Welcome to the inaugural issue of Roots In Research

We are elated to provide you with an inside look at the research taking place here at the Central Maryland Research and Education Center in Upper Marlboro (CMREC-UM). Even though we are one of the smallest Research and Education Centers (RECs) in the State, our scope of research is quite vast. Here at CMREC-UM you will find research on agronomy, cover crops, forestry, horticulture, irrigation, livestock, water quality and more.

The staff here at CMREC-UM consists of six full time employees: four from the Maryland Agricultural Experiment Station (MAES); one from the University Of Maryland Extension (UME); and one from the University Of Maryland Dining Services. We support over a dozen University Of Maryland faculty members as well as researchers from the U.S. Food and Drug administration (FDA) and the United States Department of Agriculture (USDA).

This newsletter is the passion project of our Administrative Assistant, Elizabeth McGarry. It was her idea to bring much needed attention to the excellent research conducted here on a yearly basis. We are grateful for her hard work and hope you enjoy reading about some of the projects from the past year.

https://agnr.umd.edu/research/research-and-education-centers-locations/cmrec/upper-marlboro

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Crops Twilight Tour, Barbeque & Ice Cream Social

Our Annual Crops Twilight Tour was held in the evening on August 7th and was an absolute success with over 80 in attendance!

There may have been a challenging thunderstorm at dinner time, but the Pit Beef from Bayside Bull was excellent and the weather became nearly perfect as we all enjoyed a little homemade ice-cream before taking a self-guided Terp Farm Walking Tour with Guy Kilpatrick and his team. See Guy's article on page 25.

The farm looked spectacular as we traveled by wagon to our first stop with Jerry Brust speaking on his field grown grafted vs. non-grafted tomato trial, see page 5 for a report of his findings.

There were stops along the way with studies on Spotted Wing Drosophilia IPM, Bee Varroa Mite Monitoring, Brambles and Small Fruit Projects by Ben Beale (pg. 19), Planting Green Slug Effects, Neonicotinoid Seed Treatment, Intercropping Impacts on Stink Bug & Harlequin Bug Egg Mortality (pg. 21), Marigolds – a Beneficial Insectary by Cerruti Hooks (pg. 17), Using Living and Dying Mulch for Pest Control in Sweet Corn (pg. 7), Reduced Tillage Vegetables & Living Mulch Tactics by Alan Leslie (pg. 13) and Perennial Cover Crop Impacts on Natural Enemy Populations (pg. 11).

Each stop allowed time for questions, so there was much to cover by 8:30 pm when the tour ended.

Our 2020 Twilight Tour will be the evening of August 5th! Don't miss it!

A New Admin on the Farm

In July, we welcomed Elizabeth McGarry as the Administrative Assistant providing support to the faculty and staff as it relates to the farm. Elizabeth has worked for Extension for 8 years and has now joined our team as the farm continues to grow and take on more projects. We are happy to have her! It's nice knowing that the office is covered with a friendly voice answering the phone or greeting a guest at the door while we are out working on the farm. If needed, she will be happy to assist you...just let her know! emcgarry@umd.edu

Upper Marlboro Weather Station

Did you know that we have been keeping weather data from here on the farm since 1956?

The link below is to view the weather data from 2008 to current. We hope to digitize the older data and update the website in the months to come, so keep an eye out for it, or contact Elizabeth McGarry and she can help you get the info you're looking for.

https://agnr.umd.edu/research/resources/weather-data/weather-data-cmrec-upper-marlboro-facility

Maryland Tobacco

The Maryland Agricultural Experiment Station is a 210-acre farm located in Upper Marlboro that was purchased by the University of Maryland in 1947. At that time, tobacco was considered one of the most important agricultural crops throughout the entire state. The combination of climatic and soil conditions in Southern Maryland made this region particularly adapted to the production of tobacco. The farm originally focused on tobacco research with studies on nutrient management, row spacing, fertilization, breeding and selection of varieties, seedbed management, and the mechanical handling of tobacco, to list a few. The Maryland Tobacco Improvement Foundation, Inc. is synonymous with the farm and continues to be housed here today.

The farm, now better known as CMREC Upper Marlboro (Central Maryland Research and Education Center) has diversified through the years with studies on field crops, vegetables, small fruits, entomology and much more. Not forgetting our roots, we continue to offer Maryland Tobacco Seeds for the growers that continue to produce tobacco. Growers can purchase MD609 this year in pelletized form. Raw seed remains free of charge for Maryland residents and is available in MD609 and MD601. See the last page of this newsletter for the order form or click here. For more information, please call 301-627-8440

Cucurbit Downy Mildew, Sentinel Plots

Jake Jones, PhD Candidate UMD
Dr. Kathryne Everts, Director of Wye REC UMD

Fig. 1. Cantaloupe leaf heavily infected with cucurbit downy mildew.

The cucurbit downy mildew (CDM) sentinel plots located at the Upper Marlboro Research Farm were part of a monitoring network to map and predict the spread of this important cucurbit disease. CDM is caused by Pseudoperonospora cubensis and does not overwinter in areas with a killing-frost. The disease epidemic spreads northward from southern Florida, annually. The sentinel plots consist of cucumber, watermelon, butternut squash, acorn squash, cantaloupe, buffalo gourd, and kabocha squash, which can all show CDM infection at different times. The plants in the plot are monitored for symptoms of CDM (Fig. 1) throughout the year and once confirmed, are reported online at http://cdm.ipmpipe.org/. The website allows growers, extension personnel, and crop consultants to track the disease and make informed decisions and recommendations on fungicide applications. The most effective fungicide programs for CDM are preventative and must be applied before infection of the cucurbit host occurs, but not so early that the disease inoculum isn't present in our area. Recommendations based on cucurbit host are available for our region at: https://go.umd.edu/MD-Vegetables_mid-atl-comm-veg-prod-recom. CDM can occur in commercial fields or home gardens before it infects sentinel plots and once confirmed, those cases can be reported by extension personnel to the CDM tracking website, as well. Sentinel plots were an annual installation at the UMD Central Maryland Research and Education Center, the Wye Research and Education Center, and the Lower Eastern Shore Research and Education Center. They allow UMD extension personnel to monitor this annual epidemic and provide reminders during field days to growers about the importance of being prepared and using preventative fungicides to manage CDM.

Does it Pay to Graft Tomatoes For Increased Yields When There Are No Soil Disease Problems

Jerry Brust, IPM Vegetable Specialist

Tomatoes are grafted by joining the top part of one plant (the scion) to the root system of another plant (the rootstock) (Fig. 1). The resulting plant is usually more vigorous and productive. Many studies have been conducted over the last 10 years that show the benefits of using grafting for soil disease control in tomato production, but there is not much research that examines the influence of rootstocks in no-disease field tomato production systems. In general, vegetable grafting can increase yield by improving crop tolerance to abiotic stresses because of the plant's ability to increase water and nutrient uptake via a more vigorous rootstock. I looked at what would be the benefit, if any, of grafting four different tomato varieties into a field that had not had any vegetables in it for at least 4 years and had no history of soil disease problems. The varieties were: Red Deuce, Red Mountain, Big Beef and Mt. Fresh+ onto the rootstock of Maxifort.

Fig. 1. Grafted tomato plant

Fig. 2. Tomato grafting study in 2019

Methods:

Grafting treatments consisted of two combinations: a scion/rootstock graft and a non-grafted control using the same variety. Approximately seven weeks after grafting, all grafted and non-grafted seedlings were transplanted into the field on 3rd May, 2019. Before transplanting the field was fertilized and black plastic mulch with drip irrigation was laid forming 8 rows 100 ft long. There were three replications of 10 tomatoes of each variety grafted and 10 plants non-grafted spaced 2 ft apart within a row (Fig. 2). Eight harvests took place starting on July 9 and continuing on July 12, 15, 18, 23, 29 and Aug. 1 and 8. Yields were subjected to a 2-factor ANOVA looking at variety (4) by grafted or not (2) and means were separated using Tukey HSD test. ANOVAs with p values equal to or less than 0.05 were considered significant as were mean separation tests.

Leaf tissue samples were taken at first flower bud and every two weeks throughout the study. Fruit harvests were conducted two-three times per week and separated into marketable and non-marketable fruit. Non-marketable fruit categories consisted of yellow shoulders, uneven ripening, cat-facing, blossom end rot, fruit cracking and 'other'. Fruit harvests were conducted two-three times per week and separated into marketable and non-marketable fruit. Fruit number and weight were recorded.

Results:

Overall the total marketable fruit weight for grafted plants (mean of 15.2 lbs/plant) had significantly greater yields compared with non-grafted plants (13.7 lbs/plant). All varieties that were grafted had on average 11% more marketable fruit compared with their non-grafted variety. Early yields (9 and 12 of July) showed no differences between grafted and non-grafted plants for any of the varieties, although the variety *Red Mt.* significantly out yielded *Big Beef* and *Mt Fresh+* by almost 93%. For the main harvests (15-29 of July) grafted plants were significantly greater in marketable yields (13.3 lbs/plants) compared with non-grafted plants (11.8 lbs/plant). There was a significant difference between three of the varieties (overall mean of 12.9 lbs/plant) vs. *Mt. Fresh+* (11.3 lbs/plant). For the later harvests (1 and 8 of August) yields for grafted plants were significantly greater (1.67 lbs/plant) vs non-grafted plants (1.05 lbs/plant). For this harvest period *Red Deuce* had significantly greater yields (1.86 lbs/plant) than *Big Beef* (0.95 lbs/plant) or *Mt. Fresh+* (1.30lbs/plant). The all-important nutrient potassium (K) was 22.2% greater in grafted plants vs. non-grafted plants in July, but that was about the only difference between grafted and non-grafted plants for nutrient levels. Early harvests had a mean of 5.2% unmarketable fruit while main harvests had a mean of 11.3% unmarketable fruit and the final harvests had a mean of 22.6% unmarketable fruit. There were no significant differences in unmarketable fruit between grafted and non-grafted plants or among any of the varieties.

Conclusions:

I was encouraged when I saw that the grafted plants out yielded the non-grafted plants by a small but significantly consistent amount. However, when I applied some basic economics to the results looking at the difference in costs of the grafted vs non-grafted transplants and the return on yield I found I lost $0.21 per grafted plant vs. a non-grafted plant. If you multiplied that by 5,000 plants/A that would be an estimated loss of around $1050/A between using grafted vs. non-grafted plants in this particular trial for this year. More trials will be needed in the coming years to see if this trend holds or if using grafted plants in non-stressed fields can more than pay for itself.

Fig. 3. Excellent fruit set and quality of tomatoes in July.

