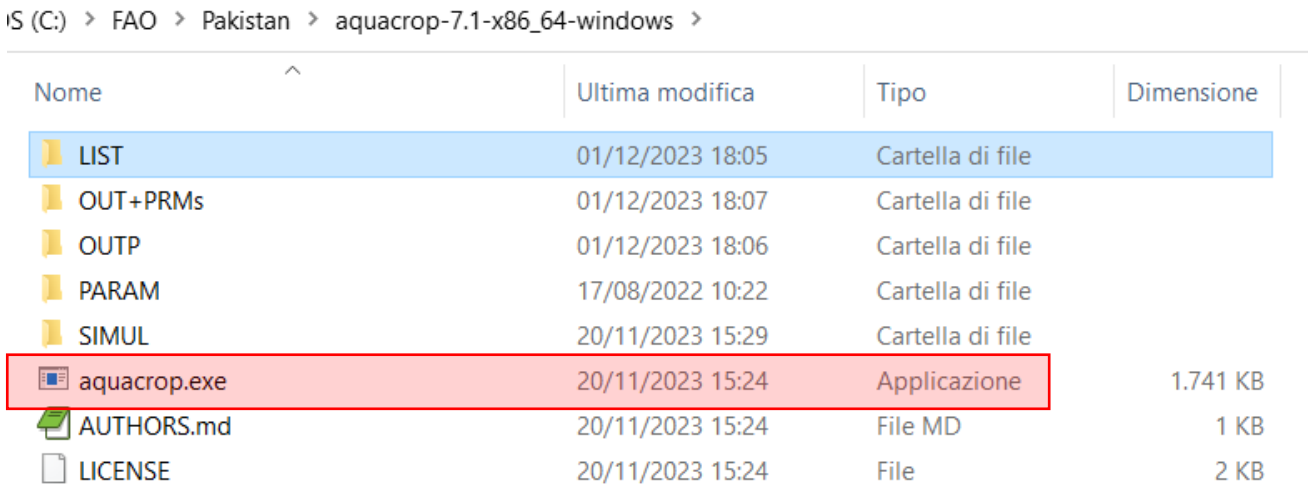




Execute the Plugin

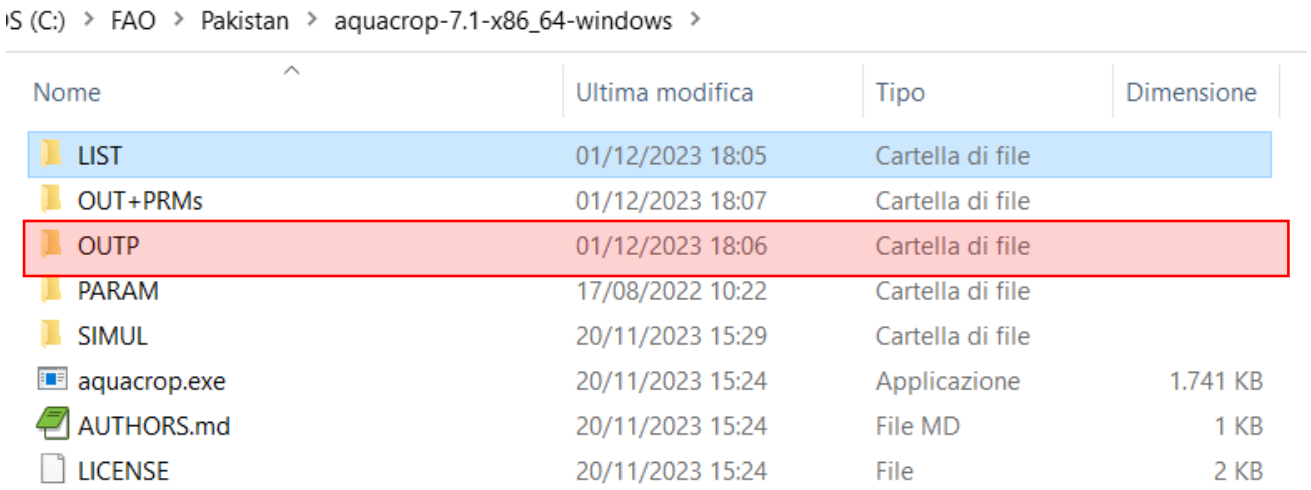
Step 1: Double click on the .exe file to run the plugin

