

Microgreens: Production and Opportunities



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Introduction

- Three “young” vegetable products
 - ▣ Sprouts
 - ▣ Microgreens
 - ▣ Baby greens
- Benefits in common
 - ▣ Short production cycle
 - ▣ High value
 - ▣ Flexible systems
 - ▣ Nutritional qualities

Sprouts

- Consume entire plant (shoots and rootlets)
- Harvest shortly after germination
- Entire production cycle <10 days
- No light or fertilization required
- Microbial contamination risk



Microgreens

- Consume the shoot, cotyledons, and first true leaves
- Production cycle 7-21 days
- Light is required
- Limited nutrition requirement





Image Source: Roberto Lopez, Michigan State Univ.

Baby Greens

- Harvest occurs after seedling stage
 - ▣ Before 8 true leaves
 - ▣ Later harvests would not be considered “baby leaves”
- Consume true leaves
- Production cycle >21 days
- Light and nutrition are required



Microgreens Background



Why Microgreens?

- Garnish or enhancement
- Sold in many upscale markets and restaurants
- High market value




Image Source: Roberto Lopez, Michigan State Univ.

Why Microgreens?

- Desirable characteristics
 - ▣ Flavor (sour, sweet, bitter, spicy, etc.)
 - ▣ Texture
 - ▣ Color (red, green, yellow, purple)
 - ▣ Nutrition





Image Source: Roberto Lopez, Michigan State Univ.


Why Microgreens?

- Health promotion
 - ▣ Higher concentrations of phytonutrients and vitamins than mature crops
 - ▣ Antioxidant capacity
 - Phenolic compounds
 - Vitamins C and E
 - Glucosinolates
 - Carotenoids



Species Selection

- Species selection criteria
 - ▣ Ease of germination
 - ▣ Uniformity
 - ▣ Short production time
 - ▣ Price and availability
 - ▣ Environment
 - ▣ Mixes with similar production requirements



Microgreens Production



Media Selection

- Peat-based substrates
- Perlite
- Vermiculite
- Coconut coir

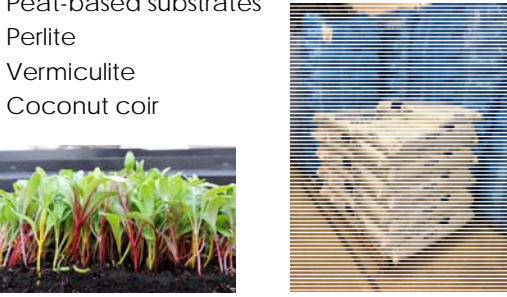
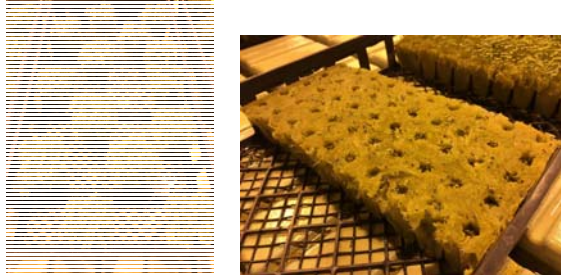


Image Source (left): Di Gioia, F., A. Reina, and P. Santamaría. 2017. Sprouts, microgreens and "baby leaf" vegetables, p. 403-432 in Minimally Processed Refrigerated Fruits and Vegetables. Springer Science+Business Media.

Media Selection

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- Rockwool propagation cubes



Media Selection

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- Polyethylene terephthalate (PET)
- Burlap
- Commercial products


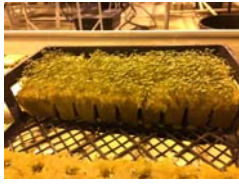


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Media Selection

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- Media selection considerations
 - ▣ pH between 5.5 and 6.5
 - ▣ Good water holding capacity (55-70% v/v)
 - ▣ Good aeration (20-30% v/v)
 - ▣ Clean media is essential
 - Organic medias have potential for pathogens
 - *Salmonella* and *E. coli*
 - ▣ Species performance may differ based on media



Production Systems

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- Plastic trays and pots
 - ▣ Growing media in bottom
 - ▣ No drainage may cause problems
 - ▣ Labor intensive



Production Systems

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- Troughs with fibrous mats
 - ▣ Recirculating systems
 - ▣ Similar to nutrient film technique (NFT)


