2017 Proceedings

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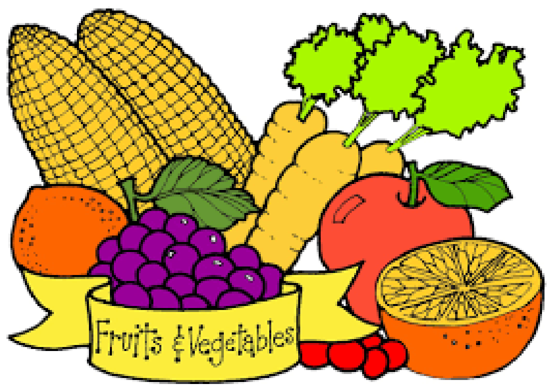
February 7-9, 2017



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New Jersey Agricultural Experiment Station

NEW JERSEY DEPARTMENT OF AGRICULTURE

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Tuesday, February 7

Finances and Risk Management – Michelle Infante-Casella, Agricultural Agent, Rutgers NJAES Cooperative Extension of Gloucester County

Organic Agriculture – Joseph Heckman, Specialist in Soil Fertility, Rutgers NJAES

Sweet Corn – Raymond Samulis, Agricultural Agent, Rutgers NJAES Cooperative Extension of Burlington County

Farm Brewery Opportunities and Regulations – William Bamka, Agricultural Agent, Rutgers NJAES Cooperative Extension of Burlington County

Alternative Crops –Jenny Carleo, Agricultural Agent, Rutgers NJAES Cooperative Extension of Cape May County

Direct Marketing/Agritourism – William Hlubik, Agricultural Agent, Rutgers NJAES Cooperative Extension of Middlesex County

High Tunnel Production – A.J. Both, Specialist in Bioresource Engineering, Rutgers NJAES

Farm Brewery Crops – Steve Komar, Agriculture Agent, Rutgers NJAES Cooperative Extension of Sussex County

Plant Health Technologies – William Sciarappa, Agricultural Agent, Rutgers NJAES Cooperative Extension of Monmouth County

Wednesday, February 8

Small Fruit – Peter Nitzsche, Agricultural Agent, Rutgers NJAES Cooperative Extension of Morris County

Farm Safety – Raymond Samulis, Agricultural Agent, Rutgers NJAES Cooperative Extension of Burlington County

Bee Safety and Emerging Insect Threats– Joe Mahar, Program Coordinator, Vegetable IPM, Rutgers NJAES Cooperative Extension

Wine Grapes I-Gary Pavlis, Agriculture Agent, Rutgers NJAES Cooperative Extension Atlantic County

Peppers – Andy Wyenandt, Extension Specialist in Vegetable Pathology, Rutgers NJAES

Food Safety – Meredith Melendez, Senior Program Coordinator, Rutgers NJAES Cooperative Extension of Mercer County

Tomatoes – Wesley Kline, Agricultural Agent, Rutgers NJAES Cooperative Extension of Cumberland County

Pumpkins - Michelle Infante-Casella, Agricultural Agent, Rutgers NJAES Cooperative Extension of Gloucester County

Blueberries – Gary Pavlis, Agricultural Agent, Rutgers NJAES Cooperative Extension of Atlantic County

Thursday, February 9

Food Safety Audit Training Workshop – Wes Kline, Agricultural Agent, Rutgers NJAES Cooperative Extension of Cumberland County

Sprayer Technology Workshop – John Grande, Director, Rutgers Snyder Farm

Farm Safety Workshop – Raymond Samulis, Agricultural Agent, Rutgers NJAES Cooperative Extension of Burlington County

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FINANCES AND RISK MANAGEMENT

USING SWOT ANALYSIS FOR ASSESSING YOUR FARM BUSINESS

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Introduction:

Farm business planning tools are available in many forms. Some types of self-assessment can be difficult and time consuming. However, using SWOT analysis can be an easy-to-understand concept that takes a pen and paper to start. SWOT analysis is a strategic planning method used to evaluate the **S**trengths, **W**eaknesses, **O**pportunities, and **T**hreats involved in a project or in a business venture. It involves specifying the objective of the business venture or project and identifying the internal and external factors that are favorable and unfavorable to achieve that objective.

Setting the objective should be done after the SWOT analysis has been performed. This would allow achievable goals or objectives to be set for the business. There are four headings to assess when conducting this type of analysis:

- **S**trengths: *internal* characteristics of the business that gives it an advantage over others
- **W**eaknesses: *internal* characteristics that place the business at a disadvantage relative to others
- **O**pportunities: *external* chances to improve performance (e.g. make greater profits) in the environment
- **T**hreats: *external* elements in the environment that could cause negative impacts on the business

Users of SWOT analysis need to ask and answer questions that generate honest and meaningful information for each category (strengths, opportunities, weaknesses, and threats) in order to maximize the benefits of this evaluation and find their competitive advantage.

Below are some typical items to analyze for a farm business under each evaluation category:

Internal Factors:

Strengths (Internal): characteristics of the farm business that are beneficial in regards to products, marketing, finances, etc. already in place.

Weaknesses (Internal): are characteristics that place the team at a disadvantage relative to others (liabilities, safety, location, marketing, business plan, environment, cost of production, overhead, etc.)

- Location
- Acreage
- Facilities
- Equipment
- Products
- Marketing Type/Strategies
- Leadership
- Employees
- Business Plan/Insurance
- Business Relationships
- Other items related to farm business…….

External Factors:

Opportunities: **(External)** chances to improve performance (e.g. make greater profits) in the environment (location, risk management, marketing, production, employees, environment, etc.)

Threats: (**External)** elements in the environment that could cause trouble for the business or project (community, regulations, safety, liability, economic, environment, etc.)

- Neighbors (surrounding population)
- Demographics
- Regulations
- Customers
- Economy
- Weather
- Traffic
- Municipal Government Relationship
- Agricultural Support Entities/Suppliers
- Other items that impact farm business……

When writing down the items under each category, just remember to keep separate the internal and external points. The internal points are things that can be changed or managed "in house". External opportunities or threats are not easily changed or may not be able to be changed.

Conducting your own SWOT analysis is a start. Additionally, you may want to bring in others who work with your business to have an "outside" set of eyes into the assessment and to move forward in decision making. For instance, your insurance agent, your financial advisor, or county agricultural agent may be able to assist with evaluating your farm business.

Using SWOT analysis is one way to do a quick and simple evaluation without spending money. After putting this information to paper, you may wish to do more investigation or use the information to start a more complex evaluation, especially in the area of business planning. Nevertheless, any level of evaluation can be helpful in moving forward.

GARDEN STATE CROP INSURANCE EDUCATION

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Each year Rutgers Cooperative Extension applies for the Targeted States Grant though the Risk Management Agency. The Targeted States Program is a USDA funded grant program given to 17 targeted states (AK, CT, DE, HI, MA, MD, ME, NV, NH, NJ, NY, PA, RI, UT, VT, WV, WY). The purpose of the Targeted States program is to deliver crop insurance education and information to U.S. agricultural producers in States where there is traditionally, and continues to be a low level of Federal crop insurance participation. In 2015 1,067 crop insurance policies were sold to New Jersey Growers covering 161,208 of New Jersey's agricultural acres with $77,174,070 of crop insurance protection.

With the 2014 Farm Bill there were some changes to risk management programs. The NAP program offered through the Farm Service agency increased its risk management crop insurance protection by offering new buy-up coverage. Producers were now able to insure their NAP crops at 100% of the price election and with a 50-65% coverage level. The Risk Management Agency's (RMA) Enterprise insurance unit's authority changed from a temporary to a permanent program; and growers were able to choose separate enterprise insurance units for irrigated and non-irrigated crops. Different coverage levels by practice may be selected if producer has both irrigated and non-irrigated production practices. Organic Protection was improved and organic crop insurance became available for more crops. 16 crops now featured organic price coverage and producers had the option of using the organic or conventional crop prices when insuring their production. RMA also removed the 5% premium surcharge for farmers electing to use organic price options. New benefits became available through RMA for beginning farmers who wanted crop insurance. Beginning Farmers are growers with less than 5 years of farming experience. Beginning farmer benefits included an Increase in premium subsidy by 10% meaning that if a crop insurance policy premium was 45% subsidized for regular growers, beginning farmers subsidy would be 10% more than that so 55%. Beginning farmers that need to resort to using T-Yields (county averages) because they don't have enough years of established records are able to get up to 80% of the T-Yield in comparison to non-beginning farmers who are only eligible for 65% of the T-Yield. Beginning farmers are also exempt from paying the administrative fee for CAT (catastrophic) crop insurance coverage. With the release of a new farm bill came the new Whole Farm Revenue Protection Program crop insurance policy. This policy insures ones entire farm revenue and does not focus on individual crop yield losses like other types of crop insurance policies do.
The Risk Management Agencies Multiple Peril Crop Insurance Policy program is the most widely used crop insurance program. Under this type of crop insurance Soybeans, Grain sorghum, Oats, Wheat, Barley, Forage production/seeding, Nursery, Dairy, Apples, Peaches, Blueberries, Cranberries, Fresh market sweet corn, Potatoes,

Processing beans, Processing tomatoes, and Corn are insurable. Crop insurance policy availability varies by county. With the APH (Actual Production History) plan, coverage guarantee is based on farmers own production history and coverage is available from 50%-75% and up to 85% in select states. APH crop insurance provides comprehensive protection against: weather related causes of loss, unavoidable perils resulting in: low, yields, poor quality, late planting, replanting and prevented planting. Crop insurance premiums for this program are subsidized partially by the government as an incentive to get growers to sign up for insurance. Certain factors that cause crop damage are insurable, these include: adverse weather conditions, failure of irrigation water supply, fire, insects/plant disease, and wildlife damage. What is not considered insurable is: negligence, mismanagement/wrongdoing, crop abandonment, theft or vandalism, inability to market commodities due to quarantine, boycott, etc... lack of labor, and failure of buyer to pay for commodities. In the event of crop damage, producer must, protect the crop from further damage by providing sufficient care, notify their agent within 72 hours of the initial discovery of damage (no later than 15 days after the end of the insurance period), leave representative samples intact, and not destroy any damaged crop. Crop insurance Indemnities are calculated by taking the per acre average yield and multiplying that by the coverage level chosen. This gives you the per acre guarantee. Should you have a loss, and should your production fall below this guarantee, you will receive a payment. Your loss is determined by taking your per acre guarantee and subtracting from that your per acre production. You take that number (your per acre loss) and multiply that by the price election for that crop and that gives you your indemnity payment amount. Example: Assume an average yield (APH) of 240 hundredweight per acre of potatoes and a 65% coverage level. By choosing a 65% coverage level your per acre guarantee is 156 hundredweight (240cwt/acre x 65%= 156cwt/acre), but due to an insurable cause of loss you only harvested 48 hundredweight of potatoes. With a $11.65 price election per hundredweight and a per acre loss of 108 hundredweight (156cwt/acre – 48cwt/acre = 108cwt/acre) your gross indemnity per acre would be $1,258 (108cwt/acre x $11.65 = $1,258).
Crop insurance premiums are subsidized by the federal government as an incentive to encourage more growers to participate in crop insurance programs. With the actual production history crop insurance program coverage levels range from 50 to 85 percent of your average yield and are subsidized as shown below. For example, an average APH yield of 240 hundredweight (cwt. of potatoes) per acre results in a guarantee of 156 cwt. per acre at the 65-percent coverage level.

Item	Percent							
Coverage Level	50	55	60	65	70	75	80	85
Premium Subsidy	67	64	64	59	59	55	48	38
Your Premium Share	33	36	36	41	41	45	52	62

Source: Risk Management Agency Fact Sheet for Potatoes
Subsidy amount varies by crop insurance policy and by crop insurance coverage level. As seen above, a 65% coverage level for crop insurances yields a 41% crop insurance premium subsidy meaning producers are only responsible for the cost of 59% of their

premium. With an 85% coverage level there is a 62% premium subsidy and growers only pay 38% of the cost of their premium. CAT or catastrophic coverage is the lowest amount of coverage you can get though the MPCI APH crop insurance program. Coverage is 50% of average yield and 55% of the price election. CAT is 100% subsidized with no premium cost except an administrative fee of $300 per crop regardless of acreage. This is the bare minimum insurance you can get and it usually won't provide adequate protection for most growers; buy up coverage is recommended. If there is not a policy in place for the crop you want to insure in the county (crop policies vary by county) you can insure your crop though NAP, Whole Farm Revenue, or a written agreement. If a policy exists for your crop in another county in any state, your insurance agent can adapt it for your conditions and write you a written agreement, providing that you have at least 3 years of production records for the crop or a similar crop.

There are a few insurance options available to producers who want to insure their grain. Producers can choose yield protection or revenue protection. Within the revenue protection option there is the choice to choose revenue protection which incorporates the higher of either the projected price at planting or the price at harvest into your guarantee. The other revenue protection option only incorporates the projected price at planting into your insurance guarantee. Trend Adjustment is a new option available for grain crop insurance policies. Trend Adjustment (TA) gives you credit for technological and genetically driven increases in yields, which are not reflected in your historical actual production history (APH) records. The average yields have usually increased a small amount each year, sometimes by as much as a bushel (corn) per acre. Producers who have four or more years of actual yield records for the insurable unit may benefit the most. If a producer wants to benefit from including trend adjustment but doesn't have four or more years of actual yields then they would get a percentage of the trend adjustment factor. Trend Adjustment is not available for CAT policies and Trend Adjusted APH is a continuous election that remains in effect year after year until canceled. Trend Adjustment is available for the following crops in the following counties:

Corn– Burlington, Cumberland, Gloucester, Hunterdon, Mercer, Middlesex, Monmouth, Morris, Ocean, Salem, Somerset, Sussex, Warren

Soybeans– Burlington, Cumberland, Gloucester, Hunterdon, Mercer, Monmouth, Salem, Somerset, Warren

Wheat-Burlington, Cumberland, Hunterdon, Monmouth, Salem, Somerset

Trend adjustment can account for genetic and technological increases in yield for recent years which can lead to an increase in your APH (Actual Production history) at no extra cost, a higher APH can allow you to have a higher coverage guarantee, and you have more coverage. Getting your actual production history adjusted using trend adjustment can allow you to have more coverage at the same coverage level you elected before trend adjustment but for the same premium cost.

Whole Farm Revenue Protection (WFRP) is a new program that came out with the new 2014 farm bill. It replaced ARG/AGR LITE program. WFRP protects against natural causes of loss and decline in market prices during the insurance year. When revenue to count for the insurance year is less than the insured revenue amount, a loss payment will be issued. WFRP covers all farm commodities including: animal and animal products revenue, commodities purchased for resale (limit up to 50% of total expected revenue) and natural causes of loss and declining market prices within the insurance year. It does not cover protection for timber forest, forest products and animals for sport, show or pets. WFRP coverage levels from 50 to 85% of expected revenue. Premium subsidies for WFRP vary from 55% to 80%. In order to sign up for WFRP you are required to have your 5 previous years of tax records. You can still have some Multiple Peril Crop Insurance policies for certain crops while also participating in Whole Farm Revenue Protection. With WFRP, all farm revenue is insured together under one policy and Individual commodity losses are not considered; the overall farm revenue determines losses. WFRP is a great program and well-suited for: highly diverse farms, farms with specialty commodities (not typically covered) and farms selling to direct markets, specialty markets, regional or local markets, and farm-identity preserved markets.

Important contact info:

Crop Insurance Toll-free hotline:
1-800-308-2449
http://salem.njaes.rutgers.edu/cropinsurance
www.rma.usda.gov

ORGANIC AGRICULTURE

Managing Pests and Pesticides in Organic/Conventional Operations

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Vegetable growers, organic and otherwise, are frequently faced with decisions regarding control of insect pests. Depending on the pest situation, insecticide use may be necessary. For organic growers, the USDA National Organic Program Code 205.206 (Crop pest, weed, and disease management practice standard) states:

(e) *When the practices provided for in paragraphs* ***(a)*** *through* ***(d)*** *of this section are insufficient to prevent or control crop pests, weeds, and diseases, a biological or botanical substance or a substance included on the National List of synthetic substances allowed for use in organic crop production may be applied to prevent, suppress, or control pests, weeds, or diseases. Provided the conditions for using the substance are documented in the organic system plan.*

For conventional growers, the choices of what insecticide to use is typically based on 1) permissible (labeled) uses, 2) efficacy, and 3) cost. For growers who have split (organic/conventional) operations, however, there are considerations as to how to manage insecticide use between both halves of the operation. The USDA Guide for Organic Crop Producers, chapter 11 - Preventing Contamination of Organic Crops, states the following about spraying and maintaining buffers:

"Residues from spray used for conventional crops must be thoroughly removed before equipment is used to spray organic crops. Residues may be removed more effectively by using a cleaner such as Nutra-sol."

"Buffers may need to be larger than 25', or they may be smaller, but they must be large enough to prevent measurable drift. Windbreaks, made of hedgerows or tall crops such as corn, will reduce the likelihood of drift."

There are various incentives for any grower to limit insecticide use. These include cost, time, managing insecticide resistance, management decisions (harvest intervals, cross-contamination – in the case of split operations) and with some insecticides, applicator safety is also a factor. A good understanding of insect pest biology, host preferences and life cycles is a critical step in developing plans to manage insect pests with as little insecticide input as possible. Here, we will use several insect pests as examples of how this information may be helpful. We will also discuss efficacy of permissible insecticides.

Flea Beetles

Striped and crucifer flea beetles

Plants contain chemical defenses (toxins) to deter feeding. This is why all herbivorous insects do not feed on all plants. However, many insects have developed the ability to feed on certain plant groups. That is, they can metabolize or detoxify the defensive compounds in the plant host. Striped and crucifer flea beetles are attracted to the glucosinolate compounds found in brassica crops. These "peppery" flavored compounds (think of arugula or mustard greens) deter feeding from many insects, but the above flea beetles prefer them, with decreasing favorability toward the milder hosts, like cabbage. There are also wild hosts, such as wild radish, rocket, etc. Flea beetle populations tend to build up where hosts, wild and cultivated, are present for extended periods. Flea beetles, having limited ability to fly and a larval stage that is soil-dwelling, are not likely to move in great numbers over even short distances. Therefore, it is extremely helpful to rotate host crops as far as possible from previous sites. Also, identify wild hosts (signs of feeding on leaves are easily seen), and attempt to eliminate them from areas where host crops will be grown. Once a host crop is no longer useful, it is critical that all residue be incorporated into the soil to eliminate it as a food source. All of these measures will help prevent the buildup of flea beetle populations in the area.

Tobacco, eggplant and potato flea beetles

These pests feed on solanaceous crops (potato, tomato, eggplant, etc.) with a distinct preference for plants with higher concentrations of alkaloid compounds in their foliar tissue. Of all cultivated vegetable hosts, eggplant is the most at risk from flea beetle feeding. Horsenettle is highly favored among weed hosts. Here again, rotation and elimination of weed hosts and over-mature crops is critical to limiting population buildup. Trap cropping with a favored host can limit feeding on a crop temporarily. However, unless an effective insecticide is utilized with the trap crop, it can serve as a means to increase flea beetle populations locally.

A number of effective insecticides are available in conventional production, (see the 2017 Commercial Vegetable Production Recommendations). Organic operators seeking immediate relief from flea beetles are limited to Entrust (spinosad) or OMRI approved products containing pyrethrin.

Striped cucumber beetle

This beetle feeds on cucurbit hosts, having evolved to utilize the bitter compound, cucurbitacin found in their tissues. Striped cucumber beetle will feed on any growth stage of a host, but is particularly damaging to seedlings. Feeding on cotyledons (seed leaves) can be extensive, resulting in 1) major stress to developing plant, and 2) the transmission of bacterial wilt to susceptible hosts (watermelons are not hosts for this disease, and several cucumber cultivars are available with good resistance). As with flea beetles, the larval stage occurs in the soil, but striped cucumber beetle adults are more mobile than flea beetles.

Large populations can build up with inadequate rotation. Volunteer plants from a previous crop also serve as hosts. This is common in fields having had a previous crop of pumpkins, as seeds from fruit that were disked under begin to germinate the following year. Good rotations with distance and management of volunteers are essential to limiting large populations. Row covers can help limit feeding and disease transmission on small plants, however the covers must be off by the time the plants flower, as bee access to flowers is necessary for pollination. Fortunately, bacterial wilt development is less likely on vines that have begun to run, as there is generally too much plant mass for the bacteria to overcome. Feeding on large, vigorous plants is acceptable until fruit enlargement occurs. At this time, beetles may feed on the rinds of developing cucumbers, melons and pumpkins, causing superficial, but unacceptable injury.

While broad spectrum insecticides such as synthetic pyrethroids are effective at killing beetles, and systemic neonicotinoid insecticides used at planting will virtually eliminate seedling injury and wilt transmission, these materials are not permissible in organic systems. OMRI approved materials are largely ineffective on cucumber beetle. Therefore, it is critical to limit population buildup, through rotation and sanitation. Row covers are useful for protecting seedlings, but must be removed prior to bloom.

Aphids

Melon, green peach, potato, and cabbage aphids are principles among those that may attack vegetable crops in New Jersey. The degree to which they are an economic problem for these crops varies by aphid species, crop, crop maturity, environmental factors (including status of predators and parasites) and human intervention. Chemical control is difficult in organic systems because OMRI approved insecticides are not very effective. While there are a number of effective materials for conventional growers, organic growers, or those with split operations must look for other management options. Aphids have many natural enemies, such as syrphid (flower fly) larvae, ladybird beetles, lacewing larvae and parasitic wasps. The adult stages of these predators/parasites need flowering plants as alternative sources of nutrition (pollen and/or nectar). The presence of companion plantings consisting of plants with easily accessed pollen and nectar will enhance the viability of native bio-control of aphids and other pests. For more information, see: http://articles.extension.org/pages/18573/farmscaping:-making-use-of-natures-pest-management-services

Aphids (green peach, potato) often infest tomato and pepper plants. These infestations may be tolerated while the plants are in the vegetative state. Once fruit enlargement occurs, should aphid colonies still be active, economic injury may be realized as sticky droppings are deposited on the fruit. In practice, growers often allow aphid populations to be managed by natural enemies prior to fruit enlargement. Native bio-control is assisted through habitat modification and avoidance of broad-spectrum insecticides. Should populations persist into or appear during fruit enlargement and maturity, conventional growers have several good options for management. Organic growers are faced with less effective tools. All growers should attempt to manage aphid populations first through habitat modification and avoidance of broad-spectrum insecticides.

Caterpillar pests of brassica crops

Imported cabbageworm (ICW), cross-striped cabbageworm (CSCW), cabbage looper (CL) and diamondback moth (DBM) larvae are all pests of our brassica crops. Of all, ICW are probably the most damaging, as they are the most common, and prefer to feed on the youngest plant tissue. DBM can be problematic due to its' resistance to pyrethrin and pyrethroid-based insecticides, and its' quick generation time. CL and CSCW are somewhat less common, but capable of damage on these crops. Native biocontrol organisms exist here, but rarely provide noticeable control in our fields. Fortunately, there are effective insecticides available to both organic and conventional growers. All of the above caterpillar pests are controlled by spinosyn-based insecticides. The OMRI approved material Entrust (spinosad), as well as Radiant (spinetoram) and other non-OMRI materials all work well. Additionally, insecticides utilizing *Bacillus thuringiensis* (*B.t.*) are capable of providing adequate control provided they are used when small larvae are detected. A specific *B.t.* formulation (Xentari) is reasonably effective against DBM. *B.t.* formulations are OMRI approved for organic production. Pyrethrin-based products, like Pyganic, are OMRI approved and will provide reasonable control of ICW, but should be used with caution, as they will kill beneficial insects (including bees) by direct spray contact. Conventional growers have more options for control, but should avoid broad spectrum insecticides as much as possible.

Crop rotation is always valuable for disease and flea beetle management, but offers little help in managing caterpillar pests. However, sanitation is critical, particularly when DBM is present. Over-mature fields should be destroyed promptly, with residue incorporated into the soil. This prevents DBM and other pests from using these plantings as a nursery on which to build up populations.

ORGANIC PRODUCE CONSUMERS IN THE MID-ATLANTIC: A 2016 SURVEY

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PROCEEDINGS

Organic is a labeling term that refers to agricultural products produced in accordance with the Organic Foods Production Act of 1990 (OFPA) and the National Organic Program (NOP) Regulations. The principle guidelines for organic production are to use materials and practices that enhance the ecological balance of natural systems and those that integrate the parts of the farming system into an ecological whole. Organic agriculture practices could not ensure that the products are completely free of residues; however, methods are used to minimize air, soil and water pollution. The final guidance on labeling pesticide products under the National Organic Program (January 31, 2003) describes how registrants can obtain U.S. Environmental Protection Agency's (EPA) approval of the labeling language. Approved label language for all pesticide ingredients (active and inert) and all uses of that pesticide must meet the criteria as defined in the United States Department of Agriculture's (USDA) National Organic Program (NOP) Rule (2015).

Organic agriculture continues to be one of the fastest growing sectors in the U.S. The organic produce market has grown rapidly since the late 1980s when the media publicized the dangers of pesticide residues. At present, it represents 4.2% of all food sales in the U.S. A new research study in organic farming helps to address inadequacies in the current knowledge of the organic market, but also provides innovative new options for struggling small farmers. Against this background, this study aims to document a profile of the typical organic consumer in the mid-Atlantic region of United States, with a focus on boosting small organic farm profitability. The market development in this area could enhance both the net profits and the sustainability of small farms choosing to service the organic niche market.

The overall goal of this project is to establish and develop a successful partnership to foster the organic farm produce marketing industry in the Mid- Atlantic regions of United States, with a focus on boosting small farm profitability. General objectives of the project include:

1. Document characteristics of patrons of organic farm activities such as purchase behavior, number of visitations, frequency of purchase, travel distance, desired store characteristics, and other related factors.
2. Estimate the market size of organically produced farm commodities based on the visitation frequencies and spending characteristics.
3. Develop forecasting models to predict the willingness to pay, patronage rates, spending behavior, and other related characteristics.

Form a coalition and communicate the results to the stakeholders of the industry. Since a majority of the investigators have an extension appointment, project outreach will be a priority.

The consumer survey conducted in 2016 indicate that, 41% of the respondents were from the state of New York, 27% from Pennsylvania, 18% from New Jersey, 12% from Maryland, and only 2% resident from the state of Delaware. About 76% of the respondents were female and the remaining 24% were male. About 40% of the respondents obtained a 4 year college degree, while 23% attended up to a graduate degree. Among the total responses, 82.6% were white, 6 % were Asian, 5.5 % were African American, 4.8% Hispanic or Latino and 1.1% of them were others. About 32% of respondents earned an annual income ranging from above $100,000. Similarly, 31 % earned an income between $60,000 - $99, 999, 17% earned between $40,000 – $59,999, 14% earned between $20,000 - $39,999 and 6% earned less than 20,000 per year.

In terms of serious hazards, 75 % of respondents feel that a serious hazard exists with foodborne-illness. About 68% of respondents stated that serious hazard exists with residues from pesticides or herbicides. By the same token, only about 45% of respondents feel that a serious hazard exists with genetically modified crops. While 76% of respondents preferred organically grown produce over conventionally grown. On average, about 38% of the respondents have visited supermarkets 4 to 6 times per month. Almost 46% of the respondents shopped for agricultural produce 1 to 3 times a month in a small/local grocery store. Only 36% of the respondents visited a direct market at a farm between 1 to 3 times per month. Similarly, 49% of the respondents visited community farmers markets 1 to 3 times per month. It was also observed that 84% of the respondents never purchased agricultural produce via online shopping, through community supported agriculture (63%), Pick-Your-Own (60%) and other direct market outlets (51%) respectively.

Over 90% of respondents stated that freshness is very important. Absence of pesticide residues, ripeness, and price were indicated as equally important. On the other hand, 83% of the respondents stated that they provide support for local farmers and agriculture. They also believed that organic produce does not contain GMO's. Almost 68% of the respondents stated that they would buy the same quantity of organic produce even though it is sold at a premium price. Nearly, 43% of the respondents stated that they would pay at least an additional 10 cents per dollar more for organic produce. Slightly less than 68% of respondents stated that organically grown produce is of better quality compared to conventionally grown produce in supermarkets and other retail facilities. On average, 51% of the respondents consider organic produce as fresher when compared to conventional produce. About 50% of respondents feel that organically grown produce has less variety than conventionally grown produce in supermarkets and other retail facilities. Overall 91% of respondents felt that organic produce has higher prices than conventional produce. About 45% of the respondents felt that conventionally produced fruits and vegetables are generally safe to consume. Overall 78% of respondents feel that the use of synthetic chemicals in agriculture has a negative effect on the environment. Also 74% feel that they would buy organic produce if it were more readily available. Almost 82% stated that they would buy organic produce if it were cheaper.

Nearly, 86% of the respondents reported that, they make 3.9 visits per month to purchase organic fruits and vegetables, whereas 14% of the respondents make 15.9 visits per year. On average, they spend $26.88 each visit for organic fruits and vegetables. Typically they visited on average 4 different organic farms/ markets/ stores to buy organic fruits and vegetables in the past year. On average, they travelled (one way) 9.7 miles to reach organic farms/ markets / stores. Apples (27%) are the most popular organic product that respondents reported purchasing among fruits and vegetables. Organic tomatoes (10%), organic strawberries (8.5%), bananas (8%), grapes (2%), and oranges (2%) were most often purchased by respondents. In the case of organic vegetables, they reported that organic lettuce (9%), carrot (7%), spinach (3%), broccoli (3%), greens, herbs & salad (2%), potatoes (2%), kale (2%) and rest of the other fruits and vegetables (14.5%) were most often purchased by the respondents.

In terms of processed foods, about 46% of the respondents were interested in purchasing organic sliced fruits and vegetables, 39% were interested in organic juice/sauces and organic dried/chips fruit and vegetables, 38% were interested in organic jam/jelly/marmalade. And 22% were interested in organic chutney/pickles and 21% in organic wine. While buying organic produce, on average, 60% of respondents feel that organic food is too expensive to consume. Over 49% feel that there are limited varieties/produce available to purchase. Almost 31% of respondents feel that, there is an inconsistent supply of organic produce and19% of the respondents agree that organic food is not available.

In summary, organic producers and intermediaries can target, females, middle age group consumers (on average 48 years old), white races compared to others, annual income of $100,000 – 249,999 earning households, those who prefer certified organic followed by locally grown, natural, pesticide free, country-of-origin, eco-friendly produce, those who shop very often from community farmers markets and small/local grocery stores to sell their organic produce. Also organic apples are the most popular organic product among the fruits and vegetables followed by organic tomatoes, strawberry, banana, grapes' and orange. In the case of organic vegetables, lettuce, carrots, broccoli, greens, herbs and salad; spinach, potatoes and kale are preferred vegetables among the respondents. The processed organic products like organic sliced fruits and vegetables, juice/sauces, dried/chips fruit and vegetables, jam/jelly/marmalade, organic wine are in significant demand among the organic consumers.

WHAT TO EXPECT DURING AN ORGANIC FARM INSPECTION

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Organic certification has become an increasingly popular tool for farmers to differentiate and add value to the crops and livestock they raise. The USDA reported a total of 21,781 certified organic production and handling operations in 2015, representing a nearly twelve percent increase from the previous year. We can expect that consumer demand for certified organic products will continue to grow across the spectrum of marketing channels from direct sale to the largest chain stores. Many current and new entry farmers are asking whether organic certification can strengthen their bottom lines and they will benefit from a fuller understanding of the process, including the on-farm inspection.

A significant amount of work precedes the on-farm organic inspection itself, beginning with the farmer selecting which USDA-accredited certifying agent to work with. The farmer then prepares an Organic System Plan (OSP) which describes all activities and practices pertinent to their organic production system including the specific materials they intend to use. The certifying agent reviews the OSP for accuracy and completeness, a process which typically requires additional input from the farmer. When the certifying agent determines that the amended OSP satisfies all applicable organic standards, they will assign an inspector to provide on-the-ground verification of compliance. The inspector receives all of the OSP paperwork including field maps, production history and material lists and is responsible for contacting the farmer to schedule the inspection on a mutually agreeable date.

Having conducted more than three hundred and fifty organic inspections, I find that farmers are typically apprehensive when meeting with their inspector. No matter how much they have educated themselves about certification, there can be lingering concerns that something they don’t know or haven’t adequately considered could adversely affect them. Farmers preparing for inspection should take confidence in knowing that the inspector’s role is narrowly defined in the organic regulations. Essentially, the inspector serves as the certifying agent’s eyes and ears for the purpose of verifying that the conditions spelled out in the OSP are consistent with the practices being implemented on the farm. Farmers who work upfront to produce a clear and comprehensive OSP will be far less prone to unpleasant surprises during the inspection.

An organic inspection contains three core elements – OSP and recordkeeping review, a physical inspection of all organic production, handling and storage areas and the exit interview. Naturally, the exit interview concludes the process, while the inspector generally decides how to sequence the other two activities. My preference is to conduct most if not all of the physical inspection first. Seeing the operation firsthand helps me piece together the paperwork I've been reviewing. Walking the farm first also helps put farmers at ease, since they tend to be more comfortable when talking about soil types and livestock health than their recordkeeping practices. Farmers should understand that the inspector is authorized to request access to any and all parts of the operation that could affect the integrity of organic production, including storage buildings and livestock medicine cabinets. The inspector may request permission to collect a product sample for subsequent testing, though this occurs infrequently.

The recordkeeping review is perhaps the most important element of the inspection because it reflects year round activity on the farm and not just conditions on a single day. An aversion to extensive recordkeeping is one of the most commonly cited obstacles to pursuing organic certification, yet most farmers I have inspected would agree that the benefits of the requirement outweigh the added costs. Certifying agents have a done a good job of limiting their recordkeeping demands to information that is genuinely important. More than one farmer has reported learning something significant about their operation from organic recordkeeping which they might not have otherwise. There are both paper and electronic recordkeeping systems which can facilitate compliant recordkeeping for almost any farmer. It is vital that every inspection accurately record the farm's productive capacity since this provides the most basic safeguard against non-organic product entering the market as certified.

Even for an initial inspection, reviewing the OSP and making necessary updates is an important part of the process. For example, a farmer may have modified their planting intentions in response to changes in field conditions or seed availability, and their OSP should be revised accordingly. A good inspector will scrutinize the OSP with the farmer to ensure that the information it contains is both accurate ***and*** current. The recordkeeping review will also document material usage on the farm. It is always advisable for farmers to seek approval from their certifying agent for using a product ***before*** they do so. Too many farmers have waited until inspection to disclose their use of a material which is subsequently determined to be prohibited. This scenario almost always results in decertification of at least a portion of the affected field or fields.

The final element of the inspection – the exit interview – establishes a formal record of significant outcomes from the inspection. The inspector uses the exit interview to document specific findings from the inspection which raise compliance concerns. For example, the farmer may have failed to provide a necessary record or receipt, or conditions in the field or barn may be inconsistent with the specifications in the OSP. The inspector must disclose all such issues at the time of inspection to allow the farmer an opportunity to respond and may not cite additional concerns after leaving the farm. The inspector will submit the exit interview along with their overall findings and any additional documentation collected at inspection to the certifying agent for further review. In my experience, when both the inspector and farmer are well prepared, a quality inspection for a family-sized commercial farm should take no longer than three to four hours, perhaps longer for a larger crop and livestock operation.

Farmers should be aware of the specific legal restrictions which govern the inspector's actions. For one, an inspector is required to limit their inquiries to issues which are directly related to assessing organic compliance. Inspectors will rightly ask about yields, but questions about prices and other financial or personal information are inappropriate. The inspector is expressly prohibited from providing any advice or guidance for achieving compliance, even for free, whether or not the farmer requests such information. Farmers should also appreciate that inspectors are responsible solely for gathering information and that separate certifying agent staff will decide whether or not to grant certification. A professional inspector arrives fully conversant with the OSP, moves the process forward without rushing the farmer and keeps their opinions to themselves.

SWEET CORN

Sustainable Soil Fertility Management for Sweet Corn

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Maintaining a proper balance between nutrient inputs and outputs is a fundamental principle of sustainable agriculture. To achieve balance growers need information on crop yield levels, nutrient uptake values, soil test results, and history of nutrient applications.

For sweet corn, we now have a good data set to show how much NPK and micronutrients are removed with every harvest of sweet corn ears (Table will be provided as a handout or on request by email: heckman@aesop.rutgers.edu).

Depending on whether sweet corn is grown for direct marketing, wholesale, or processing, growers may use different units to express yield. Thus, the nutrient removal values can be expressed both in units of ear number or weight. Also, the data set takes into consideration differences in nutrient uptake values for early, midseason, and late season sweet corn types.

A crate typically consists of 50 ears as a market unit. Whether expressed as per 1000 ears, hundredweight (100 lbs = 1 cwt), or crate (50 ears), nutrient management planners can scale nutrient removal values up to a yield goal per unit land area by multiplication.

As an example, nutrient removal data obtained in this study will assume a typical full season variety of sweet corn. And assume the yield level = 150 cwt/acre (or about 18,396 ears/acre or about 368 crates). (This example assumes weight of a typical fresh sweet corn ear of market size with green husk included = 0.815 pounds) This full-season variety of harvested fresh ears would be projected to remove in pounds per acre: N, 51, P, 9.1 (P_2O_5, 20.8), K, 34 (K_2O, 40.8), S, 3.7; Ca, 2.0; Mg, 3.9; B, 0.024; Cu, 0.014; Fe, 0.09; Mn, 0.044; and Zn, 0.072. Nutrient removal values are less for short season sweet corn varieties.

This presentation will also provide an update on where cover cropping, soil testing, and corn stalk testing for nitrogen may be useful in sweet corn production. New research on use of Sunn Hemp, a soil fertility building cover crop that can grow 140 pounds N per acre will be discussed. A research summary on Sunn Hemp is available in The Soil Profile newsletter at this link: https://njaes.rutgers.edu/pubs/soilprofile/sp-v23.pdf

Sweet Corn Industry Innovations

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This presentation will highlight a variety of innovations, research results, and industry news that are of interest to anyone who grows or markets sweet corn during the summer growing season in New Jersey.

Bird Damage

Birds have been a perpetual problem when growing sweet corn for many years. As global warming continues, we are seeing changes in bird concentrations and populations as their adaptable ranges change and expand to new areas. This is particularly trure with migratory birds such as geese and swans but also applies to common farm species as urbanization reduces the bird's normal habitats. The good news is that there are some newer control strategies including repellants such as methyl antralinate (grape extract) which are environmentally safe as well as effective. Because urbanization has brought more housing into formerly rural farm areas, the usage of traditional scare devices are being challenged more often and are becoming more difficult to use. This part of the presentation will highlight the latest in bird control strategies including how and where to apply for permits to use noise making devices as well as provide some simple strategies to avoid some of the farm urban conflicts.

Variety Susceptibility to Birds

Observations I have made from my research trials in sweet corn during the last 40 years has made me keenly aware that birds have definite preferences to certain varieties of sweet corn. There are many mitigating factors that cause this such as hybrid tip fill of ears, presence or absence of corn ear worm and armyworms, and the abundance of sap beetles in the silks of over mature corn ears. In addition to these situations, I have found over the years that there may be genetic taste differences that attract or repel birds form corn silks.

New use Products

Very recently some premium pet product companies have developed new products used to make pet litter products. This may become a new alternate use product for sweet corn crops. There are now products that make sweet corn into environmentally appealing pet litter products. A sweet corn grower in New York has developed sweet corn tortilla chips called "Off the Cob". The product appeared on the popular TV show Shark Tank but was not funded. However this setback has not extinguished the enthusiasm of the grower who now sells the chips in 300 stores and has more than 4,000 customers. Some other innovative marketing techniques for selling sweet corn cater to non-traditional customers of sweet corn. There is a large ethnic following for roasted sweet corn ears. The flavor is superb and in recnet years this is how I make the majority of the sweet corn I eat. This value added marketing technique at farm stands, farm fairs and other events regularly results in sweet corn prices of between $100 to

$150 per crate or $2 to $3 per ear which is considerably more than either local retail or wholesale prices. How you ever heard of sweet corn ice cream? Yes it is real and I have personal tasted and made sweet corn ice cream which was incredible in taste and flavor. I can envision some recipe directions provided by farm stand that give specific instructions on how to make this delightful treat at the point of where they display their corn!

Results of Pesticide Residue Survey by AMS

Pesticides and pesticide residues are not far from many discussions about vegetable eating and consumer demand. The recent survey produced by the Agricultural Marketing Service of the USDA on pesticide residues show that sweet corn has one of the lowest number of samples with detectable residue, samples over the dissectible limits, and most samples with any residues at all. This fact may have possibilities in establishing sweet corn as an environmentally sensitive crop that will appeal to many consumers in the Northeast US.

Assorted other developments

This presentation will cover additional, new developments and issues that can benefit the sweet corn industry, provide additional marketing opportunities, and enhance the profitability of the overall industry. Many growers feel that in recent years that sweet corn sales have declined or stagnated at best as consumers do less cooking at home. Unfortunately, sweet corn is one vegetable that is not utilized to a large degree by restaurants and is often considered an item that is saved for special occasions when compared to other popular summer vegetables.

Seed Technology

New breeding technologies fostered by GMO techniques, are making disease resistance, herbicide resistance, and other beneficial traits possible that will enable growers to provide sweet corn with less inputs. Reality dictates that this will only progress significantly if consumers are willing to accept new breeding techniques which remains to be seen at this time. Newer varieties will contain new genetics such as Augmented, Super Sweet, and Synergistic which will greatly enhance eating quality and other traits.

TRENDS WITH SWEET CORN INSECT POPULATIONS

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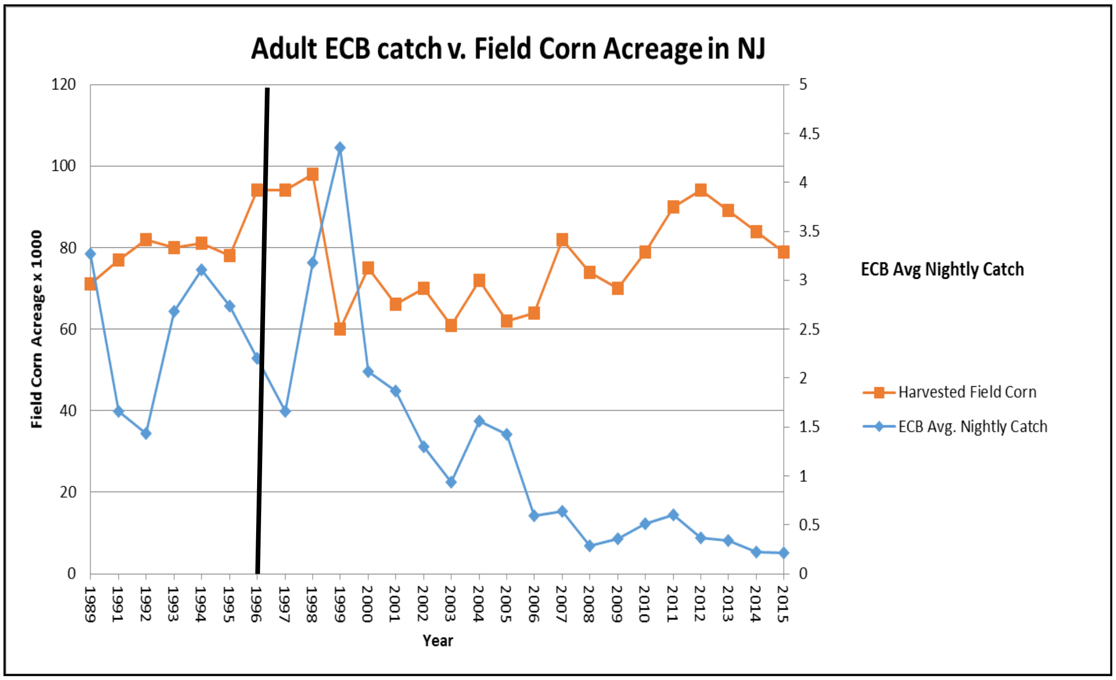
Synthetic pyrethroid insecticides (IRAC-3)* have been the primary class of insecticide used to manage caterpillar pests of sweet corn for 20+ years. Many of the insecticides in this class are still very effective, but some target pests have developed varying degrees of resistance to pyrethroids.

