Fruit Notes

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Fruit Notes

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Cover: 2014 NC-140 Honeycrisp Vineland Geneva rootstock planting after pruning February 19, 2024 at the UMass Cold Spring Orchard, Belchertown, MA. Photo Credit: Jon Clements.

The UMass Research and Extension Experiences for Undergraduates (REEU) Internship Program

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According to the USDA's "Employment Opportunities for College Graduates in Food Agriculture, Renewable Natural Resources and the Environment 2020-2025" Report, employment opportunities for college graduates in food and agriculture are almost perfectly matched with the number of anticipated graduates, with 7,300 graduates and 7,900 job opportunities (the remaining 600 jobs are expected to be filled by graduates in allied fields of study). Specialties like horticultural crop scientists, consultants, pest management specialists, and extension and outreach educators are expected to be in high demand. Furthermore, employers are expected to prefer graduates with practical experience.[1]

Students often disregard agriculture as a future career due to a lack of knowledge on the diversity of job experiences it offers.[2] Even at land-grant institutions, undergraduates are often unaware of Extension departments and the wide variety of services they have.[3] Remedying this by demonstrating the variety of opportunities beyond basic food production is the first step towards recruiting the future agricultural workforce.[4] The next step after that is practical agricultural education, which has three components: classroom instruction, experiential learning, and leadership education.[5] Combined, these three attributes empower students to pursue agriculture as an engaging and fulfilling career. Another important factor in recruitment is personal connection and mentorship.[6] When contacting stakeholders for this project, Dr. Terence Bradshaw, of the University of Vermont, stated, "*Having been mentored by an Extension Professor myself as an undergrad, that experience was hands-down the most important training I had in helping me to build skills to relate to and educate growers*."

The above barriers discourage undergraduate students who could enjoy a successful and fulfilling career in agricultural science. Namely, there is a lack of opportunity for hands-on practical agricultural education that would expose them both to the diversity of opportunity in the that field and mentors to help them determine their niche within that field. In 2022. Liz Garofalo and Dr. Jaime Piñero started the "***Engaging Undergraduates in Research and Extension Training using Experiential Learning and Technology to Enhance the Sustainability of Food Production Systems"*** program, an internship for UMass and local community college undergraduates. Its objectives are three-fold:

1. To provide research training to undergraduate students through formal internships integrating hands-on applied research and technology-based experiences.

2. To engage interns in Extension activities that will both demonstrate Extension's role in local food systems and provide them with unique training experiences and professional development.

3. To increase awareness of agricultural research education and Extension employment opportunities within the high school and community college student groups in cities with large historically underrepresented groups.

The internship program, advertised as the Research and Extension Experiences for Undergraduates (REEU) internship, is set to run for five years, starting in 2022. This report will detail the internship structure and then go over results from the final survey filled out by participating 2022 interns.

Materials and Methods

Logistics. REEU runs each summer for 14-15 weeks, starting the first week after the end of the UMass spring semester and ending the week before the UMass fall semester begins. Interns work for 37.5 hours per week, with an hourly wage. In 2022, working the full summer was required. In 2023, the option was given to applicants to work either the full summer or a combination of 3 "sessions", roughly one per month, in order to increase flexibility.

Required Personnel. Program Directors (J. Piñero and E. Garofalo) provide direction and final decision for all internship activities, control funding, and mentor interns. Research Coordinator (currently Mateo Rull-Garza) sets deadlines, leads research seminars, provides feedback on drafts, and mentors interns through the scientific process. Program Coordinator (Zoe Robinson in 2022 and 2023) sets the schedule of intern activities, coordinates logistics such as transportation with the director and serves as a point of contact for all module leaders, farmers, and other involved stakeholders.

Recruitment. The REEU program is advertised through several channels, including a dedicated internship website (CAFE: Research and Extension Experiences for Undergraduates (REEU) Program), flyers posted at local community colleges (namely Greenfield Community College, Holyoke Community College, and Springfield Technical Community College), professors in science departments at UMass Amherst and local community colleges (same as above) who are asked to discuss the REEU program with their students, and word-of-mouth advertising by the REEU personnel. Potential applicants are required to be currently enrolled in UMass Amherst or community colleges in the area. For 2022 and 2023, the UMass students were also required to have at least one semester of their undergraduate left after the completion of the REEU internship they were applying for. There is no requirement for specific majors or prior research experience. Instead, students who lack research or Extension experience are encouraged and, in some cases, favored to apply. The application cycle begins in November and ends in March. Applicants are interviewed to gauge interest and ability to commit to program timelines. Offers are sent out in early March. In 2022, we extended an internship offer to five UMass students. That amount increased to nine in 2023. Based on an internal assessment, we expect to decrease the number of slots per year to six, with a goal of 2-3 community college and 3-4 UMass students per cohort.

Activities. The weekly REEU schedule includes a variety of activities designed to give interns experience with both research and Extension.

<u>Learning Modules</u>: Most weeks include a learning module taught by a UMass faculty or staff member(s). Modules introduce different segments of agriculture, including soils, fruit production, entomology, and agrijournalism, or specific crops, like grapes or cranberries. This develops a common knowledge base and introduces interns to the role of Extension in each sector. In addition to classroom time, most modules include hand-on activities that provide interns with an opportunity to apply their new knowledge.

<u>Independent Research</u>: Each intern is required to design and execute their own independent research project with assistance from the program directors and the research coordinator. The research topic can relate to work pioneered by UMass faculty or be entirely novel. Either way, the intern goes through all steps of the scientific process, including project conception and development, data collection and analysis, and project write-up in the form of a full research report and a popular-science-style article for the REEU magazine. To this end, the research coordinator prepares and imparts lectures on the scientific method and how to write various parts of a research paper, as well as providing feedback on drafts, mentoring, and assistance with data collection.

<u>Farm Visits</u>: About once a week, interns visit a farm, cidery, nursery, or winery. This provides an opportunity to observe the variation of growing operations in Massachusetts, talk to farmers, and participate in some hands-on farm labor.

<u>Additional Lectures and Field Trips</u>: Lectures on niche topics, such as nematodes, unmanned aerial vehicles (UAVs), or a career options panel, round out the intern's knowledge and spark curiosity in the more niche subjects within agriculture. Field trips, such as our 2023 trip to the Forest Pest Management Lab, also exposes interns to the variety of careers in agriculture.

Professional Development Workshops: REEU partners with the UMass CAFÉ Summer Scholars program to participate in their professional development workshops on topics such as resume building, scientific writing skills, and networking.

Field Days: the interns attend at least one field day: the Massachusetts Fruit Growers Association annual summer meeting. At this meeting the interns listen to research presentations and then present an overview of their own research projects.

REEU Symposium: On the last day of the internship, the interns present their research to UMass faculty and staff, along with colleagues, friends, and family.

Survey Data Collection. Each week, the interns were asked to fill out a Google survey. The survey asked about the interns' opinions on the schedule clarity, the amount of time allocated to research, the internship's overall pace, and feedback. The interns also filled out a final longer survey at the end of the summer asking how much their knowledge of the scientific process and their knowledge of agriculture and research in general had changed.

In 2022, the final survey asked intern's to rank specific activities on how helpful and how engaging they were. In 2023, the 'helpful' and 'engaging' rankings were included in the weekly survey in order to get feedback closer to the actual time of the activity. This feedback is used to refine the activity roster for the following summer.

Results

In 2022, there were five REEU interns, all of whom were UMass undergraduates in various majors ranging from plant and soil science to political science. All five interns successfully completed their research paper and REEU magazine article, and three presented their projects at the REEU 2022 symposium. They participated fully in the modules and other activities. In 2023, the number of REEU interns increased to nine, three of which were from community colleges. All 9 students presented their work at the REEU 2023 symposium. Two research articles conducted by students are included in this issue of Fruit Notes.

The results from the final survey show that, in both years, all interns reported a moderate to significant increase in knowledge about Extension and agriculture as a direct result of their REEU Experience (Figure 1). Such a level of increase in knowledge about Extension and agriculture seems to be comparatively greater than the increase in knowledge reported for research and the scientific process (Figure 2).

