



Winter Spinach Production & Pests

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A close-up photograph of fresh spinach leaves, showing their characteristic crinkled texture and vibrant green color. The leaves are densely packed and fill the top portion of the frame.

Outline

- Winter high tunnel production systems
- Spinach diseases
- Spinach insect pests
- Recommendations for improving production

Why winter spinach?

- Demand for fresh local greens in winter is HUGE
- \$9/lb wholesale, \$14/lb retail – pre-pandemic!
- Winter revenue
- Year-round employee retention
- Attracting customers to increase sales of other crops

Challenges

- No winter break
- Access to frost-free water
- Economics



Range of Production Systems



Low-input manual systems



Highly mechanized, specialized systems



Farm 1

Marketing	CSA
Average price per pound	\$6.41
Equipment cost*	\$0
Plant density	80 plants/ft ²
Seeding date	September 21
Harvest period	December 3 – April 16 (19 weeks)
Total labor cost	\$1,745 \$1.29/ft²
Production materials cost	\$68 \$0.05/ft²

- Sells solely through winter spinach CSA
- Hand and walk-behind tools
- Low production material cost
- High labor cost



Farm 2

Marketing	75% wholesale, 25% retail
Average price per pound	\$10.25
Equipment cost*	\$55,350
Plant density	2.8 plants/ft ²
Seeding/Planting date	Seeded early September Transplanted early October
Harvest period	November 2 – March 22 (20 weeks)

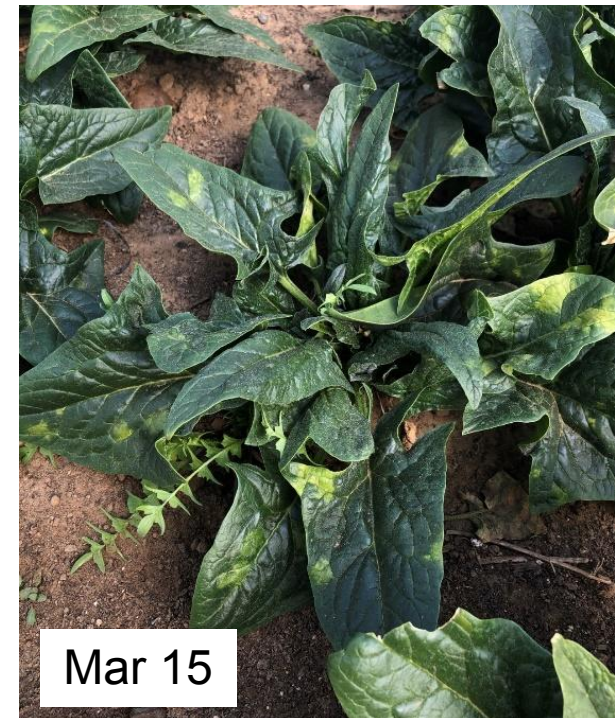
- Certified organic
- Transplant spinach
 - Early September: summer crops removed and spinach transplants seeded in greenhouse
 - Early October: spinach transplanted into high tunnel
 - Just starting to use PaperPot system



Farm 2

Total labor cost	\$1,267 \$0.42/ft²
Production materials cost	\$2,298 \$0.77/ft²

- Row cover: pushes growth faster but added labor + materials cost
- Downy mildew starting in late October
- Harvesting by hand, leaving young leaves uncut
- High production materials cost: soil amendments, row cover, transplant materials



Farm 3

Marketing	Mostly wholesale
Average price per pound	\$9.75
Equipment cost*	\$75,140
Plant density	140 plants/ft ²
Seeding date	October 12 Re-seeded October 25
Harvest period	January 24 – March 13 (7 weeks)

- Certified organic
- Tunnel in cover crop summer 2020
- Seeded Auroch October 12 – DM on field Auroch nearby, so tilled under
- Re-seeded Kolibri ~October 25



