UMassAmherst | Center for Agriculture, Food, and the Environment

UMass Extension Annual Field Day

July 27, 2021 3 pm – 6 pm

UMass Crops Research and Education Farm, 89-91 River Rd., S. Deerfield

Demonstrating no-till transplanter at work

Using cover crops to enhance the sustainability of garlic production

Strategies for terminating cover crops

Vegetable nitrogen use in roller crimped winter rye

Maximizing soil health benefits by cover crop seeding rate

Sunn hemp; grow your own nitrogen fertilizer

Stockpile management for fall grazing

Finding the right mixture of summer cover crops for harvest

Organic control of wireworms in sweet potatoes

Downy mildew-resistant cucumber variety trial

Organic control of Cercospora leaf spot in Swiss chard & Alternaria leaf spot in broccoli

Bacterial wilt-resistant slicing cucumbers

Reducing damping off in winter high tunnel spinach

The UMass student farming enterprise –Training the next generation of farmers

Dual-use solar on Massachusetts farms

Bumblebee responses to different “flavors” of basil

From Teosinte to corn: making modern crops

How corn breathes: investigating the formation and function of stomata

Welcome to the UMass 2021 Summer Field Day!

After over a year delay in in-person outreach due to the COVID pandemic, the UMass Extension Vegetable Program and Crops, Dairy, Livestock, and Equine Program are pleased to present to you in-person 2021 summer field day. Many farmers seek research-based information about key agricultural issues, therefore, the research projects undertaken by UMass Extension focus directly on such real-life challenges. Although the main focus of the field day is soil health and sustainable farming practices, attendees will learn about a diverse range of agricultural related research topics. We hope you enjoy our beautiful research farm while learning about innovative ways to improve the sustainability and resiliency at your farm. These research projects were made possible with generous contributions from several organizations, listed at the bottom of this page. We are sincerely thankful to these organizations and their generous support.

At the bottom of the summary page of each project, you will see the contact information of the principal investigator, in case you have a question or you would like to learn more about the research project.

What is the UMass Center for Agriculture, Food, and the Environment?

The UMass Center for Agriculture, Food, and the Environment ensures that the issues growers are dealing with in the field are being addressed in our research and extension outreach education. The Center helps communities to prosper by addressing key needs of the agricultural, forestry, and green industries, including training the next generation of farmers and growers with the skills they will need. The Center is part of the University's College of Natural Sciences and is home to both UMass Extension, a major outreach unit, and the Massachusetts Agricultural Experiment Station, sponsor of research on agriculture, nutrition, natural resources, and related topics.

For more information about UMass Center for Agriculture, Food, and the Environment visit the following link: https://ag.umass.edu/

What is UMass Extension?

UMass Extension conducts research and provides educational opportunities on topics of public concern for individuals and industries in Massachusetts. UMass Extension programs include Agriculture & Landscape, Natural Resources & Environmental Conservation, Nutrition Education, and 4-H Youth Development Program. UMass Extension is part of the national Cooperative Extension System and works in collaboration with Barnstable and Plymouth county Extension programs.

The Extension Agriculture and Landscape Program works with agricultural producers, the green industry, governments, and citizens around issues of an environmentally sustainable, economically viable food system.

For more information about UMass Extension visit https://ag.umass.edu/

Acknowledgements:

This field day is made possible by the UMass Extension Vegetable Program and Crops, Dairy, Livestock, and Equine Team, in collaboration with the UMass Center for Agriculture, Food, and the Environment, the Stockbridge School of Agriculture, Northeast Sustainable Agriculture Research and Education, Massachusetts Department of Agriculture, American Farmland Trust, Johnny's Selected Seeds, the New England Vegetable & Berry Growers Association, Syngenta, Marrone Bio, USDA-NIFA, and the USDA IR-4 Program.

We are grateful to the UMass Crop and Animal Research and Education Farm crew members, including Bob Skalbite, Neal Woodard, Keith Lilly, Jim Cronk, Stefanie Puro, and Caroline DeGrappo, for their continuous cooperation and support. To the funders and supporters of each research experiment, along with authors, graduate and undergraduate students, post-doctoral, as well as visiting scholars, your encouragement, collaboration, and innovative ideas are deeply appreciated.

No-Till Trans-planter: What's the deal?

Masoud Hashemi, Arthur Siller,

The potential benefits of no-till are well-documented, from improving soil health to reducing annual fuel and labor investments. Cover crops must be terminated late to maximize their agro-ecological benefits. However, planting into high residues of the late terminated cover crops using regular trans-planters is challenging and often fails. Commercially available no-till vegetable trans-planters are usually equipped with a coulter that is able to cut through relatively high cover crop residues. During the summer field day, a newly purchased no-till trans-planter will be demonstrated.

Contact info:

For more information about the no-till trans-planter please contact Arthur Siller at asiller@umass.edu

Acknowledgment:

This equipment was provided to UMass Research Farm by American Farm Trust through a grant funded by Massachusetts Department of Agriculture.

Using Cover Crops to Enhance the Sustainability of Garlic Production in the Northeast

Alexa Smychkovich and Masoud Hashemi,

Rationale and Hypothesis:

Typically, garlic is planted in the fall into black plastic or covered with straw mulch to alleviate weed pressure in the spring and early summer months. In the proposed alternative system, annual cover crops are planted in the first week of September and allowed to grow until they are winterkilled in December. Garlic is relay cropped between the standing cover crops in October and grows through the decomposing residues in the spring. This system supports soil biology throughout the production cycle by keeping living cover crop roots in the ground for as long as possible in the fall, feeding soil microbes through the release of exudates, and by returning nutrients captured by cover crops to the soil in the spring as residues decompose.

