

UMass Agricultural Field Day



Wednesday

June 24th

9:30am-4:00pm

Crop and Animal Research

Education Center

89-91 North River Road

S. Deerfield, MA

Join us for a guided tour
of the research farm

-Growing Malt Barley in New England

-Hardwood Biochar in Agricultural Soils

-No-Till Forage Radish Cover Crops

-Effect of bee disease and hedgerow
plantings

-Dual-Purpose Cover Crops

-and more...

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Welcome to the 2015 UMass Agricultural Field Day

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vibrant business, policy and public interest sectors in the state, including agriculture, the horticultural 'green industries,' environmental decision-makers and food system interests.

For more information please visit: <http://ag.umass.edu>



Today's guided tour will include:

Session A and B 10 am to 12.

Session A: Cover Crops and Vegetables 10-12pm

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Lunch 12-1

Session C: 1-4 pm

Session C: Growing Barley for Brewing 1-3pm

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Dr. Richard Horsely	

Panel Discussion:

Dr. Richard Horsely– Coordinator of the NDSU Malting Barley Improvement Program

Andrea Stanley- Owner and Operator of Valley Malt Hadley, MA

Matt Zarif– Carter and Stevens Farm, LLC

Dr. Masoud Hashemi

Nitrogen Management of Sweet Corn Production by Planting Fava Beans

Block 11

Fatemeh Etemadi, Masoud Hashemi, Sarah Weis

Rationale: Fava beans are a cool season legume crop with high nutritional values and have the potential to replace imports of soybean meal to Northeastern United States. Fava beans has the potential for being grown after harvesting a spring planted cash crop and be used as dual purpose cover crop. Fava beans planted in late July-early August may produce satisfactory pods for fresh market while the remainder of plants continues to grow until they winter killed. Residues fava beans as a legume crop possess the ability to fix atmospheric nitrogen and therefore reduce the cost of nitrogen fertilizer. It has been reported that fava beans can fix up to 120 pounds of nitrogen per acre when complete crop is incorporated into soil. Consequently, fava bean can improve the economic value of a following crop by enhancing the yield and/or increasing the protein concentration of the grain.

As a cover crop, fava beans can significantly stimulate microbial activity and thereby enhance natural soil fertility, improve soil structure and water-holding capacity, thus improving the yield potential of succeeding crops when compared to continuous cropping system which relies on synthetic nitrogen fertilizers.

The duration of time between fava bean harvest and sowing the next crop, the turnover rate of above and below-ground legume N in soil, the timing of the requirement for N by the subsequent crop in relation to the supply of plant-available forms of N, and the prevailing climatic conditions are among factors that will influence the efficiency at which N derived from fava beans residues will either be utilized for the growth of a following crop, or be lost from the plant–soil system. Leaving legume residues as mulch rather than soil incorporation may ensure a slower release of plant nutrients and thus improve the synchrony of nutrient release with subsequent crop nutrient removal from the soil.

Research Goals: The main goals of this study are: a) Feasibility of fall planting fava beans as dual purpose winter killed cover crop, b) Studying decomposition rate and nutrient release trend of fava beans residues, c) Studying nitrogen uptake trend of spring planted sweet corn and its synchrony with nitrogen release from fava beans residues, d) Assessing nitrogen contribution from fava beans to spring planted sweet corn

Treatments: Treatments include three date of planting of fava beans including August 01, 07 and 14, and in following year planting sweet corn in two till management (till and no-till) with five rates of Nitrogen fertilizer including 0, 25, 50, 75 and 100 kg ha⁻¹.

Results: The first year of this study showed producing more biomass of fava beans, resulting fix more nitrogen. So, it had a positive effect on quantity and quality of following sweet corn. Second year of this study is ongoing and sweet corn years will be analyzed after harvest to determine yield and quality parameters.



This research is funded by Sustainable Agriculture Research and Education program (SARE) and Massachusetts Department of Agricultural Resources (MDAR).



For more information contact Fatemeh Etemadi: fetemadi@psis.umass.edu

Integrating Forage Radish Cover Crops and No-Till for Sustainable Early Sweet Corn Production

Block 10

Julie Stultz Fine and Masoud Hashemi

Rationale:

Fall-planted forage radish cover crops have shown successful suppression of winter annual weeds and spring pre-plant weed growth as well as recycling of fall-captured nutrients. Early spring crops may take advantage of these benefits. Specifically, a nitrogen-demanding crop such as sweet corn can benefit from nitrogen released from rapidly decomposing forage radish residue. Large root channels created by the radish provide excellent water infiltration and warmer soil temperature for early planting. Research is lacking on the effects on sweet corn of low-residue winter-killed forage radish and cover crop mixtures.

In 2012, nearly 15,000 acres were devoted to sweet corn production in New England (USDA-NASS, 2013). Unfortunately, sweet corn is an herbicide-, fertilizer-, and water-intensive crop. Production systems can be improved to reduce herbicide requirements, reduce tillage, and increase nutrient cycling, while maintaining sweet corn yields. This study will evaluate the feasibility of early planting and weed suppression from forage radish in a no-till sweet corn system.

