Managing Disease in High Tunnel Winter Greens

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Managing Diseases - Winter Tunnels

Be proactive. Know what diseases can occur + symptoms.

Expect disease occurrence to be different from field.

Be aggressive about management.

Share observations.
Diseases Occurring in Winter Greens and their Management

Updated July 2020

This factsheet contains information on the following:

- Downy Mildew of Spinach | Lettuce | Kale and other Brassicas
- Powdery Mildew of Kale, other Brassicas, and Lettuce
- Cladosporium Leaf Spot of Spinach
- Botrytis Crown Rot of Lettuce
- Root Rot

Additional Information:

- Downy mildew and powdery mildew of arugula
- If you grow winter greens please complete this survey.
- Summary information from survey responses received in 2018
- What Works for Organic Disease Control in Winter Tunnels
- Presentation on Organic Disease Control in Winter Tunnels at New England Vegetable and Fruit Conference Dec 2019

Introduction

Foliar diseases observed recently in winter greens are of special concern. They include downy mildews (spinach, brassicas and lettuce) and powdery mildews (brassicas and lettuce). All are capable of rendering a crop unmarketable. Plants are susceptible at all stages, including cotyledon stage. Their occurrence in field-grown plants in late fall and in winter tunnels is perplexing because most have not been observed recently in these crops grown during traditional production periods, with the exception of brassica downy mildew. Conditions during production of winter greens evidently are very favorable for these pathogens that tolerate cool temperatures. Prolonged periods of leaf wetness or high humidity likely is a factor. Low light levels and short days mean these pathogens have long periods to produce spores. Plastic covering high tunnels protects the pathogens from exposure to damaging UV radiation.
Managing Diseases - Winter Tunnels

1. Avoid introducing pathogens into tunnel.
   Wind-dispersed spores, seed, soil, infested debris.
   Hot-water treat seed.

2. Grow resistant varieties. Grow more than one.
   Spinach and lettuce downy mildew – race specific resistance –
   pathogen continuously changing.

3. Create conditions unfavorable for pathogens.
   Minimize leaf wetness, humidity, soil moisture.
   Drip irrigation, ventilation, heating. Cover plants when leaves dry.
   Maintain constant temperature.

4. Look for disease symptoms regularly + thoroughly.
   Accurate diagnosis is important.
Managing Diseases - Winter Tunnels

5. Harvest early when disease found.
6. Promptly remove affected plant tissue.
8. Root diseases:
   - Apply biofungicides to soil.
   - Use transplants. Avoid overwatering, but also salt build up.
   - Don’t plant soon after incorporating plant tissue.
   - Anaerobic soil disinfestation. Soil solarization. do in summer.
10. Apply fungicides preventively. Thorough coverage critical for foliar diseases. Esp. with biopesticides.
Biostetics for Organic and Conventional Disease Management in Vegetables and Strawberries

Biostetics registered in New York for specific crops with labeled diseases occurring in the Northeast.

Lists do not include the few conventional biostetics (e.g., phosphorous acid fungicides) that are not permitted in organic production.

- Beet
- Brassica crops
- Bulb crops
- Carrot
- Cucurbit crops
- Eggplant
- Leafy vegetables
- Pepper
- Potato
- Strawberry
- Tomato
- Biostetics labeled for bacterial diseases

More information:

https://www.vegetables.cornell.edu/pest-management/disease-factsheets/
Foliar Diseases – Winter Greens

**Downy Mildew Pathogens:**
- Spinach: *Peronospora farinosa f. sp. spinaciae*
- Brassicas*: *Peronospora parasitica*
- Lettuce: *Bremia lactucae*

**Powdery Mildew Pathogens:**
- Brassicas*: *Erysiphe cruciferarum*
- Lettuce: *Erysiphe cichoracearum*

* Brassicas include kale, arugula, Bok choy, and mustard greens.
Host specificity?
Spinach Downy Mildew (aka Blue Mold)

Race specific resistance. Excellent. Races detected in northeast recently: 12, 13, 14 (most cases), 15, 16, 17, novel

Images cf. Teresa Rusinek, Cornell
Spinach Downy Mildew: Race specific resistance. Excellent.

**Corvair**
Organic (F1) Spinach Seed

Organic all-season spinach.


**Sunangel**
(F1) Spinach Seed

Heavily savoyed DMR spinach for spring, fall, and winter.

