2016

Hop Pest Scouting Report

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NORTHWEST CROPS & SOILS PROGRAM

2016 Hop Pest Scouting Report

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During the 2016 growing season, the major pest challenges we encountered at the hop yard at the Borderview Research Farm in Alburgh, Vermont were two-spotted spider mite (Tetranychus urticae), potato leafhopper (*Empoasca fabae*), and hop downy mildew (*Pseudoperonospora humuli*).

Two-spotted Spider Mite

The hot, dry year we experienced in 2016 truly favored two-spotted spider mites (TSSM). TSSM feeding causes a characteristic stippling of leaves (Image 1) which, at low to moderate levels, doesn't cause economic injury since there is no apparent effect on yield or quality later in the season. However, heavy infestation of two-spotted spider mites, especially late in the season, can lead to reduced photosynthesis, defoliation and dry, brittle cones. This accounts for the economic thresholds for two-spotted spider mites suggested, in the Pacific Northwest to be 1-2 spider mites per leaf in June or 5-10 per leaf in July, by Strong and Croft in 1995. However, in other parts of the world, average populations of up to 60 mites per leaf are considered safe. This past year saw one of the highest spider mite levels since establishing the yard (Figure 1).

Image 1. Stippling caused by two-spotted spider mite damage.

Management

Typically, predatory mites and the specialist spider mite destroyer maintain TSSM levels below economic thresholds. Particularly in years like 2016, an integrated pest management (IPM) program of weekly monitoring of the pest and beneficial populations is crucial for decision making. In hops, weekly scouting of the underside of three leaves per plant out of every 25-30 plants, and in each variety, is recommended. When TSSM populations began to explode in 2016, we were forced to take action in applying Trilogy (Certis USA), an OMRI approved fungicide/miticide/insecticide, at several points. For more information regarding approved pesticides for hops production, please see our website, www.uvm.edu/extension/cropsoil/hops.

Pesticide applications, particularly broad-spectrum insecticides and repeated application of sulfur, can exacerbate spider mite problems. Following an insecticide application, spider mite populations are generally quick to rebound, much quicker than natural enemies like spider mite destroyers. This allows spider mites to re-infest hop yards without any natural control.

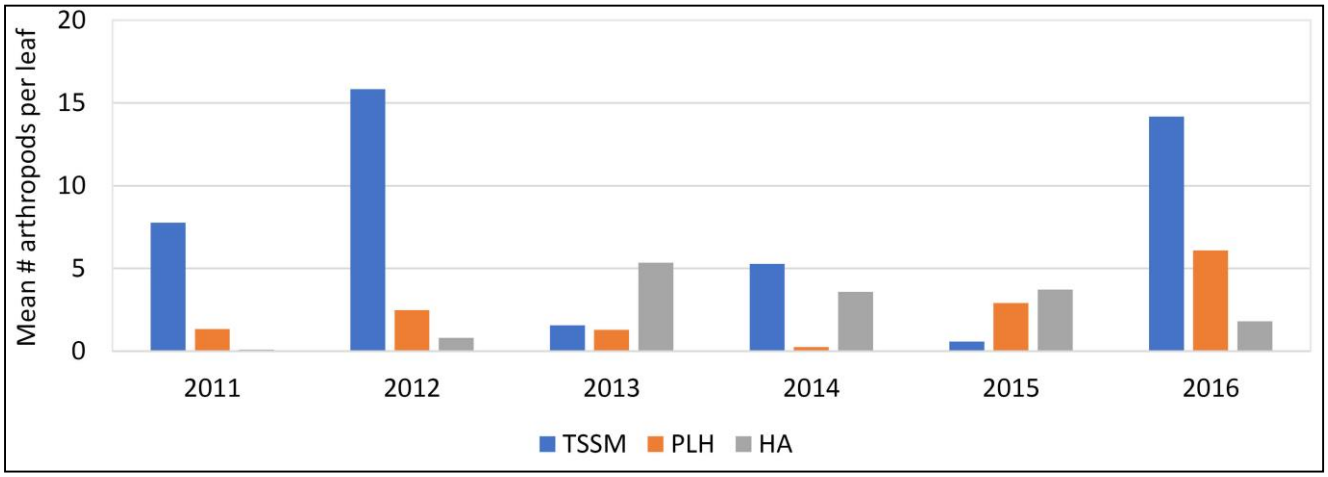

Figure 1. Number of Two-spotted spider-mites (TSSM), Potato Leafhoppers (PLH), and Hop Aphids (HA) found per leaf by variety, 2011-2016, Alburgh, VT.

Potato Leafhopper

Potato leafhoppers (PLH) often have a better year immediately following a warm winter like we experienced in 2015/2016. PLH blow in to Vermont from their overwintering habitat in southern states. The warmer the winter, the further north PLH are able to stay for the winter, which means they will have a shorter journey to Vermont in the spring. This combination of circumstances set the scene for the greatest number of PLH seen in our hop yard since the outset of our seven-year project (see Figure 1). These huge numbers of PLH, an average of 6 PLH per hop leaf throughout the season, lead to extensive PLH damage, called "hopperburn" (Image 2). Hopperburn is caused by an interaction between PLH feeding and plant responses, resulting in reduced photosynthesis and ultimately leaf necrosis.

Image 2. Potato leafhopper damage (hopperburn) and nymphs (inset).

<u>Management</u>

Populations of natural enemies including spiders, minute pirate bugs, lady beetles, predatory flies and parasitoid wasps remain high in our research hop yard. Reduced pesticide usage has enabled the natural enemy population to generally maintain low pest levels, but in years like 2016 the pest pressure was just too great for the natural enemies. Economic thresholds for potato leafhoppers in hops have not yet been determined. An in-depth literature review revealed that two leafhoppers per leaf may be economically damaging to hops, and 2016 saw levels much higher than that for a good part of the season.