New classes of insecticides, with novel modes of action began to come on the market over 10 years ago. Among these newer materials are those based on spinosyn (IRAC-5). These include Entrust and Blackhawk (spinosad), and Radiant (spinetoram). A combination product containing spinosad (Consero IRAC 5+3) also is available. More recently, the diamide group (IRAC-28) has entered the market. For sweet corn, this includes Coragen (chlorantraniliprole), and the combination product Besiege (IRAC 28+3). The more recent materials are, with some variability, effective against the caterpillar pests of sweet corn. Additionally, they have reduced impact (spinosyn) or almost no impact (diamides) on beneficial insects.

The three main ear infesting caterpillar pests of sweet corn are the European corn borer (ECB), the fall armyworm (FAW) and the corn earworm (CEW). Of these, the corn earworm is the most significant. Since the advent of transgenic field corn (expressing toxins from *Bacillus thuringiensis* (*B.t.*)) in 1996, populations of all three have declined. This has been most dramatic in the ECB and CEW populations. While reduced populations of these pests has been beneficial to growers; resistance issues, both to commonly used insecticides and to types of transgenic sweet corn have complicated pest management. At present, resistance to insecticidal compounds is present in FAW and CEW, with the latter pest undergoing important changes as selection pressure increases. Insecticidal resistance is not a significant issue in ECB populations at this time. This paper incorporates insecticide efficacy trials from the Mid-Atlantic states, as well as insecticide resistance data and discussion of selection pressure on corn earworm populations in the Mid-Atlantic states by exposure to transgenic corn hybrids.

Primary caterpillar pests of sweet corn.
European corn borer (ECB):

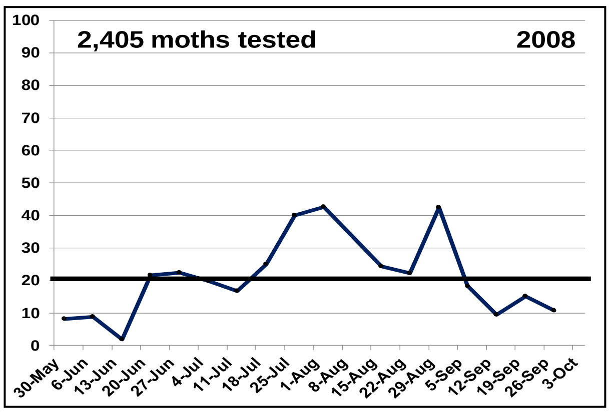
Populations trending steeply downward with increased adoption of *B.t.* transgenic field corn in ag areas where other host crops are grown. See graph (below) of ECB adult catches in NJ blacklights relative to field corn acreage. B.t. transgenic field corn entered market in 1996, with NJ adoption increasing from an average of 42% in 2006 to 78% in 2013.

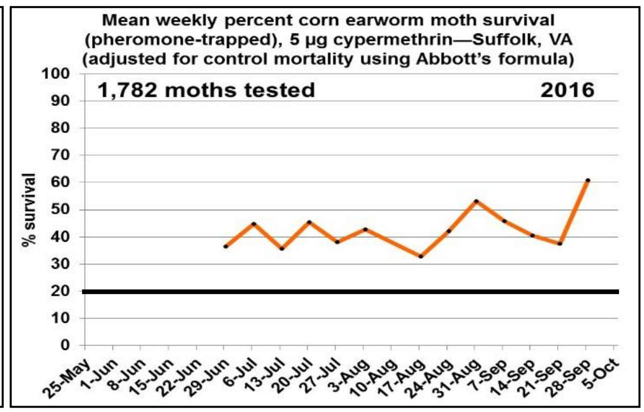


Goal: Manage ECB larval population ***in plants*** prior to ear infestation.
Resistance/Other Issues: Not significant. Pyrethroid, carbamate, spinosyn and diamide insecticides all work well. Control decisions in vegetative stages are based on scouting results (12% plants infested = action threshold). All transgenic hybrids control ECB effectively.

Fall Armyworm (FAW):
While populations of FAW are not nearly as high as they were two decades ago, this pest is still a significant threat to sweet corn. As a species not able to overwinter in NJ, FAW adults generally migrate here beginning in July with assistance from southerly winds or storm systems. FAW have a preference for whorl-stage sweet corn, but will feed on all stages including seedling. Heavy feeding can kill small plants and stunt larger ones.
Goal: Manage FAW larvae in plants to limit feeding injury. Protect ears to limit direct infestation from eggs/larvae deposited during silking.
Resistance/Other Issues: Control decisions in vegetative stages are based on scouting results (12% plants infested = action threshold). Management of ear infestations is typically achieved while controlling CEW with silk sprays, as there is generally overlapping presence of both pests. Significant resistance to synthetic pyrethroid (IRAC-3) insecticides exists in FAW populations. Additionally, FAW exhibit tolerance to Cry 1a toxin found in the initial *B.t.* transgenic (Attribute I) hybrids. Realistic control of FAW must include spinosyn (IRAC-5) or diamide (IRAC-28) insecticide classes. *B.t.* hybrids expressing Cry 1a + Cry 2a toxins (Performance Series) and those containing Cry 1a + Vip 3a toxins (Attribute II) effectively limit FAW injury.

Corn earworm (CEW):
Populations also trending downward, but subject to uncertainty due to occasional overwintering success and mid-late season migrations.
Goal – manage CEW larvae on silks between egg hatch and ear infestation.
Resistance/Other Issues: Control decisions (spray frequency) is determined by adult CEW moth catch in local traps. Documented but variable resistance to pyrethroid (IRAC-3) insecticides. Documented resistance developing to Cry 1a and Cry 2a toxins in *B.t.* hybrids.
Va. Tech entomologist **Ames Herbert** has conducted vial tests with live CEW moths captured in southeastern VA to determine the extent of their resistance to the pyrethroid cypermethrin. Vials contain 5 µg cypermethrin. % moths surviving have been plotted by week (when individuals were captured) since 2008. These graphs (below) show that resistance has increased over time.





The following data are summarized from a 2015 insecticide efficacy trial conducted by Univ. of Delaware entomologist, **Joanne Whalen**. The purpose of the trial was to evaluate a diamide/pyrethroid mix (Warrior) against a pyrethroid-only mix (Hero) alone, or rotated with different spinosyns (Blackhawk-spinosad and Radiant-spinetoram).

Treatment	Rate/A	App. Dates A-8/13, B-8/17, C-8/20, D-8/24, E-8/27	% clean ears	% CEW damaged ears
A,B,C-Besiege D,E-Lannate LV+Warrior II	10 fl. oz. 24 oz + 1.92 oz.	A,B,C D,E	89.00a	11.00d
A,B,C-Besiege D,E-Warrior II	10 oz 1.92 oz	A,B,C D,E	86.88a	13.13d
A,B-Hero EC B,C,D-Blackhawk 36WG	4.5 oz. 3.3 oz	A,B C,D,E	30.00c	69.38b
A,B-Hero EC C,D,E-Radiant SC	4.5 oz. 6 oz.	A,B C,D,E	52.50b	43.75c
A-E- Hero WC	4.5 oz.	A-E	41.88bc	56.88bc
Untreated			0.00d	100.00a

In the above study, the diamide-containing product (Besiege), in rotation with the pyrethroid Warrior or Warrior + the carbamate Lannate out performed both pyrethroid/spinosyn combinations.

The following data are summarized from 2014 insecticide efficacy trials conducted by Virginia Tech entomologists, **Tom Kuhar** and **Helene Doughty**. This study was primarily designed to look at labeled materials, and an as yet unnamed diamide insecticide (cyclaniliprole), with Warrrior II (lambda cyhalothrin), although a new pyrethroid (Fastac) and cylaniliprole were also included on their own. Here, the diamide/pyrethroid combination (Besiege) rotated with the pyrethroid (Warrior) provided the best control. In this trial, a total of 7 silk applications were made at 2-3 day intervals. A common thread in these trials is the very good control provided when diamide products are include in rotation with a pyrethroid material.

Treatment	Rate/acre	% total damaged ears	Mean # live CEW larvae/25 ears
Untreated		88 a	28 a
Blackhawk r/w Warrior II ZT	3.2 fl oz / 1.92 fl oz	42 cd	12.3 b
Besiege r/w Warrior II ZT	10 fl oz / 1.92 fl oz	4 f	0.3 d
Fastac	3.8 fl oz	45 bcd	5.3 cd
Cyclaniliprole 50 SL	22 fl oz	70 b	14.8 b
Cyclaniliprole 50 SL	16.4 fl oz	56 bc	8.5 bc
Coragen r/w Warrior II ZT	5 fl oz / 1.92 fl oz	21 de	1.8 d
Belt r/w Warrior II ZT	2 fl oz / 1.92 fl oz	55 bc	8.8 bc
Cyclaniliprole 50 SL r/w Warrior II ZT	16.4 fl oz / 1.92 fl oz	16 ef	1.5 d
P-value from ANOVA		<0.0001	<0.0001

Some growers have opted to use transgenic sweet corn varieties, especially for late season plantings when CEW pressure is highest. These hybrids express genes from the soil dwelling bacterium *Bacillus thuringiensis* (*B.t.*), which are toxic to caterpillars. Initial *B.t.* sweet corn varieties (Cry 1Ab) for fresh market remain extremely effective against ECB larvae, but are less effective on FAW, and have become much less effective in the control of CEW. Newer varieties, with Cry1A.105 and Cry2Ab (Performance Series – Seminis), are now available for fresh market, as well as hybrids with Cry1Ab+Vip3A (Attribute II – Syngenta).

Dr. Galen Dively, of University of Maryland, reports increasing evidence of CEW resistance to the Cry1A.105+CryAb2 (Performance Series) events, with 67% CEW damaged ears on average in 2016. While these varieties appear to maintain very good FAW control, the incidence of CEW infestations on sweet corn in Maryland is increasing, and New Jersey had one reported failure in 2016. Individuals that develop resistance to these toxins suffer some loss of vitality and ability to successfully reproduce. This makes areas where CEW overwinters (ie. southern Md.) more prone to the development and maintenance of resistant populations. In NJ, where most CEW individuals are migratory, resistance to transgenic sweet corn has been less dramatic. Despite this, CEW infestations in transgenic sweet corn in NJ have been increasing, indicating that migratory populations have higher numbers of resistant individuals. Growers in NJ are advised to treat silking sweet corn as they would non-transgenic corn for the first two silk applications. After this, growers may opt to treat on a 5-day schedule when local blacklight traps indicate a 3-day silk spray schedule on non-transgenic corn. At this time, hybrids containing Cry1Ab and Vip3A toxins (Attribute II) are providing excellent control of ECB, FAW and CEW.

Note. Thanks to Galen Dively, Ames Hebert, Tom Kuhar, Helene Doughty, Joanne Whalen and Bill Cissel for sharing data and information contained in this article. – KH

*IRAC – Insecticide Resistance Action Committee

FARM BREWERY OPPORTUNITIES AND REGULATIONS

STATUS OF THE CRAFT BREWING INDUSTRY IN NJ

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1-WHAT IS A CRAFT BREWER

Craft Brewer definition as defined by the Brewer's Association:

1) Small – Annual production less than 6,000,000 barrels of beer or less (1 barrel = 31 gallons)

2) Independent – Less than 25 percent of the craft brewery is owned or controlled (or equivalent economic interest) by an alcohol industry member that is not itself a craft brewer.

3) Traditional – The majority of the total beverage alcohol volume in beers whose flavor derives from traditional or innovative brewing ingredients and their fermentation. Flavored malt beverages are not considered beers.

NJ CRAFT BEER BY THE NUMBERS

New Jersey currently ranks 45th in breweries per capita according to the Brewer's Association, averaging .4 gallons per 21+ adult which puts NJ ranked at 49. Total beer produced us 79,942 barrels of beer or 19,825,616 pints of beer (35th rank) with an economic impact of $1,236,000,000. Although the current boom in craft beer in NJ has been magnified due to the short time frame it has occurred, there is still plenty of room for growth. Many areas of NJ are actually seeing small hot spots of craft breweries opening up leading to an influx of tourism to these beer destinations. Hackettstown has 3 craft breweries – Jersey Girl Brewing, Man Skirt Brewing, and Czigmeister Brewing – and together with the local business development association has been putting Hackettstown on the craft beer map. Other similar locations are occurring in Medford, Mt. Holly, Collingswood, and more.

The majority of craft breweries are selling the bulk of their product right out of their own tasting or sampling rooms on premise. With a main focus on direct-to-consumer sales the industry has seen a means to make the highest margins, invest and reinvest in the growth of their business, and rely solely on their own performance rather than 3rd part retailers or wholesalers. This coupled with the ability for a craft brewery in NJ to self-distribute to off premise accounts leaves an immense amount of control in the brewery's own success.

CHANGES IN LAWS CREATE A BOOM

Prior to 2012 it was not this easy. The laws changed in 2012 to allow limited license holders to sell to any consumer onsite up to 15.5 gallons of beer. This now allowed breweries to sell pints, flights, samples, growlers, and kegs directly to consumers. Prior to 2012 the limit was 2 six packs could be sold to a consumer, limited samples could only be free, and no on-site consumption other than those limited free samples could take place. The tasting room was not a great revenue generator for the brewery.

Older breweries have or are currently working on updating and expanding their tasting rooms while new brewers that have opened after the law change have opened with large portions of their brewery footprint devoted to a fully operational tasting room.

POSITIVE CHANGES IN LAWS LEAD TO STRUGGLES FOR FUTURE GROWTH

Changes in laws have helped NJ start to become a speck on the US's craft beer map, however it is starting to see growing pains due to nuances of the law that were necessary to get the support for its passage in 2012. The law does not allow a brewery to sell food in anyway (operate a kitchen) on premise. The law requires that prior to any onsite consumption that the consumer must take a tour – even if they have been there before. Both of these details are beginning to become burdensome on the growth of small craft brewers.

NEW LAWS ON THE HORIZON

There are several pieces of legislation currently working their way through Trenton to help in the growth of the industry in NJ. The bills include:

S-2910/A-4389 – Permits certain breweries to sell beer at community farm markets
S-2911/A-4390 – Allows consumption of food on limited brewery premises
S-2912/A-4391 – Authorizes restricted breweries (brewpubs) to annually sell up to 1,000 barrels of beer to in-State and out-of-State retailers (limited self-distribution)

NJ FARMERS AND BREWERS A PERFECT FIT

Brewers and Farmers are a perfect match together for several reasons

1. Spent Grain
    a. In 2016 craft brewers in NJ gave approximately 4,500,000 pounds of spent grain to farmers (Garden State Craft Brewers Guild)
2. Adjunct Ingredients (ingredients other than the 4 core ingredients of a beer)
    a. Brewers are utilizing more and more local ingredients to make unique beers such as honey (Flounder Brewing & Sam Adams collaboration) and even beets (Cape May Brewing).
3. Core ingredients
    a. Brewers are now beginning to use malted barley and rye from NJ farms that are being malted in NJ or PA in beers
    b. Hop farms are springing up all over NJ and brewers are utilizing local hops in some "harvest" style beers

With ingredients the fresher the better for most brewing. Locally sourced ingredients help create flavorful and fresh beers that are unique to the region and season similarly to local restaurants.

CONSIDERATIONS FOR FARMERS IN WANTING TO WORK WITH BREWERS

Hops:

Many farmers are looking into growing hops for the craft beer industry. Many hop farms have popped up in NJ and many are in planning. Overall for certain varieties NJ has good conditions for hop growing. However the growth of hop product in NJ isn't still where it needs to be to be a sustainable supply for a brewer. Many hop farmers are not investing or have yet to invest in the equipment necessary to fully process and package hops. Currently the bulk of the NJ hop business is focused in September during the hop harvest time where brewers and hop farmers work together in harvesting wet hops that are used in a wet hop harvest style beer that typically comes out in October. Some hop farmers are drying the whole leaf hops and this allows a brewer to brew some other styles of beers as well using these dried whole leaf hops that have a longer shelf life than wet hops. However, most craft brewers in most of their production utilize hop pellets. These are hops that have been dried then milled and pressed through a die to make the hop matter into a pellet shape. They are then packaged in vacuum sealed bags, typically with nitrogen first injected into the package to eliminate all oxygen (oxygenation is terrible for a brewers hops). These hops give the brewer longer shelf life and brewers often are buying pellets from the prior year's harvest a year later. Also a complete analysis of the hops are provided including crucial alpha and beta acid levels – all necessary in a brewer being able to create their recipes.

Malted Barley:

Malted barley has been coming around NJ brewers as well now with several farms providing barley and rye to local maltsters (or in some cases investing in their own malting machinery). The cost is considerably higher than the large malt houses most brewers purchase from, but there is demand for local products made with local ingredients and there is room in a brewery portfolio for specialty beers made with more expensive, local ingredients that support local farmers.

Jersey Fresh:

The Jersey Fresh program is a strong program in NJ. This program helps showcase and market local, fresh NJ agricultural products. As farmers in NJ begin to work more into the production of hops a huge benefit would be to get hops under the Jersey Fresh program. As brewers look for ways to utilize local hops, and pay the higher cost for the smaller batch, locally sourced hops, and the Jersey Fresh mark helps the brewer easily educate the consumer on what the beer itself contains, local Jersey Fresh hops. Two breweries in NJ have worked with local farms that participate in the Jersey Fresh program with certain ingredients and it would be great if this could become the norm for hops produced in NJ. Flounder Brewing brewed a collaboration beer with Sam Adams utilizing Jersey Fresh cranberry honey from Fruitwood Orchards and the Jersey Fresh program was promoted nationally by Sam Adams bringing awareness to not only the NJ craft beer industry but also the NJ agricultural community. The other brewery is Cape May Brewing who has two beers made with Jersey Fresh ingredients. This helps both industries to cross promote.

OVERVIEW OF ALCOHOL BEVERAGE CONTROL LICENSING

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Discussion on this topic pertains to the process and permit types for the NJ Alcohol Beverage Control Board according to Title 33 Statutes. There are also Federal Statutes regulated by the Alcohol and Tobacco Tax Trade Bureau (TTB) whose requirements for licensure and reporting are much more easily laid out on the website, ttb.gov. When deciding to plan a business in a highly regulated industry it is highly advisable to seek the assistance of a licensed lawyer practicing in the intoxicating liquor law field. No information in this presentation should be deemed as legal advice and is purely information provided via various sources and personal experience in opening a brewery and working for several years on the Board of Directors for the Garden State Craft Brewer's Guild, and also assisting many start-up breweries with questions.

LICENSE TYPES (key details)

- Plenary Brewery License
  - Produce more than 300,000 barrels of beer
  - Sell to wholesalers (NO self-distribution)
- Limited Brewery License
  - Produce not more than 300,000 barrels of beer
  - Sell to wholesalers AND retailers (self-distribution)
  - Sell beer for on-site consumption as part of a tour, can also offer samples for free
  - Sell up to 15.5 gallons of beer (a half barrel keg) for off-site consumption
- Restricted Brewery License
  - Produce not more than 10,000 barrels of beer
  - Must have a Plenary Retail Consumption License ("liquor license")
  - Can only sell on-premise, to wholesales, and festivals (NO self-distribution)

Except restricted license holders no licensee can operate a kitchen or sell food in anyway. Only light snacks such as crackers and cheese can be made available, for free, to consumers.

There is possible future legislation for the introduction of new licenses including a possible farm brewery license.

APPLICATION PROCESS

To apply for a brewery license the ABC has a website entitled POSSE for all license applications and permits. The start of the licensing process begins here. There are several "rounds" to the licensing process. In the first round (initial application) you will need to provide the following as well as some other things but for time cannot all be covered here.

- Application and License Fee
- Beverage Tax Bond (surety bond to cover potential tax burdens)
- Affidavit of Qualification (each owner confirming their qualification to be an owner on a brewery license)
- Federal basic permit (also known as a brewer's notice issued by the Alcohol and Tobacco Tax Trade Bureau – TTB)
- Public Notice (notarized proof of a public notice ran twice in a newspaper stating the applicants and their intention on requesting a license)
- Statement of Business Intention (an affidavit stating the nature of the business)
- Additional documents as noted throughout the lengthy application – some questions on the application will ask for documents to be attached I.e. your lease if you are renting

After the initial submission several months (6+ possibly) may pass and you will receive a notice from the ABC requesting more information. This will bring you into round 2. Typically round 2 deals a lot with the financial aspects of funding the new business. Often large amounts of bank statements showing the trail of the funding all the way to its origin will need to be provided. The ABC is looking for (among other things) any connections to organized crime, or other criminal activities, or anyone that is possibly linked to other liquor licenses where the person cannot be associated with the different licenses all at the same time (i.e. a wholesaler cannot also be on a limited brewery license). This round will also have any additional questions or request for documentation that may have come about from the review of your initial material.

The third round if round 1 and round 2 all went smoothly and all info provided was sufficient for the ABC's evaluation is the inspection. The ABC will schedule a site inspection where they will evaluate your premises, its security, ability to asses tax, etc. The ABC will also want to see what your tour plan will be prior to a consumer consuming alcohol.

It cannot be stressed enough this is just a brief synopsis based on our experience in opening our brewery. You are strongly urged to talk to an attorney who is experienced in NJ Intoxicating Liquor Law and also speak with the ABC in advance. The ABC is more than happy to talk to people about their plans to help them avoid timely and costly pitfalls.

This entire process (if each round is completed without issue) would take not less than 6 months but very easily 9-12 months or longer. It is expected that by the time you are applying you can provide details of your brewery layout, a copy of a lease if you are renting the space, etc. There is a lot of upfront cost on the applicant in order to be able to file for a license.

ADDITIONAL RESOURCES

Visit the Garden State Craft Brewer's Guild website, even as in very early planning stages you can join the Guild and gain immediate connections with brewers throughout NJ. The Guild also can provide a valuable document known as Tasting Room Best Practices. This document helps highlight and explain some expectations the ABC has in regards to the operation of a tasting room associated with a limited brewery. The Guild also has several law firms that are trade members who have experience in laws effecting breweries.

ALTERNATIVE CROPS

EXPANDING YOUR MARKET WITH CUT FLOWERS

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Today's consumers typically want to be *involved* in what they purchase. Often, they are not only looking for a product, but also an experience that is connected to the product. The perfect example of this is a typical farm market customer in New Jersey. These customers tend to be educated and have disposable income. They are often Caucasian and from the suburbs or urbanized areas. They are savvy consumers and eager to buy items that they can feel good about purchasing - the ideas of healthy living, supporting a local business or farm family and being connected to the product are all motivating aspects in their decision to visit or make a purchase.

One way to give them the experience that they are looking (and willing to pay) for is to offer cut flowers at your market. Cut flowers are not only nice to look at, they stir up positive emotions in both men and women. Having flowers on display can significantly increase farm income not only from the actual sale of the flowers, but also from the sale of other products available when the customer is in a positive mood. Involving and educating the customer on which flowers would be best for them is a great way to give them what they want in a product and an experience.

Things a farm market should consider when choosing to grow cut flowers:

1. What does your customer want?

   Take a look at their past purchases:
   - What are the types of items they purchased the most last year?
   - What were they willing to pay the highest prices for?
   - What was the average price they paid per trip?

   Knowing the answers to these questions will help determine the direction to go in when offering cut flowers. If they prefer traditional products like corn and red tomatoes consider offering traditional, annual flowers like sunflowers, zinnias or snapdragons. If they were often willing to pay higher process for unique items like specialty radishes or melons you can get more adventurous with your offerings. You'll want to grow items that you can cover your costs of production for. So target your bouquet or bunch prices based both on covering production costs and on how much you think the customer may be willing to pay based on past information. Keep in mind that they will be making emotional purchases and therefore may be willing to pay higher prices for a luxury item like flowers.

2. How can value be added?
   There are several optional actions that can be taken in order to add perceived value to the product with minimal effort:
   - Add a small packet of floral preservative
   - Create simple yet professional-looking bouquets
   - Wrap paper or a plastic sleeve around the bouquet
   - And a bow or decoration
   - Give them a small card to write out
   - Seal a farm logo sticker on the finished product

   The basic idea is to make it look professional and highlight the care that goes into producing the best product possible for your customer.

3. Setting up “shop”
   Although cut flowers are a farm product some changes to the market may be made to accommodate this different type of crop:
   - Create full displays. Although the flowers should remain cool they will not sell if they are not on display. It is a mistake to keep flowers hidden in a cooler in the back when the market is open. Use groupings of 3 or 5 bunches or items when setting up a display.
   - Larger displays. If you have the expertise, consider making larger demonstration displays throughout the store. (Not the items typically for sale, but a large, decorative item.) Place it near items with the largest profit margins for you or ones you need to move quickly. The mood-boosting effect of the flowers will keep the customers in that part of the store longer and help sell the other products. Keep in mind that some customers may want to purchase this “model” display, so pre-price it and be ready to say “yes!” when they ask if they can buy it.
   - Collect and pay sales tax. Since flowers are not a food you may need to charge sales tax to the customer and pay it on a quarterly basis. Contact NJDA at least a month before your first sale in order to determine the necessary steps for your business. Keep the final prices as round as possible. For example, if you sell a bouquet for $20, have the tax included so no change is involved for you or the customer. In this example, if tax is 7% (or $0.07/$1.00) then $20.00/1.07 = $18.69. Collect the $1.31 as the tax and pay it to the state. If you price a bunch as $15.00 and tax is 7% then $15.00/1.07 = $14.02 + $0.98 tx.
   - Have a cooler. If you do not have a separate cooler or CoolBot available for cut flowers you may want to consider putting-off growing them until you do. Flowers should never be stored with fruits or vegetables because the emitted gasses will cause rapid decline of the product. If you have the ability to harvest them early in the morning and sell them all that day this will work too, but is not optimal.

4. Are you ready?
   Growing annual flowers is a lot like growing annual vegetables, but with more hand labor and less pest control options. Educating yourself first is a good start! Then be sure to educate your staff. Educating your customers will go a long way in generating repeat sales!
   - Educate yourself – on growing, harvesting, post-harvest handling and adding value (see link below).
   - Educate your employees – They need to know everything you learn about the crop to ensure a high quality product
   - Educate your customer – the customer may not know that they *need* the flowers! Cut flowers are an under-tapped market in the United States. Educate your customers on as many things as possible about the flowers: what the colors or species mean; where they are from originally; why they grow well here; which are customer favorites etc. This small effort can be done easily while wrapping the bunches at purchase and will build customer loyalty and give them a great experience.

For more information on growing and selling cut flowers see the new 2016 website on the “Rutgers Ultra-Niche Crops Project”. It has a video and factsheet on cut flowers with more resources coming in 2017. www.njaes.rutgers.edu/ultra-niche-crops/

ARONIA: A NEW CROP FOR THE MID-ATLANTIC

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Amongst the most profitable agriproducts in the U.S. are specialty crops, especially fruits and vegetables. Markets for specialty crops are expanding because of an increase of consumer interest in locally grown foods and with foods having high nutritional value. One such specialty crop is aronia (*Aronia mitchurinii*), and with over two million plants growing in over 1000 hectares (2470 acres), with increasing numbers yearly (discussions with Midwest Aronia Association, Mid-Atlantic Aronia Growers Association, National Aronia Growers, LLC and Aronia Berry Services of Northeast Iowa), timely research is needed for this fruit industry. The parent plant of the cultivated aronia is an eastern U.S. native. Aronia has a long history of fruit production in Eastern Europe. As an alternative crop, aronia has considerable market potential. The fruit is about the size of a large blueberry and comes in clusters of about 10 to 20, making them relatively easy to harvest. A mature plant (about 7 to 8 years) can yield over 15 lbs, but they start fruiting within two years after planting (averaging 1 or 2 lbs of fruit per plant). The fruit is closely related to an apple and is dark purple in color. The color is attributed to high concentrations of flavonoids including anthocyanins. Due to health-promoting effects, there is great interest in fruits and vegetables containing high concentrations of flavonoids, which are considered potent antioxidants. Amongst several research institutions, aronia is being studied at University of Maryland's Wye Research and Education Center. For over 11 years the research orchard with the varieties 'Nero' and 'Viking' has been maintained and observed to determine best cultural management strategies to optimize yield. An additional variety 'Galicjanka' has been introduced last year. Aronia is a low input crop. From establishment and first few years, plants require only 7 grams of N (0.25 oz) per plant per year, which equates to about 15 kg N/ha/yr (14 lb N/ ac/yr). After the 4th year, N rates should double to maintain yield. However, aronia is not free from pests and diseases. Major pests include Japanese beetle, lacebug, and cherry fruit worm. Aronia is resistant to rust (Gymnosporangium spp), but is susceptible to powdery mildew (Podosphaera spp) and is possibly to a scab (Fusicladium spp). Several successive years of chill requirement studies performed to determine southern extent of cultivation in U.S., inferred that aronia should be grown where there is an accumulation of at least 1000 chill hours. To assure long-term survival the industry, further research into breeding and culture should be assessed and more marketing efforts need to be made to enlighten target sectors, including organic and health conscious consumers.

OPPORTUNITIES AND CHALLENGES FOR STARTING A VINEYARD IN NJ

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Opportunities

In New Jersey wine grape has been one of the fastest growing crop commodity in last several years. Currently NJ produces around 2 million gallons of wine, generating total revenues in between $35-45 million dollars. The demand for wine grape far exceeds supply even though existing vineyards have been expanding at a rapid pace. These demand is governed by ever increasing consumption of locally produced wine and remarkable improvements in wine quality from local wineries. Wine grape industry generates income from grape production, vineyard tours, wines sold at the tasting rooms, and retail stores. According to the last USDA-NASS survey of 2012 there was 98% increase in the acres under wine grape production.

New Jersey's diverse climates and soil types offers opportunities to grow multiple types of wine grape varieties be it French (e.g. Cabernet Sauvignon, Cabernet Franc, Chardonnay, Syrah, and Merlot), German (e.g. Riesling and Traminette) Italian (e.g. Grenache, Barbera and Dolcetto), Austrian (e.g. Lemberger) or French-American hybrids or native (e.g. Niagara, Fredonia and Ives). According to latest survey by NJCWRE (NJ Center for Wine Research and Education) there are at least 60 different varieties grown throughout grape growing regions of NJ. Once established properly and effectively managed diseases and cold damage, grapevine can be productive for up to 25-40 years! Also if a grower can make wine at their own winery, wine grape production can be highly profitable (Table 1) enterprise, however one has to consider all the initial costs of winery and vineyard establishment.

There is an active institutional support from Rutgers University's New Jersey Agricultural Experiment Station (NJAES) comprising extension agents and specialists who organize educational sessions round the year from beginners and established wine grape growers and wine makers (Figure 1). Most of the programs are either free or offered at nominal fees. Hands on training are also included for beginners.

Challenges

There are two main challenges to start a vineyard in NJ. First, very high initial capital required to establish a vineyard (Figure 2) which can go up to $15,000 per acre, not including with fixed cost (e.g. tractor, sprayer, etc.). Establishing winery is also highly capital intensive and one requires skills to make high quality wines. Secondly, it takes up to 3 years to achieve harvestable crop to make wine and up to 4 years to achieve full crop. Both of these factor results in a vineyard taking 8-12 years before it can break even. Additionally one may need to replant a block of variety in case of virus infection.

Table 1. Conservative estimates of potential *revenues** from selling wine grapes and wine, based on possible yield (tonnage), average and maximum market price and number of bottles. Example are of suitable varieties for NJ.

Variety	Yield (ton)	**Price per ton		Selling grapes Revenue/acre	Bottles/ton	Price/bottle	Selling wine Revenue/acre
Chardonnay	4	average	2000	8000	600	15	36000
Chardonnay	4	maximum	3300	13200	600	20	48000
Chardonnay	4				600	25	60000
Chardonnay	4				600	30	72000
Cab Franc	4	average	1800	7200	600	15	36000
Cab Franc	4	maximum	2000	8000	600	20	48000
Cab Franc	4				600	25	60000
Cab Franc	4				600	30	72000
Chambourcin	5	average	1500	7500	600	12	36000
Chambourcin	5	maximum	2000	10000	600	15	45000
Chambourcin	5				600	18	54000
Chambourcin	5				600	22	66000
Traminette	5	average	1200	6000	600	10	30000
Traminette	5	maximum	2000	10000	600	12	36000
Traminette	5				600	15	45000
Traminette	5				600	20	60000
Lemberger	4	average	1000	4000	600	15	36000
Lemberger	4	maximum	1800	7200	600	20	48000
Lemberger	4				600	25	60000
Lemberger	4				600	30	72000
Riesling	4	average	1500	6000	600	15	36000
Riesling	4	maximum	2500	10000	600	18	43200
Riesling	4				600	20	48000
Riesling	4				600	25	60000

**Revenues* are income not including the expenses, which are substantial during the establishment years.
**based on 2015 pricing reported in Virginia as prices in NJ are more close to Virginia then other mid-Atlantic region.

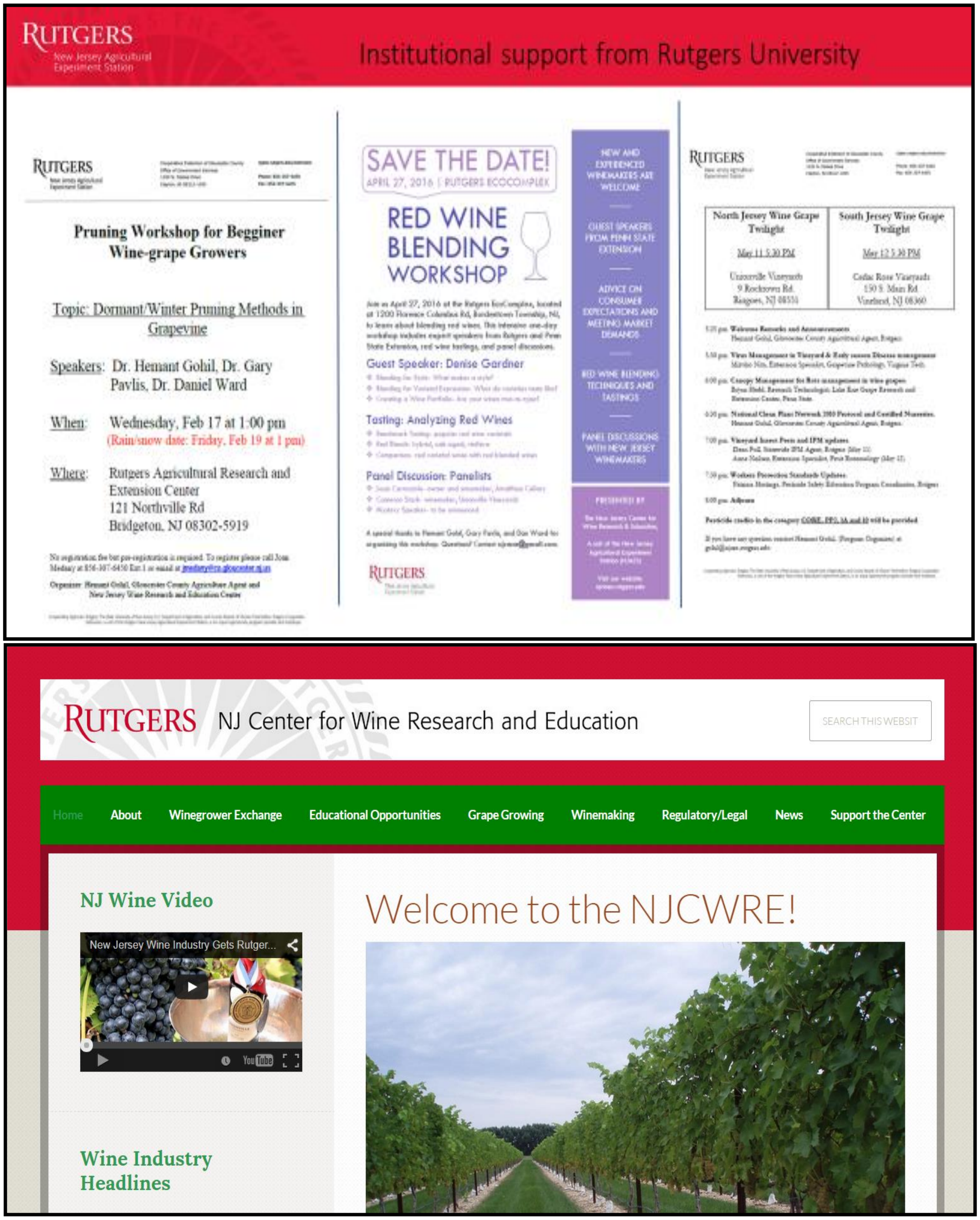

Figure 1. Examples of Institutional support (upper) and learning resource (lower) from Rutgers University's Research Extension and outreach programs.

Summary of Growing Costs for New Jersey Wine Grapes Trained to a Vertically Shoot Positioned System, 2015				
Item	Year 1	Year 2	Year 3	Year 4+
Site preparation	$5,066			
Vines & Planting	$4,109			
Trellis materials & construction	$5,001			$127
Replanting & rogueing		$148	$134	$134
Dormant pruning & removal		$60	$363	$363
Weed control	$173	$182	$220	$128
Fertilization	$28	$28		$62
Canopy management		$99	$298	$718
Disease & insect control	$93	$125	$354	$681
Take away & hilling up	$72	$246	$220	$166
Mowing		$94	$140	$140
Bird Control			$60	$60
Pick-up (fuel, maintenances, etc.)	$75	$75	$75	$75
Crop insurance				$109
Total growing costs	$14,617	$1,057	$1,864	$2,763

Grand total years 1- 4 = $20,300

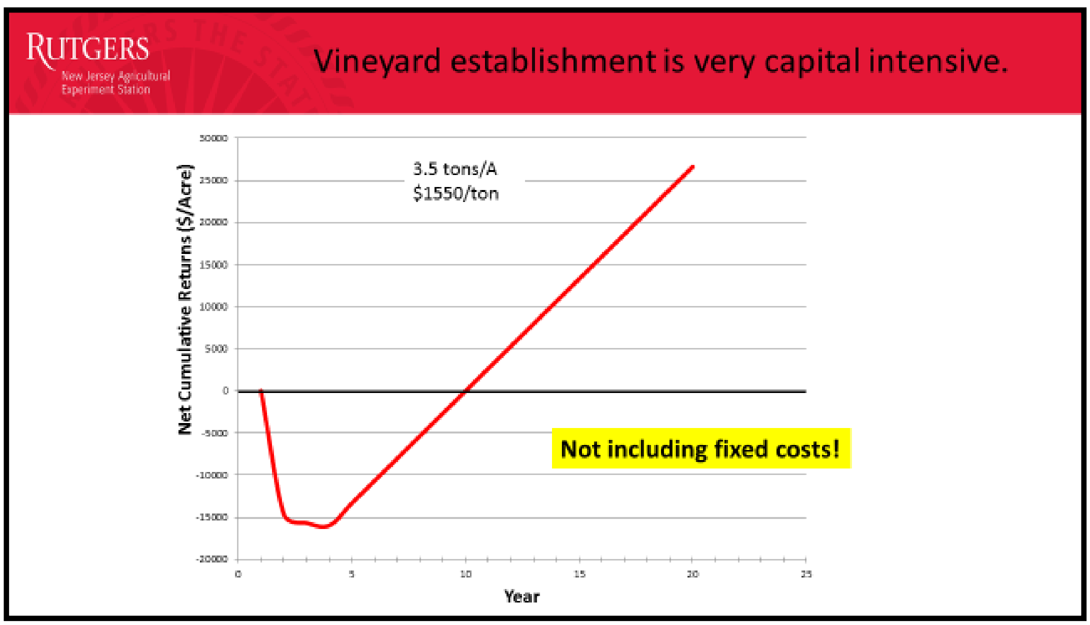

Figure 2. The biggest challenges of establishing a vineyard are that; it is capital intensive (upper) specifically during the first year; and return on investment can be as far as 8-10 years (lower). Figures courtesy, Dr. Daniel Ward.

DIFFERENT TYPES OF BEACH PLUM PRODUCTS

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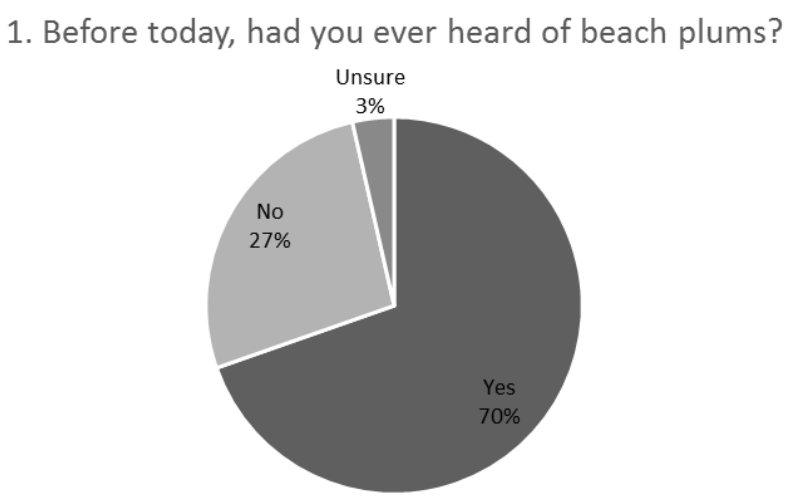
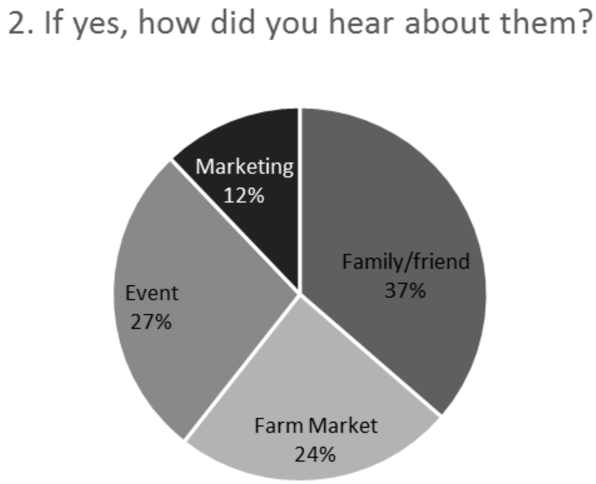
Beach plums (*Prunus maritima*) are small, tart plums with a pit. Although the species is not a large, commercial crop, the fruit is sought after by those familiar to coastal areas such as the Jersey Shore and Cape Cod. Visitors or residents of these areas often have long family traditions of harvesting wild fruit and using it in jams and jellies. As a crop, beach plums are becoming more popular with consumers interested in agritourism; the local food movement and unique fruit species with health benefits. According to the 2008 unpublished research results of Dr. Amy Howell from Rutgers, beach plums have been found to have very high antioxidant levels as well as the same UTI prevention activity of cranberries. All of these attributes offer opportunities for farmers to capitalize on beach plum products.