Research Goals:

The purpose of this research project is to explore an alternative garlic production system that uses annual, fall-planted cover crops to enhance the sustainability and resiliency of garlic production by building natural soil fertility and prioritizing soil health during production. The major goals of this project are:

1) Evaluate the impacts of the proposed alternative garlic production system on the yield, nutritional quality, and nitrogen use efficiency of field grown garlic
2) Document the spring decomposition trend and nutrient release of four commonly planted annual cover crops, as well as the impact of their decomposition on the soil food web
3) Understand the influence of the various treatments on overall soil health

Materials and Methods:

Five cover crop treatments were established in the fall: 1) field pea monoculture 2) oat monoculture 3) forage radish monoculture 4) a mixture of the three, and 5) no cover crop. Garlic was relay cropped into standing residues (treatments 1-4) or planted into bare ground and mulched with straw (treatment 5) in October. In the spring, garlic plots received one of four nitrogen fertilizer treatments: 1) 0% of the recommended N rate 2) 33% of the recommended N rate 3) 66% of the recommended N rate and 4) 100% of the recommended N rate. Garlic was harvested in the second week of July and cured for two weeks.

Decomposition litterbags were placed into the field in November, each containing a known amount of cover crop residue. Litterbags were harvested every two weeks April – June in order to obtain data about the rate of spring decomposition and nitrogen release of fall-planted cover crop residues. Simultaneously, full plant garlic samples were harvested to measure garlic growth and nitrogen uptake in the spring. Finally, the soil food web response to residue decomposition across treatments was documented throughout the spring by using free-living (non-plant parasitic nematodes) as ecological indicators of food web condition and processes.

The data collected from this experiment will include garlic yield, nutritional quality, and nitrogen use efficiency, as well as detailed analysis of spring decomposition (biomass, N release, soil food web response) of common fall-planted cover crops in the northeast. Because data from this project is still being compiled and analyzed, results will be available next year.

Left: Garlic sprouting through field pea residues in the spring. *Right*: Garlic samples being processed for nitrogen use efficiency and nutrient content analyses

Contact info:

For more information about this research project please contact Alexa Smychkovich at asmychko@umass.edu

Acknowledgment:

This research is funded by a Specialty Crop Block Grant from the Massachusetts Department of Agricultural Resources (MDAR).

MDAR
MASSACHUSETTS DEPARTMENT OF AGRICULTURAL RESOURCES

Strategies for terminating cover crop

Sachina Sunuwar, Masoud Hashemi, and Arthur Siller

Rationale and Hypothesis:

Soil is the foundation of agriculture, and its quality is measured by its physical, chemical, and biological properties. However, research on the biological aspect of the soil is often neglected. The soil biology can be enhanced with agricultural practices like use of cover crops (CCs). CC helps to foster the microbial community and improve soil health by decreasing soil erosion, compaction, and suppressing weeds. However, if CCs are not winter killed, they must be terminated, and the timing and methods of termination are major factor that influences their agro-ecological benefits. CCs are terminated either mechanically or chemically, both detrimental to the soil health. Recently, roller crimping CC have been emerging as ecological termination method, especially among organic growers.

Sweet corn is an economically important vegetable grown in New England. Traditionally, sweet corn requires extensive weed control and nitrogen. The hypothesis of the experiment is proper selection & termination of CC will not only reduce the off-farm resources including nitrogen and herbicide, but also high CC residue will enhance microbial community in the soil and improve soil health.

Research Goals:

Roller crimping method of mixed cover crop termination will contribute nitrogen content for the sweet corn, suppress weed and enhance the overall soil health.

Main objectives:

1. To evaluate the use of roller crimper as more environmentally friendly method for termination of CC.
2. To quantify nitrogen contribution of CC in sweet corn nitrogen need.
3. To evaluate if high residues of CC can successfully suppress the weeds.

Materials and Methods:

The experiment is laid out as split plot design with 4 different CC termination type as main plot and 4 different recommended doses of nitrogen as sub plot. The cover crop termination types are:

1. Herbicide disk tillage (HDT): This is the conventional treatment where CC were terminated using glyphosate, residual incorporation with disk tillage and in-season chemical control will be done.
2. Herbicide no-till (HNT): This is conventional no-till practice where CC were terminated by glyphosate and no residue incorporation and no in-season weed control.
3. Cultivation disk till (CDT): This is analogous to organic growing practices, where CC were mowed and incorporate into soil and in-season cultivation for weed control.
4. Roller crimping no-till (RCNT): Termination by roller crimper, no residue incorporation, and no in-season weed control.

In addition, each termination treatment will have 4 different recommended doses (0%, 33%, 67% and 100%) of nitrogen application.

To evaluate the efficacy of treatment following measurements will be taken:

1. Nitrogen sufficiency assessment will be done prior planting, during growing season, and at harvest.

2. In season and at harvest weed assessment will be done.
3. Sweet corn yield and quality will be measured.
4. Finally, after harvest soil health measurement will be done.

Contact info:

Sachina Sunuwar, ssunuwar@umass.edu

Acknowledgment:

The No-till transplanter used in this study is a contribution from American Farm Trust through a grant fund from MDAR. The researchers appreciate both organizations.

Vegetable nitrogen use in roller crimped rye

James Siakakaba, Arthur Siller, and Masoud Hashemi

In the late spring and early summer winter rye cover crops grow quickly and add a lot of stem. This biomass is high in carbon and low in nitrogen. This biomass can encourage microbial activity which may reduce nitrogen availability to the following summer crops. To avoid nitrogen "tie-up", rye must be terminated much earlier in the spring. Unfortunately, this leaves the fields exposed in late spring and reduces the amount of organic matter added to the soil.