Research Goals:

Data from this research will be used to develop an innovative no-till production system for early sweet corn to take full advantage of the benefits of a fall-planted forage radish cover crop. It will:

1. Determine the effects on plant nutrition in sweet corn of preceding forage radish and cover crop mixes;
2. Assess the feasibility and success of earlier planting of sweet corn into a no-till seed bed following winter-killed forage radish cover crop mixes;
3. Measure the sweet corn yield and date of maturity to determine the effectiveness of a forage radish/sweet corn cropping rotation for producing high quality, early sweet corn.

Results:

Among data collected in fall 2014 measuring cover crop biomass and weed biomass, there were no significant differences among treatments. Soil samples and cover crop tissue samples are currently being analyzed for differences in nutrient cycling. Sweet corn nutrition, quality and yield will be measured during the 2015 growing season.



Above: Forage radish root in late fall, an effective “biodrill”.



Above Near total weed suppression achieved by an August planting of forage radish.

Above Near total weed suppression achieved by an August



Above: Forage radish cover crop residue in mid-April, after winter-kill.

For more information please contact Julie Stultz Fine via email at jsf@umass.edu

This research is funded by Northeast SARE
(Sustainable Agriculture Research and Education).



Evaluation of Conventional and OMRI-Approved Insecticides to Reduce Cabbage Root Maggot Damage

Block 9

Susan Scheufele, Katie Campbell-Nelson, Lisa McKeag, Ruth Hazzard

Rationale: Cabbage root maggot (*Delia radicum*) larvae feed on roots of brassica crops, causing substantial losses in spring plantings due to plant collapse. Feeding damage to fall root crops such as turnips and rutabagas renders them unmarketable. Chemical control options for conventional and organic growers are limited. A banded, soil drench of the organophosphate Lorsban (chlorpyrifos) at transplanting has been the commercial standard treatment for preventing root maggot infestation, but growers are seeking alternative chemistries for resistance management, and to reduce risk to applicators and the environment. In 2014, we evaluated two new products in the diamide class, Coragen and Verimark, that offer greater flexibility in application method and timing, have a long residual, and provided effective control of cabbage root maggot. This year we are re-testing Verimark, and evaluating alternative application methods for direct-seeded crops.

In 2014 we also evaluated the OMRI-approved insecticide Entrust SC (spinosad) applied as a transplant drench followed by banded sprays after transplanting, or just as banded sprays after transplant, and found Entrust SC to be as effective as Lorsban when applied as a tray drench plus follow-up banded applications. Entrust is not currently labeled for cabbage root maggot or for transplant drench applications, so this data will be used to support a label expansion in order to make available a new tool for controlling cabbage root maggot on organic farms and a new rotational chemistry for conventional growers. This year we will also test alternative OMRI-approved insecticides including that could be used in rotations on organic and conventional farms alike.

Research Goals:

- To demonstrate efficacy of new synthetic insecticides to reduce damage caused by cabbage root maggot and increase yields in spring brassica plantings.
- To evaluate efficacy of synthetic insecticides applied as in-furrow treatments for direct-seeded crops.
- To evaluate efficacy of OMRI-approved insecticides in reducing cabbage root maggot damage.

To pursue an expanded label for Entrust SC.

Treatments:

Table 1. Products and application methods evaluated in transplanted cabbage study.

Treatment	Product	Active Ingredient	Rate	Application Method
1	Untreated	na		
2	Lorsban	chlorpyrifos	2.75 fl oz	Banded over row after transplant
3	Verimark	cyantraniliprole	13 fl oz	Tray drench
4	Entrust SC	spinosad	10 fl oz	Tray drench
5	Entrust SC	spinosad	10 fl oz	Tray drench plus banded at first flight
6	Azadirect	azadiractin	2 pints/A	Tray Drench
7	Azadirect	azadiractin	2 pints/A	Tray drench plus banded at first flight
8	Venerate XC	Burkholderia spp. strain A396	1% solution	Tray drench
9	Venerate XC	Burkholderia spp. strain A397	1% solution	Tray drench plus banded at first flight

Table 2. Products and application methods evaluated in direct-seeded Hakeuri turnip study.

Treatment	Product	Active Ingredient	Rate	Application Method
1	Untreated	na		In-Furrow
2	Lorsban	chlorpyrifos	2.75 fl oz	In-Furrow
3	Verimark	cyantraniliprole	13 fl oz	In-Furrow
4	Verimark	cyantraniliprole	13 fl oz	Banded at Germination



For more information please contact Sue Scheufele at sscheufele@umext.umass.edu. Funding for this project was provided by DuPont Crop Protection, Syngenta, the New England Vegetable & Berry Growers' Association, and a grant from USDA NIFA.



