

Commercial Microgreen Production

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Microgreens!



What are Microgreens?

- Edible Seedlings
 - Harvested at cotyledon or first true leaf stage (looks like plant)
 - Not sprouts (grown in jar under super moist conditions)
- Typically 1-3 weeks until harvest!
- Used in soups, salads, smoothies, or any replacement for greens



Vegetable crops harvested at an immature growth stage:

- Sprouts: germinated seeds with emerging root
- Microgreens: 2-3 inches in height; 7-21 days (harvest stem, cotyledons, and true leaves)
- Baby greens: 4-6 inches in height; 21-40 days
- Mature greens: >6 inches in height; 40-60 days

Cotyledons vs True Leaves



Phot Cred: <https://flic.kr/p/KqrvmQ> (Anna Gregory)

What are shoots?

- Just bigger microgreens
- Grown the same as microgreens, but usually larger seed size (3-5")
- Crops that make good shoots:
 - Peas
 - Sunflowers
 - Wheat
 - Popcorn
 - Nasturtium
- To avoid confusion, they are often marketed as microgreens rather than shoots



Photo Cred: <https://flic.kr/p/ny7vr4> (Lotus Johnson)

Why grow Microgreens

- Fun & easy to grow (fill gap for “winter blues”)
- Quick crop turnover and ROI
- Can be produced year round\$\$\$\$
- Super Food
 - Rich in phytonutrients and secondary plant metabolites!
 - Some studies show they are more 4-6 more nutrient dense concentrated than their mature counterpart (cotyledons stage)
- \$1/oz. in Whole Foods
- \$0.25/ oz to produce
- High gross/sq ft (\$25)

Sprouts vs Microgreens!!!!

- Microgreens are not sprouts!
- Sprouts are grown in jars or germination chambers without soil
- Sprouts require daily rinsing and a moist environment with limited light exposure
- Sprout=eating root, stem, cotyledons, and seed hulls
- Microgreen=only eating stem and leaves/cotyledons
- Microgreens are usually grown in a soil like media with air circulation and sunshine
 - Less risk of pathogen spread and/or **contamination**
 - Tested seed and/or sanitize the seed with peracetic acid chemistry



Photo Cred: <https://flic.kr/p/dHs37J> (Suzie's Farm)

Microgreen Seeds

- Same as their larger version
- Need a lot of seed! (5-25 lb quantities)
- Pre-mixed blends for better uniformity
- Untreated and ideally lot tested for pathogens
- Lot code on packets important for record keeping and tracking seed germination and other records
- Presoaking helps larger seeds germinate (6-8 hours)
 - Peas, sunflowers, etc
- Sanitize seeds if pathogens are a concern or disease issues (sunflowers)
 - Four tsp white vinegar and 4 tsp food grade hydrogen peroxide in 1 quart of water and soak seeds for 10 minutes
 - Other commercial peroxyacetic acid formulations available (Oxidate 2.0 and Tsunami 100) read and follow labels!

Good Microgreen Varieties?

Fast and easy: arugula, kale, radish, broccoli, mustard, broccoli raab, bok choy, komatsuna and other Asian greens, cress, lettuces (fragile)

More challenging: amaranth, beet, Swiss chard, cilantro, basil, dill, carrots, scallions, purslane



VEGETABLES HERBS FLOWERS COVER CROPS SEED RACKS / WHOLESALE GIFT IDEAS RETAIL LOCATIONS QUICK ORDER

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Organic Non-GMO Micro Greens

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Micro-greens are riding a wave of popularity onto the plates and into the greenhouses of restaurants, homes, and farms all across America, and for good reason: easy to grow, easy to harvest, easy to prepare, delicious to eat, highly nutritious, and highly marketable! Whether you are a commercial grower looking to expand a niche into fresh supply for restaurants or a home gardener wanting to add a little healthy zest to your diet, we've got the seeds you need to do the job - and as always, you can be assured that a lot of our seeds are 100% certified organic!