Furthermore, the 2022 interns reported an overall 27% average increase in Scientific Competence across various criteria because of their REEU experience. In 2023, that figure soared to a 41% increase in scientific competence (Table 1). Specifically, the interns were asked to rate their competence in various areas of research before and after the REEU internship on a scale of 1 to 5 (with 1 being poor and 5 being highly

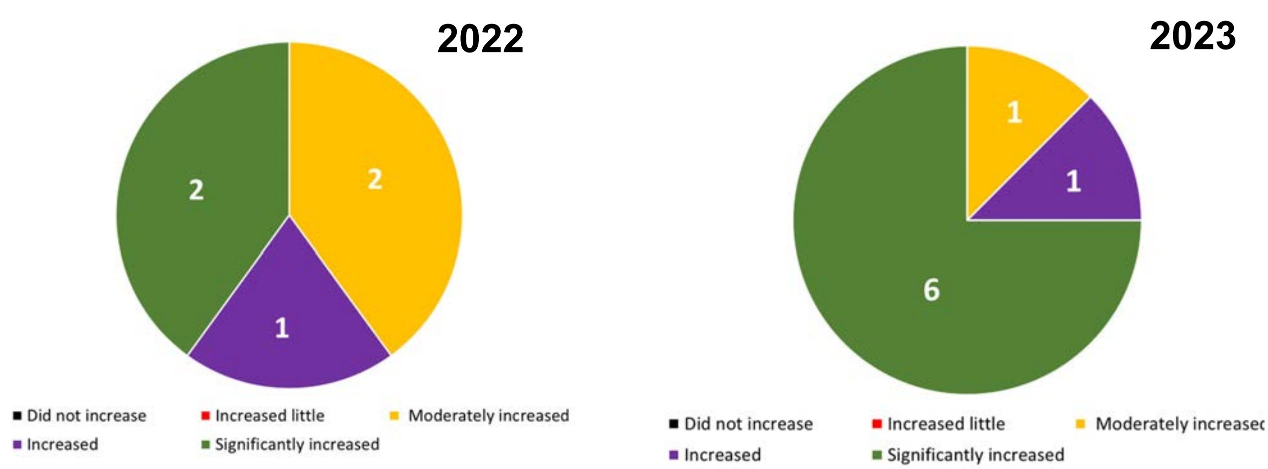

Figure 2. For 2022 and 2023, REEU intern's self-reported change in knowledge research and the scientific process.

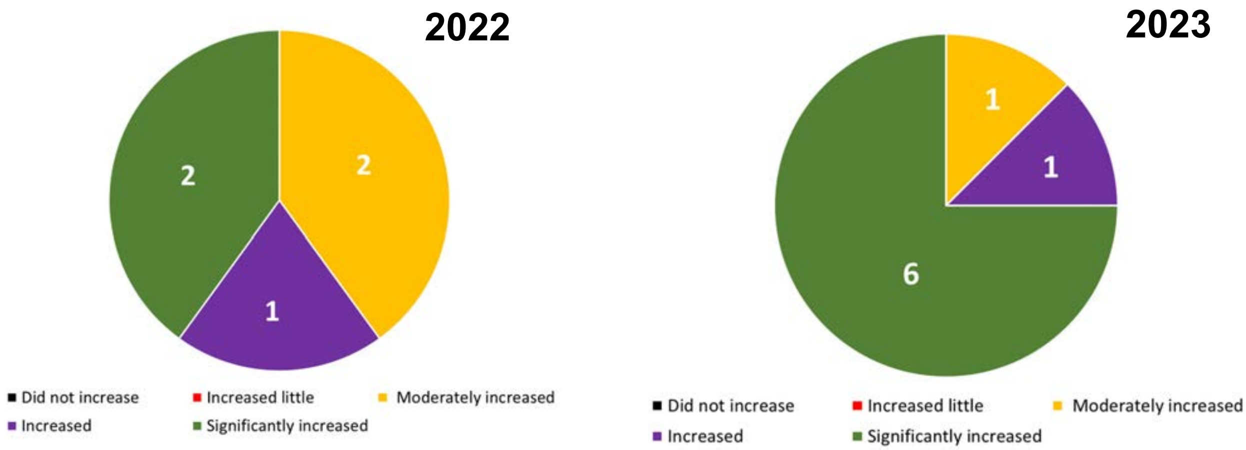

Figure 2. For 2022 and 2023, REEU intern's self-reported change in knowledge research and the scientific process.

Table 1: Average percent increase in scientific competency across criteria for 2022, 2023, and across both program years.

Year	Experimental Skills	Communication Skills	Ability to Conduct Experiments / Surveys	Ability to Excel in Academic Laboratories	Ability to Pursue Graduate Education
2022	32%	16%	40%	28%	20%
2023	35%	40%	45%	35%	48%
Overall	33.50%	28%	42.50%	31.50%	34%

skilled) as follows:

- Field and/or laboratory skills (e.g., following experimental procedures, collecting data, taking field samples, conducting surveys, identifying agricultural pests etc.):
  - » In 2022, the average increase was 32%, from 2.2 to 3.8.
  - » In 2023, the average increase was 35%, from 2.1 to 3.9.
- Science Communication Skills (e.g., presentations, reports, posters, fact sheets, popular articles, podcasts, etc.):
  - » In 2022, the average increase was 16%, from 2.6 to 3.4.
  - » In 2023 the average increase was 40%, from 2.1 to 4.1.
- Ability to conduct experiment (or survey)-based research:
  - » In 2022, the average increase was 40%, from 2.2 to 4.2.
  - » In 2023, the average increase was 45%, from 1.6 to 3.9.
- Ability to excel in academic laboratories:
  - » In 2022, the average increase was 28%, from 2.4 to 3.8.
  - » In 2023, the average increase was 35%, from 2.6 to 4.4.
- Ability to pursue future education that involves research (e.g., master's degree, doctoral degrees, and post-baccalaureate programs):
  - » In 2022, the average increase was 20%, from 2.4 to 3.4.
  - » In 2023, the average increase was 48%, from 1.7 to 4.1.

After participating in the 2022 REEU program, Matthew Bley stated, "*I know that this summer's experience will stick with me as I find myself inspired to pursue science and research further in the field of agricultural entomology.*" Matthew went on to apply for an M.S. graduate degree at the UMass Stockbridge School of Agriculture, which he got accepted to. Further, he later applied and was hired as a UMass Extension Educator in August 2023.

Conclusion

Although the REEU program is only in year 3 of 5, it has made significant progress towards its stated goals of providing students with research training, Extension experiences, and increased awareness of employment opportunities in research and Extension.

All interns indicated an increase in research knowledge. Intern perception of their ability to conduct experiments increased, on average, 40%. One student wrote in their reflection "*I feel much more confident walking into a laboratory setting*". After moving through the research process during the summer, interns were much more confident in their competence to conduct future research.

All interns indicated an increase in knowledge about agriculture and Extension. Most indicated that the hands-on modules were the most engaging and helped them to understand the purpose of Extension.

As with all programs, there are some limitations that, if overcome, would better the program. The number of community college students who participate in REEU is limited because of a lack of applications from community college students. Out of a total of 14 students across both 2022 and 2023, only 3 of these students came from Community Colleges, and two of them participated only for one third of the total summer experience. This could be remedied in two ways. First, with an improved recruitment campaign, perhaps by liaising with the head of pertinent programs, such as environmental science or agriculture. The REEU team has started creating relationships with community college faculty and staff. Second, by encouraging students to apply for the whole internship term. The REEU team stipulated in the 2024 application that priority will be given to students who apply for the whole internship term.

While the full impacts of the REEU program cannot be fully assessed until its completion, the results of years 1 and 2 are very promising. The continued investment in the future of agricultural research and Extension through hands-on internships such as REEU will ensure a vibrant future workforce, contributing to the overall sustainability of our food system.

Acknowledgements

We thank growers in Massachusetts, New Hampshire, and Maine for sharing some of their time with the REEU students, and to all research and Extension collaborators from UMass and partner institutions. Support for this internship program was provided by the NIFA's Agriculture and Food Research Initiative (AFRI) - Education and Workforce Development (EWD) program through Award 2022-67037-36619.

Effects of Soil-Applied Kaolin Clay on Weed Suppression and Soil Nutrients

Charlie Petersen[1], Mateo Rull-Garza[1], Jon Clements[2], Duane Greene[1], Elizabeth Garofalo[2], Samantha Glaze-Corcorran[2], Jacob Aliengena[3], Jaime C. Piñero[1]

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To mitigate weed pressure, farmers and researchers have developed means to reduce the need for herbicides, such as physical barriers (known as groundcovers) that prevent weed growth. One such barrier is made up of kaolin clay, which covers the top layer of soil, in turn blocking sunlight and preventing weeds from sprouting through the clay. Past studies on the effect of soil-applied kaolin clay for weed management have revealed effective control in blackberry (Takeda et al., 2005) and bell pepper (Keay et al., 2018). However, to our knowledge, the impact of kaolin clay on soil health and nutrients has been ignored. Clays have a built-in negative charge with a unique property called cation exchange capacity (CEC) that will attract cations present in the soil such as calcium, magnesium, sodium, and potassium. These cations can then become trapped in the clay due to their structure. Previous studies have not investigated whether plants surrounded by kaolin clay are able to access enough nutrients, or if the clay may hinder their ability to grow by reducing nutrient mobility in the ground substrate.

Here, we examined (1) the ability of soil-applied kaolin clay to suppress weeds and (2) the nutrient content of soil under different groundcover treatments. Tree foliage was also analyzed to determine if trees were able to adequately take up and allocate nutrients from the soil despite the addition of kaolin clay. We hypothesize that the presence of kaolin clay groundcover leads to lower nutrient levels in the soil and leaves of apple trees.