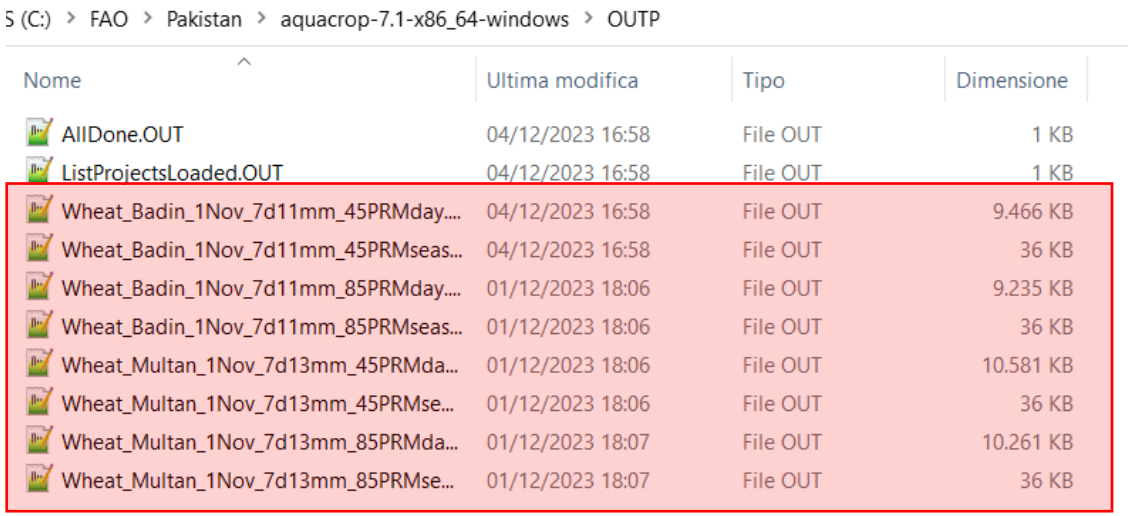
The plugin does not have an interface, wait until this black window closes.



Use of the Plugin

You can now find the OUTPUT data in the OUT folder: the plugin produces two OUT files per PRM: daily and seasonal files.



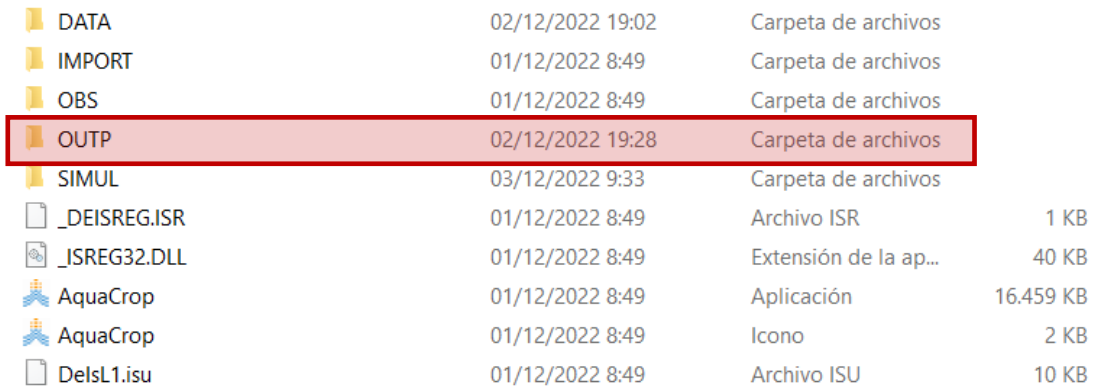


INTERPRETING AQUACROP OUTPUTS

Interpreting AquaCrop outputs: climate info.

