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Winter Greens Diseases

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Many Vermont farms with high tunnels plant leafy greens to fill a niche after tomatoes have been harvested to increase profits. Growing high tunnel winter greens can be tricky and although tunnels protect greens from low temperature damage and extend the season, fluctuating winter temperatures and the use of row covers can promote high humidity and leaf wetness, resulting in a lot of foliar disease problems.

The most important way to avoid issues in your winter greens is to scout your crops regularly and be proactive-know the diseases and associated symptoms that can occur. Be aware that the diseases found in high tunnels may differ from those found in the field on the same crop. Your biggest enemy in high tunnels is high humidity and the goal is to take advantage of all the ways to AVOID the disease in the first place since rescue fungicides are not usually effective.

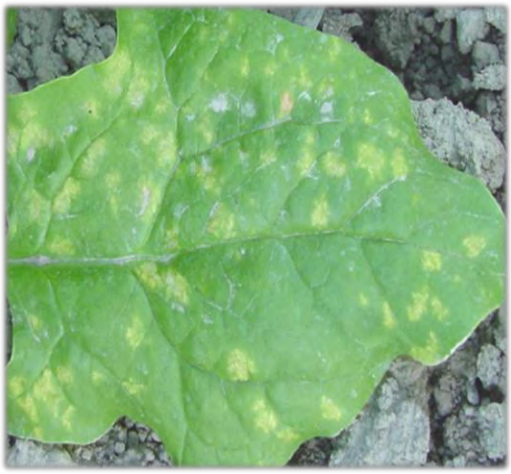
Pathogens in high tunnel greens can be challenging due to consumers' low tolerance for disease symptoms (or residues) on the crop. All these pathogens can destroy the crop, all do well in cooler temperatures, and all tend to prefer prolonged periods of leaf wetness or high humidity. The low light and short days in the winter create extended periods of time for pathogens to produce spores and the plastic covering of tunnels protects the pathogens from exposure to damaging UV radiation.

Cladosporium leafspot is the most common disease on fall/winter high tunnel spinach. Symptoms include tan 1-3 mm leafspots that can coalesce. In time, velvety green sporulation is visible within the spots. The fungus thrives in cool wet conditions with relative humidity over 80% and can grow at 41 F. The pathogen overwinters on crop residue for several years and spores are spread easily by splashing water, wind, workers, and equipment. Since the pathogen can be seedborne, spinach seed should be hot water treated at 104 F/40 C for 10 minutes to eliminate disease without impairing germination. This can be done by the seed company, by a university providing the service or by the grower with the right tools and time to do it. Till under infected crops as there is no rescue with fungicides once infected. Use drip irrigation on sunny days so that foliage will dry quickly. Manage row covers and ventilation so moisture does not build up. Do not cover crops when wet! There is some variation in cultivar susceptibility so keep track of the best cultivars for your operation.

Cladosporium in spinach. (Photo credit: G. Higgins, UMASS)

Spinach Downy Mildew is on the rise due to the increase in the use of tunnels and the potential "green bridge" effect of overlapping summer and fall field crops with tunnel crops. Symptoms of downy mildew show up as yellow discoloration on the upper leaf surface with brown/purple velvety spores on the leaf undersides. The downy mildew pathogen (*Peronospora effusa*) has many "races" but all ONLY attack spinach. The pathogen will not survive on dead tissue so does not overwinter on refuse. The fungus-like organism prefers cool moist conditions with high humidity and can explode when conditions are conducive. Seed treatment does not work for this pathogen. The best way to manage/avoid downy mildew is to choose disease resistant cultivars. Races recently detected in the northeast include 12, 13, 14 (most cases), 15, 16, 17 and a novel race.

Choose cultivars with the widest range of race resistance and grow multiple cultivars with differing gaps of resistance. Select varieties with resistance to at least races 12 and 14, which are the most common in New England. Once infected there is no rescue treatment, and it is best to till under the crop. Never apply row covers to wet leaves. It is critical to destroy all high tunnel and overwintering spinach crops infected with downy mildew at least 2 weeks before the start of spring field spinach production to avoid infecting the new crop. **Downy mildew** can also be found on kale, lettuce, arugula and other brassicas but those downy mildew pathogens are specific to those crops. Although you may see downy mildew on different crops at the same time it is because all downy mildew pathogens like the same high humidity conditions.



Yellowing on upper leaf surface with velvety purple/brown spores on the leaf undersides. (Photo credit: UVM Plant Diagnostic Clinic)

Arugula bacterial leafspot is a new disease caused by the bacteria *Pseudomonas cannabina* pv. *alisalensis*. The pathogen is most likely seedborne and can survive in plant debris for up to two months. Hot water seed treatment is not feasible in arugula, so using good cultural practices and removing/destroying all crop debris between plantings is critical. There are few effective controls for bacteria, but copper and hydrogen dioxide may give fair control if applied early in the disease cycle and repeated at regular intervals.

(L) Bacterial leafspot on arugula. (Photo credit: L. DuToit); (R) Bacterial leafspot of arugula. (Photo credit: C. Bull)

Powdery mildew in kale, brassicas and lettuce causes superficial white growth on both leaf surfaces. Like downy mildew, powdery mildew also has a narrow host range and is specific to each individual plant type (i.e., the PM that attacks kale is NOT the same one that attacks lettuce). The pathogen only lives on live tissue and prefers drier conditions with no free water only high humidity. There are several good organic controls for the pathogen including Sulfur, JMS Stylet-oil and other mineral oils, MilStop and other potassium bicarbonates but to be effective these must be applied early and repeated.

There are also abiotic (non-infectious) issues that can be common in spinach including glandular trichomes and edema.

(L) Powdery mildew white sporulation on high tunnel kale. (Photo credit: T. Rusinek); (R) Powdery mildew on high tunnel lettuce. (Photo credit: A. Ivy)

Glandular trichomes are plant hairs emerging from the spinach leaf epidermis and can be easily seen with a hand lens. They are often mistaken for fungal spores or insect eggs but are of no concern. In some cultivars the trichomes may be more noticeable than in others.

Edema can be a common occurrence in spinach when the plant takes up a lot of soil moisture and yet does not transpire the water due to cloudy cool conditions. The liquid builds up in the cells until they burst producing corky lesions often seen along the ribs on the leaf undersides. When favorable conditions return, the plant will grow out of the damage.

(L) Glandular trichomes in spinach. (Photo credit: UNH); (R) Raised lesions due to edema in spinach. (Photo credit: Pop Vriend Seed Co., Holland)

In summary, it is best to avoid these spinach diseases rather than try to rescue the plants. Minimize disease occurrence by selecting resistant cultivars when available. Grow more than one! In the case of pathogens that evolve rapidly, like downy mildew, be aware that a cultivar that worked last year may not be resistant to new races the next year. Use hot water treated seed where applicable. Locate field plantings as far away as possible from the same crop grown in tunnels. Destroy field and tunnel plantings immediately after harvest. Avoid cool and moist or humid conditions and never cover wet foliage with row covers. If reusing covers, clean at the end of the season. Promote rapid drying in tunnels with fans. Vent high tunnels as often as temperature permits. Routinely check plants for disease symptoms. Manage weeds inside and around tunnels as some can be alternate hosts for pathogens and insect pests, and inside they contribute to humidity. For more information on high tunnel greens diseases check out "Diseases Occurring in Winter Greens and Their Management" Remember, all Land Grant Universities have Plant Diagnostic Clinics to help identify your winter greens diseases through pictures or samples!

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