Propagating Perennials

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Overview

- Seed Propagation
- Vegetative Propagation
- Managing the Propagation Environment
    - Substrate Moisture
    - Substrate Temperature
    - Vapor Pressure Deficit
    - Light

Benefits of Seed Propagation

- Propagules are less expensive
- May be able to source locally (native plants)
- Find new plants or cultivars
    - Genetic diversity

Drawbacks of Seed Propagation

- Will not have access to desirable cultivars

- May not flower the year they are sown
  - Spring flowering – sow in late summer or early fall
  - Summer flowering – sow in mid- to late winter

- Some seed have dormancy requirements

Seed Propagated Plants

- *Iberis*
- *Platycodon*
- *Digitalis*
- *Veronica*
- *Helenium*

Plants that are *difficult* propagate by seed

- The following species may have a thick seed coat or dormancy issues:
    - *Baptisia* (may be grown from seed that are soaked in 180 F water for a few hours)
    - *Delphinium* (may be grown from fresh seed – a few weeks old)
    - *Liatris* (germination improved with moist, cool)
    - *Campanula*
    - *Asclepius*
    - *Primula*
    - *Sempervivum*

Benefits of Vegetative Propagation (i.e. Stem Cuttings)

- Cultivars are available

- No need to worry about seed dormancy issues or germination percentages

- Drawback???

    - Propagules can be more expensive

A wide variety of perennials are propagated via stem cuttings

- Examples include:
  - *Phlox* sp.
  - *Perovskia atriplicifolia*
  - *Lamium maculatum*
  - *Gaura lindheimeri*
  - *Dianthus* sp.
  - *Heliopsis* sp
  - *Monarda didyma*
  - *Coreopsis verticillata* and *Coreopsis rosea*

Propagation and Greenhouse Environment

- Factors impact rooting:
  - Substrate Moisture
  - Vapor Pressure Deficit
  - Substrate Temperature
  - Light

- Goal is to optimize environment for rooting success

Mist System Design to Optimize Environment

Apply Enough Water to Replace what is Lost Via Evaporation and Transpiration!

Photo compliments of Griffin Greenhouse

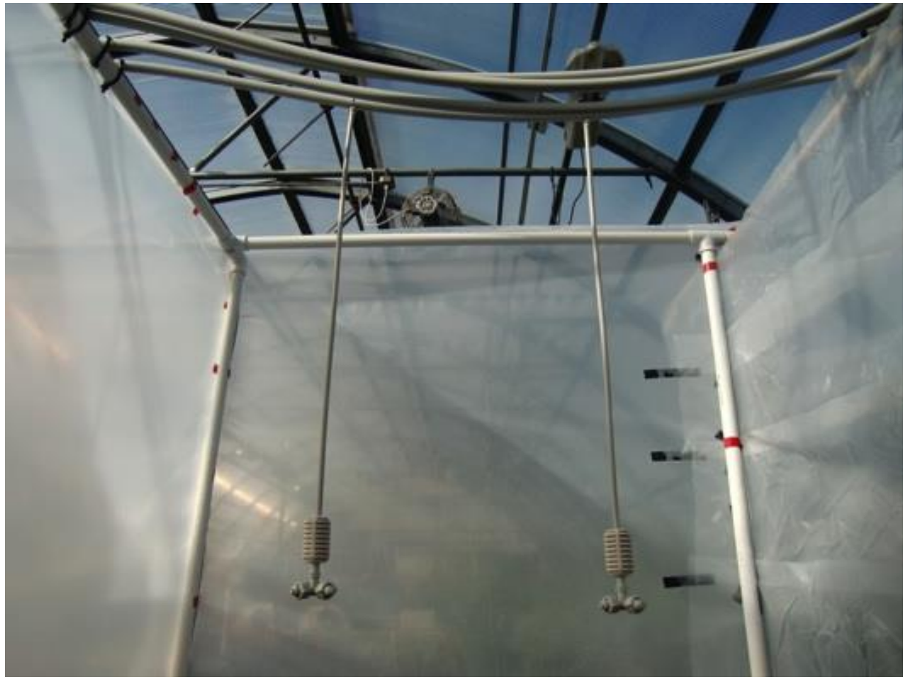
Ensure you are applying the correct amount of water