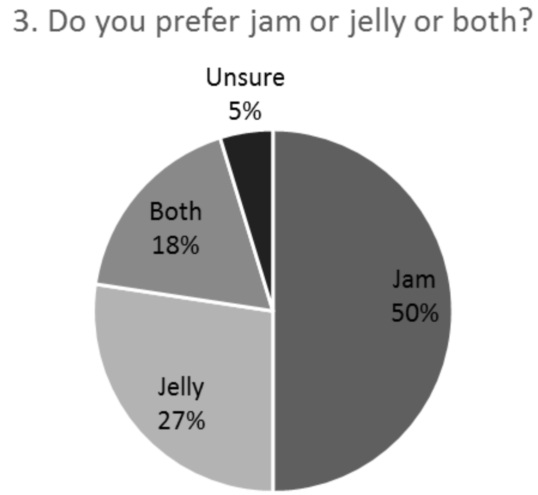
In recent years additional beach plum products have become available on the market. Beach plum juice or pulp has been added to gin, a large variety of mixed cocktails, iced tea, jams, jellies, salad dressing, vinegar, wine and similar other products.

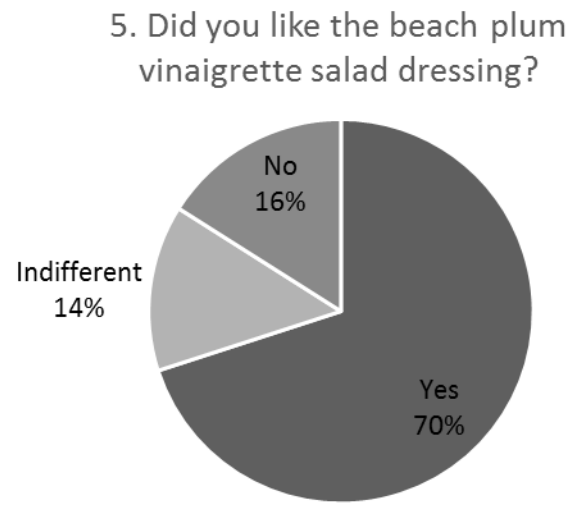
In 2014, the Cape May County Beach Plum Association received a Specialty Crop Block Grant from NJ Department of Agriculture to further develop and market the crop. Through this grant a series of consumer taste tests were conducted at various events.

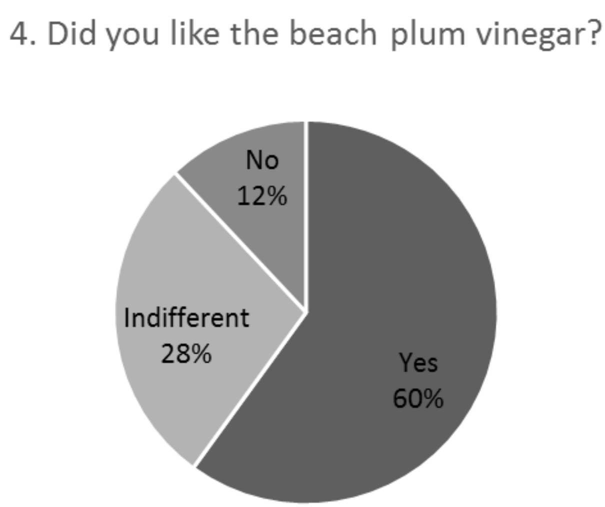
Results of 2016 Consumer Taste Testing Survey on Beach Plum Products




2. If yes, how did you hear about them?
Marketing
12%
Family/friend
37%
Event
27%
Farm Market
24%


3. Do you prefer jam or jelly or both?
Unsure
5%
Both
18%
Jam
50%
Jelly
27%


5. Did you like the beach plum vinaigrette salad dressing?
No 16%
Indifferent 14%
Yes 70%


4. Did you like the beach plum vinegar?
No 12%
Indifferent 28%
Yes 60%

The results show that although only 70% of the people had heard of beach plums before that day, 100% of the participants said they may try beach plum products again and 94% of the 56 taste testers responded “very likely” that they would try them again in the future. Based on our research, consumers are willing to try new and different beach plum products in addition to the traditional jams and jellies, and the majority of them have a favorable opinion of all the products sampled.

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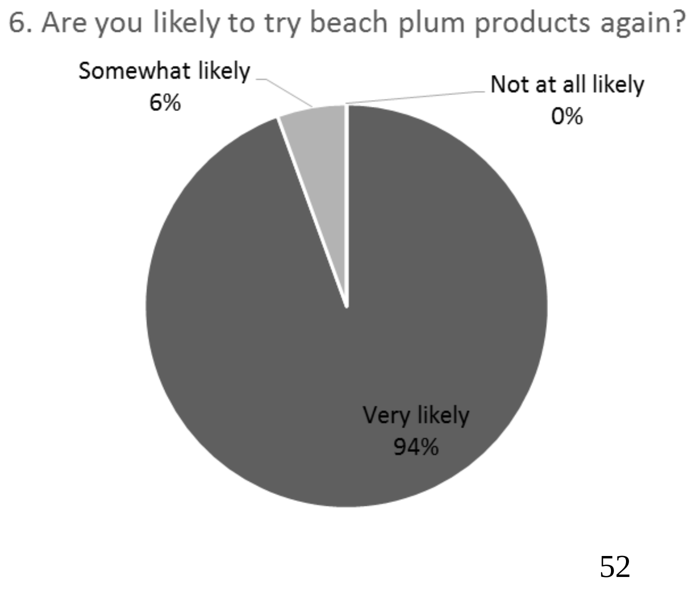
DIRECT MARKETING / AGRITOURISM



Reducing Risks for Your Direct Marketing Farm Business

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In recent years, there has been an influx of interest in farming that ranges from traditional, intergenerational farm families to nontraditional individuals seeking a fresh start in farming. However, significant barriers and risks exist for entry-level or beginning farmers as well as for established farmers looking to make significant changes in their crop production systems.

This discussion will provide an overview of ways to minimize risk and refine the control of capital expenses and cash flow. More specifically, ways to keep better production records, the importance of accurate field maps, and opportunities that are currently available for beginning, women, and minority farmers. This discussion will also introduce the USDA Noninsured Assistance Program (NAP) no-cost incentive for those specified groups of producers.

Since the 1930's, the United States Department of Agriculture (USDA) Farm Service Agency (FSA) has provided invaluable support to agricultural producers to enhance, expand, begin and maintain farming operations. In speaking with growers and FSA professionals, it has become clear that there may be a disconnect between the NAP program and growers who would apply. The NAP program provides financial assistance to producers of non-insurable crops when low yields, loss of inventory, or prevented planting occurs due to natural disasters. This discussion will explain how the NAP programs newly released county average direct market and organic prices can help provide farm businesses with a better financial safety net. A short video created by Rutgers Cooperative Extension will conclude the presentation by highlighting successful specialty crop growers within the program.

DIRECT FARM MARKETING AND AGRITOURISM, CONNECTING WITH YOUR ETHNIC CUSTOMERS

Stephen Specca
Specca Farms
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Our farm has been a Pick Your Own direct marketing operation since we ourselves, were immigrants from Italy. I have been helping my dad, Dave Specca on the farm all of my life. I have firsthand noticed a shift in some of the culture of our customers and that of New Jersey and the East coast. As a result of this shift, our farm has adapted our operation to appeal to other cultures. Besides, what is more distinctive of culture than food?

This discussion will present novel ideas other growers can use when trying to reach and connect to new customers of different ethnicities and cultures. Often many immigrants are looking for reminders of their cultures that often involve food.

Discussion points:

- Immigration chart to NJ
- Gross domestic product
- Using written language to appeal to a culture.
- Connectivity in a community.
- Creating loyal costumers
- Multi-cultural customer Cohesion
- The bartering system how to implement it.

Something you can feel good about. In a small way you are helping preserve a person’s heritage and culture by offering them a connection to home.

Culturally different people are good costumers and can be yours.

HIGH TUNNEL PRODUCTION

HIGH TUNNEL PLASTICS: WHAT'S COOKING?

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A USDA-NIFA Specialty Crops Initiative Project "Optimizing Protected Culture Environments for Berry Crops", led by Michigan State University and involving research and extension personnel at 7 universities plus the USDA, is underway. One of the first goals of the project was to better characterize what plastics are available to growers, and then test several plastics with a range characteristics to better understand their effects on the tunnel environment, raspberry and strawberry growth, and pest complexes under high and low tunnels.

Types of Coverings Available

Many different brands and types of plastic film coverings are available to growers – at least 50 different ones were available to growers in North America. Plastic coverings affect transmitted light and the high tunnel environment, plus they have other characteristics affect their performance.

The covers most frequently used on high tunnels are thin plastic films, usually 6-mil in thickness with an expected life of 4 years, and that is the type of covering that this project focuses on. Films are also available that are thinner (1-mil, 3-mil, or 4-mil), but these are intended for shorter-term use or are for use on structures other than high tunnels. Plastics used on low tunnels are generally thinner (4-mil), as the thinner plastic is easier to manipulate when tying the plastic to anchor posts.

If growers want a covering with additional durability or additional insulation, there are woven materials, reinforced materials, semi-rigid materials, and one product that resembles bubble-wrap.

Plastics Effects on Light/Heat Transmittance and Crops

Visible light

The light that we see, which includes the wavelengths that plants use for photosynthesis, is referred to as (not surprisingly) visible light. Crop plants best conduct photosynthesis utilizing wavelengths that we see as red and blue light. That is why "grow lights" and LED lights used for indoor plant culture have a purple hue to them - the color results from higher output in the wavelengths that produce the colors red and blue.

High tunnel plastic film coverings transmit the majority of the visible light reaching the tunnels, generally in the range of 85 to 95%. This is enough to keep leaves that are receiving all of this light working at their maximum photosynthesis rates, though other factors (inadequate soil moisture, wrong temperature, or leaves shading other leaves) can limit photosynthesis of the whole plant. One interesting characteristic of some films is that the light being transmitted through the film may “come through” at different wavelengths than the ones that originally reached the plastic, so that transmittance values of certain wavelengths are sometimes greater than 100%. Having sufficient light transmittance is important for plants that require high amounts of light for maximum yield and quality light (tomatoes, raspberries).

Some portion of the visible light (and also wavelengths outside of this range) striking the tunnel is diffused as it passes through the plastic. The amount of diffusion taking place varies for different plastics, and can be judged by how clearly one can see through the plastic and by the presence of shadows in the tunnel on a bright day, or more correctly the lack of shadows. Plastics that diffuse a greater proportion of the light are referred to as diffuse or diffusing films. With more diffusing films, the majority of the light striking the plastic is transmitted, but it is scattered as it passes through the plastic and so is more evenly spread throughout the tunnel and plant canopy. Lower leaves receive more light instead of being shaded by upper leaves, especially with taller plants such as raspberries or indeterminate tomatoes. Thus, total photosynthesis for the entire plant, especially for tall crops, would be expected to be higher in a tunnel with a diffusing film than in a tunnel with a less diffusing film, as long as the total amount of light being transmitted is roughly the same.

<u>Ultraviolet (UV) light (aka UV radiation, and “black light”)</u>

UV light consists of wavelengths shorter than visible ones, and is further broken down into UV-A, UV-B, and UV-C radiation, with UV-A being next in line from visible light. UV-C radiation, which is very dangerous to living organisms, is filtered out by our atmosphere. UV-A and UV-B wavelengths, as one can infer from sunscreen and sunglasses labelling, are the ones responsible for giving us sunburn and being tough on our retinas. These wavelengths also break down plastic, so plastics used for high tunnels and greenhouses contain UV stabilizers or blockers that minimize damage to the plastic. This is one of the main characteristics that sets greenhouse films apart from plastic sheeting that one might pick up at a local hardware store, which would become brittle within about a year if used on a tunnel.

Plants react to UV-A light by producing anthocyanins which shield the plant from some of the harmful rays. These compounds make blueberries blue, and strawberries red, and are also often categorized as anti-oxidants. Though UV-A light is not visible to us, it can be seen by many insects – in fact, many of them use UV-A and blue-green wavelengths for vision. Various types of fungi can sense its presence, and use it as a cue for sporulation. Plastic tunnel coverings can filter out certain types of UV light and thus are being tested for their effects on a number of plant, insect, and disease responses.

<u>Infra-red (IR) radiation and near infra-red light</u>

Infra-red wavelengths are sensed as heat, and thus are the ones responsible for heat build-up in a tunnel. Visible light and shorter wavelengths of infra-red light enter the tunnel during the daytime and are stored as heat in the soil and plants, but then are emitted back towards the plastic as longer IR wavelengths at night. Some plastics include an additive that reduces the amount of long-wave IR radiation passing through the plastic. These plastics are used to hold reflected heat (IR radiation) in the tunnel at night, and therefore are sold as thermal energy-saving films. Usually they are used in more northern locations, and are recommended for use as an “inside” layer of film with another layer overtop, with the space between the two being inflated with a blower.

Other films are capable of blocking IR radiation coming into the tunnel, and then have potential to keep the temperatures in the tunnel cooler than outside temperatures. Plastics intended to keep tunnel temperatures lower also diffuse light, which also helps with preventing heat build-up in the tunnel. Berry crops are especially sensitive to high temperatures, and given our extreme temperatures as of late, these plastics may be valuable in helping in keeping the plants cool. Tunnel height and venting of course, also plays a large role, so the cooling effect may not be as great in shorter tunnels.

Current Research

However, over the past 2 years, 15 of the tunnels at Penn State’s High Tunnel Research and Extension Facility have been refurbished and covered with 5 different plastics with a variety of characteristics, and raspberry and strawberry trials were established. In additional, a low tunnel trial on raspberries that compares the same plastics, plus different plastic mulches (white, black, or no mulch) was established. First-year data produced some interesting results, and are helping to explain some of the effects that have been noticed over the years in tunnels, such as reduced numbers of Japanese beetles, and lower incidence of botrytis and fruit anthracnose. It is too early to say whether the best plastic in one year will be the best in the next year, but data will continue to be collected so some conclusions can be drawn.

Over the next few years, economic analyses as part of the TunnelBerries project will also be conducted to determine whether differences in yield or quality with different plastic types are sufficient to result in differences in profitability in raspberry and strawberry production.

Information on sources of available plastics can be found on the project website: www.tunnelberries.org

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PROTECTED CULTURE FOR BERRIES: LOW AND HIGH TUNNEL RESEARCH

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A major limitation for berry growers is the short season when berries are typically available to sell. The first strawberries ripen in mid-June and harvest ends near the 4th of July. Raspberries end their season by early October and it is difficult to even grow blackberries in our climate due to the cold winters. Rainy weather during harvest, especially on weekends, can have a significant negative financial impact on growers, particularly if they market through pick-your-own. It would greatly benefit growers if berries could be protected from the weather and produce over a longer season, into the summer and late fall, as this would extend the season and open up new markets.

Many parts of the world are using plastic tunnels to protect berries and extend their season. The newest plastics greatly reduce ultraviolet light that normally would promote fungal spore germination and they reduce infrared light that produces heat. By coupling this plastic technology with varieties that are day length insensitive, one can extend the season both earlier and later than the typical season.

Strawberries

In the 1980s, varieties of strawberries (day neutral) with the capacity to produce flowers during all day lengths (spring, summer and fall) were released to the public. While there was initial excitement with these new varieties and their flavor was excellent, grower interest waned because 1) yields were low, 2) fruit size was small, 3) berries were expensive to pick, and 4) tarnished plant bugs (TPB) damaged the ripening fruit.

A new generation of day neutral varieties was released in 2004. Although these originated from California, they were relatively well adapted to the Northeast, producing much larger fruits and higher yields than earlier releases. They produce fruit the year of planting and continue fruiting into the fall. After overwintering, they produce another flush of fruit in spring. The fall crop and the second-year spring crop can be protected from rain and cold temperatures by covering rows with plastic on metal hoops – a technology called “low tunnels.” The tunnel plastics not only exclude rain but they can decrease the amount of ultraviolet light and infrared radiation - reducing spore germination and heat load on the plants. The combination of day neutrals and low tunnels has the capacity to extend the strawberry season from 3 weeks to 5 months.

We have conducted studies with 1) various day neutral cultivars, 2) various plastic covers, 3) varying planting dates, and 4) grower-cooperators. After four years of research, the following procedure is recommended for growing and producing day neutral strawberries.

Establish raised beds (18 inches or wider) in late fall or early spring so they can be planted as soon as possible in spring. Delaying planting until May or Jun will significantly decrease yields. Each bed should have a trickle irrigation line attached to a fertilizer injection system. Cover each bed with white plastic and plant ‘Albion’ in a staggered double row, with plants 9 – 12 inches apart in each row. Use a tool that will insert roots into the bed while disturbing the plastic as little as possible. ‘Albion’ is the variety that has the best flavor and performs consistently well in our climate.

Fertilize the planting with 2 lbs of actual nitrogen per planted acre per week for the first few weeks after planting. Remove the flowers for the first three weeks, or until vigorous new leaves appear from the crown. Plant grass seed between the rows, or lay a landscape fabric or straw mulch to prevent mud from splashing on the berries.

Install tunnels when plants begin to throw new flower trusses. Cover the tunnels with 4 to 6 mil plastic, preferably with a type that excludes ultraviolet light and reduces infrared radiation. Dubois Agrinova (http://www.duboisag.com/) sells kits with plastic that has predrilled holes for ventilation when the plastic is lowered. The cost for the tunnel kits is $450 per 100 foot of row. This cost is recovered in the first year.

At least one side of the plastic should remain up under normal weather conditions to allow for pollination and to prevent heat build-up. Infrared-inhibiting plastic does provide some shade which is beneficial for the plants, so allow them to be shaded by the plastic if possible. Lower the sides when the weather is cold or stormy. A benefit of the plastic is the near elimination of Botrytis gray mold from water exclusion and inhibition of spore germination from the reduction of UV light.

Once plants begin to set fruit, increase the nitrogen to 5 lbs/acre per week. Failure to provide weekly applications of nitrogen was a major reason why our grower-cooperators had lower yields than expected.

Harvest the fruit at least twice a week. Peak yields will occur in late August-early September, with production occurring through October.

Once the temperature falls below 40F, lower the tunnels. If the temperature falls below 30F in mid-October, cover the entire field with row cover for the night to continue fruiting. This will extend the harvest season should the weather warm again.

Once harvest is over, lower or remove the plastic and cover the beds with straw. ‘Albion’ does not overwinter well in cold weather. Remove the straw in late March/early April and allow these plants to fruit again. The tunnel can be used to protect from late spring frost.

Over the course of the first year with an April planting date, we harvested 20,000 lb/acre, which is as much as a good June-bearing cultivar will produce in one season. Average berry size of ‘Albion’ was 15 grams, which is the size of a medium king fruit on a June-bearer. Flavor is excellent. Production peaked in early September with two quarts (four pints) of berries per 10 feet of row, but in October plants consistently produced about a quart of berries every 10 feet of row until a hard frost.

In spring of the second year, a large flush of fruit is produced about the same time as that of early June-bearers. Tunnels can be used to accelerate flowering if desired. Spring yields can be almost as much as the previous year’s yield. We have not found it to be economical to hold over these plants into a second summer and fall. Rather, we grow them for about 15 months and then remove them. This past summer, in particular, with 26 days above 90F was not conducive for second-year production.

We found that, while attractive, growers may not be able to “fit” such a crop into their farm operation since day neutrals require constant attention. Plastic has to be raised and lowered, plants have to be fertilized weekly, and once harvest begins, it lasts for months. However, the rewards can be great. Growers have reported gross sales of $50,000 per acre from Albion in New York State. Given that the cost of materials for an acre is about $44,000, sales can pay for the materials in the first year. In the second year, costs include plants, fertilizer, labor and harvest. Conservatively, this can be $20,000, but with sales approaching $30,000 or more, the margins are quite good.

Spotted winged drosophila (SWD) damage has been minimal in our trials provided that fruit is harvested regularly and not left rotting in the field. In one trial we used netting in place of plastic to determine how it would perform when the sides were down continuously throughout the fall to exclude SWD. Surprisingly, the netting had many of the benefits of the plastic. Sufficient air movement occurred so that flowers were pollinated without bees. Enough moisture was excluded so that fruit rot was low, and enough heat was retained on cold nights to prevent early frosts and extend the season. There was no SWD damage on those fruit, but damage levels were low throughout the planting.

Raspberries

Fall-fruiting raspberries, in particular, are amenable to production under tunnels. Rather than ceasing production with the first frosts, raspberries under tunnels can continue to fruit well after the first frost. In a tunnel raspberry rows can be planted as close as 7.5 feet apart. Because there is no wind the plants grow tall. The fruit is protected from rots so % marketable yield is high.

Outdoors one wants the plants to fruit as early as possible so the crop can be harvested before the first heavy frost. However, because the season is extended under tunnels, it may be desirable to plant later cultivars or pinch the primocanes when they reach a height of about 3 or 4 feet to delay fruiting, at least on a portion of the planting. Canes may be overwintered and fruited again the following spring for additional yield. Yields under this system can be quite a bit higher than in the open field. The plastic can be removed for winter or left on, depending on how early one wants the second year crop.

Special attention must be paid to managing SWD as red raspberries seem to be their preferred food. Regular harvest of all ripe and overripe fruit is essential for managing this insect. Many growers couple this practice with insecticide sprays at least once a week.

Blackberries

Blackberries respond exceptionally well to tunnel cultivation as they grow well under hot conditions. In the north plants are often damaged from cold winter temperatures if they are not protected. So coupling tunnel technology with some form of winter protection allows robust blackberry production in northern climates. With tunnels that are not built to withstand a snow load, blackberry canes must be laid prostrate on the ground and covered with a protective sheet to survive the winter. A specific type of horizontal trellising is required in order to bend canes without breaking them. A second option is to use a reinforced tunnel that will support a snow load and overwinter the blackberries under the closed tunnel. Horizontal trellising is not required since canes are not laid down, but it may help manage vegetative cane growth and facilitate harvesting.

We plant blackberries in the tunnel at a 7.5 spacing between rows, with plants at 6 – 8 feet within row, depending on the trellis used. Compost is incorporated prior to planting for nutrition, and once established, little to no fertilizer is applied.

We have had the greatest success with 'Chester' and 'Triple Crown' cultivars. Both of these are thornless floricane-fruting types. We have also tried fruiting 'Prime Jan' under tunnels but they required a longer season than even our tunnel could provide. Yields of 'Chester' approach 20,000 lbs/acre once they reach maturity in 4 or 5 years.

Economics

Each of these systems pencil out as profitable with what we believe are reasonable assumptions. Much of the world is now producing berries under tunnels. The Northeast is one of the last regions to move in this direction. China has been producing strawberries in plastic houses for decades. Most of Spain's strawberry production in is tunnels. Northern Europe and now much of California's raspberry production is under tunnels. Quebec and Ontario are also moving quickly to tunnel cultivation as is South Africa. The Northeast stands to benefit more than these other regions from protected culture because of the triple threats of rain, wind and cold and the benefit of large number of consumers at our doorstep, allowing us to profitably produce better quality fruit than what is shipped in from distant locations.

HIGH TUNNEL CONSTRUCTION

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High tunnels can be used to extend the growing season or to grow year-round using cold-hardy crops during the winter season. They provide shelter and some degree of protection from unfavorable weather conditions. They are relatively inexpensive, require minimal amounts of readily available construction materials, are easy to install, and for tax purposes are usually considered temporary structures (i.e., they don't have a foundation or solid floor made of concrete).

High tunnels are designed as free-standing or as gutter-connected structures and are typically stationary, although some designs allow for periodic movement (typically after a growing season) in order to cope with soil-borne diseases. Most often, crops are grown directly in the soil, but when root disease pressure is high, crops can also be grown in rooting media bags (bags filled with a potting mix) that are placed on top of the soil.

While high tunnels can increase crop yields, they need to be installed and managed properly in order to result in maximum profitability. Consideration should be given to: construction materials, location, typical weather conditions, orientation, crop(s), and management strategy, including soil bed preparation, stand-by heating (if necessary), irrigation, ventilation, people & material flow, and pest & disease management.

In this presentation, I will review design options, construction and installation procedures, material choices, as well as design features that can have a positive impact on tunnel management strategies. I will also discuss some ongoing research findings.

FARM BREWERY CROPS

AGRONOMIC CONSIDERATIONS for GROWING MALTING BARLEY in NJ – IS IT FEASIBILE?

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The continued growth of the craft brewery and malt industries in New Jersey and consumer interest for buy local foods have begun to take hold in the brewery and distillery industry. This has resulted in interest among NJ grain producers as to how they can take advantage of niche markets supporting on-farm breweries, craft distilleries and other distilled products. The idea of producing specialty and niche market crops is a fairly unfamiliar concept to traditional grain farmers in the northeast region. Grain farmers are typically geared to producing for the commodities market where price is largely determined by CBOT pricing. In this model there are generally no price premiums paid for producing superior products. The typical measure of success is measured solely in terms of yield. Many opportunities for specialty or niche market crops presented to farmers at extension and industry meetings are vegetable or fruit crops. Grain producers tend to shy away from such ventures as it often would require investing in additional equipment for production, packaging etc. Such opportunities would require the grain farmer to learn about producing a commodity they have no experience with. These opportunities often require the grain farmer to operate outside of their comfort level. However, recently opportunities for producing specialty and niche grains have become increasingly more available. This is particularly attractive to existing grain farmers as they have the knowledge and understanding to produce grain crops. In addition there is generally minimal capital and infrastructure changes which must be made to produce these crops. An emphasis on higher quality products over traditional commodity grade is one of the usual defining characteristics the specialty markets are seeking. Organically produced and GMO free may also be additional considerations. Alterations to crop production and management are generally the predominate changes that must be made. The transition to producing such crops is generally easier for an existing grain farmer. The most readily apparent market for grain farmers is the craft brewing and distillery markets.

The National Association of Brewers reports that 75% of 21+ year olds live within 10 miles of a local brewery. The resurgence of local brewing in America is certainly evidenced by the more than 4,000 active American breweries contained in the National Association of Brewers database. In fact the US is currently approaching the historical high of 4,131 breweries reported in 1871. Craft beer is in many ways a reflection and driver of the local food movement. In an age of massive corporate brands, people are thirsty for experiences like riding a bike or hiking to the local brewpub and having a beer produced with local ingredients. Very similar to the consumer's desire to source and purchase locally produced fruits and vegetables. Unlike a chef in a local restaurant, craft brewers can find it to be difficult to source locally-grown hops, barley and other

ingredients in the U.S. That’s starting to change as brewers seek out more local ingredients.
Presented will be some of the production techniques, considerations and challenges New Jersey growers may be faced with when trying to produce malting barley. Results of NJAES malting barley research will also be presented and discussed.

QUALITY CONSIDERATIONS FOR MALTING GRAINS AND HOPS

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The recently expanding demand for craft brewed and distilled products has led to new interest in the feasibility of growing crops such as malting barley and hops in the northeastern United States. Although the potential exists for agricultural producers to grow these crops, strict quality considerations must be met in order to produce a quality product. In 2016, Rutgers initiated a study to evaluate both Spring and Winter malting barley varieties for the potential to meet the demands of this market. This presentation will discuss the quality demands from the brewing and distilling industry and will present the findings of the 2016 malting barley research. The major quality factors including; purity, germination, protein, moisture, plumpness, disease and other factors will be presented. Production practices, variety selection and other agronomic factors play a large role in the successful production of both malting barley and hops. The influence of these factors on quality and yield will be discussed. As well as potential alternative uses for crops not meeting quality considerations.

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PLANT HEALTH TECHNOLOGIES

OVERVIEW OF PLANT BIOSTIMULANTS
Definition, Effects, and Categories

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Introduction

Recent years have seen an explosion of non-chemical plant production products termed "biostimulants" as alternatives to chemical products and new methods to enhance the sustainability of agricultural systems. Although biostimulants were initially used in organic farming, consumer demands for more sustainable crop production and a growing number of reports regarding their beneficial properties have resulted in increasing popularity among conventional growers. The global market for biostimulants is projected to more than double by 2021 and to reach $2.9 million compared with $1.4 million in 2015 (Global Plant Biostimulant Market Report, September 2016). Although the largest market for biostimulants is in Europe, the North American market is estimated to reach $605.1 million by 2019.

Definition

Confusion exists regarding the meaning of the term biostimulant, and various definitions have been proposed. Most of these definitions attempt to differentiate between biostimulants and fertilizers and between pesticides and biocontrol agents and are geared towards their acceptance by future regulations (Du Jardin, 2015). According to the North American Biostimulant Coalition 2013, biostimulants are defined as: "Substances including microorganisms that are applied to plant, seed, soil or other growing media that may enhance the plant's ability to assimilate applied nutrients, or provide benefits to plant development. Biostimulants are not plant nutrients and therefore may not make any nutrient claims or guarantees." By this definition biostimulants have no direct action against pests, and therefore do not fall within the regulatory framework of pesticides. However, some biostimulants can have a dual function of biostimulant and biocontrol agent. Hence, their regulatory status is still unclear and despite efforts, no legal or regulatory definition of plant biostimulants exists.

Effects and Categories

Biostimulants are available in many formulations and with varying ingredients. The most popular ingredients include humic substances (humic and fulvic acids), beneficial bacteria, beneficial fungi, and seaweed extracts. Other products may contain chitosans (a soluble version of chitin), protein hydrolysates, and inorganic compounds such as silicon. For many years these substances were considered to be “snake oils” and skepticisms regarding their positive effects on plant growth persists. However, a large number of scientific studies have shown that many crop systems respond to these materials with higher productivity and improved tolerance to diseases and other biotic and abiotic stresses (Calvo et al., 2014). Other positive effects include improvement of water and nutrient uptake, improvement of water and nutrient use efficiency, improvement of root architecture and lateral root growth, improvement of soil physico-chemical properties, and improvement of fruit quality (Figure 1). Although the scientific basis of biostimulant effects is well documented, the exact mechanisms of action are not always understood.

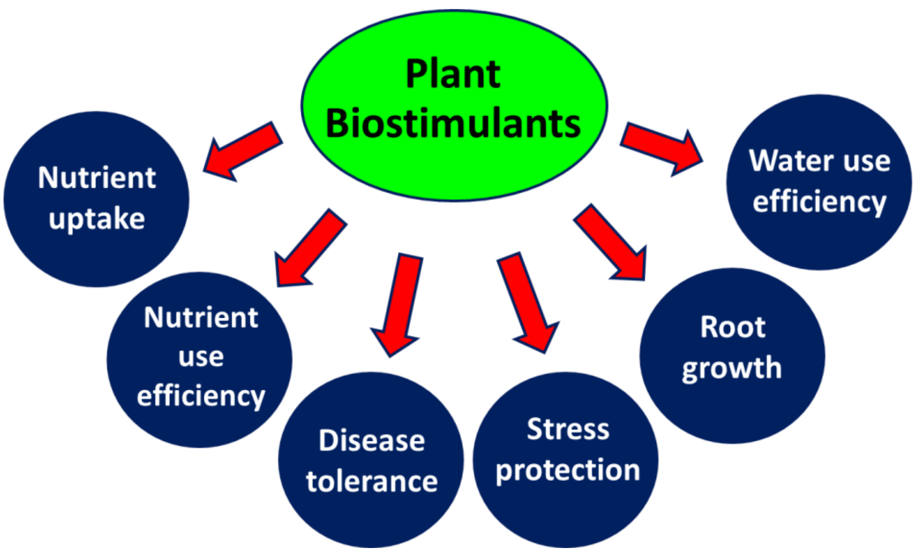

Fig. 1. Biostimulant effects on plants.

Humic substances are collections of natural components of the soil organic matter with relatively low molecular mass that result from the decomposition of plant, animal and microbial residues, and the metabolic activities of soil microbes. Compared with fulvic acids, humic acids are darker in color, have a higher molecular weight and carbon content, and a higher degree of polymerization. Most sources of humic substances used in agriculture are non-renewable and include natural humified organic matter such as peat and organic soils, and mineral deposits such as leonardite and soft coal. More sustainable, renewable sources are humic substances derived from compost and vermicompost. Plant physiological responses are often better with humic substances isolated from peat, compost, or vermicompost compared with those isolated from brown coal. Most reported positive effects of humic substances on plants are improvement of root nutrition and lateral root development. These effects are associated with the polyanionic nature of humic substances, resulting in an increased cationic exchange capacity (CEC) of the soil, and their ability to interact with root membrane transporters (Canellas et al., 2015).

Beneficial bacteria that promote plant growth or PGPRs (plant growth-promoting rhizobacteria) include free living bacteria that inhabit the zone around the root, bacteria that colonize the root surface, and bacteria that live within the roots. Their mode of action is currently well understood (Ruzzi and Aroca, 2015). Rhizobacteria with plant growth-promoting activity are found in the genera *Bacillus*, *Rhizobium*, *Pseudomonas*, *Azospirillum*, *Azotobacter*, and other genera. One of the best-understood effects of PGPRs on plants is their ability to fix nitrogen. This ability is specifically associated with root nodule-forming rhizobacteria living in a symbiotic relationship with leguminous plants. Another effect of PGPRs is their ability to produce siderophores, small iron-chelating compounds that reduce the growth of deleterious soil-borne pathogens. PGPRs can also influence plant growth directly by producing plant hormones such as auxins, cytokinins, and gibberellic acid, and indirectly by inducing hormonal changes in the plant host. Several PGPRs emit volatile organic compounds (VOCs), such 2,3-butanediol (2,3-BD), which were shown to not only induce fruit yield, but also resistance to insects and bacterial pathogens.

Beneficial fungi with plant biostimulant activity are found in the group of symbiotic fungi, particularly arbuscular mycorrhizal fungi (AMF), which penetrate plant roots and form a highly branched tree-like network of roots and hyphae. This network enables the plants to extend their root system beyond the depletion zone, allowing for enhanced uptake of nutrients and water, and rendering them considerably more tolerant to drought stress. Besides improving nutrient uptake, the best-known effect of AMF is their improvement of phosphorous uptake, particularly in phosphorous-deficient soils. One of the difficulties associated with the use of AMF is their susceptibility to different crop management practices, such as soil tillage, bare fallow periods, and the use of high levels of fertilizers and fungicides. Other plant-beneficial fungi are found within the genus *Trichoderma*, a group of hyphae-forming fungi found in the soil or on dead wood and bark. *Trichoderma* form close symbiotic associations with plants and are known to release active metabolites into the rhizosphere, promoting root-branching and nutrient uptake (López-Bucio et al., 2015). Due to their ability to parasitize other fungi, they are often used as biocontrol agents for control against fungal diseases of plants.

Seaweeds have long been known for their beneficial effects on plant growth. The most commonly used seaweeds in agriculture are the brown seaweeds and include species of the genera *Ascophyllum*, *Fucus*, and *Laminaria*. Most seaweed products are soluble powders or liquid formulations derived from different extraction procedures. The biological activity of these extracts strongly depends on the raw material and the extraction process which includes alkali extraction, acid extraction, and other technologies (Battacharyya et al., 2015). One of the major components of seaweed extracts are polysaccharides which may account for 30-40% of the dry weight and include alginates and laminarins. These polysaccharides possess plant growth-promoting activities and are known to elicit plant defense responses against fungal and bacterial pathogens. In addition, seaweed extracts are rich in phenolic compounds and may contain phytohormones, which can directly influence plant growth and development. Besides facilitating the uptake and use of nutrients, seaweeds also possess soil-conditioning and metal-chelating properties. Because of their ability to form gel-like networks or hydrogels, seaweeds are also known to positively influence the water retention capacity of plants.

Chitosans are deacetylated forms of chitin, a naturally occurring component of fungal cell walls, nematode egg shells, and the exoskeleton of insects and crustaceans. Chitosans are best known for their ability to induce plant-defense responses, rendering the plants more tolerant to stress and diseases. As with other biostimulant products, plant effects vary depending on the time and the rate of application, but also depend on the molecular weight of the chitosan product, the percentage of deacetylation, and other characteristics resulting from the manufacturing process.

Silicon is a biostimulant in the group of inorganic products. Its beneficial properties are best documented in regards to their positive effects on abiotic stress tolerance and resistance to pathogens and diseases. Silicon is easily taken up by plant roots and is deposited in the plant tissue, where it increases mechanical strength and modulates nutrient and water mobility (Savvas and Ntatsi, 2015). Other stress-alleviating effects of silicon include its ability to immobilize toxic metals in plant tissues and in the soil, and to delay plant senescence processes.

Concluding remarks

It is important to recognize that many crop systems respond differently to biostimulants, although the effects are usually positive. Different product formulations, often containing multiple types of biostimulants, different agricultural practices, and varying environmental conditions further complicate their use, and optimization is required when using these products. At the UF/IFAS Southwest Florida Research and Education Center in Immokalee, FL, we are currently investigating the effects of different biostimulant materials on citrus and other agricultural crops under greenhouse and field conditions in collaboration with commercial growers. Besides investigating biostimulant effects on plant growth and productivity, our research is also focused on deciphering the physiological mechanisms of effects and on discovering physiological markers which may aid in the selection of products most suited for a particular plant system.

References

Battacharyya D, Babgohari MZ, Rathor P, Prithiviraj (2015). Seaweed extracts as biostimulants in horticulture. Sc. Horticulturae 196:39-48.

Calvo P, Nelson L, Kloepper JW (2014). Agricultural uses of plant biostimulants. Plant Soil 383:3-41.

Canellas LP, Olivares FL, Aguiar NO, Jones DL, Nebbioso A, Mazzei P, Piccolo A (2015). Humic and fulvic acids as biostimulants in horticulture. Sc. Horticulturae 196:15-27.

Du Jardin P (2015). Plant biostimulants: Definitions, concept, main categories and regulations. Sc. Horticulturae 196:3-14.

López-Bucio J, Pelagio-Flores R, Herrera-Estrella A (2015). *Trichoderma* as biostimulant: exploiting the multilevel properties of a plant beneficial fungus. Sc. Horticulturae 196:109-123.

Ruzzi M, Aroca R (2015). Plant growth-promoting rhizobacteria act as biostimulants in horticulture. Sc. Horticulturae 196:124-134.

Savvas D, Ntatsi G. (2015). Biostimulant activity of silicon in horticulture, Sc. Horticulturae 196:66-81.

LIQUID, GRANULATED, AND CONTROLLED RELEASE FERTILIZER EFFECTS ON BLUEBERRY

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Introduction

Blueberry production acres in southeastern Georgia, USA have expanded by 63% from 2009 to 2014. Many of the new plantings are southern highbush blueberry (SHB) and established in pine bark culture with plastic mulch, which utilizes a drip irrigation system to deliver water and nutrients. Traditional granular fertilizer (GF) is being replaced by liquid (LF) and some farms are trying controlled release fertilizer (CRF) to minimize nutrient leaching. Recommended nitrogen (N) source for fertilization of blueberry is ammoniacal and not to exceed 25% nitrates. If soil pH is below 5.0, urea is suggested and if above 5.0 pH ammonium sulfate is the preferred source of N. However, there is commercially available LF and CRF that have levels of nitrates (NO_3^-) in the form of potassium nitrate (KNO_3) and ammonium nitrate (NH_4NO_3) above 25% total NO_3-N being applied to blueberries in Georgia.

Highbush blueberry has low nitrate reductase (NR) activity in the leaves, shoots, and roots. Nitrate reductase is a protein that reduces nitrate to nitrite (NO_2^-), which is the first step to reducing NO_3 to N. The nitrogen is reacted with hydrogen (H^+) to form an amine ($-NH_2$) that is combined with a carboxylic acid (–COOH), which is the backbone of an amino acid. Amino acids are combined to form proteins. Because NR is not abundant in highbush blueberry, the uptake of NO_3^- suggests that the plant is either sequestering it in an organ such as the vacuole of a leaf or slowing the rate of amino acid production. The objective was to determine if NO_3^-N is being sequestered in the leaf, and measure LF and CRF effect on growth and fruit quality.

Materials and Methods

The study was conducted with SHB 'Star', planted in 2008, to evaluate the effects of GF, LF, and CRF at the University of Georgia's Alapaha Blueberry Research Farm in Berrien County, GA in 2014 and 2015. The plants were grown on Leefield loamy sand. The bushes were planted in pine bark culture at a spacing of 5 ft (in-row) ^{x} 12 ft (between-row) on 4 ft (width) ^{x} 18 inch (height) beds. Irrigation was provided through a single line of drip tape positioned down the center of the bed and over the crown of each plant. Water was applied based on a total of 1inch of water per week including precipitation during the growing season. Plants were managed according to standard agricultural practices for the southeastern region of the U.S.

In a complete randomized design, there were five treatments of 9 bushes in each treatment that one of five fertilizer treatments were applied: 1) GF 10-10-10 (95% NH_4-N, 5% NO_3^-N; Super Rainbow, Agrium, Denver, CO.), 2) LF 10-5-5 (63.5% NH_4-N, 36.5% NO_3^-N; Deep South, Douglas, GA.), CRF 18-6-12 (100.0% NH_4-N, 0.0% NO_3^-N; Everris, Dublin, OH) as 3) 3 month CRF (CRF3), 4) 6 month CRF (CRF6), and 15-8-11(56% NH_4-N, 44% NO_3^-; Suncote, Scotts, Marysville, OH) 5) 12 month CRF (CRF12). Each treatment had three guard or untreated bushes between the treatments. All treatments were fertilized at the rate of 100 $lb{\cdot}A^{-1}$ nitrogen. The GF was applied at bud break (60% of total N), fruit set (20% of total N), and postharvest (20% of total N). The CRF 12 and 6 month was applied at 100% rate of total N at bud break and the 3 month was split into two applications at bud break (50% of total N) and 3 months later (50% of total N). The LF applications started at bud break at 5% of total $N{\cdot}week^{-1}$ for 20 weeks. All applications were applied by hand in a 24 inch wide band beneath the plants and not incorporated in to the soil.

All treatments were hand harvested when the GF treatment was at 40% maturity, 2 May and 9 May for 2014 and 2015, respectively. Only marketable fruit were evaluated and fruit that was green, red, or damaged were discarded. Within each treatment, the bushes were randomly divided where 3 bushes represented a replication so that each treatment was harvested in triplicate. The marketable fruit was analyzed for weight, firmness, soluble solid concentration (SSC), and acidity. The weight of 100 berries was measured in grams (g) and 50 fruit per subsample were measured at the equator for firmness ($g{\cdot}mm^{-1}$) (FirmTech2, Bioworks, Inc. Wamego, KS). Soluble solid concentrations were measured with a digital hand-held refractometer (° Brix) (BrixStix, Cole Palmer, Vernon Hills, IL), and 0.1 N sodium hydroxide (NaOH) was used to determine the titratable acidity (TA) of the fruit (Mettler Toledo DL15 Titrator, Columbus, OH). For SSC and TA analyses, 25 fruit per subsample were pulped (PowerGen 500, Fisher Scientific, Waltham, MA) and centrifuged (Allegra 25R Centrifuge, Beckman Coulter, Brea, CA) at 4100g_n in 50 mL high-speed plastic centrifuge tubes (Fisher Scientific, Waltham, MA). The liquid portion was collected and evaluated for SSC and TA.

Leaf tissue was collected in May and Sept in 2014 and 2015. The tissue collection was in the same manner as harvest with sampling in triplicate, 3 bushes per replication, and 50 fully expanded leaves were collected from the present year’s stem growth. The bushes were not summer or winter pruned. Tissue collection from suckering shoots was avoided. All tissue collected was washed in a dilute phosphate-free detergent solution (0.1% detergent) followed by rinsing with distilled water. The tissue samples were then dried to a constant weight at 80 °C (Grieve model 13-261-28A, Round Lake, IL). The samples were analyzed for total N and nitrate (Waters Agricultural Laboratories, Inc., Camilla, GA).