Overall a couple of things surprised me. The first was that Mt. Fresh+ did not do as well as the other varieties, this variety has always performed well for me in my studies and for some reason this year it did not. The second thing was the quality of the tomato fruit during the main harvest period, basically most of July, was outstanding. Often times in the past my unmarketable fruit reached 25-35% of my harvested fruit in July, but this year the mean was only around 11% - amazingly low and using grafted plants did not reduce the unmarketable fruit significantly compared with non-grafted plants. Part of the reason for this I think was the great reduction in rainfall that led to low disease incidence in the field, but also to the excellent fruit set in both grafted and non-grafted plants (Fig. 3). Grafting seems to help with the yields or quality of the fruit when plants are under some kind of stress such as flooding, high salts, soil diseases, soil nematodes, etc. If environmental conditions are good the grafting does not seem to help as much, as shown in this study.

For more information on the University of Maryland Vegetable Program, contact Dr. Gerald (Jerry) Brust, Regional Extension Specialist at 301-627-8440, or visit https://go.umd.edu/MD-Vegetables

Creating an Eco-Friendly Weed Suppression System in Reduced Tillage Sweet Corn

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Introduction

Cover crops aid in weed management by filling ecological niches otherwise occupied by weeds. Different cover crop species and combinations may result in different levels of weed suppression and competition with the main crop. After termination in the spring, residues from winter cover crops can create a physical barrier to weed emergence. The level of weed suppression and length of time that the barrier remains effective is partially dependent on cover crop species and total biomass accumulation at termination. Living mulches are cover crops interplanted with a main crop. Cover crops grow alongside the main crop its entire growth cycle. Thus, living mulches can compete with weeds throughout the growing season.

Previous research performed in the Hooks' lab determined that a combination of red clover, used as a living mulch, and strip tillage can effectively suppress weeds throughout the growing season in the between row area of vegetable plantings. However, competition between red clover and the main crop resulted in reduced vegetable yields. Additionally, strip tillage resulted in a subsequent flush of weeds in the within row area. The following study was designed to eliminate strip tillage in the formation of planting rows and prevent yield reductions caused by competition between the main crop and red clover living mulch.

The study contained two living mulch treatments. Living mulch treatments consisted of red clover and rye (RC-Rye) or red clover and forage radish (RC-FR). The planting pattern for the living mulch treatments consisted of two rows of red clover alternating with three rows of forage radish or rye (Fig. 1). The planting distance between cover crop rows was six inches. Forage radish died naturally over the winter, resulting in 18-inch wide untilled planting rows by late spring. In early spring, the rye was terminated using a roller crimper which created 18-inch wide planting rows with surface residue. Sweet corn was seeded down the center of the 18-inch wide strips.

Fig. 1. Layout of a red clover and rye (RC- Rye) treatment plot prior to rye termination. Three rows of rye alternating with two rows of red clover.

In addition to the red clover + rye and red clover + forage radish treatments, the study consisted of a no-till (NT) and conventional-till (CT) treatment (Fig. 2). In CT and NT treatments, cover crop mixtures of crimson clover, forage radish and rye were planted the previous fall and terminated in the spring prior to sweet corn planting. The NT treatment plots were roller crimped to terminate the rye. CT plots were mowed and the remaining cover crop residue tilled into the soil prior to sweet corn planting.

Fig. 2. Four cover crop treatments. CT = conventional till; NT = no-till; RC-Rye = red clover living mulch + rye; RC-FR = red clover living mulch + forage radish.

Another goal was to 1) compare the weed suppressive ability of the cover crop treatments with herbicides typically used in sweet corn production and 2) determine if the combination of herbicide application plus cover crop treatment could lead to greater weed suppression. To accomplish this, each whole plot was divided into subplots; and half of all treatment plots (subplots H) were sprayed with a single application of Atrazine + Simazine + Medal herbicides immediately following sweet corn planting. In treatments containing red clover living mulch, the herbicide application was banded within the sweet corn rows, while broadcast applications were made in the NT and CT subplots. The other half (subplot NH) did not receive any herbicide inputs. All data was subsequently collected separately from herbicide (H) and non-herbicide (NH) subplot treatments.

Impact of cover crop treatments on weed suppression and sweet corn growth

Weed suppression was rated in unweeded areas of all subplots by quantifying overall weed biomass and visually estimating percent ground coverage by weeds following the final sweet corn harvest. Overall, we found that the living mulch (RC-FR and RC-Rye) and no-till (NT) no herbicide (NH) subplot treatments provided similar weed suppression as the herbicide treated (H) conventionally tilled (CT) sweet corn treatment plots (Fig. 3). Weed biomass accumulation in CT treatment subplots without herbicides was nearly 80 times greater than that in plots containing red clover. Additionally, we observed no statistical differences in weed biomass accumulation between living mulch subplot treatments with and without an application of at-planting herbicides. This suggests the use of herbicides is not warranted when using red clover living mulch for weed suppression under similar field conditions.

In addition to the red clover + rye and red clover + forage radish treatments, the study consisted of a no-till (NT) and conventional-till (CT) treatment (Fig. 4). In CT and NT treatments, cover crop mixtures of crimson clover, forage radish and rye were planted the previous fall and terminated in the spring prior to sweet corn planting. The NT treatment plots were roller crimped to terminate the rye and CT plots were mowed and remaining cover crop residue tilled into the soil prior to sweet corn planting.

The majority of weeds contributing to the biomass accumulation in most treatments were grasses and perennial weeds, with goosegrass, nutsedge and crabgrass being the most problematic. In CT and NT plots with and without herbicides, over 90% of the biomass accumulation was due to these three weed species. In plots containing red clover, broadleaf weeds made up a greater percentage of weed biomass accumulation, with wood-sorrel and narrowleaf plantain also contributing. Due to irregularities incurred during sweet corn planting, we were unable to compare yield among treatments.

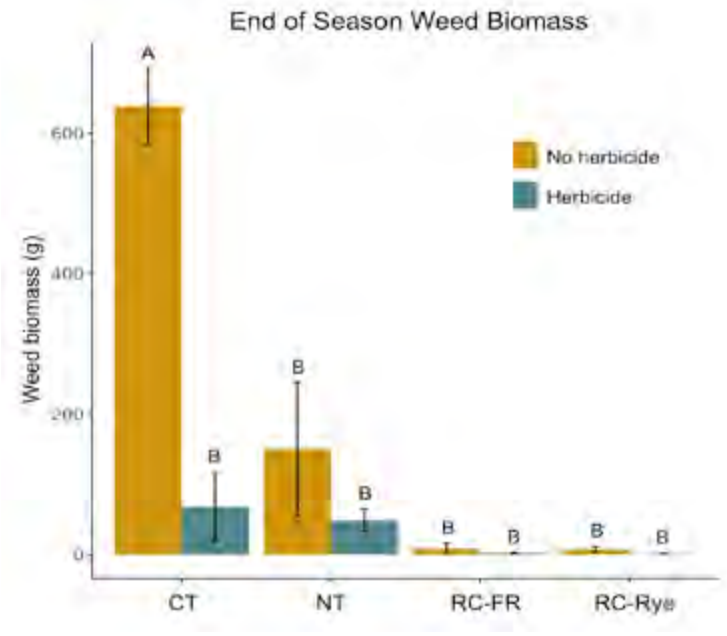

Fig. 3. Average weed biomass collected from 0.46m^2 unweeded areas within each subplot after final sweet corn harvest. Only biomass accumulated in CT - No Herbicide differed significantly from other treatments. CT = conventional till; NT = no-till; RC-FR = red clover + forage radish; RC-Rye = rye clover + rye.

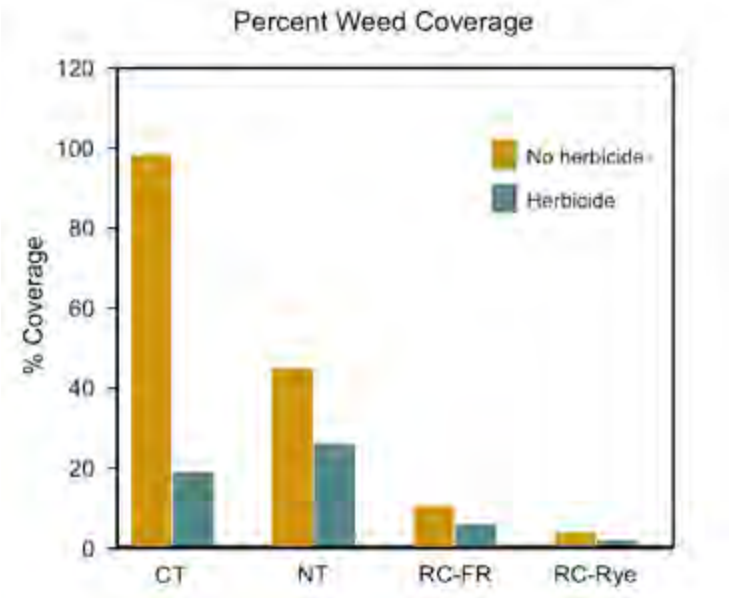

Fig. 4. Average percent weed coverage. Percent coverage visually estimated in unweeded areas of all treatment plots prior to biomass collection. CT = conventional till; NT = no-till, RC-FR = red clover living mulch + forage radish; RC-Rye = red clover living mulch + rye.

Evaluating the Impact of Irrigation with Reclaimed or Pond Water on the Lettuce Microbiome

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As part of the project CONSERVE, A Center of Excellence at the Nexus of Sustainable Water Reuse, Food and Health, funded by the U.S. Department of Agriculture, Dr. Shirley Micallef and her graduate student Sultana Solaiman (PSLA) conducted a field experiment at the Upper Marlboro CMREC. The objective of the study is to evaluate how irrigation water may impact the lettuce microbiome, which may result from the introduction of new bacterial taxa present in water, the depletion of taxa as a result of the washing effect of irrigation, or shifts in bacterial assemblages as moisture levels fluctuate with irrigation. The sources for bacteria associated with plant surfaces are varied and include air, soil, adjacent plants, rain, insects and other environmental media, including irrigation water. Understanding sources and drivers of plant microbiomes is crucial for managing plant health and crop safety for consumers.

Romaine lettuce cultivar 'Sparx' seedlings were transplanted into the field on 16th September 2019, arranged in a randomized complete block design (RCBD) with four treatments based on the type of irrigation water applied overhead. Water spray using a handheld backpack sprayer was applied with reclaimed water from a waste water treatment plant, pond water collected from the Upper Marlboro CMREC and sterile water. A fourth treatment received no overhead irrigation. Overhead irrigation continued for 5 weeks until crops were at a harvestable stage. Lettuce samples were collected weekly for retrieval of surface bacteria. Altogether 68 lettuce samples were collected at 6 timepoints before and after field transplantation. The leaf microbiome will be assessed using metagenomics, an approach that will allow us to assess the bacterial diversity present on the leaves, including temporal and spatial differences that may exist among treatments. This method has the added advantage of allowing us to investigate other important traits of interest, such as any differences in virulence genes and antimicrobial resistance genes that may be harbored in the bacterial assemblages present on the plant surfaces, in relation to irrigation water used and plant developmental stage. Samples are at present being prepared for DNA sequencing. Stay tuned!