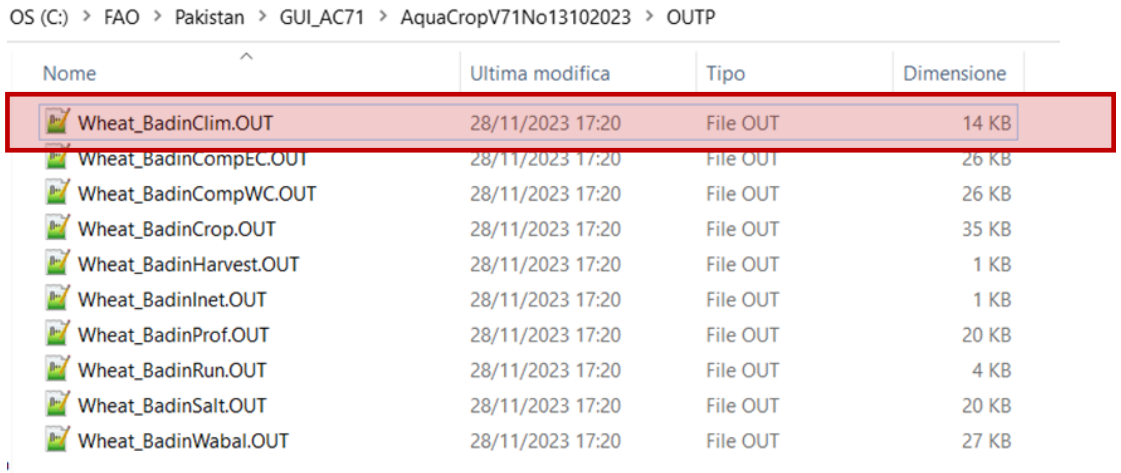
Step 1. Open **AquaCrop** desktop folders and click on **OUTP** (outputs)

1



DATA	02/12/2022 19:02	Carpeta de archivos	
IMPORT	01/12/2022 8:49	Carpeta de archivos	
OBS	01/12/2022 8:49	Carpeta de archivos	
OUTP	02/12/2022 19:28	Carpeta de archivos	
SIMUL	03/12/2022 9:33	Carpeta de archivos	
_DEISREG.ISR	01/12/2022 8:49	Archivo ISR	1 KB
_ISREG32.DLL	01/12/2022 8:49	Extensión de la ap...	40 KB
AquaCrop	01/12/2022 8:49	Aplicación	16.459 KB
AquaCrop	01/12/2022 8:49	Icono	2 KB
DeIsL1.isu	01/12/2022 8:49	Archivo ISU	10 KB

Step 2. Open the file **Wheat_Badin**



OS (C:) › FAO › Pakistan › GUI_AC71 › AquaCropV71No13102023 › OUTP

2

Nome	Ultima modifica	Tipo	Dimensione
Wheat_BadinClim.OUT	28/11/2023 17:20	File OUT	14 KB
Wheat_BadinCompEC.OUT	28/11/2023 17:20	File OUT	26 KB
Wheat_BadinCompWC.OUT	28/11/2023 17:20	File OUT	26 KB
Wheat_BadinCrop.OUT	28/11/2023 17:20	File OUT	35 KB
Wheat_BadinHarvest.OUT	28/11/2023 17:20	File OUT	1 KB
Wheat_BadinInet.OUT	28/11/2023 17:20	File OUT	1 KB
Wheat_BadinProf.OUT	28/11/2023 17:20	File OUT	20 KB
Wheat_BadinRun.OUT	28/11/2023 17:20	File OUT	4 KB
Wheat_BadinSalt.OUT	28/11/2023 17:20	File OUT	20 KB
Wheat_BadinWabal.OUT	28/11/2023 17:20	File OUT	27 KB

Step 3. Visualize the **climatic** outputs

3

AquaCrop 7.1 (August 2023) - Output created on (date) : 28/11/2023 at (time) : 17:20:34
Climate input data

** Run number: 1

Day	Month	Year	DAP	Stage	Rain mm	ETo mm	Tmin °C	Tavg °C	Tmax °C	CO2 ppm
1	11	2010	1	1	0.0	4.3	21.6	28.4	35.1	390.74
2	11	2010	2	1	0.0	4.2	20.0	26.9	33.9	390.74
3	11	2010	3	1	0.0	4.1	18.7	25.8	32.8	390.74
4	11	2010	4	1	0.0	4.0	17.6	24.8	32.0	390.74
5	11	2010	5	2	0.0	4.1	17.5	25.0	32.5	390.74
6	11	2010	6	2	0.0	4.2	17.7	25.4	33.1	390.74
7	11	2010	7	2	0.0	4.2	17.9	25.6	33.4	390.74
8	11	2010	8	2	0.0	4.1	17.9	25.4	33.0	390.74
9	11	2010	9	2	0.0	4.0	18.4	25.6	32.9	390.74
10	11	2010	10	2	0.0	3.9	18.5	25.6	32.6	390.74
11	11	2010	11	2	0.0	3.8	18.6	25.4	32.3	390.74
12	11	2010	12	2	0.0	3.8	19.0	25.8	32.6	390.74
13	11	2010	13	2	0.0	3.8	18.3	25.3	32.2	390.74