Organic Non-GMO Micro Greens

Organic Green Kale Micro Greens Organic Mild Mix Micro greens Organic Onion Micro Green Organic Spicy Mix Micro greens Organic Broccoli Micro Green



Organic Purple Orach Micro Greens Organic Arugula Micro Greens Organic Red Beet Micro Greens Organic Green Chard Micro Greens Organic Golden Chard Micro Greens



Organic Red Chard Micro Greens Organic Mizuna Asian Micro Greens Organic Red Mustard Micro Greens Organic Pac Choi Micro Greens Organic Red Russian Kale Micro Greens



University of Illinois Extension does not endorse any particular vendor

Micro Greens Comparison Charts



HERBS — Slow-Growing Micro Green Varieties (16-25 days)

Part #	Variety	Description	1/4 lb. @/Lb.	1 lb.	5 lbs. @/Lb.	25 lbs. @/Lb.
904M	NEW Anise	Bright green, round, toothed leaves, mild licorice flavor	—	\$31.55	\$27.95	\$23.95
3123M	NEW Anise Hyssop	Light green and pink tinged leaves, licorice-mint flavor	\$39.95	\$135.00	\$127.95	\$114.95
902M	Basil, Dark Opal	Purple and green leaves, sweet spicy flavor	\$26.95	\$86.40	\$79.03	\$75.65
944M	Basil, Italian Large Leaf	Shiny green leaves, sweet spicy flavor	\$6.95	\$21.95	\$20.95	\$18.95
727M	Basil, Lemon	Shiny green leaves, spicy lemon flavor	\$14.05	\$45.25	\$36.25	\$32.60
724M	Basil, Red Rubin	All purple leaves, sweet spicy flavor	\$24.95	\$89.95	\$77.25	\$58.25
924MG	Basil, Red Rubin	All purple leaves, sweet spicy flavor	\$29.95	\$97.90	\$93.33	\$85.86
2441M	Chervil	Intricate green leaves, anise flavor	\$6.95	\$21.95	\$20.95	\$18.95
919M	Cilantro	Intricate green leaves, cilantro flavor	\$4.95	\$12.95	\$12.00	\$8.95
922M	Cutting Celery	Finely-textured green leaves, mild celery flavor	\$16.25	\$50.35	\$44.50	\$33.27
920M	Dill	Feathery leaves, mild dill flavor	\$5.95	\$17.45	\$15.48	\$12.92
7848MG	Fennel, Bronze	Feathery bronze leaves, mild fennel flavor	\$42.15	\$144.15	\$136.00	\$122.45
3152M	Fennel, Green	Finely textured light green leaves. Great fennel flavor	\$5.95	\$17.45	\$15.48	\$12.92
266M	Lemon Balm	Tiny, shiny green leaves, distinct lemon flavor	\$38.50	\$120.60	\$104.50	\$93.34
6023M	NEW Marigold, Gem	Intricate leaves, spicy flavor	\$90.60	\$340.00	\$310.50	—
2390M	Parsley	Intricately lobed leaves with mild parsley flavor	\$8.30	\$21.50	\$19.01	\$16.89
839M	Salad Burnet	Intricate leaves, mild cucumber flavor	\$19.05	\$64.40	\$56.43	\$53.44
2677M	Saltwort	Thread-like succulent leaves, mild earthy flavor	\$30.05	\$108.30	\$89.81	\$76.25
2943M	Shiso, Britton	Purple ruffled leaves, mild licorice flavor	\$35.00	\$122.70	\$115.20	\$109.40
383M	Sorrel	Lemon flavored	\$15.40	\$47.55	\$42.97	\$39.78
2827M	Sorrel, Red Veined	Red-veined, lemon-flavored leaves	\$57.05	\$193.05	\$172.00	\$164.08

VEGETABLES — Slow-Growing Micro Green Varieties (16-25 days)

