

## Sustainable Pest Management in High Tunnel Winter Greens Production

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### Introduction

Many Northeast vegetable growers are looking for ways to extend their season and provide fresh, locally grown produce to winter CSAs and winter farmers markets. High tunnels are proving to be an excellent way to produce ‘off-season’ greens with little-to-no fossil fuel based heat, contributing to environmental sustainability. These production systems also contribute to economic and social sustainability by creating year-round income and maintaining customer relations during the traditional off-season.

However, pest infestations, such as aphids, mites and cabbage worms restrict the economic potential of these systems. As an experienced grower put it- “Pest management is so much more important in the winter because your losses are so much more”. The Cornell Vegetable Program received an award from NESARE to research and promote natural pest management in winter high tunnels over the last 4 seasons. Techniques included early fall releases of parasitoids, winter releases of predators, late fall and winter applications of biorational pesticides, specifically *Beauveria bassiana*, a commercialized fungal pathogen of aphids (Table 1).

Table 1. Natural Pest Management Tools for Winter Greens Growers

Beneficial Insects:	Type of Control	Pest Target
<i>Aphidius colemani</i>	Parasitoid wasp	Aphids
<i>Aphidius ervi</i>	Parasitoid wasp	Aphids
Lady beetles	Predator	Aphids
<i>Aphelinus abdominalis</i>	Parasitoid wasp	Aphids
Biorational sprays:	Type of Control	Pest Target
Botanigard (conventional)	<i>Beauveria bassiana</i> Stain GHA, a fungal pathogen of aphids	Aphids
Neem	Horticultural Oil	Aphids, mites
Mycotrol-O	<i>Beauveria bassiana</i> Stain GHA, a fungal pathogen of aphids	Aphids
Bt (i.e. DiPel)	For caterpillars	Caterpillars
Entrust	Iron phosphate (sluggo)	Caterpillars
Iron phosphate	Bait	Slugs

### Methods

In this project we found that key pest management steps take place before the winter greens crop is in the ground. Summer tunnel crops (such as tomatoes and peppers) are the single highest source of pests of winter greens. We noted repeatedly in this project that managing a high population of aphids, slugs, cabbage worms, etc. is difficult under cold conditions; biocontrols are too cold sensitive, biopesticides are temperature driven, and periods below freezing

make sprays impossible. It is clearer now more than ever that managing pests on the summer crops is key to having marketable winter greens. Fortunately we can use bicontrols in the summer crop successfully as well as appropriate sprays.

Another pre-plant management step is selecting pest/disease resistant varieties. For example Downy Mildew resistance is essential when selecting spinach and lettuce varieties. The cold, damp growing conditions in winter tunnels is perfect for diseases such as Downy Mildew. Growing susceptible varieties is high risk.

Insect resistance is another important trait. At one of our cooperating sites we found aphids were more prevalent in mustard crops, than spinach or other Asian greens (Figure 1).

Appropriate planting density can help with both insect and disease control. High density plantings trap moist air within the canopy which leads to diseases such as Gray Mold and Downy Mildew. The tight canopy also interferes with insect management. For example, aphid materials such as Botanigard or Mycotrol, require contact with the insect. When the greens canopy is closed our sprays cannot effectively reach the target.

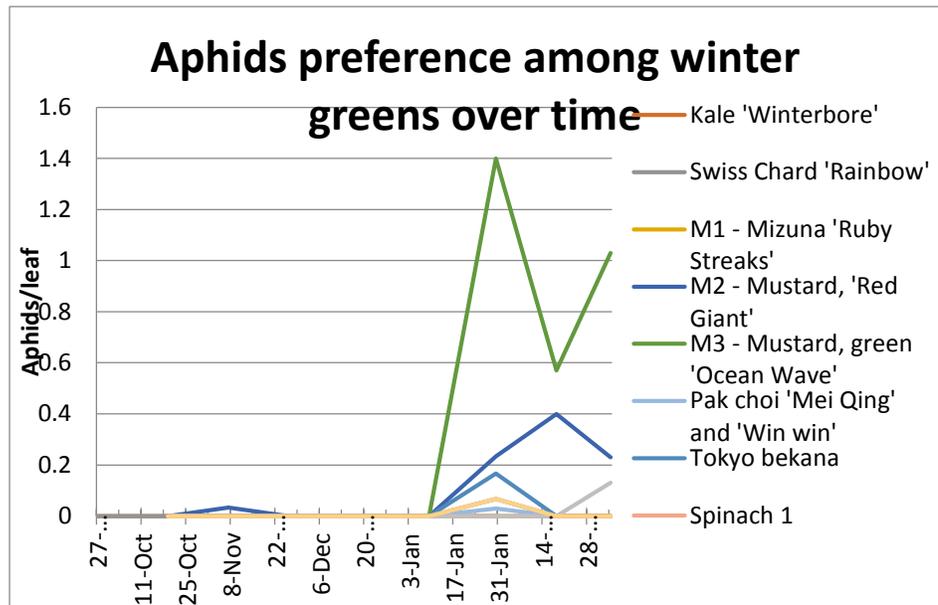


Figure 1. Aphid counts were higher on mustards than other winter greens at one farm.

