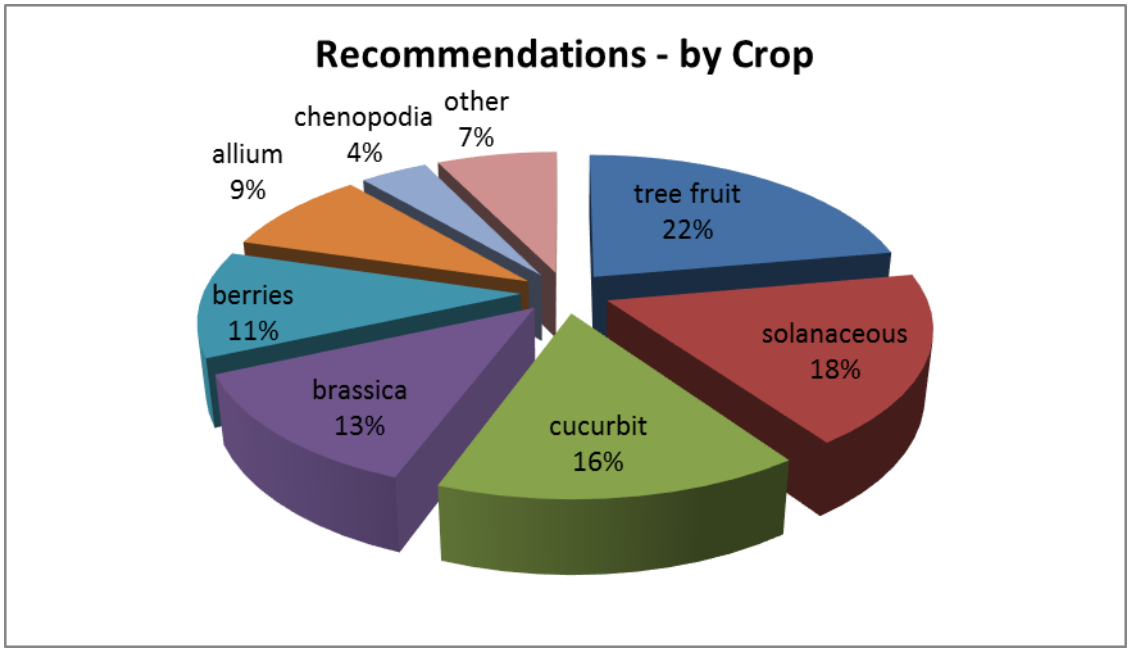
Fruit and Vegetable On-farm IPM Evaluation
April – October 2016

At the beginning of the 2016 growing season, members of our team worked with 9 farms to identify pests and problems and set goals based on different Integrated Pest Management (IPM) strategies. In total, growers identified **88 problems or pests they wanted to address using IPM, each associated with a specific crop (or crops).** Throughout the growing season, we visited participating farms on a bi-monthly basis and worked with growers to recommend and implement IPM practices. A total of **275 specific management practices were recommended** to address these 88 problems or pests. During the fall and winter, we interviewed growers to evaluate the extent to which recommended practices were adopted and how successful they were in helping farmers achieve their goals.

- **76% of the practices were adopted by growers as recommended; an additional 11% were adopted with some modification**
- **For those practices that were adopted, 87% were rated by growers as successful (65% - largely successful, 22% moderately successful) in helping them to reach their goals**