Part #	Variety	Description	1/4 lb. @/Lb.	1 lb.	5 lbs. @/Lb.	25 lbs. @/Lb.
2247MG	Amaranth, Garnet Red	Fuschia-colored leaves and stems, mild earthy flavor	\$10.15	\$28.70	\$25.55	\$23.49
2891MG	Arugula	Nutty, spicy flavor	\$11.50	\$34.35	\$30.92	\$28.50
385M	Arugula	Nutty, spicy flavor	\$8.10	\$23.10	\$20.39	\$18.56
2912MG	Beet, Bull's Blood	Lofty, red leaves, red stems, earthy flavor	\$17.00	\$55.85	\$49.45	\$46.35
2912M	Beet, Bull's Blood	Lofty, red leaves, red stems, earthy flavor	\$9.95	\$21.95	\$19.98	\$17.85
123M	Beet, Early Wonder Tall Top	Lofty, bright green leaves, red stems, earthy flavor	\$5.35	\$11.35	\$10.05	\$9.39
3115M	Beet, Rubens	Lofty, red leaves and stems, earthy flavor	\$9.55	\$20.55	\$19.59	\$17.50
2965M	Beet, Yellow	Lofty, bright green leaves, yellow stems, earthy flavor	\$7.05	\$19.45	\$16.53	\$14.68
2468M	Carrot	Feathery leaves, mild carrot flavor	\$7.20	\$19.85	\$16.86	\$14.97
703DM	Chard, Bright Lights	Lofty, red, yellow, pink, white stems, earthy flavor	\$34.45	\$101.40	\$91.14	\$88.00
702MG	Chard, Ruby Red	Lofty, bright green leaves, red stems, earthy flavor	\$14.95	\$36.95	\$32.76	\$31.20
702M	Chard, Ruby Red	Lofty, bright green leaves, red stems, earthy flavor	\$6.95	\$14.95	\$12.39	\$11.81
337M	Komatsuna O.P.	Round green leaves, mild flavor	\$12.65	\$39.95	\$35.55	\$32.45
2778MG	Magenta Sprout	Bright green leaves with hint of pink, earthy flavor	\$39.70	\$132.30	\$120.37	\$115.08
328M	Mustard, Red Giant	Green leaves, red veins, spicy flavor	\$15.40	\$47.55	\$42.97	\$39.78
2884MG	Mustard, Red Giant	Green leaves, red veins, spicy flavor	\$15.95	\$51.40	\$46.47	\$43.02
3999MG	Orach, Ruby Red	Lofty, purple-red leaves and stems, earthy flavor	\$42.35	\$136.50	\$125.83	\$113.25
3168M	Pac Choi, Red Pac	Dark red pac choi for micro greens	\$22.60	\$71.70	\$68.39	\$62.93
2257M	Purslane, Red Gruner	Succulent leaves, white-pink stems, earthy flavor	\$15.40	\$47.55	\$42.97	\$39.78
502M	Scallion, Evergreen Hardy White	Green thread-like leaves, onion flavor	\$12.30	\$35.70	\$30.77	\$28.53
314M	Shungiku	Toothed leaves, mild flavor	\$12.10	\$36.10	\$31.04	\$28.59

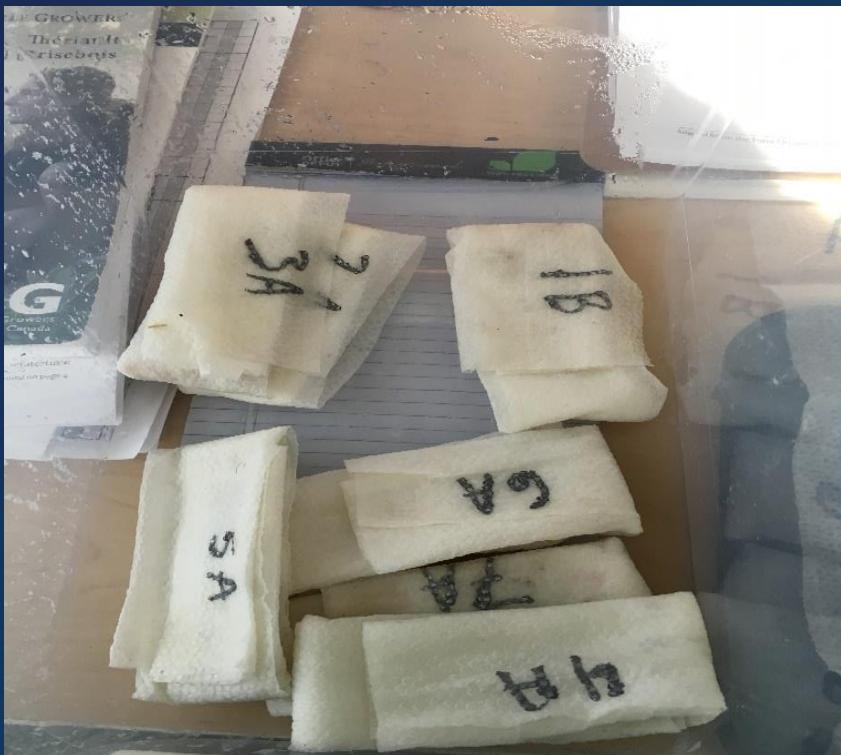
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Germination Testing