Roller crimping rye has shown promise as an alternative cover crop management strategy. This method leaves the rye residue on top of rather than mixed into the soil. The high amount of residue can control weeds but also makes transplanting and seeding more challenging. Furthermore, the effect of roller crimping on soil nitrogen dynamics has not been completely investigated.

Research Goals:

1- Does roller crimping winter rye reduce nitrogen tie up after late terminated rye compared to incorporated high-carbon residues?

2- Is the vegetable quality similar in both tillage treatments?

3- Does nitrogen application affect weed growth in roller crimped vegetables?

Treatments:

- Sweet potatoes, sweet corn, and butternut squash were planted following winter rye cover crop. Rye was either roller crimped or tilled in late spring. Different nitrogen rates were applied between no nitrogen and 150% of the recommended nitrogen rates for conventional crop production. The plots are arranged in a randomized complete block design (RCBD) with four replications.

- Leaf chlorophyll content will be measured during the growing season. Vegetable yield will be measured in late summer or fall for each crop and corn stalk nitrate will be measured following the harvest.

- Weed growth will be measured at harvest.

For more information about this project please contact:
Arthur Siller
asiller@umass.edu

Oat and pea mixed cover crop seeding rate

Raina Naylor, Arthur Siller, and Masoud Hashemi

The appropriate seeding rate for cover crops is affected by many conditions and can vary greatly from farm to farm. Local climate conditions, planting time, species combination, seed cost, and the goals of the cover cropping are all among the important considerations for farmers when choosing how much seed to plant for a cover crop. In order to minimize costs, planting the lowest cover crop rate which accomplishes a particular farm's goals is ideal. One rate may be needed to provide ground cover while another may be necessary to supply nitrogen to a following crop. This becomes even more complicated with cover crop combinations.

Oats and peas are a popular winterkilled cover crop combination in the Northeast. They are primarily used to scavenge nitrogen in the fall and provide ground cover over the winter while minimizing extra work in the spring for early season crops. This experiment aims to quantify how different seeding rates of oats and peas planted before cabbage impact several aspects of crop production and ecological services which would be of interest to specialty crop producers.

Research Goals:

1- Does a reduction in oat and pea seeding rate reduce nitrogen available to following cabbage crop to a degree that it would affect fertilization needs?

2- How much does a reduction in cover crop rate increase overwintered weeds like shepherd's purse?

Treatments:

- Five seeding rates of a mix of oats and peas at 25% increments between 0% and 100% (90 lbs oats and 60 lbs peas) were planted in a randomized complete block design. Each plot was split into two fertilization sections and each sub-plot received composted chicken manure at either full fertilization or half fertilization rates during the growing season.
    - Weed ground cover was measured in early spring before tillage and cabbage planting. Leaf chlorophyll and soil nitrogen content will be measured during the growing season and at harvest. Vegetable yield will be measured in late summer.

For more information about this project please contact: Arthur Siller - asiller@umass.edu

Maximizing soil health benefits by cover crop seeding rate

Corey Palmer, Arthur Siller, and Dr. Ashley Keiser

Rationale and Hypothesis:

Improving soil health is key to sustainably meeting the growing demand for food production across the globe. Planting cover crops is an effective method for reducing soil erosion, increasing microbial biomass in soils, and increasing the amount of nitrogen (N) and carbon (C) held in the soil. Cover crops retain N in their biomass in the fall. Terminated cover crop biomass then builds soil C and gradually provides N for the succeeding cash crops throughout the growing season. However, few studies have examined the seeding rate of cover crop mixtures necessary to maximize the soil health benefits. The goal of this study is to determine the percentage of recommended oat/pea cover crop seeding rate that maximizes soil health benefits. We measure soil health benefits through N turnover and availability, and soil microbial activity. We hypothesized that N turnover and retention rates will increase with increasing cover crop percentage, but plateau below the current recommended seeding rate.

Research Goals:

1- To determine the economic seeding rates for oat/pea cover crop mixture
2- To investigate how the amount of cover crop residues impacts the activity of the soil microbial community.

Materials and Methods:

- To examine N taken up by cover crop and mineralization, we are working across plots composed of five cover crop seeding rates: 0%, 25%, 50%, 75%, and 100% of the current recommended seeding rate.
- Soil samples were taken at peak cover crop biomass, after winter kill, and during the spring thaw. A final soil collection will occur after the cash crop (cabbage) harvest to measure remaining N pools.
- Soil microbial activity and soil C pools will be measured for soil samples taken before crop winter kill and during mineralization.

Contact info:

For more information about this research project, please contact Corey Palmer, coreypalmer@umass.edu

Acknowledgment:

USDA Hatch Project NC1178 provides support for this project.

Sunn Hemp: Grow Your Own N Fertilizer

Sam Corcoran, Masoud Hashemi

Rationale and Hypothesis:

Sunn hemp might have a familiar name, but it bears no biological relationship to *Cannabis.* Rather, sunn hemp is in the legume family, *Fabaceae*, and its scientific name is *Crotalaria juncea.* The tropical plant thrives in the heat and excels under drought conditions. It grows to easily reach 10' in height in warm and dry conditions, and its status as a legume means that it forms a relationship with nitrogen fixing bacteria.

In tropical and subtropical parts of the world, sunn hemp is grown for animal forage, green manure, and for fiber. In 2014, we noticed increasing interest in the plant in the southern United States and found ourselves wondering if the plant would grow for us Northerners, too. We planted sunn hemp from May through August and narrowed down our optimal planting dates to mid-July through mid-August. We then sampled the plants throughout the growing season to determine growth characteristics and suitable uses of the plant in the Northeast.

Research Goals:

Main objectives:
1- Determine rate of growth relative to planting date.
2- Determine nitrogen accumulation relative to planting date and termination time.
3- Characterize forage quality relative to growth stage.
4- Analyze the potential for weed suppression.