Shoot length (cm) and shoot count were measured mid-winter 2015 and 2016. Shoot length measurement was a random sampling of 10 shoots per bush from the top third of the plant, which avoids measuring suckering shoots from the crown. Shoots counted were reddish shoots from previous season's growth.

The experiment was analyzed using SAS's 9.3 Proc GLM (SAS Institute Inc., Cary, NC, U.S.). Means were separated at $P<0.05$ level using Fisher's least significant difference (LSD) test.

Results

The levels of NO_3-N in GR, LF, CRF3&6, and CRF12 were 5%, 36.5%, 0% and 44%, respectively. Total leaf nitrogen was not significantly different within each sampling date except 16 May where CRF3 was 17% lower in % N than the GR; however, none of the plants were deficient for N in 2014 or 2015 (Table 1). Sufficiency range for SHB is 1.44-2.20 % N. None of the treatments had >200 ppm nitrate, which was the lower detection limit for the sample matrix.

Fruit quality was assessed as firmness ($g \cdot mm^{-1}$), weight of 100 fruit (g), sugars (°Brix), and % acid. Firmness in 2014, the LF and the CFR were ~ 4% firmer than the GF. In 2015, CFR12 was the firmest treatment, which was ~ 10% firmer than the GF (Table 2). The average firmness of all the treatments were ~ 56% less in 2015 compared to 2014. Daily maximum and minimum temperatures averaged over 7 days prior to harvest were 77 and 59 °F and 28.1 and 82 °F for 2014 and 2015, respectively. The average rainfall over the same 7 days was 1.1 and 0 inches for 2014 and 2015, respectively. However, the maximum temperature on the day of harvest was 75 and 90 °F for 2014 and 2015, respectively. The maximum temperature in 2015 was 26% higher than 2014, which suggests temperature has an impact on fruit quality. Fruit weight between the treatments in 2014 was not significantly different. In 2015, CFR3 was 18% heavier than CRF12. Fruit weight when averaged over all the treatments was 4% heavier in 2015. Considering the rainfall difference between 2014 and 2015, this suggests that water moving into the fruit did not affect the firmness because the heavier fruit were in 2015 when 0 inches of precipitation was observed 7 days before harvest. Further, in 2015, CFR12 fruit were significantly firmer than the other treatments (Table 2); however, the fruit with lowest weight were not significantly different than the fruit with the least firmness. In addition, leaf N was not significantly different (Table 1), which suggests that the source of N was not singularly contributing to the variation. Possibly, environmental factors, harvest timing, and transport are affecting fruit quality and additional research is needed to identify effects on fruit quality. Sugars and acidity were not significantly affected by the treatments (Table 2).

Vegetative growth was measured as shoot length (cm) and shoot count. In 2014, CRF12 had significantly more growth than the GF by 22% and in 2015 GF had 4% more growth than CRF12, though not significant. Also in 2015, CRF6 had 18% more growth then GF (Figure 1). During 2014 there was no difference in shoot count between the treatments. In 2015, LF had significantly more shoots than CRF12 by 25% (Figure 1).

The vegetative growth was not consistent through the years when comparing treatments, suggesting that growth was not inhibited by the N treatment and further study is needed to ascertain long term effects upon growth.

Conclusions

In this study, low concentrations of NO_3^- were noted in the leaf tissue. Further, the % N, fruit quality, and growth were similar between treatments. The use of GF, LF and CRF suggests that any of these formulas are appropriate for blueberry production in pine bark culture. However, more work is needed to identify nutrient leaching, long term use on soil characteristics, and plant production.

Table 1. Leaf nitrogen as % N and NO3-N (ppm) from fertilizer trial 2014 and 2015

Treatment	16-May-14		5-Sep-14		20-May-15		15-Sep-15	
			% N					
GF[z]	2.56	a[y]	1.85	a	2.03	a	1.61	a
LF	2.53	a	1.87	a	2.23	a	1.64	a
CRF3	2.12	b	1.75	a	2.22	a	1.65	a
CRF6	2.45	a	1.80	a	2.26	a	1.62	a
CRF12	2.45	a	1.63	a	2.03	a	1.65	a

[z]GF) 10-10-10, granular fertilizer; LF) 10-5-5 liquid fertilizer; 18-6-12 controlled release, CFR3) 3 month CRF, CRF6) 6 month CRF; and 15-8-11 controlled release CRF12) 12 month CRF.
[Y]Means within columns with the same letter are not significantly different according to the LSD test (*P*≤0.05).

Table 2. Fruit quality measurements from fertilizer trial 2014 and 2015

Treatment	Firmness (g.mm-1)		Weight (g)		Brix		% Acid	
			9-May-14					
GF[z]	238.3	b[y]	190.5	a	10.8	a	1.20	a
LF	248.9	a	190.8	a	10.2	a	1.82	a
CRF3	248.8	a	175.5	a	10.8	a	1.78	a
CRF6	248.8	a	181.3	a	10.3	a	1.10	a
CRF12	248.4	a	187.7	a	10.9	a	1.70	a
			2-May-15					
GF	131.9	d	189.3	bc	9.7	a	0.58	a
LF	133.3	cd	183.7	bc	9.3	a	0.55	a
CRF3	136.4	cd	214.5	a	9.7	a	0.47	a
CRF6	141.5	b	202.8	ab	9.1	a	0.58	a
CRF12	145.9	a	175.5	c	9.3	a	0.60	a

[z]GF) 10-10-10, granular fertilizer; LF) 10-5-5 liquid fertilizer; 18-6-12 controlled release, CFR3) 3 month CRF, CRF6) 6 month CRF; and 15-8-11 controlled release CRF12) 12 month CRF.
[Y]Means within columns with the same letter are not significantly different according to the LSD test (*P*≤0.05).

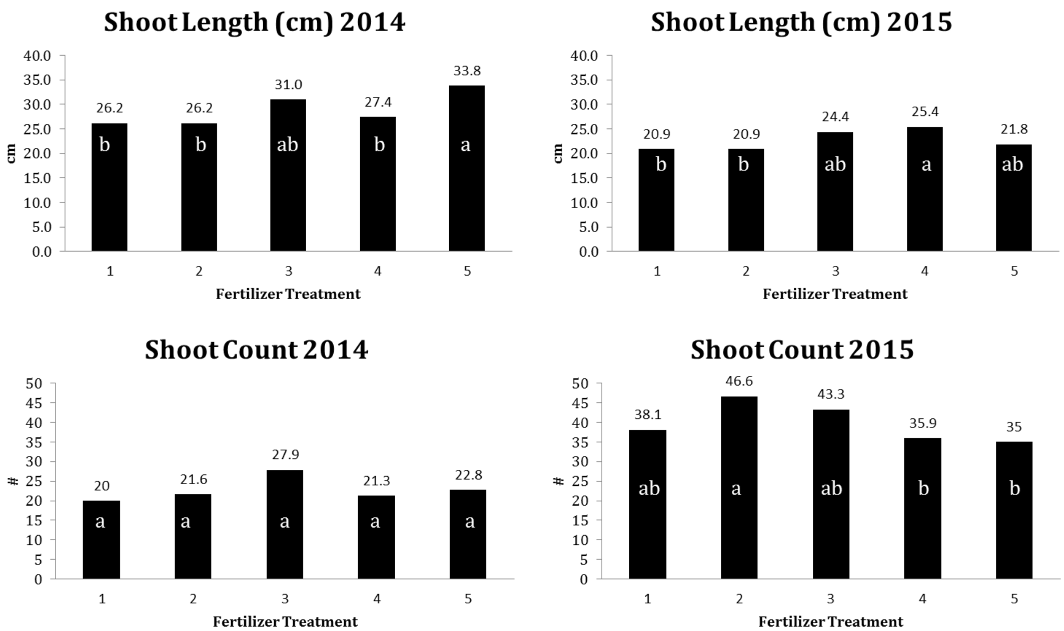

Figure 1. Shoot length and shoot count measurements from 2014 and 2015 fertilizer trial: 1) 10-10-10, granular fertilizer; 2) 10-5-5 liquid fertilizer; 18-6-12 controlled release, 3) 3 month CRF, 4) 6 month CRF; and 15-8-11 controlled release 5) 12 month CRF. Means within columns with the same letter are not significantly different according to the LSD test (*P*≤0.05).

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Foliar Nutrient Uptake in Blueberry

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Introduction

Foliar applications of nutrients are a popular method to amend nutrient programs. Foliar calcium applications are successful for controlling bitter pit and cork spot in apple. However, recommdations for foliar nutrient applications usually follow a deficiency or low nutrient level found through tissue analysis or by observation of a symptom. Many blueberry growers subscribe to nutrient programs where healthy plants are given foliar applications of macro- or micro-nutrients. Macro-nutrients are chemical elements that appear in the plant in relatively large amounts and consist of nitrogen (N), phosphorous (P), potassium (K), magnesium (Mg), calcium (Ca), and sulfur (S). Micro-nutrients are also chemical elements that are required by plants in trace amounts and consist of, but not limited to, boron (B), zinc (Zn), manganese (Mn), iron (Fe), and copper (Cu). Macro-nutrients are measured as a percentage (%) of the tissue; whereas, micro-nutrients are found in concentrations of parts per million (ppm) (Table 1).

Table 1. The nutrient elements generally associated with plant tissue analysis and deficiency/sufficiency ranges for southern highbush blueberry. Macro-nutrient concentration is in percentage (%) and micro-nutrient concentration is in parts per million (ppm). Included is nutrient mobility in soil and plant leaf tissue.

Nutrient	Deficiency Range	Sufficiency Range	Mobility	
			Plant	Soil
Macro-(%)				
Nitrogen (N)	1.35	1.45-2.20	mobile	immobile as NH_4^+
Phosphorous (P)	0.07	0.10-0.40	somewhat	immobile
Potassium (K)	0.30	0.40-0.90	very	somewhat
Magnesium (Mg)	0.08	0.12-0.40	somewhat	immobile
Calcium (Ca)	0.13	0.35-0.80	immobile	somewhat
Sulfur (S)	0.10	0.12-0.40	mobile	mobile
Micro- (ppm)				
Boron (B)	20	25-75	immobile	very
Zinc (Zn)	8	10-100	immobile	immobile
Manganese (Mn)	23	40-600	immobile	mobile
Iron (Fe)	25	35-200	immobile	immobile
Copper (Cu)	4	4-20	immobile	immobile

Blueberry has a thick wax cuticle on the leaves, all of the micro-nutrients are immobile within the plant, and there is varying mobility of macro-nutrients within the plant (Table 1). In previous experiments in blueberry with N and B foliar applied chemistries have shown very low response and uptake (Hanson, 2000; Widders and Hancock, 1994). However, growers are applying these compounds to their plants, which begs to question the efficacy of this practice. In 2015, a trial was conducted to identify uptake of foliar applied compounds.

Materials and Methods

Site and Cultivar. In Lanier County, Georgia near Lakeland, the southern highbush blueberry cultivar Emerald was chosen for the experiment. The plants were five years in the ground on a commercial farm with standard production practices being applied for southern highbush blueberry production. The plants were growing in Alapaha series soils (loamy, siliceous, subactive, thermic, Arenic Plinthic Palequults), under drip irrigation, and frost protection.

Treatments. Two foliar applied nutrient products were tested with and without a deposition aid. Albion Metalosate Crop-Up® an amino acid chelate liquid foliar (Clearfield, UT: Mg, 0.5%; B, 0.025%; Cu, 0.25%; Mn, 2.5%; Fe, 0.25%; and Zn, 1.25%) and R.W. Griffin (RWG) Industries custom mixed sulfate salts and boric acid (Douglas, GA: Mg, 2%; B, 0.1%, Cu, 0.25%, Mn, 1%; Fe, 2%, and Zn, 1%) were applied on 5/29/15 and 8/18/15. On 5/29 the application rate was 4 pt/A. Because the response was negligible, the 8/18 application was at 3 gal/A. On both application dates, a deposition aid was used (LI 700, Loveland Products, Greeley, CO) for some treatments. For the treatments with LI 700, the rate was 0.125% v/v. Each treatment consisted of 5 bushes in a continuous row and each treatment had two guard bushes to avoid over spray into the adjoining treatment. The treatments were randomized and the treatments were 1) untreated (water only), 2) LI 700 solution (water and 0.125% LI 700), 3) Crop-Up, 4) Crop-Up with LI 700, 5) RWG, and 6) RWG with LI 700. All treatments were applied via backpack sprayer (Solo 3.79 L 473-P, Newport News, VA) to runoff and were applied mid-morning.

Uptake assay. To identify uptake in the leaf tissue, leaf samples were collected at 3 and 10 days after the application, only fully expanded leaves that were exposed to full sun were collected at 30 leaves per bush from 3 randomly selected bushes (analyzed in triplicate) within each treatment. Tissue collection from suckering shoots was avoided. June leaf sampling was collected from one year old wood and sampled before summer hedging. For August leaf sampling, the leaves were collected from new growth after pruning. All leaf tissue collected was washed in a dilute phosphate-free detergent solution (0.1% detergent) followed by rinsing with distilled water. The tissue samples were then dried to a constant weight at 80 °C (Grieve model 13-261-28A, Round Lake, IL). The samples were analyzed for leaf tissue nutrients (Waters Agricultural Laboratories, Inc., Camilla, GA), where the dried leaves were ground to pass a 20-mesh screen, the samples were reduced to ash in a muffle furnace, acid digested, and measured by inductive coupled plasma spectrophotometer (ICP) coupled to a Digiblock 3000 (SCP Science, Baie D'Urfé, Quebec, Canada).

Statistics. The experiment was analyzed within the year and date to avoid additional interactions using SAS's 9.4 Proc GLM (SAS Institute Inc., Cary, NC, U.S.). Means were separated at $P<0.05$ level using Fisher's least significant difference (LSD) test.

Results

Nutrient profiles were within sufficiency ranges on all sampling dates (Table 2). At 3 days after application (DAA), the sample from 6/1 showed Fe and Cu were increased by the RWG product over the treatments without foliar nutrient applied. However, by 10 DAA the nutrient levels of Cu and Fe showed a decrease from 6/1 and the sample with just LI 700 was statistically similar to the applied foliar nutrients. The August application was at 3 gal/A, 6 fold increase of product from the 4 pt/A in late May, the 3 DAA Zn, Mn, Fe, Cu showed significantly higher amounts in leaf tissue than the treatments without foliar fertilizer. However, by 10 DAA there were decreases in the treatments compared to 8/21. Interestingly, the RWG sulfate salt solutions did not show significant uptake in S when compared to the treatments without foliar fertilizer applied. Further, applications with LI 700 did not improve uptake.

Discussion

Blueberries have a thick wax cuticle protecting the leaves, and even with a dispersing aid, the uptake of nutrients seen after 3 DAA did not have similar levels to 10 DAA, suggesting the dispersing aid had minimal effect. Considering nutrient mobility, all of the micro nutrients are immobile in the plant. August treatments were at 3 gal/A, the 8/21 leaf tissue samples showed significant increases in Zn, Mn, Fe, and Cu compared to the treatments without foliar fertilization; however, the 8/28 samples showed that the immobile micro-nutrients had decreased in concentration. This suggests that even with cleaning procedures, the nutrients were not within the leaves and being metabolized but rather embedded in the wax of the leaf. This work does show that Fe and Cu are increased by foliar fertilization and that the less expensive sulfate salts without deposition aid are as effective as the chelated compound used in this study. However, some consideration should be made as to the usefulness of applying immobile nutrients as foliar fertilization to plants that are within sufficiency ranges.

Conclusions

Foliar fertilization to blueberry of Mg, S, B, Zn, Mn, Fe, and Cu shows only short term uptake and unfertilized plants were within sufficiency ranges for these nutrients throughout the growing season. With the migration of immobile micro-nutrients out of the leaves, this suggests that the material may not be entering the cells of the plant.

Table 2. Analysis of leaf tissue after foliar fertilizer applications of Albion Metalosate Crop-Up® and R.W. Griffin (RWG) Industries custom mix applied on 5/28/15 (rate 4 pt/A) with leaf sampling on 6/1 and 6/8 and a second application on 8/18/15 (rate 3 gal/A) after sufficient regrowth from summer hedging with sampling on 8/21 and 8/28. Comparisons are within a sampling date.

	Mg		S		B		Zn		Mn		Fe		Cu	
Treatment	%		%		ppm		ppm		ppm		ppm		ppm	
C-1[z]	0.250	c[y]	0.18	b	53.0	b	16.0		65.7	b	50.7	c	5.3	c
L-1	0.268	ab	0.20	a	62.7	a	10.7		71.3	ab	68.3	b	5.7	bc
A-1	0.270	a	0.20	a	60.7	a	17.7		76.0	a	70.3	b	7.0	a
AL-1	0.262	bc	0.20	a	56.0	b	15.3		76.0	a	58.0	bc	6.7	ab
R-1	0.268	ab	0.20	a	60.7	a	12.7		69.3	ab	87.3	a	7.0	a
RL-1	0.250	c	0.19	b	54.3	b	22.0		68.7	b	59.3	bc	5.7	bc
P value	*0.0246*		*0.0037*		*0.002*		*0.1204*		*0.042*		*0.0021*		*0.0173*	
C-8	0.24	b	0.20		55.3		11.0	b	64.7	ab	48.0		5.3	
L-8	0.25	b	0.21		59.3		10.3	b	66.0	ab	55.3		6.0	
A-8	0.25	b	0.20		53.3		11.7	b	59.3	b	54.7		6.3	
AL-8	0.28	a	0.22		63.7		15.3	a	78.3	a	65.3		6.3	
R-8	0.24	b	0.19		51.7		11.3	b	52.7	b	65.7		6.7	
RL-8	0.24	b	0.19		53.0		11.7	b	61.3	b	59.7		5.7	
P value	*0.0257*		*0.1422*		*0.0798*		*0.0013*		*0.041*		*0.1863*		*0.0813*	
C-21	0.20		0.17		55.2		22.4	bc	48.7	c	45.1	d	5.8	b
L-21	0.20		0.17		65.6		16.3	c	61.2	bc	52.7	cd	8.6	b
A-21	0.22		0.17		57.6		35.0	a	89.1	a	57.8	bc	9.6	b
AL-21	0.21		0.19		61.3		33.7	a	76.4	ab	63.9	b	9.6	b
R-21	0.21		0.18		56.1		29.9	ab	77.9	ab	65.3	b	10.4	b
RL-21	0.22		0.17		62.8		37.1	a	90.5	a	76.4	a	23.1	a
P value	*0.1984*		*0.072*		*0.1176*		*0.0024*		*0.012*		*0.0002*		*<0.0001*	
C-28	0.21		0.18		56.4		11.9	c	42.4	c	47.8	c	5.3	cd
L-28	0.20		0.17		54.4		12.8	c	45.8	c	36.2	d	4.9	d
A-28	0.21		0.17		58.0		15.4	bc	55.4	b	60.1	b	7.2	ab
AL-28	0.22		0.17		59.4		18.9	ab	72.7	a	52.6	c	7.0	ab
R-28	0.21		0.17		56.6		19.8	a	42.8	c	67.5	a	6.1	bc
RL-28	0.22		0.18		56.8		18.9	ab	51.2	b	65.5	ab	7.8	a
P value	*0.064*		*0.119*		*0.2192*		*0.0023*		*<0.0001*		*<0.0001*		*0.0009*	

[z]C = untreated, L = LI 700, A = Albion Metalosate Crop-Up, R = RW Griffin custom mix, A or R with L = LI 700 added; 1 = 6/1/15, 8 = 6/8/15, 21 = 8/21/15, and 28 = 8/28/15

[y]Means within a column with a different letter are significantly different at $P \leq 0.05$ according to Fisher's least significant difference (LSD) test.

References

Hanson, E.J., 2000. Foliar boron sprays do not affect highbush blueberry productivity. *Small Fruits Review* 1:35-41.

Widders, I.E. and Hancock, J.F., 1994. Effects of foliar nutrient application on highbush blueberries. *Journal of Small Fruit & Viticulture* 2:51-62

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SOIL HEALTH TESTING WITH THE SOLVITA® SYSTEM

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Introduction

Plant health is considerably influenced by soil health with its various components. Soil quality is defined as the capacity of soil to function for different uses, such as a growing medium for plant production (commonly measured as yield), in the regulation of water flow in the environment, and in the recycling of organic residues. Soil quality has intrinsic and dynamic components. Soil mineralogy and soil texture (percentages of sand, silt, and clay) are intrinsic properties that affect a soil's ability to function and are not easily altered. Some dynamic characteristics of soil quality, which respond to changes in management include pH, nutrient status, density, organic matter, and soil biology. Farmers and gardeners commonly manage specific soil amendments by incorporating limestone, humus, compost and cover crops to improve soil health.

Maintenance of the chemical, physical, and biological “health” of the soil is a goal of sustainable soil management. Standard soil fertility assessments involve field sampling with soil probes and laboratory analysis of macro- and micro-nutrients as well as soil pH. Fertilizer recommendations are based upon current soil nutrient levels and estimated crop needs. The ability of farmland or garden soil to produce its own biological nutrients such as nitrogen over the growing season, typically has not been measured due to a lack of economical, practical and/or accurate testing equipment.

Solvita® technology is a patented environmental measurement system with applications for soil, compost, manure and grain. The concept is based on color-reactive gels which absorb or react with gases and allow color to serve as an indicator of the gas concentration. One type of Solvita® gel is used to measure carbon dioxide (CO_2) in either low or high ranges, and another type is for ammonia (NH3) (Haney and Brinton, 2008). In assessing soil health, the low-level CO_2 gel is used to measure CO_2 emissions from soil, which are primarily due to microbial respiration. The level of microbial activity is indicative of the amount of active organic matter that is being metabolized and nutrients being released simultaneously from the organic matter (Figure 1).

While the Solvita® soil respiration test can be used in the field, the laboratory method, referred to as the CO_2-Burst Method or Haney-Brinton Protocol, is performed under more controlled conditions and utilizes a drying-rewetting procedure which stimulates a flush of microbial activity to accurately assess biological potential. The visual color chart or an electronic digital color reader provide a 0 to 5 scale of soil health calibrated with the approximate level of CO_2 respiration. This ranking corresponds to the biomass of micro-organisms in the soil. Based on this ranking, an interpretive chart shows the farmer, agent or advisor the amount of additional nitrogen potentially released by soil biology. Soil ratings of low, moderately low, medium, ideal, or unusually high microbial activity provide estimates of 5, 10–20, 20–30, 30–50, or 75–100 lbs. N/acre that could be credited against the total crop needs (Figure 2, Solvita® Guidelines, 2013).

Fig. 1 Solvita® soil test equipment and supplies; color chart, color reader, soil beakers and gel indicators in air-tight jars.

Color 0 - 1 Blue-Gray	1 - 2.5 Gray-Green	2.5 - 3.5 Green	3.5 - 4 Green-Yellow	4 - 5 Yellow
VERY LOW SOIL ACTIVITY Associated with dry sandy soils, and little or no organic matter	MODERATELY LOW SOIL ACTIVITY Soil is marginal in terms of biological activity and organic matter	MEDIUM SOIL ACTIVITY Soil is in a moderately balanced condition and has been receiving organic matter additions	IDEAL SOIL ACTIVITY Soil is well supplied with organic matter and has an active population of microorganisms	UNUSUALLY HIGH SOIL ACTIVITY High/excessive organic matter additions
APPROXIMATE LEVEL OF CO_2- RESPIRATION[a]				
< 300 mg CO_2/kg soil/wk	400 (300 - 500)	750 (500 - 1,000)	1,500 (1,000 - 2,000)	> 2,000 mg CO_2/kg soil/wk
Approximate quantity of nitrogen (N) release per year (average climate)				
< 5 lbs/acre	10-20 lbs/acre	20-30 lbs/acre	30-50 lbs/acre	75-100 lbs/acre

Soil Quality Curve

Fig. 2

Sampling Program

From 2013 – 2016, over 800 soil samples were processed with the Solvita® system. Seventy-four crop fields were GPS/GIS mapped and sampled at the same location in spring, summer and fall. Representative categories of crop production included:

A. Vegetables in Monmouth County - Representative types of plant production in the county included sweet corn, pepper and tomato.
B. Blueberry fields throughout New Jersey –Soils from commercial operations, wild blueberry and organic blueberry operations.
C. Perennial Grass crops in Monmouth County – equine pasture, Miscanthus – a bio-energy grass, residential lawns, sod farms and golf course fairways and greens.
D. Agronomic farms – conventional soybean and field corn rotations in Central NJ.

Results

A. 18 representative soil sites were selected in Monmouth County, NJ; primarily farms having sandy loam soils with pH values ranging from approximately 5.1 to 6.3 and typical organic matter from 1.0 to 2.0%. Solvita® values for carbon dioxide respiration in annual vegetable crop production generally indicated a moderately low level of beneficial soil activity.
B. Blueberry – Conventional blueberry fields were very low in beneficial microbial activity and correlated with very low pH and low organic matter. Conversely, adjacent areas of wild blueberry stands and nearby organic blueberry operations had very good soil health associated with higher pH and soil organic matter.

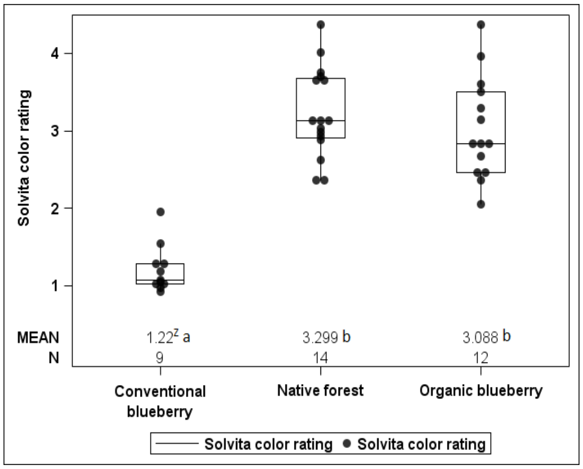


Figure 3. Comparing conventional, native and organic blueberry soils with the Solvita® 0-5 scale. z Means with different letters are significantly different at α = 0.05 according to Fisher's Protected LSD.

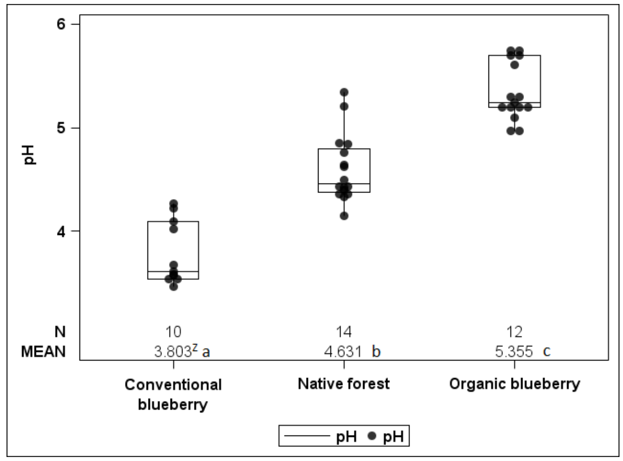
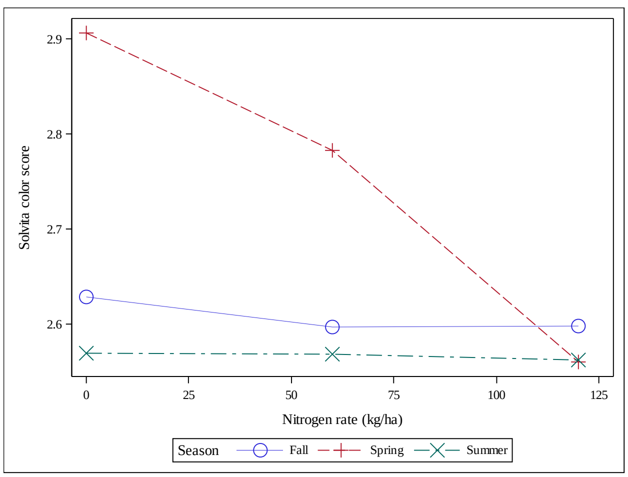


Figure 4. Comparing pH levels among conventional, native and organic soils. z Means with different letters are significantly different at α = 0.05 according to Fisher's Protected LSD.

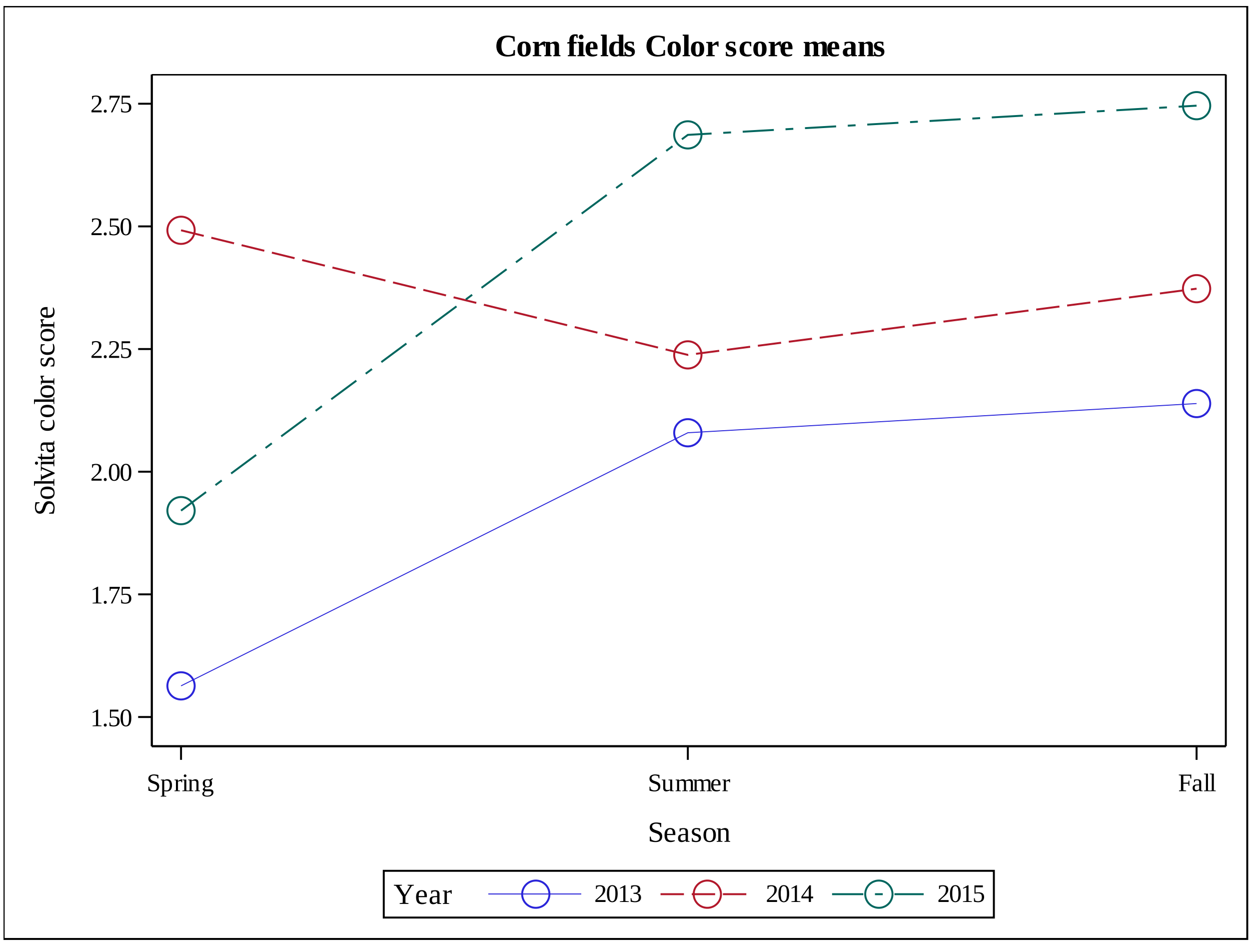
C. Perennial Grass Crops – Miscanthus bioenergy crop had very good soil health.



Type 3 Tests of Fixed Effects				
Effect	**Num DF**	**Den DF**	**F Value**	**Pr > F**
Year	2	81	1.55	0.2189
Season	2	81	3.26	0.0436
Year*Season	4	81	4.70	0.0018
Nrate	2	81	1.43	0.2450
Year*Nrate	4	81	1.41	0.2382
Season*Nrate	4	81	1.14	0.3447
Year*Season*Nrate	8	81	1.36	0.2277

D. Agronomic Crops – Six traditional farms with corn-soybean rotation were compared as to Solvita® values, soil fertility, micronutrient level and crop tissue analysis in 2016.These studies will continue in 2017 investigating tillage, cover crop, soil amendments and pesticide use in relation to soil biology.

E. Agronomic Crops – Six traditional farms with corn-soybean rotation were compared as to Solvita® values, soil fertility, micronutrient level and crop tissue analysis in 2016.These studies will continue in 2017 investigating tillage, cover crop, soil amendments and pesticide use in relation to soil biology



F. Agronomic Crops – Six traditional farms with corn-soybean rotation were compared as to Solvita® values, soil fertility, micronutrient level and crop tissue analysis in 2016.These studies will continue in 2017 investigating tillage, cover crop, soil amendments and pesticide use in relation to soil biology.

Small Fruit

UPDATES ON SPOTTED WING DROSOPHILA MANAGEMENT FOR DIVERSIFIED SMALL FRUIT FARMS

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Spotted wing drosophila (SWD), is an invasive insect pest that continues to be a serious problem for growers of soft-skinned fruit, such as blackberries, blueberries, cherries, and raspberries. Able to lay their eggs in undamaged fruit as it ripens, SWD cause direct damage to fruit. SWD has many cultivated and non-cultivated alternate hosts, and can utilize overripe as well as ripe fruit. Mid-Atlantic diversified small fruit farms often plant multiple crops that are suitable hosts for SWD, and also extend the harvest period for those crops by planting multiple varieties. Therefore, these farms have susceptible fruit available for SWD for a large portion of the growing season. SWD populations build as the season progresses, and fruit that ripen later in the season (July-October) are especially at risk.

Management of SWD is difficult, and weekly sprays of broad-spectrum insecticides are often needed to effectively control populations. Diversified small fruit farms typically use one sprayer for all their crops, which requires the sprayer to be adjusted for best coverage in each crop. Using orchard airblast sprayers, we are working to optimize spray coverage in Maryland bramble crops. However, alternatives to pesticide sprays are desperately needed, and researchers around the world are working towards an in-depth understanding of SWD's biology to discover weak points in the life cycle that can be targeted for management. Because climate factors such as temperature, humidity, and light are thought to impact SWD's preferences and survivorship, we are also investigating how canopy and floor management within small fruit crops can impact SWD as part of a USDA-OREI funded team (Grant # 2015-07403). Both projects have just begun, and our first year preliminary results are summarized below.

Optimizing spray coverage with orchard air blast sprayers.
Fall-fruiting red raspberries were sprayed at two carrier water volumes, 50 and 100 gallons per acre (GPA), using a Durand Wayland 100 Sprayer, which had a 24-inch fan and the bottom 3 nozzles turned on. Vision Pink Foam Marker Dye (Garrco Products Inc.) was added to the tank mix, and white spray cards were deployed in the inner and outer canopy of the raspberry plant at three heights: high (4.5 ft. above the ground), medium (3 ft. above the ground), and low (1.5 ft. above the ground). Once the residues dried, the spray cards were scanned, and the percentage of the card dye pink (percent coverage) was calculated using ImageJ software.

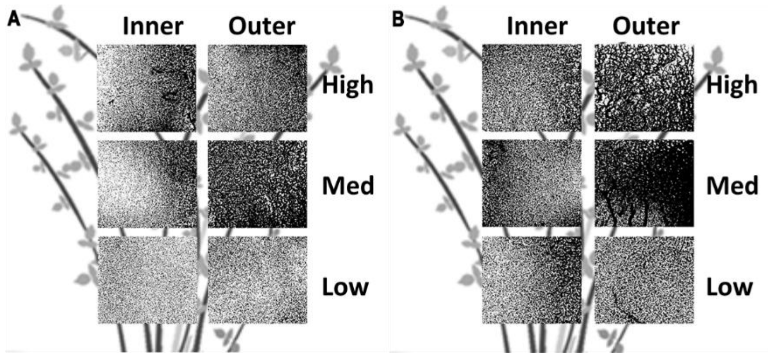

Figure 1. Average spray coverage in six locations of the raspberry canopy when treatments were applied using (A) 50 GPA and (B) 100 GPA on 9/21/16.

The first time this experiment was conducted very little dye was detected on the lower cards, indicating that the sprayer needed adjustment. On the second date (9/21) we lowered the sprayer to its lowest height setting on the hitch and adjusted the angle of the nozzles by turning the two lowest sets of nozzles downward, which increased the amount of spray hitting the lower cards. Overall, coverage was higher in the outer canopy relative to the inner, and percent coverage rates were variable. There were no significant differences in coverage between 50 and 100 GPA in the inner canopy on either trial date, regardless of height. However, a higher spray volume did improve coverage in the outer canopy. For example, on 9/21 percent coverage in the outer canopy was significantly higher at 100 GPA across all heights (Fig. 1).

Increasing the carrier water volume improved coverage in the outer canopy, but did not have any significant effects in the inner canopy, which suggests that optimizing the carrier water volume alone may not be enough to ensure adequate spray coverage. Further study is needed to determine the best system for growers to optimize spray coverage, and this study will be continued in 2017.

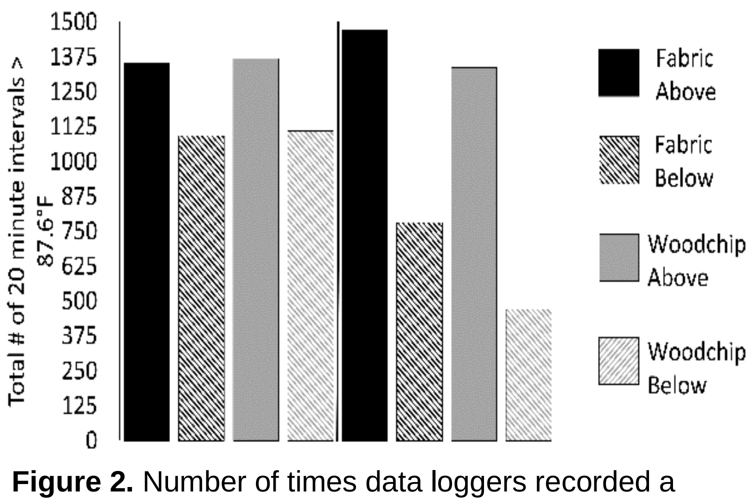

Figure 2. Number of times data loggers recorded a temperature event greater than 87.6 degrees Fahrenheit.

Canopy and floor management impacts on SWD.

Research suggests that SWD do not continue development at temperatures greater than 87.6°F (Ryan et al. 2016). Therefore, we compared canopy and floor management treatments by counting the number of times temperature loggers recorded a temperature above 87.6°F. Fall bearing primocane red raspberries were used for canopy manipulation trials, and were pruned in the spring after the canes had regrown. Pruning treatments included no pruning, medium pruning, and high pruning, such that the canopy density varied. Differences in canopy varied by site, and the no pruning treatment was significantly cooler (fewer intervals exceeding 87.6°F) compared to the other treatments only at the site with the stronger differences in canopy. Floor management studies compared two different mulches in blueberries, a wood chip mulch and a black weed fabric (over wood chip mulch). Temperatures on top of the mulch (above) were much warmer (more intervals exceeding 87.6°F) compared to below the mulch (see Fig. 2). Therefore, our preliminary work suggests that canopy and floor management can change the climate within fruit crops, with the potential to reduce favorability for SWD. The impact of these strategies on marketable yield and fruit quality will be evaluated to determine their feasibility for use in SWD management.

Conclusions.
Diversified small fruit farms face unique challenges for managing SWD, with multiple susceptible fruit crops as well as equipment and labor that are shared between these crops. Comprehensive management of all susceptible crops on the farm throughout the growing season, not just during harvest, can reduce on-farm SWD populations. When insecticide sprays are applied, be sure that the sprayer is calibrated and evaluate coverage throughout the canopy to determine whether good spray coverage has been achieved. Spray coverage may be an important factor in SWD management as many of the effective products require direct contact with adult flies. Additionally, canopy and floor management can be used to manipulate the climate SWD experiences within fruit plantings. With further optimization, this can be used to reduce the favorability of the crop environment to SWD and has potential for use in SWD management strategies.

Acknowledgements.
We would like to thank our funding sources, the USDA-NIFA OREI Grant # 2015-07403, the MAES Competitive Grants Program, the Maryland State Horticultural Society, and the Maryland Department of Agriculture. We also thank Adrienne Beerman, Galen Dively, Aditi Dubey, Michael Newell, Douglas Price, Shulamit Shroder, Jessica Van Horn, and Claire Weber for their assistance. Vision Pink Foam Marker Dye samples were provided by GarrCo Products Inc. (Converse, IN).

References.
Ryan GD, Emiljanowicz L, Wilkinson F, Kornya M, Newman JA. 2016. Journal of Economic Entomology DOI: 10.1093/jee/tow006

GROWING AND MARKETING HARDY KIWI AND OTHER SMALL FRUITS

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Introduction and Background

Hello, I am Justin Weaver from Weaver's Orchard Inc. in Morgantown Pa. We are located in Berks County about 1 Hour west of Philadelphia. I am 4th generation on this farm and currently manage/coordinate most tasks and details related to the production, harvest and packing of what we grow. I am also fairly involved in the oversight of the Pick Your Own (U-pick) part of our operation and somewhat involved in the direct marketing of what we grow.

Weaver's Orchard Inc. farms approximately 100 acres. My Great Grandparents purchased the farm in 1932. The crops we grow (listed in approximate order of acreage/value) are: Apples, Peaches, Cherries (both sweet and sour), Strawberries, Blueberries, Pears, Raspberries, Blackberries, Plums, KiwiBerries, Pumpkins, Asparagus, Apricots and Rhubarb. Our main sales outlet is our on-site Market that is open year round in which we also sell almost a full line of fresh foods. (Produce, Dairy, Deli, Meats etc.) We wholesale some of our products, mainly apples, peaches and cider. PYO is a driving force of our operation, not only in the direct sales of the crops but also in drawing people out to the farm who also purchase things in the store.

We have been growing Kiwiberries (Hardy Kiwi) for about 8 years. We purchased the plants from Kiwi Korners in Danville Pa. (kiwiberry.com) The variety we have is 'Passion Poppers'. Kiwiberry plants take about 7-8 years to begin fruiting but we were able to buy plants that were already 5-6 years old. We have about 80 plants on approximately .6/acre. Spacing is about 16' between rows and 18' between plants. Training system is a main cordon at about 6' high with laterals every 18" supported by a post 6' high with a 7' crosspiece on top. Posts are spaced at 36' with 5 wires on top.

The most challenging part of the care for kiwiberries is that they are extremely vigorous growing in excess of 10' per year. This requires a fair amount of summer pruning to keep the rows from growing shut. We do the main pruning in March which can also be a challenge as the vines become a tangled mess. The goal is to renew most laterals off the cordon annually and never have laterals older than 2 years old. Fertility and disease management needs are very minimal. The main pests are SWD and Japanese beetle. Pollination is also a challenge. Male and Female plants are needed and some years pollination is lacking. Bumblebees are brought in to attempt to aid in pollination.

Harvest is in September. Harvest for resale must be done before the fruit gets soft as the stems will pull out damaging the fruit if picked soft. We watch for the first soft fruit and then we pick leaving some fruit for PYO. Fruit is ripened in a 50F cooler before sale. Fruit can be held at around 35F for 4-6 weeks. Kiwiberries are a challenging crop for PYO as it is difficult to have fruit that tastes good in the field for people to sample. I think that limits out ability to sell larger volumes PYO, though sales are slowly increasing annually.