Recommendations by IPM Strategy & Problem Type

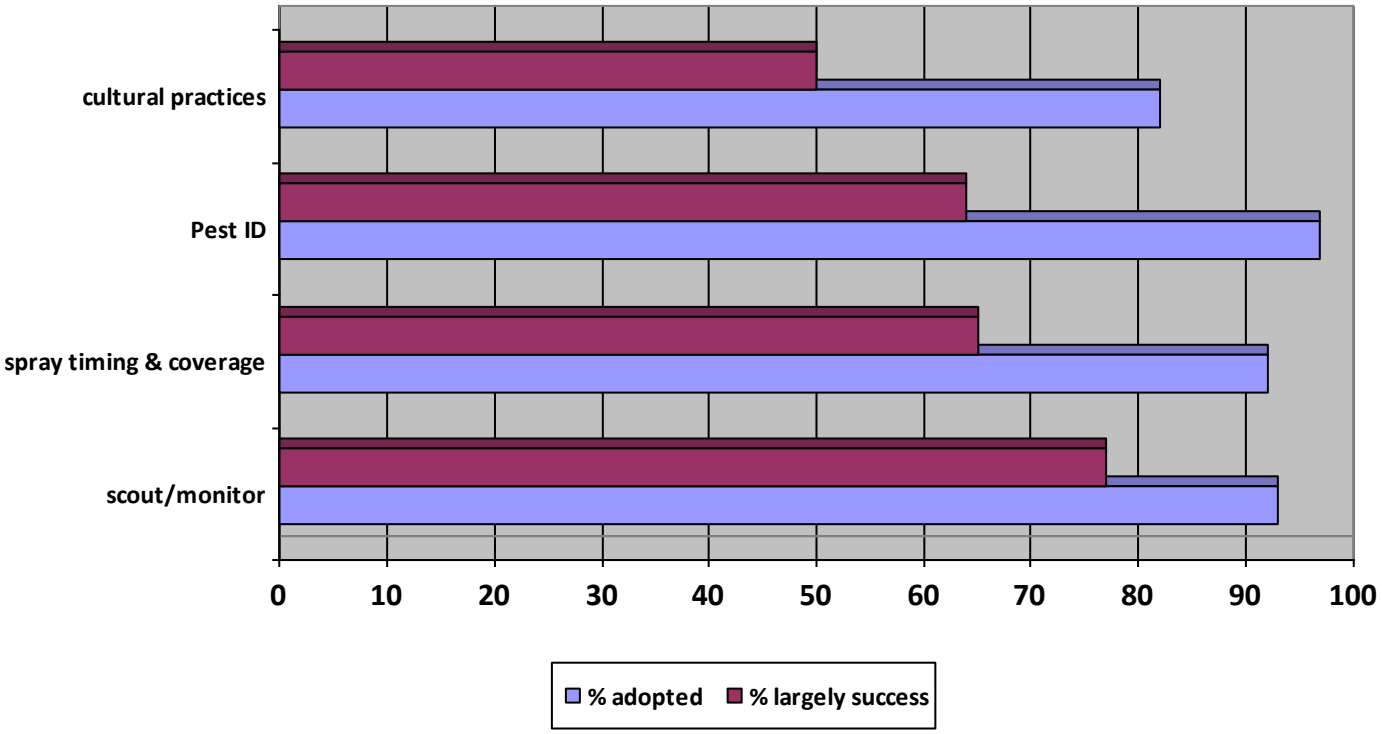
IPM Strategy	%
Pest scouting and monitoring	27%
Optimizing spray timing and Coverage	23%
Cultural practices	17%
Pest identification	15%
Maintaining optimum conditions for crop health	7%
Using reduced risk pesticide tactics	4%
Using a forecasting model	4%
Using bio-controls	3%
Consumer education	1%

Problem Type	%
Insects	45%
Diseases	25%
Other	18%
Weeds	6%
Fertility	5%
Animals (non-insect)	4%

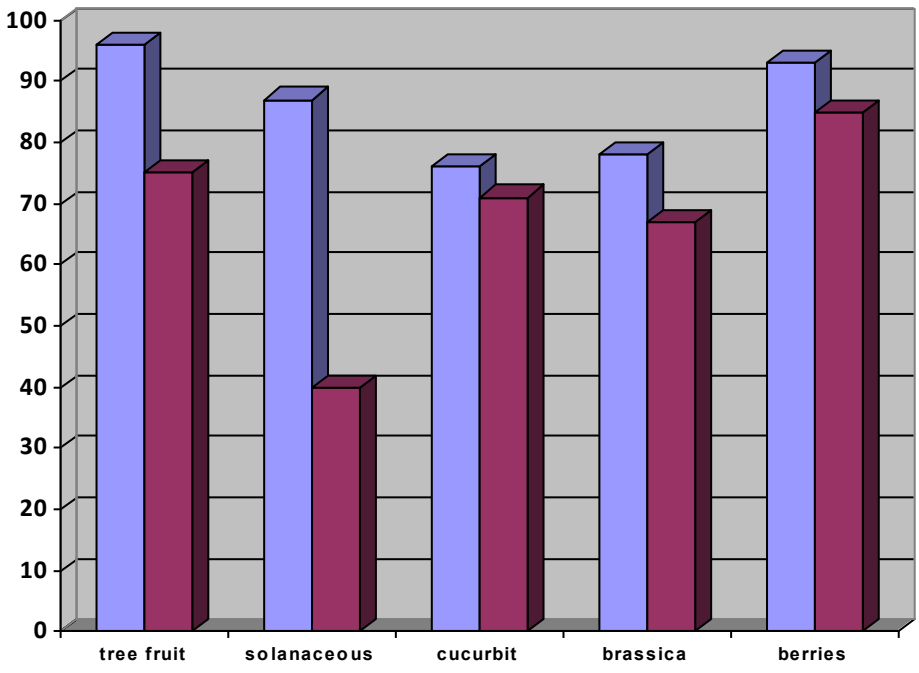
Differences in Adoption and Success of Recommendations