Materials and Methods:

- Sunn hemp was planted on July 10, July 24, and August 8. Beginning 30 days after planting, the plants were harvested every 10 days until first frost. Leaves and stems were separated and analyzed individually. Split plots were used, with one half of the plot being weeded and the other half left unweeded to determine if sunn hemp can suppress/compete with weeds.
- Yield, nitrogen concentration, total nitrogen, height, and weed biomass were collected; a subset of plants were analyzed for forage characteristics.

Preliminary Results

Age relative to planting date has many affects on plant characteristics. For example, plants planted on July 12 produced 2.2 tons of biomass per acre by the time they reached 50 days old, while plants planted on July 24 took 60 days to produce the same amount of biomass. Plants planted on August 10 trail behind, producing just 1 ton of biomass per acre at 50 days old. In a hot and dry year, sunn hemp planted on July 12 can accumulate 250 pounds of nitrogen per acre before it winter kills. While weeds did not have an effect on sunn hemp biomass production, we did find sunn hemp to be ineffective at suppressing weeds when planted alone.

Contact info:
For more information about this research project please contact Sam Corcoran, sglazecorcor@umass.edu

Stockpiled management for fall grazing

Arthur Siller and Masoud Hashemi

In the Northeast, data from climate scientists predict that farmers can expect milder/wetter winters and hotter/dryer summers, significantly reducing pasture productivity. Wet soils in spring may delay planting of long season annuals like corn and changes in summer conditions may intensify the summer slump of perennial forages. Pasturing on New England's farms is currently limited during the late fall. To avoid over-grazing, livestock producers heavily rely on stored/purchased feed. Stockpiling has been commonly used to extend the grazing season in late fall but there is no documented research in New England showing the preferred species and management practices for establishing high quality stockpile forage. Tall fescue is the dominant species in stockpiling and although its sugar content increases during the fall, the quality may not meet the needs of lactating animals. Research on other cool-season grasses as alternatives to tall fescue and integrating legumes into stockpiles has not been thoroughly explored.

In addition to this experiment at the UMass research station, we are looking for farmer-collaborators interested in exploring stockpiling on their farms. Contact us if you're interested!

Research Goals:

1- Is tall fescue, orchardgrass, or their mixture best for stockpiling in New England?

2- What timing of nitrogen fertilizer application produces the highest yields and best quality forage?

3- Can the inclusion of red clover or alfalfa replace nitrogen fertilizer in stockpile pastures?

Treatments:

- Established pastures comprised of tall fescue and orchardgrass as monocrops and mixed, will be evaluated for yield and quality. To improve the quality of stockpile grasses and possibly reduce nitrogen application, we have integrated red clover and alfalfa along as well as application of nitrogen in either early or late August. No nitrogen plots will be used as controls. We will simulate grazing by harvesting forages in late October. The plots are arranged in a randomized complete block design (RCBD) with 15 treatments and four replications. Plots are 6' x 25'.

- Forage yield and quality indices will be measured.

For more information about this project please contact: Arthur Siller - asiller@umass.edu

This research is generously funded by SARE grant LNE20-399.

Evaluating the right mixture of summer cover crops for harvest

Andrea Marroquin, Arthur Siller, and Masoud Hashemi

Rationale and Hypothesis:

In the Northeast, future summers are expected to get hotter/dryer. Summer slump is an issue where cool season perennial and annuals in pastures do not perform well enough to meet the farmers' needs during the months of June, July, and August. The dryer/hotter summers will continue to increase the summer slump. Finding an efficient and sustainable mixture to grow during this time period is a way of increasing forage availability for grazing or ensiling during these summer months. Compared to cool-season forages, summer annuals generally are drought and heat tolerant and produce high biomass during summer slump. Growing a mixture of a grass, such as Sudangrass or pearl millet, and a legume, either crimson clover or red clover, at the right ratio may meet the nutritional needs of livestock.

Research Goals:

What ratio(s) of warm season annuals leads to the best and most efficient combinations that maximize yield and quality of feed during the summer slump?

Treatments:

Experimental plots are consisted of a grass (pearl millet or Sudan grass), and a legume (red clover or crimson clover) planted as monocultures or varying mixed ratios. The plots are arranged in a randomized complete block design (RCBD) with 20 treatments and four replicates. Forage mixtures include pearl millet-red clover, pearl millet-crimson clover, Sudan grass-red clover, and Sudan grass-crimson clover, planted in 5 ratios: 100:0, 75:25, 50:50 25:75, 0:100.

Biomass of each mixture will be measured by cutting a 2x3 ft section from each plot on a weekly basis to establish how companion forages in various ratio grow over time. A separate first cut will be taken around 8 weeks after germination to evaluate yield and quality of intercropped forages, along with a second cut a few weeks later to examine regrowth of plants after the first cut.

Forage harvested in the first cut will be ensiled and quality of silage made from different intercropped ratios will be determined.

Contact: For more information about this research project please contact: Andrea Marroquin - amarroquin@umass.edu

Organic control of Cercospora leaf spot in Swiss chard
&
Alternaria leaf spot in broccoli

UMass Extension Vegetable Program
Susan Scheufele, Genevieve Higgins, Lisa McKeag, Jordan Smith, and Jared Schneider

Rationale:
Cercospora leaf spot of Swiss chard and beets and Alternaria leaf spot of brassicas are two common and highly damaging fungal, foliar diseases on vegetable farms in the Northeast. Both are widespread and occur annually when susceptible crops are present, and resistant varieties are not available to either disease.

Many biofungicides and OMRI-listed fungicides are labeled for control of both Cercospora and Alternaria leaf spots, but efficacy has not been demonstrated in the field. This study is part of a regional effort of Extension professionals to generate efficacy data on bio- and OMRI-listed fungicides, and both of these trials are being replicated in NY to generate a more robust data set.