Due to the pollination issues yields range from 3800 lb/acre to 8500 lb/acre. Our pricing varies depending on size of the crop but a ballpark is $3.99/lb PYO and 3.99/ ½ pint retail.

Marketing this new crop has boiled down to the need to get people to taste them. From sampling to handing out small sample containers in the early years. They have a tremendous flavor, similar to Kiwi, but sweeter and softer when ripe. Caution is needed as they are bitter before they are fully ripe. Most people who taste them when ripe cannot resist the purchase!

Overall, it has been a fun new crop to grow. We are now able to make some profit on it but as all berries go, there is a fair amount of labor involved. At least they are easy to grow!

Strawberries are probably our most important small fruit from the standpoint that they get the cash flow going in the spring and we see a big uptick in our customer flow when PYO Strawberries start. We grow 3-4 acres of strawberries of which around 50% are sold PYO and 50% sold in our market. A very small percentage are sold wholesale in good crop years. Botrytis, Anthracnose, sap beetles and the amount of labor involved are generally our biggest challenges for strawberries.

Our production system for strawberries is basically a plasticulture system but we use compostable film. This does allow runners to root after a few months. We generally keep fields for 2 years. The 2nd year the field is more like a raised bed matted row as the plastic film is mostly degraded. Generally we plant 1 acre of bare root plants in May of varieties such as Galletta, Cabot, Malwina etc. We then plant 1 acre of plug plants in August of varieties such as Chandler and Flavorfest.

Raspberries: We generally have about 2 acres of raspberries, mostly floricane/summer bearing varieties, though we have a few primocane varieties. Also, some of our varieties produce a spring and a fall crop. We are split close to 50/50 with Red varieties and Black varieties. The highest percentage of our raspberry crop is sold PYO, followed by sales in our market and also a few wholesale on good years. SWD and the labor intensive nature of the crop are our biggest challenges for Raspberries.

Our training system is what I would call a double T-post (post with two crosspieces). All old canes are removed annually and all new canes are tied to the wires, with the exception of the primocanes which are not tied. We do have 1 small Haygrove solo tunnel with Red Raspberries in it planted by our strawberries. Those raspberries come in 1-2 weeks earlier which falls in the peak of Strawberry season

Blackberries are one of the crops that is increasing in demand. We now have about 1 acre. Sales are primarily through PYO with some also sold in our market and a few sold wholesale when available. SWD is the biggest challenge. Our training system is similar to raspberries.

Blueberries: We have about 2.5 acres of blueberries of which about 75% are sold PYO and 25% through our market. Blueberries are a challenge to grow in our soils but the rewards are worth it. All our blueberry fields are now netted with Smart Net. Birds are a huge problem and while netting is very time consuming, it is well worth it in our situation. Getting good growth and SWD are our biggest challenges.

PYO Procedures

As I mentioned earlier, PYO is very important to our business. We make many of our decisions based around PYO. There are of course challenges, but we have to find ways to overcome them. One thing that is a challenge is pricing. In years long gone, PYO was a way for the customer and the farm to "save" money. Now, most of our customers pick for the experience and we must have ways to recoup our costs when someone only picks a pound or two of fruit. We have thus far been hesitant to charge an admission, though we discuss it annually. Our current approach is a tiered pricing system that gets cheaper the more someone picks. If all someone picks is a couple pounds, the price is generally similar to what they would pay in the Market. We also have a PYO club card which give our regular customers a 10% discount.

Another challenge with PYO is getting the fields clean. For Strawberries we assign people rows and track their progress with flags. For other crops we direct people to specific areas in the field. We try to rotate our PYO with our harvest for our market to keep the fields cleaned up.

SWD

I would be remiss to not address how much an impact SWD has had. With the exception of Strawberries, SWD has changed everything. We significantly reduced our Primocane raspberry production due to SWD. We had toyed with some dayneutral strawberry production and dropped that. Our choices of varieties is filtered through SWD management. Inputs are up, profits are down. Headaches are up, later nights, earlier mornings…who wants to spray Saturday night? (We are closed Sundays). New equipment needed to be purchased to keep up and even to fit in the fields at harvest time- we previously never sprayed Blueberries after we put netting on. The list goes on and on.

We all have labor in the back of our mind so I would take that out of the running and name SWD as currently our biggest challenge and risk in growing small fruits. SO, why grow small fruits? For us it is all about crop diversity and customer flow, and the biggest upside, demand is strong! A field full of happy PYO customers always dulls the pain, and I must admit, I generally love the challenge!

STRAWBERRY DRIP IRRIGATION AND FERTIGATION

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Water Importance. Irrigation is recommended for most, if not all, vegetable and fruit crops. Being dependent on cooperative weather to deliver appropriate amounts of rainfall with precise timing encourages a high risk of failure. Plants are made up of a handful of essential elements, which are divided into mineral and non-mineral. We all recognize mineral nutrients as macro (nitrogen, phosphorous, potassium, calcium, magnesium, and sulfur) and micro (boron, copper, iron, manganese, zinc, molybdenum, chlorine, cobalt, and nickel) from tissue analysis reports. However, the most abundant elements in a plant are non-mineral (carbon, oxygen, and hydrogen). Carbon is acquired by the plant from atmospheric CO_2. Hydrogen and oxygen are derived from water (H_2O), which is what we are delivering though an irrigation system. Plants also use water to move nutrients into and within the plant. The bulk of water used by a plant is in transpiration or the process of moving moisture from the roots through the plant to the leaves and into the atmosphere.

Strawberry production is generally accomplished with two planting systems: matted-row or an annual hill (plasticulture). Matted-row plantings encourage growth from the mother plant called runners (Figure 1). The runners will produce another fruiting plant called the daughter. Matted-row systems are perennial and rooting of the daughter plant is important for continued production. Hence, barriers such as plastic mulch are not used and the planting is irrigated from overhead. Overhead irrigation can be accomplished with impact or micro-emitter irrigation devises. The goal is to cover the entire production area with water. For overhead irrigation, the water used for irrigation should be

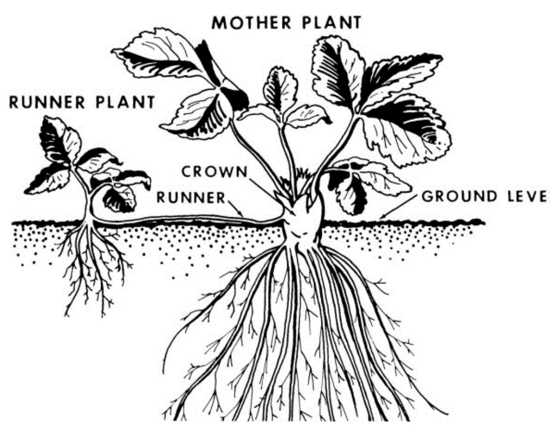

Figure 1. A strawberry plant illustrating the mother plant, crown, runner and runner or daughter plant. Also note planting in relation to ground level depth. United States. Science and Education Administration. *Strawberry Culture: Eastern United States*. Washington D.C.. UNT Digital Library. http://digital.library.unt.edu/ark:/67531/metadc85867/. Accessed December 6, 2016.

filtered and low in hardness. Hard water will leave white spots, which consumers might interpret as pesticides, which warrants irrigation water testing, especially from a well. *Water quality* for irrigation is important, if water is salty, high in sediment, and/or acidic or caustic the effect on the irrigation system and ultimately the crop can mean success or failure.

Drip Irrigation. Strawberry production in the annual hill system uses plastic mulch, hence the name plasticulture. Plasticulture of strawberry usually cultivates the plants as an annual; however, some growers will attempt a second year of production. Mulching with plastic inhibits root penetration from the daughter plants, so runners are pinched. Further, mulch creates a barrier to rain and overhead irrigation, so irrigation is applied via drip tape or tube. Strawberries are shallow rooted and susceptible to drought stress if under-irrigated. The amount, pattern, and timing of irrigations is dependent on soil type, sandy soils drain quickly and strawberries planted in sandy soils will require short duration with higher frequency irrigations. Strawberries are susceptible to freeze damage and overhead irrigation should also be deployed for frost protection in plasticulture production.

Irrigation system. Delivery of water though an irrigation system is similar regardless of demand; however, the timing and volume of water delivered is determined by the capacity of the system and the metering type. The irrigation system starts with a source of water. There is a pump that is the prime mover for water through the system. A pump can be electric, petrol, or gravity powered. Water quality dictates the system layout. Screens and pre-filters (usually sand filters) should be used for surface water. Backflow prevention devices are usually mandatory and the number and type will be listed in the regulation code. Flow meters are important to determine water usage and can be an indicator of leaks

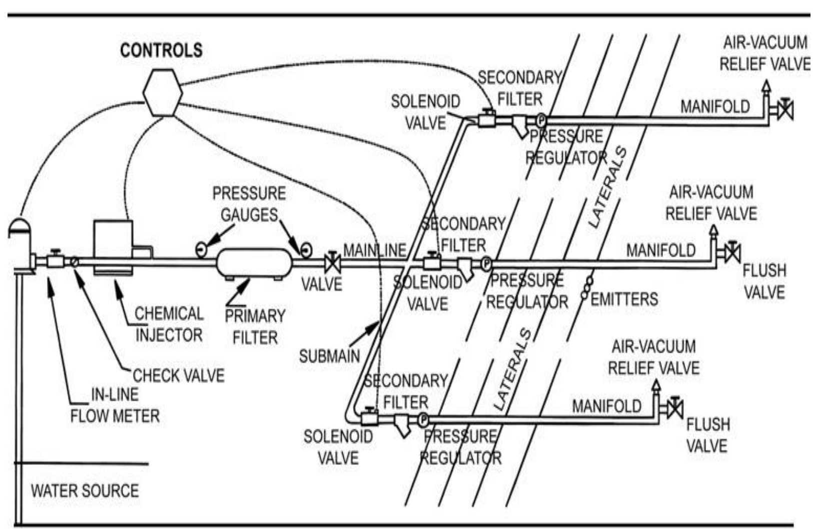

Figure 2. Typical components of a drip irrigation system.

Use valves liberally to isolate components, zones, or any other critical areas where repairs and maintenance can be accomplished with minimal impact on the system. If an injection system is to be used, add the system to the outflow side of the backflow prevention device and before the final filters. Fertilizer in liquid form can precipitate or fall out of solution with time, volume, and changes in temperature, which necessitates filtration before injection into the water metering devices. Pressure gauges should be installed pre and post filter, which will indicate clogging when pressure drop is noted across the filter. Choice of water metering system dictates the type of pressure regulator. Drip tape operates at 10 psi and the corresponding pressure regulator needs to be installed, which ensures the correct amount of water is being applied and to minimize drip line ruptures. Air relief valves should be installed at high points, which allows for air to escape from the system, avoiding air hammer.

Water Demand. A good question to ask is 'How much water needs to be delivered to my crop?' For frost protection, pump capacity should deliver 90 gallons per minute or 0.2 inches per hour per acre using fast rotation overhead sprinklers to cover the production area. If growing in matted-row the frost protection overhead system will also be the irrigation system. For plasticulture, drip systems are used and emitter spacing is dependent on soil type. For sandy loam and clay soils, 12-inch spacing is sufficient and in coarse sands 8-inch spacing is recommend. Mature strawberry plants can use 0.2-inches of water per day, which is 5,431 gallons/acre/day. Drip systems are 80-85% efficient at water delivery, so water demand will be 6,390-6,789 gallons/acre/day. To determine pump capacity, irrigation zones, and irrigation time, we need to make some calculations. Defining the system - for this example we will use the following parameters noted in Table 1.

Table 1. The parameters used for the example calculations for lateral flow rate of a drip emitter irrigation system. Feet = ft, gallons per minute = gpm, gallon = gal, and acre = A.

How to calculate lateral flow rate for drip irrigation in plasticulture:

System parameters used for this example

Drip emitter flow rate =	**0.4 gpm/100 ft**
Bed spacing =	**5 ft x 100 ft**
100 ft row/A =	**[43560 ft^2/(5 ft x 100 ft)] = 87.1**
Efficiency at 80% =	**6789 gal/A/day (GPAD)**

Calculation of water demand for 0.2 inches per day with a system that is 80% efficient:

[1]Water delivery in each 100 ft of drip line per day
6789 GPAD/87.1 (100 ft rows/A)
= 78 gal/100 ft/day

[2]Pump capacity needed to deliver the water in gallons per minute (gpm) to an acre (A)
87.1 (100 ft rows/A) x 0.4 gpm/100 ft
=34.8 gpm/A

[3]To irrigate 8 acres of strawberry production, the capacity of the pump is:
8 A x [2]34.8 gpm/A
=278.4 gpm

[4]If the demand on the pump is to great, divide into zones, example shown is 2 A
2 A x [2]34.8 gpm/A
69.6 gpm

[5]Irrigation time to irrigate 8 A with 4 zones of 2 A each
[1]78 gal/100 ft ÷ 0.4 gpm/100 ft
= 195 min or 3 hrs 15 min (2 A or 1 zone)
4 zones x 195 min
= 780 min or 13 hrs to irrigate 8 A

Chemigation/Fertigation. Injecting pesticides and fertilizers through the irrigation system is an effective method of delivering soluble products directly to the plants without the added expense of labor, specialized equipment, and tractor hours. Two, non-electric, commonly used methods of injection are venturi and positive displacement. Venturi injection uses water pressure from the system to draw the concentrated solution into the irrigation system. Venturi injectors work by creating a high-velocity jet stream of water where an increase of velocity in the injection chamber results in a decrease in absolute pressure. This causes a vacuum that draws the concentrated solution into the irrigation water. Non-electric positive displacement injectors operate using water pressure and are installed directly in the water supply line. Instead of a continual draw of concentrated solution into the irrigation water stream as with venturi injectors, positive displacement injectors draw an intermittent volume of liquid from the intake to the discharge side of the pump, which activates the piston that draws the concentrated solution into the irrigation water at specific volumes with each stroke of the piston.

Strawberry can use in excess of 100 lb of nitrogen (N)/A/season. Soil sampling is recommended to determine phosphorous (P) –potassium (K) available in the soil and determine nutrients needed for the season. At planting in plasticulture apply 66% of the total N needed and apply corresponding P and other nutrients. Application of K is dependent upon fertilizer formulation, for this example we will use a liquid formulation of 7-0-7 N-P-K (Table 2).

Table 2. Represents the recommendation of 100 lb of nitrogen (N) and 165 lb of potassium (K) for plasticulture strawberry production grown in sandy soils of New Jersey. Pre-plant addition of N is 66% of the recommended total or 66 lb of N with 34 lb N to be applied via the irrigation system. The corresponding K applications are 131 lb pre-plant and 34 lb through the irrigation system.

Fertilizer Analysis	Total Recommendation	Pre-plant N (66%)	Injected N and K2O	Pre-plant K
7-0-7	**100 lb N**	**66 lb N**	**34 lb N**	
(1:1 ratio)	**165 lb K_2O**		**34 lb K_2O**	**131 lb K_2O**

Fertigation scheduling at 7 lb N a week over two irrigation days

8 A of production area

Density of 7-0-7 =	10.5 lb/gal
Application =	7 lb N/week/acre
How much N per gallon:	
[7/100 (N = 7%)] x 10.5 lb/gal =	0.735 lb N/gal
How much N applied per day:	
7 lb N/2 days=	3.5 lb N/day/A
How many gallons of 7-0-7 per acre per day:	
(3.5 lb N/A)/(0.735 lb N/gal)=	4.76 gal/A
How many gallons of 7-0-7 applied over 8 A per day:	
4.76 gal/A x 8 A =	37.1 gal

Conclusion. Drip irrigation of strawberries allows for plasticulture production by placing water directly to the rooting zone of the plants. Building a drip irrigation system is dependent on knowledge of system demand, crop water demand, soil type, and water quality. Drip systems can be used to deliver water soluble fertilizer and other water soluble agri-chemicals, which saves time and money.

References

Himelrick D.G., L.M. Curtis, and T.W. Tyson. 1999. Commercial Strawberries http://www.aces.edu/anr/irrigation/pubs/ANR-0662.php

Hochmuth, G. and E. Albregts. 2014. Fertilization of Strawberries in Florida http://edis.ifas.ufl.edu/cv003

Poling B., K. Krewer, J.P. Smith. 2005. Southeast regional strawberry plasticulture production guide
http://www.smallfruits.org/SmallFruitsRegGuide/Guides/2005culturalguidepart1bs1.pdf
Kirsten, A. (ed). 2014. The Mid-Alantic Berry Guide.
https://rucore.libraries.rutgers.edu/rutgers-lib/43412/PDF/1/

PLASTICULTURE AND MATTED ROW STRAWBERRY VARIETY TRIALS

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Trial Establishment

Coordinated plasticulture and matted-row trials of strawberry cultivars had been established in 2014 and data from them was collected in 2015 and 2016. The plasticulture trial was conducted at Penn State's Southeast Research and Extension Center in Landisville while the matted-row trial was conducted at Penn State's Horticulture Research Farm at Rock Springs. Varieties included as standards in the plasticulture trial were 'Sweet Charlie' and 'Chandler' and in the matted-row trial were 'Earliglow' and 'Jewel'. Cultivars or advanced selections that were included in both experiments were 'Galletta', 'Sonata', 'Rubicon', 3 advanced selections from Rutgers University and 3 advanced selections from Cornell University. Additional varieties in the plasticulture experiment were 'Radiance', 'Daroyal', 'Donna', 'Earliglow', 'Flavorfest' and 'AC Wendy'. Additional varieties in the matted-row trial were 'Laurel', 'Herriot', 'Mayflower', 'Malwina' and a fourth advanced selection from Cornell.

Practices used for plant establishment and care followed recommended practices, with the exception that Rutgers selections were planted about a month later than the other varieties and selections at Landisville.

Following harvest of the plasticulture planting at Landisville in 2015, half of the plants were thinned by removing approximately 50% of the crown by hand. The purpose was to determine whether there is a benefit to this practice when carrying over plasticulture plantings for a second harvest year.

Variety Performance in the Plasticulture System

The 2015 growing season in Landisville started wet and then turned dry before becoming wet again. The 2016 season was different in two ways – first – it was generally wet the entire harvest season (total rainfall 4.1 inches in 5 weeks) which necessitated use of a standard fungicide application program. In addition, the temperatures were well above normal with 15 consecutive days of 80º+ starting the second week of harvest and two 90º+ days in the last week of harvest. There were also some early flower losses because of the weather. High temperatures of 79º and 78º on April 1 and 2 were followed by low temperatures of 18º and 22º on April 6 and 10. Even under two rowcovers on these cold nights the most developed king blossoms were killed on the earliest varieties, particularly 'Sweet Charlie'.

Harvest started on May 13 with ‘Chandler’ and one of the Rutgers selections; ‘Sweet Charlie’, ‘Daroyal’ and a second Rutgers selection started on May 16; ‘Earliglow’, and ‘Radiance’ started May 18; ‘Galletta’ May 20; ‘Rubicon’, ‘Wendy’, two Cornell selections and the last Rutgers selection on May 23; ‘Donna’, ‘Flavorfest’, and ‘Sonata’ on May 25 and on May 27 the final Cornell selection started harvest.

The thinning treatment generally affected yield and the percentage of marketable fruit, but had no effect on berry size or brix (soluble solids) levels. Thus data presented below for yields and percentage marketable fruit are given for unthinned and thinned treatments respectively, but are averaged over thinning treatment for berry size and soluble solids.

‘Chandler’ performed about average this season with total yields of 12,230 and 9,611 lbs/acre in the non-thinned and thinned plots, respectively. The marketable percentages were 67 and 72%. ‘Chandler’ had one of the highest plant losses in the planting. A sample was sent to the PSU Plant Disease Lab and showed *Phytophthora* root rot on this variety. Average size of the marketable fruit was 12.9 g/berry with an average brix reading of 6.6. Overall performance of ‘Chandler’ in this study was not consistent with its position as the standard variety for plasticulture production in the SE part of PA.

‘Sweet Charlie’ yields were poor whether plants were non-thinned or thinned (8,139 and 7,366 lbs/acre, respectively) with marketable fruit percentages of 79 and 77% and average berry size of 12.1 g. As noted earlier, many early flowers were lost in the April sub-freezing temperatures.

‘Daroyal’ had good yields in the unthinned treatment (18,327 lbs/acre) but markedly lower yields when thinned (9,491 lbs/acre). Average marketable percentage increased from 56% to 73% with thinning and average fruit size was 12.0 g with a brix reading of 6.7. Flavor and appearance were good.

‘Radiance’ had total yields of 13,458 lbs/acre unthinned and 12,334 lbs/acre thinnned with marketable fruit percentages of 62 and 59%. Average berry size was 15.1 g/berry, brix level was 5.3 and while appearance was excellent, flavor was poor just as in 2015.

‘Earliglow’ had marketable percentages of 77 and 81% on yields of 11,567 and 11,699 lbs/acre. Flavor was excellent with an average brix of 7.9. Average size was 10.5 g/berry but we discarded any fruit weighing less than 9.0 g.

‘Galletta’ had very good yields (17,669 and 15,457 lbs/acre) and average fruit size (16.1 g/berry). Brix was 6.8 and marketable percent fruit was 67 in both treatments. Powdery mildew was again present on this variety.

‘AC Wendy’ was the 2nd highest yielding of the named varieties (18,891 and 17,665 lbs/acre) with marketable yields of 55 and 68%, an average brix of 5.9 and average berry size of 12.9 g. Flavor was poor.

‘Rubicon’ had yields of 10,446 and 14,273 lbs/acre, marketable percentages of 58 and 62%, brix of 6.8 and average fruit size of 12.9 g. Berries were very susceptible to softening in the high temperatures we had during harvest. ‘Flavorfest’ was the highest yielding of the named varieties this season with production of 17,977 and 20,599 lbs/acre. Average brix was 6.2, marketable percentages were 62 and 59, average berry size was 15.3 g. and flavor and appearance were good.

‘Sonata’ had yields of 13,948 and 17,217 lbs/acre, average berry size of 11.0 g, marketable percentages of 55 and 66% and brix readings averaging 5.3. The fruit had average flavor. This variety is very vigorous and because of the dense foliage many berries rotted, which likely accounted for the improvement in the percentage of marketable fruit when thinned. In addition, the fruit was also susceptible to softening in the high temperatures during harvest.

‘Donna’ had yields of 13,946 and 12,532 lbs/acre and marketable percentages of 61 and 71%. The fruit had an average brix of 7.6 with good flavor and an average fruit size of 10.9 g. ‘Donna’ was another variety that had high plant losses in this planting.

The three Cornell selections each suffered from at least one major flaw such as low yields (< 10,000 lbs/acre), low percent marketable fruit (< 44), high plant losses or poor fruit quality. Two of these selections had higher plant losses in this study as well.

The three Rutgers selections performed better this year – perhaps because they had become better established, but yields were still low in two of these selections in the unthinned plots. Yields in the unthinned plots were 9,301, 9,890 and 20,675 lbs/acre and in the thinned plots were 12,456, 12,547 and 16,948 lbs/acre. One selection was the highest yielding in the trial this year. Brix readings were 8.1, 7.2 and 6.0; average fruit size was 14.1, 12.7 and 15.5 g and marketable percentages were between 58 and 78%.

Variety Performance in the Matted Row System

In 2015, the harvest season had been fairly wet and it seemed like the foliage almost never completely dried out, which affected gray mold incidence, followed by a hot spell in mid-June which probably had spurred on some anthracnose development. In 2016, conditions were interesting, in that a very warm spell in April resulted in us delaying straw removal to try to keep the plants cold so bloom wouldn’t be advance too much. May and June were drier than usual so disease incidence was low overall. In order to be able to determine disease and insect susceptibilities, no fungicides or insecticides were applied in 2016. Unlike last year, when nearly all of the cultivars started to fruit at the same time except for ‘Malwina’, there was more of a spread in the harvest time of the varieties making it easier to divide the cultivars into early- vs. late-season ones.

'Earliglow' and 'Jewel', our early-season and mid-late season standards, respectively, continued to perform as expected with yields up relative to last year and fruit size dropping off a bit, as would also be expected. 'Earliglow' produced total yields of 9,900 lbs/acre with a mean berry weight of slightly less than last year at 9.0 g/berry (compared to 10.0 g/berry last year) while 'Jewel' produced 14,200 lbs/acre of fruit averaging 9.2 g/berry. 'Jewel' fruit size dropped off more markedly between years averaging 9.2 g/berry compared to 11.3 g/berry in 2015. Common leaf spot was quite noticeable on 'Jewel' leaves by the end of the harvest season. Only 54% of 'Earliglow' fruit was considered marketable, mainly due to small berry size for the remainder of the fruit. 'Jewel' had a greater percentage of marketable fruit, at 72% of the total, with the main reason for unmarketable fruit also being small size. The first significant harvest date (figured as at least 1 ripe king berry per 2' of row) was June 3 for 'Earliglow' and June 10 for 'Jewel'.

'Galletta' was the second variety to ripen, following 'Earliglow' by about 3 days. 'Galletta' was developed for plasticulture, but produced sufficient runners to fill the rows in very nicely after last year's renovation. 'Galletta' yield was about 50% higher than it was last year, but it was still a bit low-yielding, producing 7,000 lbs/acre. Fruit size was lower than last year but still nice-sized averaging 11.1 g/berry and it had a decent percentage of marketable fruit at 65%.

'Laurel' was another early-season variety and continued to perform well yielding 13,100 lbs/acre – 26% higher than last year - and berry size was acceptable, averaging 9.8 g/berry with 70% marketable fruit. Flavor was good, but not excellent. It was very resistant to foliar diseases. It is only available from Canadian nurseries at this time.

'Sonata' fruited in the mid-season, with first significant yield being June 8th and was the top-yielder mainly because of its high vigor, producing 18,800 lbs/acre of average-tasting fruit, averaging 9.3 g/berry, lower than the 10.5 g/berry size of last year's fruit. 71% of the fruit was marketable, up from 56% last year when much of the fruit was lost to gray mold presumably because of the plant's dense foliage.

'Rubicon' produced fruit at the same time as 'Sonata'. Yields were perfectly acceptable at 11,800 lbs/acre, but berries were on the small side averaging only 8.8 g/berry. The fruit were as tart as they were last year and still light-colored, but much less of the fruit was lost to gray mold with this variety as well, probably because we had a considerably drier harvest season this year. The percentage of marketable fruit was 63% this year compared to last year's 43%.

'Mayflower' fruited at about the same time as 'Jewel'. Its yield increased 50% over last year's yield, coming in at 11,900 lbs/acre. As happened last year, this cultivar had the highest percentage of marketable fruit compared to any other variety, at 75% marketable fruit. This is fairly impressive, especially considering that no fungicides or insecticides were applied to this plot this year. The flavor wasn't the best but seemed somewhat improved compared to last year when some unusual spicey and floral flavors were detected.

'Malwina' was again in a late harvest season all its own, not beginning to fruit until June 24 when only 'Jewel', 'Mayflower', and 'Rubicon' were still fruiting decently and continued to produce until July 13. The first year this variety had produced very few runners, so yields were very low in 2015. It renovated surprisingly well after the 2015 harvest though, so the beds filled in nicely bringing 2016 yields up by nearly 80% to 7700 lbs/acre – which still wasn't high for this trial – but was a significant improvement. Once again, a tiny percentage of the fruit (only a few berries) sprouted leaves, which is just a genetic disorder with this variety, and some of the caps looked like they were trying to mimic leaves.

Two of the four Cornell advanced selections had good total yields but fruit tended to be on the small side. Because of last year's high incidence of anthracnose fruit rot, disease resistance is a significant weakness of these selections. One of the three Rutgers advanced selections had amazing flavor later in the harvest season, and yields of all three were decent ranging from 7,100 to 10,000 lbs/acre, which was a significant improvement in yields compared to last year, which was probably a result of the small original plant size.

Crown-Thinning Effects in the Plasticulture System

The effects of thinning the crowns varied somewhat with variety, and depended on the vigor of the variety but overall, unthinned plots had a delay in the start of harvest. All of the varieties except for 'Sonata' and 'Rubicon' were average in vigor, and thinning the crowns after harvest resulted in lower, similar, or very slightly higher yields when compared to plants where the crowns were not thinned. Only 'Sonata' and 'Rubicon' showed a trend towards yield increases when the crowns were thinned, and 'Sonata' also showed a significant improvement in percentage marketable fruit when thinned. The conclusion was that there may be a benefit to crown-thinning only with varieties that demonstrate excessive vigor in their first production year. There were no consistent trends in effects on berry size.

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Farm Safety

FARM SAFETY AUDIT & HAZARD ANALYSIS

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Farm safety and health is a management issue. Managing for farm safety and health requires a proactive stance toward the elimination, prevention, and control of work-related hazards and risk. Reducing hazards will reduce injuries and deaths on farms. There are several principles of injury prevention. First, safety is both a positive and negative concept. Positive in that we are less likely to have an injury but negative in that being too safe can cause us to miss some opportunities. Injuries have identifiable causes which are either preventable or controllable. Injury incidents normally derive from multiple causes rather than a single cause. Risk is all around us and our perceptions of risk are not very accurate.

The good news is that human behavior can be changed if we let ourselves be open to change and we realize that occupational safety and health is a function of management that should be part of everyone's work life. Employees have a responsibility to follow safety rules and practices and management has the responsibility to provide safe place of employment.

Safety makes good business sense. An unsafe workplace that results in injury/death leads to lost production and higher costs. If the legal responsibility and business sense doesn't convince us to apply safety practices, then morality and ethics should. The engine that often drives safety is our concern for each other.

Each farm business should set work safety and health goals. Ideally you want to strive for zero incidents. You want to create an environment that enables workers to safely perform all tasks and maintain safe conditions on the farm. If PPE is a requirement, the business should provide that PPE to its workers. One very important goal is the performance of regular hazard inspections and correcting of unsafe and hazardous situations. This process should involve everyone on the farm, not just management. Finally, each farm business should prepare employees to deal with an emergency incident detailing correct (and incorrect) actions to take in an emergency.

Identifying and assessing hazards and risks is a three step process. First you need to identify the hazards. Once identified hazards need to be assessed to determine the potential for injury. Finally, the list of hazards can be prioritized for corrective action. Not every hazard needs to be eliminated but every hazard should be acknowledged. There are various tools that can be used to assess hazards on farms. The remainder of this article will deal with a system developed at Penn State University during the 1990's and some current work that is taking this tool and developing it into a mobile friendly website application.

The Farm/Agriculture/Rural/Management-Hazard Analysis Tool (FARM-HAT) is a simple method that can be used by farm operators, the insurance industry, extension agents, and others to reduce farm hazards. Users of this tool will: gain further understanding of agricultural safety and health hazards; learn what types of safety devices provide the most protection; learn what type(s) of personal protective equipment is appropriate for a given situation; find other sources of related information; and understand what behaviors can protect an individual from being harmed by a hazard. Farmers may use this tool as a guide for directly eliminating hazards or improving the safety of machinery, buildings, structures, etc. The insurance industry may use this tool to identify what hazards are present on farm operations and to make assessments of overall risk associated with those hazards (risk is the probability of suffering harm or injury from a hazard). Extension agents and others may use the tool to develop and direct agricultural safety and health programs, activities, and events. You can find this tool and more information on the FARM-HAT website: http://extension.psu.edu/business/ag-safety/farmhat

Penn State University is partnering with the National Farm Medicine Center in Marshfield Wisconsin to create a mobile friendly website application of FARM-HAT. This will make the process of hazard assessment on the farm more portable and user friendly. Information of this can be found by visiting: https://saferfarm.org

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Pesticide Sprayer Safety

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Background

Pesticide sprayers are a farm tool that is often overlooked when it comes to farm safety issues. The fact that you generally are handling pesticides in the most concentrated forms lends added importance to both the pesticide handler as well as the sprayer equipment itself. In many instances growers initially calibrate the sprayer when they get new equipment, follow-up calibrations are sometimes forgotten in the hustle and fast moving pace on the farm. Not only is proper calibration important in reference to potential phytotoxicities but it becomes an economic issue when you consider that some modern day pesticides cost in the hundreds or even thousands of dollar per container.

Problems Specific to Pesticide Sprayers

There are many components to sprayer safety however four areas are of specific concern. First, is the reality that on vegetable farms there are many types of different crops grown that all have specific pesticide label requirements. In some cases even very minute amounts of residues are sufficient to give unacceptable amounts of cosmetic injury which results in an unsalable crop. Second, when cleaning pesticide sprayers it seems obvious that the tanks are one of the primary concerns to clean. However what about the multitude of hoses, lines, joints, sprayer nozzles and other parts that are less obvious to the naked eye but are prone to collect resides in them. Third, many herbicides such as the phenoxy materials like 2-4 D are active on vegetables at literally microscopic amounts. Even slight amounts result in noticeable epinasty and other growth distortions that will prevent marketing them. Fourth, what effect do the multiple types and chemistries of tank additives have on removing residues form tanks?

Spray Tank Additives

There are four types of tank additives I would like to discuss in this segment. Adjuvants have long been used for various pesticide formulations to improve the efficacy of them. This makes them both more effective and as well as more economical to use. A good example of this is the material known as PBO which enhances the effective of some pyrethroid insecticides to control piercing and sucking insects, These advantages however make the risk potential for injury form tank residues all the more a possibility when tanks are not carefully cleaned. With the increased usage of liquid fertilizers, many farmers now add foliar fees to spray mixtures when applying herbicides etc. In some instances these fertilizers act as a burning agent for herbicides such as Roundup to get quicker kill of post emergence applications. In other high value vegetables the liquid fertilizer is added to enhance the soil applied fertilizers in order to improve crop color. In fruit crops, various oils are used to kill eggs of insects during the early season. But the fact they are used when the weather is still cold enhances the potential for crop injury making proper tank cleaning more critical.

Spray water quality is often overlooked as important when filling your spray tanks. Much of the water supply in central and southern New Jersey is from the Pinelands which are characteristic and traditional very acidic in nature. Ph. adjusting materials can be added to spray tanks in these4s cases to get the ph. in line with what is recommended. These materials add to the complexity of tank cleaning procedures.

Tank Cleaning Guidelines

The first question to ask is how often should sprayers be cleaned? Is it daily, weekly, when changing pesticides, or changing spray locations? In vegetable growing operations it would be best to clean sprayer whenever you are changing spray materials and when you are changing to other crops. In cases you only grow one or two crops, this would become less critical. It also is advisable to have separate herbicide and insecticide/fungicide sprayers due to the small amounts needed for cross contaminant issues.

There are four strategies that are employed to properly decontaminate pesticide sprayers. Dilution, increasing solubility, deactivation, and extraction of the materials are components of a good cleaning program. Some strategies utilized to clean tanks use a 3 part process. First, tanks are filled ½ with fresh water, then agitation is applied to loosen up residues, and finally the diluent is applied to a labeled crop field site. Cleaning of growth regulators out of tanks can utilize ammonia, TSP, chlorine, or commercial tank cleaners. For persistent pesticides, it is recommended that the tanks sit overnight with the solution and then agitated before empting them out.

There are problem areas that need special attention when properly cleaning sprayers. One of these areas includes any area where spray residue or micro sprays leakage. This is important because as spray residues rapidly leak and then dry out, the level of residue continues to concentrate and becomes stronger in exposed pesticide residues. Consideration must also be given to the type of materials spray tanks are made of. The rate of pesticide adsorption is much greater in fiberglass tanks than stainless steel tanks.

There are other pesticide sprayer safety considerations regarding the applicators who fill tanks, mix loads, and do the spraying which will be covered in the presentation.

Bee Safety and Emerging Insect Threats

WHEN DO WE NEED TO CONSIDER ALTERNATIVES TO NEONICS?

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Neonicotinoids ("neonics") are a class of insecticides that have achieved prominence because they are highly selectively toxic to certain insects, meaning that they have relatively low toxicity to people and pets; and they are systemic, which means that they can move upward within xylem sap to reach the entire aboveground part of the plant following an application to the soil or stem. This combination of properties permits a single application of a neonicotinoid to provide long-lasting protection of plants from various insect pests, which decreases the need for potentially more environmentally disruptive foliar sprays. Furthermore, systemic insecticides applied as seed treatments or in-furrow applications, because they are presented in the interior of the plant for above-ground plant parts, mitigates exposure to predators and parasitoids of pests, which makes them more likely to be compatible with integrated management of pests than the same active ingredients applied as foliar sprays.

The fact that systemic insecticides can reach all parts of plants also means that there is concern that they could poison pollinators that feed on pollen or nectar. The nitroguanidine subclass of neonics (clothianidin [Belay, Clutch, Poncho], dinotefuran [Scorpion, Venom], imidacloprid [Admire, Provado, many generics], and thiamethoxam [Cruiser, Platinum]) is extremely acutely toxic to honey bees, requiring less than 10 nanograms (a nanogram is a billionth of a gram; a nickel weighs five billion nanograms) of insecticide as a median lethal oral dose (LD_{50}). However, to reach this level of exposure, a honey bee (which consumes about 22 microliters of nectar per day) would have to feed on nectar containing 200 ppb (parts per billion) of insecticide. One part per billion is equivalent to one half teaspoon in a full Olympic swimming pool. Surveys of honey bee pollen have detected an average of about 2 ppb of imidacloprid, and about 6 ppb in combined toxicity imidacloprid equivalents (combining the toxic effects of all the neonicotinoids into one value). These survey values are consistent with the values observed from nectar or pollen from treated agronomic crops. This is far less than the 25 ppb threshold value for nectar contamination with imidacloprid that the U.S. EPA has determined can cause sublethal effects on honey bee colonies.

Concerns about toxicity of neonicotinoids to bees from their use in agricultural crops (vs. nursery crops and landscape uses of these insecticides) are mostly unfounded: crops growing from treated seeds contain minute quantities of insecticides in their nectar or pollen, and honey bee colonies surrounded by large expanses of these crops are observed to be unaffected by these low exposure levels. Impacts on bumble bees and solitary bees, which can be extremely important for crop pollination, are poorly known, but they are expected to be more sensitive than honey bees because they directly feed newly hatched larvae pollen mixtures, whereas honey bees initially feed newly hatched larvae glandular secretions. Sublethal exposure of bees to neonics are well documented to cause behavioral abnormalities, such as the inability to find their way back home. Such "drunken" behavior argues that label directions for use of these insecticides on vegetable and fruit crops should not be expected to present the insecticides at levels that would cause intoxication, otherwise pollination behavior would be affected and poor fruit set would result.

Cases in which agricultural uses of neonics may lead to harm to bees include inappropriate application, such as foliar sprays to plants during bloom, and liberation of dust from insecticide-treated seed at the time of planting, a problem that is being addressed for the affected crops. Misapplication of these insecticides to crops in bloom is a practice prohibited by the pesticide label because such misuse results in a nearly immediately lethal exposure to bees. Liberation of insecticide-laden dust has been linked to large-scale acute bee kills, particularly when planting corn. To reduce risk of exposure due to use of treated seeds with vacuum planters, mow flowering vegetation next to fields about to be planted, plant when there are low-wind conditions, load treated seed into planter boxes carefully to minimize dust becoming airborne, and use deflectors or filters on the planting equipment (see http://fieldcropnews.com/wp-content/uploads/2014/01/pollinator-protecton-Jan-9final.pdf).

So, if neonicotinoids are not the cause of poor bee health and "Colony Collapse Disorder" (CCD) of 2006 - 2007, what are the real causes? Initially, there were concerns that sublethal exposure to neonics would cause worker bees to become disoriented while foraging in the field, so they weren't able to return to their colonies. This would explain the lack of worker bees in colonies affected by CCD. When there are too few workers, the colony cannot function and dies. However, the fact that scenarios that looked exactly like CCD occurred in 1906, 1961, and 1979 signifies that this phenomenon cannot be completely explained by neonicotinoids, because this class of insecticides was not in use until approximately 1992. An alternative explanation is a phenomenon called altruistic suicide, in which very sick honey bee workers leave the hive to die, which can be an adaptation among social insects to protect the hive from diseases. Global difficulties in maintaining honey bee health are closely linked to (1) worldwide (except for Australia) introductions of varroa mite, a parasite of bees, and (2) worldwide infection among bees by deformed wing virus, as well as other viruses of bees. Varroa mites directly weaken bees by feeding on their blood, may suppress the bee immune system, and transmits many viruses among bees. The Australian situation is especially informative, as they use neonicotinoid insecticides, varroa mites are absent, and the bees have remained healthy. Contrast this with Europe, which in spite of a 3-year moratorium on the use of neonics, continued to have serious losses of honey bees. It is especially worrisome that the viruses carried by varroa mites can be transferred from honey bees to other species of bees by varroa mites left on flowers. Even though varroa mites cannot reproduce on these other bee species, keeping sick colonies of honey bees then may jeopardize the health of our native pollinators. Clearly, then, efforts to better manage varroa mites in honey bees, and genetic improvement of honey bees for resistance to varroa and viral diseases may do much to improve the health of both honey bees and our native pollinators.

Although scientific evidence appears to be converging on an assessment that most agronomic uses of neonicotinoids (even the nitroguanidine subclass) are unlikely to cause harm to honey bees, there are two major reasons for vegetable and fruit growers to consider transition to other classes of insecticides: (1) insecticide resistance, and (2) marketing considerations.

Neonicotinoids have had a “long run” of success, in which the incidences of resistance in target pests have probably not happened as quickly as with several other classes of insecticides, especially pyrethroids. However, neonicotinoids are not immune from the process of evolution of resistance, as demonstrated by resistance to imidacloprid among Colorado potato beetles, whiteflies (2 species) and aphids (2 species). Colorado potato beetles are an especially tough case, because selection for resistance to many other insecticides could have preadapted them to become among the first insect pests to develop resistance to neonicotinoids. After nearly 25 years of intensive use, we may be poised to see much more common failure of control for other pests targeted with neonicotinoids, and so switching to alternative chemistries may be advisable on that basis alone. As with other insecticides, resistance to neonicotinoids may result from several possible routes, including metabolic detoxification (most common), and from target site insensitivity. Although rotation among insecticides can help to delay resistance due to target site insensitivity, this strategy can be jeopardized when resistance is due to detoxification mechanisms.

Public backlash against neonicotinoids saw a watershed moment on June 20, 2013, when an arborist applied dinotefuran to control aphids infesting blooming linden trees in a Target parking lot in Wilsonville, Oregon. This illegal application was especially damaging to the reputation of neonics because (1) a field of red clover adjacent to the parking lot had just been mowed, and so the lindens were teeming with bumble bees attracted to the area, (2) it took place in a parking lot, so the dead bees were immediately visible, (3) this happened during Pollinator Week, when there was already a focus on the importance of pollinators, and (4) the parking lot was only 20 miles from the headquarters for the Xerces Society for conservation of invertebrates, a leading non-profit group advocating for pollinator health. The worldwide attention from this incident morphed into a compelling narrative that has been repeated by many organizations, including Friends of the Earth and Natural Resources Defense Council, groups that persist in campaigns that paint neonicotinoids as the leading cause for poor bee health. Although the position taken by these groups are not well supported by evidence, they appear to have been profitable for fundraising, and this steady campaigning has yielded a grassroots effort to ban neonics. Short of an outright ban, the key demand has been to force purchasers of fruits, vegetables, or ornamental horticulture products to sell neonic-free produce and plants. In response, big box stores such as Wal-Mart and Loews now are asking ornamental horticulture producers to no longer use these insecticides, and Whole Foods favors production of crops without the nitroguanidine class of neonics. Only time will tell whether these demands will gain momentum, in which case federal registration of these insecticides on crops will become moot – purchasers demanding that they be free of these residues is equivalent to withdrawing the products' registrations.