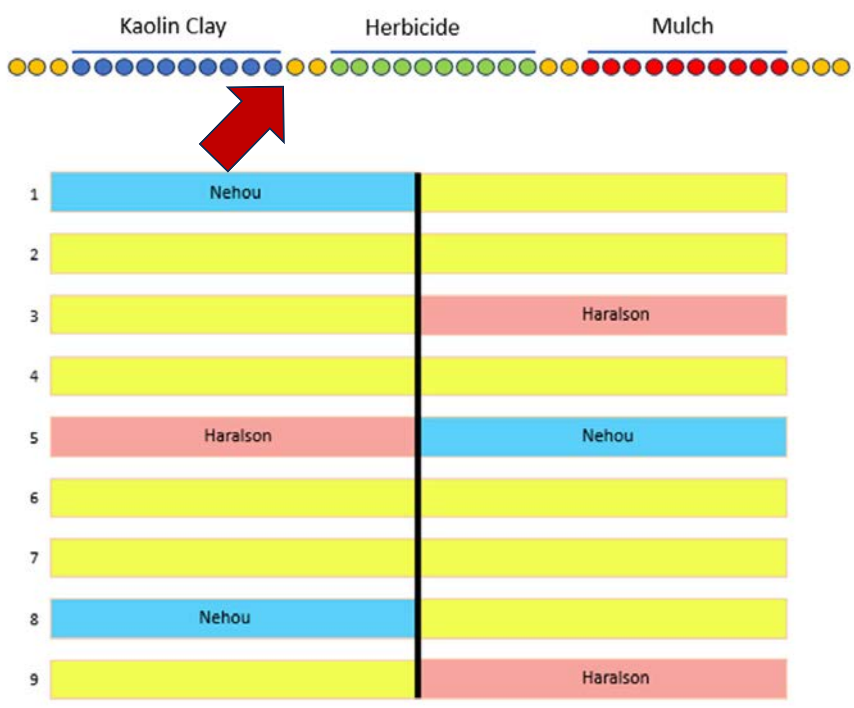

Figure 1. Schematic representation of the experimental area. Although there are nine rows with six cultivars of cider apple trees, we only focused on rows that had Haralson and Nehou. The arrow points to a single row used for data collection. Each circle represents one tree. Treatment trees are indicated by overlined area and by color. Orange circles in between treatments represent trees acting as buffer areas to avoid contamination.

Materials and Methods

Study Site. This study was conducted in a cider apple tree block at the University of Massachusetts Cold Spring Orchard (CSO) from April to August 2023. Specifically, our study site was comprised of five rows of trees (Figure 1). We selected these rows to include only two different apple tree cultivars, with 40 trees per cultivar in each row. Within one replication, cultivars were divided into three treatments: (1) pre-emergent herbicide spray (Chateau® EZ, Valent USA LLC) applied on March 28th, 2023, at a rate of 6 oz/A (sprayer output: 50 gpa), (2) kaolin clay (Surround™ NovaSource, Inc.) applied around the tree trunk, and (3) mulch alone. The kaolin clay slurry was prepared by mixing 452 grams of Surround per liter of water. During the applications, we used a ring (8 cm in height) made by cutting a 5-gallon bucket (Figure 2). Each ring was cut transversally to be able to place it around the trunk of experimental trees. Each treatment consisted of 10 trees with buffer trees in between to prevent spillover effects.

Figure 2. Application of kaolin clay around the trunk of experimental trees. One replication consisted of 10 trees per treatment. The orange rings had a 30 cm diameter survey zone.

Weed Assessment. Weeds were sampled three times throughout the summer on June 16th, July 20th, and August 23rd. For the samples taken in June and July, a visual scan was done for every tree in rows where the three treatments were applied (rows one, three, five, eight and nine). For this survey only, other cultivars in treatment rows were also sampled. Weed pressure was given a rating between one and four, with one indicating 'no pressure', two, 'little pressure', three, 'moderate pressure', and four, 'high pressure'. An orange plastic ring (30 cm in diameter) was placed around the rootstock of each tree for a consistent survey area (Figure 2). On August 23rd, weeds were removed from the ground and grouped based on treatment and cultivar for a total of thirty samples. Weeds were then oven-dried overnight and weighed.

Leaf Sampling. Leaf sampling was conducted on July 20th. Fifty leaves were sampled per treatment across rows. Leaves from the midsection of branches were selected, making sure to sample from different heights and sides of the canopy. This was repeated for all treatments in each row for a total of nine samples per cultivar. The leaves were oven dried and sent to Waypoint Analytical for further analysis of nutrient contents. This analysis included the amounts of nitrogen, phosphorus, sulfur, potassium, calcium, magnesium, sodium, copper, boron, manganese, zinc, iron, and aluminum.

Soil Sampling. Soil sampling was conducted on July 28th. Soil was gathered by driving a 25-millimeter diameter soil auger below the topsoil layer. Samples were taken from trees in each treatment (Figure 3) 3) for a total of 180 trees. Each tree had two sub-sample sites: one that went from the top layer of the soil to a depth of ten centimeters, and one from a depth of ten to twenty centimeters. All sub-samples from the topsoil to 10 cm depth for a given 10 tree treatment were combined into one unified sample. The same process was done for all sub-samples from the 10-20 cm depth. Once combined, the soil was oven dried on a low setting for 24 hours and sent to the Soil and Plant Nutrient

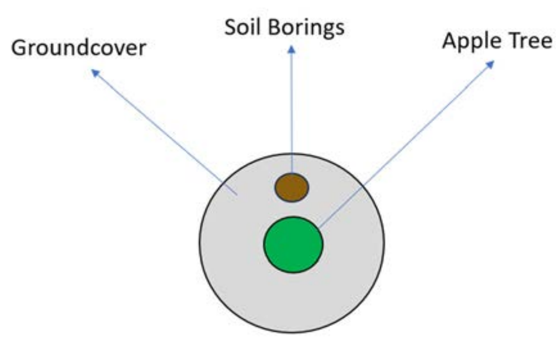

Figure 3. Schematic of soil sampling at a model apple tree. Soil borings were made roughly 8 centimeters away from the rootstock of each apple tree after the clay was peeled back.

Testing Laboratory at the UMass Amherst, where they were tested for soil pH, extractable nutrients (same as leaf nutrient analyses except for nitrogen and sulfur) as well as lead, cation exchange capacity, and percent base saturation. In total, there were thirty-six samples, with twelve per treatment.

Results

Weed Assessments. The mulch and kaolin treatments reduced weed pressure significantly when compared to a single pre-emergent herbicide application (Figure 4). However, mulch and kaolin were not different from one another.

Leaf Sampling. When comparing nutrient levels between cultivar irrespective of treatment conditions, we found no significant differences in nitrogen, calcium, or potassium (Figure 5W, X, Y). However, magnesium levels in the leaves of Neohu trees were significantly lower than those recorded in Haralson trees (Figure 5Z).

Soil pH and nutrients. When disregarding the depth of samples, kaolin clay-covered soil had significantly lower pH when compared to herbicide-treated soil (Figure 6W). When comparing soil levels of potassium (Figure 6X), calcium (Figure 6Y), and magnesium (Figure 6Z) (irrespective of soil depth), we found no statistically significant differences between treatments.

When comparing pH level of soil samples between depths, we found no significant differences across treatments (Figure 7W). There were also no significant differences in potassium levels (Figure 7Y). However, we found significantly higher calcium content in kaolin clay-covered soil samples from the topsoil-10 cm sample depth than those from the deeper, 10-20 cm depth (Figure 6X) but found no significant differences in the mulch or herbicide treatments (Figure 7X). There was a significantly higher magnesium content in the superficial samples (topsoil-10

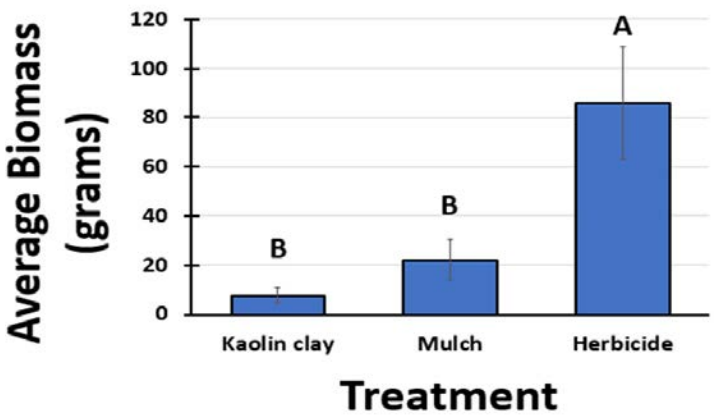

Figure 4. Average biomass of weeds across different treatments.

