Microgreen Production

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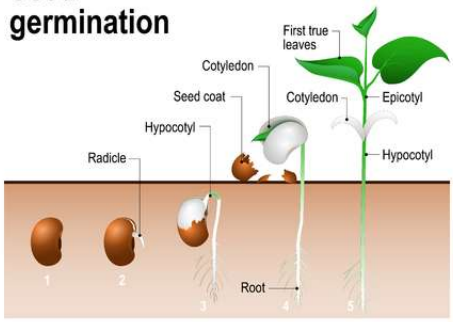
What are Microgreens?

- Seedlings that are harvested at the first true leaf stage and sold with the stem, cotyledon (seed leaves) and first true leaves attached. Usually vegetables and herbs.



Benefits of Growing Micro Greens

- Relatively easy to grow
- Short cropping time (7-10 days)
- Year round production
- Minimal space required
- Colorful
- Tender texture
- Flavorful
- High nutritional value

Nutritional Value

- Microgreens are rich in nutrients and often contain higher nutrient levels than their mature counter parts

Nutrient Assessment

- Study by Gene Lester Ph.D. USDA-ARS
- Objective: to analyze the concentration of vitamins and carotenoids in 25 varieties of microgreens

Gene Lester, Ph.D. USDA-ARS

Nutrients Assessment

- Nutrients analyzed:
  1) Ascorbic Acid (Vc)
  2) Phylloquinone (V_{K1})
  3) Tocopherols (V_E)
  4) Carotenoids: β-Carotene, Lutein/zeaxanthin,and violaxanthin.

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Top 5 Microgreens Rich in Ascorbic Acid (Vc)

147.0 ± 3.6 Red cabbage	131.6 ± 2.9 Garnet amaranth	95.8 ± 10.3 China rose beet	90.8 ± 2.7 Opal basil	90.1 ± 2.7 Opal radish

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Total ascorbic acid (Vc)

Red cabbage microgreens

Mature red cabbage

147.0± 3.6 mg/100g FW

57.0 mg/100g FW

3-fold

1

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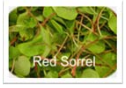
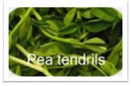
Top 5 Microgreens Rich in Phylloquinone (V_{K1})

- No. 1 Garnet amaranth
- No. 2 Red sorrel
- No. 3 Green basil
- No. 4 Pea tendrils
- No. 5 Red cabbage





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Phylloquinone (V_{K1})

Garnet amaranth microgreens

Mature garnet amaranth

Microgreens: Mature = 4 :1

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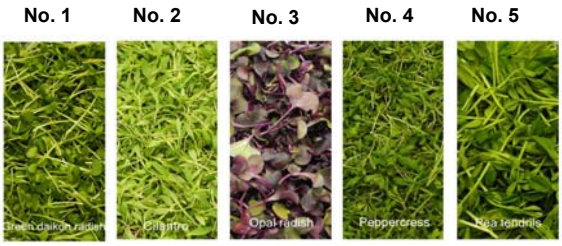
Top 5 microgreens Rich in α-Tocopherols (V_E)



87.4 ± 15.9 Green daikon radish	53.0 ± 13.5 Cilantro	47.7 ± 14.6 Opal radish	41.2 ± 3.7 Peppercress	35.0 ± 6.8 Pea tendrils

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Tocopherols (V_E)

Daikon Radish Microgreens

Mature Daikon Radish

- α-Tocopherol mg/100g FW Microgreens: Mature = 87:0
- γ-Tocopherol mg/100g FW Microgreens: Mature = 39:0

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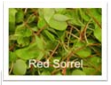
Top 5 Microgreens Rich in Carotenoids

- No. 1 Cilantro → 
- No. 2 Red sorrel → 
- No. 3 Garnet amaranth → 
- No. 4 Red cabbage → 
- No. 5 Pea tendrils → 