Use Seed Lot Code or Other Code to track germination rates

- Look for 80-95% Germination
- If stored properly (cold and dry), microgreen seed will last 3-5 years

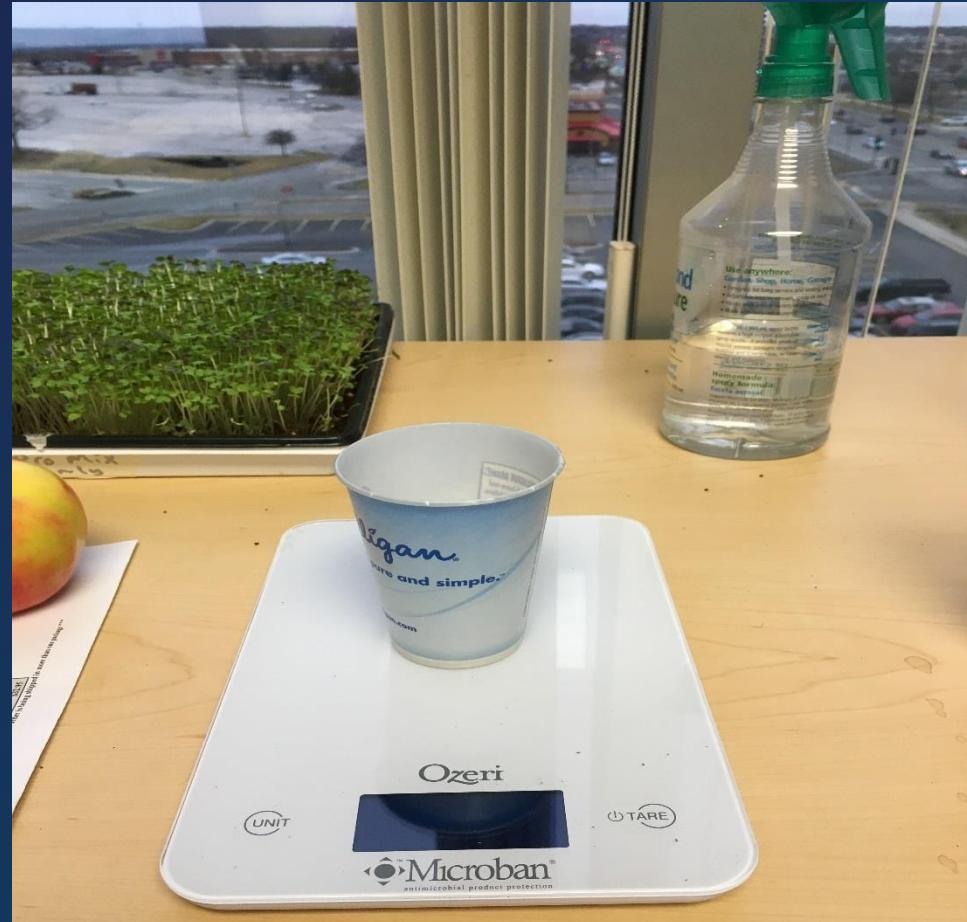


Seeding Rates

- By Volume
 - 2-2.25 tbs / flat for large seeds
 - 1 tbs/ flat for Brassicas
 - Equivalent of about 10-12 g/tray
- By Weight
 - 3g/1020 tray for small seeds
 - 10-15g/1020 tray for medium sized seeds
 - 25g/1020 tray for large seeds (radish)
- Seed at lower density for first true leaf MG's
 - Ex. For medium sized seeds sow @ 10-12g/1020 tray instead of 15g/tray
 - Not exact, do some trials with the varieties you want to grow

- Seeding Rates

- Use eye ($6-8/\text{in}^2$ for large and $10-12/\text{in}^2$ for small)
- Weight/tray
- Volume/tray