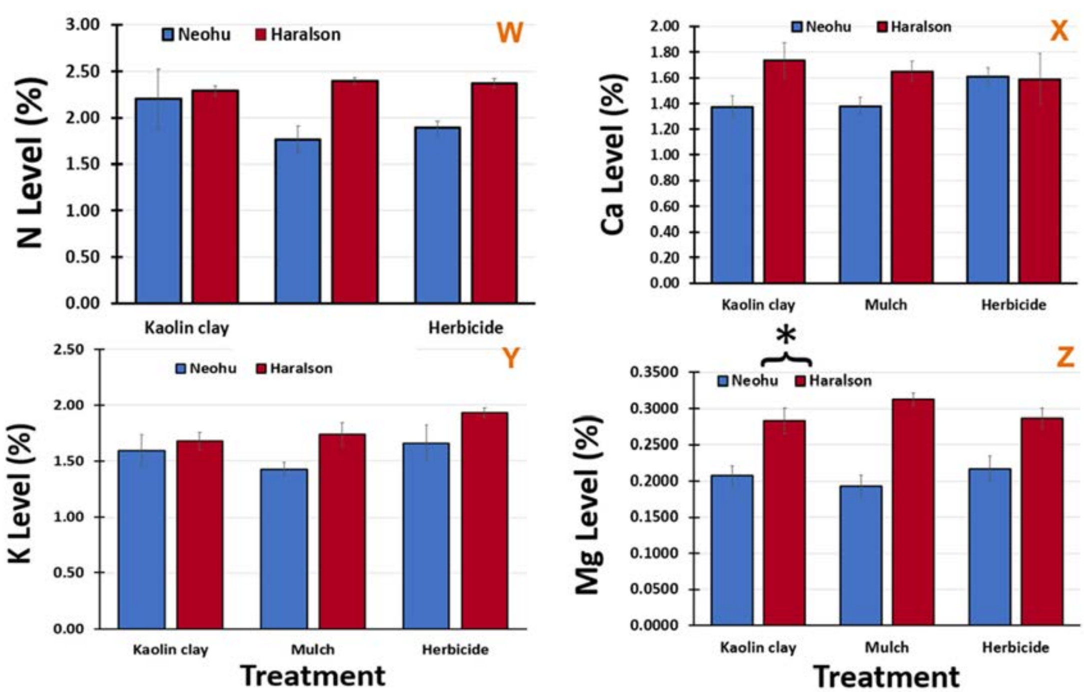

Figure 5. Leaf nutrient levels for nitrogen, calcium, potassium, and magnesium across treatments and apple tree cultivars.

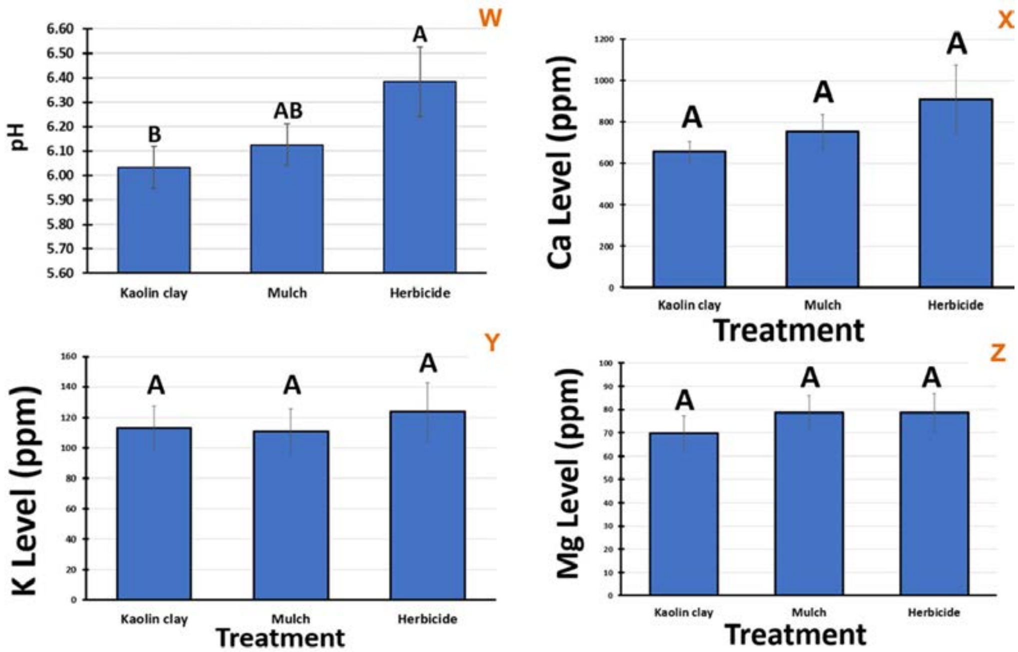

Figure 6. Effects of soil treatment on soil pH, potassium, calcium, and magnesium levels regardless of sampling depth.

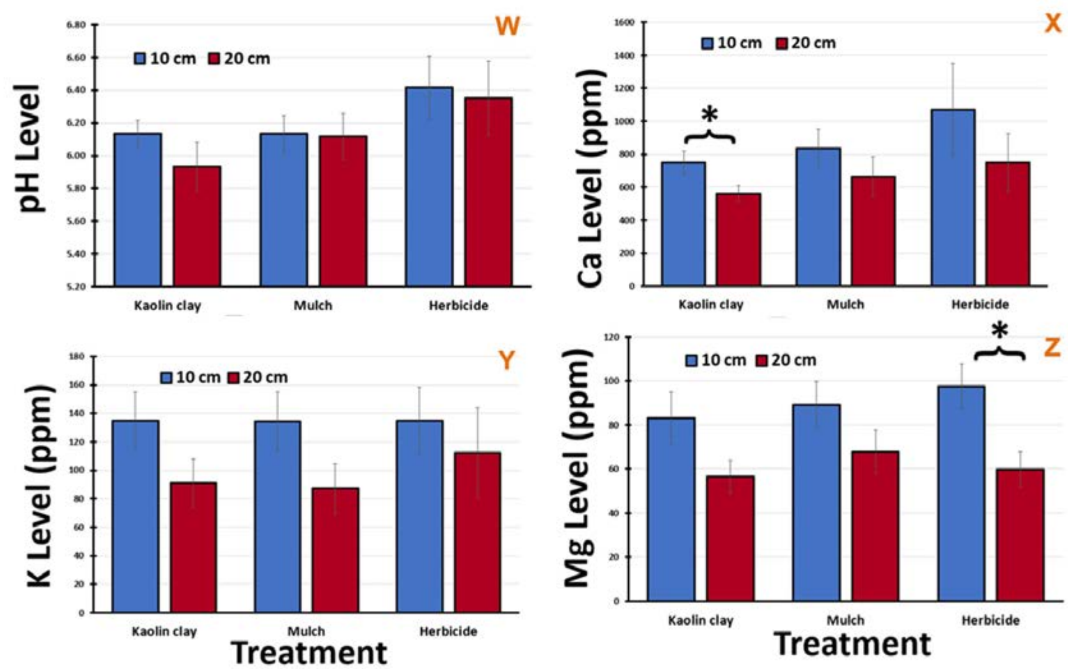

Figure 7. Soil pH and calcium, potassium, and magnesium levels between soil depths and across treatments.

cm) of herbicide-treated soil when compared to the deeper (10-20 cm) soil samples. However, we found no significant differences between the kaolin clay or mulch treatments (Figure 7Z).

Conclusions

The results from this study showed that kaolin clay and mulch were equally effective at suppressing weeds over a 4-month period. The single pre-emergent herbicide application was less effective at controlling weeds compared to the other treatments. We report no significant effects of treatment on soil and leaf nutrient levels but did find cultivar-specific differences, the leaves from trees of the Haralson cultivar had significantly higher magnesium content than those of Nehou. Soil pH was significantly lower in kaolin clay-treated soil compared to soil treated with herbicide. This finding could be useful to growers trying to grow fruits that require more acidic soil, such as blueberries.

The trees planted in the cider block from which we collected our data are still young, and the kaolin clay was only applied this spring, so it will be interesting to see how long-term groundcovers impact trees and the soil over time.

Acknowledgments

We thank Jaelyn Kassoy, Ajay Giri, and Hayat Junejo (UMass Stockbridge students) for technical support. Financial support for this student research project as part of the 2023 REEU internship program was provided by the NIFA's Agriculture and Food Research Initiative - Education and Workforce Development program through Award 2022-67037-36619.

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Charlie Petersen is an undergraduate student in the Stockbridge Plant and Soil Science BS program and he participated in the 2023 REEU summer internship program.

Mass Trapping of Japanese Beetles in Massachusetts Grapes and Blueberries

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The Japanese beetle (JB) (*Popillia japonica*) continues to pose a significant threat to agriculture, particularly in North America, where it has become an invasive pest. Known for its distinctive metallic-green hue and coppery wings, this voracious beetle inflicts substantial damage to crops, including fruits, vegetables, and ornamental plants. Adult beetles feed on leaves, skeletonizing plants, while their larvae, known as grubs, feed on grassroots. The economic impact of JB infestations underscores the urgency of effective pest management strategies in affected regions.

Insecticide-based control of JB is largely used to manage populations of adults and larvae. Although adults are the cause of defoliation and the source of reproduction of future offspring, controlling larvae before they emerge can prevent the rapid rise of adult populations in the summer. In organic settings, insecticidal options are more limited and include microbial and plant-derived insecticides, such as pyrethrins. However, most organic insecticides are either ineffective, or too expensive (e.g., spinosad). Thus, organic growers struggle to effectively control JB.

