2011 Proceedings

56th New Jersey Annual Vegetable Meeting

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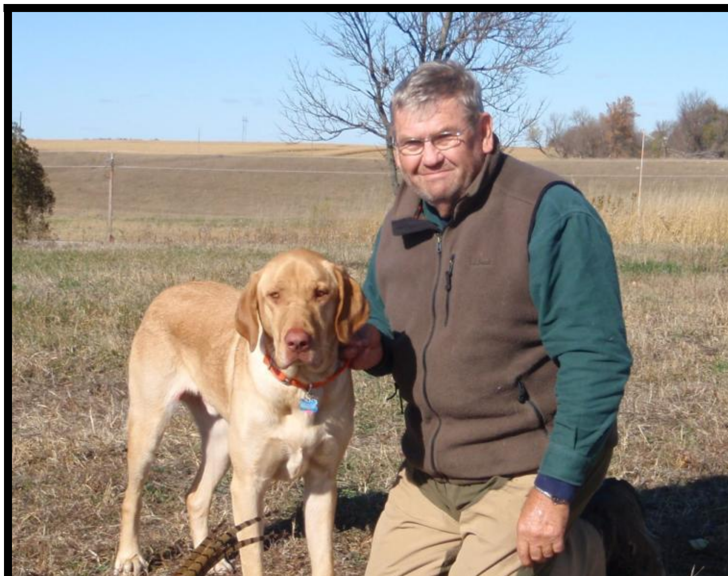

Dr. Mel Henninger, Specialist in Vegetable Crops, Rutgers NJAES and Education Program Chairman of the New Jersey Annual Vegetable Meeting and "Oliver"

Sponsored by,

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In conjunction with:

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Vegetable Growers Association of New Jersey, Inc. — The Garden State

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New Jersey Department of Agriculture

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FARM SAFETY SESSION

MID-ATLANTIC AGRABILITY PROJECT – USING TECHNOLOGY TO FARM SAFELY AND MORE EFFICIENTLY

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The Mid-Atlantic Agrability Project is a 3 state project to support farmers and their families with disabilities. This project is funded by USDA through a competitive grant.

INTRODUCTION

Farming is one of the most hazardous industries in the United States and its vitality is threatened by an aging (average age, 57) and disabled workforce (16% with disabilities). The leading causes of disability in the project area are arthritic conditions followed by back injuries, hearing loss, diabetes, visual impairments, and respiratory conditions.

It remains a sad commentary that most farmers are not connected to service providers to help them cope with disabilities and incorporate assistive technologies into the farm workplace. Through the leadership of the land grant institutions, disability partners, service providers and other partners, the Mid-Atlantic Agrability Project (MAAP) will reach out to the targeted population to assess needs, address the barriers of rural isolation, limited financial resources and inadequate access to needed services.

SCOPE

MAAP will methodically expand into New Jersey and address over 15 goals in the priority areas of education, networking and assistance. With support from the six lead partners and over 25 associate partners, the needs of farmers with disabilities will be addressed.

Education Objective:
MAAP will educate Extension staff, health care providers, ATs, OTs, PTs and other professionals in the three-state area regarding farming and disabilities and use their expertise to support farmers and their families with disabilities. By understanding farmers, agriculture, farm life and its challenges, these professionals will be able to better address their needs and help them. The project will educate farmers and their families about disability issues in agriculture, health-related issues and resources available for them.

Networking Objective:
MAAP will identify and network with agriculture organizations, health organizations, disability service providers and other organizations to support and provide the most comprehensive services to agrability clients and their families.

Assistance Objective:

MAAP will utilize partnerships and state and private resources to provide maximum assistance to the target population to the extent that they are able to return safely to work and have a degree of independence at home. We are using the SF-36 Quality of Life indicator to critically measure our successes in meeting the needs of farmers.

PARTNERS

The major partners are: University of Delaware, University of Maryland, Rutgers University, Easter Seals of Delaware and the Eastern Shore of Maryland, Goodwill, and Centers for Independent Living.

SUCCESSES

Successes are typically measured by introducing assistive technologies to the workplace that will enable farmers to continue to work safely and productively. Such technologies might include a tractor lift, automatic coupler, gate opener, ergonomically designed tractor cab, video monitor in the cab and more. A variety of technologies are available on the project website at www.mid-atlanticagrability.com.

HOW IT WORKS

Farmers typically contact county agents or project case managers with questions concerning the project. At this point we may visit the farm to further discuss the project and this is followed by a worksite assessment. We may simply provide ideas and resources and the farmer follows-up to modify equipment and the workplace to meet his needs. He may also request additional expertise such as an occupational therapist, assistive technologists or others to further evaluate the workplace and make recommendations. Vocational rehabilitation is also a strong partner and may become involved to provide financial resources to invest in the technologies.

HOW TO GET STARTED

Email ronjester@udel.edu for a program brochure or visit the website at www.mid-atlanticagrability.com

PTO Mayhem and Other Less Obvious Farm Hazards

Ray Samulis, Agricultural Agent
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Agriculture continues to be one of the most dangerous occupations in the world. The other occupations that compete for this title are mining and commercial fishing. Due to the nature of this business, farmers are around the same equipment for years and even decades in many cases. Because of this, the inherit dangers are accepted as the cost of doing business. It is this complacency that feeds carelessness as well as the almost certainty that improvement is slow and catastrophic accidents continue to plague agriculture.

The purposed of this talk is to alert and remind growers of the serious nature of farm hazards and to challenge them to do something about changing agriculture's distinction of being the most dangerous occupation. The first piece of equipment to be discussed will be the power takeoff unit. This tool enables farmers to utilize torque which is energy released and transferred into a circular or spinning motion. There are two speeds namely 540 rpm and 1000 rpm. On the surface these speeds seem slow it relation to jet turbines engines that spin at 50,000 or 70,000 rpm's, however, it is the strength of the force behind the spinning that is unforgiving.

There are three basic components to PTO mechanisms including shafts, joints and shields. Both the shaft and joints are the moving parts that you are protected from by the shields. Unfortunately the first thing many farmers do is remove the shield in order to more quickly remove the attached implements in the least amount of time. Any farmer who removes PTO covers is not using common sense when you understand how devastating PTO injuries can be.

With 540 rpm's PTO's the shaft will travel 7.1 feet in one second. Understanding this, you can easily see even the person with the fastest reaction time in the world cannot avoid, the grave reality of PTO accidents resulting in the following scenarios:

- Clothes completely torn off (best case scenario)
- Clothes and skin torn off
- Clothes torn off and body wrapped around shaft
- Hair entanglement or instantaneous scalping

There are many factors that contribute to PTO accidents. Some of these are fatigue, lack of knowledge, slow reaction time, being in a hurry, invincible attitude and durability of clothing.

What are some of the procedures and precautions to preventing these horrific accidents?

1. Always turn off PTO when dismounting tractor
2. Keep all shields and safety decals in place
3. No loose hair or clothing around the shaft
4. Tie shoes laces
5. Proper use training for operators
6. Walk around the equipment do not step over the equipment.
7. No bystanders
8. Test shaft guards for free movement before use

Less Obvious Farm Safety Hazards

Large equipment is the normal suspect for potential farm dangers. I will now discuss some less obvious farm dangers.

1. Water – besides large farm equipment drowning in farm ponds is the second leading cause of death of U.S. farmers in the northeast. So make sure everyone can swim.
2. Center of Balance – Farm equipment manufacturers go out of their way to provide good balance on their tractors. However add a bucket loader, raised high into the air, can cause any tractor to tip over. Be sure to understand the weight restrictions and lift height capability of your equipment.
3. Grain and Fertilizers Pile Cave-ins – Sounds far fetched but getting sucked under as grain or fertilizer is being augered from the bottom of the pile and it doesn't take long to suffocate if you are working alone as many farmers do.
4. Pesticide Drift - Pesticide technology today strives to develop pesticides specific to a crop as opposed to wide spectrum materials of old, that could be used on many crops. Drift is a real problem that can have dire consequences particularly if the crop is your neighbors.
5. Wildlife – Birds can be attractive and fun to watch but if they are in your irrigation pond, e coli contamination of crops and irrigation water can be a big problem. Controlling migratory wildlife on your farm is of utmost importance.

The last topic I will discuss is the Agri-Ability Program. You might be asking what is the Agri-Ability and how can it help me? Surveys following farm accidents all say the same thing a farmer's immediate concern is how soon can they get back to farming? Some might question if that a sane request after being injured? Good question and a topic for another day. Let's face it, farmers are a different breed than most people.

I have started an Agri-Ability program here in New Jersey to help farmers with disabilities stay in farming. We have funds and relationships with organizations that can and do help farmer with arthritis, back injuries, recovering from surgery, vision impairments and just about all other determents to help keep you farming.

I encourage all farmers to visit with me regarding how Agri-Ability can help you stay farming. My contact information is:

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GREENHOUSE FLORICULTURE SESSION

FLOREL: STILL RELEVANT IN GENERATING PROFITABLE ORNAMENTAL CROPS

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Florel is the trade name of the commercial plant growth regulating compound ethephon. Ethephon is a compound that is made up of the molecule ethylene, chlorine, and phosphorus in an acidic solution. Ethylene is a naturally occurring plant hormone and is a gas in its natural state. However, by combining it with the above ingredients (discussion is oversimplified in the interest of space) the ethylene is trapped in a liquid form which makes it extremely easy to apply to plants.

The key to the stability of the ethephon molecule is an acidic solution pH. Ethephon is stable at pH levels below 5.0 and unstable as the pH rises above this level. When in an unstable environment, the ethephon molecule breaks apart and releases its ethylene in its natural, gaseous state. After an ethephon solution has been applied to a plant and the solution penetrates the tissue surface, the pH of the plant's cells is high enough to cause the ethephon molecule to break apart and release its ethylene into the cell. As a result, Florel provides an effective way to get ethylene into the plant without having to gas an entire greenhouse. It is an efficient way to target certain plants while not exposing non target plants to the hormone.

Three Effects

Florel has been shown to have three significant effects on plants; prevention of flower initiation and development, stimulation of lateral branching, and inhibition of internode elongation. Because Florel is ethylene and ethylene is a natural plant hormone, it is effective on a very wide range of species. Whereas most commercial plant growth regulating products are man made chemicals that, once applied to a plant affect the activity of its natural hormone levels, Florel is the actual hormone. The distinction is important because Florel has a direct effect on the plant's growth while the other products effect growth indirectly. This is a main reason why Florel is effective on such a wide range of crop species not only in floriculture but in woody ornamentals, vegetables, and agronomic crops.

Flowering

Ethylene causes premature aging in many flowers and fruits. When a Florel application is made to a plant, the amount of ethylene introduced into the tissue is sufficient to flood the system and artificially cause flowers and buds to abort at whatever stage of development they are in. Open petals will drop overnight, tight buds will turn yellow and drop within a week, and initiation of new buds will be prevented while the ethylene level remains in this flooded state. While under Florel treatment a plant is forced to grow vegetatively and not reproductively.

Stock plants benefit greatly from Florel's ability to maintain vegetativeness. Reproductive growth on stock plants is unwanted and, prior to the use of Florel, was removed using costly hand labor. In addition, valuable photosynthetic energy was lost in the process of allowing reproductive growth to develop enough so hand disbudding could be performed. The use of Florel on stock plants early and often can prevent flower initiation from occurring long before buds are even visible to the human eye, thereby directing all of the plant's energy to vegetative growth resulting in higher cutting yields.

Finished crops also benefit by prevention of reproductive growth. Cuttings and seedlings can be maintained in vegetative growth which allows them to develop faster and grow better because energy is not wasted on the flowering process. As long as the last application is timed properly, to allow enough time for the plant to shift into its normal reproductive growth phase, flowering will occur normally.

Branching

Florel's second effect on plants is to overcome apical dominance and allow the plant to branch freely, often without needing a manual pinch. By overcoming apical dominance, fuller plants can be produced without the added expense of hand pinching. Timed studies have shown that labor associated with applying a Florel application is reduced by 70 percent compared to that associated with hand pinching.

The branching effect is also stimulated in another way. Hand pinching removes the growing tip of the stem, thereby limiting the branching potential to the number of nodes left on the stem. Florel treatment, on the other hand, allows the growing tip to remain and continue to grow, forming new nodes and opportunities for additional branching as the crop develops. Consistently, Florel treatment compared to traditional pinching doubles the final number of branches on a plant. For finished crops, more branches translates into more flowers at sales, an extremely desirable result.

Stem elongation

Florel's third effect is a traditional growth regulating effect. Ethylene inhibits internode elongation and leaf blade expansion. Plants under Florel treatment are short and compact with smaller leaf blades. Smaller leaves allows for more light to penetrate the canopy and sustain the lateral branching that is stimulated by the treatment.

Explosive Growth

When Florel is used regularly on a crop the following response is common. During the treatment period plants will grow vegetatively, branching will be stimulated, and growth will be compact. At some point in the crop's development, usually after the final application is made, an explosive growth phase may be experienced. All of the branching, fueled by the channeling of all of the plant's energy into vegetative and not reproductive organs, will eventually develop into fuller, larger, and more heavily flowered plants.

Every time a plant is pinched by hand approximately one to two week's worth of time and resources are removed and thrown onto the compost pile. Each inch of stem tip requires this amount of time and the associated resources including light, fertilizer, temperature, labor, and so on. When Florel is used to stimulate branching instead of pinching, all of these resource inputs remains in the plant. If the crop is pinched more than once as many hanging basket crops are, the results can be significant. Keeping all of the plant's energy in the plant allows for faster crop times and higher quality to be achieved.

Depending on the desired size and quality, growers have learned to harness this growth in one of two ways. Some growers, often working on the wholesale side of floriculture, don't want larger plants. They have found that using one less cutting in a basket is possible once they learn to use Florel properly. Other growers, often working on the retail side of floriculture, welcome added size and fullness because the additional quality allows for higher prices.

Another way growers have learned to harness the Florel effect is to adjust crop time. Wholesale growers have learned that the same size and quality that they were used to achieving can now be achieved in less time with Florel. Retail growers take advantage of the effect by raising larger plants in the same crop cycle that they used in the past. Summarizing, a grower has a choice of producing similar quality in less time or better quality in the same time.

Application

The general recommendation for Florel application is a 500ppm solution, sprayed to drip or runoff. A good coverage rule is to use one gallon of solution for every two hundred square feet of crop area to be treated. Use of a surfactant (spreader-sticker) is recommended on species with waxy cuticles such as begonia, ivy geranium, and poinsettia. Florel is not translocated in the plant so thorough coverage is essential for a uniform response.

The best time of day to apply Florel is in the late afternoon to avoid stressful temperatures and light levels during the middle part of the day. It has been determined that the application must remain on the foliage for a minimum of sixteen hours to obtain a full treatment effect. Because of this requirement an afternoon application allows the material to remain on the crop overnight. By the next morning the ethylene has entered the plant and overhead watering will not diminish the effectiveness of the treatment. Conversely, if the application is made in the morning and overhead watering is done during the remainder of the day, a proportional amount of the application will be washed off the foliage before it penetrates the leaf tissue, resulting in a less than effective application.

BIOENERGY SESSION

CHALLENGES AND REWARDS OF LOCAL BIOENERGY PRODUCTION

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A growing number of NJ farmers have expressed a genuine interest in producing their own on-farm energy. Meetings on alternative energy production conducted by NJAES and Farm Bureau over the past two years have attracted hundreds of interested farmers. Surveys conducted at these meetings reveal that growers are genuinely interested in alternative energy as a means to decrease their energy costs and increase profits.

Current state and federal incentives have helped to decrease the cost of establishing solar, wind, and biomass energy alternatives for growers. Solar Renewable Energy Credits (SREC), for solar energy technology reached over $600 per credit in the past year. SREC profits are dependent on supply and demand and therefore fluctuate throughout the year. As more growers and businesses enter the SREC market, supply will undoubtedly reduce immediate profits for investors in this technology and lengthen the time needed to pay off these systems. Some growers with moderate sized 25kW to 50kW solar panel systems can expect to cover their systems total costs in as little as 5 to 7 years at current SREC prices. Compared to other energy alternatives, on-farm solar technology can be producing within a short time frame with immediate returns to the grower. Without current incentives, the technology would be beyond the reach of most small farm operations in New Jersey.

Wind energy options are more site specific. Anemometer tests determine if wind speeds average over 11mph, the minimum needed to warrant investment in this technology. Growers near large bodies of water or near mountainous regions are more likely to benefit from wind energy technology. In some cases, wind energy generators may need to be constructed to capture wind currents well above the tree tops. Local township ordinances and neighbor relations can be complicated with the selection of wind energy alternatives. Wind turbines create noise and turbines require more maintenance than solar panels. However, when properly placed, wind turbines create abundant electricity on cloudy and sunny days and throughout the night.

For the majority of small farms using these techniques, the electricity produced is not stored on site but returned to the energy grid. Storing of electrical energy in the form of batteries is costly and also prevents producers from securing Energy Credit dollars which help pay off these systems. In order to be eligible for monetary incentives, energy producers must return that energy back to the grid. In addition to energy credits, federal tax incentives and reduced energy bills help encourage participation in alternative energy programs.

Current research on bio-energy crops has revealed some interesting options for growers and some challenges making the bioenergy choice more complex. Current research in NJ has focused on switchgrass and Miscanthus as two possible bio-energy crops for heat energy or combined heat and power sources. Although sterile hybrids are being tested, Miscanthus is a more controversial crop to grow than our native switchgrass. Environmental groups are concerned that non-native Miscanthus species will become an invasive threat and contribute little to the environment when compared to native switchgrass. In addition, the current cost of establishing Miscanthus rhizomes is high and can be prohibitive for growers. The harvest of Miscanthus can be more challenging due to characteristics of the mature grass. A significant advantage of growing Miscanthus, is that it can potentially produce higher biomass yields when compared to other biomass crops.

Currently, the conversion processes to ethanol or other fuels has not proven economically feasible for the average small farm operation. Corn stover, sorghum hybrids and other grasses are also being investigated for their bio-energy potential.

After over ten years of research conducted across the Nation, the US Department of Energy has focused on native switchgrass as a viable bio-energy crop for select parts of the nation. Switchgrass can be seeded and harvested with conventional farm equipment and, similar to hay and straw, dried without additional energy. Native switchgrass also provides habitat for nesting birds and, therefore, increases the conservation value of that land. Switchgrass is a perennial crop with an extensive root system. Once established, switchgrass helps prevent soil erosion and increases the diversity of soil microbes. Switchgrass can tolerate a wide range of pH and soil types depending on cultivar selection. In addition, the crop can be grown continuously for 15 or more years with minimal inputs of Nitrogen and water. Yields increase with added Nitrogen but often peak at approximately 60lbs of N/acre. Low input needs of switchgrass make it an ideal candidate for marginal soils or satellite farm sites where irrigation or other on-site investments are in question.