Carotenoids

Cilantro microgreens

Mature cilantro

- ß-Carotene : Microgreens: Mature = 3:1
- Lutein/zeaxanthin: Microgreens: Mature = 12:1
- Violaxanthin: Microgreens: Mature = 6:1

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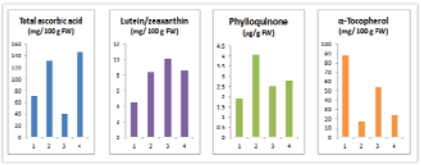
Top 4 Nutrients Concentrated Species

1. Green Daikon Radish
2. Garnet Amaranth
3. Cilantro
4. Red Cabbage



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Considerations Prior to Growing

- Do you have a market demand? If so what quantities?
- Space needed to meet that requirement?
- Will you produce single, mixes or both?
- How will you package, sale or deliver?
- Sources for supplies?
- Do you have the time and labor for planting, watering, harvesting, packing etc.?

Growing Microgreens

- Where?
  - Greenhouse
  - Other protected area
  - Personal Use - Kitchen

- How?
  - Potting mix
  - Hydroponic

Popular Microgreens

- Cauliflower
- Broccoli
- Cabbage
- Watercress
- Radish
- Arugula
- Lettuce
- Endive
- Chicory
- Radicchio
- Dill
- Carrot
- Fennel
- Celery
- Garlic
- Onion
- Leek
- Amaranth
- Swiss Chard
- Beet, Spinach
- Melon
- Cucumber
- Squash
- Mustard greens
- Broccoli
- Kale
- Radish
- Swiss Chard
- Cress
- Cilantro
- Legumes
  - Peas
  - Lentils
  - Beans

Easiest to Grow

- Arugula
- Broccoli
- Brussel Sprouts
- Buckwheat
- Cabbage
- Cauliflower
- Chia
- Endive
- Kale
- Kohlrabi
- Lettuce
- Mustard
- Red Clover
- Sunflower
- Wheatgrass

Challenging Microgreens

Moderate Difficulty

- Celery Leaf
- Corn Shoots
- Fennel
- Leeks
- Peas
- Sorrel
- Spinach

Difficult

- Amaranth
- Basil
- Beets
- Chard
- Chives
- Cilantro
- Cress

Getting Started

- Determine What to Grow
- Gather Supplies
  - Planting Media
  - Trays
  - Covers
  - Heating mat, circulation fans, and lighting (indoor or offseason)
  - Seeds

Seed Selection

- Start simple
- Select a few varieties or a prepackaged mix
- Diversify later
- Desired size of finished product major factor
- Days to harvest can vary from 2 - 4 weeks
- Sow seeds according to needs and times for optimal size and flavor
- Trial and Error as some grow faster
- Keep records!!!!

Seed Sowing (Soil)

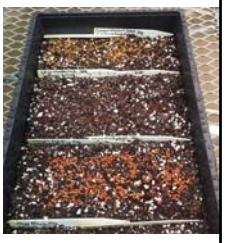
- Sow seeds into a 1020 flat with no holes
- Place 4 cups water in tray first then add media
- Soil mix – germinating mix or pre mixed
- Fill tray with 1 -1 ½ inches soil (leave room for harvest). Press soil surface.
- Starting in the corners - broadcast seed thickly on growing medium
- Press seeds firmly for maximum soil contact
- Mist with spray bottle or mist nozzle
- Cover tray (3-5 days; varies per crop)

Seed Sowing (Hydroponic)

- Sow seeds into a 1020 flat with no holes
- Place 1 cups water in tray first then add media
- Hydroponic growing mat or material
- Growing mat biodegradable wood fibers
- Starting in the corners - broadcast seed thickly on growing medium
- Mist with spray bottle or mist nozzle
- Cover tray (3-5 days; varies per crop)

Seed Density

- Small seeds
  - 10-12 seeds per square inch
  - 3 grams
- Large seeds
  - 6-8 seeds per square inch
  - 25 grams
- Practice
  - Too dense – no air
  - Too spare – difficult to harvest



