

Irrigation scheduling worksheet

This spreadsheet will generate an annual calendar to irrigate a single hydrozone based on local historical evapotranspiration (ET), distribution uniformity (DU) assessment information, soil type, and desired soil wetting depth. The worksheet will accommodate irrigation that is restricted to specific days of the week (designated irrigation days).

Description

This tool will calculate and determine an irrigation schedule for one irrigation zone for a calendar year. The user enters information about the site location including: CIMIS ETo zone (using the included map), soil type (use the Soil Web application available online if needed), DU assessment information, the year of the desired irrigation schedule, and the desired depth to wet the soil. Some water providers restrict the days of the week when irrigation can occur and those days can be accommodated.

An irrigation assessment needs to be conducted and the catch can values from the assessment is entered into the spreadsheet. If runoff occurred from the site or significant puddling or pooling appeared, the duration of the irrigation when that occurred is also entered. From those values, irrigation information is calculated including DU, precipitation rate, minimum irrigation duration (lower boundary), and recommended duration (upper boundary). If runoff occurred, valve cycling will be calculated to determine the length of the cycle (duration) and number of cycles per irrigation event. This information can be used for programming an irrigation controller. Because of rounding, cycling may deliver less water than the upper boundary amount and that amount is determined.

The irrigation calendar shows the days that irrigation should occur based on historical ET and days of the week when irrigation is allowed. If there are restrictions when irrigation occurs and ET rates are high, sometimes the irrigation cannot “keep up” with water demand. So this spreadsheet will “look ahead” to see if and irrigation may be required in the next day or so (depending on the number of days when the next irrigation is allowed) and may schedule an irrigation on an earlier allowed day if necessary.

Before using this spreadsheet, an irrigation assessment needs to be conducted to determine the distribution uniformity of the irrigation system. If needed, instructions to conduct this assessment are in: **Landscape Irrigation System Evaluation and Management** which can be retrieved at: <http://ucanr.org/sites/urbanhort/files/80223.pdf>

Using the spreadsheet

All of the entries on the first page of the spreadsheet are optional. On the remaining pages of the spreadsheet, information that is required is denoted by green boxes. The blue colored boxes indicate where optional information could be entered.

1. Descriptive information about the irrigation zone is entered on the **Irrigation System Information** tab.
2. Provide information on the **ET₀, Soil, C.C., Irr Info.** tab of the spreadsheet including:
 - a. Location- Enter information that identifies the irrigation zone.
 - b. ET₀ zone- These are ET zones as defined by CIMIS. Use the map on the **ET₀ Zones Map** tab to identify the zone where the site is located. Then, on the **ET₀, Soil, C.C., Irr Info.** tab, use the pull-down list and select the ET₀ appropriate zone number in the cell.
 - c. Soil texture- Use the pull-down list and select the soil texture of the site. If you don't know the soil type, use the **SoilWeb** application for computers and smart phones at: <http://casoilresource.lawr.ucdavis.edu/soilweb/>.
 - d. Catch can throat area- Identify the type of catch can used and enter the throat area in the appropriate green space. If you used a non-standard catch can, you'll need to determine the throat area. If you used a round can, you can enter the diameter of the throat (in inches) in the space provided and the area will be calculated. Enter the calculated area in the green space.
 - e. Year of the schedule- Enter the year for the desired irrigation calendar.
 - f. Soil wetting depth- Enter the depth that the soil should be wetted. The recommended depth for turf is 12 inches. Wetting depths for trees and shrubs varies by type. Trees should be irrigated to 2 to 3 feet.
 - g. Days of the week when irrigation is allowed- Check the box next to each day that irrigation is allowed. If there are no restrictions, **make sure all of the boxes are checked.**

3. On the **Catch Can Field Worksheet** tab, data about the catch can test is entered:
 - a. Run time- Enter the duration in minutes that the valve was on during the catch can test.
 - b. K_L or K_s - Enter the K_L (landscape coefficient) or K_s (species coefficient) for the hydrozone. The K_s for cool and warm season turfs are 0.8 and 0.6, respectively. During drought, these can be reduced to 0.6 and 0.4 respectively, but expect a decline in appearance.