The results below show the proportion of recommendations that were adopted for the IPM strategies that were the most frequently recommended, for different crops and for insect and disease problems. Figures also show the proportion of growers who indicated that adopting recommendations were "largely successful."

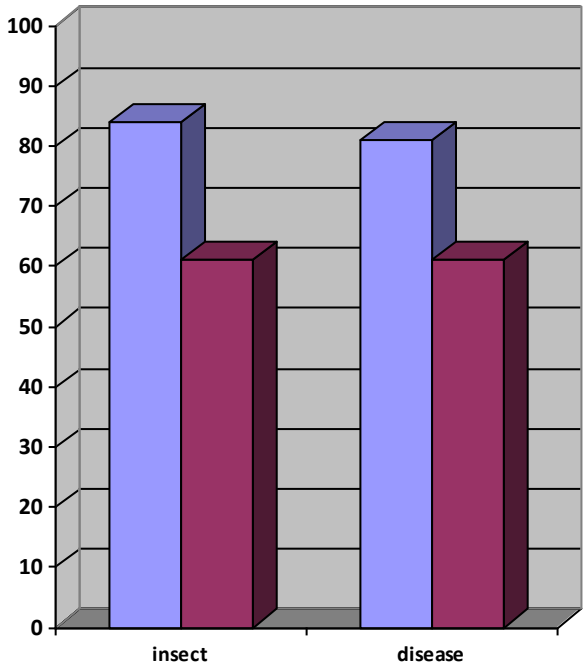
By IPM Strategy



By Crop



By Problem



Helping Growers Achieve Specific Goals

As a result of working with our team to implement recommended IPM practices, growers reported the extent to which 3 specific goals were attained for 80 separate crop-problem combinations. Growers responded according to a 4-point scale (1 = not at all, 2 = minimally, 3 = moderately, 4 = largely). The results reported are the proportion of problems for which growers achieved their goals either "moderately" or "largely."

- 55% resulted in changes in pesticide use consistent with IPM practices
- 63% resulted in reductions in crop loss
- 65% resulted in improvements in crop quality

To consider these results in greater detail, the average (mean) grower responses on the scale from 1 (not at all) to 4 (largely) are presented below in regard to implementing practices for different crops and for addressing problems with insects and diseases.

	Tr. Fruit	Solanace	Cucurbit	Brassica	Berries	Insects	Disease
Changes is pesticide use	**3.1**	**2.4**	**2.7**	**2.7**	**2.3**	**2.9**	**2.6**
Reduced Crop Loss	**2.6**	**2.5**	**2.7**	**2.4**	**3.7**	**2.8**	**3.5**
Improved Crop Quality	**3.5**	**1.8**	**2.9**	**2.2**	**3.6**	**3.0**	**3.3**

Finally, we asked participating growers whether working with our team increased their knowledge and their confidence implementing different IPM strategies. For each strategy, growers responded according to a 4-point scale (1 = Not at all, 2 = minimally, 3 = moderately, 4 = largely). The results presented show the proportion who indicated their knowledge and their confidence had increased either "moderately" or "largely."

IPM Strategy	% increased knowledge about this	% increased confidence in implementing
Pest scouting and monitoring	100%	100%
Optimizing spray timing and Coverage	89%	89%
Cultural practices	78%	67%
Pest identification	100%	100%
Maintain optimum conditions for crop health	50%	63%
Using reduced risk pesticide tactics	63%	63%
Using a forecasting model	57%	43%
Using bio-controls	75%	50%
Consumer education	40%	40%

University of Massachusetts Amherst
FRUIT IPM Report for 2016
Dan Cooley, Arthur Tuttle, Jon Clements, Sonia Schloemann
Elizabeth Garofalo, Hilary Sandler, and Katherine Ghantous

DISEASES

Apple scab -- there were 7 primary apple scab infection periods according to NEWA (http://newa.cornell.edu) at the UMass Orchard with 100% ascospore maturity occurring on 23-May. Research at UMass suggests that ascospore maturity was delayed beyond 23-May, and there was one additional primary infection event in early June. Scab was quite manageable by most, however, an exception or two was noted. In addition to the apple scab model being available on 48 NEWA sites in Massachusetts, there were 4 RIMpro (http://www.rimpro.eu/) sites using either NEWA weather data or Meteoblue, plus 9 experimental RIMpro sites using HRDPS. There were also 6 AgRadar (http://agradar.info) locations available. All DSS's (Decision Support Systems) provide valuable IPM decision support through the use of apple scab, fire blight and insect models, among others.