The broccoli trial is also evaluating the efficacy of a product for the IR-4 Project—a USDA program aimed at registering safe and effective pesticides for specialty crops, including vegetables.

Cercospora leaf spot on beet (above) and Alternaria leaf spot on broccoli (below).
Photos: UMass Vegetable Program

Materials & Methods:
Cercospora leaf spot in Swiss chard treatments:

- Untreated control
- Conventional standard: Quadris (azoxystrobin) rotated with Tilt (propiconazole)
- Badge X2 (copper hydroxide + copper oxychloride)
- Stargus (*Bacillus amyloliquefaciens* strain F727) + Badge X2
- Regalia (extract of *Reynoutria sachalinensis*) + Badge X2

Alternaria leaf spot in broccoli treatments

- Untreated control
- Conventional standard: Luna Experience (fluopyram + tebuconazole – 8.6 fl oz/A)
- Badge X2
- Stargus + Badge X2
- Regalia + Badge X2
- Stargus + Badge alternated with Regalia
- XDE-659 low rate + adjuvant
- XDE-659 high rate + adjuvant
- XDE-659 high rate

Contact info: Sue Scheufele, sscheufele@umass.edu

Acknowledgments: This work is funded by Marrone Bio Innovations, the USDA IR-4 Project, and USDA-NIFA Extension Implementation Program (EIP) grant funds, Award No. 2017-70006-27137.

Downy mildew-resistant cucumber variety trial

UMass Extension Vegetable Program
Susan Scheufele, Genevieve Higgins, Lisa McKeag, Jordan Smith, and Jared Schneider

Rationale:
For several years, the UMass Extension Vegetable Program has evaluated new cucumber varieties with resistance to the damaging cucurbit downy mildew pathogen, with the aim of identifying resistant varieties for fall production. This year we are evaluating 10 varieties, including slicing and pickling types, and some open-pollinated varieties. Some successful varieties we have evaluated in the past with good DM resistance include Bristol, Citadel, NY264, and DMR401.

Cucurbit downy mildew sporulation on cucumber. Photo: G. Higgins

Materials & Methods:
Varieties:

- Cool Customer
- Chaperon
- Journey
- Brickyard
- SVCS 0951
- SV4142CL
- Raceway
- Marketmore 76
- 20-4213 x sib_03
- 20-4203-03.2

Cucumbers were transplanted on July 6. Plants are evaluated weekly for downy mildew and powdery mildew disease severity and total and marketable yields. As of July 13, no cucurbit downy mildew has been reported in New England—the closest reports currently are in NY.

Contact info: Sue Scheufele, sscheufele@umass.edu

Acknowledgments: This work is funded by Johnny's Selected Seeds and the New England Vegetable & Berry Growers' Association.

Organic control of wireworms in sweet potatoes

UMass Extension Vegetable Program

Susan Scheufele, Genevieve Higgins, Lisa McKeag, Jordan Smith, and Jared Schneider

Rationale:

Wireworms are soil-dwelling insects that cause damage to seedlings and root crops when the feed on underground root parts. There are few insecticides labeled for control of wireworm, and efficacy of OMRI-listed insecticides has not been demonstrated. In this study, we are evaluating three OMRI-listed insecticides for their efficacy in reducing damage to sweet potato tubers. This project is being replicated in VT and NY in order to generate a robust data set.

Wireworm damage in sweet potato. Photo: E. Coleman

Materials & Methods:

Treatments:

- Untreated control
- Conventional control: Brigade 2EC (bifenthrin – 9.6 fl oz/A)
- Majestene (*Burkholderia* spp. strain A396 and fermentation products – 8 qts/A)
- BoteGHA (*Beauveria bassiana* strain GHA – 8 oz/1000 row ft)
- Seduce (spinosad – 1 lb/1000 sq ft)

Sweet potatoes were planted on June 7, and materials were applied on June 15-16. Materials were re-applied 4 weeks later on July 6. Sweet potato tubers will be evaluated for wireworm damage at harvest in September.

Contact info: Sue Scheufele, sscheufele@umass.edu

Acknowledgments: This work is funded by Marrone Bio Innovations and USDA-NIFA Extension Implementation Program (EIP) grant funds, Award No. 2017-70006-27137.

Reducing damping off in winter high tunnel spinach

UMass Extension Vegetable Program
Susan Scheufele, Genevieve Higgins, Lisa McKeag, Jordan Smith, and Jared Schneider

Rationale:

The UMass Extension Vegetable Program has been conducting trials for the past 4 winters aimed at finding varieties of spinach that perform well in New England winter production systems and have resistance to the very damaging spinach downy mildew pathogen. This year we will be studying another major disease challenge for winter spinach producers, damping off, which kills seedlings, causing uneven germination and poor stands. Damping off can be caused by several soil-borne fungal and fungal-like pathogens. We will investigate two techniques for reducing damping off symptoms—seed priming and cover cropping—used together and individually.

Spinach downy mildew sporulation.
Photo: G. Higgins

Studies have shown that incorporating buckwheat residues 3 weeks before planting can reduce damping off caused by *Rhizoctonia solani*, and seed priming can speed up germination considerably, giving damping off pathogens less time to infect and kill seedlings.

Goal:

The overall goal of our spinach research program is to increase yield and profitability of winter greens production. To that end, we worked with 3 farms last winter to create winter spinach enterprise budgets. We will present these financial reports today and will be working with farms to track improvements in yield, quality, and profitability over the next winter season. ***If you are a winter spinach producer who would like to implement some new practices and monitor changes in their yield and profitability, please get in touch after the tour!***

Materials & Methods:

Treatments

- Unprimed seed, no buckwheat
- Primed seed, no buckwheat
- Unprimed seed, buckwheat
- Primed seed, buckwheat

Buckwheat will be seeded in late-July and incorporated in mid- to late-September. Spinach will be direct seeded in early October and evaluated weekly for pre- and post-emergent damping off.