Watering & Fertility

- Consistent moisture for best germination
- Mist 1-2 times a day
- Do not keep media saturated at all times to avoid disease
- Must be gentle to avoid washing seeds out
- Generally do not need fertilizer
- Media will provide most as long as it has some nutrient value
- Fertilizing can give off flavor

Temperature

- Germinate using heat mats, germination chambers or greenhouse bench
- Ideal soil temperature for germination varies by crop
- Ambient air temp of 65-75°F is generally a good range
- Temperatures above 75°F can increase disease pressure and slow germination

Air Circulation

- Dense planting can restrict air flow
- Best Practices to avoid problems:
  - Use clean media and water
  - Use correct seed density
  - Ensure horizontal air flow within the greenhouse

Lighting

- Additional lighting may be needed if natural light is insufficient
- Supplemental lighting can reduce time from seed to harvest up to 20%
- Greenhouse lighting is generally sufficient

Diseases

- Prone to damping off due to poor air flow
- Can get mold due to dense planting
- Proper watering and airflow reduce occurrence
- **KEY:** Know the difference between root hairs and mold

Root Hairs

Mold

https://www.growformore.com/microgreens/how-to-recognize-handle-and-prevent-mold-on-microgreens/

Days to Harvest

- QUICK QUICK QUICK
- Each day can make a difference
- Days to maturity vary with each crop
- Depends on market for size and flavor
- Average is 2 weeks up to 4 weeks

10-15-18

10-16-18

10-16-18

Harvesting

- Typically at 1st set of true leaves with cotyledons attached
- 1-2 inches tall
- Appearance and taste will let you know
- Takes practice

Harvesting Methods

- Scissors
- Sharp Kitchen Knife
- Compact Grass Shear

Yield

- Vary within crop and size of plant at harvest
- Larger seeded crops tend to yield higher volume faster

Trial 1

Variety	Date Seeded	Date Harvested	Amount Seeded (g)	Yield (g)
Hong Vit Radish	8-7-18	8-22-18 (15 days)	15 grams	30 grams
Spicy Micro Mix	8-7-18	8-23-18 (16 days)	5 grams	30 grams
Mild Micro Mix	8-7-18	8-23-18 (16 days)	5 grams	30 grams

Marketing

- MUST evaluate <u>YOUR</u> market
  - Chefs
  - Schools
  - Farmers' Markets
  - Health Food Stores
- Considered a luxury item
- Currently perform best in upscale markets
- We WANT to change that
- EVERYONE NEEDS MICROGREENS!

Packaging & Delivery

- Sold by loose weight, clamshell or bag
- Biodegradable options for clamshells and bags
- Can be sold as live plant – let customer cut them
- Refrigeration is a must
- Washing reduces overall appearance and shelf life
  - *Must follow food safety rules*
  - *Must make sure buyer knows your growing site and that you did not wash and that this is acceptable*
- HIGHLY PERISHABLE
- Need a cooler if making delivery

Pricing

- Must cover costs of production
  - Materials, labor, overhead
- Typical target price point for Microgreens is $40.00 per lb.
- $$$ Hold on just a minute…
- 1 lb. ~ 454 grams
  - 454 grams/30 grams clamshell = 15 clamshells
  - $40.00/15 clamshells = $2.67 each

Profitability

- Several Factors
  - Materials
  - Time
  - Labor
  - Yield
  - Price and Market Demand

Estimated Costs

Costs		
Fixed Costs	10 x 20 Trays	$1.00/Tray
Variable Costs	Seeds	<$15 lb. ($1.00/Tray)
	Soil	~ $1.00/Tray
	Water	Negligible for small crops
	Packaging	Varies
Total		$2.00-4.00/Tray

Estimated Income

Revenue	
Production	8-12 oz. per Tray
Pricing	$2.50 oz.
Revenue	$30 minimum per Tray
This will vary per crop and does not include your time, but your original cost is $2.00-4.00 per tray