- Place saucers or cups uniformly in your propagation area

- Measure for 10 days

- Goal = 1 L/ft^2 over a 10 day mist cycle

- May need to increase or decrease for certain species



How to Control Mist System

- Static
  - Timer

- Dynamic
  - Vapor Pressure Deficit

Vapor Pressure Deficit vs. Relative Humidity

- Vapor Pressure Deficit – difference between the moisture in the air and how much moisture the air could hold
  - A larger number indicates less moisture in the air
  - Calculated from relative humidity and temperature
  - ***Does not*** change as temperature changes

Vapor Pressure Deficit vs. Relative Humidity

- Relative Humidity – Water vapor in the air expressed as a percent
    - A larger number indicates more moisture in the air
    - Changes as temperature changes

Vapor Pressure Deficit versus Humidity

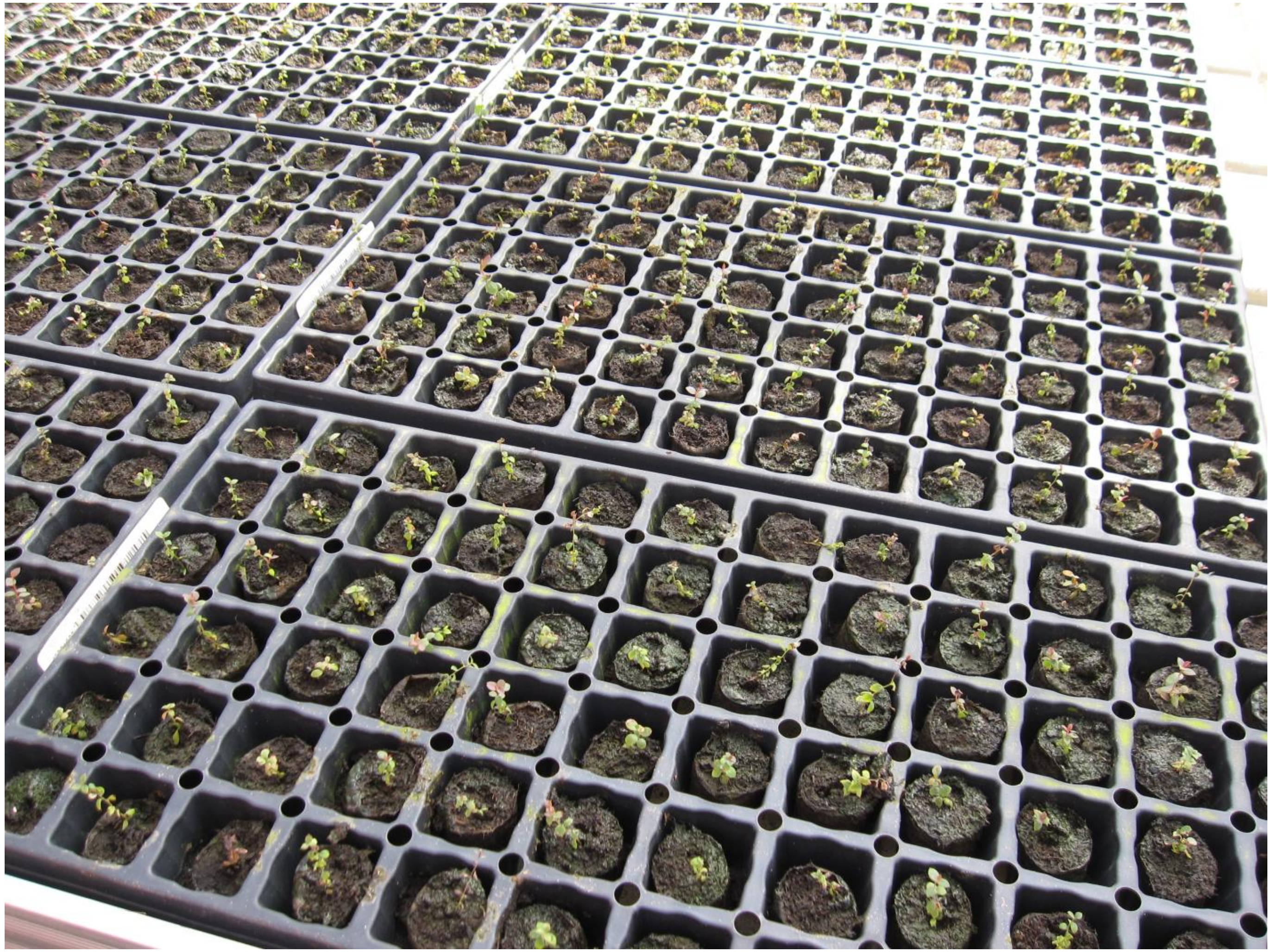
Temperature	Relative Humidity	Vapor Pressure Deficit
60 F	70%	0.55 kPa
75 F	70%	0.90 kPa
90 F	70%	1.45 kPa