Before investing alternative energy technologies or establishing bioenergy crops, growers should consider the following in order to make a more informed decision:

- What are my current energy needs?
- Should I conduct an energy audit before moving forward?
- What incentives are available to help cover technology investment costs?
- Will local regulations allow me to adopt this technology? (wind turbines)
- Is my location conducive to this technology?
- Do I have the equipment and infrastructure to grow, harvest, store and process bioenergy crops? (Each crop may have different requirements)
- Is it cost effective to use the energy on-farm, produce energy products for sale (pellets, briquettes etc.) or should I do both?
- Is there a local or regional market for products made from bioenergy crops?

These are but a few of the questions that should be considered before establishing alternative energy technologies on your farm. Each farm and each location may have unique characteristics that make it more or less suitable for specific alternative energy options. Some growers may benefit from a combination of alternative energy technologies but every grower should perform a thorough evaluation before moving forward with any of these alternative energy choices.

Economic Analysis of Various Production and Handling Alternatives for New Jersey Perennial Bioenergy Crops

Dr. Zane R. Helsel, Extension Specialist in Agriculture Energy, Rutgers Cooperative Extension
Dr Robin Brumfield, Extension Specialist in Farm Management, Rutgers Cooperative Extension

ABSTRACT: Perennial grass crops like switchgrass are being considered for production in New Jersey as a source of bioenergy on non-food crop lands. We used budgeting and sensitivity analyses to evaluate production of switchgrass with and without irrigation at different yield levels and lengths of stand. Several cost levels of processing harvested hay into pelleted (grinding, pelleting, and bagging) were evaluated as was marketing at the wholesale or retail level versus on-farm use.

Results of the analyses of these various scenarios revealed several trends. Unless both energy prices and yields are high in the seeding year, it does not appear profitable to harvest the 1-2 tons that are generally expected the year of establishment. Yields were evaluated ranging from 3 to 5 tons per acre for non-irrigated crops, and from 5 to 8 tons per acre for irrigated crops. While supplemental irrigation may be helpful/needed for stand establishment, application to established stands was only slightly more profitable than without supplemental water under our assumptions of an average yield of 6 tons per acre for irrigated switchgrass, and 4 tons per acre for non-irrigated crops. Irrigation costs would need to be under about $20/acre-inch to break even. Costs for pelletizing reported to us ranged from $40-$95/ton depending on the amount of pre-processing, type of equipment, etc. It was difficult to find profitable scenarios, even at high energy prices when those costs exceeded $80/T. As exists with other commodities in NJ, retailing of pelletized biomass was more profitable under all yield levels compared to wholesaling. On-farm use of pellets for home, shop, greenhouse or other heating was more profitable than either retail or wholesale. Even so, yields would have to be, in most cases, greater than 5 T/A and wood pellet prices in excess of $225/ton for pelletized grass biomass to be economical for on-farm use. The costs of baling, transportation and pelletizing were the three highest costs in the overall production. Practices to reduce these costs such as direct flail chopping of dry standing switchgrass, local group processing and/or utilization in raw (non-pelleted) forms could result in substantial cost reductions and the opportunity to realize significant profits for production of biomass energy on non-food crop lands in NJ to replace purchased fuel or possibly retail or wholesale to others.

A base budget for one set of scenarios production, harvesting and marketing follows:

NEW JERSEY BUDGETS

SWITCHGRASS PER ACRE - NOT IRRIGATED - Established Year - 8 Year Stand

Dr. Robin G. Brumfield, Specialist in Farm Management
Dr. Zane R. Helsel , Specialist in Energy

ITEM	UNIT	PRICE	QUANTITY	TIMES	TOTAL	MY COSTS
Revenue						
Yield[a]	Ton[b]	$240	4	1	$960.00	
VARIABLE COSTS PRODUCTION						
Establishment Costs[c]		$601.35	7		$85.91	
Fertilizer						
Fertilizer application (Custom Hire)	$/acre	$8.00		2	$16.00	
Nitrogen	lb.	$0.50	80	1	$40.00	
P_2O_5	lb.	$0.80	60	1	$48.00	
K_2O	lb.	$0.70	80	1	$56.00	
Harvesting						
Mowing (Custom Hire)	$/acre	$13.40		1	$13.40	
Raking (Custom Hire)	$/acre	$8.55		1	$8.55	
Baling (Custom Hire)	$/acre	$18.00		4	$72.00	
Storage of Hay	$/ton	$4.00	4	0.17	$2.67	
Storage bags of switchgrass pellets	$/ton	$4.00	4	0.17	$2.67	
Irrigation	acre-inch	$18.00		0	$ -	
Total Production Costs					**$345.19**	

MARKETING					
Drying					?
Pelletizing	ton	$80.00	4		$320.00
Selling Charge		4%			$38.40
Transportation and Handling[d]	Ton-miles	$0.50	4	30	$ 60.00
Total Marketing Costs					**$418.40**
Total Production and Marketing Costs					**$763.59**
INTEREST ON OPERATING CAPITAL[e]		4%			$30.54
TOTAL VARIABLE COSTS					**$794.13**
OVERHEAD COSTS					
Taxes and assessments	acre		1		$60.00
Land Charge	acre	$100	1		$50.00
Miscellaneous[f]	acre	10%	1		$ 76.36
TOTAL OVERHEAD COSTS					**$186.36**
TOTAL OVERHEAD AND VARIABLE COSTS					**$980.49**
MANAGEMENT FEES[g]			7.00%		**$ 65.13**
TOTAL COSTS					**$1,045.63**
NET RETURNS					**$(85.63)**
Harvest: December 15 or March 1					

[a]This is a retail price assuming that farmers are producing their own energy and replacing purchased fuel.

[b]1 ton biomass = 100 gal fuel oil = 2 round bales.

[c] Establishment costs of $601.35 are spread over the life of the stand-8 years

[d]Calculated at $0.50/ton/mile over 1 mile, assuming a yield of 8 ton/acre, and a distance from the field to the processing plant of 10 miles.

[e]Calculated at 8% of total production and operating costs.

[f]Includes office supplies, legal and accounting expenses, membership dues, insurance, subscriptions, utilities, and other costs. Calculated at 10 percent of variable costs.

[g]Calculated at 7% of total production and operating costs except for the land charge.

Cutting costs by understanding energy use

Tom Manning
Project Engineer
New Jersey Agricultural Experiment Station
Rutgers University

Energy costs can be a significant part of operating costs in agricultural operations. Energy issues are often complex, and the economics are affected by market trends, government policies and energy utility practices. Even so, farmers and growers can gain a better understanding of their energy use and costs, which can lead to more efficient, less costly operation. Managing energy costs is a two-step process. The first step is understanding energy use and the second step is implementing operational and technological changes to cut energy costs. This presentation focuses on the first step: how to gain a better understanding of energy use and costs.

Much as a business needs to determine revenues and expenses in order to understand the financial health of the organization, understanding energy efficiency requires quantifying energy flows in an operation. The process of gathering and analyzing information in order to understand energy use is an energy audit. The United States Department of Energy defines an energy audit as `"the process of determining energy consumption, by various techniques, of a building or facility". An energy audit characterizes the energy use profile of a facility or operation and develops prioritized opportunities for reducing energy consumption. An audit may involve a number of activities, including compiling energy records, visual Inspections (walk-through), characterizing equipment and systems and interviews. More detailed audits might include some on-site measurement and testing as well as simulation and modeling.

In simple terms, an energy audit attempts to answer three questions:

- How much energy does this operation use?
- What for?
- What measures will reduce energy consumption?

Having at least partial answers to these questions is an essential step in making decisions about operational changes and capital improvements to reduce the cost of energy.

Agricultural operations can often perform some of the activities typically included in an energy audit on their own. Compiling and reviewing energy records and visual inspections are within the capabilities of many and can provide a great deal of information about an operation. Summarizing energy records helps identify areas of greatest opportunity for energy and cost savings. The first step in gathering energy records is collecting bills or other energy records. Ideally these records will include at least one year of operation, preferably more. The most common sources of agricultural energy are electricity and fossil fuels. Fuels include heating oil, natural gas, propane, gasoline and diesel fuel. Solid fuels can include coal, wood and other biomass based solid fuels. Determining energy use for some solid fuels can be difficult; energy content for wood and other biomass derived fuels may vary depending on source and composition and quantities may be difficult to establish.

Electricity, natural gas, oil, propane and other fossil fuels are often billed monthly or on the basis of a more or less regular delivery schedule. Other energy sources (solar, wind, firewood, etc.) may require a little more effort from an owner to quantify. As a minimum, a record of for each month or each delivery should include the date, amount of usage (gallons, kilowatt-hours, cubic feet of gas, etc.) and the cost. Electricity providers often use the amount of peak electrical demand, shown as kilowatts (kW) or kVA, as part of their calculations of the cost of energy.

Some basic calculations can help in interpreting and reviewing energy records. One important number is the unit cost of an energy resource. This is calculated by dividing the cost for the entire bill or period by the amount of usage:

Unit cost = Cost ÷ Usage (in therms, cubic feet of gas, kW-hr, gallons, etc.)

For electricity, the unit cost would be:

¢/kW-hr = Total $ X 100 ÷ Total usage in kW-hrs

Sometimes it helps to convert energy use into consistent units, by multiplying usage by a constant. Table 1 shows some common conversion constants.

Common Units = Conversion Constant X Usage (in therms, gallons, kW-hr, etc.)

New Jersey Cooperative Extension publishes a fact sheet that explains energy billing in detail (*Understanding On-Farm Utility Costs and Billing*, available online at http://njsustainingfarms.rutgers.edu/PDF/understanding.pdf,).

Table 1: Average Heat Content of Various Fuels (*U.S. Department of Energy*)

Fuel Type	BTU/Unit	Kilocalories/Unit
Kerosene (#1 Fuel oil)	134,000/gallon	8,921/liter
Burner fuel oil (#2 oil)	140,000/gallon	9,320/liter
Electricity	3,413/kWh	860/kWh
Natural gas	1,000/cu.ft.	7,139/cubic meter
Propane	91,600/gallon	6,098/liter
Anthracite coal	27,800,000/ton	6,354,286/tonne
Hardwood (20% moisture)	24,000,000/cord	1,687,500/cubic meter
Pine (20% moisture)	18,000,000/cord	1,265,625/cubic meter
Wood pellets	36,000,000/ton	8,228,572/tonne

Tabulating energy use over time is a simple way to evaluate energy use. Table 2 shows an example. Once energy data has been tabulated it can be examined in any number of ways to look for trends, unusual data, areas with the potential for greatest savings and other information that may help conserve energy and reduce cost.

Table 2: Annual Summary of Electricity Use

Electric Bills - Storage Barn Area: 4,800 Square feet

Meter # G123456789 (acct 0000000)

Billing Period	Amount Billed	kW-hr	kVA	¢/kW-hr	kW-hr per sq. foot	Btus (millions)	Btus per sq. foot
Dec 15 - Jan 16	$170.92	1,010	5.1	16.9	0.21	3.45	718
Jan 17 - Feb 15	$176.80	1,059	4.9	16.7	0.22	3.61	753
Feb 16 - Mar 19	$133.65	776	4.7	17.2	0.16	2.65	552
Mar 20 - Apr 18	$127.23	763	4.5	16.7	0.16	2.60	543
Apr 19 - May 17	$57.21	332	2.6	17.2	0.07	1.13	236
May 18 - Jun 18	$218.14	1,105	5.1	19.7	0.23	3.77	786
Jun 19 - Jul 18	$169.86	782	7.9	21.7	0.16	2.67	556
July 19 - Aug 16	$510.64	2,966	6.9	17.2	0.62	10.12	2,109
Aug 17 - Sep 13	$457.65	2,639	7.8	17.3	0.55	9.01	1,876
Sep 14 - Oct 12	$445.43	3,167	8.0	14.1	0.66	10.81	2,252
Oct 13 - Nov 13	$189.80	1,086	7.8	17.5	0.23	3.71	772
Total:	**$2,657.33**	**15,685**			**3.27**	**53.53**	**11,153**
Maximum:	**$510.64**	**3,167**	**8.0**	**21.7**	**0.66**	**10.8**	**2,252**
Minimum:	**$57.21**	**332**	**2.6**	**14.1**	**0.07**	**1.13**	**236**
Average:	**$241.58**	**1,426**	**5.9**	**16.9**	**0.30**	**4.87**	**1,014**

In Table 2, the June to July billing period shows higher than normal energy costs (21.7 cents per kW-hr, shaded cell). High costs per kW-hr are often an indication of large equipment running for relatively short periods. Table 2 also shows large differences between winter and summer consumption. If there is no obvious explanation for this variability it is worth looking more carefully at the details of operation to determine the causes.

Summary:

Tabulating and evaluating energy records is one of the most useful aspects of an energy audit that can reveal inefficient operations, identify areas of greatest opportunity for savings and show short and long term trends. A basic understanding of utility bills, good record keeping, and some basic calculations can provide a framework for evaluating energy use in buildings and facilities. This framework can help identify areas for further investigation through visual inspections and more detailed studies. A study of energy records will also help in calculating the potential payback of specific energy conservation measures.

Some of the simplest techniques for reducing energy costs include:

1. Shifting electrical use to off-peak periods.
2. Reducing demand charges (installing variable frequency drives, purchasing smaller equipment, rescheduling the operation of large equipment, etc.)
3. Installing programmable thermostats and taking advantage of nighttime setbacks.
4. Lowering heating setpoints and raising cooling setpoints where possible.
5. Shifting to lower cost energy sources (by changing suppliers, taking advantage of storage to purchase fuels when costs are low, etc.)

New Jersey Clean Energy Program
Biopower Incentives

Larry Barth
Renewable Energy Program Manager
New Jersey Clean Energy Program
75 Lincoln Highway
Iselin, NJ 08830

Larry Barth will talk about the incentives provided by the New Jersey Clean Energy Program available to biopower projects. He will discuss what types of biopower projects are eligible for incentives, what the incentives are, and the overall process for applying and receiving the incentive. Larry will also talk about federal incentives, and Class 1 Renewable Energy Certificates, which are also available to eligible biopower projects.

FSA'S ENERGY OPPURTUNITIES

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BCAP, created in the 2008 Farm Bill, is a primary component of the domestic agriculture, energy, and environmental strategy to reduce U.S. reliance on foreign oil, improve domestic energy security, reduce carbon pollution, and spur rural economic development and job creation. BCAP provides incentives to interested farmers, ranchers and forest landowners for the establishment and cultivation of biomass crops for heat, power, bio-based products and biofuels.

BCAP will address a classic chicken-and-egg challenge: if commercial-scale biomass facilities are to have sufficient feedstocks, then an established, large-scale energy crop source must exist. Conversely, if profitable crop production is to occur, then a viable consumer base must exist to purchase the product.

With the enactment of the updated federal Renewable Fuels Standard, which requires 36 billion gallons of advanced biofuels in the national fuel supply by 2022, new crops must keep pace with these revised Federal targets. Many bioenergy crops need several years to become established. Many bioenergy facilities need several years to reach commercial scale. BCAP serves as catalyst to unite these multiple dynamics by reducing the financial risk for landowners who switch from familiar, revenue-generating crops to new, unconventional crops in preparation for these emerging markets.

With BCAP, crop producers and bioenergy producers will be able to team together to submit applications to USDA to be selected as a BCAP project area. If selected, crop producers will be eligible for reimbursements of up to 75 percent of the cost of establishing a bioenergy perennial crop. Producers also can receive up to 5 years of annual payments for grassy crops (annual or perennial), and up to 15 years of annual payments for woody crops (annual or perennial). Assistance for the collection, harvest, storage and transportation of biomass to biomass conversion facilities will be available for 2 years, per producer, in the form of a matching payment for up to $45 per ton of the delivery cost to the facility.

During the Notice of Funding Availability period, $250 million was expended during roughly one quarter year of BCAP matching payments. Refinements to the BCAP final rule has the BCAP cost-benefit analysis estimating that total expenditures over 15 years will be $461 million. Prior (NOFA period) participants are not penalized. Previous participation counts against the “clock”, but the clock stopped between the last matching payment received under the NOFA and the next matching payment received after the final rule.

BCAP will reduce the financial risk for producers who support emerging biofuel crops including, but not limited to, switchgrass, miscanthus, fast-growing woody poplar, jatropha, algae, energy cane, and pongamia. Biomass must be certified to have been collected and harvested only with an approved conservation, forest stewardship, or similar plan to protect soil and water quality and preserve land productivity into the future. Harvesting must occur with an approved harvest plan. BCAP project areas cannot occur on native sod. All crop collection, harvesting and transportation must be in strict accordance with invasive plant species protections. Eligible materials may not qualify for matching payments for BCAP purposes if UDSA determines that in those distinct localities that the materials are used for pre-existing markets. The eligibility of both woody and herbaceous biomass for energy purposes is fully maintained, and the objectives of heat, power, biofuels and bio-based products all remain supported by BCAP, as required by statute.

BCAP also provides bonus incentives for the cultivation of cellulosic biofuels that have 60 percent lower lifecycle greenhouse gas emissions, promotes the cultivation of new biomass for new purposes, doesn't penalize existing users of biomass for heat and power, and disallows windfalls or undue financial gains for producers seeking payment for using their own waste products in existing conversion practices.

FSA also provides an opportunity for farmers to fund the establishment of their BCAP projects through the newly established Conservation Loan Program, provided that the project is an approved conservation practice. FSA makes and guarantees conservation loans to promote conservation on farms and ranches throughout the US to conserve our natural resources. Many farmers who need and want to implement conservation measures on their land do not have the "up front" funds available to implement these practices. The goal of FSA's Conservation Loan (CL) program is to provide farmers access to credit to implement these practices.

CL funds can be used to implement a conservation practice approved by the Natural Resources and Conservation Service (NRCS), such as to reducing soil erosion, improving water quality and promoting sustainable and organic agricultural practices. This would include installation of conservation structures; establishment of forest cover; installation of water conservation measures; establishment or improvement of permanent pastures; transitioning to organic production; manure management, including manure digestion systems; adaptation of other emerging or existing conservation practices, techniques or technologies.