Innovation in Ecological Technology Design for Improving Urban Spaces

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My research at CMREC is focused on developing novel ecological technologies that incorporate plants into the built environment to make urban spaces, patios, and public spaces more comfortable and inviting. We are especially interested in protecting people from the excess heat that is found in cities. Plants are one of the main ways to cool cities. At CMREC we are focused on identifying species of vines that will grow well on our living umbrella technology, which we patented through UMD. We look for vines that are easy to culture, produce a lot of leaf material, are showy, durable, possibly edible, non-invasive and appealing to people. In addition we are also testing small "smart" solar powered irrigation systems that can be integrated into living umbrellas and other urban green technologies to make it easier for people to take care of plants.

Greening the outdoor room with beautiful flowering plants is made easier with the University of Maryland's patent pending smart, solar-powered watering system. Dr. Tilley's research at CMREC is testing and improving the novel watering system.

Managing Striped and Spotted Cucumber Beetles in Cantaloupe with Living Mulches

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Introduction

Cucurbit growers face an assortment of economically important pests. Spotted cucumber beetle, striped cucumber beetle, squash bug, squash vine borer, aphids and the pathogens that they vector are all significant concerns. Arguably, the striped cucumber beetle (Fig. 1) is one of the most serious cucurbit pests. It feeds on all plant parts; and their feeding can cause significant yield reductions in melons, cucumbers, squash and other cucurbits. For these reasons, they are the primary target of insecticide spray programs for cucurbits grown in the Northeastern US. Unfortunately, chemicals used in their management can have disruptive effects, including being fatal to pollinators (Fig. 2) and other beneficial arthropods. This suggests that alternative management strategies should be investigated. To this end, research is currently underway at the University of Maryland Upper Marlboro Research and Education Center to investigate alternatives to synthetic insecticides for the management of cucurbit pests.

Fig. 1 Striped Cucumber beetle. Photo credit: Katja Schultz, creative commons.

Research Objectives

The purpose of this ongoing study is to investigate the viability of interplanting cantaloupe with living mulches to control insect pests, primarily cucumber beetles, by augmenting their natural enemy populations. Living mulches are cover crops interplanted with cash crops that live the entire duration of the cash crop cycle. This research was designed to build off previous research conducted by former Hooks lab graduate-student, Hanna Kahl. In her research, Ms. Kahl intercropped cucumber with red clover and linked the presence of the red clover living mulch with decreased striped cucumber beetle numbers and increased abundance of generalist predators relative to monoculture cucumber plots. The specific aim of this study is to determine if similar results can be replicated in cantaloupe, with two additional perennial living mulches.

Fig. 2 Swallowtail butterfly visiting a red clover patch.

Experimental Protocol

This experiment consisted of three treatments. Cantaloupe interplanted with alsike clover or Virginia wildrye and cantaloupe grown in bare-ground plots (Fig. 3) Alsike clover is a perennial legume, and Virginia wildrye is a short-lived cool-season perennial bunch grass. The purpose of selecting these two plant species was to determine if a legume or a bunchgrass would attract similar numbers of natural enemies and particularly which would serve as a better overwintering refuge for ground predators. Many ground predators such as spiders, rove beetles and ground beetles are known to overwinter in grass environments. However, there is limited information regarding their propensity to overwinter in clover. By establishing conditions that allow beneficial arthropods to overwinter directly in the field, this better ensures that they are already present in the field after the crop is planted. The benefit of this information is that it can be used to inform farmers which plant types will serve as the best in season and overwintering quarters for ground predators and other beneficial arthropods.

Fig. 3 Cantaloupe monoculture or bare-ground treatment.

Sampling Techniques

To monitor the abundance of beneficial and pest arthropods, four sampling methods are being deployed: Yellow sticky cards, pitfall traps, visual counts, and emergence cages. The sticky cards are mainly for monitoring aerial natural enemies including parasitic flies and wasps that attack adult cucumber beetles as well as other insect pests. The pitfall traps are used for monitoring the activity density of ground predators such as rove beetles, ground beetles and wolf spiders. The direct visual counts give us a look at arthropods residing in or under the canopy of cantaloupe plants, and primarily informs us about the abundance of herbivorous and beneficial arthropods such as praying mantis (Fig. 4) within the cantaloupe plants. Insect emergence cages will be deployed in each experimental plot early this spring (2020) to provide us an assessment of arthropods that overwintered in the different treatment plots. Insects and other arthropods that emerge in these cages will be collected and identified. To determine treatment impact on yield, cantaloupe is harvested from the interior rows.

Fig. 4 Praying mantis found near study site.

Future Plans

Future plans include analyzing data obtained from the field study completed during the 2019 growing season and repeating the cantaloupe study at a new field site. In addition, grain sorghum will be planted as a rotational crop in the prior cantaloupe study field. The objective will be to determine how the presence of alsike clover and Virginia rye impact aphid and beneficial arthropod populations on grain sorghum. In addition, this may help us determine whether beneficial arthropods that overwinter in a field can have an impact on insect pest populations in a subsequent crop.

Experimenting with No-till Vegetable Production with Living Mulches

Alan Leslie, Agriculture Agent, University of Maryland Extension - Charles County
A. Farrar Ransom, Undergraduate Student - Dartmouth College

Weed management is a top concern of organic vegetable farmers and they have a limited number of options for managing weeds so they rely mainly on tillage, cultivation, and hand weeding. Furthermore, anyone growing organic bean crops face additional risks from insect pests that cause significant defoliation, damage to pods, and contaminate harvests. Few organic insecticides are effective (Fig. 1). Last summer, we carried out a field experiment to develop and test new tools for managing weeds and insect pests in organic lima beans. This strategy involved combining a perennial cover crop as a living mulch with conservation tillage to suppress weeds and support arthropod natural enemies. The goal was to test whether a living mulch can provide adequate, full-season weed suppression without the need for between-row cultivation or hand weeding using lima beans as a model crop. We also wanted to determine whether the living mulch effectively reduced the abundance of pest insects and augmented numbers of natural enemies on lima bean plants.

Fig. 1 A saltmarsh caterpillar, one of many herbivores that attack lima beans. (Photo by F. Ransom)

Cover crops can be used to help suppress weeds in multiple ways as a part of an integrated weed management program. When planted during the fall, cover crops compete with winter annual weeds and prevent their establishment and reproduction during an otherwise fallow period. During the growing season, cover crop residues on the soil surface can act as an organic mulch, and can suppress weed growth by blocking sunlight from small-seeded annual weeds, which keeps them from germinating (Fig. 2). Winter cover crops are widely grown in MD to prevent soil erosion and nutrient runoff between cropping periods, and to provide nitrogen and organic carbon inputs to the soil. Winter-planted cover crops can also be used to reduce insect pests in vegetable crops, since they increase habitat complexity within cropping systems, and can reduce the colonization of pest insects to host crops.

Fig. 2 A crimson clover/rye cover crop mixture flail mowed and left on the surface as an organic mulch. (Photo by A. Leslie)

Weed suppression by cover crops that are killed and kept on the surface as organic mulch has limitations, though. Adequate weed suppression typically requires production of large amounts of cover crop biomass, usually over 8,000 tons per acre. In some cases, it may not be possible to produce this amount of biomass before vegetable crops need to be planted. Weed suppression by organic mulches is typically limited to the early part of the growing season, as the mulch decomposes over time. Organic mulches also do not typically provide good control of large-seeded weeds or perennial weeds, which have energy reserves to grow through dense mulch layers. One possible solution is to replace organic mulches with species of cover crops that can be maintained in the field as a living mulch during the entire growing season. Cover crops that grow alongside the main crop may be able to provide weed control benefits throughout the growing season by actively competing with weeds for resources. Living mulches are not subject to decomposition over time, and should continue to compete with weeds during the entire growing season.

Red clover is an ideal choice for a living mulch because it is a low-growing, short-lived perennial that will live the entire season without interfering with the growth of the main crop (Fig. 3). Since it is a legume, red clover will also fix nitrogen, and could contribute to the nutrient demands of the growing cash crop. Red clover can withstand mowing, which can help reduce competition with the cash crop at planting. Recently, all clover species have become eligible for cost-share assistance through the Maryland Agricultural Water Quality Cost-Share Program. Under this program, the clover must be planted as a mix with a cereal grain such as rye.

Combining a living mulch with no-tillage planting of vegetable crops can further increase environmental benefits and economic return to farmers. By planting without any soil disturbance, farmers are able to maintain a more diverse soil food web, which provides greater levels of ecosystem services such as nutrient cycling and pest control, and preserves soil organic carbon. No-till planting typically requires fewer field operations, costing farmers less money in terms of fuel, labor, and depreciation of farm equipment. Reducing soil disturbance can also help to deplete the weed seeds available to germinate by preventing the movement of buried seeds to the surface, and by keeping seeds on the surface exposed to birds, insects, and diseases that attack seeds. To our knowledge there is no accepted method of no-till direct-seeding vegetables into stands of living mulch, especially none that would be compatible with organic agriculture practices.

Fig. 3. Strip-tilled rows within a red-clover living mulch cover crop. (Photo by A. Leslie)

Widespread adoption of no-till agriculture has occurred primarily within conventionally grown field crops, where genetically engineered crops and highly effective pre- and post-emergent herbicides have eliminated the need for tillage and cultivation to control weeds. In vegetable systems, there are no genetically modified plants that can withstand broad-spectrum herbicides, and in organic systems, there are no cost effective herbicides available. Incorporating a living mulch into organic vegetable crop systems could provide adequate weed suppression throughout the season and prevent the need for soil disturbance through tillage or cultivation. However, a novel approach would be necessary to suppress the living mulch within the crop row without using tillage or conventional herbicides.

This experiment consisted of four treatments; lima beans were planted into different cover crop/tillage treatments, of which two were conventional cover crop practices and two were novel living mulch methods. The conventional tillage (CT) treatment was planted with a rye/crimson clover cover crop mixture in the previous fall, which was mowed, chisel plowed, and rototilled to incorporate organic material into the soil prior to planting. The strip-till (ST) treatment was also planted with the rye/crimson clover mixture the previous fall, but was mowed and strip-tilled using a two-row strip tiller that only worked the soil within a narrow (25 cm) strip where lima beans were planted. The living mulch/strip-till (LM-ST) treatment was planted with a rye/red clover mixture the previous fall, and then mowed and strip-tilled similar to the ST treatment, although the red clover was not killed by the mower. The living mulch/no-till (LM-NT) treatment was planted with a rye/red clover mixture and then mowed. Red clover was terminated within the planting rows by burning strips of the remaining stubble using a propane torch, providing a means of planting into the living mulch without disturbing the soil with tillage. Mowing in all treatments was timed such that the rye was at pollen-shed to ensure that rye had produced maximum biomass, and was killed without reseeding itself. For all treatments, cover crop mixtures were planted using rates and ratios that conform to the Maryland Department of Agriculture's (MDA) requirements for the Maryland Agricultural Water Quality Cost-Share Program.