Enhancing Soil Health with Hardwood Biochar

Block 7

Emily Cole, Stephen Herbert, Masoud Hashemi and Baoshan Xing

Rationale: The sustainability of small farms in the Northeastern U.S. has been continually threatened by both the rising costs to operate and the degradation of soil quality. Small farms compete with large farms for economic viability and without the large land area to increase profitability, they must find alternate ways to increase yield and/or decrease operating costs to stay profitable. One large factor involved in the sustainability and yield is the quality and health of the soils. Soil quality must be maintained to ensure high crop yield, yet often, conventional farming practices cause continual soil quality degradation from intensive cultivation and inorganic fertilizer application. Counteracting this inverse relationship is a major challenge and often requires significant shifts in agricultural management practices. Biochar has been touted as having many potential uses as a soil amendment including remediation of contaminated soils, carbon sequestration and specific soil characteristic alteration, such as increased cation exchange capacity, pH and nutrient availability. This project aims to investigate the influence of biochar on the soil's chemical, physical and biological properties as they relate to overall soil health and productivity.

Research Goals: The overall goal of this proposed work is to evaluate the addition of biochar as a soil amendment in a temperate agricultural field and in the greenhouse using live field soil. The specific objectives of this study are as follows:

- (1) to study nutrient retention in soil amended by biochar; specifically to detect macro- and micronutrient status as a result of application of biochar to the soil.
- (2) to quantify and analyze the nitrogen uptake and yield of sweet corn in biochar amended field soils.
- (3) to characterize the effect of biochar on selected chemical and physical properties of the soil including pH, moisture retention and CEC.
- (4) to observe soil biotic (bacteria and nematodes) community shifts due to application of biochar at field scale.

Treatments:

5 levels of biochar, 5 replicates, 25 total plots.

0% by weight, 0 Mg/Ha

2% by weight, 40 Mg/Ha

4% by weight, 80 Mg/Ha

6% by weight, 120 Mg/Ha

8% by weight, 160 Mg/Ha

Results: While no significant differences in yield have been seen thus far; there have been significant changes in the soil properties. Besides the increased pH and CEC, large increases in retained cations such as Mg, Ca, K and Mn.

<i>Initial Sample & char%</i>	<i>Density (g/cc)</i>	<i>Soil pH</i>	<i>CEC (Meq/cg)</i>
<i>July 2012</i>	<i>0.92</i>	<i>5.6</i>	<i>8.4</i>
<i>July 2013, 0%</i>	<i>0.89</i>	<i>6.2</i>	<i>9.3</i>
<i>2%</i>	<i>0.84</i>	<i>6.6</i>	<i>9.1</i>
<i>4%</i>	<i>0.84</i>	<i>6.9</i>	<i>9.2</i>
<i>6%</i>	<i>0.79</i>	<i>7.1</i>	<i>9.6</i>
<i>8%</i>	<i>0.83</i>	<i>7.1</i>	<i>9.7</i>



Biochar Application, July 2012



Sweet Corn Rows, July 2014



For more information please contact Emily Cole via email at ejcole@umass.edu.

Using Cover Crop Mixtures to Reduce Nitrate Leaching and Fertilization in Potato Production

Block 2

Emad Jahanzad, Allen V Barker, Masoud Hashemi, Touria Eaton, Amir Sadeghpour

Rationale

Tuber yield and quality of potatoes are highly affected by soil N fertility levels. Often, farmers over-apply nitrogen fertilizer to ensure against yield loss, which results in increased costs of production, it is estimated that about 40% of potato production costs is related to N fertilizer application. On the other hand, high mobility of nitrate in the soil profile makes it susceptible to leach to the lower soil levels resulting in water contamination and environmental concerns. Soil fertility practices such as tailoring N fertilizer rate and selecting appropriate type of cover crops in rotation with potato can not only reduce nitrate leaching but enhance profitability by cutting fertilizer costs. By scavenging such large quantities of nitrate, cover crops contribute to protecting water quality and decrease enormous health care costs caused by nitrate contaminated water. Therefore, the objectives of this study were to (i) evaluate influence of different cover crop mixtures on minimizing nitrate leachate caused by excess N fertilization and (ii) to study nutrient density and tuber yield of potatoes as affected by cover crop mixtures and N fertilizer.

Materials and Methods

Five cover crop mixtures including oat/peas, rye/peas, daikon/peas, daikon/rye, and daikon/oat, were planted in late August at the research farm of University of Massachusetts, Amherst in 2013 and 2014. Prior to planting cover crops, nitrate collector units filled with nitrate absorbent resin were prepared and buried below the cover crop root zone based on plant species in the mixtures (Figure 1). Nitrate absorbent units were collected at different intervals and before cover crop termination in the winter and were later analyzed in the lab for nitrate determination (Figure 2). Early in the spring, cover crop residues were disked, potato seeds were planted, and four N fertilizer levels (0, 50, 100, and 150 kg ha⁻¹) were banded in rows at the time of planting. Potatoes were harvested in early August and separate tuber samples were taken to calculate yield and nutrient density.