Mass trapping systems influence insect behavior through the sense of smell. Insect pests are attracted and killed in the mass trapping devices. A 6-year study conducted in Missouri provided the foundation for the use of mass trapping systems as an alternative to spraying and a cheaper option compared to the current ineffective and expensive organic management practices for JB. The Missouri study tested the efficacy of a dual-lure mass trapping system as a management option which would replace the need for spraying insecticides. The design for a mass trapping system used in Missouri consisted of a large mesh cylindrical sock attached to the yellow trap top with tape and hung nearby the crops. Another effective mass-trapping system used in Missouri was a trash bin system. The results from those studies can be found HERE.

Figure 1. Above *left*, sock trap design used in MO. Above *right*, failed in-ground trap for automatic Japanese beetle composting.

The goal of the present study was to evaluate the efficacy of the Missouri mass trapping system in Massachusetts in two crops: grape and blueberry. We wondered if the system used previously in blueberry in Missouri would hold up to different environmental conditions and perform as effectively on other crops such as grapes.

Materials and Methods

Study Site. This study was conducted at the University of Massachusetts Cold Spring Orchard (CSO) in Belchertown, MA, during July and August of 2023. We used one block of Frontenac grapes and one block of blueberries (mixed cultivars). Each block measured about 2000 square meters.

Traps. Pest pressure in Massachusetts is not nearly as strong as in Missouri as reported by Piñero and Dudenhoeffer (2018). Therefore, large traps made of 32-gallon trash bins were not deemed necessary. Instead, we initially tested two designs (Fig. 1): a new in-ground trap designed to auto-compost JB which was unsuccessful, and the sock trap design, which in Missouri was effective at controlling the pest and easy to implement due to its portability, size, and low cost.

We followed the protocol established by Piñero and Dudenhoeffer (2018) to manufacture mass trapping socks. Briefly, we used rectangular 0.75-meter x 0.5-meter cuts of fiberglass anti-mosquito screen, which was folded and stapled onto itself on the side and bottom to create a cylindrical shape. Then this mesh cylinder, or "sock", was securely taped to a plastic trap funnel acquired from Trécé (Trécé Inc., Adair, OK), which consists of a one-piece molded vane of yellow panels that intersect at 90∘ with a funnel underneath ending in a wide rim. Beetles hitting the vane fall through the funnel into the collecting device (sock).

All traps were baited with a double lure system comprised of a floral-based lure and the JB sex pheromone. Each dual lure was inserted inside vane slots. Yellow tops and lures were purchased from Great Lakes IPM (Vestaburg, MI).

Monitoring JB emergence. Early-season JB monitoring was necessary to determine when to implement trapping systems to effectively intercept the beetles emerging from the orchard's soil. To that end, we implemented a monitoring system using the same pheromone lure and a commercial trap (available at Great Lakes IPM). The monitoring system was hung from vegetation in the perimeter on June 12th and the first JB was captured on June 26th, 2023.

Adult beetle trap counts. One single mass trapping sock was deployed at the grape block and at the blueberry block. The sock traps in blueberry and elderberry were both emptied weekly and weighed. To estimate the population of beetles caught by weight we used the formula developed by Piñero & Dudenhoeffer (2018) which uses the weight of beetles captured per trap capture to estimate the number of beetles trapped.

Assessments of adult JB on foliage. We assessed JB densities on the foliage of both the grapes and blueberries weekly. Walking down every other row of the block, the surveyor would stop once every 2 meters and record how many beetles they could see in thirty seconds at that stop. Due to the size of the fields and density of foliage, 10 stops were made in the blueberry rows while 20 were made in grape.

Results

Mass trapping JB captures. One single sock was initially deployed at each of the two blocks (grape and blueberry). Due to unacceptably high numbers of JB found on grape foliage at the peak of activity (see below), one whole-block insecticide spray was made on July 13th. On the same day we increased the number of traps from one to six at the grape block, and from one to two at the blueberry block. Figure 2 shows the total number of JB adults captured on each of five collection dates, for each crop. Trap capture data stemmed from six traps in grape and two traps in blueberry. Comparing JB between the two crops, 12,496 (61% of the total) beetles were captured in traps within the grape block and 8,022 (39%) beetles in the blueberry block (Fig. 2). The highest number of adult JB captures was recorded on July 25th and captures quickly subsided

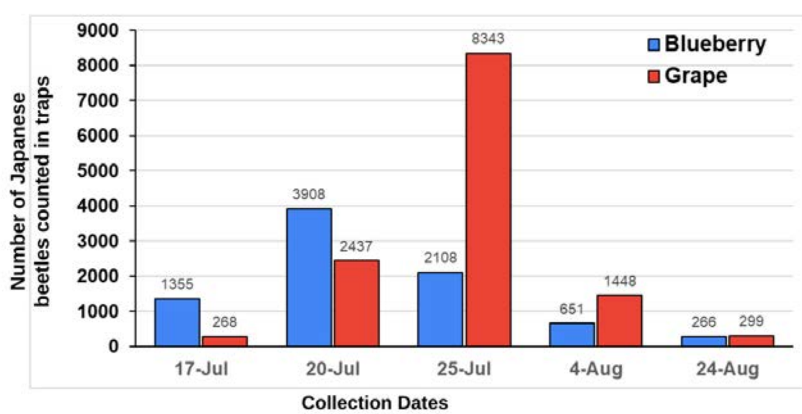

Figure 2. Weekly captures of adult Japanese beetles in mass trapping socks according to crop.

after that date. At the blueberry block, no insecticides were sprayed and little to no damage was found on plant foliage, highlighting the high efficacy of the mass trapping system for blueberries.

Beetle densities on crop foliage. Surveys were conducted to assess the population of JB on the foliage of both crops. As shown in Figure 3, the blueberry surveys consistently showed little to no pest pressure on the crop, while a high number of JB catches were recorded in the mass trapping system (see Fig. 2). In contrast, in the grape block, more JB adults were recorded on foliage and low trap catches (particularly on the July 13-17th and 20th dates), showing that a single mass trapping system was not effective in grapes when JB populations were at their peak. Once the number of mass trapping systems were increased to six, deployed around the grape block after the insecticide spray (applied on July 13th) JB densities on grape foliage dropped significantly, and they did not bounce back. In contrast, high numbers of JB were captured by the six mas trapping systems in the grape block (see July 20th captures in Fig. 2).

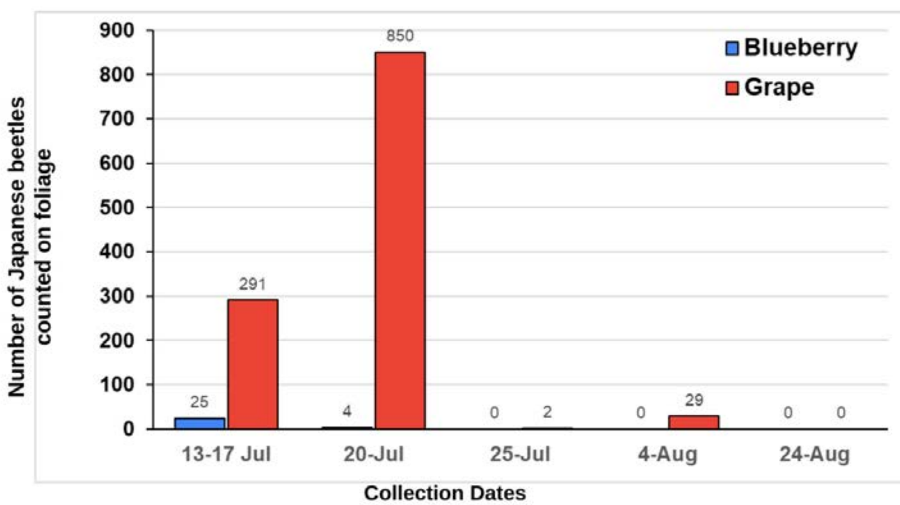

Figure 3. Weekly densities of adult Japanese beetles recorded on grape and blueberry foliage.

Conclusions

In the grape block, one drawback was that initially one mass trapping system was deployed in one location outside the grape block. This was insufficient. JB pressure on the grapes began to overwhelm the crop in early July and the farm manager sprayed an insecticide on July 13th. Shortly after the spray five additional traps were deployed along the perimeter. This six-trap perimeter system was effective in controlling the resurgence of the JB population after the July 13th spray. In the blueberry block, the performance of the single mass trapping system was excellent given that JBs were always suppressed from the crop without using any insecticides. Organic blueberry farmers in MA struggling to control JB may benefit from a mass-trapping system, which our results suggest can be an effective means of control depending on the timing and number of traps used per block.

Acknowledgements

We thank Jake Aliengena, Shawn McIntire, and other staff at the Cold Spring Orchard for their assistance. Financial support for this student research project as part of the 2023 REEU internship program was provided by the NIFA's Agriculture and Food Research Initiative - Education and Workforce Development program through Award 2022-67037-36619.

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Moshe Skoglund is an undergraduate student in the Stockbridge Sustainable Food and Farming Associates Degree program, and he participated in the 2023 REEU summer internship program.