Fire blight -- while bloom was a long, drawn out affair for most of the state, drought conditions prevailed through most of this time creating conditions that were not particularly favorable for FB, except very late in the bloom period. Some strikes were found here and there, but seriously a pretty much a "no-show" in 2016. Orchards with a previous recent history of fire blight saw more strikes. FB will be back in force we are afraid one of these years, largely a consequence of earlier bloom combined with warmer early spring temperatures.

Rust diseases -- Cedar apple rust lesions were prevalent on foliage in orchards where fungicide management was not sufficient to arrest this disease; fortunately, there was little fruit infection.

Summer diseases -- sooty blotch/fly speck/fruit rots were definitively hampered by the dry weather in late summer. Really not much news to report here, we suspect minimal summer fungicide sprays were necessary. Golden Delicious trees in at least one orchard were seriously afflicted by necrotic leaf blotch.

Peach leaf curl -- With a total crop loss throughout the entire state, not many people were thinking about pesticide applications in peaches this year. As a result peach leaf curl was seen in several orchards.

Powdery mildew -- not a bad year, although some was certainly observed (in Honeycrisp in particular); growers need to be sure to include a PM-effective fungicide (SDHI's in particular, or sulfur) every year beginning at pink bud stage.

White Pine Blister Rust on 'immune' black currant cv 'Titania'. *Cronartium ribicola* was found in Massachusetts on the black currant cultivar 'Titania', which has been considered to be immune to this disease. A breakdown of this immunity was first reported in a limited number of plants in Connecticut in 2008. See here for more information on this. Since that time, incidence have increased in CT but *C. ribicola* infection of 'Titania' had not appeared in MA until 2014 and then again this year. There has not been a reported increase of the disease on White Pine trees, the alternate host.

INSECTS

San Jose scale -- we are seeing ongoing issues with SJS. Softer insecticide use (aka Assail) may be contributing to this and/or warmer winters. (Or a decline in spring oil/Lorsban applications.) Aggressive management, including a good dose of spring oil (with or without Lorsban, depending on your inclinations), and effective insecticides such as Esteem, Centaur, and Movento/Sivanto are being recommended.

Plum curculio -- an early influx of PC with warm and wet conditions (on or about 24-May and the days after) caught some growers off-guard as fruit were only 5-6 mm in size and significant damage resulted here and there. Overall it was a pretty high-pressure year for plum curculio, but still easy to control with timely effective insecticide application. (Emphasis on timely and effective. And Imidan.)

European apple sawfly -- Yet another one of those pests that is usually well managed by a petal fall (or pre-bloom) spray that was dicey to get on this year due to the prolonged bloom period. Above average EAS activity and damage was noted this year.

Lepidoptera moths/worms -- despite significant pheromone trap catches, little damage observed from these worms. Some growers are effectively controlling these leps either with targeted sprays (of Delegate, or Altacor among others) where a known, historical problem exists or they are still being effectively controlled by insecticides (Imidan, Assail) targeting other pests (like plum curculio). The lack of a peach crop made Oriental Fruit Moth control less urgent, but late-season tip injury to peach trees was noted. (Although no shoot tip invasion was to be found earlier in the year.) Just in -- reports of either codling moth or Oriental fruit moth damage to harvested fruit are increasing.

Mites -- dry weather favored mites, most likely both European red mite (ERM) and two spotted spider mite (TSSM). Spot or whole orchard treatments with miticides became necessary, however, with some control failures. One report of significant damage to pear foliage by TSSM. Rust mites on apple foliage were also documented in late July, they may be an under-rated problem on some susceptible varieties, however, generally don't warrant treatment.

Gypsy moth -- caterpillars were observed in young trees and treatment was needed; by late-summer, gypsy moth adults were being caught in pheromone traps (for other moths) in at least one orchard, however, no damage reported; anecdotal report of complete defoliation of small/organic orchard in south-central MA by GM; young plantings, which are often not sprayed with insecticide, will need to be monitored in 2017 if GM has another banner year.