Results

The results of the first year of this experiment indicated that cover crop mixtures reduced the amount of nitrate leaching compared with no cover crop plots. The highest amount of nitrate leachate was collected from no cover crop plots followed by peas-forage radish (P+FR) mixtures. Nitrate leaching was minimum in rye-forage radish (R+FR) compared with other mixtures and there was not a significant difference between rye-peas (R+P) and oat-peas (O+P) mixtures (Figure. 3). Cover crop mixtures produced higher yield compared with no cover crop plots. While the highest level of N increased tuber yield in no cover crop plots, mixtures produced higher tuber yield at lower N rates, the highest tuber yield was obtained from oat-forage radish (O+FR) (25.8 ton ha⁻¹) and oat-peas (O+P) (26.1 ton ha⁻¹) mixtures, fertilized at 100 kg N ha⁻¹. Application of 150 kg N ha⁻¹ decreased yield in oat-forage radish and oat-peas plots compared to 100 kg N ha⁻¹ (Data not shown). Oat-Forage radish mixture was more efficient in providing nutrients for the following potatoes when no N fertilizer was applied (Data not shown).



Figure 1. Nitrate absorbent resin units buried before planting cover crops in August



Figure 2. Extracting nitrate from resins and nitrate determination in the lab

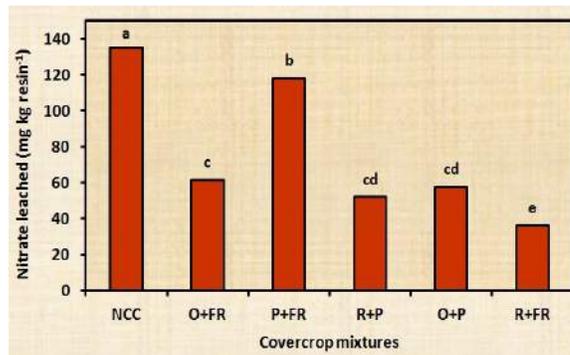


Figure 3. Nitrate leaching as affected by cover crop mixtures

This research is funded by Sustainable Agriculture Research and Education program (SARE).



For more information contact Emad Jahanzad: ejahanzad@psis.umass.edu

Dual-Purpose Double Cropping with Winter Grain and Early-Maturing Corn

Sam Corcoran, Masoud Hashemi

Rationale: Most dairy farmers do not use cover crops, or use them inefficiently. A system in which a winter grain is grown in tandem with a short-season corn hybrid will yield more forage than a traditional system using full-season corn and no, or inefficiently planted, cover crop. Efficient cover cropping for dual-purpose use has the potential to significantly reduce feed costs as it minimizes the need to purchase feed. Therefore, we are looking at cover crops that can be harvested/grazed as high quality forage in the fall and/or spring.

Research Goals: The first goal of this research is to evaluate the efficiency of on time planting of cover crops in so far as nutrient recovery (more specifically nitrogen and phosphorus), winter survival, yield, and quality of spring forage production all relative to cover crops planting date. Subsequently planted corn of early, mid, and full maturity will also be evaluated relative to cover crop planting date in terms of fertilizer requirements, quality, and yield. The second goal of this research is to identify among winter rye, triticale, and wheat, which species will serve as the best winter grain in terms of survival, yield, and quality, and which will provide maximum benefit to subsequently planted short-season corn. This study will provide enough information for selecting the best corn-winter grain cover crop system. The third goal of this research is to develop an economic analysis of the associated costs, and potential profits, of the dual-purpose system.

Treatments: Experiment One – Following fall manure application, rye was planted on 9/1, 9/15, and 10/1 along with plots left with no cover crop. In the early, mid, and full maturity corn will be planted after harvested cover crops and fertilized in season according to PSNT results.

Experiment Two – Following fall manure application rye, triticale, and wheat were planted on 9/1, along with plots left with no cover crop. Spring N applications were 0, 25, and 50 lbs./ac⁻¹ to help produce maximum high quality biomass for hay or baleage. Early maturing corn will be planted after harvested cover crops in the spring. Both experiments will be repeated in the 2015-2016 season.

Results: The first year of this study is ongoing, and fall 2014 and spring 2015 data is still under laboratory and statistical analysis.

