e-GRO Electronic Grower Resources Online

# Managing Photoperiod in a Greenhouse

Roberto Lopez PURDUE UNIVERSITY

THE Fred C. Gloeckner FOUNDATION, INC.

## Photoperiod

- Photoperiod combines the two Greek roots for 'light' and 'duration of time' to describe the duration of the day that is light
- Photoperiod influences many aspects of plant growth and development including dormancy, storage organ formation and most importantly for many greenhouse producers, flowering

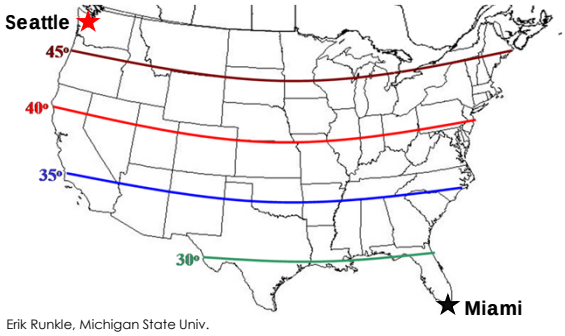
## Photoperiod

- The interval of time (day length) between sunrise and sunset changes throughout the year
- For example, in the U.S., which is in the northern hemisphere, day length increases from December 21st until June 21st, after which it decreases

## Photoperiod

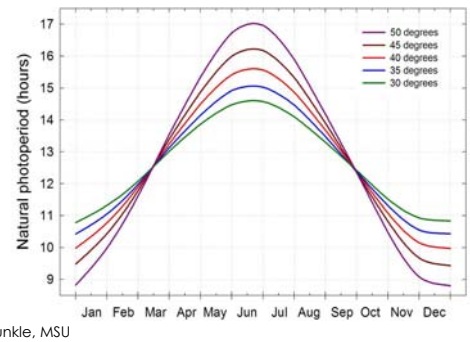
- Seasonal fluctuation in day length becomes more dramatic as the latitude increases
- For example, the day length in Miami (25.8° N latitude) ranges from approximately 10 ½ hours to a little more than 13 ½ hours
- The day length in Seattle (47.6° N latitude) ranges from 8 ½ to 16 hours

## Natural Photoperiod during the Year




Erik Runkle, Michigan State Univ.

## Natural Photoperiod during the Year




Erik Runkle, MSU

## Photoperiodic Responses

- Plants are classified as:
  - Short-day plants
  - Long-day plants
  - Day-neutral plants

- Furthermore, responses may be categorized as:
  - Obligate (qualitative)
  - Facultative (quantitative)

## Photoperiodic Responses

- Photoperiod refers to the duration of light hours in the day
- It is actually the duration of darkness that is the signal

## Photoperiodic Responses

Truncating, extending the day or interrupting the night are the three strategies used to manage photoperiodic plant responses

## When to Provide Long-day Lighting?

- Most long-day (LD) plants flower faster when the night length is less than approx. 10 hours
- Long-day lighting can be used to delay flowering of short day crops (ie. poinsettia)
- In the northern hemisphere, provide LD lighting from Sept. 1 to April 15

## Lights for Creating Long Days

- Incandescent (INC), compact fluorescent (CFL), light emitting diodes (LEDs) stationary, moving or cyclic high intensity discharge (HID) lamps such as high-pressure sodium (HPS) and metal halide (MH)
- Low intensity lighting of 10 foot-candles (100 lux or 2 $\mu mol \cdot m^{-2} \cdot s^{-1}$) at plant height is adequate for most greenhouse crops

## Lights for Creating Long Days

- For a standard bench, a 60-W INC bulb every 4 to 5 feet is sufficient

## Incandescent Lamps

**Advantages**

- Effective flowering responses (R/FR ratio)
- Can cause desirable morphogenic effects (flowering)
- A rich red-light source
- An even richer far-red source

**Disadvantages**

- Can cause undesirable morphogenic effects (stem elongation)
- Very electrically inefficient (6%) as most energy consumed is lost as heat
- Short life span
- Being phased out