Those interested may apply for direct CLs with loan limits up to $300,000 at local FSA offices. In addition, guaranteed CLs up to $1,119,000 (amount adjusted for inflation), may be available by applying with lenders working with FSA to obtain a guarantee.

Interest rates on guaranteed CLs will vary, but may not exceed the rate charged the lender's average farm customer. For direct CLs, the interest rate will be the direct loans rate in effect (for farm ownership loans) either at the time of loan approval, or loan closing. These rates are available at the local FSA office.

FSA also offers the Farm Storage Facility Loan Program (FSFL) which provides low-interest financing for producers to build or upgrade farm storage and handling facilities.   A recent update to this program is that Renewable Biomass is now an eligible commodity. (Other eligible commodities are: Corn, grain sorghum, rice, soybeans, oats, peanuts, wheat, barley or minor oilseeds harvested as whole grain; Corn, grain sorghum, wheat, oats or barley harvested as other-than-whole grain; Pulse crops - lentils, chickpeas and dry peas; Hay; Fruits (includes nuts) and cold storage facilities for vegetables.

An FSA farm storage facility loan must be approved by the local FSA county committee before any site preparation and/or construction can be started.

Among the types of facilities and upgrades that are eligible for farm storage facility loans are new structures suitable for storing renewable biomass built according to acceptable industry guidelines and having a useful life of at least 15 years.

An eligible borrower is any person who is a landowner, landlord, leaseholder, tenant or sharecropper who: Produces an eligible facility loan commodity and demonstrates a storage need based on cropping histories. Other terms and conditions apply. Please see you local FSA office for other terms and conditions.

The maximum loan amount through the Farm Storage Facility Loan Program is $500,000 per loan. A 15% cash down payment is required; thus, CCC's loan is limited to 85 percent of the net cost of the eligible storage facility and permanent drying and handling equipment. Loan terms available are seven (7) years, ten (10) years or twelve (12) years depending on the amount of the loan.

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BIOMASS TO ENERGY POSSIBILITIES

Serpil Guran Ph.D.
NJDEP, Economic Growth and Green Energy

Biomass is capable of being converted into renewable electricity, or renewable fuels. The ability to convert biomass into renewable electricity and sustainable biofuels can be very important toward providing additional opportunities for economic growth and “green-collar” job creation, are other attendant environmental benefits.

Various sources of biomass can be used for electricity generation and advanced fuels production. Biomass feedstocks suitable for electricity generation include energy crops, forestry residues, agricultural residues, and livestock residues. In addition to direct combustion of biomass, biogas generation from anaerobic digestion, including landfill gas, and gasification of biomass to produce synthesis gases (syngas) are proven technologies. Numerous electricity generation technologies can be applied in the process, with varying engineering and operational complexities.

In addition to known first generation biofuels, there emerging technologies to utilize energy crops, agricultural waste and unrecycled organic part waste produce advanced biofuels.

PEPPER SESSION

Bacterial Leaf Spot and Phytophthora Two-Year Variety Study

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Introduction

Several new varieties have been released in the last two years which have increased disease tolerance or resistance. At the request of the pepper advisory committee a trial was established at the Rutgers Agricultural Research and Extension Center, Bridgeton, NJ to compare the yield and horticultural characteristics of named and experimental bell pepper varieties.

Materials and Methods

Culture: Thirteen varieties were seeded April 7, 2009 and April 22, 2010 in 98 cell trays containing peat-vermiculite media and transplanted on May 27, 2009 and June 7, 2010. Plants were set with a water wheel transplanter on raised beds with black plastic mulch and one drip line per bed. Each plot was 15 ft long with 5 ft between beds, 18 inches between plants, 18 plants per plot in double rows 12 inches apart. The plots were arranged in a randomized complete block design with four replications. Plants were staked and tied using the Florida weave system on the first string then running a string on the outside of the plants forming a box around each plot for the second string.

Sixty pounds/acre of nitrogen as calcium nitrate was incorporated at bed making. Additional fertilizer was applied through the drip system on a weekly basis for a total of 168 lbs/A nitrogen, 108 lbs/A P_2O_5 and K_2O.

Annual rye covercrop was killed with Roundup followed by preplant applications of Devrinol, Command and Dual Magnum. Admire was applied as a drench to the seedling flats prior transplanting at a rate of 3 ml per flat in sufficient water to saturate the growing media. Insects and diseases were controlled using Rutgers commercial recommendations for peppers.

Peppers were hand harvested: July 30, August 13 and 24 and September 4 and 23, 2009 and August 6, 19 and 31, September 16, October 7 and 26, 2010. Fruits were graded into silvered and non-silvered fruit and into sizes by weight. At the second and fifth harvest in 2009 five fruit from each replication were randomly selected from the extra large and large fruit to evaluate for recessed shoulder, lobe number, wall thickness, fruit length and width, fruit color, smoothness, glossiness and uniformity. In 2010, ten fruit were evaluated for the above characteristics on the second harvest. Fruit size and weight categories are as follows: Extra large (0.5 lbs/fruit or larger), large (0.33-0.49 lbs/fruit), medium (0.25-0.32 lbs/fruit), commercial (slightly misshapen fruit) and culls (0.24 lbs/fruit or smaller and diseased or other problems). Yield is reported in 28 lb boxes/A.

Varieties and breeding lines

Variety/Line	Source	Bacterial Leaf Spot[1]	Phytophthora[2]
Alliance	Harris Moran	1-3, 5	(-)
Camelot	Seminis	(-)	(-)
Revolution	Harris Moran	1-3, 5	Tolerant
Aristotle	Seminis	1-3	Tolerant
Paladin	Syngenta	(-)	Resistant
0994-1819	Seminis	1-5	Tolerant
0996-7922A (Archimedes)	Seminis	1-3	Tolerant
0992-8302	Seminis	1-5	(-)
Tomcat	Syngenta	1-5	(-)
Colossal	Syngenta	(-)	(-)
Intruder	Syngenta	1-3	Tolerant
Hunter	Syngenta	1-5	(-)
Karisma	Harris Moran	1-3	(-)

[1]Numbers refer to bacterial leaf spot resistant strains
[2]Tolerance level

Results and Discussion

There were more varieties planted each year, but only those varieties planted both years are listed in this report. Hail damage occurred one week after transplanting in 2009, but the plants recovered. Little disease or insect damage was observed until the last harvest when anthracnose infected the plots. In 2010, temperatures were above normal for most of the season. Plants grew slowly for the first month. The sixth harvest was not included in the yield data since the field was heavily infected with anthracnose.

Silvering (skin separation) has been a concern for New Jersey growers over the last five years. Our research indicates this is a physiological disorder affecting several varieties. All varieties are now screened for silvering. In the following table, yield data is presented in non-silvered, silvered and total yield.

There are a number of varieties with acceptable yields in these trials. Some have the advantage of resistance to races 1-5 bacterial leaf spot (BLS) and phytophthora tolerance. Since race 4 BLS has been confirmed in New Jersey, consider trial plantings of the varieties with 1-5 resistance. If silvering is an issue with your market, pay particular attention to the following varieties which had the highest amount of silvering both years: Aristotle, Paladin, 0994-1819, Tomcat and Colossal.

Table 1. Non silvered, silvered and total yield for five harvests in boxes/A – Rutgers Agricultural Research and Extension Center - 2009

Variety	Non-Silver Ext/Large	Non-Silver Med/Com Fruit	Silvered Ext/Large Fruit	Silvered Med/Com Fruit	Total Yield Ext/Large Fruit	Total Yield Med/Com Fruit	Total Marketable Yield
Alliance	1428.43	130.73	129.90	10.89	1558.33	141.62	1699.94 ab*
Camelot	1220.88	125.07	111.53	3.27	1332.41	128.34	1460.75 bc
Revolution	1423.14	143.33	105.41	15.04	1528.55	158.37	1686.92 ab
Aristotle	1329.50	53.07	317.27	44.82	1646.77	97.89	1744.66 ab
Paladin	1317.83	114.07	297.81	70.45	1615.65	184.52	1800.17 ab
0994-1819	1287.17	67.96	431.96	10.79	1719.14	78.75	1797.88 ab
0996-7922A	1308.08	108.16	142.97	14.42	1451.05	122.58	1573.63 ab
0992-8302	806.24	68.63	240.91	6.38	1047.15	75.01	1122.16 c
Tomcat	1132.79	84.50	332.73	20.54	1465.52	105.05	1570.57 ab
Colossal	1095.60	58.20	447.99	47.98	1543.59	106.19	1649.78 ab
Intruder	1048.34	103.34	220.11	35.64	1268.45	138.97	1407.42 bc
Hunter	1074.33	104.48	251.39	29.15	1325.72	133.63	1459.35 bc
Karisma	1336.66	84.56	214.61	20.80	1551.27	105.36	1656.63 ab

* - The same letters within a column are not significantly different from one another (Tukey P<.05)

Table 2. Non silvered, silvered and total yield for all five harvests in boxes/A – Rutgers Agricultural Research and Extension Center - 2010

Variety	Non-Silver Ext/Large	Non-Silver Med/Com Fruit	Silvered Ext/Large Fruit	Silvered Med/Com Fruit	Total Yield Ext/Large Fruit	Total Yield Med/Com Fruit	Total Marketable Yield
Alliance	1222.07	288.01	185.35	16.60	1407.42	304.61	1721.03
Camelot	901.27	390.88	75.06	10.06	976.33	400.94	1377.28
Revolution	1046.01	314.26	325.73	42.72	1371.74	356.98	1728.71
Aristotle	592.67	170.15	424.60	78.44	1017.27	248.59	1265.85
Paladin	751.93	355.55	501.01	125.97	1252.94	481.52	1734.46
0994-1819	884.36	140.17	490.53	24.49	1374.89	164.66	1539.55
0996-7922A	1076.20	283.35	457.48	69.20	1533.68	352.55	1886.23
0992-8302	1008.03	142.29	421.28	22.78	1429.31	165.07	1594.38
Tomcat	652.75	337.87	529.02	104.29	1181.77	442.16	1623.91
Colossal	639.93	150.49	756.54	73.82	1396.47	224.31	1620.78
Intruder	503.34	333.81	396.95	112.53	900.29	446.34	1364.63
Hunter	604.35	291.07	400.58	87.93	1004.93	379.00	1383.92
Karisma	980.54	262.07	388.39	55.56	1368.93	317.63	1686.56

Note: Adjustment have not been made in the data. Yields may slightly vary after the data is transposed for the final report

ANTHRACNOSE AND OTHER DISEASE MANAGEMENT AND CONTROL

Andy Wyenandt

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Controlling Anthracnose fruit rot in bell pepper.

Anthracnose fruit rot has been an increasing problem in pepper production during the past few years in NJ. 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 key to controlling anthracnose fruit rot.

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

Alternate:

chlorothalonil at 1.5 pt/A or OLF

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

Quadris (azoxystrobin) at 6.0-15.0 fl oz 2.08F/A, or
Cabrio (pyraclostrobin) at 8.0-12.0 oz 20EG/A, or
Flint (trifloxystrobin) at 3.0-4.0 oz 50WDG/A

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.

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.

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

Ridomil Gold (mefenoxam, 4) at 1.0 pt 4E/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.

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

Ridomil Gold Copper (mefenoxam, 4) at 2.0 lb 65WP/A.
with one of the following materials.
Revus (mandipropamid, 40) at 8.0 fl oz 2.08SC/A plus fixed copper at labeled rate, or
Presidio (fluopicolide, 43) at 3.0 to 4.0 fl oz 4SC/A plus fixed copper at labeled rates, or
Forum (dimethomorph, 40) at 6.0 oz 4.18SC/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 7LP or Prophyt, will also help control the fruit rot phase of Phytophthora blight.

Skin separation or 'silvering' development in fruit of bell pepper.

In recent years, silvering or skin separation has become a serious fruit disorder in bell pepper production in New Jersey. As pepper fruit mature, the outer epidermis may develop 'silver' colored flecks. These flecks are thought to be caused by the separation of cells just beneath the epidermis. Although silvering does not affect fruit integrity, it reduces fruit quality making affected fruit unmarketable. Depending on commercial variety, silvering can be as high as 60% in some cultivars. Interestingly, the silvering of fruit has been associated to Phytophthora-tolerance in commercial cultivars. The more tolerant the pepper variety is to the crown rot phase of Phytophthora blight (*Phytophthora capsici*), the more likely it is to develop silvering in fruit. The bell pepper cultivars 'Paladin' and 'Aristotle' are grown on much of the commercial acreage in New Jersey because of their tolerance to Phytophthora. Unfortunately, this makes a large percentage of bell pepper production acreage in the state susceptible to silvering. According to USDA grading standards, #1 bell peppers can have no more than 10% fruit with silvering.

Research in New Jersey has shown that the more resistant a bell pepper cultivar is to phytophthora infection, the more likely it is to develop symptoms of skin separation or 'silvering' in fruit. In research trials at RAREC and on-farm sites from 2006-2008, more fruit silvering was present in the phytophthora-resistant bell pepper cvs. 'Aristotle' and Paladin' compared to the phytophthora-tolerant cv. 'Revolution' and phytopthora-susceptible cvs. 'Alliance' and 'Camelot' across all production systems.

Edema (Eodema) development on bell pepper fruit.

During the past few summers, edema has caused damage on pepper fruit. In most cases, edema developed when i) fruit were in contact (or laying on) black plastic mulch ii) in areas on fruit where more than one fruit were in contact with each other and iii) where developing fruit were in direct contact with a stem or branch on the plant. Edema is caused by an imbalance of the plant's water uptake and water loss. (Avarre and Jones). Under these conditions the roots absorb water at a rate faster than is lost through transpiration. During cool, cloudy weather conditions, humidity levels can remain high when transpiration rates remain low. Thus, a plant may absorb more water than is lost through transpiration, and is therefore unable to accommodate for expansion causing eruptions in leaf and fruit tissue. Under favorable conditions, tannish-brown raised, corky bumps (fissures) may develop. Anatomical studies show that under appropriate environmental conditions, cells adjacent to the stomatal cavity expand, divide, reorient and form a corky layer (Wulster, 2004). Growers can try to prevent edema by adjusting cultural practices. Keep plants on the dry side during periods of cool, cloudy weather, especially if relative humidity remains high. Irrigate when air temperature is rising and humidity is low. Do not irrigate on cloudy days when temperatures remain cool. Edema is often confused with 2-spotted spider mite or thrips damage. In some cases, the nymphal stages of thrips has been associated with the problem. Use a hand lens to examine the underside of leaves and growing points for the presence of insects (Pundt).

Evaluation of different cultivars and breeding lines at RAREC the past 2 years for eodema have not shown any consistency in its development among bell peppers and/or breeding lines.

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PEPPER PRODUCTION IN FLORIDA
AND RESULTS OF 2009-2010 BACTERIAL SPOT RESISTANT PEPPER TRIALS IN FLORIDA

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Bell pepper (Capsicum annuum L) is one of the primary vegetable crops grown in South Florida, with approximately 90% of Florida's production located south of Orlando (Aerts and Nesheim, 1999). Florida has historically been a leader in the production of bell peppers, second after California in total harvested acres and fresh market production with a value of $over 200 million during the 2008-2009 season (Fla. Agric. Stat. Serv., 2010). During that season 20.2 million bushels were harvested from 18,300 acres, with an average price per bushel of $10.78. Florida farmers produce most of the U.S. grown bell peppers eaten by Americans from Oct. through June.

Peppers in Florida are entirely grown on plastic using fumigation. Beds are normally on 5' centers with each bed 3' wide. Average plant density is around 17,500 plants per acre, with an in row plant spacing of 10" spacing and between row spacing was 16" with plants off-set planting design. Irrigation is typically seepage or drip.

Major insect pests include various caterpillars, aphids and pepper weevils.

Bacterial spot (Xanthomonas euvesicatoria) is the most serious diseases facing Florida pepper growers (Pernezny et al., 2003). Loss in yield due to bacterial spot can be attributed to both defoliation and spotting or rotting of fruit. Ten races of X. euvesicatoria have been identified worldwide. A race (identified by numbers 1, 2, 3, etc.) has been defined by how it can survive and grow on cultivars with or without specific genes for resistance. Over the years, genes resistant to various races of X. euvesicatoria have been identified and introduced into commercial bell pepper cultivars.

Following the 1989-90 winter vegetable season in South Florida, when private seed enterprises released horticulturally desirable cultivars with the Bs1 gene (which imparted resistance to bacterial spot race 1), a shift in the prevalent race from race 2 to 1 occurred in South Florida (McAvoy et al.). The race-1 strains defeated the Bs1 gene. As a result, major losses occurred in Florida bell pepper fields among cultivars with and without the Bs1 gene. Following this event, several seed companies released cultivars with the Bs2 gene, which confers resistance to races 1, 2 and 3 of X. euvesicatoria. Within a few years, commercial growers were planting a range of bell pepper cultivars available to growers having the Bs2 gene, expressing resistance to races 1, 2, and 3 of

X. euvesicatoria (McAvoy et al.). In the 1997-98 season in South Florida, the inevitable happened and field surveys identified races 4 and 6 as the dominant races in fields tested. As a result, serious losses occurred throughout the bell pepper industry in Florida. By 2005, commercial seed companies began to release cultivars that were resistant to races 1, 2, 3, 4, and 5 of X. euvesicatoria cultivars with resistance to bacterial spot races 1, 2, 3, and 4 or 1, 2, 3, and 5. In 2009, a few bell pepper cultivars with resistance to races 1, 2, 3, 4, 5 and 6 were released. This paper will report on the performance of some of these bacterial spot resistant varieties in the field during the 2009-2010 season.

Materials and Methods

Trials were conducted on grower's farms in two locations around South Florida (Delray Beach in Palm Beach County and Immokalee in Collier County) during the 2009-2010 growing season. Transplants were started from seed by a commercial transplant producer using commercial potting mix and polystyrene trays. Cultivars tested included standard commercial varieties with race 1, 2, 3 bacterial spot resistance, and newer cultivars and lines that include additional resistance to bacterial spot races 4, 5 and 6. Seedlings were transplanted by hand, with dead or dying transplants replaced within 10 days of transplanting. Green pepper entries in each location were planted in a randomized complete block design with four replications. Raised beds were 9 inches high and 36 inches wide. Beds were fumigated with methyl bromide/chloropicrin prior to being covered with polyethylene. Each plot consisted of 10.8 feet long and peppers were planted in double rows 11 inches apart, with in-row plant spacing at 9 and 10, in Immokalee and Palm Beach, respectively. Seedlings were planted in an off-set, staggered planting design.