Seed Density

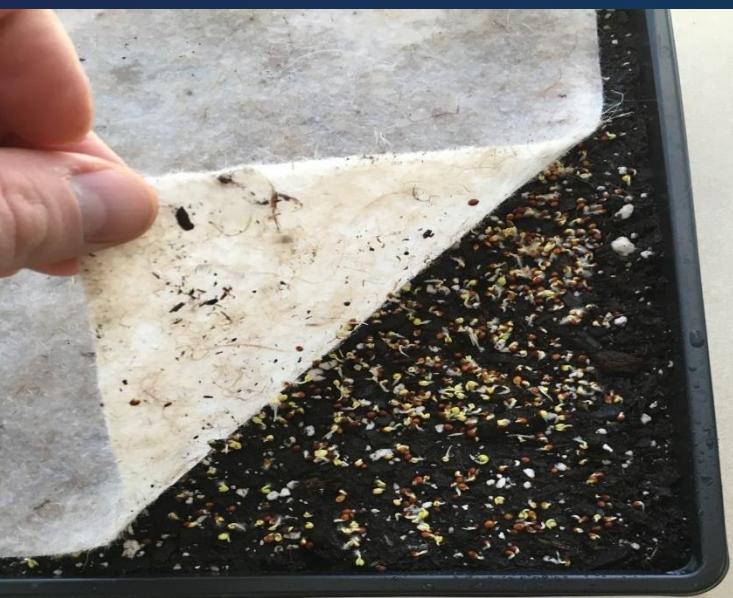


Photo Cred: <https://flic.kr/s/aHsjzoSaCq> (Eweinhoffer)



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Ben Hartman of Clay Bottom Farm Technique

- 1) Fill a perforated seedling tray with compost.
- 2) Use dibbler to make 266 impressions.
- 3) Fill the impressions with 4-6 seeds using a plexiglass plate seeder.
- 4) Cover lightly with vermiculite. The tray will sit on cafeteria trays for bottom watering.
- This system ensures great germination and spacing, and minimizes mold.
- Seedling trays, dibbler, and seeder **from Small Farm Works**
 - Dibbler and Seeder=\$625
 - Case 10 trays=\$45



Photo Cred: Ben Hartman (Clay Bottom Farm Facebook)

Microgreen Growing Trays

- Tray in tray system (collect drainage)
for 1020 flats
 - 10 or 20 row or open flat system

1-1 ½ in. depth of growing media



Growing Media

- Two schools of thought with growing medium
 - Nutrient Dense vs Not Nutrient Dense
- Media choice is one of the largest costs of production
 - \$1.50-\$4 per 1020 tray
- Opt for the highest quality and low cost media with minimal nutrients
 - Microgreens 0-15 days old need very little to no nutrients
 - 15 -21 day old microgreens benefit from a little more nutrient availability and seed spacing if first true leaves are desired
- Post Planting Fertilization can be done in a hydroponic or soil based method
 - Likely not necessary
 - Avoid smelly fertilizers like fish emulsion
- Compost used media
 - Media could technically be re-used if reinvigorated with compost or other fertilizer
 - Risky option for potential disease spread

BioFelt Pad Hydroponic Production



Photo Cred: <https://flic.kr/p/eTNDi7> (The Plant)

Commercial Growing Options

- Greenhouse
 - Heated (Nov-April) or unheated(April-Nov?)
 - Microgreens can tolerate shade so using any unused vertical space is an efficient use of the fixed cost of the structure
 - Evaluate space in a transplant greenhouse to make sure there is room for both microgreens and transplants
 - Consider focused heat within an inner greenhouse or minimum temp they will tolerate for heat savings
- Indoors
 - Growing indoors requires an additional investment , but if you don't have a transplant production greenhouse this is where most start
 - Need a bottom watering system and good air circulation to prevent funal and mildew issues
- Shipping Container Systems
 - Potential to move and stack
 - Low cost infrastructure to start (Podponics)

Commercial Growing Options (Greenhouse)



Photo Cred: Ben Hartman (Clay Bottom Farm Facebook)

Tray Filling



Photo Credits: Ben Hartman (Clay Bottom Farm Facebook)

Commercial Growing Options (Indoors)



Photo Cred: <https://flic.kr/s/aHsjzoSaCq> (Eweinhoffer)

Shipping Containers or Pods



Photo Cred: <https://flic.kr/s/aHsjzoSaCq> (Eweinhoffer)

Light and Temperature Considerations

- Indoor
 - Lettuce, arugula, mustards, Asian greens will grow ok in low light or shade
 - T-8 fluorescent lights can supplement or replace sunlight (keep tubes < 2 in. from plants)
 - Easier to regulate temps in basements might need A/C for pods
 - Air circulation is a must to prevent disease
- Outdoor
 - Microgreens can tolerate some shade
 - Growth changes with day length
 - Shade cloth may be necessary in summer
 - Can tolerate temps up to 100F
 - 40F in winter to get consistent germination
 - Heated table may come in handy here
 - Air circulation via venting and fans