From Wollaeger and Runkle

Vapor Pressure Deficit Effects

- VPD Impacts transpiration and evaporation
  - High VPD (approximately 1 kPa) – active transpiration and evaporation
  - Low VPD – little transpiration and evaporation
- Some Dynamic Controllers Measure Vapor Pressure Deficit
  - Argus
  - Phytotronics Water Pro VPD or Water Plus VPD

Substrate Moisture Effects

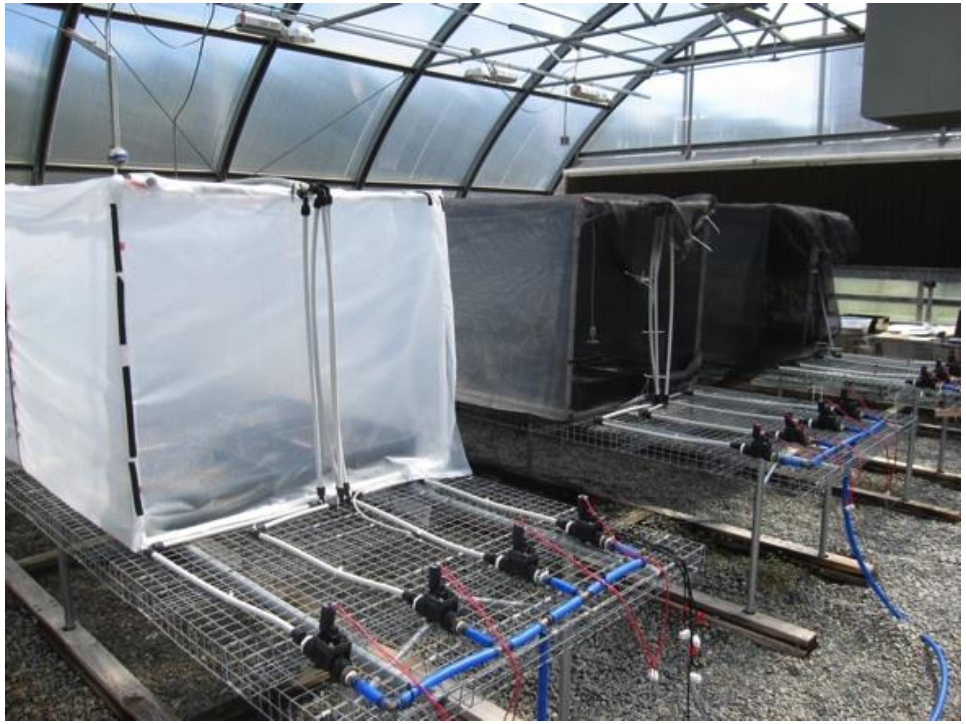


Substrate Moisture

- Cuttings are often kept in high relative humidity and in moist substrate
- Particularly important in evergreens and herbaceous cuttings
- Substrate moisture may often be high if mist is applied too frequently

