Extension

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Supplemental Lighting Run Time Worksheet

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As supplemental lighting in New Hampshire greenhouses becomes more common, the question of "how long should the lights run?" becomes more common, too. Running supplemental lights for too short a time each day can result in decreased yield, poor growth and longer production times. Running supplemental lights for too long each day is a waste of energy and money.

The worksheet at the end of this factsheet can be used to calculate how long lights should run to supplement the sun coming into a greenhouse. This worksheet can also be used to calculate run time for lights which are being used in "sole-source" production (say inside a grow room or other indoor production without any sunlight). For use in a "sole-source" application, simply skip Steps 1 & 2, write "0" for *DLI from sunlight inside* in Step 3, and proceed to Step 4.

To measure light that is useful to a plant, you must use a PAR (photosynthetically active radiation) meter, which is also called a PPFD (photosynthetic photon flux density) meter. This meter will measure the intensity of light by counting the number of photons of light useful for photosynthesis hitting a square meter every second. The unit of measure of this device will be $\mu mol \cdot m^{-2} \cdot s^{-1}$. Lumens, lux and footcandles are measurements of human perception of light, and meters which measure these are not useful for measuring light for plants in a greenhouse.

Steps for Using This Worksheet

As you work through the worksheet, the following explanations of each step may be useful:

Step 1. We know that not all the light hitting our greenhouses actually gets to the plants inside. The covering on the greenhouse, coatings, dust, condensation, as well as shade from purlins, irrigation lines, etc. all decrease the natural sunlight getting to our plant. Although the covering manufacturers list the transmission percentage of their materials, taking a reading as explained in the worksheet will give a more accurate percentage of light reaching your crop.

To measure light that is useful to a plant, you must use a PAR (photsynthetically active radiation) meter. The unit of measure of this device will be $\mu mol \cdot m^{-2} \cdot s^{-1}$.

For More Information

See the UNH Extension factsheet *Growing Seedlings Under Lights* for additional explanation of how plants use light and the different ways we use lights to grow plants. It will provide a more thorough explanation of the terms used in this publication.

Step 2. The amount of sunlight reaching earth changes by location and time of year. DLI maps give a multi-year average, by month, of sunlight at a given location. Starting with a prediction of natural sunlight at a location allows us to estimate the amount of supplemental light needed.

Step 3. Remember from Step 1 that not all the sunlight reaching the outside of your greenhouse makes it inside to the crop. This step adjusts for that reality and calculates the amount of sunlight expected to reach the crop at a given time of year.

Step 4. DLI requirements vary by crop and by crop stage. They are determined by research. Check grower guides and Extension for guidelines. This Commercial Greenhouse Production Sheet from Purdue University Extension includes a chart with suggested DLIs for finishing various crops.

Step 5. Whatever light your crop needs which does not reach it from the sun must be added by lamps. This step calculates the part of the DLI which must come from lamps.

Step 6. How much instantaneous light is provided by a lamp depends on the lamp type, power, age, cleanliness, reflector style, etc. By measuring it directly at the crop level, you will know how much light it provides.

Step 7. This step calculates how long to run your lamps to make up the difference between the DLI you want to provide, and the DLI historically provided by the sun. Since we measure intensity in micromoles per second, and the DLI in moles[1] per day, the constant of 0.0036 is needed to convert between these two attributes.

1 "A mole" is simply a number, like "a dozen," except much, much bigger. A mole is a six with 23 zeros. Imagine dumping out a dozen ping pong balls and what that would look like. If you dumped out a mole of ping pong balls, it would cover the Earth more than twice the depth of Mt. Everest!

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Did You Know?

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About the Author

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Use this worksheet to calculate how long to run supplemental lighting in your greenhouse.

Step 1. What percentage of the sun does your greenhouse let through? On a sunny day, use a PAR meter[2] to measure the sunlight outside. Then, run inside and measure the "sunlight inside" just above your crop. Make sure your meter reads in $\mu mol \cdot m^{-2} \cdot s^{-1}$.

Percent of sun getting in the greenhouse = sunlight inside ÷ sunlight outside

_____ = _____ $\mu mol \cdot m^{-2} \cdot s^{-1}$ ÷ _____ $\mu mol \cdot m^{-2} \cdot s^{-1}$

(the answer will be a decimal less than 1.0)

Step 2. How much light does the sun give **outside** the greenhouse where you live at the time in question?

This is determined from the DLI maps or from a data recorder... call this *DLI from sunlight outside*. Remember, DLI means "Daily Light Integral" and is reported in $mol \cdot m^{-2} \cdot day^{-1}$. DLI maps can be found here.

_____ $mol \cdot m^{-2} \cdot day^{-1}$ = *DLI from sunlight outside*

Step 3. How much light does the sun give **inside** the greenhouse where you live at the time in question?

DLI from sunlight inside = DLI from sunlight outside x percent of sun getting in the greenhouse

_____ $mol \cdot m^{-2} \cdot day^{-1}$ = _____ $mol \cdot m^{-2} \cdot day^{-1}$ x _____

Step 4. How much total light does your crop need?

This is determined from crop production guides, research, Extension, etc. Call this *Total DLI needed*. It is reported in $mol \cdot m^{-2} \cdot day^{-1}$.

_____ $mol \cdot m^{-2} \cdot day^{-1}$ = *Total DLI needed*

Step 5. How much additional light do your lamps need to add to the sunlight?

Additional light needed = Total DLI needed - DLI from sunlight inside

_____ $mol \cdot m^{-2} \cdot day^{-1}$ = _____ $mol \cdot m^{-2} \cdot day^{-1}$ - _____ $mol \cdot m^{-2} \cdot day^{-1}$

Step 6. How much instantaneous light do your lamps provide?

This is determined by using a light meter. Make sure it reads in $\mu mol \cdot m^{-2} \cdot s^{-1}$. Measure in the dark, the same distance below your lamps as the crop will be. Call this *Lamp Intensity*.

_____ $\mu mol \cdot m^{-2} \cdot s^{-1}$ = *Lamp Intensity*

Step 7. How many hours do you need to run the lamps to provide additional light?

Hours to run lamps = Additional light needed ÷ (Lamp Intensity x 0.0036)

_____ hours = _____ $mol \cdot m^{-2} \cdot day^{-1}$ ÷ (_____ $\mu mol \cdot m^{-2} \cdot s^{-1}$ x 0.0036)

[Be sure to do inside parantheses first!]

2 A PAR meter measures Photsynthetically Active Radiation in $\mu mol \cdot m^{-2} \cdot s^{-1}$. Also called PPFD (Photosynthetic Photon Flux Density) or Quantum Flux.