

Virtual Grower 3.0 Tutorial #4: Lighting

- (0:03) Welcome to Virtual Grower tutorials, an online series designed to help users navigate different aspects of the Virtual Grower software.
- (0:13) In this tutorial, we will continue the simulation we have been building throughout other tutorials by creating light systems and schedules in the Lighting section of the Design menu. Load your simulation by visiting the File menu and clicking 'Load'. Choose your .gsf file and click 'Open'. Click on the 'Lighting' button under the Design section.
- (0:39) This section allows you to define your lighting systems and schedules. Similar to previous versions of Virtual Grower, you are able to define multiple lighting scenarios; however, as you create those set-ups, they are not linked to one specific greenhouse as before. Later on, under the Output Section, you are able to link one lighting system and schedule to as many greenhouses as you require, or mix and match multiple set-ups to several greenhouses.
- (1:07) The opening screen of the Lighting section is for creating light schedules. The large white field lists all of the lighting schedules you have made. To add additional lighting schedules, click the 'Add Lighting Schedule' button. You can change the default name to one that more accurately describes your needs by highlighting the name field and entering in the new name. The lighting schedule you are working on from the list should be highlighted in blue.
- (1:35) Right-clicking a lighting schedule in the list gives you the option to either copy or delete that schedule. Choosing 'Make Copy' transfers all of the settings to a new schedule. If you no longer need a lighting schedule you have created, right-click and choose 'Delete'.
- (1:51) There are four schedule types to choose from in the dropdown menu. The default setting is 'Light Schedule', which allows you to choose one on/off cycle that begins and ends at specific times of the day. If you use this setting, you need to choose the beginning and ending time of your light schedule under the Schedule Setup section. Your lights will be activated for the entire time period you have chosen.
- (2:16) The 'Hourly Threshold' schedule type activates lights if the ambient light falls beneath a specified threshold that you choose for each hourly interval. Using this setting requires you to choose the unit of measurement for your threshold from the dropdown menu. The default unit is $\mu\text{moles m}^{-2} \text{s}^{-1}$, which is an increasingly common way of measuring light for plant growth, but your other options include footcandles, lux, W m^{-2} in photosynthetically active radiation or PAR, and W m^{-2} in total shortwave radiation, or SW, from a pyranometer. If you utilize daily light integral, you will want to use $\mu\text{moles m}^{-2} \text{s}^{-1}$, which can be approximated by dividing your footcandles measurement by five.
- (3:05) Now, designate the threshold value for each hour by using the arrow buttons or entering in a value. Set your threshold to a higher number for plants that require high light, and a lower

number for plants that require low light. If you do not want lights activated during a certain hour, enter in a value of zero.

- (3:26) The 'Hourly Light Schedule' allows the lights to be turned on or off several times a day regardless of sunlight availability. Use the up arrows to turn the lights on and the down arrows to turn the lights off.
- (3:38) The 'Threshold' schedule type sets one threshold for the entire period of time your lighting schedule covers. You must choose the unit of measurement and value for your threshold, and designate the starting and ending times for the time period that your threshold will be applied. Once again, you will want to use a higher number for the threshold for plants that require high light, and a lower number for plants that require low light.
- (4:03) You are now ready to describe your lighting system. Click the 'Lighting Setup' button at the top of the page.
- (4:10) The display on the Lighting Setup page is similar to that of the Lighting Schedule page. A large, white field lists the lighting systems you have made. You can add more by clicking the 'Add Lighting System' button. The active system is highlighted in blue. You can change the name of the active system by highlighting the name field and entering in a new name. If you need to delete or copy a lighting setup, you can do so by right-clicking on it and pressing the 'Delete' or 'Make Copy' button.
- (4:41) Choose the units of measurement for your lighting system from the dropdown menu. This should be the same unit that you chose on the Lighting Schedule page.
- (4:50) Use the arrow buttons or fill in the fields for the number of lights you have and lighting and ballast wattages. Note that the number of lights you indicate should be the total number of lights you have in your individual greenhouse, not the number in each span. If your ballast wattage is unknown, you should leave the value as the default setting. A dropdown menu is available to choose the type of lights that you have. You will need to input a value for the light that is measured at plant level, which can be acquired by using a light sensor. Enter in the average cost of electricity for your location, obtained from your electric bill.
- (5:29) This completes the Lighting section. You can save your work at any time by going to the File menu. Additional tutorials address others sections of the Design menu.
- (5:39) Any time you need more assistance, you can go to the Help menu. There, you will find our email address, USDA-ARS@utoledo.edu.