Contact info: Genevieve Higgins, ghiggins@umass.edu

Acknowledgements: This material is based upon work supported by the National Institute of Food and Agriculture, U.S. Department of Agriculture, through the Northeast Sustainable Agriculture Research and Education program under subaward number LNE20-402.

Bacterial wilt-resistant slicing cucumbers

UMass Extension Vegetable Program
Susan Scheufele, Genevieve Higgins, Lisa McKeag, Jordan Smith, and Jared Schneider

Rationale:
Bacterial wilt is a major disease affecting many cucurbit crops but especially cucumbers. It is caused by a bacterium that is vectored by the striped cucumber beetle. The bacteria clog the vascular system of the plant, causing wilt and, in some cases, plant death.

In this trial, we are evaluating a few cucumber breeding lines with enhanced BW resistance. These data will be used to inform future breeding efforts and studies aimed at understanding the mechanisms underlying resistance to BW in cucumbers.

Bacterial wilt in squash.
Photo: UMass Vegetable Program

Materials & Methods:
Varieties:

- Industry standard: Corinto
- Dekah
- Robust
- Ghost

Cucumbers were planted July 2 and will be rated weekly for incidence and severity of bacterial wilt.

Contact info: Sue Scheufele, sscheufele@umass.edu

Acknowledgements: This material is based upon work supported by USDA-NIFA Extension Implementation Program (EIP) grant funds, Award No. 2017-70006-27137.

The UMass Student Farming Enterprise –Training the Next Generation of Farmers

Amanda Brown, Jason Dragon and Nicole Burton

Rationale:

The Stockbridge School of Agriculture provides students with a strong science-based academic background. This knowledge base, combined with the hands-on learning that the UMass Student Farm provides, is making UMass Amherst the place to be for research based, innovative, creative and student-driven experiential learning in agriculture. As UMass student farmers, we commit to providing our campus community with nutritious, organically grown, local produce. We cultivate student empowerment through hands-on agricultural production and by educating our peers about the importance of creating a healthier food system.

Research Goals:

Main objectives:
1- Train undergraduate and graduate students in organic farming practices.
2- Provide student grown organic produce to the campus community.
3- Address food insecurity in the local community.

Treatments:
N/A

Preliminary Results (if any)

Photo related to the research (if available)

Contact info:

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Acknowledgment:

Big Y Foods, Inc.
Stockbridge School of Agriculture
College of Natural Sciences

Dual-Use Solar on Massachusetts Farms

Stephen Herbert, Stockbridge School of Agriculture

Rationale:

There is a need for sustainable renewable energy sources to meet ever increasing demands for household and industry electrical needs and for reducing environmental impacts. Solar power is an area of greatest promise for Massachusetts. However, traditional ground mounted solar installations on farmland remove arable land from potential agricultural use when the world also needs more food.

Research Goals:

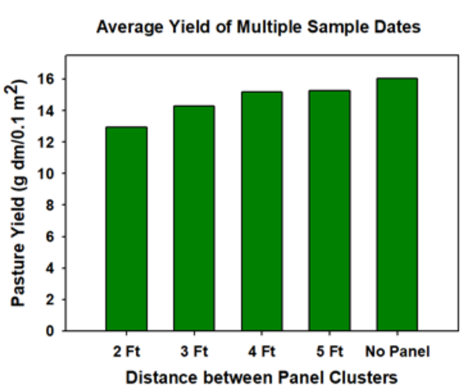
The main objective has been to demonstrate an alternative system of generating electrical energy while still maintaining the land in agriculture. Panel clusters were installed 7.5ft (2.3m) off the ground with spaces between panel clusters varying from 2 to 5ft.

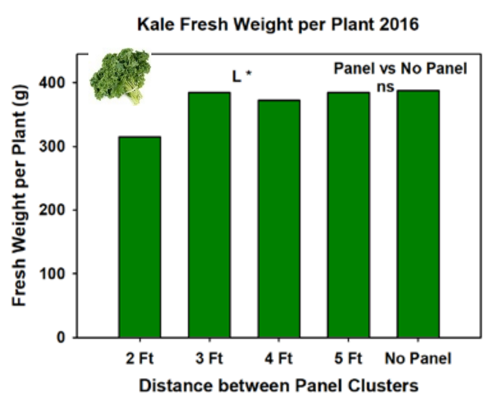
Treatments:

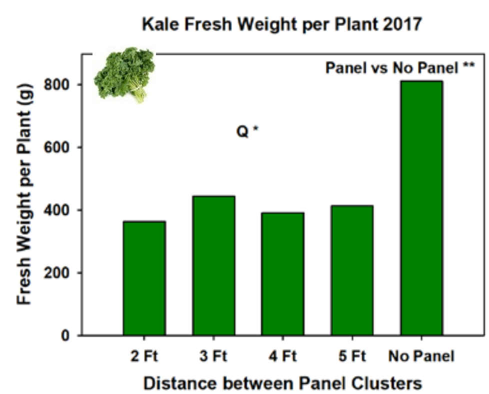
- The initial crop evaluation was pasture grazed by cattle (2011-2014).
- In 2016 to 2021 we have been conducting vegetable evaluations planted under and in the gap between the panel clusters. Broccoli, Swiss Chard, Kale, Pepper were grown under shade and unshaded plots in two configurations.