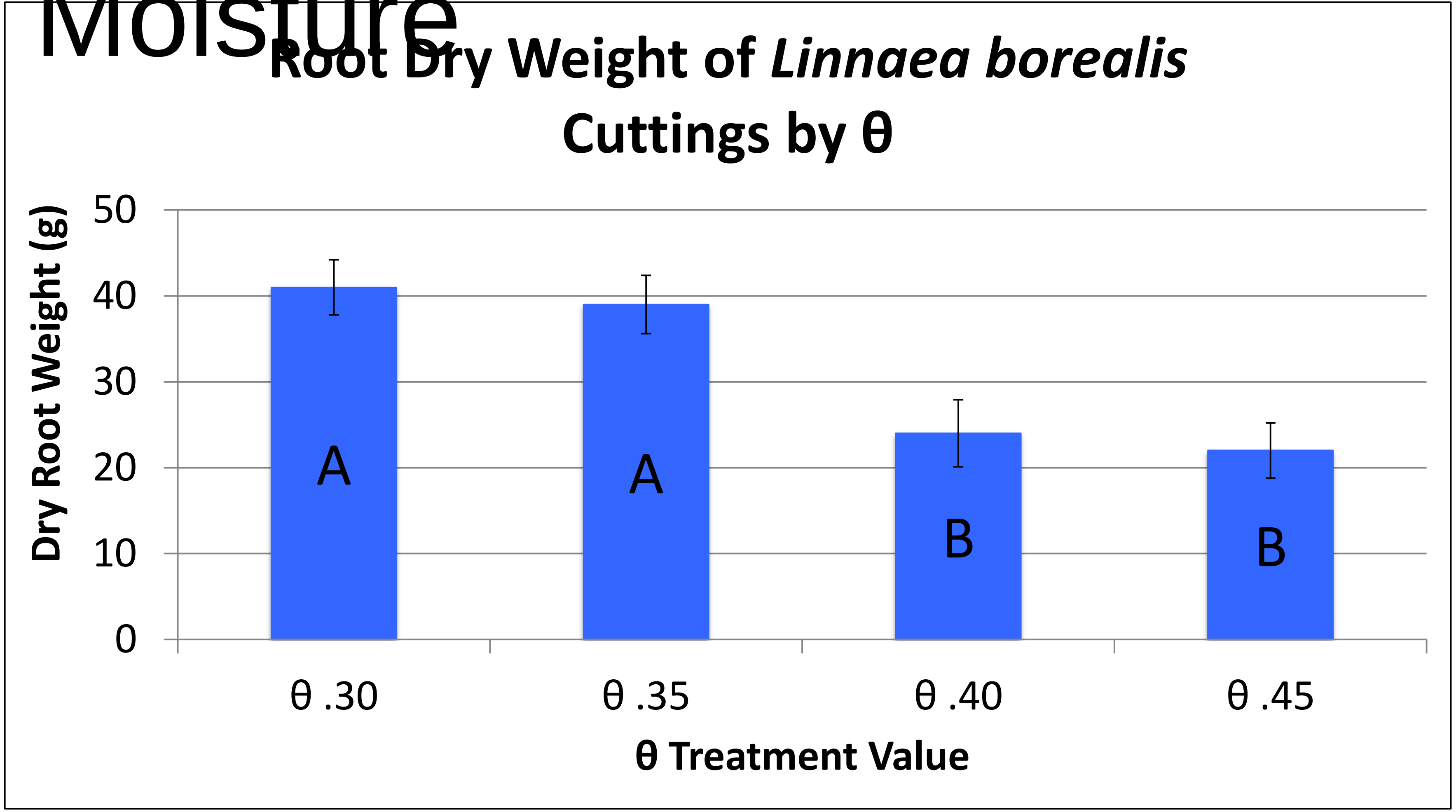
Impact of Substrate Moisture on Rooting

- A moisture sensor automated fog system was used to monitor and irrigate the crop.
- Soil Moisture = 30%, 35%, 40%, or 45%
- Twinflower (*Linnaea borealis*) propagated using fog nozzles



(Photo courtesy of U.S. Forest Service)

Impact of Substrate Moisture



$\alpha = .05 \quad P = .0001 \quad r^2 = .72$

Too much moisture in the media?