Farm 3

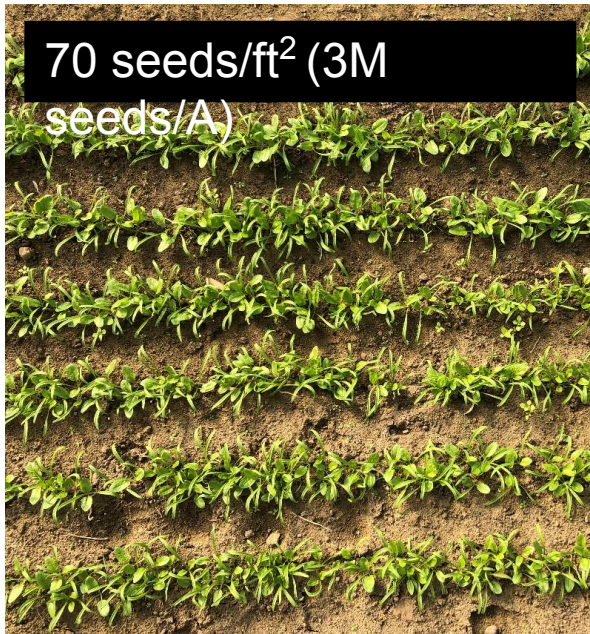
Total labor cost	\$286 \$0.05/ft ²
Production materials cost	\$484 \$0.08/ft ²

- High plant density – but they harvest small leaves
- Cladosporium leaf spot significantly reduced yield – 950 lbs loss □ \$9,200 loss
- High cost for specialized equipment
- Low labor costs



Planting

- Direct seed by early October (in MA) for *best* yield
- Can transplant seedlings for earlier harvest
- More costly, but reliable, jump start
- Recommended seeding rate: 70 seeds/ft²



Harvesting

By hand

- Leaf by leaf
- Clear cutting

Mechanical

- Drill-powered
- Tractor-mounted



Washing & Packing

- Need warm place to wash
- Some farms triple rinsing
- Hand-powered spinners or converted washing machines to dry



[Washing Machine/Greens Spinner Conversion Guide](#)
UVM Ag Engineering Blog



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- **Spinach diseases**
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Farm 1



- Manual
- No tractors
- Walk-behind seeder
- Harvesting
leaf-by-leaf, by hand
- CSA

- Low labor costs
- Low revenue



Farm 1

Farm 2



- Tunnel prep with tractors
- Transplanted spinach
- Low plant density
- Row cover
- Harvesting leaf-by-leaf with knife
- Retail and wholesale

- **High labor costs**
- **High revenue**

Farm 1

Farm 2

Farm 3



- Highly specialized and mechanized
- Tunnel prep, seeding, harvesting all with tractors
- Cladosporium outbreak
- **Low labor costs**
- **Low revenue due to disease**

Side-by-Side

	Farm 1	Farm 2	Farm 3
Tunnel size	1,350 ft ²	3,000 ft ²	6,000 ft ²
Equipment cost	\$0	\$55,350	\$75,140
Plant density	80 plants/ft ²	2.8 plants/ft ²	140 plants/ft ²
Labor time	0.07 hrs/ft ²	0.02 hrs/ft ²	0.003 hrs/ft ²
Labor cost	\$1.29/ft ²	\$0.42/ft ²	\$0.05/ft ²
Production materials cost	\$0.05/ft ²	\$0.77/ft ²	\$0.08/ft ²
Average \$/lb	\$6.41	\$10.25	\$9.75
Yield from tunnel	0.34 lbs/ft²	0.27 lbs/ft²	0.19 lbs/ft²
Sales from tunnel	\$2.22/ft²	\$2.75/ft²	\$1.53/ft²
Profit per square foot*	\$0.88	\$1.56	\$1.40

Plant density affects harvest method, or harvest method informs plant density

Transplanting has a significant effect on cost of production materials

How high of a price will customers pay for winter greens?

Specialization can lead to higher profitability but also brings higher risk

*Does not include production materials or post-harvest equipment, labor, or materials

Spinach Downy Mildew

- Oomycete pathogen
- Favored by cool, moist conditions
- Host-specific to spinach
- Requires living host to survive
- Not clear how it survives from season-to-season
- 19 numbered strains (“races”) + many novel
- Different cultivars susceptible to different races
- Management:
 - Plant several cultivars with broad DM resistance that do not share gaps in resistance
 - Reduce leaf wetness
 - Oomycete-specific fungicides can prevent disease if applied before symptoms begin
 - OMRI-listed: copper

