Survey of Plant Production and IPM Use in Northeastern High Tunnels

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High tunnels represent a **new frontier** for Northeastern diversified farmers, offering opportunities for extending the growing season and generating greater revenues by producing cold-tolerant crops (e.g., spinach, lettuce and leafy cole varieties) and protecting high value cold sensitive vegetables (e.g., tomatoes and cucumbers). High tunnels are rudimentary hoop houses covered with one-two layers of plastic, and vented with roll-up sides for cooling. They are a low-cost means of producing high value crops at times of the year when cold temperatures prevent field production. Weather appears to be less predictable and more extreme. One frost can wipe out an entire field of vegetables that otherwise would supply significant revenues for several subsequent weeks if protected. Limited data are available on the number of high tunnels in operation or the acreage they cover. The most recent is a 2009 survey that found ME and VT together had >1,500 high tunnels, covering >46 acres of intensively grown vegetables.[3] It is estimated that >60% of the >2,000 vegetable growers in ME have at least one high tunnel. Construction of high tunnels continues to expand, yet support to growers on how to maximize production lags behind.

Plant production is a balancing act. Growers must create conditions that favor the crop, but these often encourage pests and diseases. While high tunnels offer great opportunities for low-cost crop production, they also present unique pest and disease challenges. Growers commonly report that they have lost their entire crop in the high tunnel to cutworms, armyworms or aphids. A survey of growers in the Northeast was conducted in 2013-14 to generate baseline data on IPM use .

1. What state is your business located in?		
	Number of Responses	% of Surveys
NH	9/35	25.7%
NY	7/35	20%
PA	7/35	20%
MD	6/35	17.1%
VT	3/35	8.6%
ME	2/35	5.7%
NJ	1/35	2.9%

2. Percentage of respondents according to the type of horticultural business or organization they are affiliated with and their position in the organization	
Retail vegetable production	88.6%
Wholesale vegetable production	42.9%
Community Supported Agriculture organization	37.1%
Garden center	34.3%
Cut flower grower	28.6%
Retail supply sales	2.9%
Non-profit horticultural org.	0.0%

3. Percentage of respondents according to their position in the organization	
	% of Surveys
Co/Owner	60.0%
Head grower	28.6%
Field worker	11.4%
Assistant manager	2.9%

4. Description of production systems used in high tunnel production		
	Number of Responses	% of Surveys
IPM	21/34	61.8%
Conventional Control	6/34	17.6%
Certified Organic	6/34	17.6%
Non-certified Organic	2/34	5.9%
Pesticide free	1/34	2.9%
No spray-organic fertilizer	1/34	2.9%
Organic Naturally grown	1/34	2.9%
Just started	1/34	2.9%

5. Percentage of farm revenue generated from production in high tunnels	
1-10%	29.0%
11-20%	32.3%
21-30%	12.9%
31-40%	12.9%
Over 40%	12.9%

6. Crops types grown in high tunnels and at what time of year?						
Crop	Late Winter/Early Spring		Summer		Fall and Early Winter	
Kale	10/35	28.6%	3/35	8.6%	10/35	28.6%
Other leafy cole crops	8/35	22.9%	5/35	14.3%	8/35	22.9%
Lettuce/ other leafy greens	15/35	42.9%	4/35	11.4%	13/35	37.1%
Swiss chard	5/35	14.3%	4/35	11.4%	6/35	17.1%
Spinach	14/35	40%	0/35	0%	11/35	31.4%
Tomatoes	15/35	42.9%	30/35	85.7%	13/35	37.1%
Vegetable starter plants	8/35	22.9%	4/35	11.4%	1/35	2.9%
Squash	2/35	5.7%	6/35	17.1%	2/35	5.7%
Cucumbers	10/35	28.6%	19/35	54.3%	5/35	14.3%
Bedding plants	3/35	8.6%	1/35	2.9%	0/35	0%
Cut flowers	2/35	5.7%	7/35	20%	1/35	2.9%
Carrots	1/35	2.9%	0/35	0%	1/35	2.9%
Beets	1/35	2.9%	0/35	0%	1/35	2.9%
Onions	0/35	0%	1/35	2.9%	0/35	0%
Eggplant	0/35	0%	3/35	8.6%	0/35	0%
Peppers	0/35	0%	4/35	11.4%	1/35	2.9%
Small Fruits	0/35	0%	1/35	2.9%	1/35	2.9%
Strawberries	3/35	8.6%	1/35	2.9%	0/35	0%
Blueberries	0/35	0%	1/35	2.9%	0/35	0%
Raspberries	0/35	0%	0/35	0%	1/35	2.9%
Herbs	0/35	0%	1/35	2.9%	0/35	0%
Hardwood cutting	1/35	2.9%	1/35	2.9%	1/35	2.9%
Ginger	1/35	2.9%	1/35	2.9%	0/35	0%
Cut flowers	1/35	2.9%	1/35	2.9%	0/35	0%