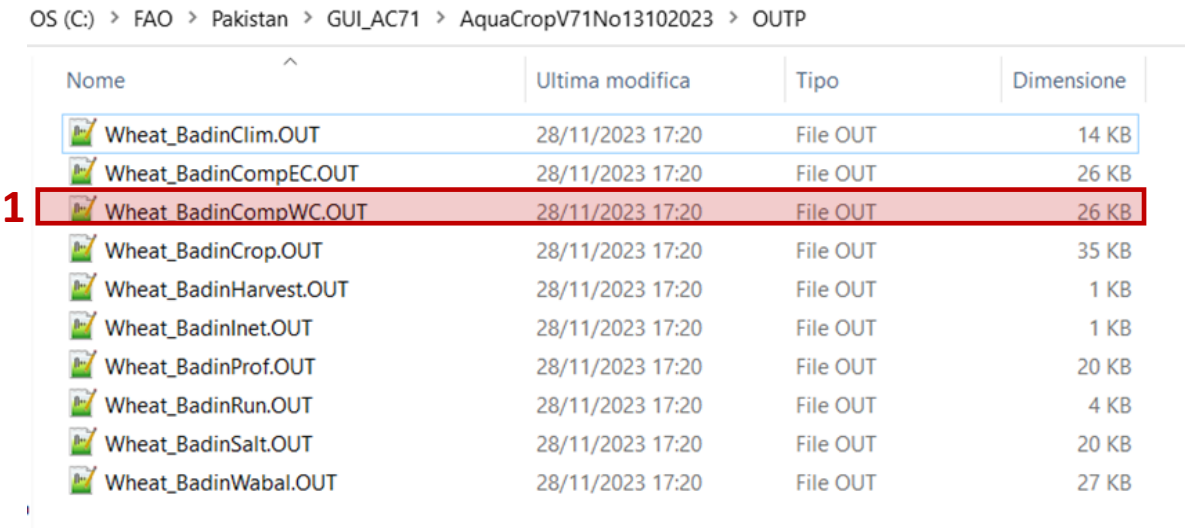
Legend

```
DAP          : Days after planting
Stage        : 0: before/after planting
Stage        : 1: emergence or transplant recovery
Stage        : 2: vegetative stage
Stage        : 3: flowering
Stage        : 4: yield formation and ripening
Rain         : Rainfall
ETo          : Reference evapotranspiration
Tmin         : Minimum air temperature
Tavg         : Average air temperature
Tmax         : Maximum air temperature
CO2          : Atmospheric CO2 concentration
```

At the bottom of the txt. file you will find the legend!

Interpreting AquaCrop outputs: soil water content

Step 1. Open the file **Wheat_BadinCompWC**



At the bottom of the txt. file you will find the legend for each variable!

```
Legend

DAP          : Days after planting
Stage        : 0: before/after planting
Stage        : 1: emergence or transplant recovery
Stage        : 2: vegetative stage
Stage        : 3: flowering
Stage        : 4: yield formation and ripening
```

Step 2. Visualize the **water content** outputs

2

** Run number: 1

				at depth (m):	0.05	0.15	0.25	0.35	0.45	0.55	0.67	0.82	0.97
Day	Month	Year	DAP	Stage	WC1(vol%)	WC2(vol%)	WC3(vol%)	WC4(vol%)	WC5(vol%)	WC6(vol%)	WC7(vol%)	WC8(vol%)	WC9(vol%)
1	11	2010	1	1	19.4	21.0	21.0	21.0	21.0	21.0	21.0	21.0	21.0
2	11	2010	2	1	18.1	21.0	21.0	21.0	21.0	21.0	21.0	21.0	21.0
3	11	2010	3	1	17.1	21.0	21.0	21.0	21.0	21.0	21.0	21.0	21.0
4	11	2010	4	1	16.1	21.0	21.0	21.0	21.0	21.0	21.0	21.0	21.0
5	11	2010	5	2	15.1	21.0	21.0	21.0	21.0	21.0	21.0	21.0	21.0
6	11	2010	6	2	14.5	20.7	21.0	21.0	21.0	21.0	21.0	21.0	21.0
7	11	2010	7	2	21.7	20.7	21.0	21.0	21.0	21.0	21.0	21.0	21.0
8	11	2010	8	2	18.2	20.7	21.0	21.0	21.0	21.0	21.0	21.0	21.0
9	11	2010	9	2	17.1	20.7	21.0	21.0	21.0	21.0	21.0	21.0	21.0

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Interpreting AquaCrop outputs: crop info.