Spotted tentiform leafminer -- only a problem in a few orchards, however, letting it get out of hand can cause pre-harvest drop and some tree health issues. Monitor flight(s) beginning in April, and treat the sap-feeding mines with effective insecticide(s) applied according to degree-day model and scouting for mines. Foliar urea applications and leaf chopping will go a long way to reducing the pupae overwintering in orchard leaf litter.

Apple maggot fly -- surprisingly heavy pressure given the dry weather. Still generally easily controlled. A Delicious tree near an abandoned orchard was really hammered. Growers are advised to monitor AMF populations through the use of sticky traps to ascertain if and when treatment is necessary.

Pear psylla -- we have had to become better managers of this pest where pear growers continue to have issues. Spring and summer oil applications are your best friend here, followed by applications of Centaur, Movento/Sivanto, etc. Conventional insecticide resistance is likely, and many generations/overlapping life stages makes pear psylla a tough one to master. Aggressive management, use of effective insecticides (lead

by oil), and timeliness of insecticide applications are the only effective approach, but well worth it to clean up this sticky (literally) situation.

Winter Moth – Warm weather in early spring prompted concern about early emergence of Winter Moth in 2016. In the end, emergence was approximately 'normal' in early April, coinciding with the April 4-6 freeze temperatures. These cold temperatures did not, however, have a noticeable impact on caterpillar survival. Damage reports from Winter Moth varied among blueberry and cranberry growers with some achieving good control with timely oil/insecticide applications and others suffering significant losses. This continues to be a difficult pest to manage. We published 9 Massachusetts IPM Berry Blasts (often in collaboration with Heather Faubert in RI) with information about winter moth.

Spotted Wing Drosophila (SWD) – Early reports from Pennsylvania and Ontario prompted worries about an early onset of SWD in New England. We monitored SWD emergence with a trapping network of 9 locations around the state. Traps were monitored weekly in most cases. First capture occurred on 7/8 but sustained captures did not occur until 7/18. Population levels seemed to remain relatively low through August. Drought conditions that prevailed during this time seemed to suppress population development. Primocane fruiting raspberries and blackberries continue to be the most significantly impacted. Late season blueberries are also affected. Wine and table grapes have mixed reports with the main issue coming where fruit damage has occurred from either bird depredation or fruit cracking following sudden rainfall. Modifying the crop canopy to allow for open air-flow and light penetration to the base of the plants has been recognized by growers as a critical component to successful SWD management. Seven issues of Massachusetts IPM Berry Blast contained information on pest status and management recommendations.

Putnam and Dearness Scale in Cranberry - For a second year, reports of dead vines across the MA cranberry-growing region were common. Over a four-month period, starting in April, we visited 22 bog sites and assessed presence of two damaging species of armored scale. New diagnoses of scale were made at 11 sites: ten were Putnam scale (*Diaspidiotus ancylus*) and one was Dearness scale (*Rhizaspidiotus dearnessi*). Sites were monitored to determine when the susceptible crawler stage appeared for best timing of treatment. A screening trial of five biological or low-impact options showed that none was effective, in comparison to conventional organophosphates.

WEEDS

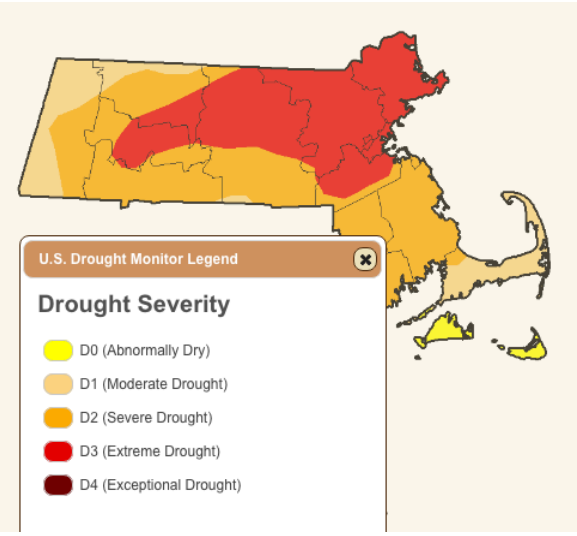
We continued work to identify herbicides that showed efficacy against poverty grass (*Andropogon virginicus* and *Schizachyrium scoparium*) and dodder (*Cuscuta* spp.). Several herbicides looked promising from an efficacy perspective, and one compound has been submitted to and accepted by the IR-4 program for cranberry trials. Residue trials will be conducted in 2017.