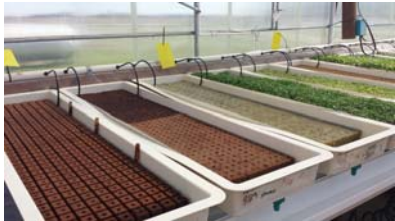


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Production Systems

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- Propagation systems
 - ▣ Recirculating
 - ▣ Adjust media type for microgreens



Production Overview


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- ½ to 2" of media in tray
- Covering may be necessary for some species
 - ▣ Vermiculite
 - ▣ Germinate in darkness
- Overhead mist until germination
 - ▣ Timing differs among species
 - ▣ Soak some larger species prior (e.g. beet cilantro)

Production Overview

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- High-quality pathogen-free water source
- Sub-irrigation is best to avoid excess canopy moisture
- Fertilization options
 - ▣ 75-150 ppm N
 - ▣ May be unnecessary for some species (fast-growing)
 - ▣ Some species accumulate high nitrates (NO₃)



Production Overview

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- Harvest
 - ▣ 7-21 days after germination
 - ▣ 1-3 in. height
 - ▣ Cut just above media surface
- Also sold prior to harvest
 - ▣ Shipped along with growing media
 - ▣ Increases shelf life and freshness
 - ▣ Clamshell containers

Vertical Indoor Production



Vertical Indoor Production

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- Multi-layered systems
- Sole-source lighting
- Light-emitting diodes (LEDs)
 - ▣ Low output of radiant heat
 - ▣ Target specific wavelengths
- Consistent quality year-round


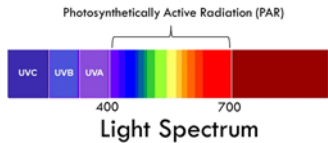
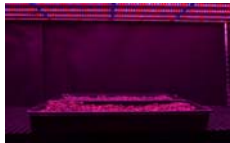


Image Source: Roberto Lopez, Michigan State Univ.

Light-emitting Diodes (LEDs)

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- Ability to target specific colors of light
 - ▣ Wavelengths (nm)
 - ▣ Red and blue are common due to role in photosynthesis

Light-emitting Diodes (LEDs)

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- Sole-source lighting systems to manipulate production
 - ▣ Growth attributes
 - ▣ Phytonutrients
 - ▣ Mineral nutrients
 - ▣ Coloration
- Results based on changes in light quality and intensity



Light Quality and Quantity from Sole-source LEDs Influences Growth and Phytochemical Content of Brassica Microgreens

Joshua Craver, Joshua Gerovac, Jennifer Boldt, Dean Kopsell, and Roberto Lopez



Materials and Methods

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- Plant Material
 - ▣ *Brassica oleracea* var. *gongylodes* (kohlrabi)
 - ▣ *Brassica juncea* (mustard)
 - ▣ *Brassica rapa* spp. *nipposinica* (mizuna)
- Walk-in Environmental Chamber
 - ▣ 16-h photoperiod
 - ▣ 70/63 °F (21/17 °C) day/night (16 h/8 h)
 - ▣ 50/60% day/night relative humidity
 - ▣ 500 ppm CO₂

Materials and Methods

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- Substrate and Fertilization
 - ▣ Polyethylene terephthalate fiber pad hydroponic tray
 - ▣ 300 mL of a 25% Hoagland's #1 nutrient solution added to each tray daily