Soil nutrient concentrations, cover crop biomass and C:N were measured in each treatment to determine whether the rye/red clover mixture performs as well as the rye/crimson clover mixture in nutrient scavenging and biomass accumulation. Treatments with the crimson clover produced significantly greater biomass than the treatments with red clover. Crimson clover establishes quicker in the fall and accumulates much more biomass in the spring than red clover. This resulted in the crimson clover/rye mixtures also providing a greater amount of nitrogen to the succeeding crop through breakdown of plant residues, even with no differences measured in the amount of residual nitrogen in the soil between treatments. Weed pressure was especially high during the growing season, and there were no significant differences in the weed suppression provided by any of the treatments. In essence, cover crop biomass production was not high enough to adequately suppress any weeds. Lima bean stand establishment was not significantly different between treatments, however individual plants reached a larger size in the CT and ST treatments when compared to the LM-NT treatment. Subsequently, the final yield was highest in the CT treatment, intermediate in ST and LM-ST, and lowest in the LM-NT treatment. The two living mulch treatments did, however, support an arthropod community with a higher ratio of beneficial to pest species than the CT or ST treatments.

Based on the results of this research project, we cannot recommend no-till as a reliable production method for lima beans. However, strip tillage shows promise for producing healthy, high yielding plants, while minimizing the amount of soil disturbance. The future success of this method will depend on having reliable weed control for the inter-row spaces of the field that do not receive any tillage. Cultivation would defeat the purpose of strip-tillage, and herbicides are only a feasible option for conventional farming operations. Organic mulches or living mulches can potentially provide season-long weed suppression, however the level of weed suppression for either of these options will depend on good establishment in the fall and good biomass accumulation through the spring. In our case, we did not have this, most likely because we were following an organic corn crop during a year with nearly twice the annual rainfall total. This meant that there would be very little residual N available in the soil for the cover crop to become established. Therefore, one way to promote success in the future would be to check the levels of available nitrate ahead of planting cover crops by doing a fall side-dress nitrogen test, and potentially correcting fertility to ensure good biomass production for the next season. Fall fertilizer applications would not be in compliance with current MDA regulations for cover crop cost-share money, but if grower priorities are weed suppression in the following season, it may be worth losing cost-share eligibility. Future work will focus on developing and refining alternative methods for incorporating living mulches in reduced and no-till vegetable systems.

Drinking Wells, Water Quality and Septic Systems

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https://go.umd.edu/wells-septic-systems-and-water-quality

The University of Maryland Well and Septic Education Program provides homeowners and businesses with general information on drinking water quality, private wells and septic systems through workshops, webinars, training classes, and printed and online resources.

About 20% of Marylanders get their drinking water from groundwater wells and there are approximately 350,000 homes supplied with private wells. Private water sources are not regulated as are public sources (EPA has specific guidelines including mandatory testing of 90+ contaminants), and therefore it is the responsibility of the homeowner to test and treat their well water. Many homeowners are not familiar with their well and specifics on testing and whether treatment is necessary. Our program works with partners including MDE and County Health Departments to provide homeowners, communities and businesses with relevant information on well care, water quality, what to test for, treatment options to ensure safe drinking water.

There are about 420,000 homes in Maryland with onsite sewage treatment (septic) systems designed specifically for each location based on home occupancy, and site conditions - soil quality and depth of soil to water table or other limiting layer. These systems can be an effective tool to treat wastewater using natural processes of the soil to reduce nutrients and pathogens, however system maintenance is critical to proper function, prolonging the life of the system, and reducing risk to environmental and public health. Most homeowners are not familiar with their system or how to care for it. Our program works with partners: MDE, County Environmental Health Offices and industry, to provide educational programming and resources for homeowners, community associations, businesses, and realtors. Topics covered include: system design, system and drainfield types, Best Available Technology (advanced treatment) and Bay Restoration Fund, troubleshooting, recommended maintenance practices, landscaping options, and risks to public health.

To request a seminar or workshop for your area, click here.

Investigating Marigold as an Insectary Plant to Enhance Stink Bug Egg Mortality

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College of Computer, Mathematical and Natural Sciences
Department of Entomology
Alan W. Leslie, Agricultural & Food System Educator
College of Agriculture and Natural Resources, Charles County Extension

Introduction

Fig. 1. Jumping spiders feeding on brown marmorated stink bug nymph (photo credit, Lauren G. Hunt).

Marigold, *Tagetes* spp., has been well studied and is justly known for its ability to suppress plant parasitic nematodes by emitting allelopathic compounds through its roots. Less known is its ability to influence insects and other arthropods. Still, some studies have shown that marigold has the potential to influence arthropod natural enemies (parasitoids and predators) as well as insect pests in cropping systems. For example, in Brazil, a study showed that onions planted with marigold borders contained increased numbers of generalist predators and parasitoids, and decreased thrips numbers compared to treatments without marigold. Similarly, in a study conducted in Delaware, University of Maryland researchers (AW Leslie and CRR Hooks) found higher abundances of chewing and piercing-sucking insect predators as well as parasitoids in the interior of lima bean plots interplanted with marigold compared to lima bean without marigold plants. Some species of predators such as spiders (Fig. 1) and minute pirate bugs (Fig. 2) found in greater abundance in marigold treatments are known to prey on stink bugs.

Further, a study showed that the longevity (lifespan) of the adult female stink bug parasitoid (*Trissolcus basalis*) increased several folds when they had access to flowers of marigold. *Trissolcus* spp. are known to parasitize stink bug eggs in Maryland cropping systems. In consequence, findings from these studies reinforced our notion that marigold could be used as a beneficial insectary plant. Insectary plants are plants intentionally introduced into a cropping environment to increase pollen and nectar resources required by the natural enemies of insect pests. To this end, we felt that marigold is capable of attracting predators and parasitoids that would subsequently feed on or parasitize stink bug eggs resulting in greater stink bug egg mortality. The main purpose of our study was to determine if stink bug egg mortality caused by natural enemies can be increased in edamame (vegetable soybean) by using French marigold, *Tagetes patula* as a border insectary plant.

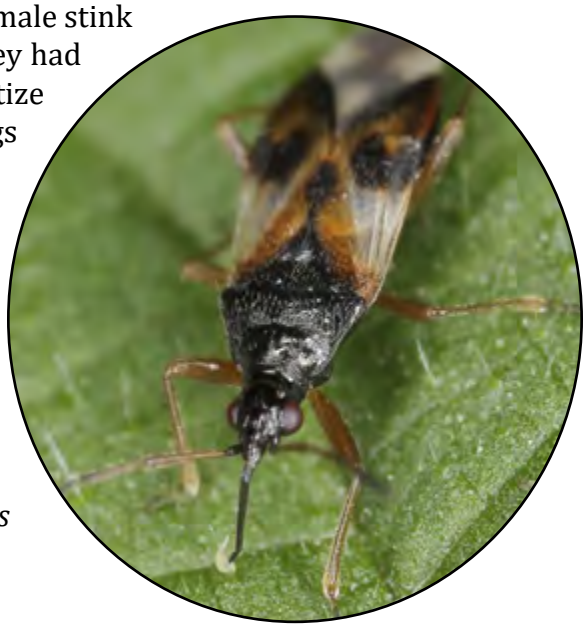

Fig. 2. Minute pirate bug eating (photo credit, Gbohne, Creative Commons).

Experiment Procedure

Experimental layout. The experiment consisted of two treatments: 1) edamame bordered by two rows of marigold on each side (MG) and 2) edamame bordered by natural vegetation (control). Treatments were replicated four times and each block containing both treatments was placed in a separate field to help maintain treatment integrity. An abbreviated illustration of the layout of a single replication/block and visual of a MG treatment plot are

displayed in Figs. 3 and 4, respectively. Arthropod pests and beneficials within the soybean foliage were sampled with a sweep net. In addition, yellow sticky cards attached to poles were used to monitor aerial active arthropods within the edamame and adjacent border vegetation (marigold and natural vegetation).

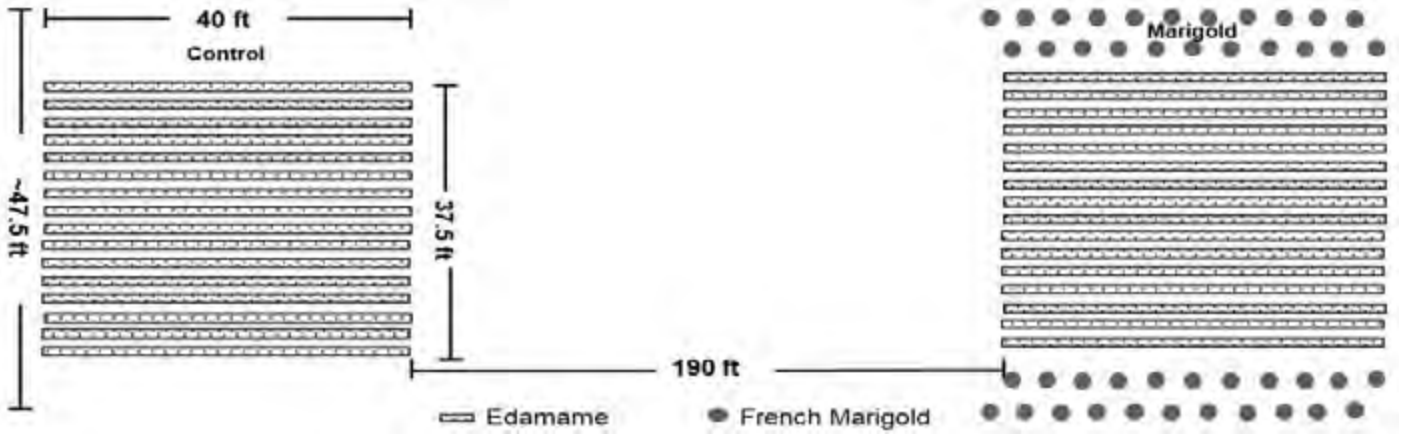

Fig. 3. Abbreviated illustration of a single replication of the control and marigold treatment plots.

Quantification of egg mortality: To quantify treatment impact on stink bug egg mortality, edamame plants in each plot were searched several days weekly once eggs appeared. If an egg mass was found, a ribbon was placed on the stem just below the trifoliate leaf containing the stink bug egg mass and a circle was drawn around the egg mass with a permanent marker. Eggs were identified to species, counted and checked several days weekly to determine their fate. Eggs were classified as (1) hatched, in which stink bug nymphs emerged; (2) missing, in which eggs disappear from the surface of the leaf; (3) mortality unknown, in which eggs do not hatch, yet they show no signs of predation or parasitism; (4) mortality due to parasitism, in which eggs are parasitized by a wasp (Fig. 5); and (5) mortality by predator, in which eggs appear shrunken or collapsed or chewed. Eggs attacked by chewing predators are distinguished from those attacked by sucking predators. During each sampling occasion, if predators or parasitoids are found on or in the vicinity (next to the egg mass) their identity and activity is recorded.