Step 1. Open the file **Wheat_BadinCrop**

At the bottom of the txt. file you will find the legend for each variable!

OS (C:) › FAO › Pakistan › GUI_AC71 › AquaCropV71No13102023 › OUTP

	Nome	Ultima modifica	Tipo	Dimensione
	Wheat_BadinClim.OUT	28/11/2023 17:20	File OUT	14 KB
	Wheat_BadinCompEC.OUT	28/11/2023 17:20	File OUT	26 KB
	Wheat_BadinCompWC.OUT	28/11/2023 17:20	File OUT	26 KB
1	Wheat_BadinCrop.OUT	28/11/2023 17:20	File OUT	35 KB
	Wheat_BadinHarvest.OUT	28/11/2023 17:20	File OUT	1 KB
	Wheat_BadinInet.OUT	28/11/2023 17:20	File OUT	1 KB
	Wheat_BadinProf.OUT	28/11/2023 17:20	File OUT	20 KB
	Wheat_BadinRun.OUT	28/11/2023 17:20	File OUT	4 KB
	Wheat_BadinSalt.OUT	28/11/2023 17:20	File OUT	20 KB
	Wheat_BadinWabal.OUT	28/11/2023 17:20	File OUT	27 KB

```
Legend

DAP          : Days after planting
Stage        : 0: before/after planting
Stage        : 1: emergence or transplant recovery
Stage        : 2: vegetative stage
Stage        : 3: flowering
Stage        : 4: yield formation and ripening
GD           : Growing degrees
Z            : Effective rooting depth
StExp        : Percent water stress reducing leaf expansion
StSto        : Percent water stress inducing stomatal closure
StSen        : Percent water stress triggering early canopy senescence
StSalt       : Percent salinity stress
StWeed       : Relative cover of weeds
CC           : Green total Canopy Cover of crop and weeds
CCw          : Green crop Canopy Cover in weed infested field
StTr         : Percent temperature stress affecting crop transpiration
Kc(Tr)       : Crop coefficient for transpiration
Trx          : Maximum total transpiration of crop and weeds
```

Step 2. Visualize the **stress** and **canopy development** outputs

2

Crop development and production

** Run number: 1

Day	Month	Year	DAP	Stage	GD °C-day	Z m	StExp %	StSto %	StSen %	StSalt %	StWeed %	CC %	CCw %	StTr %	Kc(Tr) -	Trx mm	Tr mm	TrW mm
1	11	2010	1	1	23.0	0.30	-9	-9	-9	0	-9	0.0	0.0	0	-9.00	0.0	0.0	0.0
2	11	2010	2	1	23.0	0.30	-9	-9	-9	0	-9	0.0	0.0	0	-9.00	0.0	0.0	0.0
3	11	2010	3	1	22.4	0.39	-9	-9	-9	0	-9	0.0	0.0	0	-9.00	0.0	0.0	0.0
4	11	2010	4	1	21.8	0.46	-9	4	0	0	0	3.4	3.4	0	0.06	0.3	0.2	0.2
5	11	2010	5	2	21.8	0.53	-9	6	0	0	0	4.0	4.0	0	0.07	0.3	0.3	0.3
6	11	2010	6	2	21.9	0.58	100	8	0	0	0	4.0	4.0	0	0.07	0.3	0.3	0.3
7	11	2010	7	2	21.9	0.63	2	0	0	0	0	4.6	4.6	0	0.08	0.4	0.4	0.4
8	11	2010	8	2	21.9	0.68	35	0	0	0	0	5.0	5.0	0	0.09	0.4	0.4	0.4
9	11	2010	9	2	22.2	0.73	76	0	0	0	0	5.2	5.2	0	0.09	0.4	0.4	0.4
10	11	2010	10	2	22.3	0.78	81	0	0	0	0	5.3	5.3	0	0.10	0.4	0.4	0.4

Interpreting AquaCrop outputs: crop info.