If neonicotinoids are going to be curtailed, what will take their place? Experience from the neonic ban in the U.K. demonstrated that growers placed a greater reliance on pyrethroids, which could have severe consequences for both insecticide resistance, acute toxicity to bees, and the practice of IPM. Pyrethroids tend to rapidly select for resistance, and because they have such broad-spectrum activity, their use usually completely excludes the activity of beneficial predators and parasites. There are other outcomes that would not be so negative, but these outcomes will rely on alternative new chemistries that are currently more expensive than the neonicotinoids they would replace. Among systemic insecticides, key products that would have the same pest management benefits as our familiar neonics, but are less toxic to bees are:

Acetamiprid (Assail), which is a neonic, but because it has a cyano group substituted for the nitro group, is readily detoxified by honey bees. This chemical difference makes products containing acetamiprid about 2,000 times less toxic to bees than imidacloprid. Although it is not labeled for soil applications, acetamiprid is readily absorbed into the plant through foliar sprays.

Flupyradifurone is a new insecticide marketed by Bayer as Sivanto. Bayer claims that this is in a new subclass of insecticides affecting the nicotinic acetylcholine receptor. However, their own data demonstrate that it shares exactly the same target site as conventional neonicotinoids, and even shares some of the same metabolic break down products as imidacloprid. Whether consumers treat this insecticide differently from the nitroguanidine products is questionable. Like acetamiprid, it is much less toxic to honey bees, and is about 300 times less toxic to honey bees than imidacloprid.

Anthranilic diamides, such as chlorantraniliprole (Altacor, Coragen) and cyantraniliprole (Exirel, Verimark). The latter has much greater systemic activity than the former, and may be a direct replacement for many of the current neonicotinoid seed treatments and in furrow drench treatments. Chlorantraniliprole is about 23,000 times less toxic to bees than imidacloprid. However, cyantraniliprole is only about 10 times less toxic to bees than the nitroguanidine neonics.

Curtailing some uses of neonicotinoids could have positive consequences. Perhaps growers will return to practices less reliant on preventive measures (which sometimes are not justified), and interest in pest management practices better founded on plant resistance and ecological principles could be restored.

The mention of a product does not constitute an endorsement by the Connecticut Agricultural Experiment Station.

WINE GRAPES I

SHOULD YOU BE GROWING GRAPES?
PROS, CONS, AND SITE SELECTION.

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First, I've got to ask, how much money have you got? There is an old axiom in the wine business that states if you want to make a small fortune in the wine business start with a large fortune. Doesn't sound too promising does it? As a county agricultural agent with Rutgers Cooperative Extension I meet with 6-10 prospective vineyard/winery owners every month and the economics of the business is certainly one of the considerations that must be taken into account. I find that most of these people fall into two categories; farmers that are looking for something to grow that will actually make money and what I call the 9/11 people. Today's farmers must make a decision, grow a profitable crop or sell the land to the developers. The 9/11 people are from all walks of life and since that fateful day have realized that life is precious and working in a job that they hate is a waste of a life, better to grow grapes and make wine.

The first visit I have with prospective growers is usually over lunch. I figure I have to eat lunch anyway and since 2/3 of these people will never start a winery once they hear what is involved I'm not really wasting my time. I usually start the discussion on a positive note. New Jersey is 5th in wine production in the US and 5th in per capita consumption of wine in the US. So we make a lot and we drink a lot. Given this, it is interesting to note that only 1% of the wine we drink is made in New Jersey. That translates into a tremendous marketing potential for New Jersey wines if we can tap into the other 99% of sales, which we are slowly doing. In addition, even in this down economy, wine sales in the US have continued to increase and the number of wineries in New Jersey has steadily increased. Lastly, New Jersey has some of the best sites in the east for quality wine grape production. This is important because to make great wine you need great grapes. Sounds logical but you would be surprised how many people are only concerned with what the wine label will look like, or the tasting room decor. I had one guy who had already bought the cappuccino machine for the tasting room. He didn't really want to talk about the vineyard and what it takes to produce quality grapes. He's long gone now. That's because owning a vineyard and a winery is farming first. If you get all wrapped up in the romance of wine and having your name on the wine bottle, failure is just around the corner.

The next order of business is to talk vineyard establishment, i.e. how much, where, how, and what grapes. It will cost approximately $8,000 to $12,000 per acre to establish an acre of grapes. That includes the plants, the posts and wire, the irrigation, the land prep, etc. Then you'll need a good, narrow tractor, maybe $40,000 for a good one. You'll need a sprayer to control diseases, say $1,000 to $10,000 depending on size and type. And no, we can’t grow wine grapes in the Mid-Atlantic States organically. This region gets too much rain during the summer and the fungal disease pressure is just too intense. Rutgers is conducting research to change this but so far it just can’t be done. After all this, I usually lose many of the prospective growers. In the past, I would sugar coat all this but farming grapes is expensive and better to know the facts up front then to loose your shirt later. It has been said that one of the biggest reasons that wineries fail is that they didn’t know what they were getting into financially and were under funded.

Now we need to talk site. Where are the grapes and the winery to be? Do you already own the land? Farmers of course already have the land. 9/11 folks usually don’t but if they do they ALWAYS tell me how great their soil is. Soil is not the top priority for site selection. First of all, I want to know how cold it gets on their land in the winter. If it gets to -10 degrees Fahrenheit routinely the grapes are going to die. It won’t matter that the soil was great. In New Jersey it rarely gets below 0 in Cape May County but routinely gets there in Sussex County. If you want to grow Merlot in Sussex it is not possible. You’ll have to grow Concord or the cold hardy varieties from the Minnesota grape breeding program which can withstand -35 degrees F. Matching the site with the grape variety has been the essence of fine wine for thousands of years.

From there we will cover trellis types, fertility, plant spacing, row covers, row orientation (always north/south), and site length of season. Cabernet sauvignon needs a growing season of 182 days, that’s the time from the last frost in the spring to the first frost in the fall. Sussex County for example, is at least 30 days short. Only an early maturing variety will ripen here.

After all of this and a whole lot more, some people decide to start a vineyard and a winery. Of course, they will also have to learn how to make wine and build a winery. That takes more money, time, experience, a lot of reading, and maybe hiring a consultant. Many of the 54 wineries in New Jersey have started in this way. I like to think that I’m not only helping the wine business in this state to grow but also preserving farms and open space. The New Jersey Wine Industry is keeping the “Garden” in the Garden state but to be a part of it takes a lot of planning and learning.

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Peppers

UPDATE ON PEPPER DISEASE CONTROL

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Controlling anthracnose fruit rot.

Anthracnose fruit rot has been an increasing problem in pepper production during the past few years. The pathogen, *Colletotrichum* spp., also causes a fruit rot in strawberries and tomatoes. The pathogen can infect pepper during all stages of fruit development resulting in serious losses if not controlled properly. Symptoms of anthracnose fruit rot include sunken (flat), circular lesions. In most cases, multiple lesions will develop on a single fruit. As lesions enlarge, diagnostic pinkish-orange spore masses develop in the center of lesions. During warm, wet weather spores are splashed onto healthy fruit through rainfall or overhead irrigation.

Managing anthracnose fruit rot begins with good cultural practices. The pathogen overwinters on infected plant debris and other susceptible hosts. The fungus does not survive for long periods without the presence of plant debris. Pepper fields should be thoroughly worked (i.e., disced, plowed under) after the season to help break down and bury old debris. Heavily infested fields should be rotated out of peppers for at least three years. Do not plant or rotate with strawberries, tomatoes, eggplant or other *solanaceous* crops. Once areas in fields become infested, management of the disease can be difficult. Prevention is critical to controlling anthracnose fruit rot.

Beginning at flowering, especially if fields have had a past history of anthracnose.

Alternate:

chlorothalonil (FRAC group M5) at 1.5 pt/A or OLF, or
Manzate Pro-Stik (M3) at 1.6 to 3.2 lb 75DF/A

with a tank mix of chlorothalonil at 1.5 pt/A plus one of the following FRAC code 11 fungicides:

Quadris (azoxystrobin, 11) at 6.2-15.0 fl oz 2.08SC/A, or
Cabrio (pyraclostrobin, 11) at 8.0-12.0 oz 20EG/A, or
Priaxor (boscalid + pyraclostrobin, 7 + 11) at 4.0 to 8.0 fl oz 4.17SC/A.

With a tank mix containing chorothalonil at 1.5 pt/A or Manzate Pro-Stik at 1.6 lb/A and one of the following FRAC code 11 fungicides:

Quadris Top (azoxystrobin + difenconazole, 11 + 3) at 8.0 to 14.o fl oz 1.67SC/A
Aprovia Top (difenconazole + benzovindiflupyr, 3 + 7) at 10.5 to 13.5 fl oz

Prevention is critical to controlling anthracnose fruit rot. Infected fruit left in the field during the production season will act as sources of inoculum for the remainder of the season, and therefore, should be removed accordingly. Thorough coverage (especially on fruit) is extremely important and high fertility programs may lead to thick, dense canopies reducing control. Growers have had success in reducing the spread of anthracnose by finding 'hot spots' early in the infection cycle and removing infected fruit and/or entire plants within and immediately around the hot spot.

Controlling Phytophthora crown and fruit rot.

Phytophthora blight (*Phytophthora capsici*) is one of the most destructive soil-borne diseases of pepper in the US. Without proper control measures, losses to Phytophthora blight can be extremely high. Heavy rains often lead to conditions which favor Phytophthora blight development in low, poorly drained areas of fields leading to the crown and stem rot phase of the disease. Infections often occur where water is slow to drain from the soil surface and/or where rainwater remains pooled for short periods of time after heavy rainfall. Always plant phytophthora-resistant/tolerant cultivars, such as Paladin, Aristotle, Turnpike, or Archimedes to help minimize losses to the crown rot phase of the disease. For an updated cultivar list please see the 2016 Commercial Vegetable Recommendations Guide.

For control of the crown rot phase of Phytophthora blight, apply:

Ridomil Gold (mefenoxam, 4) at 1.0 pt 4SL/A or 1 Ultra Flourish (mefenoxam, 4) at 1.0 qt 2E/A, or MetaStar (metalaxyl, 4) at 4.0 to 8.0 pt/A. Apply broadcast prior to planting or in a 12- to 16-inch band over the row before or after transplanting. Make two additional post-planting directed applications at 30-day intervals. Mefenoxam is still effective against sensitive populations of the pathogen. However, DO NOT USE mefenoxam, if mefenoxam-insensitive strains are present on your farm.

Ranman (cyazofamid, 21) at 2.75 fl. oz 400SC/A may be applied via transplant water (see label for restrictions)

Presidio (fluopicolide, 43) at 3.0 to 4.0 fl oz/4SC/A can be applied via drip irrigation (see supplemental label); PHI: 2 days

For prevention of the fruit rot phase of Phytophthora blight, alternate the following on a 7 day schedule:

Ridomil Gold Copper (mefenoxam + copper, 4 + M1) at 2.0 lb 65WP/A.

with one of the following materials.

Presidio (fluopicolide, 43) at 3.0 to 4.0 fl oz 4SC/A plus fixed copper at labeled rates

Revus (mandipropamid, 40) at 8.0 fl oz 2.08SC/A plus fixed copper at labeled rate

Ranman (cyazofamid, 21) at 2.75 fl oz 400SC/A *plus* a non-ionic surfactant

Forum (dimethomorph, 40) at 6.0 oz 4.18SC/A plus fixed copper at labeled rate.

Zampro at 14.0 fl oz 535SC/A plus fixed copper at labeled rate.

Tank mixing one of the above materials with a phosphite fungicide (FRAC code 33), such as K-Phite, Rampart, or Prophyt will also help control the fruit rot phase of Phytophthora blight.

Managing bacterial leaf spot in pepper

Bacterial leaf spot (BLS) in pepper has increased in some areas of the mid-Atlantic region over the past few years. There are ~10 races of the pathogen and in the past few years races 1,2,3,4,5 and 6 have been detected in New Jersey. The pathogen can be seed-borne and can cause significant problems in the field if transplants are exposed to the pathogen during transplant production. Hot water seed treatment can be done to help mitigate potential problems due to BLS. Any seed suspected of carrying BLS should be hot water treated, this is especially important in heirloom varieties or organic seed where BLS problems have been suspected or an issue in the past. Some of the most commonly-grown commercial bell and non-bell pepper cultivars in the region carry resistance packages to different races of the pathogen (see Table below). Many of the bell peppers grown in the region also have resistance/tolerance to phytophthora blight. Growers with past histories of BLS and/or phytophthora on their farm should only grow those cultivars that carry resistance/tolerance to both pathogens.

BELL PEPPER

Cultivar	BLS race resistance	Phytophthora Resistance/Tolerance
Paladin	none	R/T
Aristotle	1,2,3	R
Archimedes	1,2,3	T
Turnpike	1-5,7,9	T
Declaration	1,2,3,5	T
Revolution	1,2,3,5	T
1819	1,2,3,4,5	T
Intruder	1,2,3	T
Tomcat	1,2,3,4,5	none

EVALUATING BELL PEPPERS FOR RESISTANCE TO 11 RACES OF BACTERIAL LEAF SPOT AND PHYTOPHTHORA

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Bacterial Leaf Spot

Bacterial leaf spot (BLS) is caused by the pathogens *Xanthomonas euvesicatoria* and *Xanthomonas campestris pv. Vesicatoria* is the second most important disease on peppers in New Jersey. Phytophthora blight caused by *Phytophthora capsici* is the number one disease. Phytophthora continues to be a concern among growers, but with proper management and tolerant varieties growers are learning to live with the disease.

BLS on the other hand has become more of a concern over the last ten years. The pathogen is favored by high humidity, hard driving rains, vigorous plant growth, infected stakes and working in the field when plants are wet. There are eleven (0-10) races of BLS identified in the United States. Most commercial bell pepper varieties grown in New Jersey are resistant to races 1-3 which have been the main races found in the Northern United States. Until recently, growers in New Jersey have managed BLS with a combination of resistant varieties and chemical control. In 2004, growers reported that resistant varieties were being infected with BLS. A series of screening trials were carried out to determine if other races may be present in the state. It was determined that race four was found in Southern New Jersey, but not in the Northern part of the state. Since 2004 varieties e.g. 'Turnpike', 'PS0994-1819' and 'Tomcat' have been released with resistance to race 4. There are no recommended cherry, sweet frying, hot or banana type peppers resistant to race 4. Bell pepper growers continue to use a combination of resistant varieties and chemical control while specialty pepper growers only have management and chemical control.

In 2013, growers again noticed BLS showing up on varieties which were resistant to races 0-5. Differential studies were established to determine if additional races were present in New Jersey. Plots were setup in the Southern and Northern parts of the state with a series of varieties with resistance to different races from no resistance to resistances to all known races. The only varieties that did not express any symptoms were those resistant to all races. It was determined that races 6 and/or 10 were present in South Jersey, but not found in the north. Races 6 and 10 could not be distinguished from one another since they are closely related and if there is resistance to race 6 there is probably resistance to race 10. This screening trial has been repeated with similar results.

We have started to screen breeding lines and varieties that have resistance to all 11 races of BLS for yield and fruit quality. Table 1 present's data from a 2016 trial where there was no BLS present thus we were looking at yield. The lines '9325' and 'Green machine' (0972) had resistance to all know races; 'Paladin' no resistance; 'Tomcat" resistant to 1-5 and 7-9; 'Turnpike' resistant to 0-5 and 7-9; 'Aristotle' resistant to 1-3; 'Revolution' resistant to 1-3 and 5; '3964' resistant to 1-4 and 7-9; and '1819' resistant to 1-5 and 7-9. There will be trials over the next three years to identify varieties which are resistant to all known races of BLS and have acceptable yields and fruit types.

Table 1. Marketable Yield (28 lb boxes) per Acre and Percent Marketable – Grower Trial 2016

Variety/Lines	X large	Large	Medium	Marketable	% Marketable
Revolution	644 a	1386 ab	398 ab	2428 a	77.5 abc
Turnpike	692 a	1548 a	184 d	2424 a	80.0 ab
Paladin	410 bc	1498 a	425 a	2332 ab	81.8 a
3964	568 ab	1199 b	268 bcd	2036 bc	74.2 bc
Aristotle	273 cd	1472 a	286 a-d	2031 bc	77.8 abc
1819	366 cd	1373 ab	251 cd	1989 bc	72.0 c
Tomcat	298 cd	1137 bc	378 abc	1812 de	76.5 abc
9325	202 d	925 c	368 abc	1495 de	71.2 c
Green Machine (0972)	252 cd	914 c	286 a-d	1451 e	61.8 d
LSD	**171.7**	**272.3**	**143.3**	**353.6**	**6.6**

Note: The same letters in the same column are not statistically different from one another

Phytophthora Blight

Phytophthora has been a serious disease problem on peppers for at least 25 years in South Jersey. There has been only one variety ('Paladin') that has shown resistance in South Jersey over the last several years. There has been indication from some production areas that it is not as resistant as in the past. No matter what variety is grown, it must be combined with proper crop management. This starts with a good rotation program which is one of the biggest issues in South Jersey. Rotation of a vine crop, peppers and tomatoes is not a rotation. Rotation will not solve the problem, but is an important component of the management plan. This should be followed with planting on raised beds, good drainage between and the end of rows and chemical control. The bottom line with Phytophthora is growers need to learn to live with it and manage it.

Each year a screening trial is held to evaluate new varieties and breeding line for Phytophthora tolerance, fruit quality, yield and the amount of silvering (skin separation). This year 12 varieties and lines were evaluated with 'Camelot' as the susceptible control and 'Paladin' as the resistance control. In table 2 the yield per acre (28 lb boxes) and percent silvering are presented. Compared to previous trials 'Paladin had significantly lower yields than six other entries. It has been noticed over the last two years that the resistance in ‘Paladin’ has been less stable. Silvering continues to be observed in many varieties with ‘Mingun (30108)’ showing statistically more silvering than all other varieties. Varieties with statically less silvering included ‘Camelot’, ‘Revolution’, ‘Declaration’ and ‘Archimedes’.

Table 2. Marketable Yield (28 lb boxes) per Acre and Percent Silvering – RAREC Trial 2016

Variety/Line	X large	Large	Medium	Marketable	% Silvering
Archimedes	8 c	437 a	411 a	855 a	14.3 cd
9006	9 c	388 a	326 bcd	723 ab	30.9 b
1819	17 bc	346 ab	329 bcd	691 abc	25.8 bc
Aristotle	0 c	318 ab	368 ab	685 abc	30.4 b
Declaration	45 a	391 a	234 efg	670 bc	7.0 d
Revolution	34 ab	342 ab	265 cde	641 bcd	4.3 d
Intruder	8 c	178 c	339 abc	525 cde	35.6 b
Tomcat	3 c	174 c	285 cde	462 def	26.1 bc
Paladin	0 c	214 bc	241 ef	454 ef	34.1 b
Mingun (30108)	15 bc	151 c	260 de	426 efg	52.3 a
30106	0 c	128 c	157 g	285 fg	28.8 b
Camelot	0 c	90 c	166 fg	256 g	6.7 d
LSD	**21.8**	**137.8**	**78.1**	**182.8**	**13.4**

Note: The same letters in the same column are not statistically different from one another

Phytophthora resistance or tolerance is for the crown phase not aerial which can be observed some years after periods of heavy rains and wind. In 2016, fruit rot was observed in the last two harvests of September. The varieties/lines ‘30106’ and ‘Camelot’ had significantly more fruit rot than all other entries. The other entries in order of fruit rot were ‘Paladin’, ‘9006’, ‘Declaration’, ‘Mingun’, ‘1819’, ‘Revolution’, ‘Tomcat’, ‘Intruder’, ‘Aristotle’ and ‘Archimedes’. ‘Archimedes’ had the least fruit rot and was statistically different from ‘Paladin’, ‘Camelot’ and ‘30106’.

Exotic Pepper Project at Rutgers NJAES: 2016 Field Evaluation of Habanero Peppers

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Background

As part of our 2016 R&D activities in the Exotic Pepper Project (EPP) at Rutgers NJAES we carried out further field evaluation of our top habanero and jalapeno pepper selections to gather more definitive data on plant growth and fruit production behavior. Two scenarios were compared: a) Growing plants from regular 8-week old transplants and b) Growing plants from 20-week old transplants. Habanero peppers in general mature late under NJ conditions and the grower risks losing substantial fruit yield when the frost occurred early in October. Previous studies showed that starting seedlings early and transplanting at 10 or more weeks after seeding might accelerate flowering and fruiting in the field. Therefore, this year we sought to determine impact of age of transplant on earliness to fruiting, total fruit yield and other parameters. We also continued to evaluate these incipient varieties for unique fruit qualities using advanced instrumentation, and will report on results in the presentation. The Capsicum germplasm collection was substantially broadened with elements from the New Mexico State University program, the largest in the world.

Materials & Methods

Two field studies were carried out at Rutgers' Horticulture (Hort) Farm 3 at 67 Ryders Lane in East Brunswick, NJ between June and November 2016. The organic plot was used for the studies. In a replicated trial, Study 1 compared the growth and fruit production behavior of eight habanero selections: A ("Red Rosebell Hab"), B1 ("Red Long-nose Hab"), C ("Red Soft Skin Hab"), F ("Red Unnamed Hab"), H ("Red Naveled Hab"), I ("Red Unnamed Hab"), YH2 ("Yellow Rosebell Hab") and YH3 ("Yellow Pumpkin Hab"). In a non-replicated trial, Study 2 compared seven of the habanero selections listed for Study 1. YH3 was missing from Study 2 due to shortage of planting materials. In Study 1, 8-week old (regular) transplants were used while in Study 2, 20-week old transplants were used. Seedlings were transplanted into raised 90-cm beds under black plastic mulch on June 8 and 9, 2016. In Study 1, plot size was six pepper stands spaced 45 cm within the row and replicated three times. In Study 2, plot size was 20 pepper stands spaced 45 cm within the row. In both studies, plastic mulched-seedbeds were separated 75-cm apart.

Observations included a) life cycle estimation, b) visual rating of plant size using a scale of 1-5 (where 1= small size, 5 = large size), c) ripe fruit durability (RFD) on a scale of 1-5 (where 1 = poor and 5 = excellent) which describes for how long may the fruit retain integrity after ripening, d) fruit number per plant, e) weight per fruit, f) total fruit yield per plant and g) fruit shelf life at room temperature and in the cold room at 4^{o}C.

Results & Discussion

Plant size: Figure 1 compares the sizes of the habanero selections and shows that A, F and YH2 were large plants while B1, C, H and I were of medium size. In contrast to the others, YH3 was a smaller sized plant. The relative plant sizes were consistent in Study 1 and Study 2. This information will guide future plant spacing to be applied to each of the habanero types.

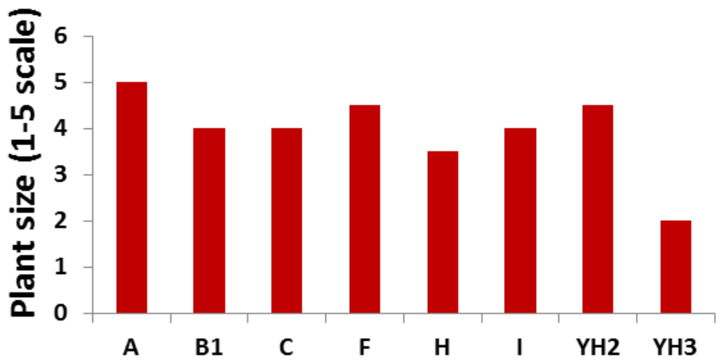

Figure 1: Plant size rating from 1-5 (1= small plant; 5 = large plant) among organically grown Habanero selections at Rutgers' Hort Farm 3 in 2016

Life cycle: From our field observations, plants in Study 2 (Old transplants) started to flower 7-10 days before those in Study 1 (Regular transplants). The use of old transplants as confirmed in this study suggests that starting habanero seedlings earlier allows the grower to harvest most of the fruit before adverse weather frost occurs, typically in mid-October. Habanero selections H, I and YH3 are early maturing, B1, C and F have intermediate maturation, and A and YH2 are later in fruit maturation (Table 1). This hierarchy was consistent in Study 1 and Study 2. For future cultural activities, starting the late selections earlier would be a prudent way to promote early fruiting in sync with the other selections.

Table 1: Life cycle, ripe fruit durability and fruit shelf life of Habanero selections evaluated at Rutgers' Hort Farm 3 in 2016

			Fruit Shelf Life (Weeks)	
Habanero ID	Life cycle	RFD*	At 4°C	At Room Temp.
A	Late	5	4-5	3
B1	Medium	5	4	2
C	Medium	3	3	1-2
F	Medium	5	4-5	3
H	Early	3	3	2
I	Early	4	3-4	2
YH2	Late	1	3	1-2
YH3	Early	4	3-4	3

*RFD = Ripe fruit durability; it describes for how long may the ripe fruit retain integrity on the plant after ripening. Fruits were rated on the plant 4-5 weeks after ripening.

Ripe Fruit Durability: Ripe fruit durability (RFD) describes for how long the ripe fruit may retain integrity after ripening. Disintegration of the fruit is both age dependent and subject to disease attack (especially anthracnose). The RFD observation is useful for growers who have the option of delaying harvest for various reasons including pressure of work schedule, market opportunities or other considerations. The longer the ripe fruit can retain integrity and remain marketable in the field, the more that growers have flexibility in making harvesting decisions. Table 1 shows the relative RFD rating for the habanero selections compared in this study. Selection YH2 has the lowest RFD while A, B1 and F had the highest scores between 4 and 5 weeks after ripening. We observed that with two 10 days of ripening YH2 became highly susceptible to what was likely anthracnose. Other selections remained healthy for much longer time periods. While YH2 has very desirable yield qualities, the low RFD score is a major flaw in a variety and for a grower that cannot harvest immediately after fruit ripening.

Fruit production attributes

<u>Study 1</u>: The habanero selection YH3 (Yellow Pumpkin Hab) was outstanding in fruit production. With the small size plant, YH3 was superior to the other selections in fruit number (Figure 2). The total yield per plant was highest in this selection and selection F. Average fruit size based on weight/fruit was among the smallest.. What the plant lost in size, it gained in number. Selection A produced the largest fruit size followed by YH2. A produced the smallest number of fruit. Yet here, what it lost in fruit number was gained in fruit weight. The other selections showed attractive fruit attributes as well. We concluded that overall selection F combines all the yield components most effectively to give an impressive fruit yield which makes it a top contender for the number one habanero among the selections compared (medium size plant, excellent RFD, high fruit number, medium size fruit, and great total fruit yield). YH3 follows closely with small size plant, high total fruit yield, attractive fruit shape/yellow color and good RFD.

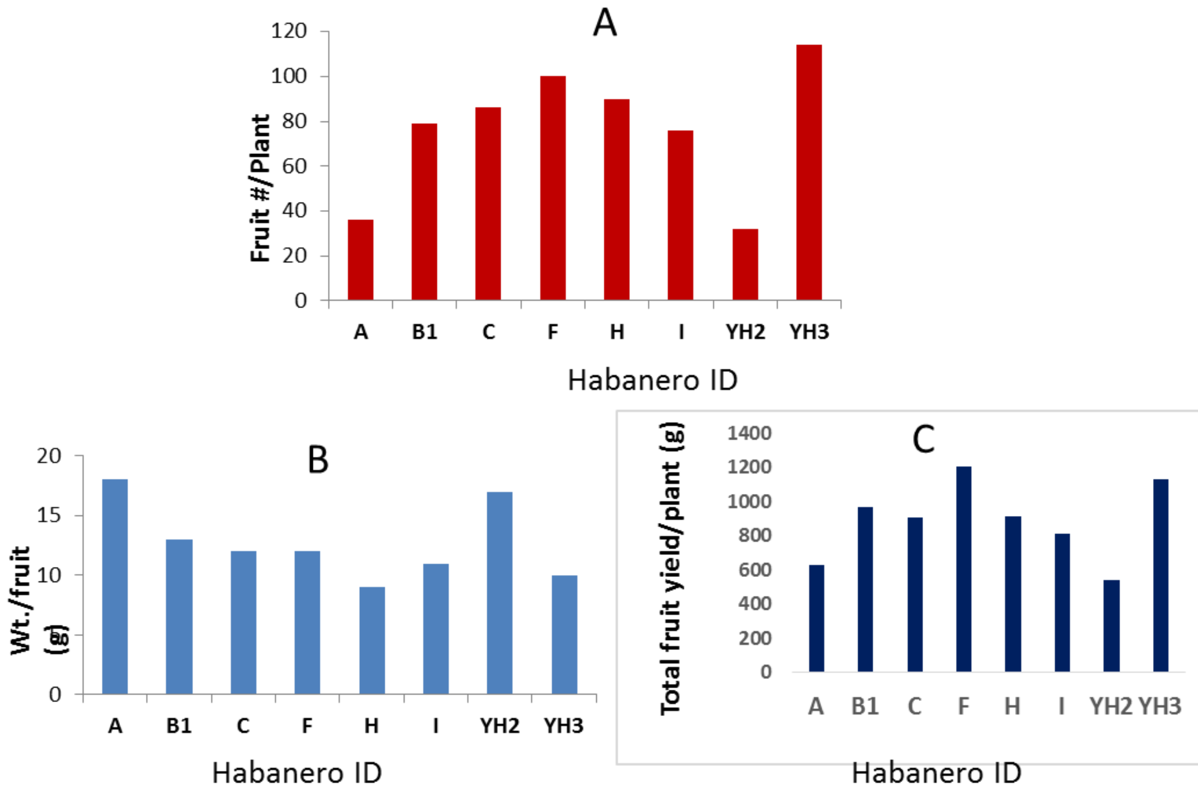

Figure 2: Fruit number/plant (A), weight/fruit (B) and total fruit yield/plant (C) in organically grown Habanero selections at Rutgers' Hort Farm 3 in 2016. Plants were grown from 8-week old transplants

Study 2: Impressive fruit production attributes were recorded in Study 2 (Fig. 3). Fruit yields were higher than in Study 1, due only to the shortage of plant material. YH3 was missing in Study 2 due to lack of planting material. Among the remaining selections, F gave the overall best performance recording over 2 kg fruit yield per plant, the highest fruit number and moderate fruit weight. As observed in Study 1, selection A produced the largest fruit size and low fruit number.

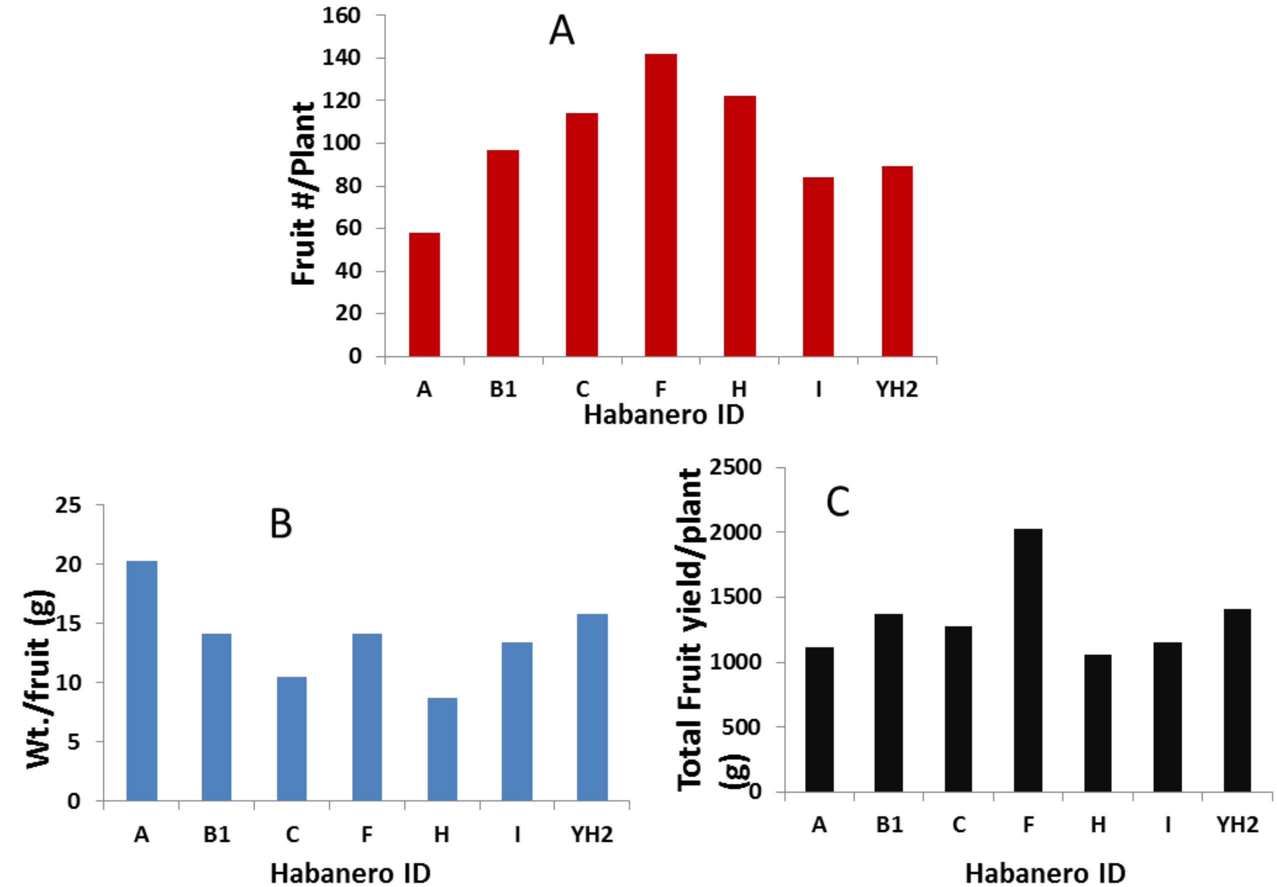

Figure 3: Fruit number/plant (A), weight/fruit (B) and total fruit yield/plant (C) in organically grown habanero selections raised at Rutgers' Hort Farm 3 from 20-week old transplants in 2016.

Fruit Shelf Life: Table 1 presents the approximate shelf life of fruit harvested from the habanero selections studied. We observed that age of transplant had no impact on fruit shelf life so the data provided were the combined observations from both Study 1 and Study 2. Selections A and F showed outstanding keeping quality in the cold room and under room temperature. Each selection retained fruit integrity for 4-5 weeks in the cold room (at 4^{o}C) and 3 weeks at room temperature (22-25^{o}C). The fruit of selections C ("Red Soft Skin Hab") and YH2 ("Yellow Rosebell Hab") were the least storable both in the cold room and at room temperature. In general, cold storage extended fruit storability by 2-4 weeks in various selections. Fruit storability is of great significance for pepper sauce producers, seed producers and the fresh market.

Conclusion

The 2016 studies on habanero selections provided useful information on the field production practices that will enhance future recommendations on plant release to our clientele for home garden use as well as commercial production. The information on shelf life will also improve our recommendations to the hot pepper sauce and seed production industries as well as the fresh market business owners. Nutrition and chemical analyses are in progress to determine the impact of the agronomic practices adopted and the production environment on the chemical composition of the habanero fruit.

Acknowledgement
We are grateful to the New Jersey Agricultural Experiment Station Hatch Project NJ12158 for funding the Exotic Pepper Program and the technical staff at Hort Farm 3 for the strong support provided in all aspects of production and handling of the habanero peppers. We are also indebted to Corinne Klewsaat, Marcus Raintree, and Jonathan Dmitruck who assisted with field establishment, management and data collection. They all performed impressively as interns.

ENVIRONMENTAL AND ECONOMIC ASPECTS OF COMPACT BED GEOMETRY FOR RAISED-BED PLASTICULTURE

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Raised-bed plasticulture with drip irrigation is used nationwide for growing high-value vegetable and fruit crops, a $22 billion industry. Most of this industry is located in east (e.g. FL, VA, NJ) and west coasts (CA) and produces high quality crops. This high-input, intensive system is facing international competition, diseases, and environmental regulation and must become more efficient to meet food demands while being economically and environmentally sustainable. Futuristic tall and narrow compact beds were designed with an aim to improve the plasticulture system by increasing or maintaining yield, reducing environmental footprint and disease risk, and decreasing input requirements. Using a systems approach, compact bed geometries were designed and evaluated on eggplant, tomato, and pepper (on-going) in the ecologically sensitive but highly productive sub-tropical southern Florida. The traditional plastic-mulched raised bed utilized by the industry is 30-36 in wide and 7-8 in high. A typical runtime in sandy soils can lead to the wetting front reaching below the bed and causing water and nutrient losses. The compact beds were designed to better fit the wetting front and were narrower and taller than the compact beds. The compact beds were 16-24 in. wide and 10-12 in. high. These geometries required one drip tape as opposed to two tapes, especially for double row crops such as pepper. The compact bed geometries were evaluated against the conventional beds at two commercial farms. Results for single row crops (tomato and eggplant) showed no adverse impact on yield. For eggplant and tomato, irrigation and nutrient (N and P) application rates were reduced by up to 50% and 19%, respectively in the compact beds with reduced input costs (up to $270/ac/yr). Reductions in cost are conservative and only include savings from reduced fumigant, irrigation (drip tape and fuel), and plastic. Cost savings can be substantially higher since they do not include potential savings realized with reduced land rent, fuel, labor, and other inputs.

Compact bed geometry evaluations for pepper were started in 2015 and are ongoing. The conventional bed for pepper was 32 in wide and 8 in high and contained two drip tapes while compact beds evaluated were 24 in x 10 in (one and two tapes) and 18 in x 12 in (one tape). Preliminary results show that compact beds produced equivalent yield with reduced irrigation, fumigant, fertilizer, drip tape, and plastic compared to the conventional bed. Preliminary productivity increases demonstrate how compact beds can lead to higher system efficiency of pepper production. Pending the results for the ongoing multi-season pepper experiment, shifting to compact beds may also bring potential non-water co-benefits, including reductions in the system's production costs, carbon footprint, agricultural and plastic waste. Compact beds provide flood protection by decreasing impervious (plastic-mulched) area and additional height (4-6 in). Compact beds may also have an added economic benefit for growers who pay to lease land, as production per acre can be increased by utilizing extra row-middle space to increase plant population density. Once confirmed by the ongoing multiple season experiment, a shift to taller

and narrower compact beds may make pepper production more sustainable as water, nutrient, pesticides, energy inputs, flooding and associated disease risks, and cost are reduced without sacrificing yields.

FOOD SAFETY

On-Farm Food Safety 101

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Spoilage microbes affect food quality while foodborne pathogens make food unsafe. Food spoilage organisms may cause undesirable odors or textures, making food unappealing. Spoilage organisms include molds (e.g. *Fusarium* or *Penicillium*), yeasts (e.g. *Saccharomyces* or *Candida*), and bacteria (e.g. *Pseudomonas* or lactic acid bacteria). Foodborne pathogens may not change the sensory properties of food and may not be detectable without special tests that require a laboratory.

There are many types of microbes that can cause foodborne illnesses. Some common bacterial pathogens include *Salmonella*, *Listeria monocytogenes*, and pathogenic strains of *Escherichia coli* like O157:H7. Some pathogenic bacteria can produce heat and chemical resistant spores (endospores), including *Clostridium botulinum* and *Bacillus cereus.* Endospores are very resistant to environmental stresses such as high heat, and chemical sanitizers. If environmental conditions are favorable, these spores can germinate and form vegetative cells that begin to grow and multiply.

Molds, such as *Aspergillus flavus,* can produce aflatoxin, a type of mycotoxin that is poisonous and carcinogenic. These toxins are heat-stable and can form in grain during storage under unfavorable conditions.

Bacteria can grow and multiply outside the human host. Other organisms like viruses and parasites do not multiply outside the human host. Viruses are much smaller than bacteria. Norovirus and Hepatitis A are viruses that have been associated with foodborne outbreaks. Parasites that have been associated with water and foodborne outbreaks include *Giardia, Cryptosporidium,* and *Cyclospora*.

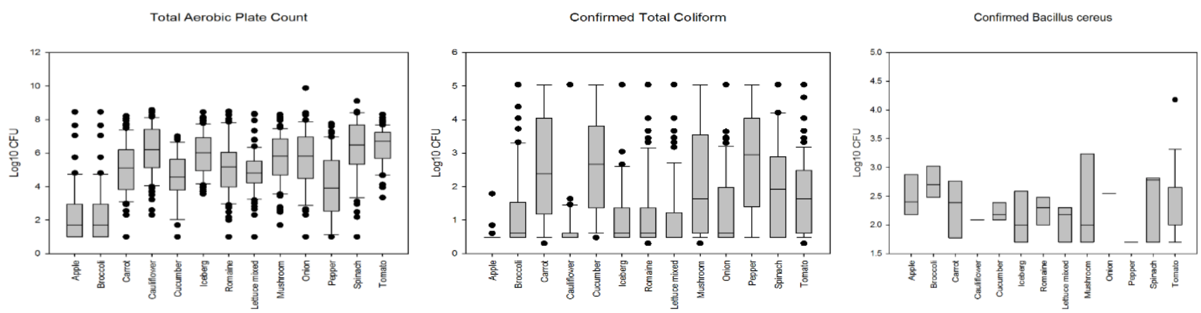
The following chart highlights the variety of microbes that have caused multistate outbreaks since 2014 in the United States (CDC 2016).

Type	Microbe	Year	Food
Bacteria	*S. enterica*	2016	Alfalfa sprouts
Bacteria	*E. coli* O157:H7	2016	Alfalfa sprouts
Bacteria	*L. monocytogenes*	2016	Frozen veggies & packaged salads
Virus	Hepatitis A	2016	Frozen strawberries
Bacteria	*S. enterica*	2015 & 2014	Cucumbers
Parasite	*Cyclospora*	2014	Cilantro
Bacteria	*L. Monocytogenes*	2014	Caramel apples
Bacteria	*S. Enterica*	2014	Bean sprouts
Bacteria	*E. coli* O157:H7	2014	Clover sprouts

Contamination of produce can come from a variety of sources on the farm. Animal and human feces can come in contact with produce, or insects can act as a vector between feces or other contamination sources and produce. Irrigation or other agricultural waters can cause contamination of the produce. Flood or runoff water can lead to produce contamination. The soil or improperly composted manure can cause contamination especially for those types of produce that grow in contact with the soil. Workers can contaminate produce during harvest if they are ill and do not practice proper hygiene. Cross-contamination can occur at post-harvest facilities like packing houses if proper sanitary practices, including adequate sanitizer levels are not observed resulting in a larger number of contaminated product.

Produce and environment samples can be tested for pathogens; however, isolating pathogens can be time consuming and difficult as such organisms may be present only sporadically and/or at low concentrations. As a result, a common practice is to test instead for indicator organisms. Indicator organisms “indicate” potential contamination and are a sign that sanitary practices may have lapsed and that pathogens may be present. Coliforms or generic *E. coli* are examples of indicator organisms. Indicator organisms may survive better and/or be present in higher concentrations than pathogens and thus are easier to detect via laboratory testing.