7. How many high tunnels do you use for vegetable production?		
	Number of Occurrences	% of Surveys
1-2 tunnels	17/33	51.5%
3-9 tunnels	10/33	30.3%
10-20 tunnels	6/33	18.2%

8. How many square feet of high tunnels do you use for production?		
	Number of Responses	% of Surveys
1-10,000	20/32	62.5%
10,001-25,000	9/32	28.1%
25,001-50,000	2/32	6.3%
Over 50,000	1/32	3.1%

9. Three most important Insect or Mite problems?		
	Number of Responses	% of Surveys
Aphids	17/30	56.7 %
Two spotted spider mite	14/30	46.7%
Thrips	8/30	26.7%
Tomato hornworm	6/30	20%
Whitefly	4/30	13.3%
Flea beetles	2/30	6.7%
Stink bug	2/30	6.7%
Vine borer	1/30	3.3%
ECB & Earworm	1/30	3.3%
Squash bug	1/30	3.3%
Army worm	1/30	3.3%
Slug/Snails	1/30	3.3%
Leaf hoppers	1/30	3.3%
Cucumber beetle	1/30	3.3%
Fungus gnats	1/30	3.3%
Leaf miners	1/30	3.3%
Leaf feeding beetles	1/30	3.3%

10. Summary of the Three most important Disease problems?		
	Number of Responses	% of Surveys
Botrytis blight	16/28	57.1%
Powdery mildew	10/28	35.7%
Leaf mold	4/28	14.3%
Grey and White mold	4/28	14.3%
Downy mildew	4/28	14.3%
Phytophthora rot	3/28	10.7%
Bacterial leaf spots/cankers	3/28	10.7%
Fungal leaf spots	2/28	7.1%
Damping off	2/28	7.1%
Phythium rot	1/28	3.6%
Rhizoctonia	1/28	3.6%
Cercospera	1/28	3.6%
Triangular leaf spot	1/28	3.6%
Septorum leaf spot	1/28	3.6%
TSWV/INSV	1/28	3.6%
Fusarium wilt	1/28	3.6%

11. Summary of the three most important General Production problems?		
	Number of Responses	% of Surveys
Irrigation/Water balance	8/22	36.4%
Scheduling/ Time management planting	7/22	31.8%
Disease problems	4/22	18.2%
Rotation	4/22	18.2%
Weather Issues	3/22	13.6%
Weeds	3/22	13.6%

Temp issues	2/22	9.1%
Insect control	2/22	9.1%
Fertilizer balance	2/22	9.1%
Layers of covers	1/22	4.5%
Algae	1/22	4.5%
Salt	1/22	4.5%
Pesticide management	1/22	4.5%
Trellising	1/22	4.5%
Lower leaves not removed	1/22	4.5%

12. Three most important <u>other problems</u>?		
	Number of Responses	% of Surveys
Finances -*Time/Help from workers/ Honor System (thefts or non-pay)/Money, returns/ Marketing*	6/17	35.3%
Weather -*Wind (hurricane)/ Wind/Floods*	3/17	17.6%
More space needed	2/17	11.8%
Animals -*Birds/Voles*	2/17	11.8%
Drainage/ Dripping issues	2/17	11.8%
Government regulations	1/17	5.9%
Humidity management	1/17	5.9%
Layout for first timers	1/17	5.9%

10&11. Due to similar responses of questions 10 &11, responses for these two questions are combined		
	Responses	% of Surveys
High tunnel management problems *-Pesticide management/ Fertilizer balance/ humidity management/ drainage-dripping issues/ lower leaves not removed/ layers of covers/Insect control/ temp control Issues/Disease problems/Weeds*	19/23	82.6%
Scheduling/ Time *-Management planting/Rotation*	11/23	47.8%
Irrigation/Water balance	8/23	34.8%
Weather Issues -*Wind (hurricane)/Wind/Floods*	6/23	26.1%
Finances -*Time/Help from workers/ Honor System (thefts or non-pay)/Money returns/ Marketing*	6/23	26.1%
More space needed	2/23	8.7%
Animals -*Birds/Voles*	2/23	8.7%
Algae	1/23	4.3%
Salt	1/23	4.3%
Trellising	1/23	4.3%
Government regulations	1/23	4.3%
Layout for first timers	1/23	4.3%

13. How often do you apply pesticides												
Product type	Weekly		Monthly		Occas.		Never		Once or twice/ season		Once or twice/ year	
Non-restricted use insecticide	2/23	8.7%	1/23	4.3%	5/23	21.7	3/23	13	---	---	---	---
Non-restricted use fungicide	0/23	0%	1/23	4.3%	7/23	30.4	3/23	13	---	---	---	---
Non-restricted use herbicide	0/23	0%	1/23	4.3%	3/23	13.0	4/23	17.4	--- ---		---	---
Restricted use	0/23	0%	4/23	17.4%	6/23	26.1	7/23	30.4	0/23	0	1/23	4.3%

insecticide												
Restricted use fungicide	0/23	0%	5/23	21.7%	6/23	26.1	6/23	26.1	1/23	4.3	0/23	0%
Restricted use herbicide	0/23	0%	2/23	8.7%	3/23	13	11/23	47.8	3/23	13.0	0/23	0%
Organic pesticides	0/23	0%	0/23	0%	0/23	0	0/23	0	0/23	0	0/23	0%