- Low adventitious root formation
- Increase in incidence of disease
- Increased time from propagule to salable plant

Temperature Effects

- Adventitious root formation:
  - Increasing temperature increases root density
  - Too high temperature results in root damage
- Optimal root zone temperature = 18-30 C

Adventitious Rooting and Temperature

Root Zone Temperature (F)	Rooting Percentage
70	85%
73	90%
77	100%

From Owen and Lopez, 2017

Temperature and Seed Germination

Temperature (C)	Light Provided?	Germination %
14	yes	38.0 ef
14	no	27.0 f
20	yes	91.0 a
20	no	63.4 bc
24	yes	78.7 bc
24	no	58.1 cd
28	yes	54.0 cde
28	no	35.3 ef

From Iapichino and Bertolino et al., 2009

Managing Light in the Propagation Environment

Stock Plant Management

- Stock plant DLI should be 10 -20 $mol{\cdot}m^{2}{\cdot}d^{-1}$
  - Encourage photosynthetic Growth
  - Prevent flowering

- Photoperiod should be managed to prevent flowering:
  - Herbaceous perennial species that are long day plants:
    - *Phlox* sp.
    - *Echinacea* sp.
    - *Rudbeckia* sp.
    - *Achillea* sp.
    - *Coreopsis* sp.