HORTICULTURE

April freeze -- which occurred at early green tip clearly damaged flower buds, resulting in significant variability in bloom, fruit set, and crop load largely depending on location; some orchards ended up with a very minimal crop whereas some were close to "average." Keep in mind a lighter crop was likely in 2016 following a heavy apple crop in 2015. Bloom was extended and flower buds were showing crinkled spur leaves and flower petals, thus significant damage; somewhat surprisingly, fruit set was remarkably good for some varieties like Honeycrisp and Macoun, whereas some McIntosh blocks appeared to be in trouble. A pretty much non-aggressive approach to chemical thinning was common, however, in retrospect it would have been advised to do more chemical thinning as fruit was clustered and in some cases heavily set; hand thinning was necessary, but not always done.

Blueberry and raspberry buds were affected. The impact on yield was less than feared. Some varieties of blueberry were more heavily impacted than others. Impact on raspberries was varied depending on location and variety. Overall, the summer crop of raspberries was good

Weeds -- maintaining effective weed management throughout the growing season is a critical piece to keeping your orchard healthy. A weed free strip in row and well mowed aisles will not only reduce competition between weeds and crop plants but will reduce safe harbors for voles and many insect pests. This practice can also help reduce pesticide exposure for pollinators, provided weeds are prevented from blooming in the orchard when insecticide sprays are made.



Drought -- at this point in the season, just over 50% of Massachusetts is in a state of extreme drought (90% in severe drought). Compared to the precipitation average of the last five years in Belchertown, as of September 28, we are down about 10" of rain this year. This has caused many issues in the orchard from weeds that are less susceptible to herbicides to uneven fruit sizing. Short of beefing up your irrigation systems (and maybe a rain dance) there is not much that can be done about this. Well, except the fact Massachusetts has been declared a primary disaster area because of the drought by USDA and there are numerous state and federal low/no interest loan programs available to farmers who need financial assistance. (Let us know if you have trouble finding those programs.) Are we tired of talking about it yet?

OTHER

Northeast Regional Berry Call-in: we participated in the weekly Berry Call in conference calls organized by Cornell University that brought together Extension and Industry and Growers from the Northeast (PA to Ontario) to discuss current observations and timely topics together. These calls are extremely useful for problem solving and general awareness of growing conditions and challenges. Calls started in mid-April and ran through July.

Resistance Management Education: a core RM module (PowerPoint presentation) was created and electronically distributed to the list of webinar series registrants on October 14, 2016 (177 total attendees including the four Key Individuals).

The module is available at: http://scholarworks.umass.edu/cranberry_outreach_resistance/1/

IPM Fact Sheets: Three new IPM fact sheets were published in 2016, Blueberry IPM – Cherry/Cranberry Fruitworm , Strawberry IPM – Tarnished Plant Bug, and Use of Tile Drainage in MA Cranberry Production (2016). More are planned for 2017.

Smartphone app series: tackles fruit diseases and pests. Developed in concert with Clemson University.. MyIPM-NED. Free on iPhones and androids.

"A Review On Bees: Northeast Crops Edition" published: 32-page pamphlet http://ag.umass.edu/cranberry/publications-resources/books-pamphlets

UMass Extension

Vegetable Program
ag.umass.edu/vegetable

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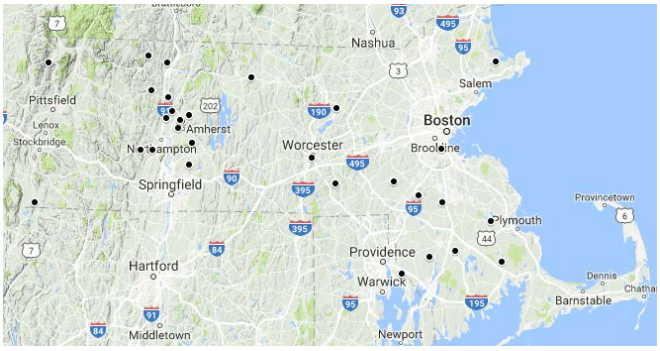
Vegetable Program Annual Report: October 2015-2016

Our team of Extension Educators includes: Katie Campbell-Nelson (nutrient management and team leader), Lisa McKeag (food safety and *New England Vegetable Management Guide* co-editor) and Susan Scheufele (plant pathology and applied researcher). Massachusetts' vegetable farmers experienced the worst drought in 30 years this season, and our team of educators responded by conducting a drought survey with over 560 respondents to inform relief programs in the state. In addition, we maintained regular programming as highlighted below.