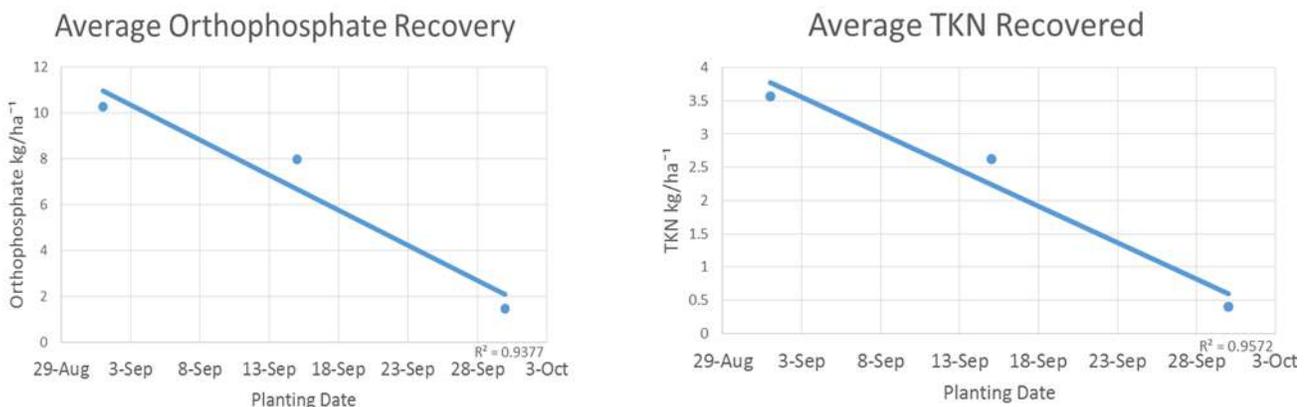


Fig 1 (Left): P recovered from fall-applied manure, **Fig 2 (Right):** Total N recovered from fall applied manure in rye crops harvested on 11/20/2014, relative to planting date.

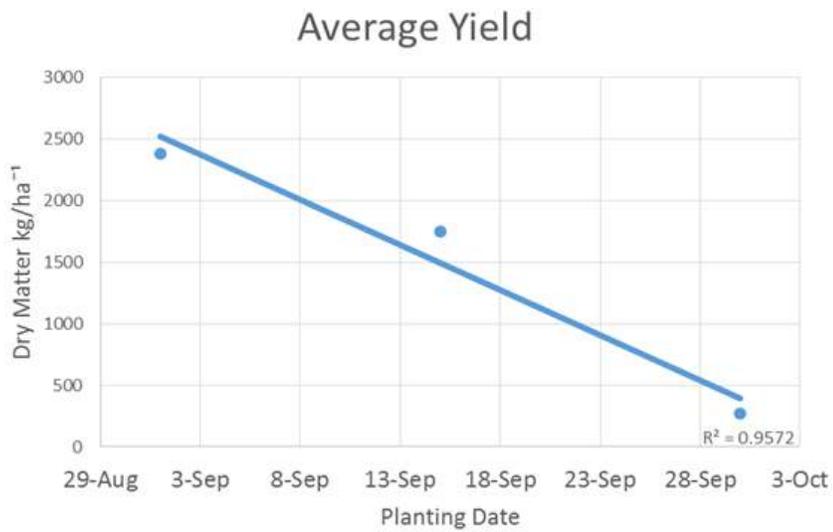


Fig 3: Average yield of rye crops harvested on 11/20/14, and preliminary profit estimates associated with fall yields (based on wrapped bales), relative to planting date. Spring yields not included in estimates.



Fig 4 (Left): Spring differences between 9/1 and 9/30 planting dates of rye.

Fig 5 (Right): Spring differences between rye, triticale, & wheat planted 9/1.

Mustard as a Biofumigant Cover Crop

Block 16

Katie Campbell-Nelson, Susan Scheufele, Lisa Mckeag, Ruth Hazzard and Neal Woodard



Rationale: In recent years, brassica cover crops have begun to be used to “biofumigate” soil, a process that can assist in managing weeds, and can reduce populations of nematodes and soil borne pathogens such as *Pythium*, *Rhizoctonia* and *Phytophthora* (including *P. capsici*). “Caliente” (*Brassica juncea*) plant tissues, especially the leaf tissues, contain glucosinolates which when broken down produce volatile, biocidal compounds called isothiocyanates, which are similar to the active ingredient in the commercial fumigant Vapam. Caliente can be grown successfully as a spring cover crop prior to seeding fall squash and pumpkins, or as a short season summer cover crop in a fallow field to prepare an area for the following year’s crop such as strawberries. In this trial, we hoped to learn how to manage this cover crop for maximum biofumigation effects and to share our experiences with growers.

Materials and Methods: We compared the effects of a biofumigant cover crop (Caliente) with a non-fumigant cover crop (oat) in suppressing *P. capsici*. Since we could not introduce the pathogen into a field with no history of Phytophthora blight, we conducted greenhouse bio-assays to test the effect of the fumigant on a susceptible host (pepper) in biofumigated and non-fumigated soil from the same field. We repeated this trial twice, once in the spring, and once in the summer to see if the suppression of *P. capsici* could be replicated in a greenhouse assay, and to improve our experience with managing this cover crop throughout the season.

Fertilization: 50 lb. nitrogen/acre in the form of urea and 20 lb. sulfur/acre in the form of gypsum were broadcast immediately prior to planting. Sulfur fertilizer is recommended to increase production of isothiocyanates by the mustard, so gypsum was added to increase sulfur without changing the soil pH. No other soil amendments were needed based on soil test results.