Fig. 4. Senescing edamame bordered by French marigold plants (photo credit, CRR Hooks).

Results

Stink bugs species generally found at the study site include green stink bug (Fig. 6), brown marmorated stink bugs, rice stink bugs, red-shouldered stink bug, brown stink bug and the spined soldier bug. During the 2019 growing season, the stink bug population was extremely low in study plots. Thus, there are plans to repeat the study during the 2020 growing seasons in anticipation of higher stink bug populations.

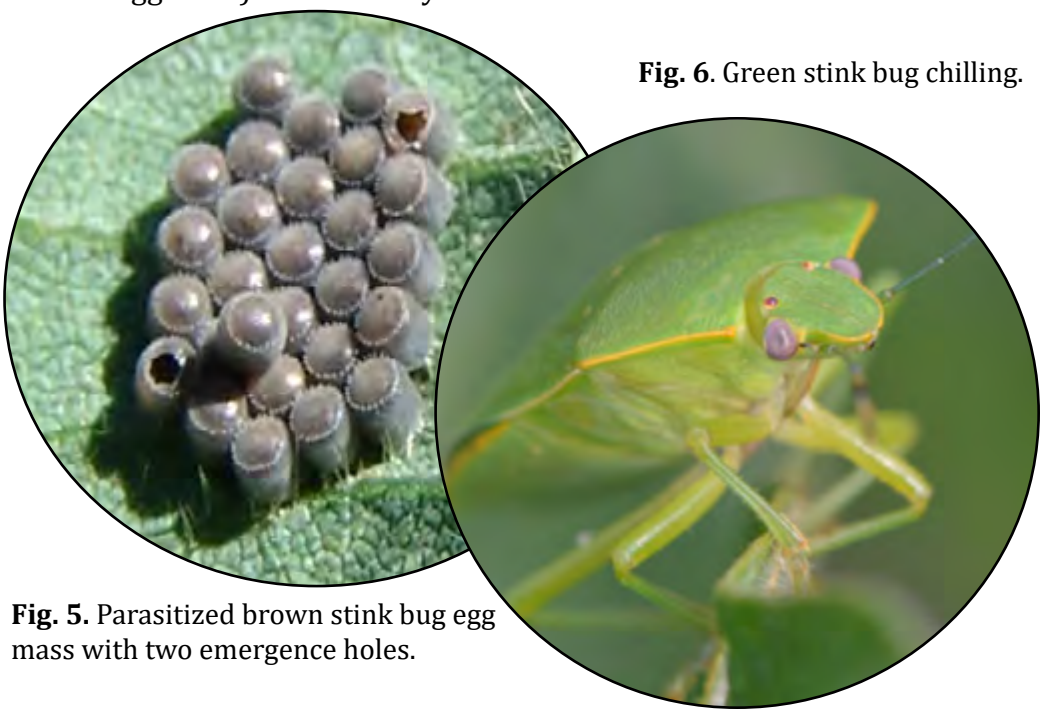

Fig. 5. Parasitized brown stink bug egg mass with two emergence holes.

Fig. 6. Green stink bug chilling.

CMREC Upper Marlboro Small Fruit Cultivar Trial

Southern Maryland Fruit Team
Ben Beale, Extension Educator, St. Mary's County
Dave Myers, Extension Educator, Anne Arundel County
Joe Fiola, Extension Specialist, WMREC-Keedysville
Alan Leslie, Extension Educator, Charles County

There is a lot of interest in brambles (blackberries and raspberries) as well as blueberries as an alternative enterprise. These small fruit have a high per acre value and are often sought after by the consumers for the nutritional benefits and fresh taste. In addition, there are many opportunities for specialty production of niche fruit varieties (Elderberries, table grapes, figs) in the Southern Maryland region. These species each bring unique market opportunities but require specialty production techniques. In collaboration with the Southern Maryland Agricultural Development Commission, UMD established a series of small fruit cultivar trials at the Central Maryland Research and Education Center-Upper Marlboro Facility.

A blueberry trial was established in 2018, building upon findings from a previous study of rabbit eye and southern highbush varieties. These new cultivars are better adapted to the hotter environment and soil types encountered in Southern Maryland. Some varieties will offer an extended harvest season for fresh market sales. Varieties being evaluated are Ozark Blue, Onslow, Legacy, Oneal, Ochlockonee, Overtime, Calypso, and Top Shelf.

Blackberries under evaluation include Von, Natchez, Osage, Ouachita, Arapaho and Freedom. These varieties represent the newest additions from state breeding programs in Arkansas and North Carolina. Blackberries can be prolific producers in the Southern Maryland region, out yielding other small fruit types in our area.

The small fruit program is also evaluating pruning programs for standard primocane varieties Caroline and Josephine. The study will attempt to manipulate fruit ripening time to avoid damage from Spotted Wing Drosophila.

For more information:
Small Fruit Portal - http://smallfruits.smadc.com/
UMD Grape and Fruit Website - https://extension.umd.edu/programs/agriculture-food-systems/program-areas/fruit-vegetable-production

BLUEBERRY TRIAL

4 plants per plot
4 replications
3.5 feet between plants
10 foot aisle ways

Cultivar	% Survival
Ozark Blue (OZB)	19%
Onslow (OSW)	69%
Legacy (LEG)	88%
Oneal (ONL)	88%
Ochlockonee (OCK)	100%
Overtime (OVT)	100%
Calypso (CLY)	100%
Top Shelf (TPS)	100%

A			B			C			D		
OSW-4	BLK	ONL-2	OCK-4	BLK	OZB-2	LEG-3	OCK-4	TPS-4	OCK-4	ONL-4	LEG-3
OVT-4	OCK-4	OZB-1	LEG-4	OVT-4	ONL-4	CLY-4	ONL-4	BLK	BLK	TPS-4	OVT-4
CLY-4	TPS-4	LEG-4	TPS-4	OSW-2	CLY-4	OSW-1	OVT-4	OZB-0	OSW-4	CLY-4	OZB-0

BLACKBERRY TRIAL

3 plants per plot
4 replications
3 feet between plants

Cultivar	% Survival	Avg. Cane Length
Von	100%	7’
Natchez	67%	4.5’
Osage	100%	8’
Ouachita	92%	6.5’
Arapaho	58%	6.5’
Freedom	75%	6’

BLOCK A			BLOCK B		
OSAGE Very nice Vigorous	**OUACHITA** Sprawling Spindly	**FREEDOM** Sprawling	**FREEDOM** Sprawling	**OSAGE** Very nice	**ARAPAHO** Very nice
VON Very vigorous Nice plant	**ARAPAHO** Nice plant	**NATCHEZ** Spindly Poor growth	**VON** Very nice	**OUACHITA** Bull canes Good growth	**NATACHEZ** Spindly - Nice plant Not vigorous

BLOCK C			BLOCK D		
FREEDOM Blooming	**OSAGE** Very nice	**VON** Very nice Good growth	**OUACHITA** Good growth	**OSAGE** Very nice vigorous	**VON** Sprawling Little less growth
OUACHITA Very nice	**NATCHEZ** Spindly	**ARAPAHO**	**NATCHEZ**	**ARAPAHO**	**FREEDOM** Sprawling

Variety	Growth	Thorns	Season	Comments
Floricane-fruiting cultivars				
Arapaho	Erect	No	Early	Lower yields; plants at higher density
Natchez	Erect	No	Early (slightly before or with Arapaho)	Very large fruit; very high yield; tends to over produce so careful pruning is essential. Winter hardiness is poor in high elevations.
Ouachita	Erect	No	Early to mid	Excellent flavor; high yields
Apache	Erect	No	Mid	White druplets can be severe; local sales only
Osage	Erect	No	Mid	New cultivar with superior flavor
Von	Erect	No	Mid to late	holds up well in rain; high yields; average size
Primocane-fruiting cultivar				
Prime-Ark Freedom	Erect	No	Floricane crop very early; primocan crop earlier than Prime-Ark 45	Thornless, primocane-fruiting; soft berries for home garden or local market only

Effects of Intercropping Broccoli with Edamame on Stink Bugs, Other Herbivores and Their Natural Enemies

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College of Computer, Mathematical and Natural Sciences
Department of Entomology

Introduction

While working towards my undergraduate degree in Environmental Science and Technology, I accepted a position working in Cerruti Hooks' Lab where I entered an undergraduate fellowship program to learn more about Integrated Pest Management (IPM). My extension and research activities are supported by an USDA NIFA Undergraduate Training Grant (2018-67032-27697). This grant is a collaboration between eight land grant institutions and the Northeast Region IPM Center aimed at providing undergraduate students experience in research and extension activities involving IPM. Students in this program are mentored similar to graduate students and help design their independent research projects.

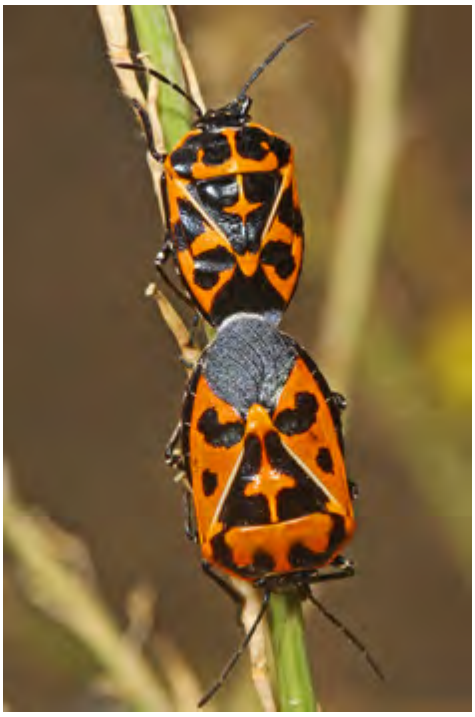


Fig. 1. Harlequin bugs (photo by J. Gallagher, creative commons)

Project objective

The objective of my project is to determine the impact of intercropping edamame with broccoli on populations of insect pests and beneficial insects as well as quantify and compare the efficacy of natural enemies in monoculture and intercropping systems. This study focuses on the Harlequin bug (*Murgantia histrionica*, Fig. 1), an economically important pest of broccoli and other Brassica crops, as well as other herbivorous stink bugs such as the brown marmorated stink bug/BMSB (*Halyomorpha halys*, Fig. 2).