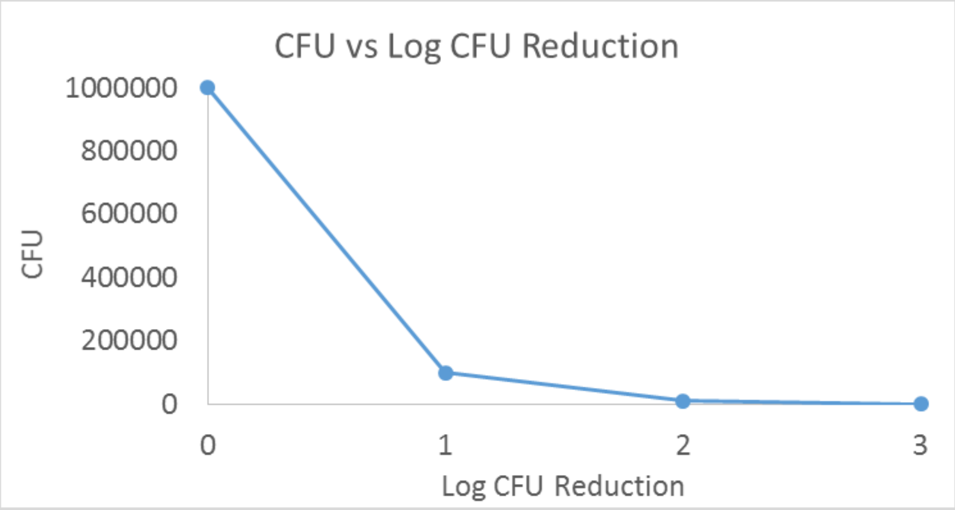
Over 900 produce samples from Rutgers University dining halls were sampled for total aerobic, presumptive and confirmed total coliform, and fecal coliform counts in addition to testing for generic and pathogenic *E. coli*, *S. enterica*, *Staphylococcus aureus, L. monocytogenes, and B. cereus*. Cauliflower, spinach, and tomatoes had some of the highest medians for the total aerobic plate counts whereas apples and broccoli had the lowest (graph below). As demonstrated in the confirmed total coliform graph, bell peppers had the highest median at 3.0 log CFU/g with apple, cauliflower and mixed lettuce having the lowest counts. When *Bacillus cereus* was present, bell peppers had the lowest counts (1.7 log CFU/g) with spinach having the highest (2.8 log CFU/g). *B. cereus* was isolated from 6.8% of the samples. In regards to *S. aureus, Salmonella* spp., and *L. monocytogenes*, those pathogens were isolated from 2.5, 0.7, and 0.3% of produce samples, respectively. *E. coli* was isolated from 1.4% of all the samples with *E. coli* O157:H7 isolated only once. Foodborne pathogens were rarely isolated, making it difficult to determine suitable indicators. Additionally, levels of indicators were highly variable, also leading to the difficulty in developing a uniform microbial quality standard.



Water activity (A_W) and pH are two important factors in microbial growth and survival. A_W indicates the availability of free water and is measured on a scale from 0 to 1. Pure water has Aw = 1 and corresponds to a relative humidity of 100% in the air above the water. Bacteria typically cannot grow in an environment with an A_W below 0.90. Molds and yeasts can grow at lower A_W of 0.8 and 0.85, respectively. The pH of a substance measures the hydrogen ion concentration on a scale from 0 to 14. A neutral pH (e.g. water) is around 7.0 with anything lower being acidic and higher being basic. Most bacteria thrive with a more neutral environment (pH=6.5-7.0), though the range of pH values that will permit growth ranges between 4 and 9 depending on the type of bacteria. Molds and yeasts can typically grow in more acidic environments than bacteria.

Injured, bruised, or damaged plant tissues may support bacterial growth and survival better than undamaged tissues. A study looking at *S. enterica* on lettuce leaves found that the bacteria preferred attaching to cut edges rather than intact surfaces. Additionally, there was a greater reduction with chlorine on intact leaves than cut leaves (Kroupitski et al. 2009). Another study looked at *E. coli* O157:H7 in apples. In four of five apple cultivars, bruising led to an increase in *E. coli* O157:H7 recovery as compared to intact apples. Bruised apples typically had a higher pH and lower °Brix value than their unbruised counterparts (Dingman 2000). These studies suggest that damaged produce can increase the likelihood of pathogen survival and growth due to the more favorable environments created.

Microbiologist speak of colony forming units (CFUs) to express the number of cells in a sample. CFUs are commonly transformed by taking their logarithm to calculate microbial growth and death. Logarithms go by factors of 10, so if there 5 log CFU on a surface, that would be 10 times greater than a surface with 4 log CFU. The graph below demonstrates that a 1 log reduction of 1,000,000 CFU would lead to 100,000 CFU, 2 log reduction to 10,000 CFU, and so forth.



Danyluk and Schaffner (2011) proposed a quantitative microbial risk assessment for *E. coli* O157:H7 on leafy greens from farm to fork. The model takes into account death of *E. coli* O157:H7 in the field, reduction and cross-contamination at the packinghouse, and then growth of the bacteria during refrigeration storage at the retail and home settings. The model predicts that most illnesses would occur because of cross-contamination at the packinghouse. Additionally, the paper simulates the dose of *E. coli* O157:H7 required for illness. The dose most likely to occur when there is an illness was -1 log CFU/g or 0.1 CFU/g. When taking into account the amount of lettuce in a serving (85 g) that would be roughly 9 CFU or cells/serving. Thus most of the illnesses are caused by a very small amount of cells.

CDC estimates that about 4000 people became sick as a result of the 2006 spinach outbreak with *E. coli* O157:H7 (Los Angeles Times 2007). This is based on the roughly 200 recorded cases and the fact that only about 5% of cases in an outbreak are actually reported. The dose-response relationship for pathogenic *E. coli* suggests that a small about of feces, only 1 to 2 pounds could have provided enough *E. coli* O157:H7 to cause the outbreak.

Works Cited

CDC. 2016. List of Selected Multistate Foodborne Outbreak Investigations. Available at: https://www.cdc.gov/foodsafety/outbreaks/multistate-outbreaks/outbreaks-list.html. Accessed 28 December 2016.

Danyluk, M.D. and D.W. Schaffner. 2011. Quantitative Assessment of the Microbial Risk of Leafy Greens from Farm to Consumption: Preliminary Framework, Data, and Risk Assessments. *J Food Prot.* 74(5):700-708.

Dingman, D.W. 2000. Growth of *Escherichia coli* O157:H7 in Bruised Apple (*Malus domestica*) Tissue as Influenced by Cultivar, Date of Harvest, and Source. *Appl. Environ. Microbiol.* 66(3):1007-1083.

Kroupitski, Y., R. Pinto, M.T. Brandl, E. Belausov, and S. Sela. 2009. Interactions of *Salmonella enterica* with lettuce leaves. *J Appl. Microbiol.* 106:1876-1885.

Los Angeles Times. “Tainted Spinach Tied to Cattle Ranch,” March 24, 2007. Available at: http://articles.latimes.com/2007/mar/24/local/me-spinach24. Accessed 28 December 201

PREPARING FOR FSMA: ON FARM READINESS REVIEW

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Introduction:

The Food Safety Modernization Act (FSMA) was signed into law January, 2011. The final rule was published November, 2015 after comment periods and public meetings. This the biggest change to food safety that directly impacts fresh fruit and vegetable growers in over 70 years. The Act will be implemented over the next six years with compliance for growers with annual produce sales (previous three year period) over $500,000 starting in January, 2018, small operations ($250,000 – 500,000) January, 2019 and the very small operation ($25,000 – 250,000) January 2020. All operations will have two additional years for the water component and some recordkeeping. Growers with produce sales less than $25,000 are not covered under this rule. If the operation produces fresh fruits and vegetables, this Act applies except if the produce is commercially processed.

The Food and Drug Administration is interested in helping growers with tools that they could use for a self-assessment prior to any visits from them. They want to educate before regulating and work in a partnership with growers and the individual states.

Objectives:

1. Offer a voluntary pre-inspectional readiness review for covered farms
2. Promote coordination between farmers, regulators and educators
3. Educate regulators about on-farm conditions
4. Identify educational needs
5. Familiarize non-qualified farms with the regulations

Process:

The On-farm Readiness Review process is driven by the National Association of State Departments of Agriculture (NASDA) and four state departments of agriculture (Oregon, North Carolina, Florida and Vermont). The partners in the project include the Food and Drug Administration (Produce Safety Office of Regulatory Affairs, Inspectors), United States Department of Agriculture (FDA liaison and GAP auditors), Cooperative Extension Organizations in Michigan, New Jersey, Florida, North Carolina and the Produce Safety Alliance at Cornell University.

NASDA believes the benefits from this project include:

1. Learning opportunity for both industry and regulators
2. Industry exposure to the regulatory process
3. Provides regulators an opportunity to build knowledge and skills necessary to uniformly and consistently regulate the fresh produce industry
4. Builds awareness of critical food safety practices for farmers
5. Provides farmers an opportunity to assess their operations against regulatory provisions
6. Assists in building consensus among industry, academia and regulatory stakeholders

The group has been working to develop a "toolkit" made up of a series of modules that will allow a grower to walk through their operation and decide if changes are needed. The modules include the following assessments:

1. Preharvest, harvest and postharvest water
2. Preharvest, harvest and postharvest sanitation
3. Preharvest, harvest and postharvest worker training
4. Preharvest soil amendments
5. Preharvest and at harvest wildlife monitoring

The modules are being tested in a series of pilot studies across the United States to make sure all the modules are clear and can be used by any grower, extension personnel or regulator who needs them. The first test was carried out in Michigan this past summer on two farms (celery and blueberry). This test showed that the modules were too large and hard to use in the field. Also, since the FDA has not released guidance documents it was hard to interpret some of the rules. The regulators in the group had not worked with Extension prior and were surprised how agents worked with the growers to use the modules.

There was a post evaluation with the growers, extension and regulators to help develop a better tool for the next pilot study. Growers felt that the tool should be aligned with third party audits as closely as possible. Also, to improve the efficiency of the tool, growers need a checklist to easily explain to an inspector which sections of the rule/tool aren't applicable to a given operation rather than being put on the defensive.

Future Plans:

The Extension group is revising the modules and developing checklists for each module. There will be a series of pilot tests (Florida, North Carolina, New Jersey, Vermont, California and Oregon) to be completed by September, 2017. After each pilot the group will assess it and make changes as needed based on grower comments. Starting in late 2017 there will be regional trainings for State Departments of Agriculture, FDA regulators and Extension on how to use the tool.

Summary:

The final tool should be used by extension as an educational tool or for growers and packers under the Produce Safety Rule to use for self-assessment.

BACTERIAL SURVEILLANCE IN A WATERMELON FIELD

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Introduction: Poultry litter is a widely used biological soil amendment. While research shows that bacterial pathogens exhibit enhanced survival in poultry litter; risks associated with watermelons grown in soils amended with poultry litter are not well understood.

Purpose: This study evaluated the survival of *E. coli* and naturally occurring *Salmonella* in field-grown watermelons in unamended soils and soil amended with poultry litter (PL).

Methods: Two trials of 12 individual plots were sampled from May-November 2015. Seedless Exclamation and Liberty watermelons were planted on plastic mulch in soil or in soil amended with one of two types of PL (cake and total clean out) applied at 6725 kg/Ha. In each trial, one half of the plots were inoculated with non-pathogenic *E. coli* (TVS 355). Soil samples collected weekly (n=1032) and watermelons collected at harvest (n=120 on days 70, 77, and 84) were analyzed for *E. coli* populations by colony count or MPN, and for *Salmonella* by enrichment using a modified FDA BAM procedure. Data were analyzed using two-way ANOVA in JMP Pro-11.

Results: Composite soil samples and weather parameters were collected weekly. On day 2, *E.coli* levels were significantly ($P<0.0001$) greater in amended soils (7.04 log CFU/g) compared to unamended (4.94 log CFU/g), and remained that way throughout the study. Type of PL did not affect *E. coli* populations. By day 133, *E. coli* populations in PL-amended soils were significantly greater (0.51±1.15 log MPN/g) compared to those in unamended plots which were below the detection limit (-0.6 log MPN/g). *Salmonella* spp. was detected in 36% of soil samples and with increased frequency during July-August ($P<0.05$). Over the study, more samples taken adjacent to the plastic mulch were positive for *Salmonella* compared to samples from under mulch ($P>0.05$). Approximately 50% of watermelons sampled were positive for *E.coli* with a highest recovery of 2.14 log (MPN/g) from amended-soils. *Salmonella* spp. was detected on watermelons (16/120) grown in both amended and unamended soils.

Significance: Incorporation of poultry litter provided conditions conducive to survival of *E. coli* and introduced *Salmonella* into soil and on watermelons.

TOMATOES

Compact Bed Geometry for Tomato and Eggplant Production Using Plasticulture System: A Win Win

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Raised-bed plasticulture with drip irrigation is used worldwide for growing high-value, freshmarket vegetable and fruit crops. Nationally, the vegetable (e.g. tomato, eggplant)_and fruit (e.g. strawberry, melons) production is a $22 billion industry with most of it located in east (e.g. FL, NJ) and west coasts (CA). Majority of vegetable and fruit crops use plasticulture to produce high quality crops. The plasticulture requires high inputs and costs and is an energy intensive system. The industry is enduring economic, regulatory, and disease pressures and must find innovative solutions that reduce the inputs and production costs, maintain or increases the production, and make efficient use of limited land and water resources to make it more sustainable. One way to effectively transform plasticulture would be to re-design the raised beds currently in practice, which tend to be wide (30-36 in) and short (6–8 in). Using a whole-systems approach, compact bed geometries were designed and tested on eggplant and tomato in the ecologically sensitive but highly productive Everglades region of sub-tropical Florida. A typical drip irrigation runtime used in sandy soils of Florida can lead to the water and nutrients leaching below the bed. The compact beds were designed to better cover the wetting front and were narrower and taller than the conventional beds. The compact beds were 16-24 in. wide and 10-12 in. high. The compact bed geometries were evaluated against the conventional beds at two commercial farms in southern Florida.

The compact bed geometries for eggplant required one drip tape as opposed to two tapes used at the commercial farm. Results for eggplant showed no adverse impact on yield with irrigation and nutrient (N and P) application rates reduced by 50% and 14-19%, respectively in the compact beds with reduced input costs ($225-$273/ac/yr). These cost savings are conservative and only include savings from reduced fumigant, irrigation (drip tape and fuel), and plastic. Other non-water co-benefits for eggplant production included reduced production cost, carbon footprint, agricultural and plastic wastes, runoff volume, and flooding and associated potential disease risks.

The compact bed geometry evaluations for tomato used measurements as well as modeling approaches. Interim results (two seasons) from the ongoing experiments and modeling showed no adverse impact on tomato yield with potential reductions in costs ($60-180/ac/yr); leaching losses; fumigant; plasticulture carbon footprint and plastic waste; field runoff and flooding risks. Cost savings are likely to be higher since they do not include potential savings from reduced land lease cost and fuel, labor, and other inputs. Productivity increases for tomato and eggplant show how compact beds can lead to higher system efficiency of plasticulture. Shifting to compact beds also bring non-water co-benefits. Compact beds provide flood protection by decreasing impervious (plastic covered) area and additional height (4-6 in). Compact beds may also have an added economic benefit for growers who pay to lease land, as production per unit area can be increased by utilizing extra row-middle space to increase plant population density. Savings in land rental cost can be significant especially in regions (e.g. FL, CA) with high land value. Re-designed compact bed geometries for the plasticulture production systems to be more compact can be a win-win production optimization. Pending the results from the ongoing study, a shift to compact beds is likely to make the tomato production more economically as well as environmentally sustainable as water, nutrient, pesticides, energy inputs, flooding and associated disease risks, and costs are reduced without reducing production.

TOMATO VARIETY TRIAL RESULTS FROM 2016, WHAT'S NEW TO TRY IN 2017

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Introduction - Fresh market tomatoes are a very important crop in Pennsylvania. According to the USDA, in 2015 total harvested acreage was 2,200 with a crop value of over $33.2 million. Since there had been no evaluation of newly released varieties in the state in a replicated trial in recent years, this study was initiated in 2016 and plans are to repeat it again in 2017.

Materials and Methods - Twenty three round red tomato varieties (named and advanced selections) were evaluated using plasticulture and drip irrigation. In addition, six advanced selections from the Penn State tomato breeding program were included for observation. Seeds were started on April 26 and transplants were set in the field on May 31. There were four 10-plant replications per variety with an in-row spacing of 1.5 ft. Preplant fertilizer was applied according to soil test results and standard fertility and pest management practices were used during the growing season as found in the Commercial Vegetable Production Guide.

Harvest started on August 1 and stopped on September 9. Fruit were graded into #1, #2 and cull and each group was counted and weighed.

Results and Discussion – Mountain Fresh Plus was used as the standard variety in this trial. Yields of #1 fruit and total marketable fruit (#1 + #2) were 6.5 and 12.0 lbs per plant (Tables 1 & 2). Varieties with similar yields of #1 fruit (+/- 0.3 lbs) were Red Bounty, Red Deuce, Rocky Top and Tribute. Varieties with higher yields of #1 (more than 0.3 lbs) were Red Morning, Red Mountain, STM 8005 and Volante. Varieties that had similar total marketable yields (+/- 0.5 lbs) were Bella Rosa, FTM 1135, Red Deuce, Rock Top, Tribute and Volante. Varieties with a total marketable yield 0.5 lbs per plant (or more) greater than Mountain Fresh Plus were Red Morning, Red Mountain and STM 8005.

Mountain Fresh Plus had a value of 80% for total marketable percent of harvested fruit. Varieties with similar total marketable percent of all fruit (+/- 5%) were Rally, Red Bounty, Red Deuce, Red Mountain, STM 8005, Tribute and Volante. Average marketable fruit size for Mountain Fresh Plus was 0.64 lbs; only 5 varieties had lower average fruit size. All varieties had acceptable average fruit size of over 0.5 lbs. No consistent differences in flavor were noted with informal tastings on selected harvests.

In the advanced selections from the Penn State breeding program PSFH 15-11 had similar yields of #1 fruit as Mountain Fresh Plus while PSFH 15-5, 15-8 and 15-28 had higher yields. All four of these selections had higher total yields. PSFH 15-8 and 15-11 had similar marketable percent as Mountain Fresh Plus while PSFH 15-28 was higher.

Table 1. Yields of #1 and #2 fruit for 23 named/numbered varieties of round red tomato and six advanced selections from the Penn State tomato breeding program. All numbers are averages from four replications except as noted and are reported on a per-plant basis.

Variety	Number #1	Weight #1(lbs)	Number #2	Weight #2(lbs)
Bella Rosa	6.9	5.1	9.3	6.6
BHN 589	6.2	4.5	7.8	5.5
FTM 1127	3.8	3.0	6.4	5.5
FTM 1135	8.4	6.1	8.4	5.7
Mountain Fresh Plus	9.9	6.5	8.9	5.6
Mountain Majesty	5.4	4.3	5.3	4.3
Mountain Merit	5.8	3.5	6.9	4.5
Primo Red	7.2	5.4	8.3	6.2
Rally	9.1	5.6	9.3	5.4
Red Bounty	9.0	6.3	8.1	5.4
Red Delight	7.4	4.9	7.5	4.7
Red Deuce	7.5	6.6	6.4	5.7
Red Morning	9.5	7.6	7.0	5.3
Red Mountain	13.8	8.3	9.4	5.2
Red Rave	9.1	5.3	7.2	4.5
Redline	6.4	4.2	7.2	4.6
Resolute	7.3	4.4	8.7	5.4
Rocky Top	9.3	6.2	7.7	5.3
Scarlet Red	7.3	5.6	6.8	5.1
STM 8005	11.4	7.5	8.4	5.4
Summerpick	5.8	4.0	7.7	5.4
Tribute	9.7	6.3	7.8	5.1
Volante	10.4	7.1	7.7	5.0
PSFH 15-1[a]	7.8	4.9	9.2	5.4
PSFH 15-5[b]	12.0	7.1	10.8	6.0
PSFH 15-8[b]	14.1	9.1	7.9	5.0
PSFH 15-11[a]	10.7	6.9	9.8	6.7
PSFH 15-25[a]	7.1	5.2	5.5	4.1
PSFH 15-28[a]	15.5	9.5	6.9	4.3

[a] = one replicate
[b] = two replicates

Table 2. Total # and weight of marketable fruit, average weight and # culls for 23 named/numbered varieties of round red tomato and six advanced selections from the Penn State tomato breeding program. All numbers are averages from four replications except as noted and are reported on a per-plant basis.

Variety	Total Number Marketable	Total Marketable Wt.(lbs)	Average Marketable Wt.(lbs)	Number Culls
Bella Rosa	16.2	11.7	0.72	8.7
BHN 589	14.0	10.0	0.70	8.0
FTM 1127	10.2	8.5	0.83	8.6
FTM 1135	16.8	11.9	0.71	7.9
Mountain Fresh Plus	18.8	12.0	0.64	5.5
Mountain Majesty	10.7	8.6	0.82	5.4
Mountain Merit	12.7	7.9	0.63	8.4
Primo Red	15.5	11.6	0.75	9.2
Rally	18.4	11.0	0.60	6.2
Red Bounty	17.0	11.6	0.68	6.5
Red Delight	14.9	9.5	0.64	7.5
Red Deuce	13.9	12.3	0.89	4.3
Red Morning	16.5	12.9	0.79	6.8
Red Mountain	23.3	13.6	0.59	8.2
Red Rave	16.3	9.8	0.61	6.7
Redline	13.6	8.8	0.65	7.1
Resolute	16.0	9.7	0.61	6.0
Rocky Top	17.0	11.5	0.68	7.8
Scarlet Red	14.1	10.7	0.76	7.4
STM 8005	19.8	12.9	0.65	5.0
Summerpick	13.5	9.3	0.69	8.4
Tribute	17.6	11.5	0.66	6.2
Volante	18.1	12.1	0.67	7.1
PSFH 15-1[a]	17.0	10.3	0.60	7.3
PSFH 15-5[b]	22.8	13.1	0.58	8.5
PSFH 15-8[b]	22.0	14.0	0.64	4.7
PSFH 15-11[a]	20.5	13.6	0.66	6.2
PSFH 15-25[a]	12.6	9.3	0.74	8.7
PSFH 15-28[a]	22.4	13.8	0.62	4.2

[a] = one replicate
[b] = two replicates

Table 3. Total # and weight of harvested fruit, percent marketable and seed source for 23 named/numbered varieties of round red tomato and six advanced selections from the Penn State tomato breeding program. All numbers are averages from four replications except as noted and are reported on a per-plant basis.

Variety	Total Number Harvested	Total Weight Harv.(lbs)	Percent Marketable	Seed Source
Bella Rosa	24.9	17.3	68	CS
BHN 589	22.0	14.9	67	SW
FTM 1127	18.7	15.2	56	ST
FTM 1135	24.7	16.9	70	ST
Mountain Fresh Plus	24.3	15.0	80	HM
Mountain Majesty	16.1	12.7	68	HM
Mountain Merit	21.1	12.9	61	SW
Primo Red	24.8	17.9	65	HM
Rally	24.5	13.9	79	CS
Red Bounty	23.6	15.5	75	HM
Red Delight	22.3	14.0	68	CS
Red Deuce	18.2	15.8	78	HM
Red Morning	23.3	17.9	72	HM
Red Mountain	31.5	17.9	76	HM
Red Rave	23.0	13.4	73	SW
Redline	20.7	13.2	67	CS
Resolute	22.0	13.2	73	SW
Rocky Top	24.8	16.3	71	SW
Scarlet Red	21.4	16.2	66	SW
STM 8005	24.7	15.8	82	CS
Summerpick	21.8	14.5	64	CS
Tribute	23.7	15.0	77	CS
Volante	25.1	16.1	75	CS
PSFH 15-1[a]	24.3	14.1	73	PSU
PSFH 15-5[b]	31.2	17.7	74	PSU
PSFH 15-8[b]	26.7	16.6	84	PSU
PSFH 15-11[a]	26.7	17.3	79	PSU
PSFH 15-25[a]	21.3	15.0	62	PSU
PSFH 15-28[a]	26.6	15.8	87	PSU

[a] = one replicate, [b] = two replicates
CS = Clifton Seed, HM = Harris Moran, ST = Stokes, SW = SeedWay
PSU = Dr. Majid Foolad, Penn State

The Newest Tomato Breeding Lines From Rutgers

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Introduction

About 3,000 acres of commercially-produced tomatoes were recorded in New Jersey in 2015. A little more than half of this production was devoted to fresh market types, mostly large “round” fruits (more accurately termed “spherical”). Other market classes include plum and grape/cherry types, but these are of very minor significance in New Jersey. Additionally, there are thousands of home and roadside gardens in New Jersey that are not included in this commercial acreage total.

Historically, commercial fresh market tomatoes have been much more impressive in New Jersey’s composite agricultural economy. In 1933, total tomato acreage in New Jersey was 36,000, most of which was used for canning. Progressively, production has moved from the Eastern U.S. to the south (mainly Florida) and west (California and Mexico). Currently, no seed companies are actively breeding tomatoes, either fresh market or processing, in New Jersey. Virtually all the new varieties that are introduced through growers and university variety trials were developed and tested initially on research stations and farms in Florida, California, or Mexico.

With regard to fresh market “round” tomatoes, most of the contemporary breeding efforts by seed companies has been directed at commodity mature green types that feature production attributes such as sophisticated disease resistance gene packages and high, concentrated fruit yield. Many of the disease resistance genes are targeted for western and southern growers, and don’t necessarily benefit tomato growers in the eastern U.S. The fruits of contemporary fresh market tomato varieties are typically very firm, flattened spheres, with small blossom and stem scars, and very uniform in external color; the color following treatment of mature green fruits with ethylene being most crucial.

In eastern states such as New Jersey, the trend is in the direction of value-added fresh market vegetable products such as specialty varieties that cater to valuable culinary niches. Commodity tomato varieties don’t necessarily fit into these categories. Moreover, the F_1 hybrid seeds are expensive, and a large part of the cost is attributable to breeding for western disease resistances and mature green fruit attributes. In fresh market tomatoes, commodity tomato acreage is shrinking, while acreage grown in new varieties such as heirlooms, plums, grapes, and ethnic types is increasing. Many consumers consider the “Jersey Tomato” to be a product that conceptually harkens back to the vine-ripe roadside fruits offered locally during the 19th and early 20th centuries, thought to feature a much preferred flavor compared to gassed mature green fruits.

The New Jersey Agricultural Experiment Station, led by Jack Rabin, started the “Rediscovering the Jersey Tomato” project in 2006. The first varietal offering from this project was the historic Rutgers variety ‘Ramapo’ that was released in 1967 then disappeared from seed catalogues in the 1980s. Home gardeners and some commercial growers clamored for more seeds of this variety. Jack and Cindy Rovins arranged to have more hybrid seeds produced in Israel, and ‘Ramapo’ has been offered continuously by NJAES since 2007. Later, the historic fresh market varieties ‘Moreton’, ‘KC-146’, and, more recently, ‘Rutgers 250’ were added to the portfolio.

‘Rutgers 250’ was the first new variety developed at NJAES and marketed through the “Rediscovering the Jersey Tomato” program. It was released in January 2016, and sold in limited quantities through the NJAES website and in larger “semi-commercial” quantities through the Rohrer Seed Co. Seeds were also provided to KubePak® for transplant production and distribution on a limited basis. In 2015, less than 1.0 lb. of ‘Rutgers 250’ seeds were produced, and these quickly sold out. In 2016, more seeds (3.12 lbs.) were produced, and will be distributed in 2017 through NJAES and Rohrer.

‘Rutgers 250’ is an open-pollinated variety, like the predecessor it was intended to emulate (‘Rutgers’). The new variety was developed using the same original parents and general breeding strategy as the original that was first released in 1934. The primary selection criteria for ‘Rutgers 250’ were fruit flavor and visual quality, since fruit of the original ‘Rutgers’ variety is now considered to be too soft, crack-prone, and uneven in external color to be acceptable to markets. ‘Rutgers 250’ was also selected for mid-season maturity, semi-determinate habit, low disease (mainly bacterial) symptoms, and high concentrated yield. Like all varieties, however, it does have flaws. Early-maturing fruits of ‘Rutgers 250’ tend to have a large indented blossom scar especially if the plant experience cool night temperatures.

Recent Results

The original intention was that ‘Rutgers 250’ would be targeted for home gardeners and small direct marketers, not mainstream commercial growers. Some growers have reported that ‘Rutgers 250’ fruits are too soft for their needs, that yields are inadequate compared to mainstream hybrids, and that flavor isn’t as good as some customers had hoped. There has been some input that the disease tolerance is inadequate, but most growers have identified this as a shortcoming.

Breeding efforts are continuing to further improve ‘Rutgers 250’, and possibly to develop a variety worthy of penetration into the mainstream fresh market domain. In 2014, the breeding lines that led to ‘Rutgers 250’ were hybridized with a panel of inbreds developed for adaptation to New Jersey growing conditions and selected for high yield and fruit quality along with excellent fruit flavor. The resulting F_1 hybrids were tested at the Snyder Farm in 2015 and 2016. A few of the approximately 50 combinations that were tested appear to have some promise.

The following table features new F_1 hybrids tested in both 2015 and 2016 that are the most promising, and that will be tested further as possible ‘Rutgers 250 Hybrid’ releases:

Performance of 'Rutgers 250' F_1 Hybrid Breeding Lines Summer 2016

Snyder Farm

Mean of 3 replications; 8-plant plots

♀ parent	♂ parent	Habit[a]	Maturity[b]	Yield[c]	Fol Cov[d]	BSR[e]	Avg Frt Wt g	Firm	Ext col	Int col	pH	Brix	Score
RU04	TRW3001	3.00	4.00	3.00	3.83	4.00	240.87	2.67	4.50	4.33	4.350	2.97	50.37
RU07	TRW3004	2.50	2.33	3.50	3.00	4.33	244.55	3.50	3.88	4.25	4.343	2.73	51.58
TRW3004	RU07	2.17	2.00	4.00	3.17	4.00	303.63	3.50	4.50	4.17	4.270	2.78	53.87
TRW3002	RU01	3.33	3.67	3.25	4.00	4.00	222.27	3.17	4.50	4.17	4.203	2.78	51.96
RU02	TRW3002	3.83	3.67	4.25	3.17	3.67	335.60	3.33	4.17	4.17	4.367	3.42	50.45
TRW3002	RU04	3.33	3.83	3.75	3.83	3.83	220.45	3.50	4.50	4.00	4.335	3.16	51.16
TRW3001	F_8	3.33	3.50	4.33	3.50	4.17	259.55	3.25	4.50	4.25	4.360	2.59	52.71
Rutgers 250	F_8	3.50	3.83	4.00	3.83	4.17	252.63	3.00	4.33	4.00	4.243	2.72	52.10
BHN589		3.50	4.00	3.00	3.50	2.50	316.83	3.17	4.17	4.00	4.317	3.80	49.70
Red Deuce		3.00	3.50	3.50	3.00	3.00	355.80	4.50	4.00	4.00	4.340	2.78	49.75
Primo Red		2.00	1.50	3.00	2.00	1.50	247.00	4.00	4.00	3.50	4.320	2.78	46.59

Rutgers 250 F_1 Hybrid' defined as having at least one parent an advanced RU250 breeding line (TRW3001, 002, 004)

TRW3002 = 'Rutgers 250'

Red Deuce' and 'Primo Red' only one replication

[a] Habit: 1-5 scale 1=highly determinate; 5=highly indeterminate

[b] Maturity: 1-5 scale 1=earliest; 5=latest

[c] Yield: 1-5 scale 1=lowest; 5=highest

[d] Foliar cover: 1-5 scale 1=least foliage; 5=most foliage

[e] Bacterial speck/spot resistance: 1-5 scale 1=most symptoms; 5=least symptoms

Average fruit weight in grams

Firmness 1-5 scale 1=least firm; 5=most firm

External color 1-5 scale 1=least red/orange; 5=most red/orange

Internal color 1-5 scale 1=lease color; 5=most color

OVERALL SCORE: A composite of all evaluation criteria

This table summarizes the performance of new hybrid combinations first tested in summer 2016. The bold/italicized entries will be retested in replicated trials in summer 2017:

Performance of 'Rutgers 250' F_1 Hybrid Breeding Lines Summer 2016

RAREC

Observational 8-plant plots

♀ parent	♂ parent	Habit[a]	Maturity[b]	Yield[f]	Fol Cover[d]	BSR[e]	Avg Frt Wt	Firm	Ext colo	nt color	pH	Brix	Score
RU03	TRW3001	2.5	3.0	4.0	3.5	3.0	242.7	4.0	3.0	3.0	3.98	2.21	***53.05***
RU03	TRW3002	3.0	4.0	2.5	4.0	3.0	145.0	3.0	4.5	3.5	4.16	3.16	49.57
RU04	TRW3002	3.0	3.5	2.5	3.5	2.0	238.6	3.0	3.0	2.5	3.97	2.97	***47.64***
RU05	TRW3001	3.5	4.0	1.5	3.0	2.5	190.8	2.5	3.0	2.0	4.35	2.97	38.91
RU05	TRW3002	2.5	3.5	2.0	3.0	3.5	227.0	3.5	3.5	3.5	4.43	4.12	46.70
RU06	TRW3002	2.5	3.5	3.0	3.5	4.0	218.8	3.0	3.0	2.5	4.03	2.78	***49.20***
RU08	TRW3002	4.0	5.0	1.5	4.0	2.5	211.0	4.0	3.5	3.0	4.31	2.97	41.81
RU11	TRW3002	4.0	4.5	1.5	4.0	2.5	225.3	3.0	4.5	3.0	4.19	3.35	44.09
RU11	TRW3004	5.0	5.0	1.5	5.0	4.0	173.7	3.5	4.0	3.5	4.10	3.73	48.35
RU12	TRW3001	2.5	3.0	1.5	3.0	4.5	19.0	4.0	4.0	3.0	4.23	3.92	49.27
TRW3001	RU03	3.5	3.5	2.5	4.0	3.0	184.9	4.0	4.5	3.5	4.03	2.78	***50.06***
TRW3001	RU06	1.5	1.5	3.0	3.0	5.0	35.3	3.5	4.0	3.5	4.15	4.12	54.33
TRW3001	RU09	4.5	4.5	1.0	4.0	2.0	205.8	4.0	3.5	3.0	4.26	2.97	41.69
TRW3002	RU05	3.5	3.5	2.5	3.5	2.5	228.6	3.5	3.5	3.0	4.13	2.97	***48.32***
TRW3002	RU08	2.5	3.0	3.0	3.5	3.5	233.5	3.0	3.0	1.5	4.26	2.78	45.42
TRW3002	RU11	3.5	3.5	2.5	3.5	2.5	332.0	4.5	3.0	2.5	4.22	3.16	46.81
TRW3002	RU14	3.0	4.0	1.5	3.5	1.5	220.2	3.0	2.5	2.5	4.20	2.78	40.85
TRW3004	RU09	5.0	4.0	2.0	3.5	3.0	106.8	3.5	3.5	2.5	4.34	3.73	43.01
TRW3004	RU11	4.5	4.5	1.5	4.5	3.5	173.8	3.5	3.5	4.0	4.18	3.92	47.59
TRW3004	RU12	1.5	2.0	3.0	3.0	3.0	128.0	3.5	3.0	4.0	4.54	2.97	46.54
TRW3004	RU15	4.0	3.5	2.5	4.5	5.0	193.8	3.0	3.3	3.3	4.23	3.26	***50.70***
TRW3001	F8	3.3	3.5	4.3	3.5	4.2	259.6	3.3	4.5	4.3	4.36	2.59	52.71
Rutgers 250	F8	3.5	3.8	4.0	3.8	4.2	252.6	3.0	4.3	4.0	4.24	2.72	52.10
BHN589		3.5	4.0	3.0	3.5	2.5	316.8	3.2	4.2	4.0	4.32	3.80	49.70
Red Deuce		3.0	3.5	3.5	3.0	3.0	355.8	4.5	4.0	4.0	4.34	2.78	49.75
Primo Red		2.0	1.5	3.0	2.0	1.5	247.0	4.0	4.0	3.5	4.32	2.78	46.59

Efforts continued toward identifying prospective F1 hybrids from among inbred parents that have been developed over the past 10 years for high combining ability for adaptation to eastern U.S. growing conditions, high/concentrated fruit yield, disease tolerance, and high fruit quality. The results of a comprehensive observational trial conducted at RAREC in summer 2016 were as follows:

Performance of F_1 Hybrid Breeding Lines Summer 2016

RAREC

Observational 8-plant plots

♀ parent	♂ parent	Habit[a]	Maturity[b]	Yield[f]	Fol Cover[d]	BSR[e]	Avg Frt Wt	Firm	Ext col	Int col	pH	Brix	Score
RU01	RU09	3.0	4.5	3.0	3.0	5.0	110.6	3.5	4.0	3.0	4.20	2.78	46.85
RU01	RU11	4.5	3.5	2.0	4.0	4.0	5.2	2.0	5.0	4.5	4.21	4.31	49.16
RU02	RU04	3.5	3.0	1.0	3.5	3.0	99.0	3.5	4.0	3.5	4.16	4.12	46.24
RU02	RU06	4.0	4.0	1.5	2.5	1.5	409.7	2.5	4.0	3.0	4.28	2.97	36.23
RU02	RU08	2.5	2.5	3.5	3.0	3.5	166.8	3.5	4.0	3.5	4.46	3.35	44.27
RU02	RU13	4.5	4.0	3.0	3.0	4.0	126.0	4.0	4.0	3.0	4.08	3.92	49.71
RU03	RU01	4.0	4.0	3.0	4.0	3.5	284.3	3.5	3.5	3.0	4.20	2.97	47.55
RU03	RU05	1.5	2.0	4.0	3.0	4.0	265.0	4.0	3.0	3.0	4.36	1.60	45.07
RU03	RU06	3.5	4.5	1.0	5.0	2.5	114.5	2.0	4.0	4.5	4.40	2.21	37.64
RU03	RU10	3.5	3.5	2.5	3.0	3.0	213.0	2.5	4.5	4.0	4.34	3.35	43.44
RU03	RU13	4.5	3.5	3.0	3.5	3.0	80.2	3.5	4.0	3.0	4.23	2.78	44.33
RU04	RU07	3.0	3.5	2.5	4.0	3.5	205.4	2.0	4.5	4.5	4.35	3.92	46.97
RU04	RU08	3.5	3.5	2.5	4.5	4.0	141.8	3.0	5.0	5.0	4.49	3.92	48.53
RU04	RU09	3.5	4.5	1.0	5.0	4.5	144.0	3.5	2.0	2.0	4.09	2.40	37.20
RU04	RU13	5.0	4.0	2.5	4.0	4.5	35.8	2.0	3.0	2.5	4.13	3.73	38.84
RU05	RU01	4.0	4.5	2.0	4.5	4.0	223.6	4.5	3.5	3.0	3.98	2.59	47.84
RU05	RU06	3.5	3.5	2.5	4.0	4.0	223.2	3.5	3.5	4.5	4.54	4.12	47.41
RU05	RU07	1.5	1.5	3.0	2.0	4.0	163.7	3.5	2.0	2.5	4.27	1.83	40.23
RU05	RU08	1.5	2.0	4.0	2.5	4.0	136.0	3.5	4.0	4.0	4.57	4.12	47.24
RU05	RU12	2.5	2.5	4.5	3.5	3.0	367.6	4.0	3.5	3.5	4.35	2.78	**49.69**
RU06	RU03	4.0	3.5	3.5	3.5	4.5	214.0	4.0	3.0	3.0	4.00	3.16	**51.29**
RU06	RU12	2.5	3.0	3.0	3.0	4.0	234.0	3.0	3.5	4.0	4.43	4.31	46.71
RU06	RU13	3.5	3.5	3.5	3.0	4.5	70.3	2.0	3.5	3.5	4.25	2.97	48.44
RU07	RU03	3.0	3.5	4.0	3.5	4.0	201.2	3.5	3.5	3.5	4.04	2.59	**52.27**
RU07	RU07	2.5	3.0	3.5	2.5	4.0	128.0	4.0	4.0	4.0	4.32	3.54	49.54
RU07	RU09	3.5	3.5	3.5	3.5	3.5	170.4	3.3	4.0	3.5	4.27	3.07	46.49
RU07	RU11	3.0	2.5	4.0	2.5	2.0	147.2	3.0	3.0	3.5	4.41	2.97	41.80
RU07	RU13	2.0	2.5	3.5	2.5	4.0	68.0	3.5	3.5	3.0	4.22	3.92	50.55
RU08	RU01	5.0	4.0	3.0	3.0	2.5	26.0	4.5	3.0	1.5	4.27	4.31	43.08
RU08	RU05	2.5	3.0	3.5	3.5	4.0	171.6	3.0	3.5	4.0	4.09	3.16	**52.37**
RU08	RU07	2.5	2.5	3.0	3.0	3.5	204.4	3.5	4.0	4.0	4.37	3.35	46.17
RU08	RU09	3.0	2.5	3.5	2.5	3.0	86.6	3.0	3.8	3.8	4.52	3.54	46.89
RU08	RU10	2.0	2.0	3.5	2.5	3.5	126.9	2.5	2.5	4.5	4.46	2.59	45.51
RU08	RU11	2.0	2.0	3.0	2.0	3.0	131.0	4.0	3.5	4.0	4.43	2.97	42.04
RU08	RU13	3.0	3.0	2.5	3.5	3.5	51.3	3.5	5.0	4.5	4.38	3.92	50.53
RU09	RU02	3.0	3.5	3.0	4.0	4.0	241.8	3.0	4.5	3.5	4.25	3.54	47.65
RU09	RU05	3.0	2.5	3.0	3.0	4.0	241.9	3.0	3.0	3.8	4.29	4.50	**52.24**
RU09	RU06	2.5	2.5	4.0	3.0	4.0	166.9	3.5	4.0	3.0	4.38	2.78	46.27
RU09	RU08	3.0	3.0	3.5	3.0	4.5	173.8	3.3	3.3	3.3	4.19	3.64	**51.58**
RU09	RU11	4.0	4.0	1.5	4.0	3.5	266.8	3.5	3.5	3.5	4.15	2.97	42.90
RU10	RU04	4.5	4.5	2.5	4.5	4.0	259.7	4.0	4.0	4.5	4.43	4.12	47.92
RU10	RU05	3.0	4.0	2.5	3.0	4.0	210.5	3.5	3.5	4.0	4.40	4.12	46.48
RU10	RU08	2.5	3.0	3.0	3.0	3.5	211.7	4.5	3.5	3.5	4.37	3.73	46.96
RU10	RU11	3.0	3.5	2.5	3.5	4.0	155.0	3.5	3.5	3.0	4.30	3.16	44.11
RU10	RU13	4.5	4.0	3.0	4.0	3.5	75.0	3.0	3.5	3.5	4.20	2.97	46.39
RU11	RU03	3.0	3.5	3.0	3.5	4.0	228.7	4.0	4.0	3.3	4.28	2.88	**49.57**
RU11	RU06	3.0	3.0	2.5	2.0	2.5	147.9	3.5	3.0	4.0	4.38	4.12	44.33
RU11	RU07	3.0	3.0	3.0	2.5	3.5	197.0	2.5	4.5	4.0	4.44	2.97	43.81
RU11	RU08	2.0	3.0	3.5	2.5	3.5	140.7	3.0	4.0	3.5	4.56	3.35	42.32
RU11	RU12	2.0	2.5	4.0	3.0	4.0	160.2	4.0	4.5	3.5	4.49	3.92	**49.14**
RU11	RU13	5.0	4.0	3.0	3.5	4.0	95.1	4.0	3.0	1.5	4.09	2.59	42.72
RU12	RU03	3.5	4.0	2.0	4.5	4.5	162.6	3.5	4.0	4.0	4.47	3.35	44.17
RU12	RU08	2.5	2.5	2.0	2.0	2.5	91.9	2.0	3.0	3.5	4.35	3.54	39.51
RU12	RU11	3.0	3.0	2.5	2.5	2.5	171.3	2.5	3.5	3.0	4.53	2.59	37.21
RU12	RU13	4.5	3.5	2.0	3.5	3.0	64.2	3.0	3.0	2.0	4.08	2.78	39.84
RU13	RU02	2.5	3.0	3.0	3.0	2.5	86.2	4.0	3.0	2.5	4.18	4.12	46.46
RU13	RU03	5.0	3.5	2.5	3.5	3.5	91.0	3.0	3.5	3.0	4.10	2.78	43.48
RU13	RU04	5.0	3.0	1.0	2.0	2.0	26.8	3.5	4.5	3.5	4.39	3.73	40.00
RU13	RU05	3.0	3.0	2.5	2.5	4.0	69.9	3.0	2.5	3.0	4.50	3.54	42.58
RU13	RU08	3.5	2.5	3.0	3.0	3.0	55.0	3.5	3.5	2.0	4.50	4.50	45.27
RU13	RU09	5.0	4.0	2.0	3.5	2.5	78.8	3.5	3.0	2.5	4.24	4.69	43.55
RU13	RU10	2.0	2.5	3.5	3.0	4.5	25.2	4.5	4.0	2.5	4.16	3.73	50.29
RU13	RU11	5.0	3.5	2.5	3.0	3.5	102.7	4.0	3.5	2.0	4.30	2.78	40.49
BHN589		3.5	4.0	3.0	3.5	2.5	316.8	3.2	4.2	4.0	4.32	3.80	49.70
Red Deuce		3.0	3.5	3.5	3.0	3.0	355.8	4.5	4.0	4.0	4.34	2.78	49.75
Primo Red		2.0	1.5	3.0	2.0	1.5	247.0	4.0	4.0	3.5	4.32	2.78	46.59

Eight hybrids were selected for seed increases during winter 2016-2017 that will be further tested in replicated performance trials. It is hoped that 1-3 new F1 hybrid varieties will be identified for limited commercial releases during the 2018-2020 time frame.
The next steps for all these new prospective products will be to conduct more replicated tests in 2017, then to produce more seeds of the top performers during winter 2017-2018. Trial seeds will be distributed to interested New Jersey commercial fresh market tomato growers in 2018 to obtain solid feedback on performance under actual production conditions. If any of these new breeding populations are deemed to have adequate merit with regard to fruit yield, quality, and flavor, larger (>5.0 lbs.) seed quantities will be produced during winter 2018-2019 for broader distribution in 2019-2020.
In addition to the breeding efforts on 'round' fresh market varieties, there is also work being done on specialty grape tomato varieties. Two promising OP populations will be tested in 2017 by selected Master Gardener groups and small commercial growers. Both of these varieties are indeterminate in habit and feature unique fruits that are very firm, bicolor (pink/yellow), have very high levels of sugars, and relatively low levels of acidity.