Seeding: (4/28/14 and 7/11/14) We used a no-till grain drill to seed Caliente at a rate of 9 to 12 lb./acre, 0.25-0.75” deep, in rows 6-8” apart and oats at a rate of 110 lb./acre, 0.5-1” deep, in rows 6-8” apart. Seeding mustard with a no-till grain drill was not highly effective because the seed is very light and did not get very good soil to seed contact; many of the seeds germinated on the soil surface. Broadcasting the seed or using a cone-seeder or a Brillion hay seeder is also an effective alternative to the grain drill but more seed is required. Germination was observed 3 days after seeding, on 5/1/14 and 7/14/14.

Chopping and incorporating: (6/24/14 and 9/17/14). Caliente and oats were allowed to grow until the Caliente was at maximum flowering (56 days) in the first trial, and 68 days in the second trial, when oat hulls and mustard seed pods were beginning to form. In both trials we flail mowed the field with a rotary mower and immediately incorporated the residue. To incorporate the residues we used a chisel plow followed by discing in the first trial and a disc only in the second trial. A plow is recommended for turning under residues so that the volatile isothiocyanates are trapped within the soil. We also learned that the disc alone did not handle the older, woody plant material well in the second trial and a lot of residue was left near the surface. In both trials, the soil surface was sealed immediately after incorporation with a heavy board, roller, or culti-packer to seal in the volatile compounds.

Greenhouse bioassay (6/26/14 – 7/14/14 and

9/18/14 – 10/17/14): We collected soil from the top 6" in Caliente and oat plots one day after incorporation. This soil was used to pot five pepper plants into each of 4 replicate containers for each treatment in the greenhouse bioassay. Replicates of sterilized non-fumigated field soil were included as a control. Pots were treated with a suspension of mycelia and sporangia of 3 local *P. capsici* isolates cultured at the UMass Diagnostic Lab. Pots were kept flooded to encourage disease development. Treatments were as follows: Caliente soil not inoculated, oat soil not inoculated, sterile field soil not inoculated, Caliente soil inoculated, oat soil inoculated, and sterile field soil inoculated. Each pot was rated daily for incidence of Phytophthora blight (number of plants affected out of 5) on pepper plants (Fig. 1). Vigor ratings were also made periodically on a scale of 0 -100%, taking into account number of plants, plant size, color, and canopy thickness. Incidence data was used to calculate area under the incidence progress curve (AUIPC), a measure of disease development over time. All data were analyzed for statistical differences using a generalized linear model and means were separated using Fisher's least significant difference at $\alpha = 0.05$.

Results and Discussion: We observed that peppers grown in Caliente-biofumigated soil inoculated with *P. capsici* developed symptoms more slowly than peppers grown in oat or sterilized soil, and symptoms were not as severe in the Caliente-grown peppers, though this observation was not significant. The same trend was observed in both trials, with the lowest incidence of *P. capsici* found in the pots containing Caliente, and the highest incidence of disease in the pots with sterile soil (Fig. 2). In the first trial, peppers grown in the Caliente-treated soil were significantly more vigorous than those grown in sterilized soil (Fig. 3) and in the second trial the same trends were observed, but the differences were not significant. All non-inoculated treatments were free of *P. capsici*, but differences in vigor were observed among these treatments in the second trial (Fig. 4 and 5). In the second trial plants were older and woodier at the time of incorporation than in the first trial. Also, we did not use the chisel plow and cover crop residues were not as well broken down as a result. This undecomposed plant material may have robbed fertility from the pepper plants, causing the observed differences in vigor. Tilling Caliente under and packing the soil surface within 50-60 days after seeding is best for garnering the most benefit this cover crop has to offer towards weed and disease suppression as well as providing nutrient benefits to subsequent crops.

Figure 1. Incidence was measured as the number of plants out of five in each pot that had symptoms of *P. capsici* or had died due to the disease. Shown here are symptoms of *P. capsici* (water soaking and white mycelium) on pepper stem growing a sterile field soil.



For more information please contact Katie Campbell-Nelson (kcampbel@umass.edu)

Funding for this project was provided by a grant from USDA NIFA.

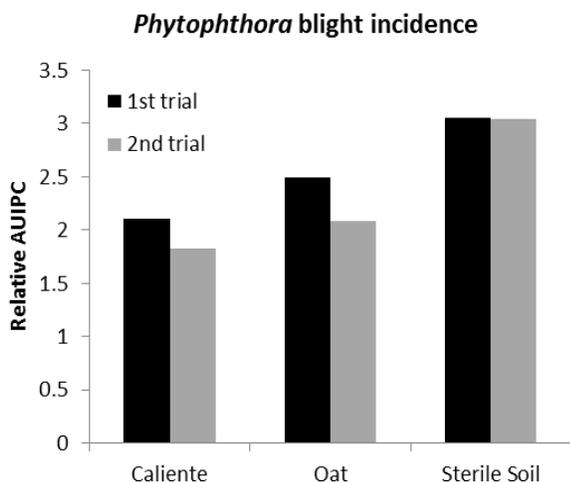


Figure 2. The area under incidence progress curve (AUJPC) is a quantitative summary of disease intensity over a varying period after pots were inoculated with *P. capsici*. The first trial ran for 18 days while the second trial ran for 32 days. There were no significant differences among the