The harlequin bug is difficult to manage especially in organically produced crops. Organic products are generally ineffective and natural enemies have a very limited impact. Although soybean is not a host plant for harlequin bug, on occasion their egg masses have been found on soybean or edamame plants and in each of those instances, those eggs were parasitized. It was discovered that the wasp responsible for parasitizing these harlequin bug eggs was the same species of wasp (*Telenomus podisi*) responsible for parasitizing other stink bug (brown stink bug, brown marmorated stink bug, green stink bug, etc.) eggs found in soybean plantings. However, this wasp appears to not search for eggs on broccoli plants as we have yet to discover any parasitized harlequin bug egg masses on broccoli plants despite their high numbers. Because *T. podisi* is known to frequently forage soybean plants for stink bug eggs, it was hypothesized that intercropping soybean with broccoli would place these foraging wasps in the proximity of broccoli plants and they would subsequently locate and parasitized harlequin bug eggs on broccoli.

Fig. 2. Newly hatched BMSB nymphs (OSU, C. Hedstrom)

In addition to harlequin bug, broccoli is colonized by several lepidopteran pests such as the diamondback moth (*Plutella xylostella*), imported cabbageworm (*Pieris rapae*) and cross-striped

cabbageworm moth (*Evergestis rimosalis*). This intercropping system may also impact the population dynamics of these pests as well as their natural enemies. In addition, the presence of broccoli may also influence insects associated with edamame. Thus, there are several goals of this study. This includes determining treatment impact on: 1) rates of parasitism of harlequin bug eggs on broccoli plants, 2) abundance of caterpillar pests and beneficials on broccoli, 3) parasitism rate of stink bug eggs on edamame, 4) numbers of pest and beneficial arthropods found on edamame and 5) broccoli and edamame yield.

Experimental layout & methods

To accomplish these goal three experimental treatments were established. This included: 1) edamame monoculture, 2) broccoli monoculture and 3) broccoli and edamame intercropping (Figs. 3a, b and c). Treatments were replicated four times and arranged in a randomized complete block design.

Fig. 3. a) edamame monoculture, b) broccoli monoculture and c) broccoli intercropped with edamame

To quantify treatment impact on insect populations, weekly visual counts were conducted on broccoli plants; and edamame plants were sampled weekly with a sweep-net. Additionally, regular scouting of edamame plants was conducted to locate stinkbug egg masses. Once found, egg masses were marked and observed regularly until they hatched (Fig 4), were parasitized by wasps (Fig. 5), eaten by predators or failed to hatch for unknown reasons. Similarly, on several dates broccoli plants were searched for harlequin bug egg masses and when found, they were marked, monitored until their fate could be determined and characterized similar to stink bug eggs. If their fate was not distinguishable in the field, egg masses of harlequin and other stink bugs were brought back to the laboratory and observed more closely under a microscope.

Fig. 4. Harlequin bug egg mass on broccoli leaf collected from field. Eleven nymphs hatched successfully.

In addition, interior rows of broccoli plants were harvested, weighed and graded as marketable or unmarketable to determine overall yield. Some harvested broccoli crowns were randomly chosen and dissected to determine if heads were contaminated with insects, insect parts and/or their frass. Contaminants found inside broccoli crowns were identified, counted and recorded. Sections of edamame rows were also randomly chosen and cut at soil level. Afterwards, pods were removed and weighed to estimate yield. Currently, data is being entered and prepared for analysis. Future plans include repeating the study again in the upcoming field season at the University of Maryland Upper Marlboro Research and Education Center and sharing my findings at their next field day event and a future scientific meeting.

Fig. 5. Parasitized stink bug eggs with exit holes (probably Thyanta custator. Note two egressed parasitoids in lower right.

Comparing the Growth and Mineral Nutrition of Two Highbush Blueberry Cultivars Planted in Containers and in Amended Soil at Upper Marlboro

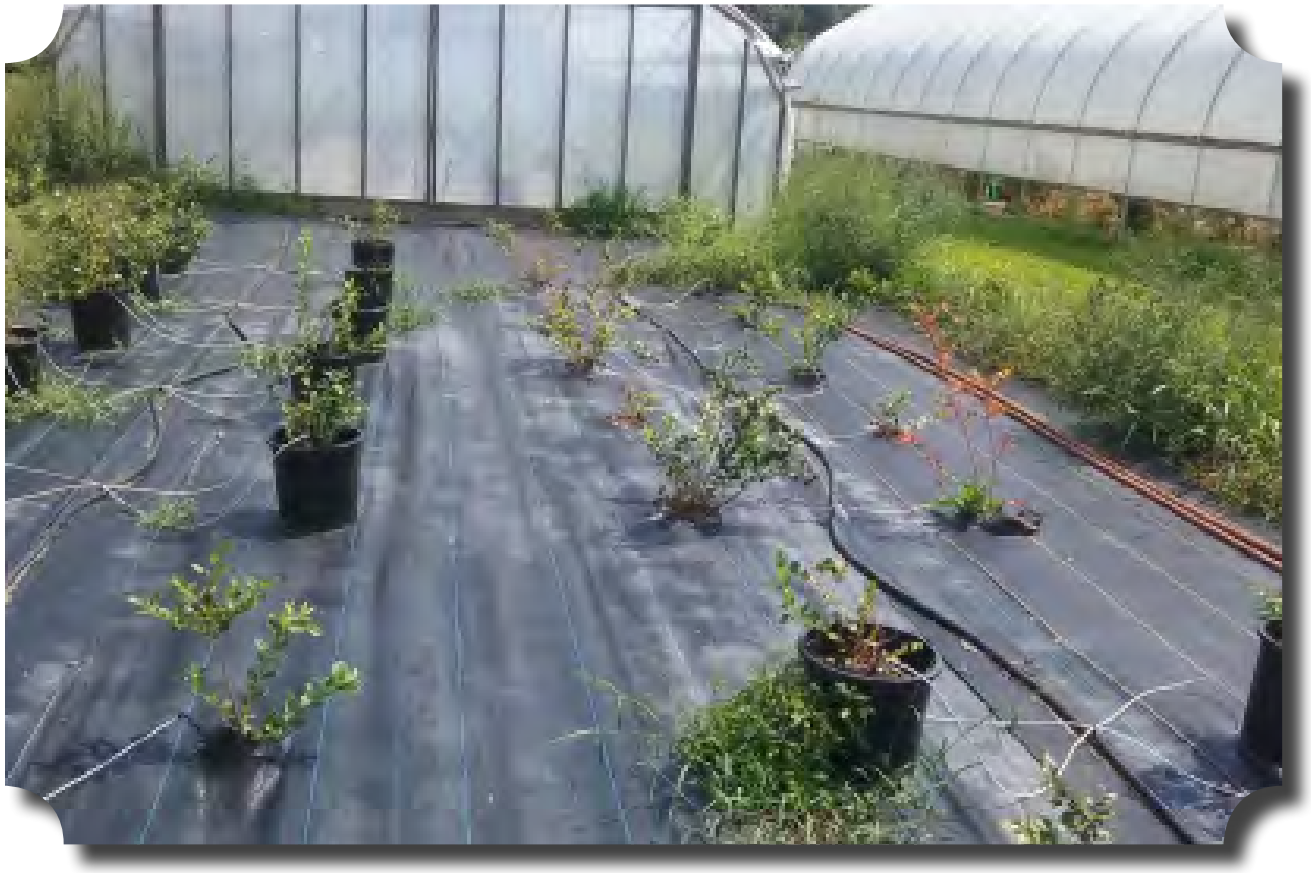
Allen, Carol D.[a, b], Frank, Claire [b], Bissett, Audra [b], Hallman, Lukas [b], Loeb, Amelia [b], Peters, Sebastian [b], & Walsh, Chris [b]

The Upper Marlboro Research facility has been the site of an ongoing study in the comparison of northern and southern highbush blueberry varieties. Started in 2017 with the installation of 80 plants of two varieties, the goal has been to examine the differences in nutrient uptake as perhaps the key to optimizing Mid-Atlantic grower success in this high value crop.

The random block array was planted as part of a capstone project and was also geared towards comparing in ground culture with pot culture. Pot culture may be a viable method of overcoming some of the heavy soil and root issues seen when blueberries are planted in Maryland's upland soils.

After the acclimation period, leaf analysis samples were taken in October 2018 and again in August 2019. It had been observed that the southern highbush variety, New Hanover showed greater vigor than Blueray, the northern highbush variety. Tissue analyses taken in the second leaf showed Blueray leaves had greater levels of N, Mn, Al and Na than leaves from the New Hanover plants. Planting in soil increased leaf levels of essential elements of N and K as well as the phytotoxic element Al.

Thanks to Alfred Hawkins for his help fertilizing and managing the irrigation system on this project.



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Measuring Insect Pressure in Maryland Field Corn

Kelly Hamby
Assistant Professor/Extension Specialist
Department of Entomology

Widespread adoption of corn insect pest management technologies has contributed to areawide suppression of key insect pests of corn in Maryland; however, some insects are developing resistance to these technologies, such as corn earworm. Maryland also experiences different insect pest pressure than the corn belt regions where corn traits are developed, for example we have lower western bean cutworm and rootworm pressure. Ultimately, the pests that challenge Maryland field corn production are inconsistent and sporadic. To better understand regional insect pest pressure in Maryland, sentinel unsprayed non-Bt organic field corn (corn with no insect management at all) was planted at 5 research farms in 2019 and monitored for pest damage. Pheromone traps for western bean cutworm, fall armyworm, and corn earworm were also used at these sites. Pest pressure and composition varied across the sites and no one key pest was identified. At most sites, less than 10% of the stand exhibited any damage from a given pest category in the absence of treatment, and ~25% of the ears were damaged by corn earworms at the soft dough stage, with >50% of ears exhibiting some damage at one site. Almost no fall armyworm and western bean cutworm were captured. Exceptionally warm June and July temperatures advanced corn earworm development such that August populations were higher than in recent years at all sites except Upper Marlboro, where very few moths were captured.

Measuring late season stand count to determine if mid-season pests reduced stand. In 2019, late season counts were similar to early season counts, indicating that early season pests were the primary cause of stand damage last year.

Corn earworm is the primary ear feeding pest we detect. This is partially due to increasing Bt resistance in this species, which is also often resistant to pyrethroid insecticides. Conditions were favorable for rapid corn earworm development in June and July, which resulted in higher than normal pressure in August.

Terp Farm Project Completes Sixth Season, Expands Capacity for Hunger Outreach

Guy H. Kilpatric, Terp Farm Manager, Department of Dining Services

The collaborative project between the University of Maryland Department of Dining Services and the College of Agriculture and Natural Resources, known as "Terp Farm," completed its sixth production season in 2019, and we were asked to share some of the highlights for this newsletter. Since the founding of the partnership in 2014, *Terp Farm* has become an integral part of the campus community by providing educational resources for students seeking hands-on farming opportunities, by raising awareness about the food system from production to consumption through our numerous dining outlets and sustainability programs, and by enhancing our capacity to solve hunger related issues on campus and the broader UMD community.