Educational Programs: We hosted 12 educational programs and collaborated with other groups to present at an additional 23 programs in MA and regionally. We reached an audience of over 1,100 people through our programming.

Individual Consultations: We made farm visits to over 30 farms this year (map) representing over 1,000 acres. We developed 106 integrated crop and pest management strategies with these farmers, and gave 297 recommendations to address the strategies through biweekly farm visits, scouting and technical assistance.



Research Trials:
Project Director Susan Scheufele:

- *Insectary Pilot Study for Cabbage Aphid Management in Brussels sprouts* Location: UMass Crop and Animal Research and Education Center, South Deerfield, MA.
- *Alternative Insecticides for Cabbage Aphid Management in Cabbage* Location: UMass Crop and Animal Research and Education Center, South Deerfield, MA.
- *Alternative Insecticides for Cabbage Root Maggot Management in Turnip* Location: UMass Crop and Animal Research and Education Center, South Deerfield, MA.
- *Evaluating Varieties for Cucurbit Downy Mildew Resistance and Yield* Location: UMass Crop and Animal Research and Education Center, South Deerfield, MA.
- *Economic Analysis of Integrated Management Strategies for Cucurbit Downy Mildew Management* Location: UMass Crop and Animal Research and Education Center, South Deerfield, MA.

Project Director Katie Campbell-Nelson:

- *Growing Mustard as a Biofumigant for Parasitic Nematode Management in Carrots and Strawberries*. Locations: Red Fire Farm, Montague, MA and Spring Rain Farm, Taunton, MA.
- *Nitrogen contribution from cover crops for vegetable crop uptake*. Locations: UMass Crop and Animal Research and Education Center, South Deerfield, MA, Tangerini Farm, Millis, MA, Langwater Farm, Easton, MA, Twin Oaks Farm, Hadley, MA, Lysonsville Farm, Colrain, MA, and Many Hands Farm Corps, Amherst, MA

Grants Awarded:
Principle Investigator Katie Campbell-Nelson

- Prime Sponsor: Nat'l Institute of Food and Agriculture (NIFA) (NESARE), Title: *2016 NESARE MA Professional Development Outreach Program*, Total Award: $18,921.00, Expiration: 09/30/2017
- Prime Sponsor: Nat'l Institute of Food and Agriculture (NIFA) (NESARE), Title: *Nitrogen contribution from cover crops for vegetable crop uptake*, Total Award: $11,069.00, Expiration: 12/31/2018

Principle Investigator Lisa McKeag

- Prime Sponsor: US Dept of Agriculture (USDA) Risk Management Agency (RMA), Title: *UMass Extension Comprehensive Crop Insurance/Risk Management Education Program*, Total Award: $217,998.00, Expiration: 09/29/2017
- Prime Sponsor: Nat'l Institute of Food and Agriculture (NIFA),, Title: *Expanding Food Safety Education in Massachusetts and Shifting from Voluntary to Regulatory Compliance*, Total Award: $144,617.00, Expiration: 09/30/2018

Principle Investigator Susan Scheufele:

- Prime Sponsor: US Dept of Agriculture (USDA) Specialty Crops Block Grant, Title: *Increasing Sales, Fruit Quality, and Profitability of Cucurbit Production Through Integrated Disease Management*, Total Award: $50,003.00 Expiration: 09/30/2018
- Prime Sponsor: Agricultural Research Service (USDA - ARS), Title: *Cucurbit IPM for reducing pollinator exposure to key fungicides*, Total Award: $23,537.00 Expiration: 12/31/2019
- Prime Sponsor: Nat'l Institute of Food and Agriculture (NIFA), Title: *Conducting Farmer to Farmer Mentoring to Beginning, Immigrant, & Refugee Farmers in Crop Production & Marketing while Employing the Existing Thirty Year Old Flats Mentoring Model*, Total Award: $53,883.00 Expiration: 8/31/2018
- Prime Sponsor: Nat'l Institute of Food and Agriculture (NIFA) (Northeast SARE), Title: *Evaluation of biological fungicides to control diseases of spinach in winter high tunnels*, Total Award: $14,981.76 Expiration: 4/15/2017

Principle Investigator Hilary Sandler

- Prime Sponsor: Nat'l Institute of Food and Agriculture (NIFA) *Multi-level Extension Delivery to Support IPM for Massachusetts Vegetable and Fruit Growers* Total Award: $194,000 Expiration: 8/31/2017

Collaborations:

- SARE – Katie Campbell-Nelson serves as state coordinator and helps applicants submit successful grant proposals.
- MDAR – We worked with MDAR staff to provide educational programming on Nutrient Management and Food Safety.
- SEMAP, NEVBGA, NRCS, New York State IPM Program, New Hampshire Extension, CRAFT, Master Gardeners, FSA and NOFA we gave presentations at workshops and conferences hosted by these agricultural organizations at multiple locations around the region.

