Hoop Houses and Tunnels

Wednesday morning 9:00 am

Where: Ballroom D
MI Recertification credits: 2 (COMM CORE, PRIV CORE)
CCA Credits: NM(0.5) PM(0.5) CM(1.0)
Moderator: Collin Thompson, MSU Upper Peninsula Exp Station, Chatham, MI

9:00 am Tomato Compost High Tunnel Project

- Mark Hutton, Extension Vegetable Specialist, Univ. of Maine Cooperative Extension, Monmouth, ME -- Compost application has become a cornerstone of soil health and soil improvement practices on many farms in the Northeast United States, particularly in high tunnels. In this ongoing four-year study, compost was applied yearly to replicated plots at the following rates: 0, 10, 20, 50, 90 cubic-yards/acre. The soil test and yield results will be discussed.

9:30 am Organic High Tunnel Tomato Production

- Brian Bates, Bear Creek Organic Farm, Petosky, MI -- Organic tomatoes can be an important crop for market growers, but for producers in northern climates, the field season can be short and unpredictable. Brian will discuss techniques, tools, and tricks he uses for growing high quality organic tomatoes in northern Michigan.

10:00 am Hoophouse Fertility

- Judson Reid, Cornell Cooperative Extension, Penn Yan, NY -- Many growers find high tunnels to be a profitable investment for their farm and have expanded their use of this technology. However, growers are also finding that long term soil health and fertility management in high tunnels is different than in the field. Specific nutrients of concern are calcium, phosphorus, magnesium. In this session we will share results from a project that monitors soil and plant nutrient levels on dozens of farms, both organic and conventional. Best Management Practices to prevent and remediate soil challenges will be shared.

10:30 am Tools and Systems for Hoophouse Production

- Collin Thompson, MSU Upper Peninsula Exp Station, Chatham, MI -- Hoophouses present unique challenges for producers including intensive production, tight spaces, and year round production. Having the right tools for the job is essential to be productive and efficient.

11:00 am Session Ends

ORGANIC TOMATO PRODUCTION IN HIGH TUNNELS

Brian Bates, Bear Creek Organic Farm, Petoskey, Michigan
bearcreekorganicfarm@gmail.com - 231-340-0104 - www.bearcreekorganicfarm.com

Organic tomatoes can be an important crop for market growers, but for producers in northern climates, the field season can be short and unpredictable. Brian will discuss techniques, tools, and tricks he uses for growing high quality organic tomatoes in northern Michigan.

Advantages to High Tunnel Tomatoes:
Yield
Quality/Cleanliness
Season Extension
Reliability
Trellising

Disadvantages to High Tunnel Tomatoes:
Capital Investment
Length of Season
Labor (vs other HT crops)
Crop Rotation

2015 Numbers	**30 x 144' Hoophouse**		
1005 total plants	**Plants**	**Total Pounds**	**Pounds per Plant**
Cherry/Grape	444	1380	3.11
Beefsteak	287	1605	5.59
Heirloom	274	1115	4.07
Total	1005	4100	4.26

What a Difference a Year Makes!

2016 Numbers	**30 x 144' Hoophouse**		
864 total plants	**Plants**	**Total Pounds**	**Pounds per Plant**
Cherry	152	1199.5	7.89
Grape	208	985	4.74
Beefsteak	309	4082.5	13.21
Heirloom	195	1872	9.60
Total	864	8139	8.86

Why the Difference from 2015-2016?

3 Key Factors in Organic High Tunnel Tomato Success:
Timing
Variety Selection
Fertility

Our Frost Free Season is May 26 - Oct 9
We had snow on May 15, no frost until 10/24
Transplanted on May 9 & May 16 (50% each day) - calculated risk.

We grow everything from seed - seed date = 2 months before TP date
First tomatoes seeded March 7
Week 1 - Seed
Week 6 - Pot Up into 4.5" Round Pots
Week 9 - Transplant in HT

Plant Deep! We use a post-hole digger, fill with compost and soil amendments, then bury plant halfway
Use Low Tunnels early on if threat of frost, HAF fans a good idea, louvers too

Variety Selection Matters! A LOT!
As you can see in our yield difference between 2015 and 2016 we were able to double yield by improving timing of planting, and most importantly, finding high-performing varieties.