Consider photoperiodic responses

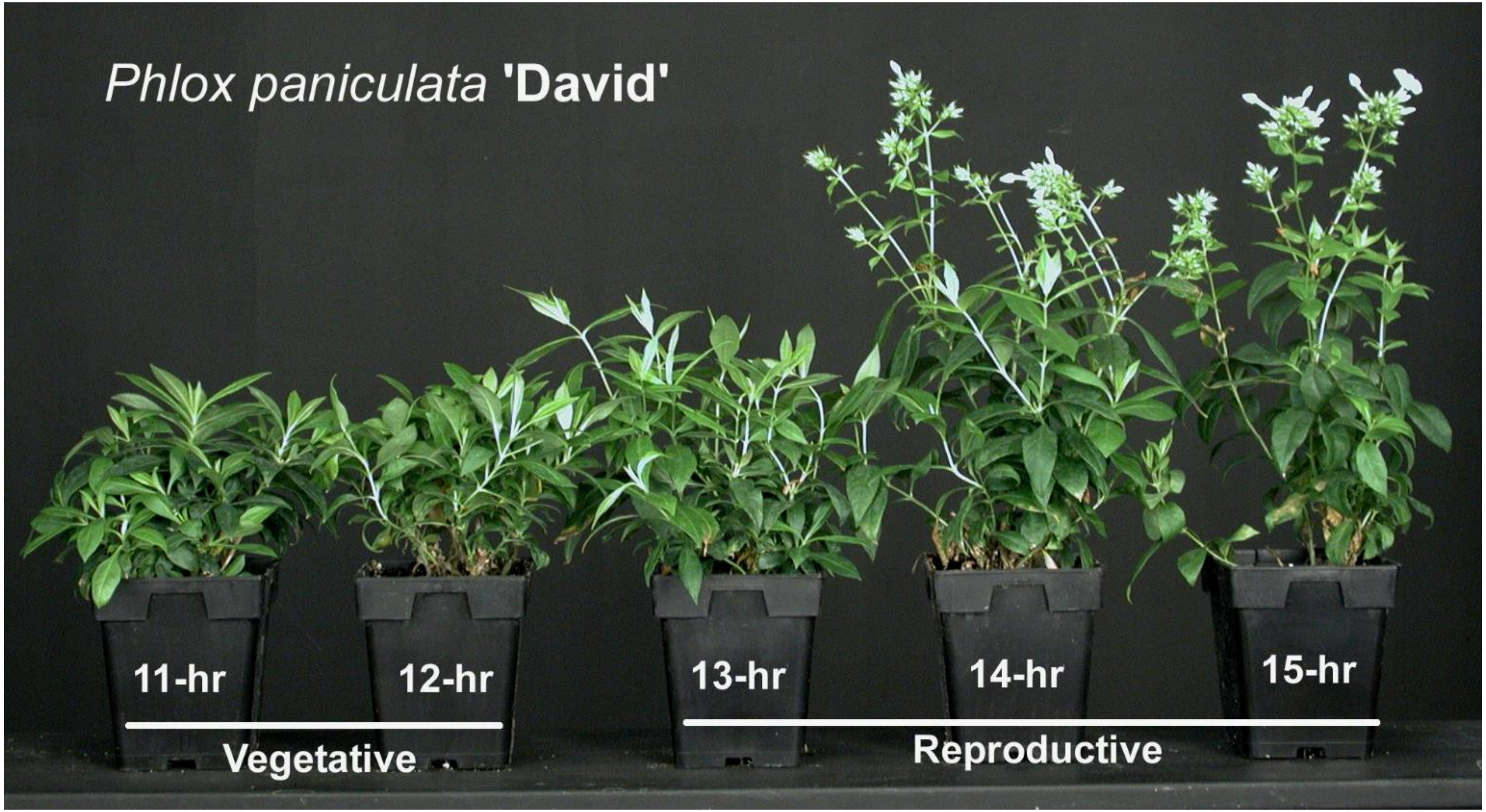


Photo courtesy of Amy Enfield, Michigan State University

From Fisher, Faust, and Runkle, 2004
Lighting Up Profits, Chapter 12

Recommended photoperiods to maintain vegetative growth of perennial stock plants

Perennial cultivar	Optimum photoperiod for vegetative growth
Achillea 'Moonshine'	13 hours
Agastache	10-13 hours
Ceratostigma plumbaginoides	24 hours
Eupatorium rugosum 'Chocolate'	16 hours
Gaura	9 hours
Geranium dalmaticum	12 hours
Leucanthemum superbum 'Snowcap'	13 hours
Phlox paniculata	12-13 hours
Sedum 'Autumn Joy'	14 hours

For long-day plants:

Too short: dormancy

Too long: flowering

From Fisher, Faust, and Runkle, 2004
Lighting Up Profits, Chapter 12

Lighting Cuttings

- Stages during propagation:
  - Sticking
  - Callus
  - Differentiation
  - Root growth
  - Toning

- Does more light help?

Lighting Cuttings (Annual Cuttings)

- Callus: 3 to 8 $mol \cdot m^{-2} \cdot d^{-1}$
- Differentiation: 5 to 10 $mol \cdot m^{-2} \cdot d^{-1}$
- Root growth: 10 to 15 $mol \cdot m^{-2} \cdot d^{-1}$
- Toning: > 10 $mol \cdot m^{-2} \cdot d^{-1}$