All of the cultivars are marketed as having resistance to at least bacterial spot races 1, 2, and 3 and included several that had resistance to races 1, 2, 3, and 4, races 1, 2, 3, and 5, races 1, 2, 3, 4, and 5 or races 1, 2, 3, 4, 5,and 6 . After transplant, fertilization, pest management, and all other cultural practices were managed by the growers. Plants were not staked or tied.

At each harvest from all locations, fruit considered mature green or turning (red or yellow) were harvested by hand from the entire plot. Fruit from each plot were placed in field lugs and graded on site. Ten randomly selected fruit samples from each rep where taken to University of Florida Southwest Florida Research and Education Center for quality measurements. Fruit were measured for length and width to evaluate blockiness. Data were expressed as an average length and width ratio per fruit. Number of lobes and wall thickness was recorded.

Foliar bacterial spot ratings were performed on 14 Jan in Delray and 11 Apr at the Immokalee trial. Two ratings were assigned per experimental unit on a 0 to 5 scale with 0 = no disease visible, and 5 = severe bacterial spot throughout entire canopy. Many plants exhibited leaf dehiscence in the lower canopy and leaf necrosis in the upper canopy. (Dr Richard Raid, pers. communication). Temperatures were obtained from the Florida Automated Weather Network (FAWN) for both locations.

Results and Discussion

Due to rainy weather in Dec 2009 and through-out the winter and Spring of 2010, bacterial spot pressure was extremely high in these trials with some cultivars showing nearly 100% infection at the time of rating.

In both trials, cultivars with advanced levels of bacterial spot resistance tended to produce significantly higher yields under conditions of severe bacterial spot pressure. However low resistance to bacterial spot did not necessarily correlate to decreases in yield and horticultural quality with some entries producing good yields despite having relatively high bacterial spot ratings. Conversely, some entries that had an elevated incidence of bacterial spot did show below average yields. Further research is needed to determine if a correlation between lower yield and bacterial spot exists for these entries.

Performance differences were noted depending on season with some varieties tending to do better in the fall or spring.

While total yield was an extremely important consideration, it was not the only one for choosing pepper cultivars or varieties. Plant architecture, as indicated by fruit placement and set, and fruit size, as indicated by fruit weight, and blockiness (ratio L: W) are also important variables to consider. Some varieties trialed tended toward three lobed fruit which could be a drawback in some markets.

Future breeding efforts may make these varieties more reliable and or combine these resistance traits with superior horticultural characteristics. Use of cultivars with of bacterial spot resistance to races1,2,3 and 4, 1,2,3,4,and 5, and 1,2,3,4,5 and 6 did significantly reduce overall bacterial spot ratings and produce significantly higher yield under severe bacterial spot pressure. Resistant cultivars should provide growers with a tool to make a crop with reduced input costs under high bacterial spot pressure. Resistant cultivars should be incorporated into an integrated disease management strategy, which should include tactics aimed at reducing the survival, spread, and reproduction of bacteria and minimizing infection of plants.

GENERAL SESSION

A History of the Rutgers Agricultural Research and Extension Center of Upper Deerfield, New Jersey 1965-2010

Dr. Gerald Ghidiu, Vegetable Entomologist
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The beginnings of the Rutgers Agricultural Research and Extension Center (RAREC) of Upper Deerfield, NJ can be traced back to the Civil War. Several important legislative acts during 1862 enabled the states to create research centers, including the Rutgers Agricultural Research and Extension Center.

Three important acts were passed in 1862. The first was the establishment of the United States Department of Agriculture (USDA), whose duties was to acquire and diffuse among the people of the US information concerning agriculture, rural development and aquaculture. The second was the Homestead Act, which provided for the transfer of 160 acres of unoccupied federal land to settlers who worked the land for 5 years, which opened up Western land to small farms. The third was the First Morrill Land Grant Act, which donated federal lands (30,000 acres for each Senator and Representative in Congress), to states to sell, using the funds to create colleges to teach agricultural, home economics, and mechanic arts in all US states and territories, because up until 1861, only 4 states had ag instruction (by 1871, 30 states had ag instruction). It's important to remember that in 1862, over 50% of the US population was involved with agriculture. The NJ state legislature picks the Rutgers Scientific School (over Princeton) to be the state land-grant college, lobbied ferociously by George H. Cook.

New Jersey accepts a commitment to the Morrill Act in 1880, allowing federal funds to help Rutgers expand its Scientific School and establish the New Jersey Experiment Station, with George Cook as the first Director. Although Land Grant Colleges provided teachers and students to conduct experimental work that contributed to agriculture, there was a need for more support and attention than could be given it by full-time professors. The federal Hatch Act was passed in 1887, funding campus-based academic programs to be complimented by experiment station research and to promote "scientific investigation and experiments in agricultural sciences". This funding created a national system of experiment stations at State Land Grant colleges, and developed a close working relationship between federal and state agencies. In 1914, the Smith-Lever Act was passed, which provided for cooperative extension work between USDA and Land Grant Colleges to "diffuse useful and practical information relating to agriculture and home economics and to encourage application of the same". This is the beginning of the Land Grant concept – integrating research, teaching and outreach.

A branch office of the NJAES was established in Camden in 1880 in an effort to extend the programs in experimental agriculture beyond New Brunswick, but support was withdrawn in 1884. Although Rutgers established the first Rutgers Research and Development Center in New Brunswick, NJ in 1912, a resurgence of interest in a southern location was supported in the state legislature in 1915, but efforts were unsuccessful to find the right land at the right place. In the early 1960's, a study of agriculture in New Jersey indicated a loss of land in agricultural production in all but the 7 southern counties. A land search committee, chaired by Dr. George Taylor (Horticulture Department), was appointed by Dean Leland Merrill, Jr. to find land in southern New Jersey that was representative of farm land (light, sandy soils), with a preference that at least some of the land was already in asparagus production (asparagus was an important crop with about 30,000 acres in production). Originally they found three potential farms, the

Patrick Farm, the Tupper Farm, and the Kandle Farm. There were difficulties with the Kandle Farm offer, and instead the Johnson Farm was considered. The Dean offered a proposal to Rutgers University President Mason Gross in 1965 for those 3 farms that was favorably received, and the University Board of Governors approved land purchases for this proposal in 1966.

The University then purchased the 3 farms, previously owned by Melvin Patrick, David Johnson and Alma Tupper, for a total of approximately 265 acres. These 3 farms are adjoining and were combined to become the Rutgers Research and Development Center (RR&DC), Bridgeton, New Jersey (although not located in Bridgeton, mail service for the Center was conducted through the Bridgeton Post Office).

The RR&DC was established as a research farm in 1966 with Ray Kienzle (previously an Egg Harbor VoAg teacher), Joe Steinke (previously a plant breeder with Asgrow Seed), Harold Carpenter (previously an ag engineer with Seabrook Farms), and with Betty Jackson and Barbara Ward as secretaries, all located in the Patrick Farm cottage. The county agricultural agent, Wilbur Runk, was housed in the basement. By early 1967, Ray Kienzle was appointed by Lee Merrill to oversee farm operations, and Laye Nagahiro (previously a clerk with Upper Deerfield Township) was hired and worked as Ray's secretary, conducting operations out of the Patrick farm cottage. John Church (previously Seabrook Farms) joined the Center as a farm worker, and removed the cow stalls at the Johnson farm barn for storage of equipment. The first research project at the Center was a cooperative effort between the Horticulture Department and the Soils & Crops Department with asparagus in April, 1967, conducted by Drs. Howard Ellison and Russ Alderfer.

Dr. James Paterson (Soils and Crops faculty) commuted to the farm from New Brunswick in 1967, and became a resident faculty member in 1968. From 1967-1969 Joe Steinke assumed management of the field and research operations and was based at the Patrick farm cottage, while Paterson, Carpenter, and Nagahiro worked out of the Johnson farm cottage.

In 1968, Dr. Jack Springer, fruit pathologist, joined the faculty and was housed at the Johnson farm. The farm and research operations increased, and need for additional field assistance was met with the hiring of Bill Pompper and Jeff Randolph as farm field technicians, and Stanton Sheppard (previously with Hunt Wesson) as farm manager.

As the research program expanded during 1968-1970, Professor Brad Johnson, Dr. Bernie Pollack, Dr. Steve Garrison, and Dr. Carter Smith commuted from New Brunswick to conduct field trials with the Center faculty on tomato, pepper, strawberries, and other crops.

The first Center office building was built in 1972, and contained a main office, 6 small faculty offices, a small library room, one laboratory, and a plant preparation room, with an attached 4-bay glass greenhouse. A farm shop and pole barn were constructed shortly afterwards. Also in 1972, Jim Paterson was appointed Director of the Center, and Irene Kaneshiki was hired as a secretary (previously with Seabrook Farms). In 1979, Dr. Steve Johnson (vegetable plant pathologist), in 1980 Dr. Jerry Ghidiu (vegetable entomology), and in 1982 Dr. Brad Majek (weed specialist) joined the faculty, and Janet Reed was hired as an additional secretary.

In 1985, the original office building received an addition to include a large conference room, 4 faculty offices, 2 large laboratories and a photographic room. Dr. Steve Garrison (horticulture) joined the faculty at the Center, moving down from New Brunswick. In 1990, Dr. Craig Storlie (ag engineer) joined the faculty, and the following year.

Also in 1990, Dr. Steve Johnston was appointed Director of the Center, and during his tenure oversaw the third and final major construction, a new building addition with a Director's and receptionist office, a large secretarial office, 2 additional large research laboratories, a large conference room with attached kitchen area, a 4-room overnight visitor area, and new powerplant and maintenance rooms. In addition, an 8-bay state-of-the-art greenhouse was attached to this building, with interconnecting walkways, a greenhouse operations office, and a large headhouse/plant preparation area. During this construction, a modern post-harvest building was attached to the original farm shop building.

In 1996 Dr. Gerald Ghidiu was appointed Director, and oversaw the hiring of three fruit specialists that joined the faculty: Drs. Peter Shearer (entomology), Bob Belding (horticulture), and Norm Lalancette (pathology), with secretaries Karen Holton and Donna Dugan replacing retiring secretaries. During his tenure, the 40-acre Haaf farm (also known as the Shafi property) was purchased and added to the Center operating farm in 1997 increasing the available land for tree fruit (total land was now 305 acres). The final series of construction began in 1998 when an outdoor pavilion was completed for various tours and outdoor meetings, followed by a new, state-of-the-art pesticide storage/loading facility in 2005. In 1999, the official name of the Rutgers Research and Development Center was changed to Rutgers Agricultural Research and Extension Center, as it remains today, which reflects the Extension component and activities of the Center.

By 2000, a non-faculty Director was hired (Dr. Shane Ball), and again in 2002 (Dr. Willie Nicholson). Dr. Nicholson oversaw the hiring of the last two faculty members to join the Center, Dr. Andy Wyenandt (vegetable pathology) in 2005 and Dr. Dan Ward (fruit horticulture) in 2006. Also in 2006, both the Johnson farmhouse and the Patrick farmhouse, with several older outbuildings, were torn down and removed.

Dr. Brad Majek was appointed Director in 2008 (currently serving as such), and during his tenure oversaw the erecting of an 8-foot gated fence to completely encircle and secure the entire Center property.

Author's Note: I would like to extend many thanks to the generous assistance of Dr. Jim Paterson, Dr. Steve Garrison, Mr. Bill Pompper, and to Ms. Irene Kaneshiki, June Sudal and Karen Holton for their time and efforts in reconstructing the events and activities of the Rutgers Agricultural Research and Extension Center from 1965-2010.

BROWN
MARMORATED STINK
BUG –
A NEW THREAT TO
AGRICULTURE SESSION

BROWN MARMORATED STINKBUG (BMSB) – THE CURRENT SITUATION IN NEW JERSEY VEGETABLES

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First captured in Milford, Hunterdon County in1999 by the RCE Vegetable IPM Program, the brown marmorated stinkbug (BMSB) is emerging as a serious threat to multiple vegetable crops in New Jersey, and may become the dominant insect pest in several of our important economic crops. Between 1999 and 2008, captures of this insect were fairly low in blacklight traps, although catch frequency and geographical range within the state steadily increased. During this time, the center of activity was in northwestern New Jersey, near the towns of Milford, Alpha and Phillipsburg. In 2009, as captures of this insect became more frequent throughout the state, BMSB numbers in the Phillipsburg area increased significantly, although no noticeable increase in damage to tomatoes or peppers occurred.

In 2010, adult BMSB captures in blacklight traps increased dramatically, with Phillipsburg (Warren), Hillsborough (Somerset), Springdale (Camden), Downer (Gloucester), and Shiloh (Cumberland) area blacklights registering tenfold (estimated) increases over any previous seasons' catches. In these areas, captures of 20-30 adult BMSB per night in traps occurred in July and into early August. At this time, the presence of BMSB in crops such as peppers and sweet corn became obvious, and damage to pepper fruit in particular, increased.

The RCE Vegetable IPM Program monitors our native brown stinkbugs (*Euschistus spp.*) in the blacklight traps and through scouting activities related to tomato production, as this crop is a favored host of these pests. The worst years are often dry ones, with irrigated tomatoes suffering up to 30% fruit injury in some late July picks as adjacent wild hosts become too dry to support stinkbugs. Interestingly, in 2010, stinkbug injury to tomatoes did not appear to rise above that typically caused by native stinkbugs. In fact, scouts reported that BMSB were infrequently discovered in tomatoes, while *Euschistus spp*. were the more common stinkbugs. This was not the case with peppers. While native brown stinkbugs do cause occasional injury to pepper fruit, it is rarely an economic problem, and the vast majority of insecticide applications target caterpillar pests such as the European corn borer (ECB) and beet armyworm (BAW). The appearance of BMSB in peppers in northern New Jersey began in mid-July, and increased through August. Injury to fruit increased in August and into September, with some Warren County farms suffering dramatic injury. At Phillipsburg, the grower reported 40% of some bell varieties and 75% of jalapenos to have stinkbug injury late in the season. At this time, multiple BMSB were present on pepper plants despite weekly applications of methomyl. In the Hackettstown area, injury to peppers was widespread, although not as severe, with sweet frying peppers more heavily damage than others. Interestingly, when questioned, growers in the southern half of the state did not complain of severe problems. In 2010, BMSB were frequently observed in sweet corn plantings throughout the northern half of the state. In most cases, the corn was in the pre-tassel stage, and it was assumed that the bugs were feeding on the developing tassels. Foliar injury was common, although this was not economically damaging. The lack of ear injury (as was suffered in some other states) is likely due to the frequent application of pyrethroid insecticides through the silking stage to reduce infestations by corn earworm (CEW) and fall armyworm (FAW).

Immediate Implications for Integrated Pest Management Programs

If the current trend continues, BMSB threatens to become the dominant pest in some of New Jersey's major economic vegetable crops. This presents several challenges for growers and IPM practitioners.

Biological control and insecticide options.

Example: The dominant pest complex in NJ peppers has been "worms" or caterpillars. The ECB has been the most serious and consistent, requiring weekly foliar insecticide applications at certain times of the season. To a lesser extent, FAW, CEW, and BAW are all potential threats to pepper fruit. At present, these pests may be effectively managed with newer insecticides that have reduced impacts on beneficial insects. These products, including those having spinosad/spinotoram, chlorantraniloprole, methoxyfenozide, and flubendiamide as active ingredients enable the effective management of "worm" pests while permitting native biological control agents to manage aphids and to some extent, thrips and mites. Preliminary studies regarding the efficacy of insecticides for BMSB control indicate that synthetic pyrethroid–based materials are among the most useful. These materials are toxic to predators and parasites of aphids and other insect pests, and their repeated use often results in secondary outbreaks of these insects. Therefore, management of BMSB with synthetic pyrethroid insecticides may require separate insecticide applications to manage aphids and other pests.

Example: In some areas, BMSB has become a pest of sweet corn, as adults are capable of piercing the husk and damaging developing kernels. Synthetic pyrethroid insecticides are commonly used to manage the CEW/ECB/FAW pest complex in NJ. This practice seems to have limited BMSB damage to sweet corn ears thus far. However, FAW populations have been increasingly resistant to the synthetic pyrethroids in recent years, causing some growers to switch to effective materials mentioned in the previous example. As noted, these insecticides do not have activity against BMSB, and their use may result in crop injury or may require secondary applications of BMSB-active materials.

Scouting methods and thresholds.

Example: Because native brown stinkbugs have not caused significant injury to peppers in NJ, no economic thresholds exist for stinkbugs in peppers. The development of economic thresholds for BMSB in peppers will likely begin in 2011, and could take several seasons to work out. In the meantime, growers and IPM practitioners will necessarily be conservative in their recommendations, possibly resulting in over application of insecticides. The habit of BMSB to drop or take flight from plants when disturbed creates difficulties in scouting. Useful scouting methods will be needed that correctly quantify the pest level and are not so time consuming as to be inefficient.

The Near-Term Outlook

Many insect and disease pests of vegetable crops in our region have been studied for many years. The IPM tactics for managing some of these pests may be considered "mature" in that complexities of the pest/crop systems have been worked out, resulting in management practices like mating disruption, farm-scale habitat manipulation and predictive models. For a new and potentially serious economic pest like BMSB, the first priority is to prevent unacceptable loss in commercial situations while Extension personnel pursue answers to questions including insecticide efficacy, sampling methods, thresholds and behavior. In the near future, this may result in increased use of insecticides on host crops.

BROWN MARMORATED STINK BUG – CURRENT SITUATION IN NJ FRUIT – 2010

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The brown marmorated stink bug (BMSB), *Halyomorpha halys*, mushroomed into a serious insect pest throughout much of eastern Pennsylvania, New Jersey, western Maryland and the Cumberland-Shenandoah area during 2010. On fruit crops, the insect feeds by puncturing the fruit with piercing/sucking mouthparts, and injecting saliva which allows the insect to suck up the plant material through its mouthparts. Fruit tissue at the point of entry and just below into the flesh, then dies and the rest of the fruit grows around it. This leaves a sunken area on the skin at the point of entry, and browning, dead tissue in the flesh. Early injury on stone fruit can go all the way to the pit. The tissue dies, and as the fruit grows, can form cavities in the flesh. Photos of adults and nymphs feeding on peaches, apples and pears can be seen in figure 1. Internal feeding damage is illustrated in figure 2.