14. What management practices do you use for high tunnel production? (check all you use)					
Remove weeds	25/29	86.2	Water testing	7/29	24.1
Drip irrigation	25/29	86.2	Foliar testing	5/29	17.2
Grow resistant varieties	20/29	69.0	Apply nematodes	5/29	17.2
Soil testing	20/29	69.0	Banker or habitat plants	5/29	17.2
Crop rotation	18/29	62.1	Sanitize soil or use new soil	4/29	13.8
Cover floor with weed cloth	17/29	58.6	Screen vents	3/29	10.3
Identify pests/ diseases yourself	16/29	55.2	Professional pest ID	2/29	6.9
Use least toxic pesticides	16/29	55.2	Fallow crop space	2/29	6.9
Regular scouting	16/29	55.2	Use disease test kits	1/29	3.4
Release predators or parasites	14/29	48.3	Hire commercial scout	1/29	3.4
Sticky Cards	12/29	41.4	Mycorhizae medium in soil	1/29	3.4
Reemay plant covering	11/29	37.9	Preventative pesticide treatment	1/29	3.4
Spot pesticide treatment	11/29	37.9	Overhead irrigation	1/29	3.4
Use pesticides with short residual	10/29	34.5	Mulch	1/29	3.4
Use microbial control (fungi, Bt)	9/29	31.0	Use guardian plants	0/29	0
Indicator or trap plants	8/29	27.6	----- -----	---	---
Chemical pesticides	7/29	24.1			

15. Where do you go to obtain information to manage your pest and disease problems?					
Other growers	17/32	53.1%	My state Dep. Of Agric. Rep	8/32	25%
My reference books	16/32	50%	Biological control supplier	7/32	21.9%
Workshops/ conferences	15/32	46.9%	Fact sheets	7/32	21.9%
The web	15/32	46.9%	Crop Consultant	1/32	3.1%
Extension service	12/32	37.5%	Cell phone apps	1/32	3.1%
University or private diagnostic lab	12/32	37.5%	Pest update UNH (A. Eaton)	1/32	3.1%
Pesticide supplier	9/32	28.1%	Master gardener program	0/32	0%

16. How can Extension or State Dept. of Agric. personnel best help you adopt more IPM?					
Hold educational workshops	19/25	76	Set up IPM certification program	6/25	24
Provide site visits by specialists	16/25	64	Establish website on local landscape issues	4/25	16
Prepare fact sheets on key pest/ production problems	15/25	60	Provide individualized IPM training tools	4/25	16
Host on-farm demonstration sessions	12/25	48	Establish email listserv on landscape issues	4/25	16
Offer web-based seminars on IPM	12/25	48	Produce paper newsletter on landscape issues	3/25	12
Conduct efficacy trials and publish the results	10/25	40	Set up landscaper incentive program to use IPM	2/25	8
Produce electronic newsletter on landscape issues	10/25	40	All already available	1/25	4
Set up demonstration projects	9/25	36	?Landscape?	1/25	4
Increase consumer awareness about benefits of IPM	8/25 32%	32	----- -----	--- ---	

17. What research/information is needed to help you adopt more IPM in high tunnels?					
Biological control guidelines	16/25	64%	Pest-resistant plant cultivators	10/25	40%
Degree day monitoring	12/25	48%	Local guidelines for IPM	10/25	40%
Action thresholds (when to act)	12/25	48%	Web-based pest management	10/25	40%
Cost/ benefit analyses	12/25	48%	Spray application methods	9/25	36%
Scouting methods	10/25	40%	Pest/disease biology	9/25	36%
Pesticide/ biocontrol compatibility	10/25	40%	All already available	1/25	4%

18. What limits your use of biological control agents (parasites, predators, nematodes, microbials, etc.)?					
Lack knowledge about how or when to use them	12/23	52.2	Customer low tolerance for damage or pests on produce	3/23	13
There are no limits	6/23	26.1	Bio control agents are not readily available	2/23	8.7
Biological control is too expensive	6/23	26.1	Lack knowledge, Slow to take it to 100%. Need to make the change.	1/23	4.3
Lack confidence that biologicals work	5/23	21.7	Planning and set up can be difficult	1/23	4.3
Poor shelf life	4/23	17.4	Time	1/23	4.3
Biological control is not reliable	3/23	13	Shipping costs (Killer)	1/23	4.3
Don't know where to order them	3/23	13	Concern over how long it will take for biological control to work/take effect on pest problem	1/23	4.3
Customer intolerance for products with nat. enemies	3/23	13	Owner/manager won't allow their use	0/23	0
Not compatible with chemical pesticides	3/23		-----	---	---