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PUMPKINS

PUMPKIN VARIETY TRIAL RESULTS FROM PENNSYLVANIA

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Introduction - Pumpkins are an important crop for vegetable growers in Pennsylvania. The state was ranked third nationally in acreage of pumpkins harvested for fresh market in the US (2012 Census of Agriculture). The purpose of our study was to evaluate yield and quality of commercially available pumpkin varieties in three locations in the state.

Materials and Methods - The study was conducted in central Pennsylvania at Pennsylvania State University's Russell E. Larson Research Center in Pennsylvania Furnace, in southeastern Pennsylvania State University's Southeast Research and Extension Center in Manheim and in southwestern Pennsylvania. Results from the central and southeastern sites are reported here.

Twenty-four medium (15-25 lbs) pumpkin varieties were evaluated and 'Gladiator' was considered the standard. At both sites, pumpkins were direct seeded in rows spaced 8 feet apart with 4 feet between plants in a row. Four plots of each variety were planted with each plot consisting of 6 plants. At the central site plasticulture and drip irrigation were used; in the southeast plants were grown using no-till by planting into a field of grain rye residue. Data were collected from all 6 plants. Harvest was September 16 and 20 at the central site and October 5 and 6 in the southeast.

Results and Discussion – Average number of fruit per plant at the central site varied from 1.8 to 2.9 with 'Gladiator' averaging 2.5 (Table 1). Average fruit size varied from 12.4 to 23.3 lbs. Most fruit had good color but 'Camaro' was lighter.

In the southeast fruit number varied from 1.7 to 3.0 per plant with 'Gladiator' averaging 2.0 (Table 2). Average fruit size was smaller in general than at the central site and varied from 10.9 to 18.5 lbs. The planting suffered from an early virus infection which may have reduced fruit numbers and size. Fruit color was similar to the central site but 'Cargo', 'Challenger', 'Eagle City Gold' and 'Rhea' were lighter (data not reported). 'Camaro', 'Challenger', 'Early King', and 'Spartan' had poorer handles than the rest of the varieties. Estimated yield per acre was

calculated for comparison purposes but actual yields will most likely be lower as no space for drive rows was included.

Table 1. Number of fruit per vine, average fruit weight, color and seed source for 24 varieties of medium pumpkins grown in central PA in 2016.

Variety	Number Fruit/Plt	Average Fruit Wt. (lb)	Color	Seed Source*
Ares	2.7	18.0	orange – dark orange	HM
Bayhorse Gold	2.2	16.8	orange – dark orange	RP
Bellatrix	2.5	17.7	orange – dark orange	RP
Camaro	2.2	23.3	light orange – orange	SW
Cargo	2.0	20.0	dark orange	SG
Challenger	2.8	20.9	orange	SW
Eagle City Gold	2.3	15.3	orange – dark orange	RP
Earlipak	2.2	17.6	dark orange	SW
Early King	2.5	21.6	orange – dark orange	SG
El Capitan	1.8	16.6	dark orange	SG
El Toro	2.1	18.7	orange – dark orange	SG
Gladiator	2.5	18.4	dark orange	HM
Gold Challenger	1.9	18.3	orange – dark orange	RP
Hannibal	2.2	16.6	orange – dark orange	SG
Honky Tonk	3.3	12.4	orange – dark orange	CS
Kratos	2.8	16.3	dark orange	HM
Magic Lantern	3.0	12.4	orange – dark orange	HM
Magic Wand	3.0	12.9	orange – dark orange	SW
Mrs. Wrinkles	2.1	14.6	dark orange	SG
Orange Rave	2.9	14.6	orange – dark orange	RP
Rhea	2.9	14.4	orange – dark orange	HM
Solid Gold	2.2	19.6	orange	RP
Spartan	2.5	15.2	orange – dark orange	SW
Zeus	2.2	12.8	orange – dark orange	HM

*CS =Clifton Seed, HM = Harris Moran, RP = Rupp Seed, SG = Seigers, SW = SeedWay

Table 2. Number of fruit per vine, average fruit weight, estimated yield and handle ratings for 24 varieties of medium pumpkins grown in southeast PA in 2016.

Variety	Number Fruit/Plt	Average Fruit Wt. (lb)	Estimated Yield (T/A)[a]	Handle Quality[b]
Ares	2.0	16.0	20.7	5.0
Bayhorse Gold	2.3	13.2	17.7	3.3
Bellatrix	3.0	15.5	28.0	3.5
Camaro	2.0	14.2	16.4	2.4
Cargo	1.9	17.8	21.1	3.3
Challenger	2.6	18.5	30.9	2.3
Eagle City Gold	1.9	12.4	14.1	3.0
Earlipak	2.0	17.0	18.8	3.0
Early King	2.6	16.7	26.6	2.5
El Capitan	1.8	14.9	15.7	2.8
El Toro	1.8	16.6	18.8	3.5
Gladiator	2.0	13.0	16.5	3.5
Gold Challenger	1.7	16.3	17.6	3.8
Hannibal	1.7	16.1	17.8	3.5
Honky Tonk	2.4	12.3	18.3	3.0
Kratos	2.2	15.4	21.2	3.8
Magic Lantern	2.5	10.9	18.0	3.0
Magic Wand	2.3	13.0	18.2	3.3
Mrs. Wrinkles	2.6	12.9	20.2	3.3
Orange Rave	2.2	14.4	18.7	2.9
Rhea	1.7	14.5	15.7	5.0
Solid Gold	2.0	18.0	20.9	4.4
Spartan	2.5	14.6	23.7	2.3
Zeus	2.6	11.6	18.4	3.0

[a]Estimated yield for comparison only. No space for drive rows was allocated so actual yields will likely be lower.

[b]Handle quality was rated using a scale from 1 to 5 with 1 being poor and 5 being excellent. Ratings included size relative to fruit, strength and color.

WEEDS OF CONCERN FOR PICK-YOUR-OWN PUMPKINS AND STATUS OF HERBICIDE CONTROLS

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What makes a plant potentially poisonous? There are several different chemical compounds capable of poisoning that can be found in a variety of plants. The chemicals range from the alkaloids, found in the nightshade family, to the glycosides, present in wild cherry. Entire plants can be poisonous, or toxicity may be confined to only roots, vegetative parts, berries or seeds. Plants can be highly toxic at certain stages of growth and relatively harmless at others. The effects of plant toxins can range from mild skin irritation, gastrointestinal distress, and possibly even death. Though reported cases of death from plant poisonings are extremely rare, other symptoms are possible. Most cases of internal poisoning are accidental and occur primarily among children who are attracted to brightly colored berries and seeds or who suck and chew other plant parts.

Pick-Your-Own operators are inviting customers to visit fields where the pumpkins are grown. This represents a potential liability to producers. Traditionally when thinking of liabilities we often think of slip, trips or falls either in the field or possibly on a wagon ride. Many of us never think of weeds or plants on the farm as a potential risk. In order to reduce and manage risk, producers should be aware of any potentially poisonous weeds or plants within their fields and develop weed management programs to address any possible poisonous plants. It is important that children and adults alike should be taught never to put any part of a plant in the mouth or swallow it, unless they can positively identify the plant and know it to be safe.

Presented will be some of the more common potentially poisonous weeds and control strategies for pumpkin products

UPDATE ON THE CONTROL OF IMPORTANT DISEASES OF CUCURBIT CROPS

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In recent years downy mildew has become a significant problem in cucurbit crops throughout the US. Symptoms of downy mildew include irregular, chlorotic (yellow) spots which develop on the upper leaf surface of cucurbit crops. These lesions expand and cause leaves to turn from yellow to brown often resulting in a scorched appearance in a few days if left untreated. Diagnostic characteristics of downy mildew are the purplish-brown spores which develop on the bottom side of infected leaves. Spores can easily be seen with a 10x hand lens. Control of downy mildew begins with the early recognition of symptom development and preventative fungicide applications. Fungicide resistance to downy mildew has been reported and there is some evidence that new race(s) of the pathogen may be present in the US. Since fungicide resistance to other important cucurbit diseases, such as powdery mildew and gummy stem blight already exist in our area, proper preventative fungicide application programs must be followed.

Powdery mildew (*Podosphaera xanthii*) continues to be one of the most important foliar diseases of cucurbit crops in New Jersey. Symptoms of powdery mildew include white ‘fluffy’ colonies which develop on upper and lower leaf surfaces, vines and handles of fruit. Control of powdery mildew begins with planting powdery mildew resistant/tolerant cultivars and early detection of symptoms along preventative fungicide maintenance programs. Fungicide resistance to powdery mildew has been detected in NJ and growers need to follow fungicide labels and restrictions accordingly.

The diagnosis and control of these diseases and other important diseases of cucurbit crops will be discussed. An update on the newest fungicide chemistries available for controlling important diseases in cucurbit crops will also be presented.

PESTICIDE APPLICATION STRATEGIES TO REDUCE POLLINATOR INJURY AND POLLINATION FACTS

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Introduction

Pollinators are extremely important for pumpkin production, fruit quality and successful yields. Pumpkins and other curcurbits are monoecious, which means they produce separate male and female flowers on the same plant. Pollen from male flowers needs to be physically transported to female flowers for pollination to occur. In the Northeast U.S., the most frequent and important pumpkin pollinators are honeybees, bumblebees, and squash bees, although the flowers will occasionally be visited by many other solitary bees.

Pesticides are synthetic or organic substances used to eliminate unwanted pests. Insecticides eliminate or reduce populations of unwanted insect pests. Unfortunately, in some cases, beneficial insects, like honey bees are affected by insecticides. There are several ways honey bees can be killed by insecticides. One is direct contact of the insecticide while the bee is foraging in the field. In this case, the bee usually dies in the field and does not return to the hive. In this case the queen, brood and nurse bees are not contaminated and the colony is not exposed to the insecticide. A second situation is when the bee comes in contact with pollen or nectar containing an insecticide and transports it back to the colony.

The main symptom of a honey bee pesticide kill is seeing dead bees in front of the hives; sometimes in large numbers. Another symptom is a sudden loss of the colony's field activity. After loss from pesticide exposure the colony may weaken and become more susceptible to brood diseases and other stresses.

Ways to decrease bee exposure to pesticides

1. **Late-day or evening application of pesticides**

Many pesticides are toxic to honey bees and other beneficial insects. Always read the pesticide label before performing a pesticide application. The label will indicate if the product is toxic to bees and often provides instructions on how to prevent bee injury. Honey bees are attracted to blooming flowers of all types. Since pumpkin blossoms open in morning hours and often wilt, becoming closed during late afternoon and early evening, applying pesticides in the evening hours is recommended for cucurbit fields, like pumpkin. Honey bees forage during daylight hours, generally when the temperatures are above 55-60°F. When the sun begins to set, they return to their hives for the evening. Therefore, spraying pesticides after bees have left the field can greatly reduce honey bee exposure to pesticides.

2. **Choice of pesticide formulation**

Although there may not be many choices for formulations when selecting a pesticide, using liquid formulations like an emulsifiable concentrate will lessen the risk of a bee bringing back pesticide particle to the hive. Pesticides come in different formulations: dusts (D), wettable powders (WP), soluble powders (SP), emulsifiable concentrates (EC), solutions (LS), and granulars (G). Solutions and emulsifiable concentrates dry quickly and do not leave powdery residues. Dust and wettable powder residues easily attach to tiny hairs found on the body surface of bees. Residues can inadvertently be transferred back to the hive and stored along with the pollen. This may lead to colony collapse if contaminated pollen is fed to the queen or the brood.

3. **Choice of pesticide chemistries**

Newer chemistries on the market recently have become safer for bees. Many times, the newer products degrade rapidly after application to reduce the chemical's activity, making it safer for bees entering a field that had been sprayed. Unlike older pesticides, these newer pesticides degrade in only a few hours, as opposed to a few days or weeks.

4. **Alter application method**

How pesticides are applied can also change the potential risk of pesticide poisoning to bees. Aerial applications can have the highest potential risk for causing bee kills since they may have high potential for drift. Most bee kills occur when the pesticide drifts or moves from the target area into the hive areas or onto other crops or other plants attractive to bees. Spraying during windy conditions will spread materials to unintended areas. When possible, applying granular formulations, soil treatments or specialized equipment that targets the spray to the intended area can help reduce the risk of drift from pesticides.

5. **Establish hives in safe locations**

The location of your apiary is probably the most important factor in eliminating the risk of pesticide poisoning. Locating hives as far away as practical from fields that are treated with pesticides will lessen the chance of bees being exposed directly to pesticides.

The Pollinator Protection Checklist

From the Coalition for Urban/Rural Environmental Stewardship

1. Read and follow all pesticide label directions and precautions.
2. Determine if the pesticide may be toxic to pollinators.
3. Understand local pollinator visitation habits.
4. Use an Integrated Pest Management (IPM) approach.
5. Always follow good pesticide stewardship practices.
6. Cooperate and communicate with others who are concerned about preserving beneficial insects, including pollinators.

7. Know the common symptoms of honey bee exposure to pesticides and what other stressors impact bee health.
8. Check for specific local ordinances pertaining to pollinators, especially beehive locations or designated preserves (if applicable).

Resources:

Pollinator Health and Pesticides. Penn State. http://extension.psu.edu/pests/pesticide-education/applicators/pollinator-health-and-pesticides

BLUEBERRIES

OPPORTUNITIES FOR MANAGING SOIL HEALTH IN BLUEBERRY CULTIVATION

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In 2016 we celebrated the 100th year of blueberry cultivation in New Jersey; the state where Highbush blueberry was originally domesticated. There are approximately 250 farms that continue to cultivate blueberry on nearly 10,000 acres in the state. Despite the long history of blueberry production in NJ, the combination of new pests and diseases, declining soil health, increasing labor costs, new regulations, and low market prices challenge the sustainability of blueberry production in the Garden State. While yields reported in other states continue to climb, the pounds of blueberries harvested per acre in NJ has plateaued around 7,000 for the last 10 years.

Since the start of blueberry cultivation in the state, intense tillage and herbicide regimes have been implemented to maintain a weed-free environment in the row middles and under the blueberry canopy; a method known as clean culture. This traditional method, along with minimal carbon returns to the soil and a monoculture system, has depleted soil organic matter and microbial diversity. These factors are critical to soil health and, as a result, plant health and productivity.

Several NJ blueberry growers recognize decline in soil health as the major contributor to the yield gap. Growers have observed fields where establishment of new plantings has become increasingly difficult, or where mature bushes decline at a more rapid rate. Stunted growth, higher incidence of disease, and low yields are characteristic of many fields in their second or third generation of blueberry cultivation. The rise in detection of these signs constitutes a serious threat to the blueberry industry in NJ which is known as Blueberry Replant Disease. My research aims to identify opportunities for managing soil health in blueberry cultivation. A secondary goal is to identify specific soil organisms as causal agents of the replant disease.

Opportunities to manage soil health rely heavily on the incorporation of cover crops to the blueberry production system. Our recommendation encourages growers remove a small percentage of this acreage in favor of building soil health through the use of cover crops. Opposition toward this recommendation is often grounded in the opportunity cost of time out of blueberry production. Due to the slow-growing nature of blueberry and the level of soil depletion, *cover crop management is a long-term investment in the farm*.

Opportunity 1: Once planted, blueberry bushes have been able to persist for 40 or more years in our Coastal Plain soils before they are removed in favor of new, younger stock. The point at which production cost outweighs marketable yield price is generally

3,800 pounds of blueberries harvested per acre. Regardless of the net profit loss when a field reaches this point, many growers opt to continue field maintenance.
The rare window between removal of the mature bushes and establishment of new plantings can be as short as a few months. The first opportunity to incorporate cover crops lies in this window. Rather than hurry to establish a new field, growers must recognize the importance of crop rotation and soil building to ensure the sustainability of blueberry production in NJ.

In the spring of 2016, research plots were set-up at a local blueberry farm in Hammonton, NJ. Each of the twelve cover crop sequences (Figure 1) represent a series of cover crops selected to optimize every season out of production. Each treatment was replicated six times in a randomized complete block design in plots 28' by 36'.

Rapeseed and sorghum-sudangrass were seeded with a John Deere Frontier TR1048 Overseeder. All other cover crops were seeded with a Land Pride OS1548 Overseeder. Irrigation and fertilizer were supplied as needed.

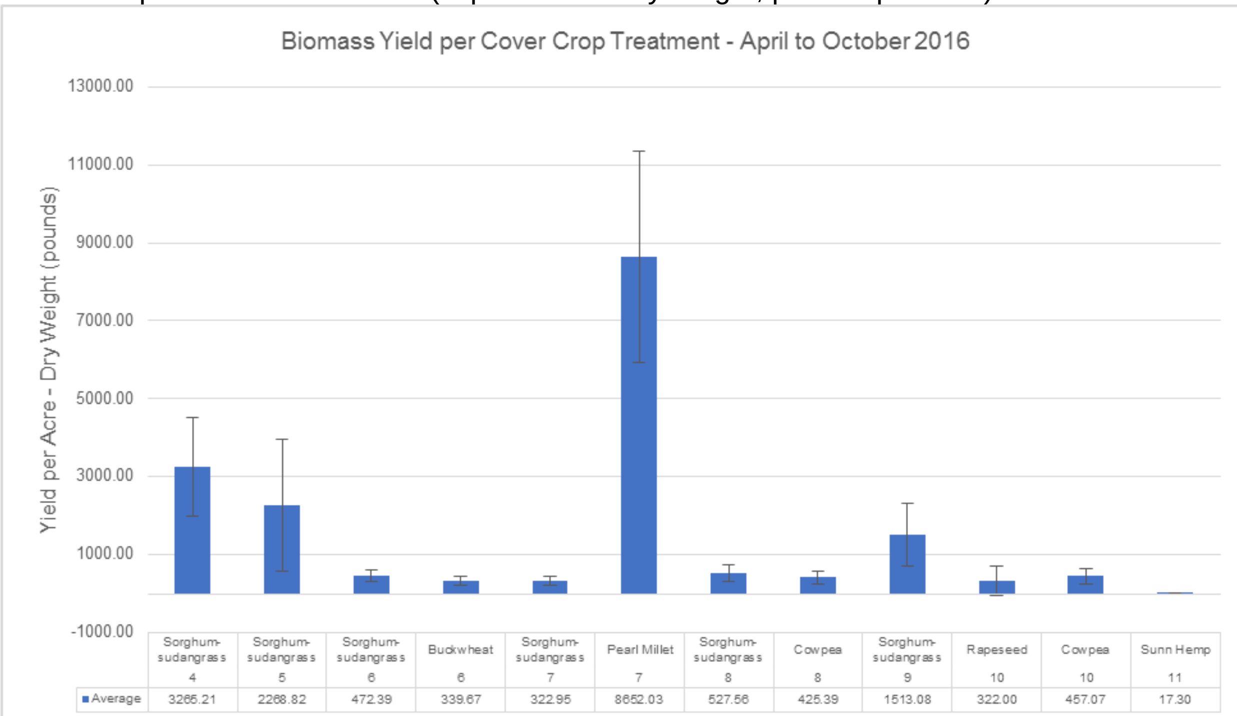
Figure 1. List of trial cover crop sequences grown April through December 2016

Treatment	Spring	Summer	Fall
1	Untreated control		
2	Composted horse manure		
3	Pine bark mulch	Pine bark mulch	Cereal rye
4	Sorghum-sudangrass		Cereal rye
5	Sorghum-sudangrass		Tillage radish
6	Sorghum-sudangrass	Buckwheat	Cereal rye
7	Sorghum-sudangrass	Pearl millet	Cereal rye
8	Sorghum-sudangrass	Cowpea	Rapeseed
9	Sorghum-sudangrass		Crimson clover
10	Rapeseed	Cowpea	Cereal rye
11		Sunn hemp	Annual ryegrass
12		Pine bark mulch	

Identification of cover crops that can succeed in sandy, worn, Coastal Plain soils has been a challenge. Cover crop success has been limited by low soil pH (~4.5), low soil organic matter, low native fertility, and my own personal learning curve. Samples of above and below ground biomass were collected from each cover crop at maturity. The combined dry weights of these samples are shown in Figure 2.

Baseline soil samples were collected from all 72 plots prior to the first planting in April. Assessments for these soil samples included nematode counts, mechanical analysis, pH, organic matter, and soil biological activity (i.e. Solvita). The average pH was 4.83 ± 0.26 and the average percent soil organic matter was 1.37 ± 0.29. Following the spring and summer plantings, the second round of soil samples were collected in November and analyzed for soil organic matter. As anticipated, no significant changes in soil organic matter were observed following this seven-month period of cover crop growth.

Figure 2. Combined above and below-ground biomass yield per cover crop treatment sampled between April and October 2016 (expressed as dry weight, pounds per acre)



Experience and data recorded from 2016 suggests the following:

1. Pearl millet accumulated the most dry-weight biomass per acre
2. Pearl millet was the most cost-effective cover crop - cost per acre/pounds of dry matter per acre
3. Termination of sorghum-sudangrass mid-season was not ideal
4. Management of short season cover crops (e.g. buckwheat, cowpea) interfere with blueberry harvest (June-August)
5. Legume cover crops (i.e. cowpea, sunn hemp) were managed improperly
    a. Appropriate seed inoculant will be applied in 2017
6. Pine bark mulch was an excellent weed suppressor

To further maximize time out of blueberry production, the potential to add professionally produced compost has now developed into another set of research plots. Despite the added cost of these materials, compost application could be a viable method for improving soil conditions for cover crops as well as more rapidly replenishing soil organic matter.

Opportunity 2: Adoption of new cultural practices is critical to the maintenance of soil organic matter in established blueberry fields. Establishment of perennial grasses in the row middles has the potential to provide many benefits to growers and to the soil. An established row middle will eliminate the need for intense herbicide and tillage management of the middles. The grass will also limit soil erosion and nutrient leaching.

Although we have not yet studied the influence of row middle plantings in NJ, several growers have expressed their interest. In response, research plots were set-up at a blueberry farm in Hammonton, NJ in fall of 2016. Six grass species – including Gladiator/Sword hard fescue, Avenger II tall fescue, Quatro sheep fescue, K31 tall fescue, creeping red fescue, and redtop – were seeded in September of 2016.

The grasses will be evaluated based on ground cover, weed suppression, and cost of management. Soil samples will be collected annually from the row middles and the hills underneath the blueberry bushes for analysis of soil organic matter content and soil biological activity (Solvita). Growers have voiced several concerns regarding row middle plantings that will also be monitored over the course of this study. These concerns include the potential for increased habitat for Oriental Beetle grubs, increased winter damage, and delayed bloom.

While this area of research is heavily studied in most crop systems in the state, methods for improving soil health in the blueberry industry are not well explored. We are looking forward to the development of a strong alliance between growers and university researchers to secure the sustainability of blueberry production in New Jersey.

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Aaron Kuenzi, Mountain View Seeds
Rich Iannaco, Farm-Rite, Inc.
Ed Dager and Curtis McKittrick, Rutgers Snyder Farm

RESOURCES FOR BLUEBERRY GROWERS

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Local extension agents and USDA-ARS research scientists are excellent resources for various aspects of blueberry production, but several print and web-based resources are also available to help commercial blueberry growers. For general information, a good place to start is the *Mid-Atlantic Berry Guide for Commercial Growers, 2013-2014* (http://pubs.cas.psu.edu/freepubs/MAberryGuide.htm). This guide was produced by Penn State in cooperation with Rutgers University, the University of Delaware, the University of Maryland, Virginia Tech, and West Virginia University. This guide covers everything from pre-plant considerations to diagnostics. In addition to blueberries, the guide contains sections on strawberries, brambles, gooseberries, and currants. A hardcopy of the book can be ordered for $25 and it may be available for free download.

The American Phytopathological Society Press recently published the *Compendium of Blueberry, Cranberry, and Lingonberry Diseases and Pests*, second edition. This is the first edition of the Compendium series to include insect pests and the first revision since 1995. This book is a comprehensive guide to identification and management of all known diseases and insect pests of blueberry and cranberry. It can be purchased through the APS website (http://www.apsnet.org/apsstore/shopapspress/Pages/compendia.aspx). The current advertised price is $149 and quantity discounts are available.

Another resource for disease identification and management is the Michigan State University publication *A Pocket Guide to IPM Scouting in Highbush Blueberries*. This book is available through the MSU website for $19.00 (http://msue.anr.msu.edu/resources/a_pocket_guide_to_ipm_scouting_in_highbush_blueberries_e2928). Many of the university extension websites have sections on weed control, but an excellent book for identification is *Weeds of the Northeast* by Uva, Neal and DiTomaso, published by Cornell University Press. This book is available from Amazon and other outlets for about $25.

Rutgers NJAES has an excellent website (http://njaes.rutgers.edu/ag/) with links to pest control recommendations, The Blueberry Bulletin, The PE Marucci Center for Blueberry and Cranberry Research and Extension, Farm safety, etc. Other university websites with good blueberry pages include Penn State Extension (http://extension.psu.edu/), Cornell (http://www.fruit.cornell.edu/), Michigan State, (http://msue.anr.msu.edu/), Oregon State Extension (http://extension.oregonstate.edu/), North Carolina State Extension (https://blueberries.ces.ncsu.edu/) and many others.

A national extension website was created a few years ago (http://articles.extension.org/) that brings together resources from US land-grant universities and the Cooperative Extension System. This website has training videos, articles on various aspects of production, marketing, and has an 'Ask an Expert' page where you can post blueberry-related questions. The Northwest Berry and Grape Information Network website (http://berrygrape.org/blueberry/) is hosted by the USDA-ARS, Oregon State University, University of Idaho, and Washington State University. This website contains links to all aspects of blueberry production as well as pages on other berries including cranberry, strawberry, raspberry and others.

There are numerous blueberry nurseries throughout the country. The Cornell website maintains a list (http://www.fruit.cornell.edu/berry/nurseries/nurseries.html), but as stated on the website, the nurseries listed are not endorsed by the host and the buyer must **'evaluate nursery quality and reputation through independent means'. It is important to purchase pathogen-free plants and varieties that are suited to the intended growing area. Be sure that nursery stock, whether purchased in New Jersey or out of state, is virus tested and certified virus free. The requirements for certification in New Jersey are listed on NJ Dept. of Agriculture website (**http://www.nj.gov/agriculture/divisions/pi/serv/blueberrycert.html**). One other cautionary note is that many nurseries now have their own varieties. These varieties may not be as extensively tested as those released from established university breeding programs. While some of these varieties may suit your needs, it is a good idea to test them on your farm before committing to large plantings.**

Remember to consider the source for all web-based information. University web sites and bulletins are always reliable. Use caution when visiting websites from other sources. Be aware that some recommendations are region-specific and consider the date that the information was posted as recommendations may have changed. Growers in our area should focus on materials available for the Northeast, but highbush blueberry is grown in other parts of the country, such as Michigan and the Pacific Northwest and some information from these areas may be applicable.

Please note that the list of resources outlined above is not intended to be exhaustive, but rather a brief introduction to the print and expanding web resources available to commercial growers.

SPOTTED WING DROSOPHILA: A RESEARCH UPDATE

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Introduction

Since its introduction in 2008, the newly invasive spotted wing drosophila (SWD), *Drosophila suzukii* (Diptera: Drosophilidae), has become one of the biggest pest problems for small fruit growers in the United States. Highbush blueberries have been one of the most affected crops. Currently, management of this pest in the United States is driven by calendar-based insecticide applications. Therefore, the development of new, environmentally-safer, and effective tactics for managing SWD is necessary to achieve sustainable integrated pest management (IPM) programs. We are testing the efficacy of an "attract-and-kill" (A&K) technology called Specialized Pheromone & Lure Application Technology (SPLAT; ISCA Technologies, Inc.). SPLAT SWD A&K consists of a wax-based formulation containing a potent SWD attractant and a toxin (insecticide) (Fig. 1). The present study evaluated the effectiveness of a SPLAT SWD A&K formulation for SWD management under semi-field and field conditions.

Fig. 1. SPLAT SWD A&K

Material and Methods

Field Experiment. A field experiment was conducted to test the efficacy of SPLAT SWD A&K on suppressing SWD fruit infestation in a blueberry farm located in New Lisbon, Pemberton Township, New Jersey. The experimental field (cv. 'Elliott') was kept insecticide free during the entire season. SPLAT SWD A&K applications were done on a weekly basis on 12 July, 19 July, 26 July, and 4 August with a R&D Sprayer's MeterJet® Spray gun (Spraying Systems Co., Wheaton, IL), using a 1 L plastic bottle (Fig. 1). The sprayer was calibrated to deliver 6.5 L per acre at 40 psi, using a single D3 orifice, yielding 5.37 ml per bush (this volume per bush was applied into four shots of 1.34 mL per shot; all the shots were spread evenly around the bush). The field was divided into 8 plots. Four plots were treated with SPLAT SWD A&K and the other four plots were un-treated controls. Every plot consisted of 18 rows of 21 bushes per row for a total of 378 bushes per plot. In the SPLAT-treated plots, we treated one of every 4 bushes within rows (6 bushes per row, total of bushes treated per block = 108).

Fruit samples were collected during each of the four weeks at the time of application on 12 July (pre-treatment), 19 July, 26 July and 4 August. For each plot, we collected six fruit samples of ¼ pint each (~250 ml volume) for a total of 24 fruit samples on each sampling date. Fruit samples were taken every other bush in the center of each plot, from the two central rows and 4 bushes from the plot's edge. The samples were weighed and placed in 0.5 L deli containers (~1000 ml), then incubated on a light bench in the laboratory under a 14L:10D photoperiod and at 25-28°C for 10 days prior to evaluation. Larval infestation data were collected using a salt water extraction method consisting of submerging the berries in warm salt water (~1000 ml NaCl: 5 gal H_2O), which causes the larvae to leave the fruit. SWD larvae and pupae caught by a 30 mesh sieve were counted and the number of larvae per pint was calculated.

Semi-Field Experiment. An experiment was conducted to evaluate the residual activity of SPLAT SWD A&K under field conditions. Ten blueberry bushes (cv. 'Elliott') were randomly selected from a blueberry field at the Rutgers P.E. Marucci Center, Chatsworth, New Jersey. Five bushes were treated with SPLAT SWD A&K using a R&D Sprayer's MeterJet® Spray gun (see above) and five bushes were untreated controls. Five terminals were randomly collected from untreated and five from treated bushes and transferred to the laboratory. Terminals were collected on the day of treatment (day 0), and 7, 14, and 21 days after treatment and placed individually in deli cup containers (~1000 ml volume). Following, ten adult SWD flies (five males and five females) were released inside each container. Adult SWD mortality was recorded after 24 hours.

Results

Field Experiment. There were no differences in the number of SWD larvae per berry between plots treated with SPLAT SWD A&K and control plots prior to the SPLAT treatment (12 July) (H=1.56, DF=1, P=0.21; Fig 2a). However, we found significant differences between treatments in all of the three weeks after the SPLAT treatment. Fewer SWD larvae were found in berries collected from SPLAT SWD A&K treated bushes as compared with the control bushes on 19 July (H=12.40, DF=1, P<0.001; Fig. 2b), 26 July (H=24.74, DF=1, P<0.001; Fig. 2c) and on 4 August (H=60.87, DF=1, P<0.001; Fig. 2d). These results indicate that SPLAT SWD A&K was effective at suppressing SWD fruit infestation under field conditions.

Semi-Field Experiment. SWD mortality was significantly higher on terminals treated with SPLAT SWD A&K on the day of treatment and 7 and 14 days after treatment as compared with the untreated control and on terminals collected 21 days after treatment with SPLAT SWD A&K (Fig. 3). These results indicate that the insecticidal activity of SPLAT SWD A&K lasts for about two weeks under field conditions.

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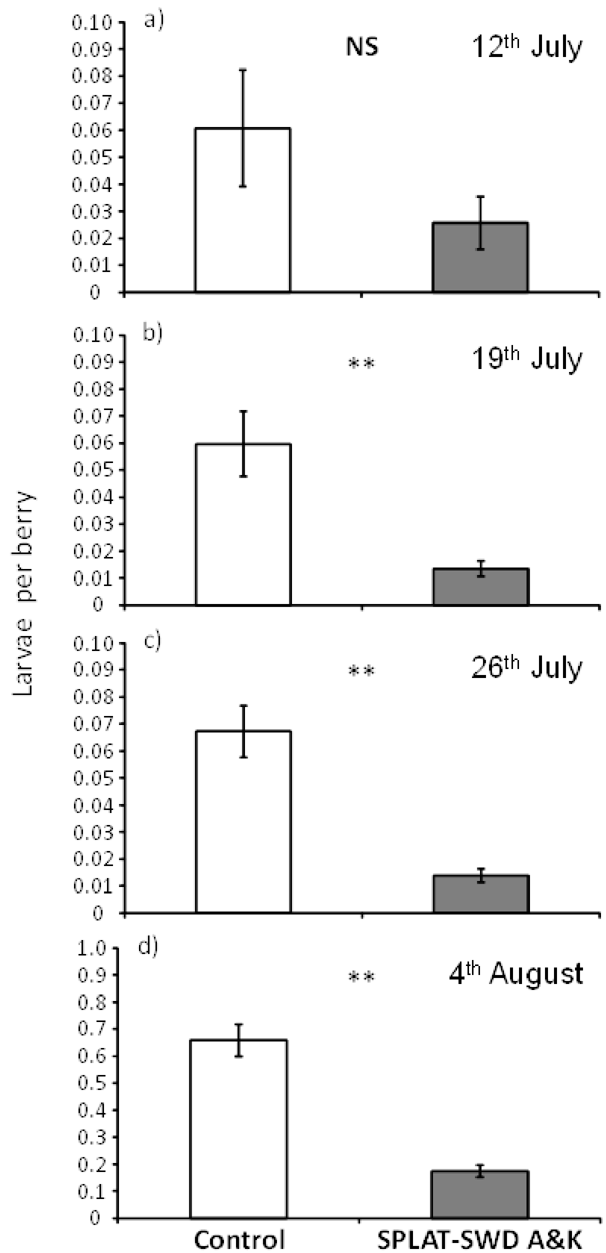

Fig 2. Mean (±SE) SWD larvae in berries collected from plots treated with SPLAT SWD A&K and untreated (control) plots. Fruit samples were taken on 12 July (pre-treatment) (a), 19 July (b), 26 July (c), and 4 August (d). ** indicates significant differences between treatments; NS indicates non-significant differences between treatments.

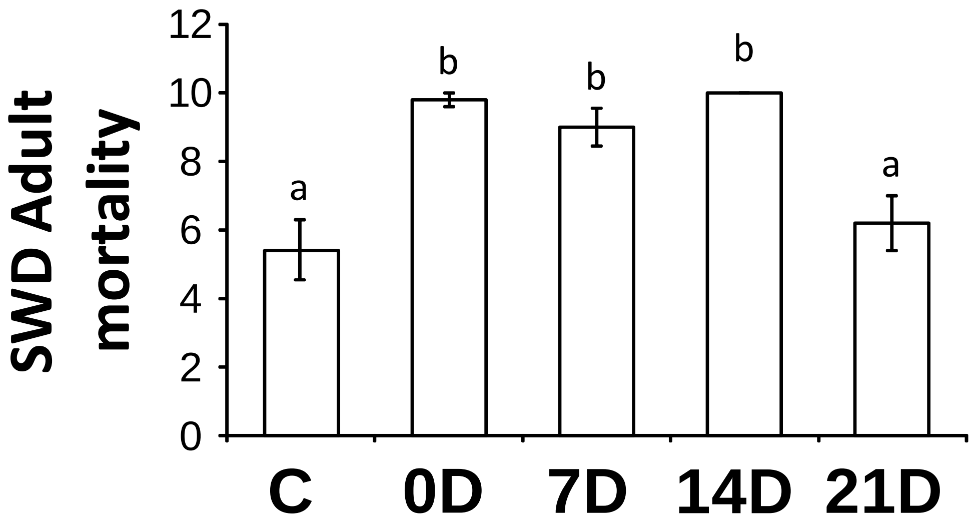

Fig 3. Mean (±SE) SWD mortality on untreated blueberry terminals (controls, 'C') and terminals treated with SPLAT SWD A&K. Terminals were collected on the day of treatment ('0D') and 7 ('7D'), 14 ('14D'), and 21 ('21D') days after treatment. Same letters above bars indicate no significant differences among treatments (Tukey HSD, P=0.05).

FOOD SAFETY MODERNIZATION ACT (FSMA) PRODUCE RULE GROWER TRAINING

FOOD SAFETY MODERNIZATION ACT (FSMA)
PRODUCE RULE GROWER TRAINING

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Introduction:
The Food Safety Modernization Act (FSMA) was signed into law January, 2011 and went into effect January, 2016. FSMA will be implemented over the next six years with compliance dates based on average annual produce sales (previous three year period). For growers with sales over $500,000 starting in January, 2018, small operations ($250,000 – 500,000) January, 2019 and the very small operation ($25,000 – 250,000) January, 2020. All operations will have two additional years for the water component and some recordkeeping. Growers with less than $25,000 are not covered by this Act. This Act applies to growers who produce fresh fruits and vegetables. If the crop is processed or is not one of the covered (included) crops then the operation does not need to comply with this portion of FSMA, but may fall under another portion of the Act.

Who Should Attend?

At least one person from each operation who needs to comply with the Act must receive a training course. This Produce Grower Training is for fruit and vegetable growers, and other persons, interested in learning about product safety, the Food Safety Modernization Act (FSMA) Produce Safety Rule, Good Agricultural Practices (GAPs), and co-management of natural resources and food safety. The Produce Safety Alliance Grower Training Course is accepted by the Food & Drug Administration to satisfy the FSMA Produce Safety Rule requirement outlined in § 112.22(c) that requires '*At least one supervisor from the farm must complete food safety training at least equivalent to the standardized curriculum recognized by the FDA'.*

What to Expect at the PSA Grower Training Course:

The trainers will spend approximately seven hours of instruction time to cover content contained in these seven modules:

- Introduction to Produce Safety
- Worker Health, Hygiene, and Training
- Soil Amendments

- Wildlife, Domesticated Animals, and Land Use
- Agricultural Water (Part I: Production Water; Part II: Postharvest Water)
- Postharvest Handling and Sanitation
- How to Develop a Farm Food Safety Plan

In addition to learning about produce safety best practices, parts of the FSMA Produce Safety Rule requirements are outlined within each module. There will be time for questions and discussion.

Benefits of Attending the Course:

Individuals who participate in this course are expected to gain a basic understanding of:

- Microorganisms relevant to produce safety and where they may be found on the farm;
- How to identify microbial risks, practices that reduce risks, and how to begin implementing produce safety practices on the farm;
- Parts of a farm food safety plan and how to begin writing one;
- Requirements in the FSMA Produce Safety Rule and how to meet them.

After attending the entire course, participants will be eligible to receive a certificate from the Association of Food and Drug Officials (AFDO) that verifies completion of the training course. To receive an AFDO certificate, a participant must be present for the entire training and submit the appropriate paperwork to their trainer at the end of the course.

Cost to Attend:
Total costs to attend the Grower Training Course will vary depending whether it is a one or two day course. The one day session will just be the certificate course. The second day will be for those who want to develop a written food safety plan. The one day course will be $50.00/person and the second day (optional) will be $25.00/person except for the session at the Agricultural Convention which is $35.00/person. These trainings are being partly funded through grants from The United States Department of Agriculture and the Food and Drug Administration. NOTE: 10 people are required for each class to be held.

Other Classes:
The additional classes listed below are being offered across the state which will satisfy the FDA requirement and a second day is added to help growers write their plans for a third party audit.

February 22-23 – Food Safety Modernization Act: Produce Growers Training & Third Party Audits, Mercer County Cooperative Extension, 930 Spruce St., Trenton, NJ, $50/person Day 1 and $25/person Day 2 includes lunch, 9am–4pm. To register call Tammy at 856-451-2800 x1.

March 6-7 – Food Safety Modernization Act: Produce Growers Training & Third Party Audits, Cumberland County Cooperative Extension, 291 Morton Ave., Rosenhayn, NJ; $50/person Day 1 and $25/person Day 2 includes lunch; 9am–4pm. To register call 856-451-2800 x1.

March 8-9 – Food Safety Modernization Act: Produce Growers Training For Blueberry Growers & Third Party Audits, Marucci Center for Blueberry & Cranberry Research & Ext., 125A Lake Oswego Rd., Chatsworth, NJ, $50/person Day 1 and $25/person Day 2 includes lunch; 9:00am-4:00pm. To register call Tammy at 856-451-2800 x1.

March 22-23 – Food Safety Modernization Act: Produce Growers Training & Third Party Audits, Hunterdon County Cooperative Extension, 314 State Route 12, Bldg. 2, Flemington, NJ; $50/person Day 1 and $25/person Day 2 includes lunch; 9am–4pm. To register call 856-451-2800 x1.

SPRAYER TECHNOLOGY WORKSHOP

HOT TOPIC: REVISED WORKER PROTECTION STANDARD (WPS)