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Codling Moth Mating Disruption Efficacy in 2023

Kaitlin Quinn
North Jersey IPM Program Associate, Rutgers University

Throughout the state of New Jersey, more tree fruit growers have been adopting the practice of using mating disruption to control orchard pests. Examples of mating disruption products available in apples include codling moth, Oriental fruit moth, dogwood borer and obliquebanded leafroller. Mating disruption works by creating a synthetic plume of sex pheromone in the orchard, which disorients males of the species it is specifically designed for, and greatly reduces their ability to find females. If the males are unable to find females of the species, they will not be able to mate, which reduces populations and the need for traditional control methods.

The codling moth is one of the most significant pests of apples. Adults in the orchard mate and the female will lay her eggs on the leaves and fruit. Once the larvae hatch, they burrow through the fruit into the core to feed (Figure 1). This damage makes the fruit unmarketable and if not discovered before harvest, it increases the chances of fruit rot in storage. In New Jersey, this pest has up to 3 generations per year. In some seasons there is a long dragged-out 2nd generation instead of a true 3rd generation. Treatments for the last generation typically coincide with harvest of September ripening apple cultivars, thus presenting a control issue due to limited low PHI pesticide options for Codling Moth. There are also challenges associated with this for pick-your-own operations. Since mating disruption reduces the needs for traditional insecticides, it may be a good option to resolve this issue.

Figure 1. Codling Moth larva and damage in apple. Photo Credits: Kaitlin Quinn

Mating disruption is typically recommended for blocks that are at least 5 acres, uniform and square to minimize border edges. In our North Jersey Tree Fruit IPM Program there are many farms that do not meet these qualifications, almost all our orchards are not perfectly square, and most have woodland on one or more sides. Some researchers are beginning to investigate the efficacy of mating disruption in blocks that do not meet these standards, or what some would call non-compliant blocks. At the moment, not enough data has been collected to reach any definitive conclusions. Based on the North Jersey Tree Fruit IPM Program's 2023 data alone, it seems that mating disruption may be a useful tool in blocks under 5 acres, but more research needs to be done to confirm these observations.

Materials and Methods

The Rutgers University North Jersey Tree Fruit IPM Program's 2023 data comes from the 28 farms in the program. Out of 28 farms, 4 farms had under 5 acres of apples and applied codling moth mating disruption. Three of these farms had 4 acres of apples and one had 1 acre of apples. 6 farms had over 5 acres of apples and used codling moth mating disruption and 18 farms did not use mating disruption. The 18 farms that did not use mating disruption used degree-day models and traditional insecticides to control Codling Moth. Growers using mating disruption used either Isomate CM/OFM TT at a rate of 200 dispensers per acre or CIDETRAK®

CM-OFM COMBO™ MESO™ at a rate of 30-38 dispensers per acre. All farms were scouted on a weekly basis for codling moth fruit injury, a total of 200 apples were scouted on each visit. Each farm had codling moth traps (Figure 2) placed in the upper 1/3rd of the tree's canopy and each trap had a 10X Suterra codling moth pheromone lure; these traps were checked on a weekly basis while scouting.

Figure 2. Codling moths in pheromone trap. Photo Credit: Steve Schoof, NC State

Results

Figure 3 presents trapping results from the 4 farms in the program that were under 5 acres and using mating disruption. We only had farms in Morris, Warren and Hunterdon counties that fit these qualifications. We caught one codling moth on May 27th in Hunterdon County and one on August 26th in Morris County. No codling moth fruit injury was found on blocks under 5 acres using mating disruption.

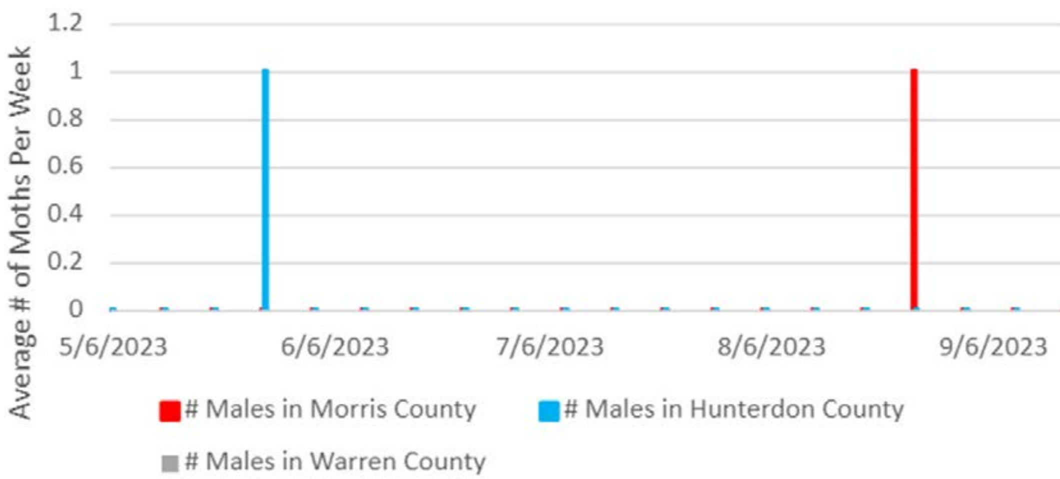

Figure 3. Weekly codling moth trap captures on four farms <5 acres using mating disruption

Codling moth trap capture results in farms >5 acres are shown in Figure 4. The data comes from the 6 farms in the program that are using mating disruption on their traditionally compliant blocks. Only Morris, Mercer, Hunterdon, and Bergen counties had farms that fit these qualifications. On June 3rd one farm in Morris County had a trap capture of two Codling Moths. No codling moth fruit injury was found on farms over 5 acres using mating disruption.

Farms that did not use mating disruption utilized degree day models to time their traditional insecticide applications to control Codling Moth populations. Only Middlesex, Morris, Hunterdon, Warren, and Sussex counties

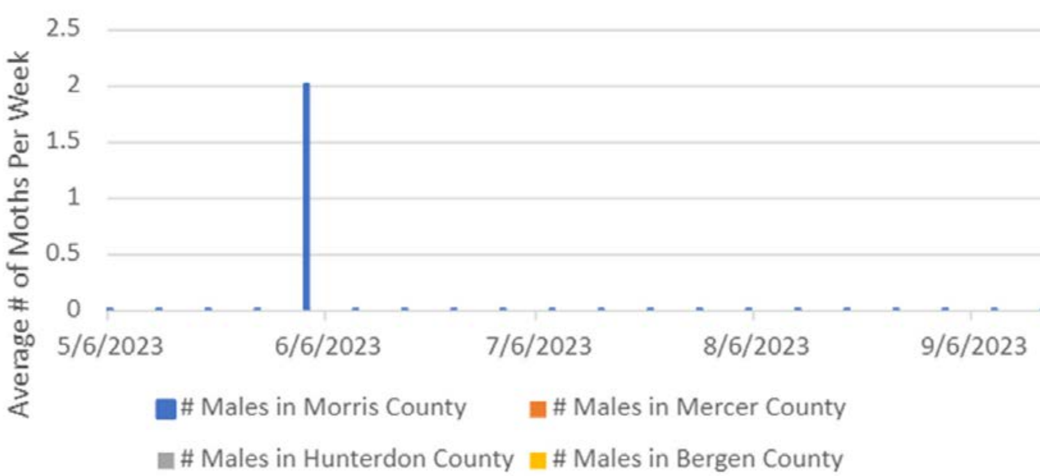

Figure 4. Trap captures on farms >5 acres using mating disruption.

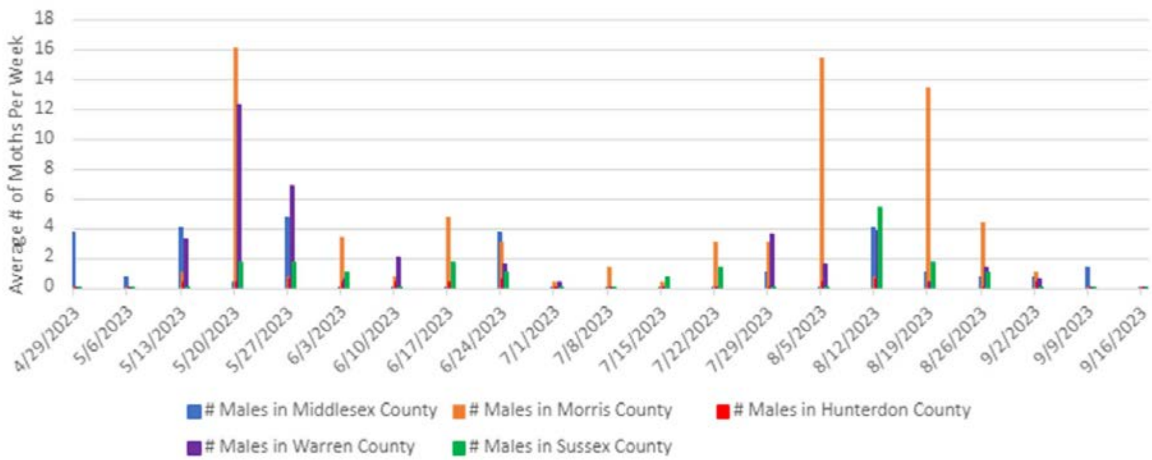

Figure 5. Trap captures on farms not using mating disruption.

had farms that fit these qualifications. All traps at these farms consistently caught Codling Moth throughout the season with the highest total trap capture being 40 moths in one week (Figure 5).