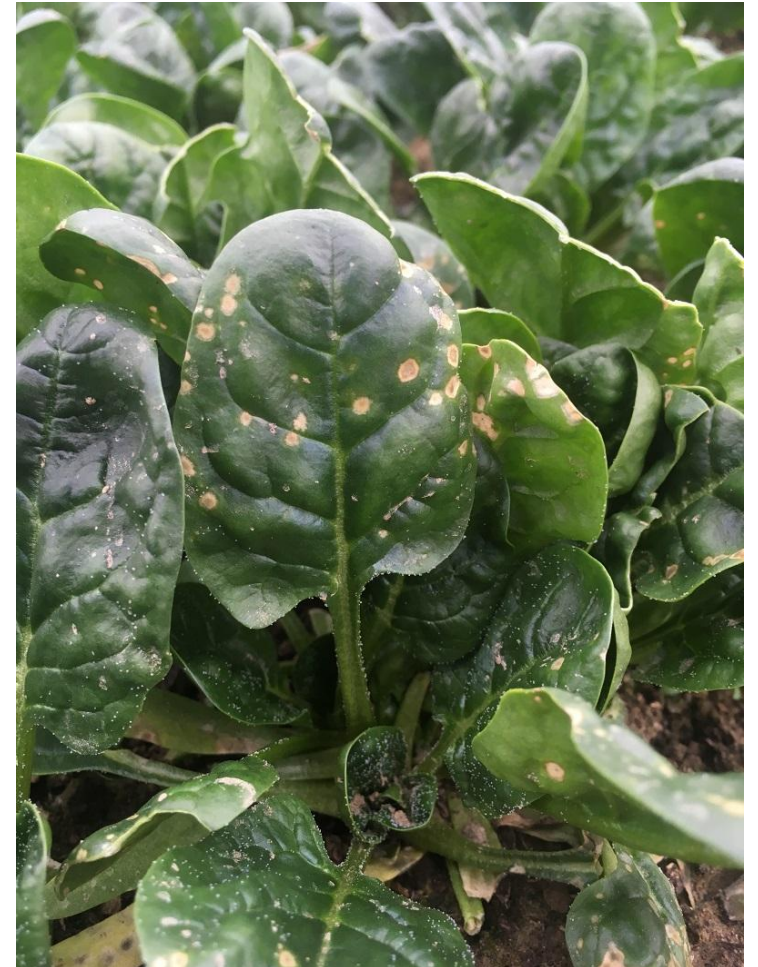


Disease Resistance Details

High Resistance: Downy Mildew (1-11, 13, 15, 16)

Cladosporium Leaf Spot

- Fungal leaf spot
- Causes round, tan leaf spots that develop olive-green sporulation
- Favored by cool, moist conditions
- Seed-borne
- Spores spread via wind, splashing water
- Varietal resistance but not reported
- Treating seeds with bleach or hot water will eliminate the pathogen
- Few fungicides labeled for *Cladosporium*



Damping Off

- Caused by several soil-borne fungal and fungal-like organisms (*Pythium*, *Fusarium*, *Rhizoctonia*), ubiquitous in soils
- Weak pathogens that attack young, slow-growing, or weak plants, under cool, wet conditions
- Pre- or post-emergence damping off
- Results in poor stand
- Management:
 - Provide proper fertility, adequate water, well-prepared seedbed
 - Practices to improve soil health can help suppress damping off: cover cropping, soil steaming
 - Inoculating with beneficial soil microbes (e.g. Rootshield)



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Winter cutworms

- Wide range of colors
- Feed on foliage at night, hide during day
- Bt products, Entrust
- Hand-picking during harvest or at night



Aphids

- Infest growing points
- Released ladybeetles are active through winter but need high population to sustain them
- Control aphids in summer crops, when options are broader
- If using pesticides, use aphid-specific materials to preserve natural enemies
- **Conventional materials** allowed in tunnels include: Venom, Beleaf, Sivanto, Malathion, Pounce, Fulfill, Torac, Mustang
- **Most effective OMRI-listed control:** Insecticidal soap, horticultural oils, azadirachtin



Crown Mites

- Feed in growing points
- Cause deformed growth
- Cause most damage mid-winter when plants are growing slowly
- More common in soils with high organic matter
- Little research on effective pesticides





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Improving Profitability of Winter Spinach

- Plant more densely
- Harvest by clear cutting
- Increase price/lb
- Increase harvest size (if harvesting babyleaf)
- Row cover not required (in MA)
- Grow multiple DM-resistant varieties
- Uniform beds & irrigation
- Fertility: Apply fertilizer up-front, then take a PSNT in late February and sidedress if nitrate is below 30 ppm
 - Per acre: 20# N, 20-40# P, 25-55# K





Questions?

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