Unlike other fruit pests, after it arrives in the orchard, BMSB can spend its entire life feeding on the fruit, and every life stage, other than the egg, causes damage. As the stink bugs become established in managed fields, they are heavily biased towards edge and border rows. In tree fruit this has resulted in higher populations near wooded borders and soybean fields.

During 2010, workers in several Mid-Atlantic States initiated a survey program using the same methodology in each state. We sampled 10 fruit from each of 10 trees on an outside row, and 10 fruit from 10 trees on several inside rows that were at least 5-6 trees in from the edge of the block. We assessed both samples for the number of fruit injured with 0,1,2,3,4,5,6,7,8, 9, or >10 injuries per fruit. We took a total of 68samples across 18 farms for a total of 6,800 sampled fruit.

Damage averaged about 54% across all sampled fruit. Damage was significantly higher towards edge rows. Interiors of peach blocks averaged almost 54% damage, while edge rows averaged 65% damage. The pattern was similar in apples where an average of 42% damage was seen on interior rows compared to 59% damage on edge rows (figure 3). One peach planting was seen with 97% damage. Other blocks were only slightly damaged, but damage was present throughout NJ at some level.

This insect cannot be controlled with many common tree fruit insecticides, including Imidan and Sevin. While we do not yet know what insecticides will be the most satisfactory, various pyrethroids gave some control in 2010. Unfortunately these materials have short residual properties, can disrupt orchard ecosystems, and insects can become resistant to them with repeated applications. Carbamates (methomyl), and several neonicotinoids have shown some activity in ongoing research tests. During 2010, the high damage levels seen were present even though most growers were using intensive insecticide programs. Since little is known about this insect, research programs need to be developed throughout the states that have become infested with BMSB. Over the next several years, researchers will attempt to address questions concerning its life history, environmental and temperature effects, monitoring and control tactics, and other management practices that can be used to control this insect.

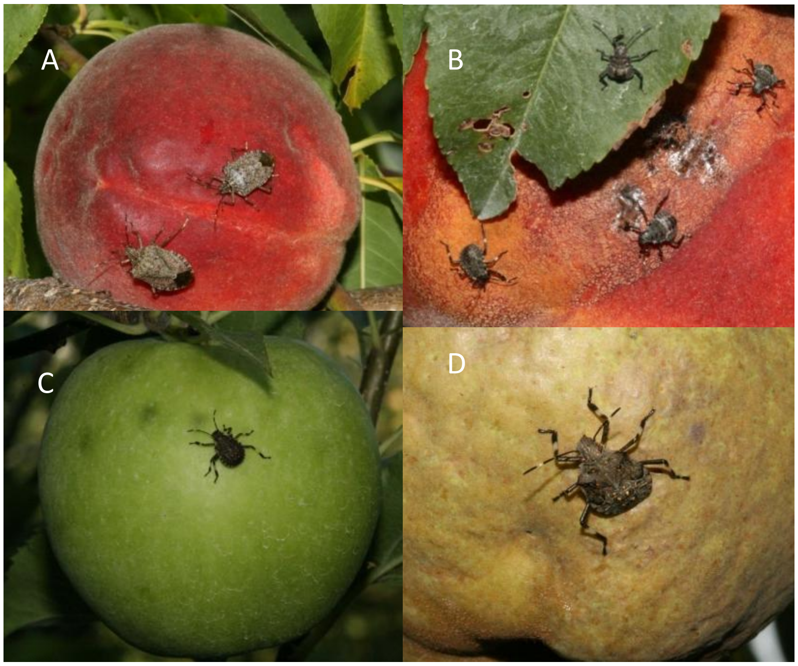

Figure 1. Stink bugs on fruit - **A.** adults on peach, **B.** nymphs on peach, **C.** nymph on apple, **D.** nymph on pear.

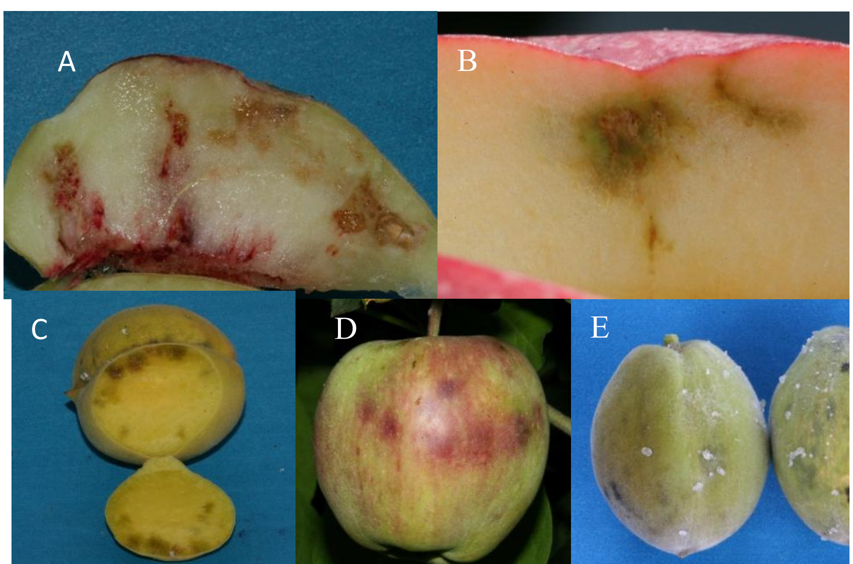

Figure 2. Internal and external damage from brown marmorated stink bug – **A.** internal necrosis in peach, **B.** internal necrosis in apple, note depth of feeding where mouthparts extended into apple, **C.** water-soaked areas in peach, **D.** external damage on apple, **E.** recent bleeding spots on peach.

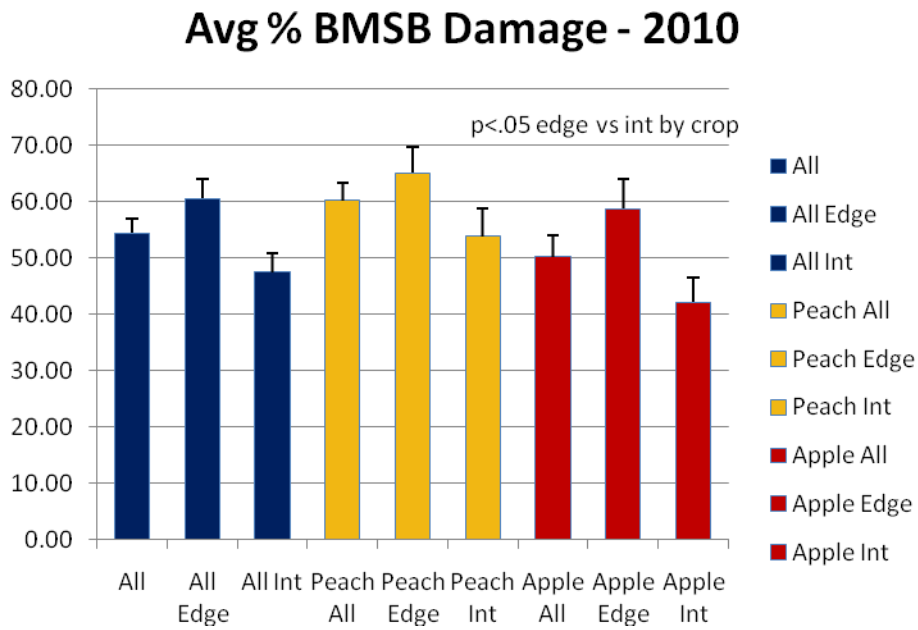

Figure 3. Average overall damage, from samples on edge, and from samples in internal rows.

SEASON EXTENSION VEGETABLE AND FRUIT

SEASON EXTENSION TECHNIQUES FOR EARLY SEASON CUCURBIT CROPS

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Vegetable growers continue to look at lengthening the growing season to achieve maximum production and to schedule harvest dates during times of short supply to attain increased prices. The use of season extension techniques, such as high tunnels, low tunnels, row covers, individual plant caps/covers, plastic mulches, and transplanting rather than seeding in spring, have all contributed to earlier production for cucurbit crops and to a lesser extent later production for fall crops. Cucurbit crops grown in the Southern New Jersey region that are produced utilizing season extension techniques include cantaloupe, watermelon, pickles, cucumbers, zucchini squash, yellow summer squash, and specialty melons. Growers report the ability to harvest these crops 5 to 7 days earlier when using fiber row covers, 7 to 10 days earlier with low tunnels and 12 to 18 days sooner with high tunnels than without covers. The highest acreage of season extension methods for cucurbits in Southern New Jersey is the use of low tunnels with clear polyethylene covering or fiber row covering. Row cover removal is critical during flowering to allow for adequate pollination. Material cost is one issue, but labor costs generally exceed material costs with these practices. Reaching the market place a week or more before other area producers can result in higher prices that make using season extension methods worth the investment, in most years. For cucurbits like melons coming into production before the Fourth of July holiday can greatly increase returns, especially when retailing melons.

Frost Protection of Vegetable Crops in Florida

Richard Tyson, Florida Cooperative Extension Service

Cold protection from frosts and freezes are often needed to protect high value vegetable and berry crops in Florida. Active cold protection methods can come in various forms such as using row covers, high tunnels, overhead sprinkler irrigation or combinations of these methods. Wetting the soil the day before a cold front has also been shown to provide a modest 1-2 º F protection up to a height of 1 foot as wet soil absorbs more radiant heat during the day for subsequent release at night compared to a dry soil. Of these choices, sprinkler irrigation has the potential, if used properly, to provide the largest degree of protection from cold temperatures. Using row covers and/or high tunnels in combination with irrigation also increases options available to growers since windy conditions can eliminate the use of overhead irrigation in open field conditions. For example, strawberries were protected in a freeze with minimum temperatures of 5 º F in North Carolina inside a high tunnel with 2 layers of row covers and overhead irrigation.

Florida has developed a sophisticated agricultural weather tracking system after the loss of funding for the National Weather Service's minimum temperature forecasts for agricultural areas in the state. The Florida Automated Weather Network (FAWN - http://fawn.ifas.ufl.edu/) has 35 weather stations strategically placed throughout the major growing areas of the state producing real time and historical weather tracking. This includes frost forecasting and growers can receive real time updates on freeze nights for their area. The website has a Cold Protection Toolkit which helps growers make decisions about using overhead irrigation for frost protection. For example, windy conditions can increase the potential for evaporative cooling which may cause more damage to plants than would occur if irrigation was not used (Table 1). Don't irrigate under extremely windy conditions since the heat lost to evaporation will exceed the heat released from freezing irrigation water.

The highest tissue freezing points for many fruits and vegetables range between 28 and 31 º F (Table 2). The critical temperature at which plant tissue forms ice and thus causes damage depends on the water/solute concentration in the tissue and varies with the crop and the stage of growth. The higher the tissue solute concentration the lower the critical temperature. When cold weather precedes a freeze event and thus hardens off plants (slows or stops growth), tissue solutes can increase while warm weather prior to a freeze encourages growth and can reduce solute concentration making plants more susceptible to cold damage. Properly designed and managed sprinkler irrigation systems can maintain tissue temperatures near 32 º F on a freeze night by creating a layer of ice around the plants. There are some important principles to consider when using irrigation for cold protection. These principles are:

1. Sprinkling protects by the release of heat as water turns to ice. As long as there is a uniform mixture of water and ice present on the plant, the surrounding temperature remains at 32 º F. If insufficient water is applied or if distribution is poor, plant damage will be more severe than if water had not been applied.

2. As expected low air temperatures decline and wind speeds increase the irrigation application rate must increase to obtain adequate levels of plant protection (Table 3). Irrigation for cold protection is considered not feasible at wind speeds greater than 8mph.

3. Leaves should be rewetted with an irrigation pass at least once every minute to keep a constant film of water present and constant heat being released as water freezes.

4. Irrigation risers should be spaced at 50% of their effective diameters so that the water discharge from one riser touches the base of the next riser for best results.

5. Irrigation should begin when falling temperatures reach about 34 º F - 38 º F and should operate continuously until the temperature increases above 32 º F and ice begins to melt.

Table 1. Considerations for determining risk level in cold protection by overhead irrigation.

Risk level	**Considerations**
Low	Maximum temperature difference between air temp and wet bulb is <1 °F. Maximum wind speed is < 5 mph.
Moderate	Maximum temperature difference between air temp and wet bulb of 1° to 2° F. Maximum wind speed is 5 to 8 mph. If wind <5 mph, move to Low Risk. If wind >8 mph, move to Strong Risk.
Strong	Maximum temperature difference between air temp and wet bulb of 3° to 4° F. Maximum wind speed is 9 to 12 mph. If wind <9 mph, move to Moderate Risk. If wind > 12 mph, move to High Risk.
High	Maximum temperature difference between air temp and wet bulb of 5° to 6° F. Maximum wind speed is 12 to 15 mph. If wind <12 mph, move to Strong Risk. If wind >15 mph, move to Extreme Risk.
Extreme	Maximum temperature difference between air temp and wet bulb is >6° F. Maximum wind speed is >15 mph.

Source: Florida Automated Weather Network - http://fawn.ifas.ufl.edu/

Table 2. Freezing points of selected vegetables and fruits in º F.

Variety	Highest freezing point
Beans, Snap	30.7
Cabbage	30.4
Eggplant	30.6
Lettuce, iceberg	31.3
Okra	28.7
Strawberry	
Tight bud	22.1
Open blossom	30.0
Green fruit	28.0
Tomato	30.5
Squash, yel. cr.	30.8

Sources: Harrison, D., J. Gerber and R. Choate. 1997. Sprinkler irrigation for cold protection, Univ. of Florida Coop. Ext. Ser. Circular 348; Perry, K. and E. Poling. 1986. Field observation of frost injury in strawberry buds and blossoms. Advances in Strawberry Production 5:31-38.

Table 3. Irrigation application rates recommended for cold protection under different wind and air temperature conditions.

Minimum Temperature Expected	**WIND SPEED IN M.P. H.**		
	0 to 1	**2 to 4**	**5 to 8**
	Application Rate (inches/hour)		
27˚F	0.10	0.10	0.10
26˚F	0.10	0.10	0.14
24˚F	0.10	0.16	0.3
22˚F	0.12	0.24	0.5
20˚F	0.16	0.3	0.6
18˚F	0.20	0.4	0.7
15˚F	0.26	0.5	0.9

Source: Harrison, D., J. Gerber and R. Choate. 1997. Sprinkler irrigation for cold protection. Univ. of Florida Coop. Ext. Ser. Circular 348.

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NEW TECHNOLOGY IN HIGH TUNNEL CROP PRODUCTION FOR SEASON EXTENSION

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There has been a linear increase in the use of high tunnels for extending the production season for vegetables, small fruits, cut flowers and tree fruits by growers, not only in the Northeast but also in many other parts of the country since Dr. Otho Wells, University of New Hampshire and growers like Ed Person and Eliot Coleman began experimenting with them in the 1980's. They were a follow on to research using row covers for season extension. One reason that the use of high tunnels has become popular with growers is their simplicity and effectiveness in protecting crops from low temperatures in both spring and fall. Now we have four-season production in high tunnels harvesting certain mature crops all winter. Because high tunnels can be viewed as affordable technology, this system is particularly appealing to new-entry growers who utilize retail-marketing channels.

High tunnels do not offer the precision of conventional greenhouses for environmental control, but they do sufficiently modify the environment to enhance crop growth, yield, and quality. Although they provide some frost protection, their primary function is to elevate temperatures a few degrees each day over a period of several weeks.

In addition to temperature control, there are also the benefits of wind and rain protection, soil warming, and in some instances control of insects, diseases, and predators such as varmints and birds. Overall, these growing systems should be considered protected growing systems that enhance earliness and higher yields, improve quality, and reduce the use of pesticides in some cases.

High tunnels have sufficient versatility to make them useful on a wide diversity of crops and in various cropping systems. Vegetables, small fruits, flowers and even tree fruits are all suited to this growing system; but the specific crops which might be grown will to a large extent depend on marketing opportunities for individual crops by individual growers.

High Tunnel Systems

High tunnels are not conventional greenhouses. But like plastic-covered greenhouses, they are generally quonset-shaped, constructed of metal bows that are attached to metal posts which have been driven into the ground about two feet deep. They are covered with one layer of 6-mil greenhouse-grade polyethylene, and are ventilated by manually rolling up the sides each morning and rolling them down in early evening. There is no permanent heating system although it is advisable to have a standby portable propane unit to protect against unexpected below-freezing temperatures. There are no electrical connections. The only external connection is a water supply for trickle irrigation. In the Northeast and in regions where snow is a consideration we recommend high tunnels with a peak and not the traditional quonset shape. Since the pioneering work by Dr. Wells and the follow-on work at Penn State University most greenhouse manufacturers now sell and promote high tunnels as part of their business.

Details of the Penn State Design

Erection of the pipe framing is the same whether the New Hampshire Design or the Penn State Design is used. The changes come in the construction of the endwalls and the hipboard and attachment of the plastic covering. For an excellent overview of the construction of a high tunnel using the Penn State University go to the Center for Plasticulture website: http://plasticulture.cas.psu.edu and go to the high tunnel button. There is a PDF file of an article "Design and Construction of the Penn State High Tunnel" that has illustrations detailing the steps in construction of a high tunnel using the Penn State Design. This article first appeared in a 2002 issue of HortTechnology Volume 12(3): 447-453. A couple of suggestions on purchasing and positioning a high tunnel. One is to purchase a high tunnel with tall sides (approximately 5 feet from the ground to the hipboard). This will improve the ventilation capacity of the tunnel. In locating a site for the high tunnel make sure to orient the high tunnel so that the prevailing winds blow through the sides of the tunnel. The wind is your means of ventilation and temperature control and also pollination for some crops. For parts of the country that experience snow in the winter we recommend purchasing a high tunnel with a peak to protect against snow accumulating on the top of the tunnel. Fourth is to space the tunnels at least 12 feet but if room allows then 20-25 feet apart to ensure adequate ventilation in the tunnels and permit the removal of snow that could possibly buildup against the sides of the tunnels during severe winters.

At the Penn State High Tunnel Research and Education Facility we have purchased all our high tunnels from Ledgewood Farm Greenhouse Frames (603)-476-8829. We have constructed in excess of 60 high tunnel frames ranging in size from 12 foot wide to 30 foot wide and 20 feet in length to 96 feet in length all Ledgewood Farm Greenhouses.

For all practical purposes, high tunnels are protected growing structures that should result in high returns. Therefore, they should be situated on the best soil -- soil that is well drained and that has had pH and nutrient adjustments as for a field soil. The soil should be smooth, firm, and moist at planting.