Step 3. Continue visualizing **crop production** outputs

3

Tr/Trx %	WP g/m2	Biomass ton/ha	HI %	Y(dry) ton/ha	Y(fresh) ton/ha	Brelative %	WPet kg/m3	Bin ton/ha	Bout ton/ha
100	15.8	0.000	-9.9	0.000	-9.000	-9	0.00	0.000	0.000
100	15.8	0.000	-9.9	0.000	-9.000	-9	0.00	0.000	0.000
100	15.8	0.000	-9.9	0.000	-9.000	-9	0.00	0.000	0.000
96	15.8	0.010	-9.9	0.000	-9.000	96	0.00	0.000	0.000
94	15.8	0.020	-9.9	0.000	-9.000	95	0.00	0.000	0.000
92	15.8	0.031	-9.9	0.000	-9.000	89	0.00	0.000	0.000
100	15.8	0.044	-9.9	0.000	-9.000	88	0.00	0.000	0.000
100	15.8	0.059	-9.9	0.000	-9.000	87	0.00	0.000	0.000
100	15.8	0.074	-9.9	0.000	-9.000	84	0.00	0.000	0.000
100	15.8	0.089	-9.9	0.000	-9.000	80	0.00	0.000	0.000

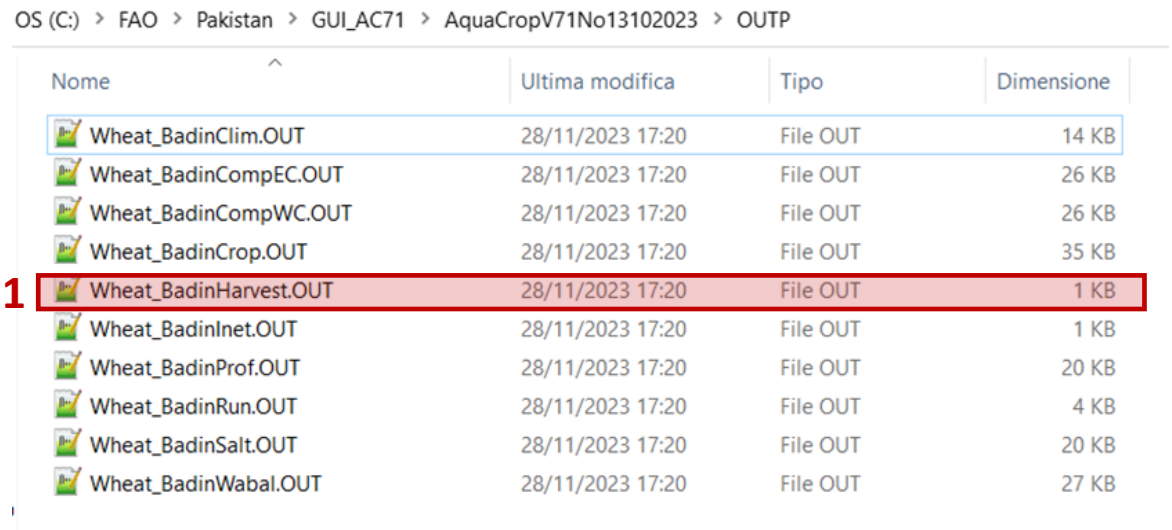
Legend

```
Trx          : Maximum total transpiration of crop and weeds
Tr           : Total transpiration of crop and weeds
TrW          : Crop transpiration in weed infested field
Tr/Trx       : Relative total transpiration of crop and weeds (100 Tr/Trx)
WP           : Crop water productivity adjusted for CO2, soil fertility and products synthesized
Biomass      : Total above-ground dry biomass
HI           : Harvest Index adjusted for failure of pollination, inadequate photosynthesis and water stress
Y(dry)       : Dry crop yield (HI x Biomass)
Y(fresh)     : Fresh crop yield
Brelative    : Relative biomass (Reference: no water, no soil fertility, no soil salinity stress, no weed infestation)
WPet         : ET Water productivity for yield part (kg yield produced per m3 water evapotranspired)
Bin          : Daily mass of assimilates mobilized from root system at start of season
Bout         : Daily mass of assimilates stored in root system at end of season
```

At the bottom of the txt. file you will find the legend for each variable!

Interpreting AquaCrop outputs: harvest info.

Step 1. Open the file **Wheat_BadinHarvest**



Step 2. Visualize values at **harvest** (dry yield and biomass)

```
Biomass and Yield at Multiple cuttings

** Run number:  1
    Nr    Day  Month Year    DAP Interval   Biomass     Sum(B)    Dry-Yield  Sum(Y) Fresh-Yield  Sum(Y)
                                    days     ton/ha     ton/ha     ton/ha     ton/ha    ton/ha     ton/ha
     0      1     11  2010                              0.000                 0.000
  9999     26      3  2011                              7.272                 2.869

Legend

DAP           : Days after planting
Interval      : Number of days between events
Nr = 0        : At start of season
Nr = 1 to n   : Harvest event
Nr = 9999     : At end of season
```

At the bottom of the txt. file you will find the legend for each variable!