## Compact Fluorescent Lamps

**Advantages**

- Can cause desirable morphogenic effects
- Low heat output
- 4x more energy efficient than incandescent

**Disadvantages**

- Life is influenced by # of on and off cycles
- Low far-red source
- Alone does not provide a effective flowering responses (R/FR effects) for all LDPs
- Disposal issues

**Growers are finding that a combination of incandescent (INC) and compact fluorescent lamps (CFL) is effective at providing long days**

- Plants can be shorter than those under all INC
- Little or no delay in flowering compared to all INC
- The use of CFL reduces energy consumption

## Creating Long-day Lighting

Day-extension lighting:

- Is the use of artificial light to extend the length of the day
- Begins at sunset and ends when the desired photoperiod is achieved

## Day-extension Lighting

If you want to provide a 16-hour photoperiod and sunrise is at 7 AM and sunset is at 7 PM, you would light from 7 PM to 11 PM

## Creating Long-day Lighting

Night interruption/ night break lighting/ mum lighting:

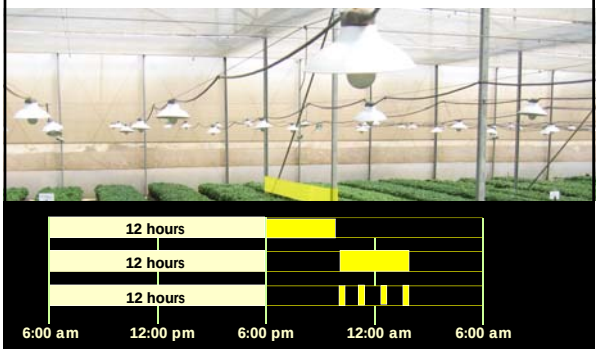
- By interrupting the night length, plants will not perceive a "long" night, but rather a "short" night (or "long" day)
- Generally 4 hours of lighting are used in the middle of night (ie. 10 PM to 2 AM)

## Cyclic Long-day Lighting (LD)

Three methods:

- INC lamps are on for 5 to 10 minutes every 30 min. during the lighting period
- HID lamps are mounted on a moving boom that passes over the crops for at least four hours during the night
- Fixed HID with an oscillating reflector/ luminaire (ie. Beamflicker)

## Long-day Lighting (LD)




## Examples of Cyclic Lighting

Erik Runkle, Michigan State Univ.

**HID mounted to a moving boom**

**Fixed HID with an oscillating reflector/luminaire**

## Creating Short Days (SD)

- Under LD conditions, SD plant responses can be achieved by shortening the day length
- Materials commonly used include:
  - Opaque cloth or fabric that does not allow light to penetrate, commonly referred to as "black cloth" or "blackout cloth"
  - Woven blankets consisting of aluminum and plastic strips
  - Black plastic

## When to Pull and Retract Black Cloth?

"Black cloth" or plastic is traditionally pulled at 5 p.m. and retracted at 8 a.m. to coincide with normal working hours

## When to Pull and Retract Black Cloth?

- Automatic systems that are operated by a timer or environmental computer can be used for individual benches or an entire greenhouse



## Creating Short Days (SD)

Potential problems:

- Accumulation of heat under the fabric or plastic
- Plastic can collapse on plants due to condensation
- Sides not properly pulled



## Photoperiod Lighting/Black cloth Requirements

| | Vegetative Growth | | Early Flowering | |
|---|---|---|---|---|
| | Winter (SD) | Summer (LD) | Winter (SD) | Summer (LD) |
| Short-day plants (SDP) | Night interruption | Not needed | Not needed | Black cloth |
| Long-day plants (LDP) | Not needed | Black cloth | Night interruption | Not needed |
| Day neutral plants (DNP) | Not needed | Not needed | Not needed | Not needed |

## Take Home Message

- Managing and manipulating photoperiod is an important aspect of greenhouse environmental management
- By understanding natural photoperiod and the techniques used to managing photoperiod, you will be able to successfully induce your greenhouse crops into flower

## Take Home Message

- For more information on the induction of flowering using photoperiod, please see Purdue Extension Bulletin HO-249-W, Flower Induction of Annuals