

## Cultural Methods to Reduce Disease in Winter Tunnel Greens

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### Cornell Vegetable Program

#### *Introduction*

High tunnels and minimally heated greenhouses are critical to the success of the 'eat local' movement. In fact a recent USDA report indicated that the adoption of hoop houses helped New York secure the highest number of winter farmers markets in the nation<sup>1</sup>. The short days and cold climate of New York winters focus the crop production on greens and some root crops. Spinach, chard, kale and an assortment of Asian greens yield well in protected culture and are gaining market acceptance.

One of the many benefits of protected culture is decreased crop disease. Indeed for many diseases, particularly those that require leaf wetness for infection, high tunnels are an excellent management tool. However, some diseases flourish inside, even more so than in the field. Given the range of crops grown, dense canopies, cold air temperatures and lack of precipitation in the greenhouse, make fungicide sprays a last choice.

An integrated approach to disease management, focusing on cultural controls can ensure yields throughout the winter. The key cultural controls we have are rotation, sanitation, varietal resistance and structural design and management. Using some common examples, we can illustrate the deployment of these management techniques in winter production settings.

#### *Rotation/Sanitation*

This may be the hardest one! As mentioned above only a small group of greens and roots are hardy enough to make it through a New York winter. This means that most tunnels see the same plants every year, many of which share diseases. Beet greens for example, are popular with the 'local' consumer, and often combined in salad mixes. However *Cercospora* Leaf Spot, a fungal disease, makes beet greens unmarketable, and can also affect Swiss chard, spinach and some weeds such as lambsquarters. This disease overwinters in the field for 2 years, and of course will do so inside as well.

In this case rotation would mean only growing these crops once every three years in the same structure. Most growers simply do not have the facilities to make a rotation like this possible. Rotation within the same structure, as much as space will allow, can help. However the fungal spores will readily move through a small greenhouse.

What to rotate with? The Asian greens, carrots and fennel are not susceptible to the same *Cercospora* and are thus options. Some growers seed a cover crop during the warmer months, others grow fruiting

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<sup>1</sup> *Winter Farmers Markets Expand, Now More than 1,200 Locations for Fresh Local Foods.* (2011).  
[www.usda.gov](http://www.usda.gov)

vegetables such as tomatoes. The key is to stay away from beets and friends during the warm season, when there is plenty of inoculum in the air from field plantings. Sanitation means staying weed free and removing or incorporating the crop as soon as it is finished, or there are signs of *Cercospora*.

### *Varietal Resistance*

This is an easy one! When picking out varieties for winter production, disease resistance is very important. In lettuce Downy Mildew resistance is a key trait. Many growers have learned the hard way that a single susceptible variety can ruin a salad mix, as other rots and diseases will follow the Downy Mildew into the planting. Although caused by a different pathogen, Downy Mildew in spinach is equally devastating. Many catalogs now make note of mildew resistance and market these varieties for winter harvest. By selecting disease resistance varieties, we can overcome some of our shortcomings in rotation. Crop resistance is much more effective than fungicides.