The single bay high tunnels come in widths of 12 feet wide up to 30 feet wide and in any length of 4-foot intervals. Most commercial lengths are 96 feet long. After researching and using different size high tunnels we recommend purchasing a 21 feet wide by 96 feet long tunnel which would cost between $4,500 and $5,000 completely finished not including labor cost. The tunnel could be erected and ready to plant in 3-4 days. The larger the tunnel the easier it is to maintain/regulate the environment inside.

There are other high tunnel structures being marketed which should be evaluated keeping in mind the comments made above about snow loads.

The Haygrove Multibay Tunnel System is a different type of tunnel than what we have been discussing and it is currently being used in Pennsylvania for the production of plasticulture strawberries, raspberries, cut flowers, tomatoes and sweet cherries. This type of tunnel can cover from 1/3 to 5 acres and is operated differently than the single high tunnel units discussed in the preceding paragraphs. In the Haygrove Multibay Tunnel System, the plastic covering is completely removed, covered with black plastic and stored in the gutter area between the bays for the winter whereas the single Penn State high tunnel units remained covered the entire winter.

Future Direction of High Tunnel Technology

We have grown a wide variety of crops as have growers and the benefits are obvious. I see moveable high tunnels as the current new concept in the use of high tunnels. There are currently two high tunnel manufacturers involved with moveable high tunnels- Rimol Greenhouses and Four Season Tools. I personally like the concept of moving the tunnel on a rail system to another plot of ground from the viewpoint of having the ability of flushing out the ground, something that we do in tradition non-moveable high tunnels only when we remove the plastic at the end of its 4-5 year life. It is important to always remember that one of the greatest advantages of tunnels is disease control. The plastic cover is a rain shelter, the raised plastic mulch bed is a barrier against evaporation of soil moisture, and early morning ventilation reduces relative humidity. Therefore, the leaves of crops are dry for most of the day and night. Because of low humidity, plant leaves remain dry, impeding the incidence and spread of disease. For example, early blight of tomatoes, a serious foliage and fruit disease on field tomatoes, is not a problem in high tunnels when the tunnels are vented daily, though powdery mildew, especially in cucurbit crops can be a problem because the conditions in a high tunnel are more favorable for the development of this disease. Thus the use of a moveable high tunnel needs to be tied to movement from perennial crops on to annual crops that need protection such as tomatoes, peppers, cut flowers, etc. while allowing a resting a portion of ground with a cover crop.

One of the greatest benefits of a high tunnel is that it allows a grower to plant and harvest regardless if it is raining, etc. This allows a degree of scheduling that is sometimes difficult to obtain with field production.

<u>Addition information on the plasticulture and high tunnels</u>
Center for Plasticulture, Penn State University: **http://plasticulture.cas.psu.edu**

2003 High Tunnel Production Manual- a157 page manual is available for $25.00 from Dr. Bill Lamont at the above address. Checks should be made out to The Pennsylvania State University.

FROST PROTECTION: TYPES OF FROST AND TIPS FOR PROTECTION

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Frost or freeze damage occurs when water in the plant tissue freezes. The temperature at which this occurs depends on the water content and concentration of water vs. solutes in the plant tissue. For this reason, the temperatures at which damage occur varies with the crop, and varies with the plant part and growth stage. Tables of these critical temperatures are available in various extension publications and on Web sites.

Types of Frosts and Freezes

Radiant frosts and freezes occur on calm, clear nights with no cloud cover. Heat is lost from the soil and plants, and radiates back to the sky. *Advective freezes*, sometimes called windborne freezes, are caused when a cold air mass moves into the region accompanied by a lot of wind. It is difficult to protect against this type of freeze.

Environmental Measurements and How They Relate to Frost Events

Air temperature can be taken with either a dry-bulb or wet-bulb thermometer. *Dry-bulb temperatures* are commonly referenced in literature and weather forecasts. *Wet-bulb temperatures* are obtained from a sensor that is covered with a wet wick. The wet-bulb temperature is essentially what the plant temperature will be once the irrigation is started and evaporative cooling has taken place. Temperatures vary with height, and should be taken at the height of the plant parts you are protecting. *Wind speeds* of more than a few miles per hour can make frost protection difficult. Light breezes however, mix the air and can increase temperatures at ground level in the case of radiational frosts. The *dew point* is the temperature at which the relative humidity reaches 100% as the air cools. At the dew point, water vapor condenses into fog or dew, which gives off heat slowing the temperature drop temporarily. If the dew point is below freezing, temperatures can drop to damaging levels extremely rapidly. In this scenario, the white crystals typically seen in a frost or freeze do not form, an event sometimes referred to as a "black frost", which can catch growers off-guard. You can determine the dew point in your location by filling a shiny metal can partway with water, adding ice cubes, and stirring while watching for the formation of water droplets on the side of the can. The water temperature, which will be similar to the surface of the can, is the dew point. Take the temperature of the water right away. Note that if the dew point is below 32 degrees, you may need to add salt to the water to lower its freezing point. The *relative humidity* is the amount of moisture contained in the air relative to the maximum amount that could be held. It changes with temperature and can change quickly with the air mass. More humid air tends to hold more heat.

Site and Soil Effects on Frosts/Freeze Occurrence

Sites downwind from or closely surrounded by a large body of water need less frost protection, though obviously this information can only be utilized when buying the farm. *Topography* affects frost occurrence. Cold air is heavier than warm air, so it flows downhill. Temperatures are often 4° to 5° F higher at the tops of slopes than in the lower areas (frost pockets). Fog usually forms first in frost pockets, and this is a way of identifying them over time without measuring the temperature. Southern slopes are generally warmer than those facing north, but perennial plants on Southern slopes will also come out of dormancy earlier, possibly negating this benefit. *Soil moisture* has an effect in that moist soils hold more heat and radiate it back to the environment for a longer time than dry soils. If the soil is dry, plantings should be irrigated two or three days ahead of an expected cold snap to allow time for heat to be captured. Irrigating the day of the frost event may actually cool the air due to moisture evaporation from the wet soil and plant surfaces. *Soil texture and compaction* are also factors, as heavier soils collect and release heat more than sandy or organic soils. Sandy soils are also lighter in color and hence tend to reflect more sunlight, rather than absorbing it in the form of heat. *Ground cover* affects the amount of heat absorbed by and released from the soil. A bare, undisturbed moist soil with no ground cover can release enough heat to raise the temperature 2 to 3 degrees in the plant canopy of a low crop as compared to a sod-, grass-, or straw mulch-covered soil. Black plastic mulch helps capture and hold heat, but crops on plastic often are advanced, and thus may need more frost protection early.

Methods for Protecting Plants from Frosts and Freezes

Floating row covers are useful for small acreages of low-growing crops or when water for overhead irrigation is not available. Usually the amount of protection increases with the weight, though differences in row cover texture make this correlation less than perfect. Protection afforded can range from 1° to 2° to more than 10° F. Weather conditions prior to the frost affect the amount of protection obtained, since little or no heat may accumulate under the row cover on cloudy windy days. When row covers are used for frost protection, they should be pulled over the crop during mid-afternoon to capture heat. A double layer of a medium-weight (0.9 ounce per square yard or heavier) row cover can get a low-growing crop through almost all types of frost events without overhead irrigation. Older covers can be used as the underlayer to cut costs. Row covers can also be used in conjunction with sprinkler irrigation on top of the row cover. On average, this decreases the amount of irrigation needed by about 50%.

Sprinkler irrigation works well as long as the irrigation rate is higher than the freezing rate. The heat release is primarily from the water freezing, not from the warmth of the water. When one pound of this water drops from 60 to 32 degrees, it releases 28 BTUs. The same pound of water then changing to ice releases an additional 144 BTUs. Overhead sprinklers should be set up in a staggered pattern rather than a square one, as the overlap results in a more consistent pattern of water application. There should be at least 50% overlap in sprinkler patterns (i.e., the outer reaches of the water stream should hit the neighboring sprinkler in the same line, or the sprinkler spacing should be 50% of the wetted diameter). If this pattern is used, nearly all areas of the field will be covered by 3 different sprinklers, which is helpful if a sprinkler clogs.

Tables in various publications list the rate of water application needed for various conditions. To find out your irrigation rate, place several straight-sided cans or buckets in the field, run the irrigation for at least an hour, and measure the water depth in each bucket. You can pour water from the buckets together to obtain an average if the buckets are same size, but check each before combining so you can judge the evenness of the wetting pattern.

A common recommendation is to start the system when the temperature at plant level falls to 4° F above the critical temperature. Under conditions with wind or low humidity, damage can occur when the air temperature is several degrees above the freezing point because of evaporative cooling. Irrigation should be operating by the time the wet bulb temperature equals the critical temperature.

<u>Taking Your Own Temperature Measurements: Accurately Depicting Crop Conditions</u>
Temperature sensors must be calibrated to be sure the temperature you are reading is correct. Calibrate them yearly by immersing the sensor in a water and crushed ice slurry, gently stirred, which will be at 32°. Note that with most liquid-in-glass min-max thermometers, the bulb is at the top. Adjust subsequent readings accordingly.

The coldest temperature in a field is often near the soil surface, a critical detail for low-growing crops such as strawberries. Readings should be made at the plant canopy level. In taller crops, several measurements should be taken at different places in the field at the various heights of the plant canopy. The temperature of the plant tissue is often lower than that of the surrounding air, so err on the side of caution within reason.

Liquid-in-glass thermometers, usually relatively inexpensive in price, can vary in their readings. However, they usually vary less than dial thermometers, and are a good value. *Thermocouple thermometers* are useful but pricey. *Thermistor thermometers* are probably the best option for accuracy, as they are designed to read a relatively narrow temperature range, and have a good percentage accuracy. Calibration of all types is still recommended. Digital readouts give the impression that, because the reading can be noted to the closest tenth or hundredth of a degree, the device must be accurate. This is not necessarily true - the reading may be very exact, but also very wrong.

Electronic devices and plug-in probes offer some useful advantages as the sensing tip can be placed where you can't easily take a reading, such as under a row cover or in the middle of an irrigated field. With some electronic devices, the number display is not meant to withstand temperatures below freezing. This means that the display could "black out" when you need it the most, so use the display portion in the field only when obtaining the reading. Frost alarms and alerts are especially valuable if your field is some distance away from where you live. Once the temperature drops to a certain point, the alarm sounds a buzzer, calls you on the phone, or flashes a light, depending on the model. An addition to frost protection gadgetry is a device that flashes a light that is color-coded to the temperature, so growers can "see" the temperature in the field from a distance.

AGRITOURISM SESSION

USING WEB-BASED TECHNOLOGIES TO PROMOTE YOUR AGRITOURISM FARM

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INTRODUCTION

Changes in the economy combined with fluctuations in agricultural income and the desire to preserve land and resources has placed increased pressure on farmers across the nation to examine alternative economic opportunities. In response, many farmers are turning to agritourism as a means of economic diversification. However, as the popularity of agritourism grows, competition in the marketplace is forcing many agritourism businesses to strategize and look for new ways to keep and grow their customer base. The overall goal of this presentation is to introduce and discuss the strategies for using various web-based technologies for marketing and promoting an agritourism business.

AGRITOURISM AND THE INTERNET

How agritourism businesses market and promote themselves is evolving from traditional strategies (e.g., print, radio, and television advertisements, faxed press releases) to newer strategies including websites and social media. In short, social media refers to a form of communication in which interactions and conversations take place via the Internet. A few examples of social media tools include social and professional networks (Facebook, MySpace, LinkedIn), content sharing (YouTube, Flickr, Photobucket), blogging and microblogging (Twitter, Wordpress), wikis, podcasts, etc. Social media marketing is the use and engagement of these tools to generate exposure and sales. In today's tech-savvy and ever-changing economy, agritourism businesses cannot afford to be invisible in the world of social media. The impact and use of social media is staggering, for example: 68% of adult Internet users already use social media; 33% visit social media sites to engage in product research before making a purchasing decision; 47% say social media sites influence their decisions to purchase specific brands or services; 26% of respondents changed their minds about purchasing a product after reading about it on a social media site; 91% say consumer reviews are the #1 aid to buying decisions; online users are 3 times more likely to trust peer opinions over advertising for purchasing decisions; and Facebook signs up 600,000 new users daily (*Market Tools,* August/September 2008 Insight Report). Moreover, more than 1.5 million local businesses have active pages on Facebook (http://graphics.ms/blog/877-social-networking-statistics%20-2010/).

Agritourism businesses cannot afford to be left behind – they must have an online presence! This presentation will include a review of the importance of having an online presence, tips for creating successful web page, social media marketing options, tips for using social media, and real-life examples of how various agritourism businesses are using the Internet and social media outlets to market and promote their business and the quality service and experience they offer to their visitors.

In addition to the use of website, some of the social media marketing examples discussed will include:

- Facebook
- YouTube
- Twitter
- Blogs
- Groupon/Social Living
- Flickr
- Geolocation Social Media (e.g., foursquare, gowalla, scvngr)

A few of the strategies that will be discussed include:

- Research and see what others are doing – ask around and look around online
  - Note what you like and do not like about other sites
  - Note lessons learned and learn from them
- Make a plan – having a successful online presence takes work
  - Identify tasks and create a timeline
- Link everything – link website and all social media sites
- Be active and interactive – update often and participate
- Be creative – photo contests, promotions, quizzes, etc.

Below are a sampling of resources related to websites and social media:

WEBSITE-RELATED RESOURCES

- Using E-Commerce to Add Value to Small Farming Businesses in California - http://www.sarep.ucdavis.edu/CDPP/ecommerce.htm
- 10 rules for your small business home page - http://www.downloadsquad.com/2007/04/20/10-rules-for-your-small-business-home-page/
- Top 10 Small Business Web Site Marketing Tips - http://www.pawprint.net/internet-marketing/small-business-web-site.php
- Website design tips- http://websitehelpers.com/design/ and www.websitetips.com

FACEBOOK-RELATED RESOURCES

- How to Create a Facebook Page - http://www.squidoo.com/facebookpage
- Dunay, P., & Dueger, R. (2009). Facebook Marketing for Dummies. Wiley Publishing. Hoboken, NJ.

- Facebook – Pages, Groups and Profiles - http://johnhaydon.com/2009/04/facebook-groups-pages-tips/
- Step-by-Step directions for creating a Facebook page – choose ‘Agritourism and the Internet: Social Media 101 and watch the 2nd half of the webinar.
    - http://www.ncsu.edu/tourismextension/WebinarSeries.html

OTHER SOCIAL MEDIA RESOURCES

- Your Guide to Social Media Survival - step-by-step instructions for Facebook, Twitter, and Blogs - Tennessee Department of Agriculture - http://www.tennessee.gov/agriculture/marketing/Agritourism%20pdfs/YourGuidetoSocialMediaSurvival.pdf
- Ohio Farm Bureau Guide to Social Media - http://ofbf.org/uploads/social-media-guide.pdf
- Jan. 26th Agriculture and Social Media Web Conference Summary - http://blog.anneadrian.com/2010/01/agriculture-and-social-media-web_26.html
- Social Media video with statistics: http://www.youtube.com/watch?v=lFZ0z5Fm-Ng

Biographies:
Samantha Rozier Rich is an Assistant Professor and Tourism Extension Specialist in the Department of Parks, Recreation, and Tourism Management at North Carolina State University. Dr. Rich’s general research interests include aspects of tourism marketing and promotion, influence of media and promotional materials, and the use and creation of collaborative relationships among tourism entities.

Sue Colucci is an Area Specialized Agriculture Agent in Western North Carolina (Hendersion, Buncombe, and Haywood counties). Her areas of responsibility include commercial vegetable and small fruit production. Ms. Colucci has a passion for sustainable agriculture and provides a wealth of information for growers on her blog www.wncveggies.blogspot.com.

UNDERSTANDING THE CUSTOMER EXPERIENCE

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Introduction

From a business perspective, transitioning from traditional agriculture to agritourism can be quite a challenge. One of the biggest challenges is successfully creating a product that customers (tourists) want. What products and/or services should be created and sold? In regard to agritourism, as with all forms of tourism, the product is the experience.

As an agritourism venture is planned or refined, it is important to remember that people are not visiting a farm or participating in agritourism just because fresh produce is grown there, or because they can go through a corn maze. People are visiting for the experiences—experiences that are unlike those of their everyday lives. So, how can farms create enjoyable and unique experiences?

The Experience Economy

Pine and Gilmore (1999) suggest that our economy has evolved into an experience economy, meaning that consumers seek out experiences and are willing to pay a premium price for the right experiences. The authors use coffee as an example to illustrate the experience economy. How does the experience economy relate to agritourism? Let's think about corn. Traditionally, a farmer might sell his/her corn as a commodity to a wholesaler. However, if that same farmer allowed visitors to come to the farm to pick their own corn, purchase fresh, hot, roasted corn-on-the-cob to eat, and run through a corn maze, the farmer is likely to garner $7-15 dollars per visitor. The farmer has transitioned from selling his/her corn at market price to creating memorable experiences at a premium price for guests. This unique experience is more valuable to customers, and sets the farm apart from other attractions or recreation options in the area, which keeps customers and visitors wanting more.

When working to create the experience, it is important to put yourself in the visitor's shoes. Visitors who are coming to a farm for fun are probably not from a farm and may not have very much experience with agriculture or the farming lifestyle. Once the visitor steps foot on your farm, they become your guest! As such, good customer service and making visitors feel welcome is the first step.

Creating the Customer Experience

Creating meaningful experiences for visitors isn't simply about entertaining them, it is about engaging them. A successful agritourism business should create experiences to engage its visitors on several levels and in different ways. Think about how you might create experiences to help engage visitors in the following ways:

1. Create ways for visitors "TO BE."
   - How can you create settings that are inviting to your guests? Create spaces and settings that encourage visitors to come in, sit down and stay for a while. Consider creating spaces that are inviting, comfortable and interesting. This might include incorporating rocking chairs, hammocks, a wood burning stove, or rustic decorations.

2. Create things for visitors "TO DO."
   - Can you create activities that allow guests to become completely immersed in their experiences? Are things that participants can actively do? Think about ways you can encourage guests "to do" something outside of the ordinary.

3. Create opportunities for visitors "TO LEARN."
   - Are there educational experiences you can create that would allow guests to absorb information and events in an interactive manner? Opportunities for guests to exercise their "creative muscles" can be created by posing questions to guests, and allowing guests to ask questions, as well as encouraging active participation in educational activities. What do you want guests to learn from the experience? What information or activities will help to engage guests in the exploration of knowledge or skills? Can you tell about the history of your farm? Or interesting stories about your farm?