For those who don't already know about Terp Farm, it began in the Spring of 2014 as a pilot initiative of Dining Services to produce vegetables year-round that could be highlighted in the dining halls to provide a truly local food experience to our dining guests. Funding for the project was awarded by the Sustainability Fund, gathered from students fees, in the form of a $124,000 grant as an initial investment to purchase necessary equipment and develop infrastructure for a four-season produce operation. A high tunnel was also generously donated by greenhouse manufacturer Rimol Greenhouse Systems, Inc., to help kickstart the project. Then by way of a developing partnership between the College of Agriculture and Natural Resources, the Maryland Ag Experiment Station, and the Department of Dining Services, the farm was able to be located on roughly 3 acres at the Upper Marlboro Facility of the Central Maryland Research and Education Center. In April of 2014 the project broke ground for the first time with the construction of the newly donated high tunnel.

During the intervening years the farm has stayed relatively within the same footprint at the Upper Marlboro Facility, but has grown immensely in terms of production output, educational outreach, and as an important touchstone in the development of a network of students, faculty, and staff working to change the food system at UMD. The farm has grossed between six to twelve thousand pounds of produce annually and donates roughly 5% of the harvest to the UMD Campus Pantry and other food banks in the National Capital Region. In 2016 as part of a student driven initiative, we created a specialty cut flower CSA program and set up a retail flower stand at the campus based Farmer's Market at Maryland located on Tawes Plaza. Students are primarily responsible for crop production, sales, and administration of the flower program and are offered a unique hands-on experience in ag entrepreneurship during their tenure at the University. We have also hosted countless visiting groups to the farm from campus and the broader community to tour the farm and try their own hand at some farm work, as well as developed strong partnerships with faculty and staff who bring students to the farm as part of class curriculum and for community and service learning opportunities. In 2019 the Department of Dining Services joined with partners on campus to take action to solve the hunger crisis on the UMD Campus, which affects up to 20% of students attending the University. While recognizing Terp Farm as a crucial resource in the development of programs to solve hunger issues, we created two CCMA AmeriCorps VISTA positions for Terp Farm and the UMD Campus Pantry, to increase our capacity to get fresh food to people who need it. The VISTA member has established a gleaning program by forging a network of student volunteer groups to divert would-be wasted portions of the harvest at *Terp Farm* to our Campus Pantry and other food banks. And we are currently developing a monumental vision

for closing the food system loop on the UMD campus by 2050 by submitting a proposal to the Food System Vision Prize, with the goal being to utilize the UMD campus as a living laboratory for modeling systems that support zero hunger and food waste, and can empower future generations of food-literate leaders.

Looking back at what we've achieved with the *Terp Farm* along with our collaborators reflects greatly on how important this project has been, and signals that there is much more we can achieve when we engage directly with students and our community through the lens of sustainable agriculture. 2019 was a banner year for production, engagement, and program development, so here are some important highlights from the farm this past season.

Crop Production Highlights:

Terps Vs Pros: Sustainable Food Challenge, Episode #4
Watch it!!

Above: Salad mix is a big part of our production in the Spring and Fall. In 2019 we harvested over 1000 pounds of our tried-and-true Premium Greens Mix, which consists of baby leaf varieties of Pac Choi, Tatsoi, Napa Cabbage, and Spicy Mustard.

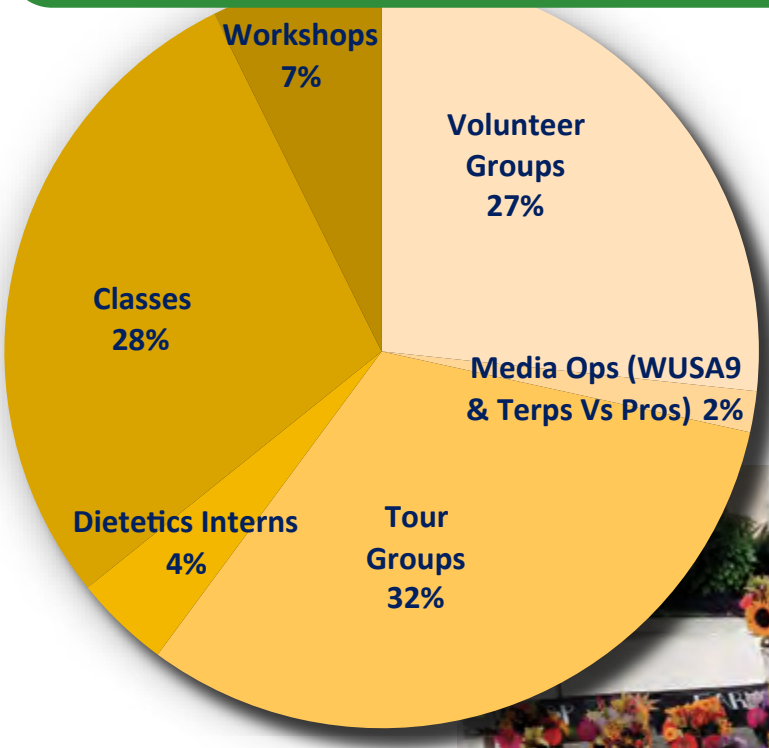
Above: Our catering chef requested we grow Tongue of Fire dry bean, an heirloom pinto variety that was first collected in the Tierra del Fuego region of South America.

Above: This year Terp Farm produced 1600 pounds of Genovese basil (Prospera variety) that our culinary team converted to over 300 gallons of pesto, enough for an entire year of servings in the dining halls.

WUSA9 Story: The garbage they produce helps grow the veggies they eat

Terp Farm Manager, Guy Kilpatric - Guy has been the Terp Farm Manager since its inception in 2014. Originally from Western Maryland, Guy earned a bachelor's degree in English from St. Mary's College of Maryland before traveling to Santa Cruz, CA to attend the Apprenticeship in Ecological Horticulture at the Center for Agroecology and Sustainable Food Systems.

2019 Terp Farm Visitors - 341 Total



The Terp Farm Flowers CSA continues to be successful and greatly appreciated by our customers. This enterprise gives students the opportunity take a leadership role to plan, grow, and sell a farm product directly.

Students and Staff who engage directly in the operation:

Left to right: Edwin, Kai, Claudia, Addie, and Terp Farm Manager, Guy

• Edwin Sanchez - This was Edwin's third season with Terp Farm. Originally from Honduras but hailing from Germantown, Edwin is a Junior Agronomy Major and Institute of Applied Agriculture graduate earning a certificate in Sustainable Agriculture.

• Kai Huang - Kai returned to Terp Farm this year for a second season. Originally from Rockville, Kai recently graduated with an AREC degree and was hired by St. Mary's College of Maryland as an adjunct faculty to teach sustainable agriculture in the Environmental Studies department. Kai was also cast as a student competitor in last year's Terps vs. Pros video series.

• Addie McCaul - This was also Addie's first season at Terp Farm. She is originally from the Four Corners neighborhood of Silver Spring and is currently an Environmental Horticulture major. Last year she graduated from the IAA with a certificate in Sustainable Agriculture. Together with Claudia, Addie will return for the 2020 season to manage the Terp Farm specialty cut flower program.

• Claudia Torrieri - This was Claudia's first season working at Terp Farm. Originally from Reisterstown, and a current IAA Sustainable Agriculture student, Claudia's interest in farming is inspired by her familial connections to Italy where she visits frequently.

• Picture Right: CCMA AmeriCorps VISTA Member, Nicole Ziesing was appointed as our first CCMA AmeriCorps VISTA service member in 2019 with the primary purpose of increasing the capacity of Terp Farm to find hunger solutions.

Farmer's Market/Campus Pantry Manger, Larry Tumlin - Larry joined the Green Dining team in 2015 after serving for 20+ years as a Dining Services production manager. He leads programming related to the Farmer's Market at Maryland and the UMD Campus Pantry. You can catch him at the Farmer's Market doing cooking demonstrations with products from the Terp Farm and other vendors selling at the market.

Dining Services Assistant Director of New Initiatives, Allison Tjaden - Allison has been creating transformation on the College Park campus since she was a student in the School of Public Health earning her Master's degree. Among the many initiatives Allison helped establish are the Community Learning Garden, Terp Farm, The Farmer's Market at Maryland, and the UMD Campus Pantry.

Hands-on Learning for IAA Students

Meredith B. Epstein
Senior Lecturer and Advisor, Sustainable Agriculture
Institute of Applied Agriculture

Terp Farm & the Upper Marlboro Facility Offer Real-World Experiences

"Honestly, no one wants to sit in a classroom and listen to a lecture all day," says freshman Destiny Daley. "For me, growing up in New York City, I was never exposed to agriculture first-hand. It was all tall buildings. Being able to pick spicy peppers and bring them home to my family was meaningful." Daley, who is majoring in Sustainable Agriculture at the University of Maryland's Institute of Applied Agriculture (IAA), was among thirty students who visited the CMREC-Upper Marlboro facility this past September on a class field trip. Her experience is one of several examples of IAA classes making the trip from campus to the 202-acre site for hands-on learning.

Destiny Daley (second from right) and classmates picking habanada peppers at Terp Farm.

The Institute of Applied Agriculture is a unique department within the College of Agriculture and Natural Resources (AGNR) at UMD. It is a 60-credit, two-year academic certificate program that provides students with the entrepreneurial, technical, and leadership skills needed to manage profitable agricultural businesses. The name says it all – everything taught at the IAA is applied to the real world, a theme across AGNR. "Students in other colleges are often surprised and shocked to hear that in the course of one week, I visited a vegetable farm, stuck my hand inside a cow and flipped a sheep!" Daley continues.

Above: Upper Marlboro Facility Manager Donald Murphy explains to a class how a combine functions.

On Right: Avery, one of the IAA's second career students harvests Terp Farm salad mix in the Crop Production Practices course.

Labs, field trips, and other hands-on exercises are a central focus of IAA courses, and having resources like the Maryland Agricultural Experiment Station and Terp Farm is essential. In one calendar year alone, the Upper Marlboro site hosted six IAA courses, including *Crop Production Practices, Tractor Operations and Safety, and Pesticide Use and Safety.*

Daley visited the farm on a field trip for the course People, Planet, and Profit: Digging Into Sustainable Agriculture. The trip began with a lesson on no-till grain production from facility manager Donald Murphy, including a soybean harvest demonstration with the combine. Many of the students, Daley included, had never seen such large machinery in operation. Later, Terp Farm manager Guy Kilpatric gave a tour of the vegetable production, focusing on crop rotation. Students had the opportunity to help pick several varieties of hot peppers. One in particular, called 'Habanada,' had the students atwitter about how a habanero could be bred to be sweet instead of spicy.