Food and Agriculture Organization of the United Nations

Interpreting AquaCrop outputs: water balance info.

Step 1. Open the file **Wheat_BadinWbal**

OS (C:) › FAO › Pakistan › GUI_AC71 › AquaCropV71No13102023 › OUTP

Nome	Ultima modifica	Tipo	Dimensione
Wheat_BadinClim.OUT	28/11/2023 17:20	File OUT	14 KB
Wheat_BadinCompEC.OUT	28/11/2023 17:20	File OUT	26 KB
Wheat_BadinCompWC.OUT	28/11/2023 17:20	File OUT	26 KB
Wheat_BadinCrop.OUT	28/11/2023 17:20	File OUT	35 KB
Wheat_BadinHarvest.OUT	28/11/2023 17:20	File OUT	1 KB
Wheat_BadinInet.OUT	28/11/2023 17:20	File OUT	1 KB
Wheat_BadinProf.OUT	28/11/2023 17:20	File OUT	20 KB
Wheat_BadinRun.OUT	28/11/2023 17:20	File OUT	4 KB
Wheat_BadinSalt.OUT	28/11/2023 17:20	File OUT	20 KB
Wheat_BadinWabal.OUT	28/11/2023 17:20	File OUT	27 KB

1

```
Legend

DAP         : Days after planting
Stage       : 0: before/after planting
Stage       : 1: emergence or transplant recovery
Stage       : 2: vegetative stage
Stage       : 3: flowering
Stage       : 4: yield formation and ripening
WCTot       : Water content in total soil profile
Rain        : Rainfall
Irri        : Water applied by irrigation
Surf        : Stored water on soil surface between bunds
Infilt      : Infiltrated water in soil profile
RO          : Surface runoff
Drain       : Water drained out of the soil profile
CR          : Water moved upward by capillary rise
Zgwt        : Depth of the groundwater table (-9.90 if absent)
Ex          : Maximum soil evaporation
E           : Soil evaporation
E/Ex        : Relative soil evaporation (100 E/Ex)
Trx         : Maximum crop transpiration
Tr          : Total transpiration of crop and weeds
Tr/Trx      : Relative transpiration (100 Tr/Trx)
ETx         : Evapotranspiration maximale
ET          : Evapotranspiration
ET/ETx      : Evapotranspiration relative (100 ET/ETx)
```

At the bottom of the txt. file you will find the legend for each variable!

2

```
Soil Water balance

** Run number:  1
   Day Month  Year   DAP Stage    WCTot    Rain    Irri    Surf   Infilt      RO   Drain      CR    Zgwt      Ex       E     E/Ex     Trx
                                      mm      mm      mm      mm      mm      mm      mm      mm       m      mm      mm       %      mm
     1    11  2010     1     1   323.9     0.0     0.0     0.0     0.0     0.0     0.0     0.0   -9.90     4.7     1.6      34     0.0
     2    11  2010     2     1   322.6     0.0     0.0     0.0     0.0     0.0     0.0     0.0   -9.90     4.6     1.3      27     0.0
     3    11  2010     3     1   321.6     0.0     0.0     0.0     0.0     0.0     0.0     0.0   -9.90     4.5     1.0      23     0.0
     4    11  2010     4     1   320.6     0.0     0.0     0.0     0.0     0.0     0.0     0.0   -9.90     4.1     0.8      19     0.3
     5    11  2010     5     2   319.6     0.0     0.0     0.0     0.0     0.0     0.0     0.0   -9.90     4.2     0.7      16     0.3
     6    11  2010     6     2   318.7     0.0     0.0     0.0     0.0     0.0     0.0     0.0   -9.90     4.3     0.6      14     0.3
     7    11  2010     7     2   325.9     0.0    11.0     0.0    11.0     0.0     0.0     0.0   -9.90     3.4     3.4     100     0.4
     8    11  2010     8     2   322.4     0.0     0.0     0.0     0.0     0.0     0.0     0.0   -9.90     3.4     3.1      92     0.4
     9    11  2010     9     2   321.3     0.0     0.0     0.0     0.0     0.0     0.0     0.0   -9.90     3.2     0.7      23     0.4
    10    11  2010    10     2   320.3     0.0     0.0     0.0     0.0     0.0     0.0     0.0   -9.90     3.1     0.6      19     0.4
    11    11  2010    11     2   319.5     0.0     0.0     0.0     0.0     0.0     0.0     0.0   -9.90     3.0     0.5      16     0.4
    12    11  2010    12     2   318.6     0.0     0.0     0.0     0.0     0.0     0.0     0.0   -9.90     3.0     0.4      14     0.4
```