Some Favorite Varieties:
Beefsteak - Arbason, Big Beef, BHN - 589, Caiman
Grape - Golden Sweet, 5-Star
Cherry - Black Cherry, Sakura, Sunpeach, (Sungold)
Heirloom/Special - Jaune Flamme, Pink Berkeley Tie-Dye, Pruden's Purple, Green Zebra, Cherokee Purple

Materials You'll Need:
Drip Tape
Woven Ground Cover + Staples (we like 3' and 4' widths between rows)
Trellis Twine + Overhead Wire
Fertilizer Injector
Kneepads
Pruning Snips
A LOT of Time & Energy

If you're planning to follow tomatoes with a winter crop, do not underestimate time of removal. We budget 3 full days to have the tunnel cleaned out, plowed, amended, and prepped for following crop.

HT Tomato Nutrient Update

pH and phosphorus management

Judson Reid and Cordelia Hall, Cornell Vegetable Program
Email: jer11@cornell.edu; phone: 585.313.8912

Working with collaborating farms and extension educators across New York State, the Cornell Vegetable Program is gaining valuable insight into the dynamics of soil and plant nutrient status coupled with on-farm management. Our focus has been on high tunnel tomatoes, due to their high return per square foot. On these farms we conduct pre-season soil tests then work with farmers to fine-tune amendments both to reduce over application of nutrients, and at the same time maximize yield and return. In season we take regular foliar tests to help make decisions for optimal nutrient levels in the plant. We have data from over 40 farms across the state reflecting different management approaches, including both certified organic and conventional.

A problem common to all types of high tunnel operations has been the escalation of root zone pH and alkalinity. As irrigation water is often high in pH and bicarbonate, high tunnel soils generally climb the pH scale without precipitation to leach through the profile. The result of is lower nutrient levels in the plant foliage, ultimately decreasing vigor and yield. Manganese (Mn) deficiency is often the first sign of this problem.

Mn deficiency often occurs mid-level in the canopy as bright yellow margins leading to marginal necrosis (see pics). There is no lack of Mn in the soil, but the pH prevents its uptake. Chelated Manganese is available to raise the level in the plant, but this is treating the symptom instead of the underlying cause of pH and alkalinity.