Whether harvesting, changing the oil on a tractor, or building a high tunnel, AGNR's research farms and the Terp Farm project provide essential academic experiences for IAA students. Many aspire to be farmers or researchers, while others gain a greater understanding and appreciation of agriculture and food systems that will help them excel in other related professions.

Watershed Protection and Restoration at CMREC and in Southern Maryland

Jackie Takacs ~ Watershed Restoration Specialist
University of Maryland Extension / Maryland Sea Grant Extension
jtakacs@umd.edu
https://extension.umd.edu/programs/environment-natural-resources/program-areas/watershed-protection-and-restoration-program

Improving water quality through stormwater management and watershed restoration techniques, the Watershed Protection and Restoration Program (WPRP) works with local and state governments, watershed organizations, and community groups in Southern Maryland to build partnerships, identify funding sources, and advise/assist in the planning, implementation and monitoring of restoration projects.

The WPRP team is consists of 6 faculty members spread across the state of Maryland. Southern Maryland is served by Jackie Takacs, Watershed Restoration Specialist who is located at the Upper Marlboro CMREC and serves the Southern Cluster of Calvert, Charles and St. Mary's and offers support to the Capital Cluster of Anne Arundel and Prince George's Counties. Nicole Basenback, Watershed Restoration Educator, was recently hired this past winter to help serve Calvert and St. Mary's Counties.

The Southern Maryland WPRP program facilitates measurable reductions in water pollution in the following ways:

- Classes and workshops are offered throughout the year to teach homeowners how to improve water quality in their own backyard with practices like rain barrels, rain gardens, and tree planting;
- Technical assistance programming helps each county address their Municipal Separate Storm Sewer System (MS4), Total Maximum Daily Load (TMDL) and Watershed Implementation Plan (WIP) regulations and requirements;
- Collaborative partnerships and effective funding techniques support the implementation of in-the-ground restoration project and stormwater best management practices;
- as brokers of unbiased, research-based information, the WPRP team also connects watershed science to policy makers and community leaders to make the most effective water quality decisions.

Three projects we are excited about getting under in Calvert County in 2020 include:

Stormwater Management at Asbury Solomons Retirement Community

Working the with the Asbury-Solomons' Go Green Team and Foundation, Takacs facilitated the development of a campus-wide stormwater management plan for the 42-acre retirement community. The plan, done by Jennifer Vaccaro of Living Landscape Solutions, identifies over 125 different areas that are prime for some type of small-scale stormwater practice. This coming year the community will implement their first project from the plan – a 484sq.ft. conservation landscaping and rainwater harvesting project. This project will be funded by the Chesapeake Bay Trust and through funds raised by the Go Green Team. Two public workshops, led by Takacs and Basenback, will also be held as part of the project.

Property Owners Association of Chesapeake Ranch Estates

We are very excited to be partnering this year with Dr. Andy Lazur, UME Water Quality Specialist, Calvert County's Departments of Health and Public Works and the Property Owners Association of Chesapeake Ranch Estates (POACRE) to offer a community-wide septic education program. The program will be tailored to the needs of the POACRE community based on an extensive survey of the property owners.

Watershed Stewards Academy

Calvert County will become the 7th county in the state to become home to a Watershed Stewards Academy (WSA). The WSA is a training program to empower residents to improve the quality of local waterways. By sharing resources, forming partnerships, and coordinating efforts, WSA works with a Consortium of Support Professionals, Master Watershed Stewards and their communities to reduce pollutants, infiltrate stormwater and restore natural systems.

Teachers can receive 5 MSDE credits for completing the WSA program.

Through classroom and hands-on training Master Watershed Stewards will be able to:

- Assess and identify pollution sources and restoration opportunities
- Educate their community on pollution sources and how to reduce them
- Engage their community in pollution-reducing action
- Implement small rainscaping projects
- Reduce pollution sources through behavior change programs (pet waste, lawn chemicals, outdoor irrigation, etc.)
- Connect communities with environmental resources and people who can help restore watersheds
- Inspect and/or maintain small stormwater best management practices (BMPs)

Interested in becoming a Steward? Contact Nicole Basenbach at nicoleb@umd.edu

Other Programs Already Scheduled for Charles and St. Mary's County

Rain Barrel Workshops - Charles County – April 18th
- Charles County - May 9th
- St. Mary's County – June 7th

Septic Workshop - St. Mary's County – June 7th

Composting Workshop - St. Mary's County – June 7th

For more information about any of these programs or to schedule a program for your community, contact Jackie Takacs at jtakacs@umd.edu or 240-393-6508

Is Starter Phosphorus Fertilizer Necessary for Corn Grown on Atlantic Coastal Plain Soils?

Nicole M. Fiorellino, Dept. of Plant Science and Landscape Architecture, UMD College Park
Robert J. Kratochvil, Dept. of Plant and Soil Science, University of Delaware
Amy L. Shober, and Frank J. Coale, Dept. of Environmental Science and Technology, UMD College Park

Some producers in the Atlantic Coastal Plain region have reported early season visual signs of phosphorus (P) deficiencies in corn (e.g., purple tissue) grown in soils with excessive soil P concentrations (>118 mg kg-1 Mehlich-3 P). However, these visual symptoms may also be plant response to cold soil temperatures during early corn growth or corn hybrid-specific colorations. Some producers question if visual symptoms of P deficiency will potentially impact corn yield and worry that these soils require starter P fertilizer. As soil P concentrations decrease over time, producers wonder if their soils will again be responsive to P fertilizers. Results in the literature vary, but generally, researchers have reported no yield response to starter P fertilizers for corn grown in soils with soil test P concentrations that are within or exceeding the agronomic optimum values (Bermudez and Mallarino, 2002; Cahill et al., 2008; Wortmann et al. 2006). To evaluate the effect of starter P fertilizer on corn yield at different soil P concentrations, we utilized plots previously established at multiple University of Maryland Research and Educations Centers (RECs) across the state (CMREC, Central Maryland Research and Education Center, Upper Marlboro Facility; LESREC, Lower Eastern Shore Research and Education Center, Poplar Hill Facility; WREC, Wye Research and Education Center). These plots were established in 1994 to evaluate phytoremediation of soils with different soil P concentrations.

Briefly, field plots at each location received four annual applications (1994–1997) of five rates (0, 100, 200, 300, 400 kg total P ha–1) of either poultry (WREC and LESREC) or dairy manure (CMREC), for a 4-yr total P load of 0, 400, 800, 1200, 1600 kg P ha–1, respectively, and had significantly different soil P concentrations prior to the long-term drawdown period (Kratochvil et al., 2006). In 2001, a comparison of soil P drawdown (phytoremediation) under grain and forage cropping systems commenced. The cropping system comparison study ended in 2015, whereby forage system plots were split to begin the evaluation of the effect of starter P fertilizer on corn yield. These plots represent the future conditions of real farms in Maryland and possibly other areas with legacy P stores in areas of intensive animal. We applied inorganic fertilizer to the plots prior to planting corn in 2015, 2016, and 2018. Soil samples were collected from each split-plot in 2015 prior to application of starter fertilizer.

We observed no significant effect of starter P fertilizer or soil P concentration on corn yield in any site year of this study (Figure 1). It is important to note no significant corn yield response to starter P fertilization for plots with soil test P concentrations that were within or below the agronomic optimum range (corresponding to the lowest historic manure P application treatments of 0 and 400 kg P ha-1), suggesting that additional drawdown of soil P can occur before P is expected to limit corn yield. We do not currently recommend the financial investment in starter P fertilizer at this time, as these results indicate that Mid-Atlantic soils with and without history of manure application may not be responsive to additional P fertilization.

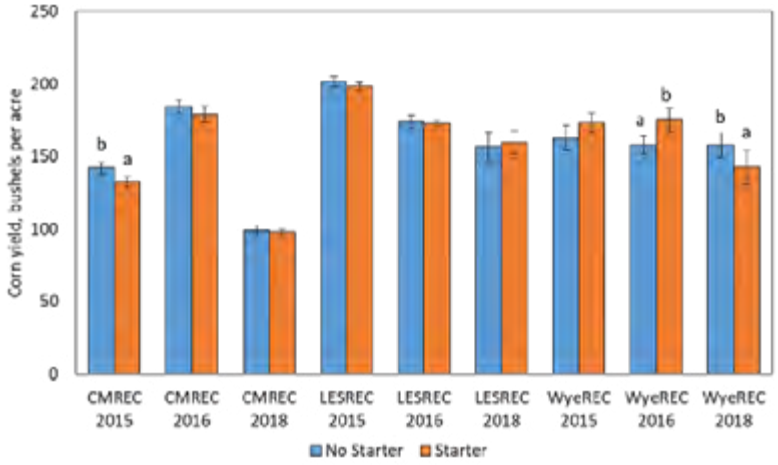


Figure 1. Corn yield within site year for corn produced with and without the addition of starter P fertilizer. Different letters indicate significant difference in yield within site year (P<0.1).

REFERENCES

Bermudez, M. and A.P. Mallarino. 2002. Yield and early growth responses to starter fertilizer in no-till corn assessed with precision agriculture technologies. Agron. J. 94:1024-1033. doi:10.2134/agronj2002.1024.

Cahill, S., A. Johnson, D. Osmond, and D. Hardy. 2008. Response of corn and cotton to starter phosphorus on soils testing very high in phosphorus. Agron. J. 100:537-542. doi:10.2134/agronj2007.0202.

Kratochvil, R.J., F.J. Coale, B. Momen, M.R. Harrison, J.T. Pearce and S. Schlosnagle. 2006. Cropping systems for phytoremediation of phosphorus-enriched soils. Int. J. Phytoremediation 8:117-130. doi:10.1080/15226510600678456.

Wortmann, C.S., S.A. Xerinda, M. Mamo, and C.A. Shapiro. 2006. No-till row crop response to starter fertilizer in Eastern Nebraska: I. Irrigated and rainfed corn. Agron. J. 98:156-162. doi:10.2134/agronj2005.0015.

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Maryland Tobacco Seed Order Form

MD 609 is available this year in pelletized form

Raw Seed Only:
Raw seed remains free of charge for Maryland residents and is available in the following varieties:
MD609 and MD601

Growers can purchase seed by completing the form below and mailing it with payment to:

University of Maryland CMREC
Upper Marlboro Facility
2005 Largo Road
Upper Marlboro, MD 20774

Please pay by check made payable to:
University of Maryland

Seed will be mailed to you by the postal service or UPS, so please provide a valid address that can accept packages.

For more information, please call 301-627-8440.

Primed pelletized MD609 seed - $18.00 per bottle of 10,000 seeds

Number of bottles needed _____(10,000 seeds per bottle)

__X $18.00__(Price per bottle)

Total amount enclosed $_____

Shipping Information:

Name:_____

Street or PO Box:_____

Town, State, Zip:_____

Phone Number:_____