As shown in Figure 6, there was some Codling Moth fruit injury from July through August in Morris and Warren counties.

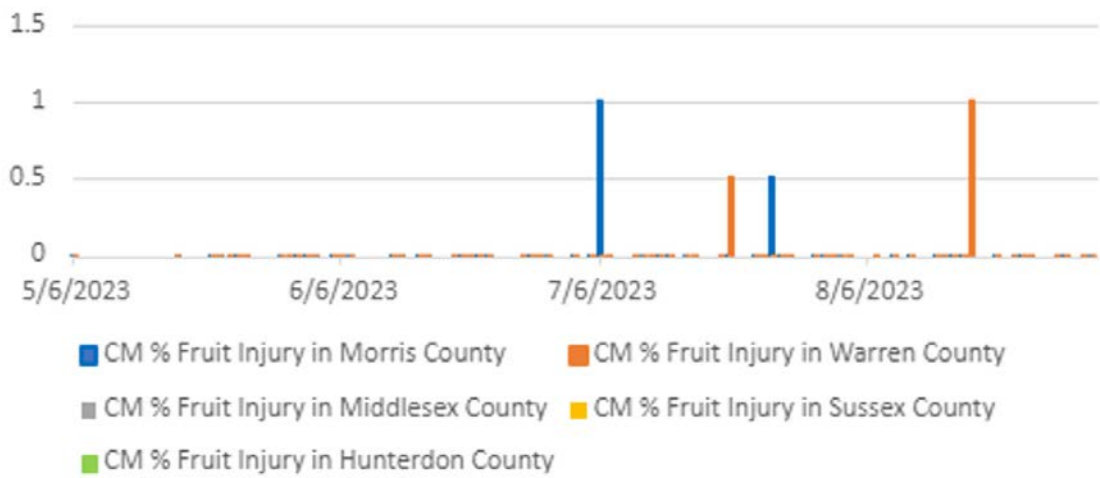

Figure 6. Percent fruit damage on farms not using mating disruption

Conclusion

The data show a trend that not only is mating disruption effective in traditionally compliant blocks, but it may also become a useful tool in blocks under 5 acres. Since this is based on only one year of data alone, more research needs to be done on the efficacy of mating disruption in blocks under 5 acres before this can confidently be recommended as a tool to growers.


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Co-Ferments Come of Age in the Northeast: Increasing the Demand for Local Fruit

J. Stephen Casscles
Cedar Cliff Vineyards and Nursery

Vière is a French word for a co-fermented alcoholic beverage made from wine (vin), fresh grapes, or grape skins and beer (bière). It is also known in Europe and the United States as Co-Ferments, Vierre, Grape Ale, or Oenobeer. Because New England and the Mid-Atlantic States grow quality fruit and make quality beers, ciders, and wine, Vière and other Co-Ferments are a perfect match for our area. This article details for our readers, who are primarily apple, berry, grape, and stone fruit growers, emerging trends in wine, beer, and cider production and how our growers can capitalize on the increased demand for fruit for alcohol production. In addition, many New England and Mid-Atlantic fruit growers are diversifying their farm operations to establish free-standing cideries, breweries, wineries, and distilleries. This trend of establishing alcohol production facilities on their farms is helping to increase year-round income; create more demand for the fruits that we grow; attract new customers to our farms who will purchase beer, cider, wine, and these hybrid co-ferment beverages; and offer our U-Pick and farm stand customers with more products to buy.

The author of this article cultivates 19th century Hudson Valley and Boston's North Shore Heritage grape varieties and other cool climate grape varieties that can be grown sustainably. Casscles cultivates over 90 different Heritage and cool climate grape varieties that are winter hardy, fungus disease resistant, productive, and make quality alcoholic beverages. He assists grape growers who want to grow their grapes more sustainably and which can cope better with our changing climate. These climatic changes are now substantially reducing our ability to make a living in farming. Casscles is a winemaker at Dear Native Grapes Winery of Walton, NY and is interested in promoting Heritage grape varieties to produce new styles of alcoholic beverages.

The production of vière and other Co-Ferments demonstrates a trend in the alcohol beverage industry that is witnessing the inter-mixing and merging of different styles in the production of wine, beer, and ciders. For years, beer makers on both sides of the Atlantic added cherries, raspberries, and currants to beer to broaden their flavor profiles. Currently, these same brewers are experimenting with adding apples, grapes, berries, and stone fruits to their beers and ciders. The manufacture of beer, cider, and wine used to be placed into separate and distinct categories, but these categories are now merging as the boundaries between them become less defined.

Simultaneously, with the blurring of boundaries of beer, cider and wine, producers are introducing more "natural" beers such as 'sours'; beers that contain 'brett' (a yeast strain called brettanomyces), volatile acidity (also known as VA or vinegar), and other bacteria that ten years ago would have been considered as an off-putting smell or flavor. In addition, beer makers have been experimenting with making cloudy beers such as 'hazy' IPAs; beers flavored with pineapples, grapefruit, and ginger; and gose-style beers that are wheat, barley, oats, and rye-based beers, flavored with coriander, other spices, or oranges and limes. Producers are experimenting with the kinds of fruits and grains that they use to make these hybrid beverages and with cultivated and wild yeasts and other bacteria they use to ferment them.

In the New England and Mid-Atlantic wine industry, we are seeing winemakers add fruits other than grapes to their wines. Further, some winemakers are now devoted to making "natural wines" from organic grapes with minimal interventions such as not adding commercial yeasts, sulfur, or sugar. Examples of some of these "natural" wines include Pet-Nats and Piquettes. These natural wines are similar in appearance, body, and flavor profile to the new cloudy and fruit-forward beer styles mentioned above. Hence, we are seeing the merging of similar styles in the making of beer, wine, and cider.

Pet-Nats and Piquettes are becoming popular with younger drinkers and are one of the few growth sectors in the wine industry. For our purposes, it is a new place that our fruit growers can sell their fruits or use already processed fruits again to make beer, cider, or wine. This is especially the case for cider, because by adding fruits other than apples, this expands the kinds of ciders that can be produced. In the production of beer, vière may become a growth market for those who have surplus apples, grapes, or other fruits and are seeking new markets to sell their fruits. In producing vière, anywhere from twenty to forty percent of its volume is raw fruit, pomace, or wine added to this malt beverage, hence the volume of fruits needed by a cidery or brewery are sizable. The other benefit for fruit growers is that such cideries and breweries can accept produce that has no other home during the Fall and quickly convert them into co-fermented ciders and beers within three to four months for sale.

Since vière is a relatively new kind of beverage in the United States, it is a fun time for East Coast fruit and hops growers and alcoholic beverage makers who are making these Co-ferments. This past Thanksgiving, Subversive Brewery of Catskill, New York, released its Heritage Grape Ale, made from grapes grown by this author. The grape varieties included are Baco Noir and Heritage grape varieties that were bred by 19th century Mid-Hudson Valley and Boston's North Shore hybridizers such as Agawam, Bacchus, Black Eagle, Delaware, Eumelan, Jefferson, Massasoit, and Lindley. The base beer of this grape ale is a very simple recipe of pilsner malt, local flaked wheat, and low amounts of hops that was fermented jointly with these very fruity heritage grape varieties. Brewmaster Zane Coffey stated that "this recipe gives just enough character to provide a backbone for the beverage, while not overwhelming the delicate character of the grape. This ale has a lovely ruby/purple color similar to a wine spritzer, its body is very light, and the carbonation makes the fruit character pop out of the glass."

Russell Orchards and Winery of Ipswich, MA is a 120-acre fruit farm that grows apples, pears, stone fruits, and berries. Doug and Miranda Russell produce hard apple cider and fruit wine. The Russell family produces nine different styles of hard cider and perry, some of which are flavored with fruits that they grow such as raspberries, pears, blueberries, and blackberries. In addition, they make traditional fruit wines and blended fruit wines, such as strawberry/lilac and strawberry/rhubarb. This multi-faceted farm operation complements its country store, winery, wine/cider tasting room, and

Agawam, a hybrid bred by ES Rogers of Salem, MA.

Baco Noir does well in Co-ferments, imparts lots of black raspberry and berry flavors.

Delaware is used a lot in Co-ferments and grows well and can be grown organically.

bakery. The Russell's have a U-Pick operation so that local families can enjoy the outdoors as they harvest agricultural produce and conduct educational farm tours for local school children.

Andre Latour of Brewery LaHoff of Climax, NY made a vière, called Isabella Hudson Harvest Ale. This co-fermented vière is a wheat ale brewed with Hudson Valley white wheat with the addition of Isabella grapes. 'Isabella' is a Heritage grape variety found in the garden of Isabella Gibbs of Brooklyn, NY in 1816 by William Prince, the famous nursery owner of the Linnaean Botanic Garden of Flushing, NY. Isabella is making a comeback on the East Coast, but for years it has been widely grown in Moldovia, Ukraine, India, and Brazil. Isabella has found a home in a wide range of places due to its winter hardiness, ability to withstand high temperatures, fungus disease resistance, high productivity, and heavy grapey and musty flavors. The brewmaster Andre Latour believes that his Isabella Hudson Harvest Ale is popular because "It appeals to beer enthusiasts and wine drinkers alike. It's a beer that almost drinks like wine. As you imbibe, you are able to explore the unique characteristics of both wine and beer simultaneously."