Preliminary Results:

- Pasture yields were >90% of control yield with a 4ft gap (first graph below).
- All crops grew successfully during the drought and heat of the 2016 summer and in normal years (next three graphs). Leaf temperature was 15ºF cooler under the shade of PV panels on clear days contributing to higher yields of shade plots vs. unshaded in hot dry years.
- Crops were watered daily in all years thus moisture availability was not an issue in a dry year.







Contact info:

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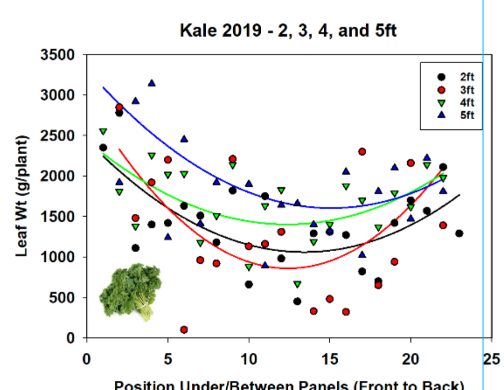
Acknowledgment:

Installation of Array - Hyperion, Amherst; UMass Extension; UMass Expt. Station; UMass Facilities; MDAR and MA Clean Energy; MA Society for Promoting Agriculture.
Research - UMass Expt. Station; NREL (National Renewable Energy Lab) and the DOE Inspire Program.



Bumblebee Responses to Different "Flavors" of Basil

Seanne Clemente & Lynn Adler

Rationale:
As a domesticated plant, basil (*Ocimum basilicum*) has many different cultivars; prominent examples include cv. 'Genovese' and cv. 'Cinnamon.' While distinct in appearance and growth habits, perhaps the most profound differences between basil cultivars are in scent and flavor, which comes from volatile organic compounds (VOCs) in the leaves and flowers of each cultivar. We previously determined that bumblebees (*Bombus impatiens*) infected with gut parasites (*Crithidia*) have reduced infection after feeding on the flowers of certain basil cultivars.

Research Goals:
This summer, we are trying to determine whether bees will change their behavior and prefer to feed on medicinal cultivars of basil when they are infected with *Crithidia*.

Treatments:
- Basil cultivars are the main treatments. cvs. 'Cinnamon', 'Greek Dwarf', and 'Lime' are medicinal, and cvs. 'Genovese', 'Mammolo', and 'Lettuce Leaf' are non-medicinal.
- *Expt 1*: In sealed tents, we will conduct choice trials with *infected* and *uninfected* bumblebees. They will be allowed forage freely and choose between *medicinal* and *non-medicinal* cultivars in pots.
- *Expt 2*: In the open field, we will also plant 5x5 ft. plots of flowering basil from *medicinal* and *non-medicinal* cultivars.

Major measurements:
- *Expt 1:* To see whether bees prefer a type of cultivar over the other, we will record bees as they forage in the tents. We will measure the time bees spend on flowers and the number of flowers they visit during each choice trial. If infection *does* affect foraging behavior, we expect infected bees to show preferences towards medicinal cultivars, and uninfected bees to prefer non-medicinal cultivars or have no preference at all.
- *Expt 2:* We are also capturing wild bees that visit the plots of basil. We will dissect them to determine if they are infected with *Crithidia.* If infection changes bees' foraging behavior, we expect to capture more infected bees in plots containing medicinal cultivars than in plots containing non-medicinal cultivars.

Preliminary Results
We have just started the project in mid-July, and thus have no preliminary results so far.

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Acknowledgment:
Current research will be supported by a Garden Club of America Centennial Pollinator Fellowship, a National Science Foundation Graduate Research Fellowship, and a Cut Flowers Grant.

From Teosinte to Corn: Making Modern Crops

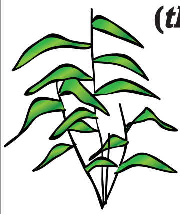
All of our major crops have been domesticated from wild progenitors; changes to developmental genes has been an important driving force in this process. The Bartlett lab studies the genes that control development in corn, and how they can be modified to improve corn yield.

Corn has gone through a series of changes over time to change from the branchy, small-kerneled teosinte to result in the plant we know today. These changes have been facilitated by:

1) Domestication 2) Crop improvement 3) Introduction of novel traits 4) Modern crop design

Each of these steps has relied on the emergence of new genetic variants - genetic mutants that had new traits that were beneficial for agriculture. Some of the mutants that have been important in each of these processes are:

1) Teosinte branched (*tb1*)

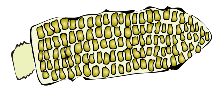


The wild ancestor of maize, teosinte, is a bushy plant that produces few seeds compared to modern maize varieties. During maize domestication, humans selected for genes that suppress branching and promote bigger ears with more kernel rows. One of the genes that was selected for is teosinte branched1 (tb1). tb1 mutants have many branches (like teosinte) and have tassels in the place of ears. Selecting for tb1 allowed for more plants to be grown in a smaller space.

2) Drooping leaf (*drl*)

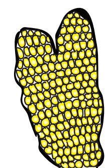
Since the middle of the 20th century, much of the focus in crop improve ment has been in enhancing yield per hectare rather than the yield of an individual plant. One way to accomplish this is to grow plants with a greater, more horizontal leaf angle, as they will not suffer reduced yield when planted closer together. Corn with a drooping leaf (smaller leaf angle) pheno-type was recently investi-gated, and the gene under-lying the trait was identified. This mutant informs us about which types of genes are involved in selecting optimal leaf angles.

