AquaCrop

Crop water productivity model

Version 3.1
January 2010

New features in Version 3.1

For full description of AquaCrop consult the Reference Manual

1. Single run and multiple run for Projects

When running a simulation, initial conditions applicable at the start of the simulation period, and environmental conditions relevant during the simulation period are considered. Before running a simulation, the user can specify in the ***Main menu*** the sowing date, the simulation period and the appropriate environmental, initial and off-season conditions (Project file is 'None'). The user can also load a project file containing all the required information for that run. This option existed already in Version 3.0.

In Version 3.1 distinction is made between projects containing the required information for a single simulation run and projects consisting of a set of successive runs, the so called multiple run projects. With a multiple run project the user asses the effect of weather conditions (rainfall, evaporative demand and air temperature) on crop development and production by running a particular simulation for a number of successive years. By altering the environmental conditions (for example irrigation or field management) the user can assess the effect of such changes over the successive years. A multiple run project can also be used to simulate a crop rotation (successive crops).

How single and multiple run projects are created and selected, and how the project characteristics can be updated is described in Chapter 2, section 2.17 Project characteristics. When running a project the totals for specific parameters obtained at the end of each run can be compared between each of the years of the multiple run. Next to the daily results, also seasonal results can be saved in output files (see Chapter 2, section 2.18 Simulation run).

2. Menus to display and update data

Once a project is loaded, the characteristics of the input can only be displayed since an update of the data is no longer possible. If data needs to be updated or a new file needs to be created, the selection of the project has first to be undone (click on the **<UNDO selection>** command in the ***Main menu***). In version 3.1 a clear distinction is made

between ***Display*** and ***Update*** menus (see Chapter 2, section 2.5 Displaying and updating input characteristics).

3. Limited and full set of crop parameters

In the ***Crop characteristics*** menu the crop parameters required by the program can be updated. As in Version 3.0, the parameters are displayed in edit-fields (cells). The color of the edit fields varies depending on the type of parameters. The conservative parameters (displayed in silver cells) are crop specific but do not change materially with time, management practices, geographic location or climate. The other parameters (displayed in white cells) are cultivar specific or less conservative and affected by the climate, field management or conditions in the soil profile. In version 3.1 the distinction between cultivar specific and conservative crop parameters is made more pronounced by offering the possibility to select a particular display mode (see Chapter 2, section 2.9 Crop characteristics). Two types of display mode can be selected:

- ***Limited set:*** Only cultivar specific parameters or less conservative parameters are displayed. These parameters are cultivar specific or might be affected by the field management, conditions in the soil profile, or the climate (especially when simulating in calendar day mode). Displaying the limited set is useful to characterize a cultivar different from the one considered for crop calibration, or to update crop parameters which might be affected by environmental conditions different from the conditions assumed at calibration. After loading a calibrated and validated crop file from the AquaCrop data base, the user can adjust where needed the crop parameters of the limited set, and save it as a cultivar specific crop file.
- ***Full set:*** All crop parameters are displayed.

4. Building up of the Harvest Index

In version 3.1 a Harvest Index is assumed not only for fruit or grain producing crops, and root or tuber crops, but also for leafy vegetable crops. Further-on the building up of the Harvest Index differs along the crop type (Chapter 3, section 3.10.3 Building up of Harvest Index):

- **Leafy vegetable crops:** After germination the Harvest Index builds up quickly and reaches after a short while the reference value HI_o. The time to reach HI_o is expressed as a fraction of the growing cycle (default is 20 %). The increase of HI is described by a logistic function.
- **Root and tuber crops:** Just after the start of tuber formation or root enlargement the increase of the Harvest Index is described by a logistic function.
- **Fruit or grain producing crops:** Just after flowering the increase of the Harvest Index is slow (lag phase) and described by a logistic function. Once the increase of the Harvest Index is sufficient large to reach HI_0 at the end of yield formation, the lag phase is ended and the increase of HI becomes linear (as in Version 3.0).

5. New options for Irrigation files

Not only the time and application depth of irrigation events, but also information required to determine net irrigation requirements or to generate irrigation events can now be saved in irrigation files (see Chapter 2, section 2.6. Creating input files and section 2.11 Irrigation management). When creating a new irrigation file, the type of file has first to be selected:

- Net irrigation water requirement;
- Irrigation schedule; or
- Generation of irrigation schedule.

6. Minor changes in user-interface

- **Generation of onset:** When selecting a criterion to generate the onset of the growing cycle based on rainfall, AquaCrop displays the first date for which the selected criterion holds within the specified window. The next 10 occurrences of onset days are displayed as well. When the start of the rainy season is not certain at the first occurrence, the user can now select one of the displayed next occurrences to avoid early canopy senescence and a complete crop failure after germination (see Chapter 2, section 2.10 Start of the growing cycle).
- **Soil fertility level:** Next to the selection of one of the classes (ranging from poor to non limiting), the soil fertility level can now also be specified directly in the ***Field management*** menu (see Chapter 2, section 2.12 Field management).
- **Water stress response functions:** The shape of the water stress response function (Ks – root zone depletion curve) can only be linear or convex (see Chapter 3, section 3.1.3. Soil water stress). The option to specify a concave shape is removed.
- **Fine-tuning of the user-interface:** A set of menus to display input data are added (see Chapter 2, section 2.5 Displaying and updating input characteristics). These menus are useful when one wants to verify input data without the intention to update the data (especially useful once a project file is loaded). Some of the graphical displays and wording on existing menus were fine tuned. An overview of all menus and its hierarchical structure is given in Chapter 2 at the start of the sections dealing with the Menu reference (sections 2.8 to 2.18)

7. Update of Data base

- **Crop files (*.CRO):**
  - After calibration and validation of the crop parameters, ***Sunflower*** and ***Tomato*** are added to the data base;
  - Further calibration with data from other locations allowed a fine-tuning of the crop parameters for ***Cotton, Maize, Potato, Rice, Soybean, Sugar beet,*** and ***Wheat;***
  - The crop file of ***Quinoa*** is not altered.
- **CO2 file (MaunaLoa.CO2):** Average atmospheric CO_2 concentration for the years 2008 and 2009 measured at Mauna Loa Observatory in Hawaii are added.