There are several breweries, cideries, and wineries in New England that are making Co-ferments. Two Roads Brewing of Stratford, CT makes several beers with grapes, pumpkins, cherries, and raspberries. This brewery also sponsors its "Area Two Experimental Brewing" Program that Co-ferments its beers with wild yeasts and cherries, black currants, cranberries, peaches, and blackberries. Allagash Brewing of Portland, ME operates a brewery and cidery that makes a wide range of beers, ciders, and sour ales that contain apples, grapes, raspberries, cranberries, cherries, apricots, and strawberries. Some of these beers are fermented with wild yeasts or bacteria or aged in wooden barrels as is commonly done with wine.

Shacksbury Cidery of Vergennes, VT makes complex, vinous, organic ciders that blur the lines between cider and wine. In their ciders, they use generous amounts of grapes such as La Cresent, Leon Millot, Baco Noir, and Frontenac. ZAFA Winery, located on Isle La Motte, VT makes carbonated fruit wines, and co-fermented wines that contain apples, grapes, and peaches. With its Co-Cellars Project, it explores various approaches to fermenting apple cider, other fruits, and grape varieties such as Seyval Blanc, Catawba, and Concord, and how these Co-ferments meld with apple cider and wild yeast strains.

At Return Brewing of Hudson, NY, brewer JD Linderman is making a vière, called Pastel Palace, which has as its base beer a sour ale with strawberries. The cool climate grape varieties added include Burdin 6055, Annie Noir, Le Colonel, Verdelet, and Concord. All of these grape varieties are winter hardy, fungus disease resistant, productive, and can be grown sustainably. Linderman believes that his vière is "a nuanced, bright, easy drinker that people will have a lot of fun sharing bottles of." Co-formulator Mikey Lenane added that "the blend is pretty remarkable - the base beer had strawberry refermented directly into it, but the bright

Jefferson, JH Ricketts hybrid from Newburgh, NY lots of quava and soft labrusca flavors.

Lindley, ES Rogers hybrid from Salem, MA, might be of interest in New England.

Red currants grow well in New England, especially in lower damp soils, great in Co-ferments.

Pet nat from Dear Native Grapes, they used Catawba and Niagara that are commonly used for Co-ferments.

Empire State developed by JH Ricketts of Newburgh, NY, around 1878

Verdelet has a reputation of not being winter hardy and susceptible to fungus diseases, I have not found that to the be case

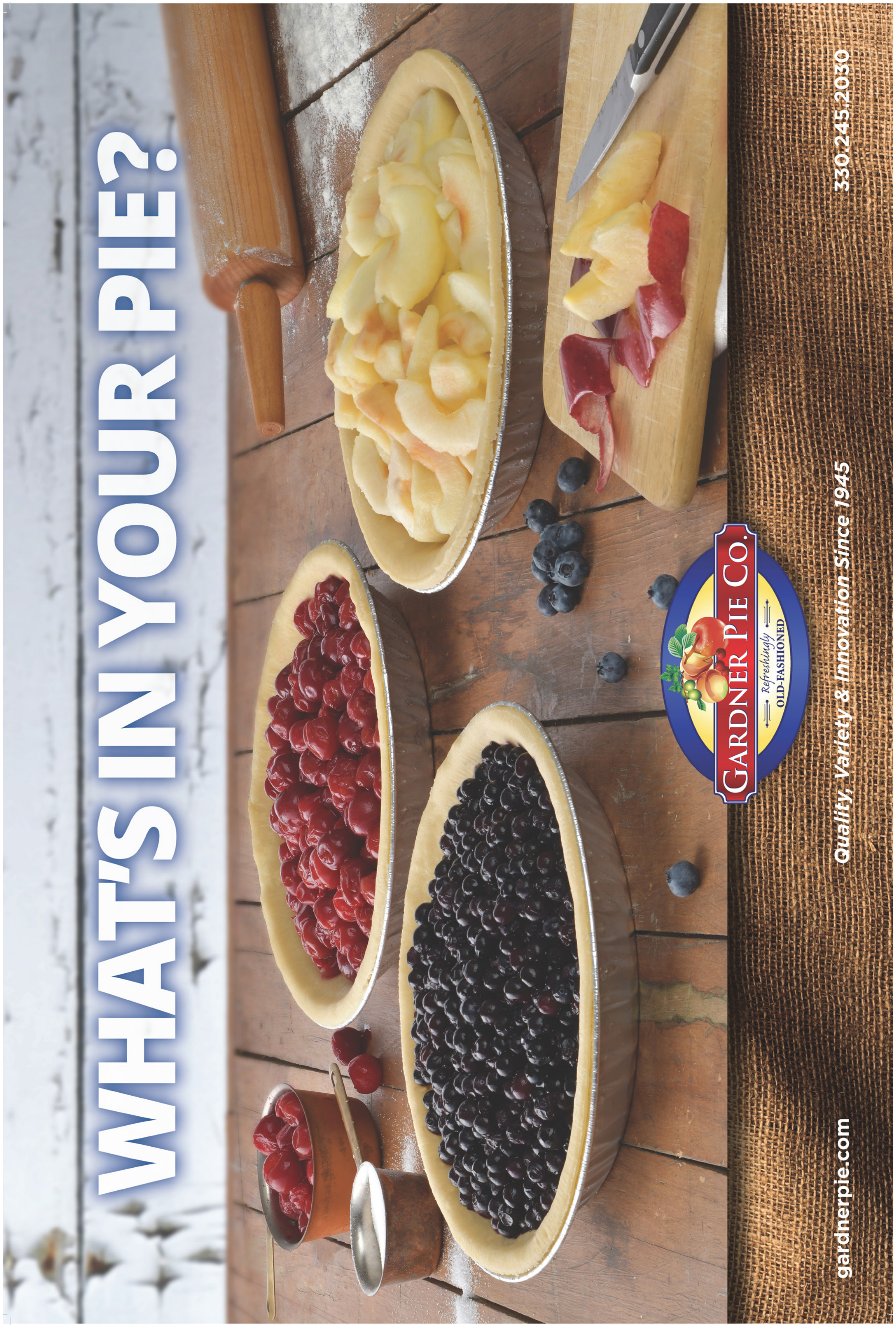
fruitiness of the grapes makes for a far more intense strawberry taste than we had originally thought possible."

What is so exciting about making vière in New England and the Mid-Atlantic states is that our producers are open to making this beverage in many ways with many different fruit varieties, malts, and cultured and wild yeasts and bacteria. These Co-ferments have many different flavor profiles, so the flavors and texture of our vière beverages is broad. In addition to the large number of fruit varieties that are used, each beer maker has a different approach in making their base vière, be it a pilsner, ale, kolsch, IPA, lager, bitter, or Hefeweizen. The same is true for apple and pear ciders which can be made into many different styles which can then produce a nuanced Co-ferment.

Denny Brownell of HeartsbyTrue Cidery, Catskill, NY, is creating his own style of an apple cider-based vière. As with beer, there are many different styles of hard cider that can be made. Here too, each base cider can be very different due to the apple varieties and the yeast strain used to ferment these apples. Brownell concentrates on obtaining hand foraged wild apples and pears which he lets ferment with wild native yeasts that are present on the fruit he has gathered. In years past, Denny has added sour cherries to his ciders. This year, to his base apple cider, Denny added fresh Baco Noir grapes. This co-fermented cider will be barrel aged and ready for consumption within the next six months.

In New Jersey, Kane Brewing of Ocean, NJ, has a "Field & Oak" Spontaneous and Saison beer project, where they ferment with wild yeasts and bacteria and add locally grown red &black currants, raspberries, blackberries, blueberries, cherries, strawberries, plums, peaches and various sorts of grape varieties to their beers. In addition, like wine producers, they have a program where they barrel age their heavier stouts, barley wine, and imperial brown ales. This brewery cooperates with the Bellview Winery of Landisville, NJ, which produces black currant, cranberry, and blueberry wines, in addition to its hardy hybrid grape wines made from Chambourcin, Vidal Blanc, and Cayuga White.

There is a movement by some in the fruit growing community to integrate different businesses into their farm operations. Just as this trend is occurring, we are seeing independent brewers, cidermakers, and winemakers merge their practices to produce vière and other Co-ferments that integrate different grains in beers with fruit, pomace or wine; ciders that also include various fruits to broaden the number of their offerings; and wines that blend fruits other than grapes into their wine products. This is an exciting time for East Coast fruit growers and alcoholic beverage makers be they making wine, beer, cider, vière, or another co-ferment by the combination of different cultured and wild yeasts, bacteria, and kinds of grape varieties or other fruits in the production of many different styles of vière.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