### *Structural design/management*

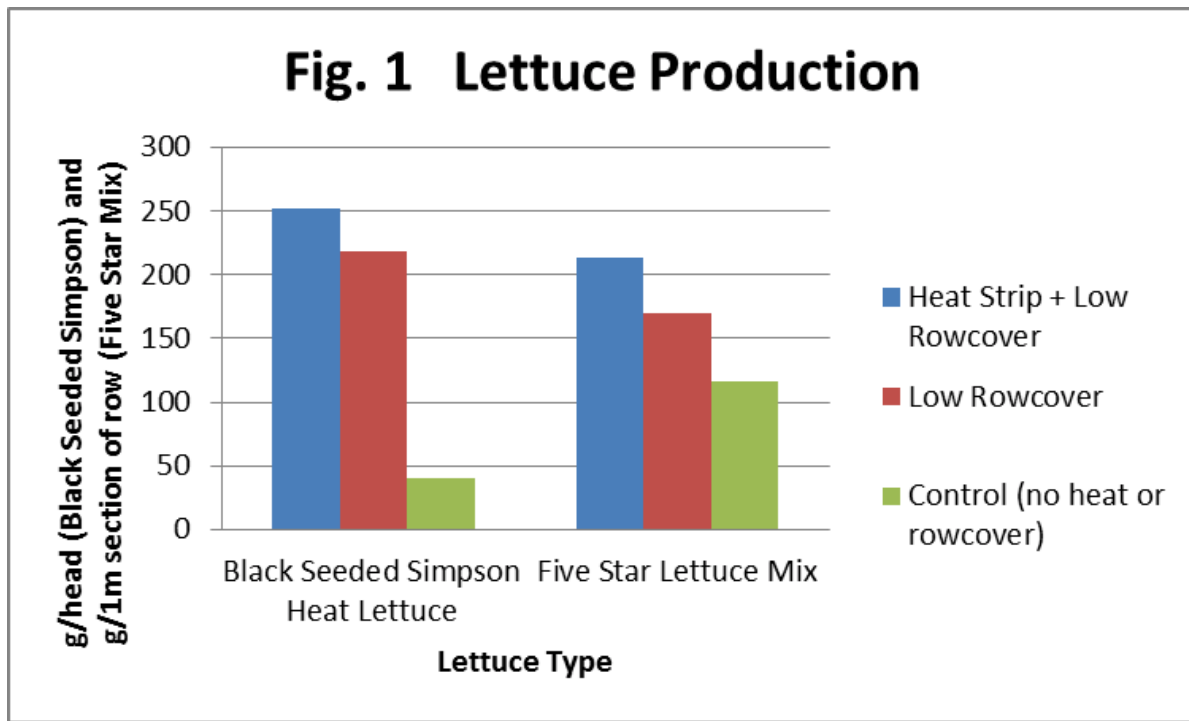
The disease management concept that drives structural design and management is air movement. Within a structure there are two types of air movement: lateral and ventilation. Lateral refers to air movement within the structure to prevent stagnation within the canopy. Small fans spaced throughout the greenhouse, targeting the crop and moving air in a circular pattern are used for this purpose. However, most winter production facilities are on the 'low-tech' side and do not use these.

Ventilation is the replacement of interior air with exterior air. This is critical for several reasons. Plants are continuously transpiring water through small openings in their leaves known as stomata. When the air around the plant becomes too high in relative humidity, it cannot transpire. Water backs up in the system compromising leaf tissue and root health. Disease spores spread and infect readily in this setting. Thus successful growers ventilate, even on cold days, to replace the saturated air with colder outside air that will have a lower relative humidity.

The design of the structure can play a critical role in keeping relative humidity low. Taller structures are preferred for light penetration and air movement. Ridge or gable vents allow for an up flow of warm saturated air. Drop-down curtains allow for improved air mixing vs. roll-up curtains. Drip irrigation keeps the canopy dry and avoids over-saturation of the soil.

The management of row covers is also critical to prevent disease. To prevent cold temperature losses, 1-2 layers of spun bond row cover can be suspended over the crop. For example, research at the Cornell Willsboro Farm in 2012 found that row covers increased yields dramatically over uncovered beds (Figure 1).

As most structures rely on the sun for heat, row covers are removed on sunny days to charge the soil. Replacing the row cover at sunset retains heat in a low tunnel over the crop. In mid-winter many growers do not remove the row cover for days on end due to cloudy weather. However, this will also keep relative humidity higher in the crop canopy and allow for infections to develop. Thus removal of row covers, even in cloudy weather is important for disease management.



**Figure 1. Lettuce grown in a high tunnel in later winter 2012.**

A final point to consider when managing for low relative humidity is plant density. If the crop canopy is too tight air movement is again restricted and diseases such as Botrytis Gray Mold flourish. Although appropriate planting rates vary by crop, in the winter the lower ranges of seeding rates are better. Many growers now transplant crops such as spinach in tunnels to create a uniform stand at appropriate densities.

#### *Conclusion*

Our goal is a cool, dry environment with maximum yields and no loss to disease. The key cultural controls we can use to reach this goal are sanitation, rotation, varietal resistance and appropriate structure design and management.