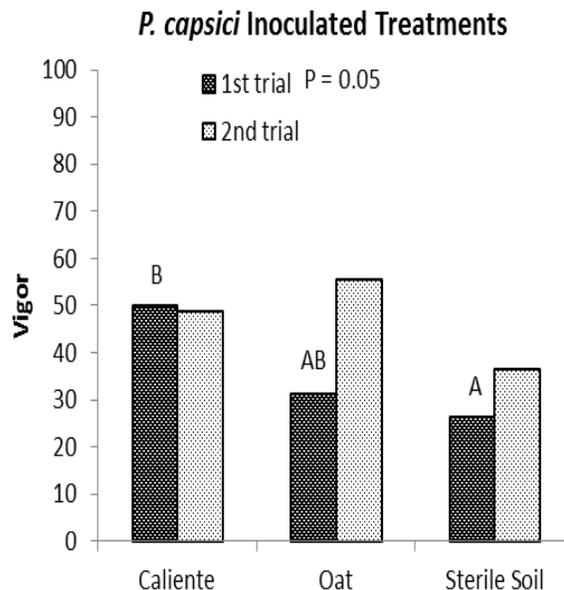


Figure 3. Vigor differences were observed 12 days after inoculation with *P. capsici* in both trials, but significant differences were only observed in the first trial.

***Phytophthora capsici* inoculated (left)
not inoculated (right)**



Figure 5. Differences in vigor including canopy coverage and plant color were observed among treatments. This photo was taken 26 days after inoculation in the second trial.

Effect of Bee Disease and Hedgerow Plantings on Pollination Service to a Main Crop

Lynn Adler

Rationale: The goal of this manipulative experiment is to assess how hedgerow plantings can affect bumble bee pathogen loads, and how both hedgerows and pathogen loads affect pollination service to canola as an example of a main crop whose yield is reliant on pollination.

Abstract: Parasitism can affect many aspects of bee learning and, but the consequences of these changes for pollination and crop yield are almost entirely unknown. For example, bumble bees infected with tracheal mites were more constant to a single flower type, while bumble bees infected by the gut pathogen *Crithidia bombi* had reduced foraging rates and ability to learn to handle novel flower types. However, these and other studies were conducted in laboratories using artificial flowers; the consequences of parasite-induced changes in behavior for pollination and crop yield are unknown.

Furthermore, planting hedgerows may provide opportunities for farmers to reduce parasite loads, and potentially increase pollination, through their choice of hedgerow species. Hedgerows (which we consider synonymous with crop margins or pollinator strips) are areas within farms that are planted with or allowed to grow flowering plants for beneficial insects, including pollinator forage and nest sites. Our previous research has found that naturally-occurring levels of floral secondary compounds can reduce bee pathogen loads. Thus, farmers may be able to play a direct role in mitigating bee parasitism through their choice of hedgerow species.

Our experiment manipulates both bee pathogens and hedgerows using 18 tents as replicates. Each tent contains canola flowers as a focal crop, and a small bumble bee colony (“microcolony”) that is allowed to forage within its tent. Half of the bee colonies are infected with *Crithidia bombi*, and the other half are not. Within each disease treatment, tents are evenly divided between having no hedgerows, hedgerows comprised primarily of plant species with low disease transmission, or hedgerows primarily of plant species that have high disease transmission. We will assess the effect of hedgerows on bee pathogen loads, and the role of pathogens and hedgerows on pollinator behavior, pollination, and yield in the main crop. We predict that hedgerows that reduce transmission will reduce parasite loads, increasing bee colony performance, pollination efficiency, and crop yield.

The Genetics of Floral Development in Corn

Block 19

The Bartlett Lab

Rationale: Many of the core genes that direct the development of corn flowers remain undiscovered and undescribed. Our work is aimed at uncovering and understanding the molecular networks that control the development of flowers in maize.

Research Goals: We use a combination of forward and reverse genetics in the Bartlett lab. With forward genetics, we characterize genetic mutants, and identify the genes underlying their altered phenotypes. In reverse genetics, we try and understand what role particular genes might play in development. We are also leveraging the immense genetic diversity of maize to identify new genetic regulators of development.

Results: This project is in its early days. We have just started to identify mutants in a genetic screen (shown below). Ongoing work will identify the genes underlying these mutant phenotypes.