4. Create opportunities for visitors "TO HAVE FUN."
   - Create opportunities for guests to smile, laugh, and enjoy themselves. When guests are entertained, they are not really doing anything but responding to the experience. If guests are entertained, if they are having a good time, they will want to stay longer. What can be done to entertain guests and encourage them "to stay"? How can you make experiences more fun and enjoyable?

Below are some other strategies for creating memorable experiences:

1. <u>Theme the experience</u>. Is the agritourism experience family-friendly? Food-oriented? Focused on crops or animals? If so, be sure to carry that theme throughout all aspects of the experience.

2. <u>Provide positive cues.</u> Consider incorporating music, highlighting charitable events and causes the farm has sponsored, and illustrating how the farm is environmentally friendly.

3. Eliminate negative cues or move them to a designated area. Ensure that smells that may be unpleasant for guests are down-wind of areas where guests might congregate. Keep chemicals and unattractive visuals out of the eyesight of guests.

4. Mix in memorabilia. Do you have old photos or equipment that could be put on display for guests?

5. Engage all five senses. Never underestimate the importance of sights, sounds, smells, touch and tastes. Consider having taste tests (for example, store bought tomatoes versus farm-grown, vine-ripened tomatoes), or other opportunities for active participation.

Conclusion

Creating a fun, enjoyable, entertaining and educational experience for guests can be one of the most rewarding aspects of an agritourism venture. The experience created for your guests should be one that is unique and reflective of your personality, your farm's personality and the story you want to tell and share with others. Unfortunately, there is no tried-and-true recipe for creating a great experience. However, with a creative imagination, a friendly personality, a strong customer service ethic, and attention to detail, worthwhile experiences can be created for guests. Happy, satisfied guests will come back again and tell their friends and family!

"To sell Jill Jones what Jill Jones buys, you've got to see your destination through Jill Jones' eyes." (paraphrased, author unknown)

Biography

Stacy Tomas is an Assistant Professor and Tourism Extension Specialist in the Department of Parks, Recreation and Tourism Management at NC State University. Her research focus is on consumer behavior and tourism marketing, with a special interest in visual quality, service quality and tourist satisfaction. From her research, she works to contribute to the understanding of what constitutes satisfying tourist experiences and to provide managerial suggestions on engineering positive experiences for guests. Through NC Cooperative Extension, Stacy works with county cooperative extension field faculty across the state to develop and promote sustainable tourism. In collaboration with community leaders and business owners, she works to develop rural, cultural and nature-based tourism as a means for community and economic development.

AGRITOURISM: UNDERSTANDING POTENTIAL RISK FACTORS

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Agritourism is the business of making farms travel destinations for educational and recreational purposes. Examples of agritourism include on-farm direct marketing, school tours, hunting and fishing, farm festivals, haunted hayrides, and corn mazes. Nationally, Census of Agriculture data show that 23,350 farms generated $566.8 million from agritourism in 2007. Further analysis shows that New Jersey ranks first nationally in the percentage of total farm revenue earned from agritourism. A more focused statewide economic impact assessment showed that one out of every five New Jersey farms offered some form of agritourism in 2006, with agritourism-related income totaling $57.5 million (Schilling et al. 2007).

Agritourism is an increasingly popular development strategy, offering benefits to the public as well as the farmer. Particularly in urbanizing areas, agritourism contributes to overall quality of life by expanding recreational opportunities, diversifying economic bases, promoting agricultural land retention, and contributing to community character. From a farmer's standpoint, agritourism is a product diversification strategy and generates supplemental income. Empirical evidence suggests that agritourism is providing opportunity for younger members of multigenerational farm families to remain engaged in agriculture. Agritourism also provides farmers with consumer feedback regarding demand for farm products and promotes positive interactions between the farm and non-farm communities.

Previous research (see, for example, Schilling et al., 2006) demonstrated a general sense of optimism among farmers about future agritourism growth. Nearly 8 out of 10 farmers participating in a series of structured interviews (n=48) felt that agritourism would experience "significant" or "moderate" growth in their respective counties, while 90 percent felt agritourism is "very important" to the economic viability of New Jersey agriculture. However, agritourism operators also report a number of challenges associated agritourism development, including marketing, liability management, public relations, labor availability, and regulation.

Farmers are well advised to be proactive in managing risks to the successful operation of agritourism enterprises by minimizing on-farm hazards posed to farm visitors and avoiding regulatory non-compliance. This presentation therefore focuses on providing information on (1) issues related to the management of on-farm risk and liability associated with farm visitations and (2) key aspects of the evolving state policy environment relevant to agritourism development. Specifically included will be a discussion on the status of "right-to-farm" regulations defining legal protections afforded to agritourism activities, availability of agritourism best management practices, and statewide agritourism promotion. Draft guidance documents promulgated by the State Agriculture Development Committee to assist county agriculture development boards with determining the conformity of agritourism activities with deed of easement provisions accepted as a condition for farmland preservation will also be highlighed.

SMALL FRUIT SESSION

BLACKBERRY PRODUCTION: OPTIONS FOR COLDER AREAS

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U.S. Census of Agriculture Reports from 1997 and 2007 showed that blackberry acreage across the U.S. increased from 8,300 acres to 10,717 acres, a 29% increase. In the Northeast, while acreage is comparatively very low, the upward trend is much more marked. In the Mid-Atlantic region (PA, NJ, MD, WV, and DE), acreage increased from 120 to 276 acres during this same time period, a 130% increase. For other Northeast states including New York and states northward, acreage increased from 122 to 392 acres, a whopping 221% increase. While some of this acreage could have shown up due to better tracking, or a better response rate of blackberry producers in later years, the fact remains that blackberry acreage is increasing greatly, an unusual trend for commodities in general. Northeastern growers who are able to produce blackberries indicate a strong demand and good price for the berries, but production can be very variable from year-to-year, with nearly complete crop losses for individual growers following winters conducive to winter injury. Some options do exist that could allow more reliable production, and some of them could be used in combination to make consistent blackberry production possible. However, we recommend that you try any new crops or production techniques on limited acreage first to determine potential in your operation.

The first option often considered when looking for cold-tolerance in blackberries is variety selection. It has generally been assumed that plants that produce a summer crop reliably are truly more cold-hardy. It's also has been stated that thorny cultivars are generally more cold-hardy than thornless ones. While both statements are logical conclusions given what we've observed, they are over-simplifications of what is actually taking place. First, in the matter of being truly cold-hardy, one important mechanism that has been overlooked has been the ability of individual cultivars to compensate for winter injury. In a study conducted in southeastern PA in 2008 and 2009, primary, secondary and additional buds were examined for winter injury. While there were differences among cultivars in injury to buds over the winter, the cultivar 'Illini Hardy', frequently cited for its cold-hardiness, was found to have primary buds that were injured to similar extents as for many other cultivars. However, this cultivar did have a noticeable ability to produce a tremendous number of secondary and tertiary buds that produced fruit clusters, and percentage of cane length completely killed over the winter was low. Secondary buds are typically differentiated in the spring, after injurious weather events have taken place, and thus 'Illini Hardy' has the ability to reliably produce a crop to a greater extent than other cultivars, as long as temperatures are not sufficiently cold to completely kill the plants. Thorny cultivars were not always more cold-hardy. In fact, the cultivars with the next lowest winter injury ratings after 'Illini Hardy' were in order, Apache (thornless), Chickasaw (thorny), and Chester (thornless). Apache, however, compensated for damaged primary buds very little. Chester Thornless did better than most other varieties in compensating for damage to primary buds. It appears then, that a combination of hardiness and/or ability to compensate for damaged buds may be key biological characteristics for consistent crop production.

A second option that allows production of blackberries in cold areas is the use of protected cultivation techniques (e.g., greenhouses, high tunnels, and row covers, listed from most to least expensive). Research in the area of protected cultivation is limited, and only a few cultivars have been trialed under these systems in the United States. In central PA on a site where blackberries typically are killed to the ground each winter, 'Triple Crown' performed well in single-bay high tunnels that were kept closed for the winter, where they produced the equivalent of 28,000 lb/acre. Based on casual observation, there may be differences in cultivar survival in tunnels, but only limited blackberry trialing has been conducted in high tunnels to date. Row covers are useful when canes can be positioned near ground level, but offer little to no protection if placed over canes that are upright.

Another option for improving winter survival is use of the rotating cross-arm trellis. With this trellis, canes are rotated to nearly ground level for the winter, and then are covered with row cover for protection. Briefly described, in May and June, 3 to 4 new primocanes per plant are trained along a horizontal trellis wire that is near ground level. These primocanes are tipped when they reach the nearest plant, which causes lateral buds to break and grow upward. The laterals are managed to grow on a series of horizontal wires as they grow upward. The wires are connected to 5-ft long rotatable cross arms that are oriented at a 60-degree angle relative to the ground. In late fall, the cross-arms are rotated to bring the canes down close to ground level, and canes are covered with the row cover in winter. In the spring, the row cover is removed just before budbreak, and after fruiting laterals have broken and are growing upward, the cross-arms are rotated back beyond the original vertical position, so that the fruit hangs downward where it can be easily picked. Commercialization of the trellis product using fiberglass components rather than metal (www.trellisgrowingsystems.com) is expected to reduce the cost of the trellis considerably.

The final and perhaps most exciting development is the release of primocane-fruiting blackberry cultivars from the University of Arkansas breeding program. Because canes of these plants are mowed to the ground in late winter or early spring during pruning, the degree of winter injury to the canes, which can be significant, has no bearing on the following season's productivity. The first cultivars to be released were 'Prime-Jim®' and 'Prime-Jan®'. Shortcomings of these cultivars were relatively low yields, small fruit, seediness, and lateness of harvest. Later advanced selections are much improved, and a more recent release, Prime-Ark® 45, shows very good potential in size, sweetness, and yields. Harvest, however, is still very late, which brings the ability of the plants to mature the fruit before the end of the growing season into question, if plants are grown in the field in a cold climate. Thus, these selections were also grown in high tunnels, which allowed a large portion of the crop to mature, and resulted in other improvements in quality attributed to high tunnels such as increased yields, fruit size, and decreased gray mold incidence.

While production of blackberries in the Northeast is still limited, changes in production methods and improvements in varieties should allow consistency of production to improve over time, allowing growers to meet the strong consumer demand for this crop.

Thanks to the Pennsylvania Vegetable Growers Association for providing funding for the blackberry variety trial, and to the North American Raspberry Blackberry Association for providing funding for the study on bud hardiness and compensation. Thanks to Penn State high tunnel crew members for their help with high tunnel plant maintenance and data collection.

WHAT'S NEW WITH PESTS AND PESTICIDES

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Several recent developments are likely to be of interest to small fruit growers in the Mid-Atlantic region, both within the area of new pests, and in changes in pesticides that can be used. When using information below, keep in mind that the label is the law, and if any discrepancies exist between the information presented below, and the label in your possession or regulations in your state, follow the directions that apply to your situation.

What's New with Pests

First, two new pests that will likely affect small fruit growers in the Mid-Atlantic are the brown marmorated stink bug (BMSB), and spotted wing drosophila (SWD). Brown marmorated stink bugs were first found in the U.S. in 1998, but may have been present for several years prior to that time. BMSBs have been problematic primarily on fall-bearing raspberries and blackberries, in addition to tree fruit and certain vegetables. The stink bugs are frequently first noticed when they are trying to gain access to protected locations during the fall, similarly to ladybugs. Adult BMSBs are similar in size and shape to other stinkbugs, but are mottled brown in appearance. A distinguishing characteristic to look for is alternating brown and white bands on the antennae – the white bands are very noticeable. Adults overwinter, emerge, mate and lay eggs during the spring and summer. Nymphs increase in size as they go through five molts. Only one generation occurs per year as of now. More information is available at http://njaes.rutgers.edu/stinkbug/ and other extension sites.

Spotted wing drosophila (SWD) is a fruit fly that is more problematic than other fruit flies because it lays eggs in sound fruit instead of only in overripe fruit. In other areas of the country, it has been a problem on strawberries, but especially on blueberries, raspberries, and blackberries, and also on cherries. After eggs are laid, the larvae hatch inside the fruit. The life cycle can be as little as 2 days under perfect conditions (for the fruit fly), but typically is a few weeks under conditions found in the Mid-Atlantic. SWD is attracted to traps containing vinegar. The males can be differentiated from other fruit flies by a black spot at the tip of each wing. The females' distinguishing characteristic is its large ovipositor which enables it to lay eggs in sound fruit, but this is not easy to see, so usually only males are monitored. More information is available at http://njaes.rutgers.edu/pubs/blueberrybulletin/2010/bb-v26n03.pdf and other extension sites.

What's New with Pesticides

Additions and subtractions in pesticides available for use are listed briefly below. Pesticides must be registered for use in each state before they can be used legally, so be sure that the uses listed are allowed in your state. Changes noted below are ones that have occurred since late fall 2009, when the 2010 Mid-Atlantic Berry Guide went to print. Note that not all formulations of each active ingredient are listed.

General

On some labels, we now see the mention of the low-growing berry subgroup (Group 13-07G), which includes lowbush blueberry and cranberry. The use of this grouping allows materials to be used on crops that previously rarely appeared on pesticide labels.

Subtractions

Endosulfan (trade name Thionex, and formerly Thiodan) use is being terminated due to concerns about worker safety and endosulfan's ability to accumulate in the food chain. Endosulfan is classified as restricted use, and re-entry intervals are already quite long (5 days for strawberries and 9 days for blueberries), so uses were already somewhat limited. However, one gap in pest control may be in materials available for cyclamen mite control on strawberries, for which endosulfan could be applied at renovation or early in the spring. For the time being, existing stocks can be used.

Additions

Portal (fenpyroximate, Nichino America, Inc.) is labeled for use on the low-growing berry subgroup, which include strawberries. Targets species are mites including two-spotted spider mites, but cyclamen mites do not appear on the full label. A 2(ee) label for cyclamen mites is available, but growers in each state should make sure that they can take advantage of this use before making an application. The label does not allow use of adjuvants, and since cyclamen mites can be difficult to reach since they are in the crown of the plant, further work is needed to determine efficacy under these conditions. Use is limited to two applications per season at least 14 days apart. The pre-harvest interval (PHI) is 1 day, and the re-entry interval (REI) is 12 hours.

Altacor (chlorantraniliprole, aka rynaxypry®, Dupont) is labeled for use on caneberries (raspberries, blackberries, etc.) for the target pests omnivorous leafroller and raspberry crown borer (adults). The PHI is 3 days, and the REI is 4 hours.

Danitol (fenpropathrin, Valent) is labeled for use on caneberries, with the most utility against Japanese beetle. It is also labeled for use against two-spotted spider mites, but the use of broad spectrum insecticides such as pyrethroids (part of the pesticide group into which fenpropathrin falls) is tough on beneficial mites, and thus has often resulted in pest mite flare-ups. The PHI is 3 days, and the REI is 24 hours.

SMALL FRUIT PRODUCTION & MARKETING AT HELLERICK'S FAMILY FARM

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Background:

- 30 acres, Sixth generation farm family
- First farm north of Philadelphia City Hall in Bucks County, PA
- Open: May-June and September-October
- Farm Motto: "We Create Memories!"

Strawberry:

- Began commercial strawberry growing in the 1980's
    - Soils produce "Best Tasting Berries in Bucks Co"
- 1990's: Maxed out at 8 acres of matted row strawberries
  Started as all U-Pick--Transitioned to U-Pick & Pre-Picked
- 2005: Converted all production to plastic culture (Still on a learning curve!)
    - Plastic culture varieties taste great on our soils
    - Crop ripens early in the season
    - Limited water to irrigate
    - Easier weed control
    - Increased fruit production with smaller acreage
    - Much more expensive upfront materials and labor costs
    - Difficulty locating high quality plugs
    - Keep planting for 3 years; Then double 3rd year with pumpkins
    - Started: Pre-pick week days; U-Pick Sat & Sun Only
    - Today: Pre-Pick & U-Pick Daily
    - Planting time conflicts with Fall Festival set-up

Strawberry Marketing:

- Set your prices so you can make a profit or stop growing strawberries!
- Pre-Picked: Only sell perfect berries, NO WHITE TIPS!
    - Add-on sales: Home made short cakes, jam, drinks, etc.
- U-Pick: Limit U-Pick Hours (Mornings OR Evenings AND Weekends)
    - Big Change!! The entire family is coming to pick berries
    - Guests are visiting the farm for the "Farm experience" and to be entertained.
    - We ask each guest to read our "Rules of the Strawberry Patch"
      (This answers many questions and solves many problems!!)
    - We have an employee in the field who "monitors and coaches" guests
    - We MUST show each guest "How to pick berries"-They don't know
    - Guests are picking smaller quantities of berries than in the past
    - We use orange cones to track picking progress
    - We use movable electric deer fencing to control where U-Pick can pick
    - We use inexpensive disposable U-Pick boxes for berries

Marketing at Hellerick's Family Farm

- Project a professional farm image to the public

- Quality signage
  Road signs: Large, good condition
  Market signs: Helpful hints, prices, directions, etc

- Quality products
  Good selection; always have something "new or different"
  Display in mass; Pile high, let if fly!

- Word of mouth

- Ask each guest for their e-mail
  Send Weekly E-Newsletter in season

- Have a great website!
    - Lots of photos
    - Your website must show exactly what you have to offer guests
    - Manage your e-mail daily
    - Change website with the seasons
    - Use hosting sites "behind the scenes tool" to understand trends
    - Need to add Face Book, etc

- Friendly employees/Old-Fashioned courtesy
    - Create an "old-fashioned farm atmosphere" of hospitality, courtesy and service for our guests.
    - Identify employees
    - Say hi, hello, welcome to the farm, please and thank you.
    - Be helpful or find the answer or someone who knows the answer
    - Carry and load guest's vehicles.
    - Knowledgeable about products

- Clean & Safe property; Especially bathrooms!

- Farm Security
    - Lock down farm to prevent unauthorized access to property
    - Install security, motion detection lighting
    - Install security cameras in high risk areas of business

- Always give the guest more than they were expecting
    - Example: we put all of our straw bales in plastic bags
      (This way there are no fights about who has to clean the car!)

- Final Though: Always Remember: Farming is a VERY Unique Business:
    - How many of YOUR guests live or work on a farm---Probably NONE!
    - Guest are looking a "Fun and Safe Farm experience"—give it to them
    - No other business can do this except YOURS!