Materials and Methods

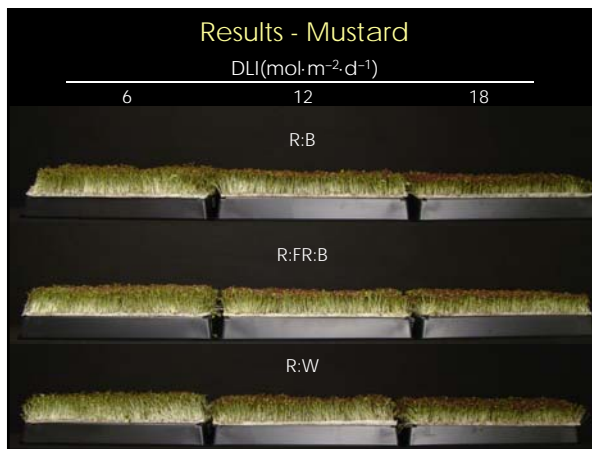
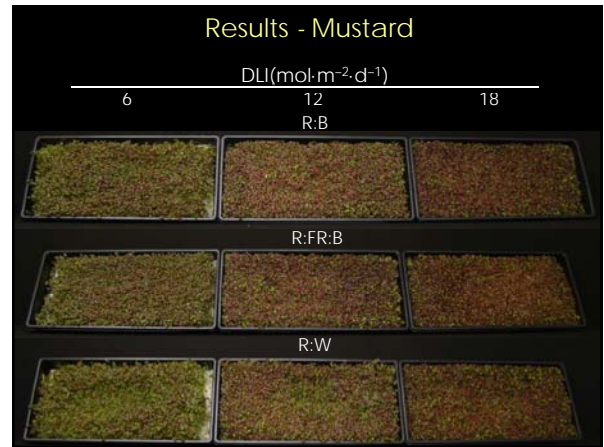
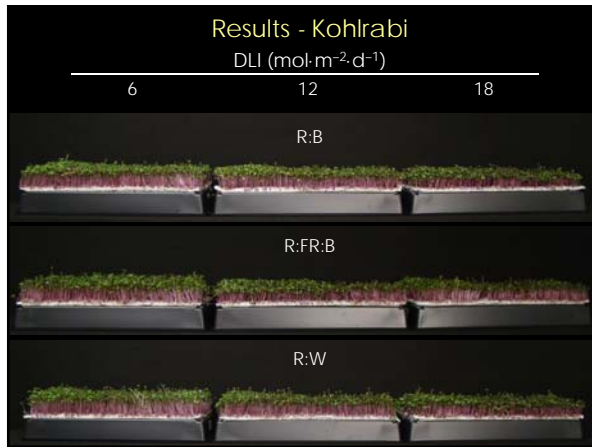
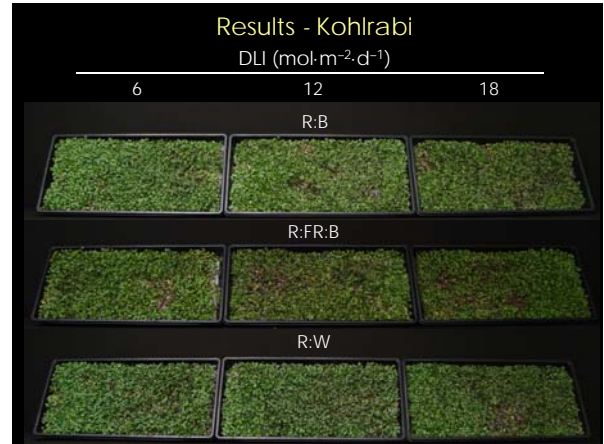
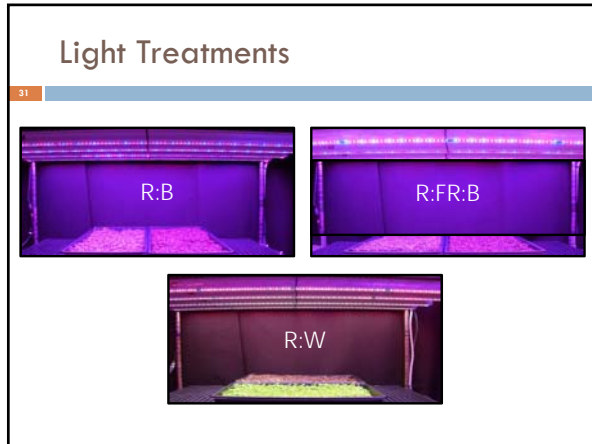
- Phillips Green Power LED Production Modules
- Light qualities consisting of (%):
 - ▣ 87:13 red:blue = R:B
 - ▣ 84:7:9 red:far-red:blue = R:FR:B
 - ▣ 74:18:8 red:green:blue = R:W



Materials and Methods

- Daily light integral :
 - ▣ 6 mol·m⁻²·d⁻¹
 - 2 modules delivering 105 μmol·m⁻²·s⁻¹
 - ▣ 12 mol·m⁻²·d⁻¹
 - 4 modules delivering 210 μmol·m⁻²·s⁻¹
 - ▣ 18 mol·m⁻²·d⁻¹
 - 6 modules delivering 315 μmol·m⁻²·s⁻¹





General Lighting Recommendations

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- Minimum intensity of 100 μmol·m⁻²·s⁻¹
 - ▣ Higher if intense coloration or reduced height is desired
 - ▣ Species dependent
- Spectrum selection dependent on desired qualities

Summary

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- Still much research that needs to be done
 - ▣ How do we define high-quality microgreens?
 - ▣ Can we market microgreens with increased nutritional qualities?



Acknowledgements

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