Figure 1. Mutant floral phenotypes isolated in a genetic screen

UMass Student Farm

Blocks 20, 21, 23, 26

Amanda Brown, Ruth Hazzard, Jason Silverman, Ian Back, Eli Bloch, Duncan Fuchise,
Benjamin Goudreau, Christopher Raabe,

Rationale: The UMass Student Farming Enterprise program is a year-long course offered through the Stockbridge School of Agriculture that offers students hands-on experience, managing all aspects of a diversified vegetable farm. The course is offered in both the spring and fall semesters with a summer farming component at the farm. It has been developed and taught by vegetable specialists Ruth Hazzard and Amanda Brown.

Goals: To provide students with the necessary skills to operate an organic vegetable farm on their own. To help train the next generation of farmers.

Results: The farm has grown to have seven acres in production, servicing a 60+ member on-campus CSA, Earthfoods Cafe, UMass Dining Services, two Big Y Supermarkets, and the UMass Student Farmers Market. Every year sees twelve to fifteen new Student Farmers who take the lead on planning the season, working the land, and harvesting and marketing the produce.



Thank you to our sponsors:



Impacts of Planting Date, Nitrogen, Cultivar and Zinc on Barley Malt Quality

Block 4,5,6

Caroline Wise, Masoud Hashemi

Rational:

There has been a steadily increasing demand for craft beer in the United States in the past 2 decades, specifically in the Northeastern and Western regions of the country. Currently, there is an insufficient body of research regarding varieties and fertility management plans that would permit growers in the pioneer valley to produce malting-quality barley. Barley must fit into a range of specific quality parameters, such as percent protein and the near absence of Deoxynivalenol (DON, produced by *Fusarium* head blight), in order to be suitable for malting. However, malt barley has a price premium (\$4/bu) over feed barley (\$2.90-\$3/bu) (2014). This price premium may incentivize production for growers in the region. Consumer demand for locally sourced ingredients, in addition to locally produced beer may provide further economic incentives for regional malt barley production. Increased understanding of the viable methods for producing malt quality barley in the region would therefore provide economic benefit to local breweries, malt houses, and farmers.

Research goals:

Research goals include determining the influence of seeding date and rate on yield and quality of barley for malting and evaluation of the impact of nutrient applications (Nitrogen and Zinc) on yield and quality of barley for malting. With increased Nitrogen (N) consistently producing higher total yields, application can also produce barley too high in protein for malting. The impact of Zn on protein levels in Barley varied with variety tested in previous studies. Additionally, research will focus on developing a comprehensive soil fertility and cover cropping recommendations for the production of malting barley in the Northeast region and assessing the impact of, and factors contributing to, *Fusarium* infestation in Northeast malting barley.

Methods:

The research is comprised of two major lines of inquiry, which is addressed via three 1-2 year field trials, focusing on factors contributing to yield and malt-quality of barley and the development of comprehensive soil fertility management of malt barley in Massachusetts.

Trial 1 will examine the influence of date of planting (DOP) and 6 nitrogen regimes on the yield and quality characteristics of a winter-planted variety of malting barley on MA. The trial will consist of three DOP (September 05, 15, and 25, 2014). Each DOP is replicated 4 times in a RCB design. Within each DOP, per block, each of six N regimes is replicated in a randomized block, to create a randomized nested design. The six N regimes consist of either 25 or 0 lbs/ac N, followed by either 25, 45, or 65 lbs N/ac.

Trial 2 consists of breeder's line experiments planted Fall 2014 and Spring 2015, using seed obtained from the University of Minnesota. Twenty-four lines is included in the Fall 2014 trial and twenty in the Spring trial. All lines in the winter are split, with half 20 lbs/ac zinc sulfate.

Head Blight of Barley

Dr. Robert Wick, University of Massachusetts

Head blight is a fungal infection of the spikes of grain. Historically, head blight has been one of the most serious diseases of barley and remains so today. The moist, humid, and moderate temperatures of the northeastern United States make this disease particularly important in our region. The fungus can also cause a seedling blight of barley, corn, wheat, and soybeans. In corn it also causes both ear rot and stalk rot.

The fungi that cause head blight are members of the genus *Fusarium*, most notably *Fusarium graminearum*. In addition, there are several synonyms and alternate names of the fungi that cause head blight. *Fusarium* readily survives the winter in the soil, but the most important source of infection is crop debris left over from previously diseased plants. No-till or minimal tillage will result in greater survival of the fungus. Spores are carried by the wind to the spikes of grain where they infect and prevent development. Spikes of grain may appear lighter in color or bleached, and reddish fungal growth may be apparent, as well as fly-speck size, blackish fruiting structures. The fungus can produce several toxins and infected grain may become toxic. Straw may also contain the toxins.

The US Wheat and Barley Scab Initiative <http://www.scabusa.org/> is the best source of information for controlling this disease. Crop rotation with non-grains, avoiding planting in the vicinity of corn (especially continuous corn), and using fungicide treated seed (to reduce seedling blight) are helpful measures. Some cultivars are less susceptible to disease than others although environmental conditions favorable to disease may result in significant crop losses.