Services: We treated seeds for 16 farms this year from CT, MA, and VT through our Hot Water Seed Treatment service.

Publications:

- 25 issues of *Vegetable Notes* reaching over 2,500 readers regionally and beyond including regional Pest Alerts in 19 weekly issues.
- Scheufele, S.B. and K. Campbell-Nelson, A. Zolondick, 2017. Insecticides for control of cabbage root maggot in direct-seeded root crops, 2015. Arthropod Management Tests. (In Press).
- Scheufele, S.B. and K. Campbell-Nelson, A. Zolondick, 2017. Insecticides for control of cabbage root maggot in organic systems, 2015. Arthropod Management Tests. (In Press).
- Susan B. Scheufele and L. McKeag, K. Campbell-Nelson, R. Hazzard, 2016. Insecticides for Control of Cabbage Root Maggot in Spring Cabbage, 2014. Arthropod Management Tests Volume 40 (1): E44. doi: 10.1093/amt/tsv100
  Susan B. Scheufele and L. McKeag, K. Campbell-Nelson, R. Hazzard, 2016. Efficacy of Thiamethoxam Seed Treatments to Control Cabbage Root Maggot in Broccoli, 2014. Arthropod Management Tests. Volume 40 (1): E43 doi: 10.1093/amt/tsv099

Action Outcomes:

- As a result of information provided by UMass Extension Vegetable Program through on-farm training, meetings, newsletters, websites, or other means, 74% (47 people) of *Vegetable Notes* survey respondents have adopted growing practices consistent with Integrated Crop and Pest Management.
- 22 Agricultural Professionals adopted growing practices consistent with Integrated Crop and Pest Management and provided educational programs and services (i.e., factsheets, newsletters, workshops, webinars, consultations) based on what they learned through the SARE Professional Development Program

- 20 Farmers participating in on-farm scouting and on-farm research trials adopted growing practices consistent with Integrated Crop and Pest Management

Knowledge Outcomes:

- 46% (29 people) of *Vegetable Notes* survey respondents gave specific examples of growing practices consistent with Integrated Crop and Pest Management that they learned from us this year.
- 25 Agricultural Professionals increased knowledge and skills for growing practices consistent with Integrated Crop and Pest Management through the SARE Professional Development Program.
- 20 Farmers participating in on-farm scouting and on-farm research trials increased knowledge and skills for growing practices consistent with Integrated Crop and Pest Management

Highlights:

Here is what some of our stakeholders are saying about our outputs this year:

- "Veggie Notes is a tremendous resource for identifying and treating pests and diseases."
- "We use traps to tell us how much insect pressure there is."
- "We use information from Veg Notes in combination with our own research and observations to determine when/what/if to spray the large variety of crops we grow"
- "Composting workshop was detailed and practical. Using the pamphlet we received I've made a specific plan to improve our composting next season so that we may be able to actually use our own compost for field applications."
- "Tomato Blight Forecasting is invaluable to saving our tomato crop - also understanding the mildew issue in basil and trying new varieties that are somewhat tolerant of this disease."
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- "Faithfully reading the Veg Notes newsletter allows me to know what to look for in the field. Also your Pest Identification Guide is INVALUABLE! I can take it into the field and compare to have accurate information."

Katie Campbell-Nelson seeding a cover crop trial for her *Nitrogen contribution from cover crops for vegetable crop uptake* grant.

Susan Scheufele spraying her *Alternative Insecticides for Cabbage Aphid Management* trial.

Ben Jankowski and Susan Scheufele setting up pheromone traps for monitoring sweet corn pests.

Lisa McKeag gives growers a Food Safety update at a twilight meeting at Tangerini's Farm in Millis, MA

UMass Vegetable Program staff and growers taste testing a tomato variety trial at a twilight meeting at the South Deerfield Research Farm.