A good balance of speed, dark color, savoy, and bolt tolerance for ample harvests through most of the year. More uniform and upright than Emperor, with a less cupped leaf. High resistance to downy mildew races 1–9, 11–19 and intermediate resistance to race 10; intermediate resistance to white rust. Avg. 25,500 seeds/lb. Packet: 1,000 seeds.
Spinach Downy Mildew

Pathogen races detected in Northeast recently, affected variety and its resistance

12, 14 (4X), novel Corvair (1 – 11, 13)
12 Acadia (1 - 13, 15, 16)
14 Kookaburra (1 - 13, 15)
15 Space (1, 2, 3, 5, 6, 8, 11, 12)

novel Escalade (1 - 14, 16)
novel Pigeon (1 - 13, 15)

Races suspected based on varieties affected and not:
12, 13, 14 (most cases), 15, 16, 17, novel.
Spinach Downy Mildew:
Race specific resistance. Excellent.

Races 1 - 11, 13, 15, 16, 18

Corvair
Organic (F1) Spinach Seed

Organic all-season spinach.

Races 1 – 19; 10 IR

Sunangel
(F1) Spinach Seed

Heavily savoyed DMR spinach for spring, fall, and winter.
A good balance of speed, dark color, savoy, and bolt tolerance for ample harvests through most of the year. More uniform and upright than Emperor, with a less cupped leaf. High resistance to downy mildew races 1 – 9, 11 – 19 and intermediate resistance to race 10; intermediate resistance to white rust. Avg. 25,500 seeds/lb. Packet: 1,000 seeds.

Images cf. grower
Spinach Downy Mildew: Race specific resistance. Excellent.

Auroch
(F1) Spinach Seed

Fast growing, upright variety for the winter tunnel.

Very tall plants with very long stems. Leaves are dark green, very heavy, smooth, and flat with elongated oval shape. Suitable for picking at all growth stages. Performs best in fall, winter, and early spring. High resistance to downy mildew races 1–12, 14–16, 19. Avg. 38,900 seeds/lb. Packet: 1,000 seeds.

Races 1 - 12, 14 - 16, 19

Sunangel
(F1) Spinach Seed

Heavily savoyed DMR spinach for spring, fall, and winter.

A good balance of speed, dark color, savoy, and bolt tolerance for ample harvests through most of the year. More uniform and upright than Emperor, with a less cupped leaf. High resistance to downy mildew races 1–9, 11–19 and intermediate resistance to race 10; intermediate resistance to white rust. Avg. 25,500 seeds/lb. Packet: 1,000 seeds.

Races 1 – 19; 10 IR
Spinach transplants

Apr 2017
Images cf. grower
Spinach Downy Mildew

Potential sources of pathogen
Seed? Oospores found but ability to infect seedlings not determined.
Wind dispersed spores (sporangia) from other crops.
Also discarded produce??

Occurs routinely in AZ and CA (field)
Managed with resistant varieties (race specific) and conventional fungicides.
Bacterial Blight
Arugula

Images cf. Shaheen Bibi, PSU
Lettuce - Downy Mildew
Yellow spots upper surface

Spores underneath

Oct 2009
Spores all over upper surface

27 Nov 2017
**Lettuce Downy Mildew**

Multiple races. Resistance is race specific.

Other hosts include: wild lettuce, artichoke, cornflower, and strawflower. Pathotypes infect specific plants.

Damp, cool conditions and moisture on leaves required for infection. 3+ hours.

Spores form during still, humid nights (dark). 68 F = optimum; Occurs 41 – 75 F. Bright sunlight and low humidity inactivate spores.

Latent period (4 - 34 days). Long when continuously cool. Short under fluctuating low temperatures.

Sources: seed, sexual spores (oospores, rarely seen), and wind-blown asexual spores.

Common in CA lettuce growing areas.
High Tunnel

Powdery Mildew Lettuce
Lettuce Powdery Mildew

Other hosts include: chicory, endive, globe artichoke, bull-thistle, sunflower, and cucurbits (uncommon).

Optimum for spore germination:

- 64 F.
- 95 – 98% relative humidity. 100% inhibits.

Common in field in Yuma, AZ (major lettuce growing area). Rare in eastern USA, except greenhouses + winter tunnels.

Sources: wind-blown asexual spores and over-wintering sexual spores (ascospores in chasmothecia).
16 Nov 2016
High tunnel

Powdery Mildew-Kale

White Russian and Red Ursa affected; not Winterbor.

ORGANIC: Stylet-oil + MilStop seen to be effective.

Image cf. Teresa Rusinek, Cornell
Cladosporium Leaf Spot

Spinach

Winter Bloomsdale is a less susceptible variety

Images cf. growers
Stemphylium Leaf Spot
Spinach - field

Cladosporium and Stemphylium leaf spots
Sources: infested seed, wind-dispersed spores, crop debris.
Favorable conditions: 59 – 68 F and RH > 80%.
Range 41 – 86 F.
Botrytis Crown Rot - Lettuce

Images cf. grower
Botrytis
Gray Mold

Large host range.
Wind-dispersed spores.
Manage humidity.

Images cf. Teresa Rusinek, Cornell
QUESTIONS about Managing Disease in High Tunnel Winter Greens