A guide to K_L is available in the WUCOLS IV document (“User Manual, Categories of Water Needs”, <http://ucanr.edu/sites/WUCOLS/>).
 - c. Valve on-time to run off- If run off, pooling, or puddling occurs, enter the duration the valve was on when that appeared. A run separate from the DU assessment could be used to determine if and when it appears. Make sure the soil is sufficiently dry after the catch can test if a separate run to determine runoff is done. If no runoff appeared, then leave this cell blank.
 - d. Catch can volumes - Enter the catch can volumes in the spaces provided. There should be at least 24 and no more than 40 catch cans used. The total number of cans should also be a multiple of four. The boxes are shaded to help to assure the correct multiple of cans.
 - e. Targeted catch can volumes- There is an optimum targeted volume of water to be caught in the catch cans based on the throat diameter. Try to capture the volume of water indicated. This is a guide only and it is okay to catch more or less. In any case, DO NOT exceed the capacity and cause the catch can to overflow. Be sure to measure the water volumes in milliliters (mL).

4. From the information and data provided, a summary of the calculations is presented on the **Irrig Summary** tab and includes:
 - a. Distribution uniformity of the lowest quartile (DU_{LQ})
 - b. Precipitation rate (PR) in inches per hour
 - c. Scheduling multiplier
 - d. Inches of irrigation required to wet to the desired depth
 - e. Valve on-time (lower boundary) to wet to that depth
 - f. Maximum valve on-time that includes the scheduling multiplier component (upper boundary).

Information that is used to program the irrigation controller is presented and considers the valve on time (duration) that generated runoff, if runoff appeared, and the number of cycles required to provide the amount of water needed to wet to the desired depth. For example, the controller might be programmed to run 4 cycles of a 6 minute on-time for a valve. To program this into a controller, for example, 6 minutes would be entered for the run time and there would be 4 start times: 4:00 am, 5:00am, 6:00am, and 7:00am.

The run time and number of cycles are determined using the time to run off, if it is entered, and will determine the combination that will provide at least 90% of the desired amount of water to be applied. Note that due to rounding, the total run time may be less than the time to run off that was entered and the percentage of the upper boundary that would be applied is displayed.

Also provided is the infiltration rate of the soil for informational purposes only.

5. A calendar for each month of the year indicating days when the irrigations should occur is displayed on the **Irrig Calendar** tab. This considers the days of the week when irrigations are allowed. The calendar also determines if the year is a leap year or not and adjusts accordingly.
6. The **ET₀ Zones Map** tab is the only sheet to which the user might refer for information needed to complete the form on the **ET₀, Soil, C.C., Irr Info.** tab.
7. Other worksheet tabs are hidden and should not need to be accessed by users and include:

Soil Information which contains a table of soil data that is used to calculate the amount of water needed to irrigate to the desired depth.

DU Calcs “mL.”, where the DU calculations take place. The cycling calculations are also conducted on this page. The % Applied Target is entered here by the spreadsheet programmer and is set to 90%.

Daily ET₀ is used to determine daily ET_L or ET_S, when irrigations are needed. This tab also includes information used to generate the calendars for each year so that the dates and days of week are correct. It also stores information of days irrigation is allowed.

Irrig Sched is used to determine when the irrigations should occur. The columns within a month are: day of week, date of month, allowed irrigation day (0=no, 1=yes), cumulative ET, and if this is a day to run the irrigation. This sheet will determine if the “trigger” (Amount applied) would be reached in the next day or so (which depends on how many days per week irrigation is allowed) and then

allow an irrigation before the "trigger" is reached. This is done so that the irrigations can "keep up" with ET. This is especially necessary if irrigation is allowed only one or two days per week and ET rates are high. At one day allowed per week, and in high ET zones, it is likely that the irrigation cannot keep up without irrigating deeper than desired.

8. Lastly, the **Instr Refs Auths** tab includes instructions how to use the spreadsheet, references and contributors to the worksheet.

Printing

Macros are included to assist with printing all or portions of the spreadsheet:

Ctrl-Shift-A: All sheets

Ctrl-Shift-I: Instructions

Ctrl-Shift-S: Irrigation system info; ETo, Soil, CC, Irr, Rain; and Catch Can Field

Ctrl-Shift-C: Irrig Summary and Irrig Calendar

Notes

Cells that contain formulas on sheets that can be accessed by users are protected from alterations.

I understand that there are limitations to this sheet, especially when it recommends many cycles. Of course there are controllers that won't be capable of running 10 start times, for example. Numerous start times are used to reduce the occurrence of runoff by limiting the valve on time to the interval when runoff was observed. This points to the importance of reducing PR or increasing infiltration rate to reduce the possibility of runoff.

This worksheet was developed using MS Excel 2010.

Thanks,

Loren
Iroki@ucdavis.edu

These instructions and notes apply to:
Irrigation Worksheet mL v1.20.xlsm
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