As temperatures drop we refrain from the release of biocontrols, with one exception: lady beetles. Under row covers lady beetles have provided excellent control of aphids at some of our cooperating sites. For example one cooperating farm released ladybeetles on November 24. By December 4 the ladybeetles reduced aphid populations by 98.5% in mizuna (Figure 2). This would not be possible with parasitic wasps at this time of year.

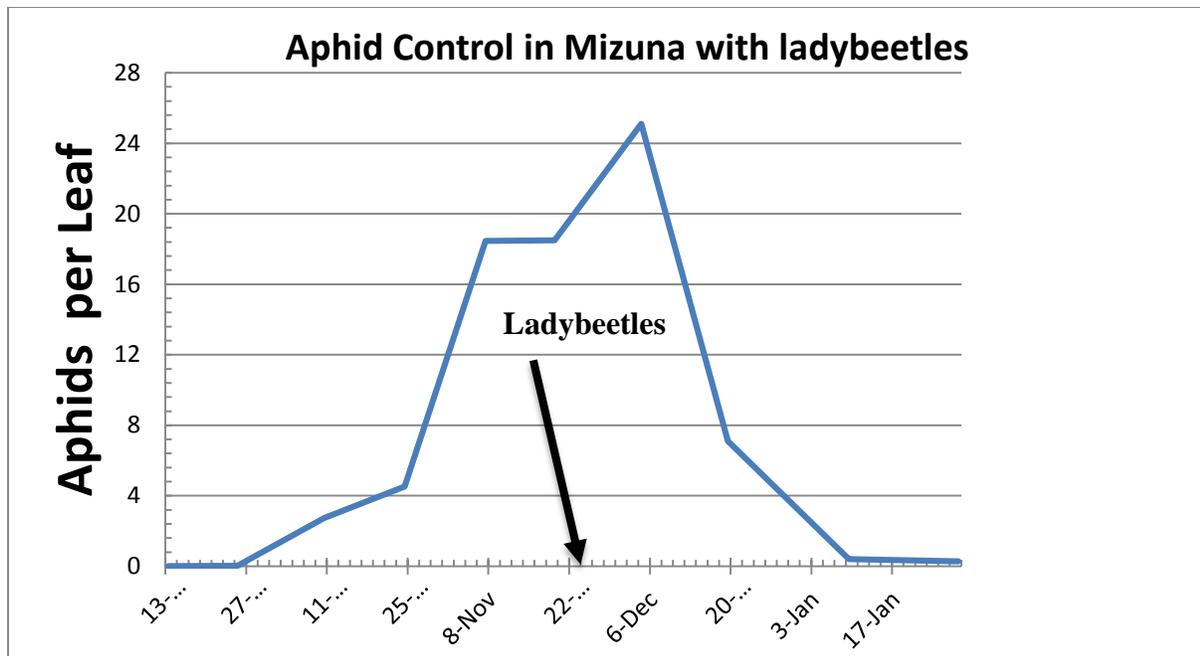


Figure 2. Successful control of aphids with lady beetles in late fall.

### Conclusions and future work

The opportunity for Northeast vegetable farmers to market winter greens continues to grow. In one of our surveys 75% of respondents had experienced an increase in cool season marketing. Over a 5 year period an average respondent increased revenue by \$6,110, over 9.2 weeks of winter.

Participants in this program were able to increase revenue by adopting natural pest management. 24 high tunnel growers adopted natural pest management methods with an average increase in revenue of \$2465.13 per farm. An evaluation indicated 61% of increased on-farm revenue was directly attributable to participation in the program. To quote one of the farmers: “Participating in this project has made me take my blinders off. Slowing down enough to emphasize pest management, reprioritizing tasks to get management things done in a timely fashion, helped lead to work environment improvements on my farm.... There is an increased quantity of high quality produce.”

However, the project found that certain pests are more difficult to control than others and can cause disproportionate economic losses. One farm lost \$1660.00 per season, with at least 75% of that due to Spinach Crown Mite, a pest that is currently without any known effective controls. Disease was as great a cause of an economic loss as insect and mite pests. Combining all seasons and sites, disease accounted for 26.1% of farm losses.

Future work is needed on Spinach Crown Mite, diseases as well as soil and fertility issues surrounding the production of winter greens. The authors express their gratitude to cooperating farmers and NESARE for funding this project.