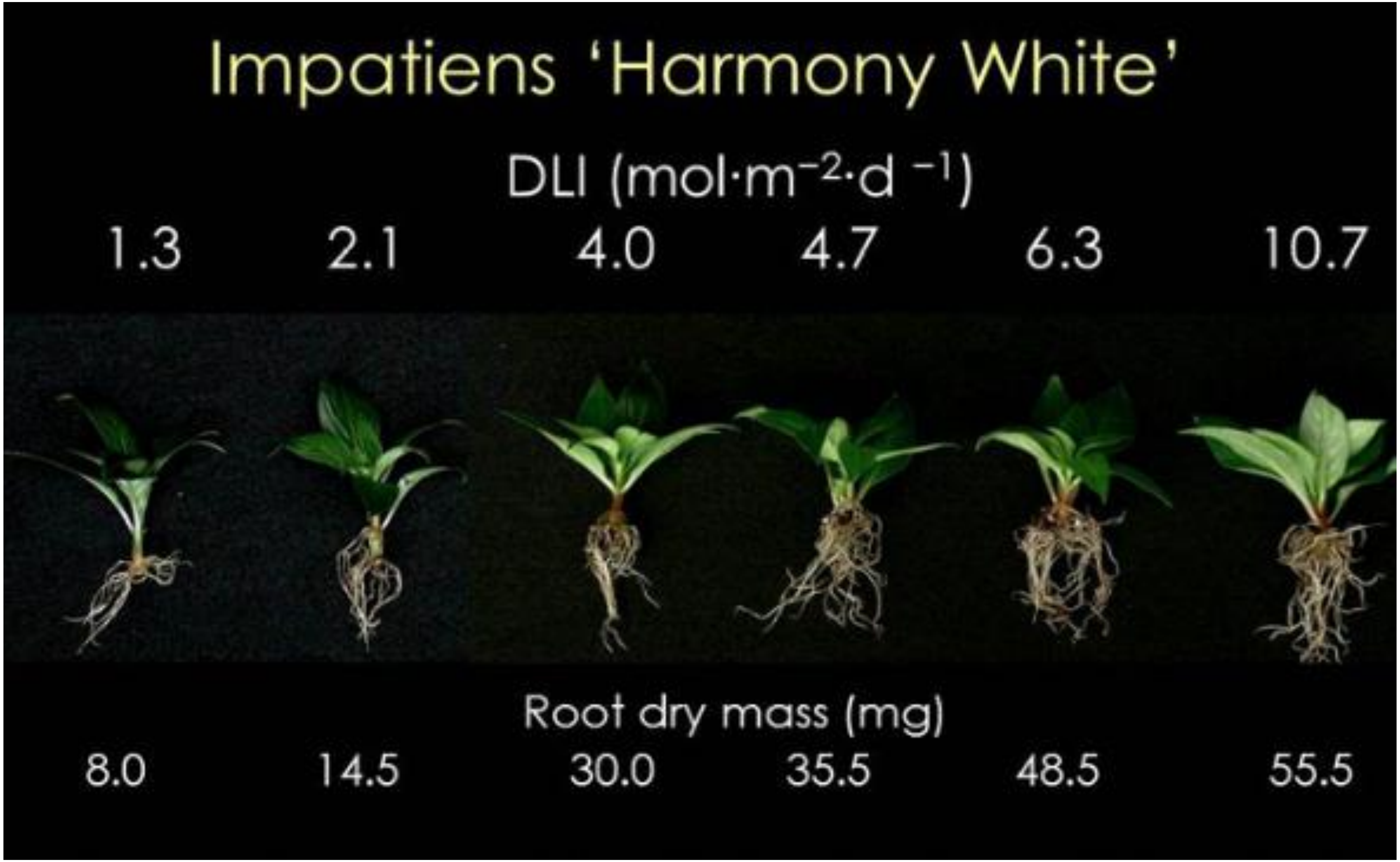


Photo: Roberto Lopez, Michigan State University.

Lighting Perennial Cuttings

- Most Species – 10 $mol \cdot m^{-2} \cdot d^{-1}$
- Sun-loving species (i.e. Gaura) – 10-15 $mol \cdot m^{-2} \cdot d^{-1}$
- Shade-tolerant species (i.e. *Heuchera* or *Linnaea*) – < 10 $mol \cdot m^{-2} \cdot d^{-1}$
- More detailed work should be done!

Vernalizing Perennial Plugs

- Many perennial species require chilling (i.e. vernalization) to flower:
  - *Heuchera sanguinea* (>16 leaves needed on plants)
  - *Lavandula angustifolia* (> 50 leaves needed on plants)
  - *Veronica longifolia* ‘Sunny Border Blue’
  - *Astilbe* x *arendsii*
  - *Iberis sempervirens* (> 40 leaves needed on plants)
  - *Gaillardia grandiflora* (> 12 leaves needed on plants)

From ‘Firing up Perennials’; Cameron, Heins, and Carlson

Techniques for Providing Cold Treatment

- At least 10 weeks less than 41 F (above 25 F)

- Acclimate to cold temperatures gradually
  - Natural acclimation outdoors
  - Reduce 3-5 F gradually to reach 41 F

Sources for more information

- Pilon, P. Perennial Solutions: A Grower's Guide to Perennial Production.
- R. Lopez. and E. Runkle. Light Management in Controlled Environments.
- Greenhouse Grower and The Michigan State University. Firing up Perennials. https://www.canr.msu.edu/uploads/resources/pdfs/firing-up-perennials-the-2000-edition-part-1.pdf