3) Sweet corn

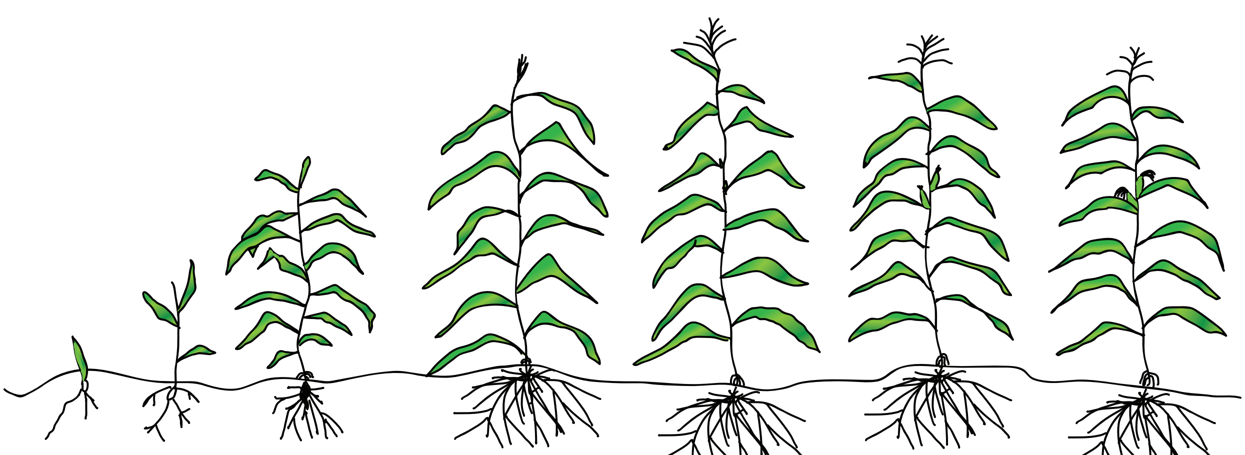


Sweet corn is the result of mutations in a gene that encodes for a protein involved in making starch. Because these mutations break this gene, sugar is no longer stored as starch in corn kernels, and instead gives us delicious sweet corn. The mutation found in commercial North Ameri-can sweet corn actually popped up in a field in the northeast - sometime before Europeans made it to North America. So sweet corn is as local as it gets for New Englanders!

4) Fasciated ear (*fea4*)



In some naturally-occurring maize mutants, fasciation, or broadening, occurs in ears. One of these mutants is called fasciated ear4. The gene causing this trait codes for a transcription factor (a gene that controls other genes) in a previously unknown growth pathway. While strong alleles can cause broader but shorter ears, weak alleles of this gene increase kernel number without decreasing the ear length. This leads to higher yield. Modern molecular tools to improve crops by altering the function of this gene.



How corn breathes: investigating the formation and function of stomata

Le Liu, Arif Ashraf, Marissa Coppola, Qiong Nan and Michelle Facette

Rationale:

All plants have many small pores on the epidermis of leaves and shoots, called stomata. Stomata allow plants to “breathe” – carbon dioxide is taken up from the atmosphere for photosynthesis, while oxygen and water vapor escapes through the pores. The plant can control the aperture of stomatal pores. Open stomata allow for maximum photosynthesis, and maximum biomass accumulation (i.e. growth). But, this comes at the cost of water loss, or potential access to pathogens. Thus, in times of drought, dark, or pathogen attack, plants will close their stomata.

Many grain crops – such as corn, wheat, barley and rice – have specialized stomata that are very quick to open and close in response to environmental cues. The stomata in these crops have unique shapes. It is hypothesized that quickly moving stomata might be more drought tolerant, because they can respond to the environment more quickly. We have identified mutants and different corn inbred lines that either do not make stomata correctly, or open and close their stomata more quickly or slowly. Using these different plants, we will try to identify what genes are important for stomatal function in corn.

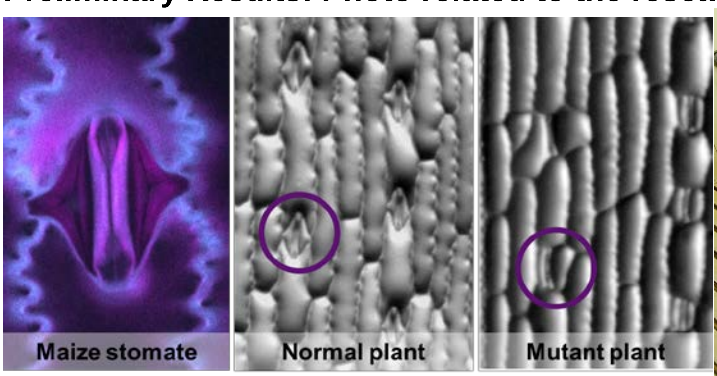
Research Goals:

1. Determine what genes are necessary for plants to from correctly shaped stomata in corn.
2. Determine what genes are necessary for corn to open and close their stomata quickly.
3. Determine if plants with quickly moving stomata are more drought tolerant.

Treatments:

- We are growing ~30 mutants that do not form stomata correctly. In future years, we will identify the genes necessary for correct stomata formation.
- We identified several different inbred lines that, in the greenhouse, open and close their stomata either more quickly or slowly in the greenhouse. This summer we will test if that is true in the field as well.

Preliminary Results: Photo related to the research



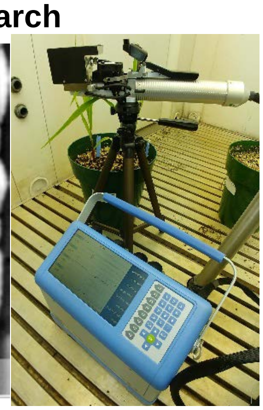


Photo 1 – examples of maize stomata from normal and mutant plants.
Photo 2 – instrument to measure plant “breathing” - measures how much carbon dioxide and water vapor passes through stomata. We will bring the instrument to the field for a demonstration.

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Acknowledgment:
Supported by USDA Hatch MAS00570 & NSF IOS 1754665 to M. Facette

NOTES