Scouting for PLH is done in the same manner described above, making sure to scout all varieties in the hop yard; PLH appear to have feeding preferences for different varieties. It should be noted that first year plants are far more susceptible to potato leafhopper damage than older, more mature stands of hops.

Therefore, insecticide usage should be reserved for more susceptible varieties and younger plants. As always, pesticides used must be registered for use on hops in your state. Read and follow pesticide labels carefully. And remember, broad-spectrum insecticides kill natural predators and often lead to secondary outbreaks of other pests such as two-spotted spider mites.

Hop Downy Mildew

Hop downy mildew is prevalent in most, if not all, hop yards in the Northeast. The pathogen has been systemic in our research hop yard in Alburgh since 2012. During the 2016 growing season, we documented the presence of disease on a number of basal and aerial spikes in addition to assessing the severity of new infection on hop leaves during the growing season and cones at harvest.

Management.
It is possible to manage downy mildew in our region; however, management does require a multi-pronged approach which includes crowning, meticulous forecasting, fungicide applications, and removal of infected plant material.

Crowning—the removal of the first flush of hop growth—is used as an early season preventative measure against downy mildew. It is implemented in early spring when it is almost guaranteed that the environment is habitable (cool and wet) for the spread of downy mildew spores. We didn't crown the variety trial in 2016 due to equipment limitations, but we did continue crowning in a section of the hop yard that was set aside to study the effects of crowning (for more information see our 2016 Hop Crowing Trial).

Fungicide applications are a must in order to produce high quality hops in our region, so we continually monitoring the temperature and humidity to predict favorable downy mildew conditions accurately for our area. We calculated the number of days that had ideal downy mildew conditions using a Pacific Northwest forecasting model based on temperature and humidity, (Gent et al. 2010) (Figure 2). The model was calculated using data from a nearby weather station in Chazy, NY. 2016 saw the second fewest number of days with likely infection seen since 2012; 28 of the 183 days between 1-Apr 2016 and 30-Sep 2016 exhibited conditions considered likely for downy mildew infection.

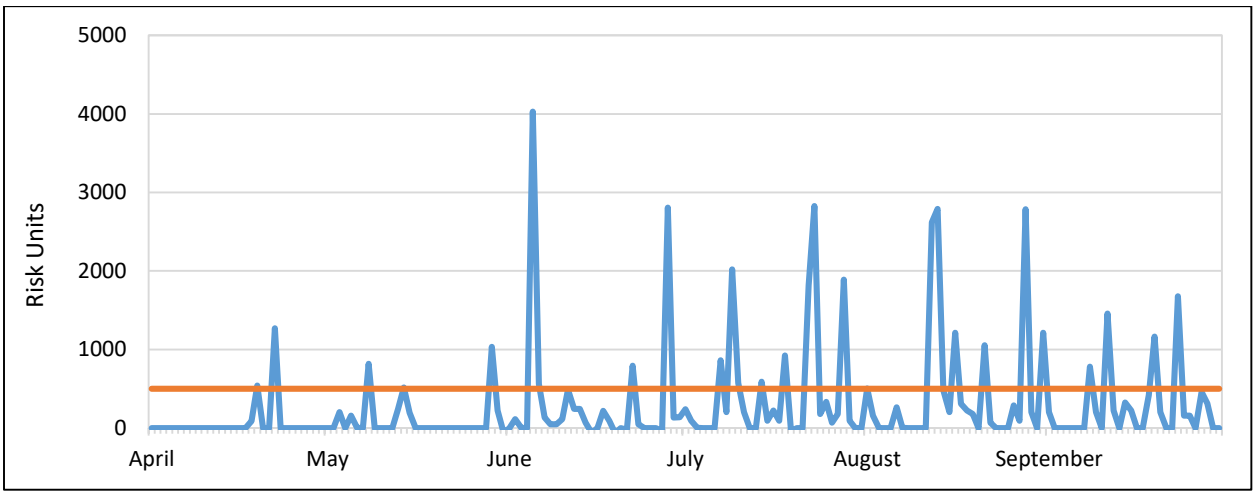

Figure 2. Number of risk units, (Gent et al. 2010), Chazy, NY, 2016.
The red line at 500 risk units indicates an increased likelihood of downy mildew infection.

Predicting habitable conditions for downy mildew allowed us to determine our spray schedule such that applications occurred before times of high infection risk (humidity/rain events). The following fungicides were sprayed regularly throughout the season until we reached the pre-harvest interval date listed on the product labels: Champ WG (Nufarm Americas Inc.), Regalia (Marrone Bio Innovations), Cease (BioWorks, Inc.), and Trilogy (Certis USA, LLC.).

In 2016, we continued to compare the efficacy of several promising biofungicide products labeled for downy mildew control: Cease – contains a strain of *Bacillus subtilis*, Actinovate AG – contains a strain of *Streptomyces lydicus*, Regalia - extracted from giant knotweed (*Fallopia sachalinensis*), and Champ WG - 77% copper hydroxide (please see the 2016 Hop Biofungicide trial for more information).

Secondary Diseases

We continue to find *Alternaria* and *Phoma sp. Cercospera*, and *Fusarium* on cones at harvest. These play an important role in cone browning and post-harvest cone aesthetic. Secondary pathogens are able to infect cones late in the season after fungicide spray applications have stopped. In order to produce the highest quality crop, we hope to research this pathogen in the future and decrease late season infection. There are few conventional products labeled for these disease, so further research will need to be conducted to determine the efficacy of organic methods of control.

For more information on hop production and current research, please visit our website at: www.uvm.edu/extension/cropsoil/hops.

References

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