CALIBRATION AND VALIDATION OF AQUACROP OUTPUTS

Food and Agriculture Organization of the United Nations

Calibration and validation of AquaCrop model

- The calibration and validation is a critical step towards achieving meaningful modelling outputs.
- **5 to 10 years** of historical yield data (for a specific location) are necessary to compare observed and simulated yields values.
- To test the performance of the AquaCrop model against observed values in the field, different statistical indicators are used.
- For example, while the **root-mean square error** (RMSE, Eq. 1) is useful for testing the differences between predicted and observed values, the **normalized-RMSE** (NRMSE, Eq. 2) provides relevant information about the average of the measured data ranges.
- AquaCrop findings are considered highly performant when the differences between observed and simulated NRMSE values **are below 5%,** and good when ranging between **6 to 15%.**
- **Willmott's index** of agreement (d, Eq. 3) provides a measure of the agreement of the deviation of modelled and observed values from the observed mean, where 0 indicates disagreement and 1 perfect agreement between simulated and observed values.

Calibration and validation of AquaCrop model

- RMSE = $\sqrt{\frac{1}{n}\sum_{i=1}^{n}(Oi - Pi)^2}$

- NRMSE = $(\frac{RMSE}{\hat{O}}) \times 100$

- d = $1 - \frac{\sum_{i=1}^{n}(Oi-Pi)^2}{\sum_{i=1}^{n}(P_i'+O_i')^2}$

Where O_i and P_i corresponds to the observed and simulated values, respectively, and n to the number of observations. While the RMSE has the same units as that of the variable being simulated (t/ha), NRMSE units are displayed as a percentage. In addition, $O'_i = [O_i - \hat{O}]$ and $P'_i = [P_i - \hat{P}]$ shows the differences between observed and simulated values, with $\hat{O}$ and $\hat{P}$ as the observed and simulated means, respectively.

Food and Agriculture Organization of the United Nations

Calibration and validation of AquaCrop model

Step 1. You first **calibrate** in one location (Badin)

CALIBRATION (Badin)

Here we introduce the observed values in the field and the simulated values from AquaCrop!

	Badin (SOUTH) -CALIBRATION									
	OBSERVED	SIMULATED	RMSE	MAE	EF	I *Pi-Oave* I	I *Oi-Oave* I	d	MAPE	Difference
2011	2,965	2,869	0,01	0,10	0,00	0,11	0,02		0,03	0,01
2012	2,738	2,999	0,07	0,26	0,06	0,02	0,11		0,10	0,07
2013	3,067	2,874	0,04	0,19	0,01	0,10	0,02		0,06	0,04
2014	3,039	2,996	0,00	0,04	0,00	0,02	0,10		0,01	0,00
2015	3,065	2,722	0,12	0,34	0,01	0,25	0,17		0,11	0,12
	2,975		**0,22**	**0,19**	**-2,04**	0,50	0,42	**0,73**	**3,17**	**0,23**
										0,22
									NRMSE (as %)	7,28

Step 2. You **validate** against one other location (Multan)

VALIDATION (Multan)

	MULTAN (NORTH) - VALIDATION									
	OBSERVED	SIMULATED	RMSE	MAE	EF	I *Pi-Oave* I	I *Oi-Oave* I	d	MAPE	Difference
2011	2,811	2,567	0,06	0,24	0,03	0,41	0,33		0,09	0,06
2012	2,600	2,761	0,03	0,16	0,14	0,21	0,13		0,06	0,03
2013	2,907	3,130	0,05	0,22	0,00	0,16	0,24		0,08	0,05
2014	2,953	3,079	0,02	0,13	0,00	0,10	0,19		0,04	0,02
2015	3,022	2,856	0,03	0,17	0,00	0,12	0,04		0,05	0,03
	2,859		**0,19**	**0,18**	**-0,02**	1,00	0,92	**0,95**	**3,23**	**0,18**
										0,19
									NRMSE (as %)	6,61

Thank you!

Contact details:
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riccardo.soldan@fao.org