Water

- Access
 - Frost free water for a greenhouse a must
 - Use pathogen free/highest quality water (potable)
 - Ideally testing 0 MPN Generic E.Coli
 - City water may or may not be a problem because of chlorine
 - Least risky water source unless you are treating your well or surface water
- Management
 - Make sure water isn't pooling in your growing space
 - Hand watering or automated overhead sprinkler system possible
 - Preferred bottom watering once established to reduce risk of fungal and mildew
 - Each microgreen variety may have different watering needs (practice and experience)

Harvesting

- Prior to Harvest
 - Make sure microgreens are properly watered and not wilted
 - Determine when you want to harvest:
 - Cotyledon or true leaf
 - Best to harvest in the morning when its not hot(greenhouse/tunnels)
- Tools
 - Scissors (not at scale)
 - Grass Shears (handheld)
 - Quick Greens Harvester
 - Newer Technologies



Microgreen Stand for Greens Harvester (\$169)



Photo credit: Farmers Friend LLC



Photo Cred: <https://flic.kr/s/aHsjzoSaCq> (Eweinhoffer)

Post Harvest Handling and Food Safety

- Some growers wash and some don't
 - Depends on how dirty your MG's get, marketing, food safety indications
- Hydroponic Growers may not need to wash greens because there is no soil
- Use a box fan to dry on drying table
 - Dried MG's have a longer shelf life
- Packing into bags, clamshells, deli containers
 - Uline, Webstaurant, Eco Products
- Keeping them as close to 32-36F will enhance their quality and shelf life
 - 10 days or more
- Not much in the way of research into safety of microgreens (lots for sprouts)
- Same GAP procedures for other products
- Test water
- Sanitize trays and seeds
- Wash Hands

Microgreens Marketing

- Direct to Consumer (Farmers Market)
 - Market customers more price sensitive?
 - Is there room for more than one microgreens grower per market?
 - Build loyal customer base
 - Part of CSA shares during slow season
- Restaurants/Chefs
 - Need quality and reliability
 - Can command a better price
 - Chefs may demand difficult crops
 - Small orders worth your time?
 - Standing orders, recurring, or contracts the best
- Retail/Wholesale
 - Lowest price point
 - How will your product look in a produce section, do you speak retail?
 - High quality and long shelf life.
- Don't grow if you can't sell!
 - Bulk microgreen seed can be pricey!



Photo Cred: <https://flic.kr/p/6nVCvW>

Microgreen Marketing



Photo Cred: <https://flic.kr/p/9mpxBH> (Seacoast Eat Local)



Photo Cred: <https://flic.kr/p/sNwmHP> (Dave Bellous)

Microgreen Marketing



Photo Cred: <https://flic.kr/p/arvpDc> (Imelda)



Photo cred: Suzie's Farm
<https://flic.kr/p/btNQKj>

Pricing

- How you sell you MG's=How you Price
 - Cut, washed, and packaged
 - Cut, unwashed, and packaged
 - Cut on site at Farmers Market
 - "Cut Your Own" trays
- Cut, washed, and packaged can go anywhere from \$20-\$98/lb
- \$5 for 2-3oz clam shell or bag is common or \$26-\$32/lb
- \$5 for 3-4oz shoots= \$16/lb
- Keeping even pricing in regular sizes is easier at the market
- Track costs of production (media, seed, packaging, labor)
 - Will help you not lose money
 - Easy to track for microgreens because the production system is simple
- Expenses of around \$2-4 per tray (not including labor)
- Net \$4.25-\$36 per tray (not including labor)
- 1 tray could yield 0.25-1 lb



\$400-2500 approximate gross in above pic!

Questions?

Favorite Youtube Videos

Westhaven Farms - Growing Microgreens:
<https://www.youtube.com/watch?v=JA8p5IT91H8>

Commercial Microgreens Operation - Curtis Stone w/ Chris Thoreau:
<https://www.youtube.com/watch?v=0uVL-PvzQxU>

Microgreens Correct Seeding Density and Yields:
https://www.youtube.com/watch?v=CPBEF_UcsUM

Good Water Farms: Providing Big Organic Nutrition in Small Plants:
<https://www.youtube.com/watch?v=Ak0U9a4BKBo>

Made in NC: Microgreens
<http://myfox8.com/2012/05/02/made-in-nc-microgreens/>



Curtis Stone (The Urban Farmer):
VLOG 28 How To: Harvest Microgreens