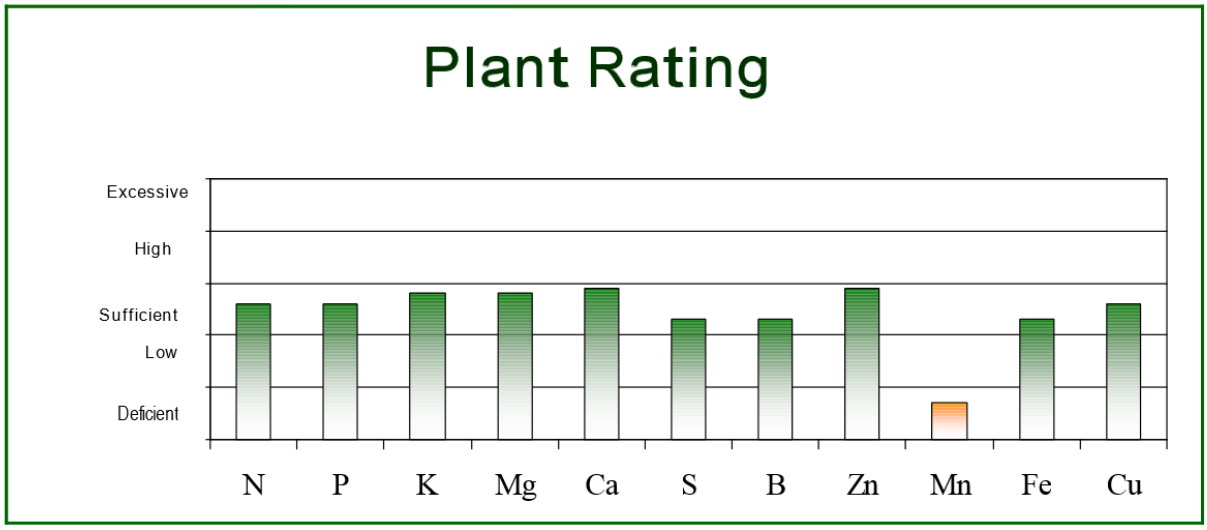


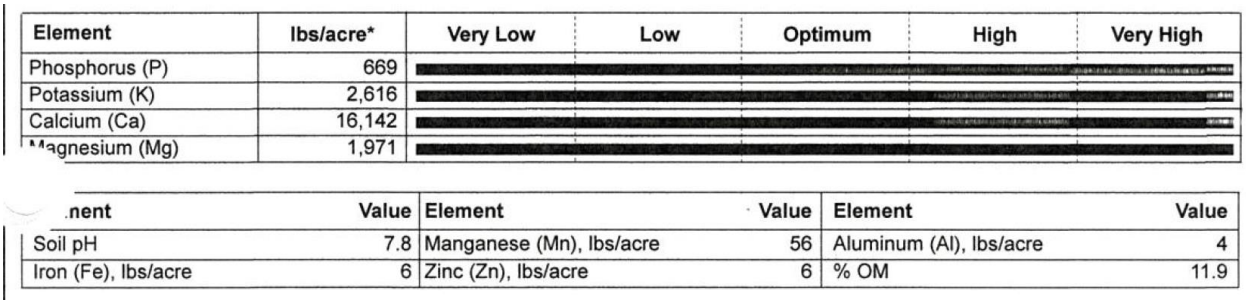
Figure 1. All plant nutrient are in optimal range in this high tunnel tomato sample except manganese. This farm is now injecting citric acid to combat the problem.

What can be done about pH/alkalinity? The first step is to test irrigation water for both pH and bicarbonates. Water pH can be measured with a digital meter, but alkalinity requires a lab test. With these two figures we can then use an online calculator from University of New Hampshire to calculate a

quantity of acid to inject into our irrigation water (https://extension.unh.edu/Agric/AGGHFL/alk_calc.cfm). The two common acids are phosphoric and sulfuric.

Organic growers can use citric acid, however there is no tool to calculate the quantity needed. A gradual addition of citric acid to the system while monitoring irrigation water pH is the common approach. Another important step is to acidify the soil profile prior to planting with elemental sulfur. Sulfur is slow to react so fall applications are advised. Rates will vary based on soil levels of calcium and pH.

Another trend among our research sites has been excessive phosphorus levels. Spring fertility management for tomatoes often emphasizes phosphorus. This makes sense given the importance of phosphorus in root growth. Cold soils inhibit phosphorus uptake, so many growers increase the ratio and rate of application to get the nutrient in direct contact with the roots. However, phosphorus is banked in the soil when over applied. In our sampling we have found that phosphorus levels are excessively high on many sites, sometimes several orders of magnitude above recommended levels (figure 2).



Element	lbs/acre*	Very Low	Low	Optimum	High	Very High
Phosphorus (P)	669					
Potassium (K)	2,616					
Calcium (Ca)	16,142					
Magnesium (Mg)	1,971					

nent	Value	Element	Value	Element	Value
Soil pH	7.8	Manganese (Mn), lbs/acre	56	Aluminum (Al), lbs/acre	4
Iron (Fe), lbs/acre	6	Zinc (Zn), lbs/acre	6	% OM	11.9

Figure 2. Phosphorus in this high tunnel soil is literally off the charts. Levels in excess of 40 lbs per acre are ranked as very high; this sample has 669 lbs/ac. Although zinc is high (6 lbs/ac), it may be deficient in the plant, restricting yield potential.

Is this a problem? Absolutely. In high pH and phosphorus soils an induced zinc deficiency can occur. Zinc is critical in a number of plant functions including flower production. Thus, there will often be a recommendation to apply zinc sulfate. Tomatoes only need ½ to 1 lb per acre of zinc, but it simply may not be available in these situations so application rates range from 10-20 lbs per acre. If making a banded application the rate is reduced to 1-2 lbs/ac. Zinc Sulfate is OMRI listed but the products generally carry the stipulation that it "may only be used as a plant or soil amendment with a documented zinc deficiency. "

Aside from the addition of zinc there are other management steps to prevent this issue.

- Soil test annually in the fall to get the most accurate measure of soil P levels.
- Fertilize in the spring and avoid fertilizers with a high P ratio (the 2nd number in the analysis).
- Apply sulfur if pH is beginning to climb
- Lay plastic well prior to transplanting to help warm the soil. This will make P more available and reduce the need to make excess application.
- Inject sulfuric or citric acid with irrigation water to reduce alkalinity and pH problems.
- Foliar test in season to make adjustments if necessary.

This work is the result of funding from New York Farm Viability Institute, Specialty Crops Research Initiative and Federal Formula Funds.