BLUEBERRIES SESSION

BACTERIAL LEAF SCORCH OF BLUEBERRY: AN EMERGING DISEASE OF BLUEBERRY AND POTENTIAL FOR SPREAD

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Blueberries are the number one fruit commodity in the state of Georgia. Recently, a new disease has been identified, and this disease has been named bacterial leaf scorch, as it is caused by the bacterium *Xylella fastidiosa*. The *X.fastidiosa* bacterium is pathogenic on numerous plant species which grow in the southern U.S., to include grape and peach. It is known to inhabit many host plants without causing disease symptoms; among these are various grasses and herbaceous weeds, and native blueberries also likely harbor the bacterium. Therefore, there is a bacterial reservoir which is readily available for infection of cultivated blueberries. There are two broad categories of *X. fastidiosa* (subspecies), and we now know that the blueberry isolates fall in the subspecies which includes peach, as opposed to the one that includes grape.

As in other *Xylella*-incited diseases, it is assumed that the bacterium blocks xylem vessels, thereby preventing water and nutrient flow. This bacterium only survives in plant xylem or within the insects which vector it. In general, *Xylella* diseases are more prevalent in warmer environments; this is related in part to the fact that the insect vectors survive better in warmer environments, but the bacterium also overwinters more successfully within host plants in warmer climates. To date, the disease has only impacted southern highbush blueberry varieties. If climates continue to warm, it may be possible that the northeastern blueberry industry will experience this disease, but to date, it has been limited to the more southern states, and North Carolina has yet to have a major epidemic reported, even though some susceptible southern highbush varieties are grown there.

The initial disease symptom is a marginal leaf scorch (burn), which unfortunately is similar to that observed with extreme drought, fertilizer salt burn, or root rots (Figure 1). Sometimes, the scorched leaf area is bordered by a darker band between the healthy and scorched tissue. This leaf symptom can be uniformly distributed throughout the plant, but in the early stages, scorching may be limited to individual stems or perhaps one side of the plant – indicating that only a partial xylem blockage has occurred which may be limited to one cane or one stem. Eventually, leaves abscise (drop), and young twigs/stems may take on a yellow appearance. After leaf drop, the plant eventually dies.

The disease cycle for *Xylella*-incited diseases is well known. Infected hosts serve as reservoirs and overwintering sites of the bacterium. In the spring and early summer, insect vectors, sharpshooters and spittle bugs, transmit the bacterium through feeding on infected plant tissues and subsequently feeding on healthy plants. In other plant systems, the glassy-winged sharpshooter, *Homalodisca vitripennis*, is the most important vector, and based on the relative numbers of sharpshooters observed in blueberry plantings, this appears to be the likely case in this system as well. Once the insect has acquired the bacterium, it is transmitted to a new plant as the insect injects the bacterium into the xylem (the conductive tissues which transmit water and nutrients from the roots to the other plant tissues) during feeding. At some point, bacteria form colonies, and through a combination of tyloses, gumming and bacterial exudate production, the xylem is clogged. In time, clogging of vessels reaches a point at which individual stems or whole plants will no longer be able to carry sufficient water and nutrients to support life. At this point symptoms develop, and eventually the plant will die.

A B

Figure 1. (A) Scorch symptoms (late summer) observed on leaves infected with *Xylella fastidiosa*. In some cases, the marginal leaf burn is very distinct and is surrounded by a dark line of demarcation between green and dead tissue. **(B)** The symptom observed here is the best indicator that the plants are actually dying of bacterial scorch, as opposed to root rot, anthracnose, fertilizer salt or chemical injury, or drought stress, any of which can mimic leaf symptoms of bacterial scorch. Prior to complete plant death, all leaves abscise (fall off), and the remaining stems take on a yellow "skeletal" appearance. The root system and stems do not show any obvious lesions or dieback symptoms, and the plant will generally appear healthy, with the exception of complete defoliation.

Extensive field surveys have been conducted to determine the prevalence of bacterial leaf scorch in Georgia's major blueberry production region. These surveys of southern highbush blueberry plantings allowed us to establish a baseline distribution of the disease and its epidemic range, while also determining which cultivars are showing field resistance. The data strongly suggest that resistance or tolerance exists among some cultivars. An example data set from one producer site is given below (Figure 2). The planting was intermixed (no solid cultivar blocks), so heavily infected cultivars were interspersed or near all other cultivars, providing a readily available inoculum source. Results from this site indicate that FL 86-19, Star, and O'Neal are susceptible, with FL 86-19 being particularly susceptible; all three had a high incidence of infection, and infected plants were generally near death.

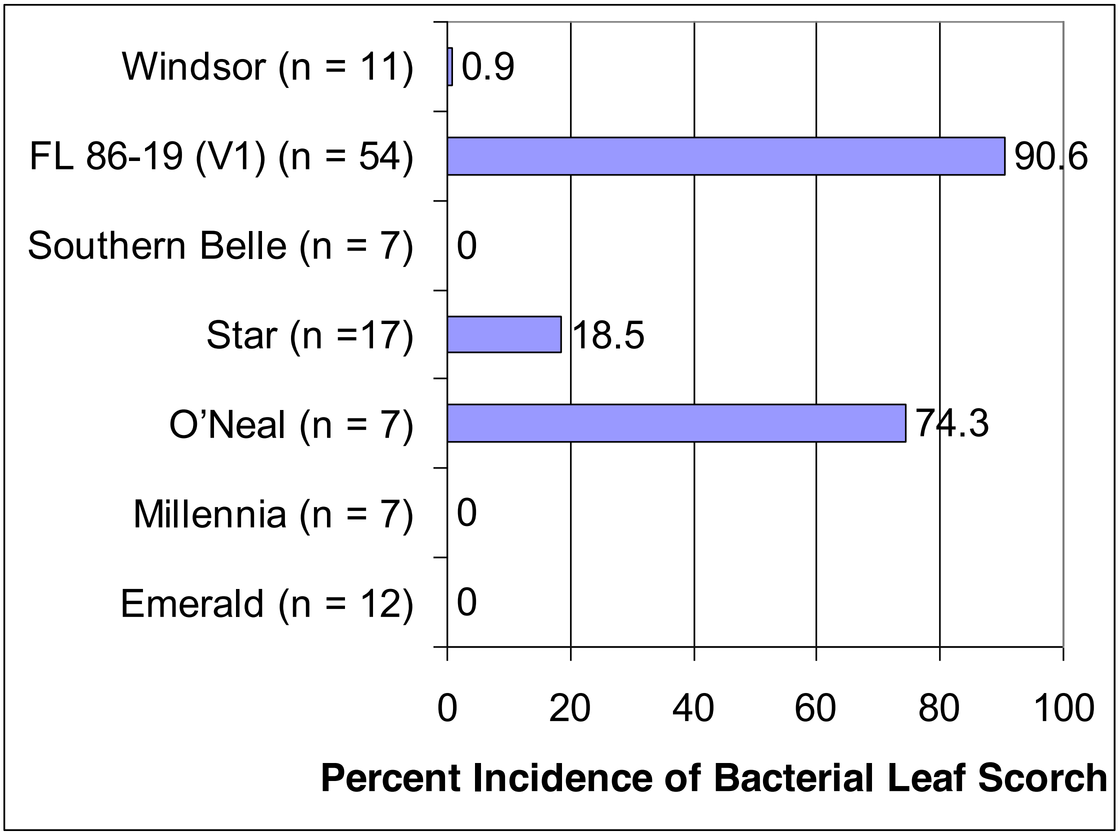

Figure 2. Incidence (percentage of symptomatic plants) of bacterial leaf scorch by cultivar at one site. The number of rows surveyed (*n*) is shown in parentheses next to the cultivar name.

If the presumed resistance noted for some cultivars is durable (lasting), then breeding for resistance will be important for the long-term health of the southern highbush industry. We still need to determine better ways of managing susceptible varieties (e.g., through vector management), especially where they are already planted. However, the long-term solution will involve breeding and selection to provide resistant lines.

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BLUEBERRY SCORCH VIRUS-STRAIN VARIATION AND DISTRIBUTION IN NEW JERSEY

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INTRODUCTION

An unknown flower blight of highbush blueberry was first described as Sheep Pen Hill Disease near Pemberton (Burlington County, NJ) in the 1970s. In 1980, a similar disease was described as blueberry scorch from a 'Berkeley' field near Puyallup, Washington. Through laboratory studies Sheep Pen Hill Disease and blueberry scorch were found to be caused by the same carlavirus which was officially named *Blueberry scorch virus* (BlScV). Since its discovery, the disease has spread throughout the Northeast, the Pacific Northwest, parts of Europe and was most recently found in Michigan.

In cultivated blueberry, the disease seems to be limited to highbush blueberry (*Vaccinium corymbosum*) and has not been reported in lowbush blueberry (*V. angustifolium*). Although not reported from grower fields, several rabbiteye blueberry plants (*V. virgatum*) in a germplasm repository were found to be infected. Symptomless infections have been described in cranberry (*V. macrocarpon*) and black huckleberry (*V. membranaceum*), suggesting that the disease may spread to related species. It is also possible that related species may provide a source of the virus that can be transferred to cultivated blueberry.

It has been shown that some west coast strains are distinct (>80% similarity in coat protein sequence) from the two strains originally found on the east coast, NJ1 and NJ2, and it is believed that the host range and symptom development may also be different among these distinct strains. There is also variation among the New Jersey strains, and these can vary from those found in other regions. Our objectives were to: 1) characterize strain variation in New Jersey within and between fields; 2) to compare New Jersey strains with those described from other regions; 3) to determine if other wild plants in New Jersey can harbor the virus; and 4) to determine if mixed-strain infections exist within a field and within a single plant.

MATERIAL AND METHODS

Leaves and flowers were collected from symptomatic blueberry plants during the spring-summer 2003 in Atlantic and Burlington Counties in New Jersey and in Connecticut and Massachusetts (Table 1). Several samples from the native vegetation were also collected in the area surrounding Sheep Pen Hill, where both the NJ1 and NJ2 strains were originally collected, and in Atlantic County near a commercial blueberry farm. The samples were tested by enzyme-linked immunoassay (ELISA) to verify the presence of BlScV. Virus particles were extracted from the infected plants and the viral RNA was isolated and cloned for sequencing of the coat protein gene.

Alignments of the resulting sequences were performed with the Clustal W program implemented in the DNAstar software package, and a representative neighbor-joining tree was drawn using the TreeView function of the same sofware package, based on the percentage of shared nucleotide sequence with the braches illustrating relative sequence similarity.

RESULTS AND DISCUSSION

Based on coat protein sequence analysis, the strains in New Jersey form two main clusters, with significant variation within a cluster (Figure 1). One cluster includes the type strain (NJ2), all of the Burlington County, NJ samples, as well as those from Connecticut and Massachusetts. The second cluster encompasses all of the Atlantic County isolates. It appears that there is significant variation among strains found in the Northeast and this may explain differences in symptom severity observed in different locations. Transmission experiments to compare the strains and their properties have been initiated. Nucleotide similarity level between the two major clusters is about 86%.

The west coast strain WA1 is distinct (82% similarity) from the population in the Northeast. The differences in the coat protein coding sequence are mainly located in the 5' terminal region. Most of the nucleotide variation is reflected in the amino acid sequence. There was evidence of mixed infection within a given field, and different strains were sometimes detected even in the same plant.

Several native plants were collected from the areas surrounding commercial blueberry fields. The only other plant found to harbor the virus was staggerbush (*Lyonia mariana*). The infected plant was collected in SPH and was found to harbor stain NJ2. This species is in the same family (Ericaceae) as blueberry.

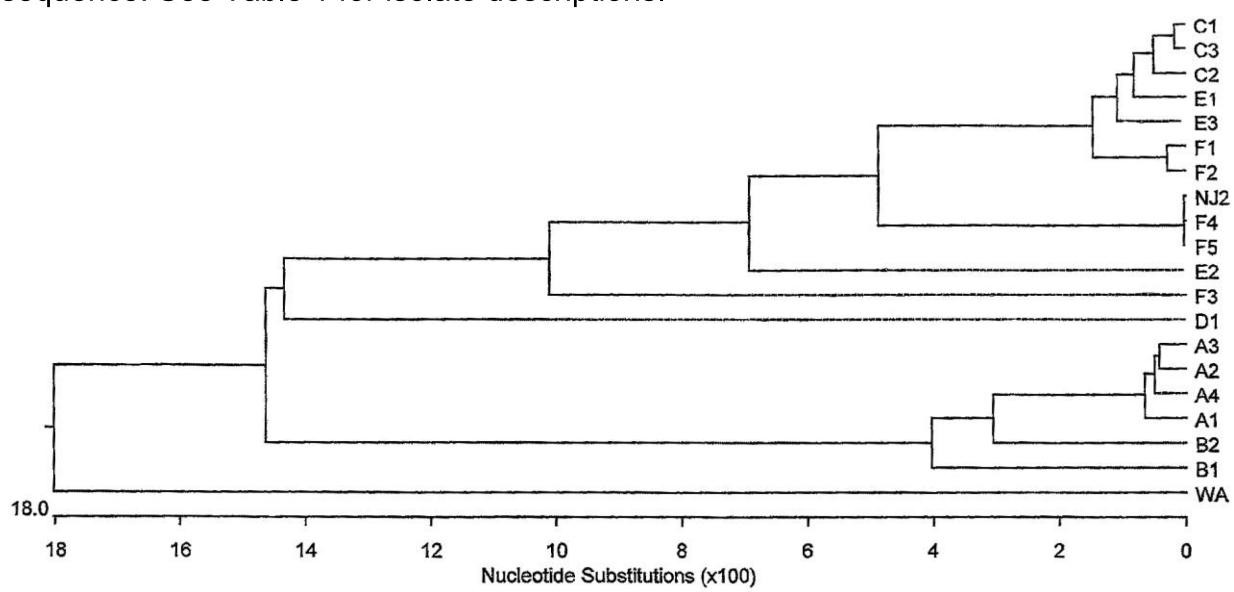
CONCLUSIONS

- New Jersey strains are quite variable and cluster into at least two main groups suggesting multiple introductions or rapid mutation.
- Isolates from Massachusetts and Connecticut group with those from the Sheep Pen Hill area of New Jersey.
- Staggerbush was found to harbor the virus and the potential transmission from this weed to blueberry needs to be explored.
- It is unknown how strain variation affects symptom expression and if different cultivars respond differently to different strains of the virus.

Table 1. Samples, origin and tissue types used in this study.

Sample Code	Origin	Tissue Type
A1	Hammonton, Atlantic County, Farm 1	Flowers
A2	Hammonton, Atlantic County, Farm 1	Flowers
A3	Hammonton, Atlantic County, Farm 1	Leaves
A4	Hammonton, Atlantic County, Farm 1	Leaves
B1	Hammonton, Atlantic County, Farm 2	Leaves
B2	Hammonton, Atlantic County, Farm 2	Leaves
C1	Sheep Pen Hill (SPH), Burlington County	Leaves
C2	SPH, Burlington County	Leaves
C3	SPH, Burlington County	Leaves
D1	Indian Mills, Burlington County	Leaves
E1	SPH, Burlington County, Farm 2	Flowers
E2	SPH, Burlington County, Farm 2	Flowers
E3	SPH, Burlington County, Farm 2	Flowers
F1	Connecticut	Leaves
F2	Connecticut	Leaves
F3	Connecticut	Leaves
F4	Massachusetts	Leaves
F5	Massachusetts	Leaves
NJ2	SPH, Type Strain	Flowers
WA1	Washington Strain	Leaves

Figure 1. Relatedness of *Blueberry scorch virus* from infected plants collected in New Jersey, Connecticut, Massachusetts, and Washington based on coat protein coding sequence. See Table 1 for isolate descriptions.



BLUEBERRY VARIETIES AND ENVIRONMENTAL EXTREMES

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Global warming is, for most people, a proven issue. One of the most likely consequences of global warming will be shifting weather patterns and greater extremes of weather. As a small fruit grower, the questions that will confront you are how the patterns will change, and how you can be prepared for these changes, both in terms of what you grow and how you grow it.

No one knows the answers to these questions with certainty, but there are numerous predictions of how our seasons and temperatures will shift. We have information about how our typical varieties respond to some of these predicted changes, and we can examine how the mix of varieties we grow might be modified to adjust to shifting climatic conditions. In many of these scenarios, we can look to more southerly areas and consider what varieties are grown and how they are grown, and view them as a partial blueprint for our future. This talk will also take the opportunity to look at the potential of new materials that are being developed.

Recent Problems with Putnam Scale in NJ Blueberries

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The Putnam scale, *Diaspidiotus ancylus* (Putnam), has 2 generations per year. They overwinter on or just under the bark of the blueberry plant, protected by a thin layer of bark and their own hard waxy covering. The insect has historically been a minor pest, but over the last few years has become more common on berries, foliage, twigs and canes. There are 4 species of scales found on the above ground parts of the blueberry plant in the Pinelands (Polavarapu et.al. 2000). In addition to Putnam scale, they include the European fruit lecanium, cottony hydrangea scale, and cottony maple scale. Putnam scale has been by far, the most common scale seen in IPM scouting surveys.

Scale activity starts in late February as the early spring temperatures begin to warm. Males molt from 2nd to 3rd instars, and by the end of March both females and males have started to turn into adults. By the end of April, most of the insects are mated adult females, and adult males have died. Polavarapu found that first generation eggs start to hatch in mid May so that crawlers first appeared in mid May, and were present through early October. There are 2 distinct peaks of crawler activity, marking the beginning of each generation. Our records from 2010 show peak activity at the beginning of June and again at the end of July and first week of August (Figure 1).

Polavarapu et.al. found 7 species of parasitoids and at least 2 species of predators, including predatory mites. Parasitoids were most abundant just prior to the first crawler emergence in late April and early May, and again in early August when second generation crawlers were most abundant. The insect can be heavily parasitized, and under a soft insecticide program it is likely to be held in check by parasitoids and predators. Synthetic pyrethroids and carbamates like Lannate are known to be harsh on these beneficials, and contribute to increased scale populations in other fruit crops. This is also likely to occur in blueberries under similar programs. The move away from OP materials may also be a factor contributing to increased scale populations.

Overwintering insects can be found on and just under the rough bark on old canes, and on young wood and branches if populations are large. Under high populations, the crawlers will disperse out to younger wood and settle on the fruit. Infested fruit is most apparent around the time of second picking of Bluecrop. Any field which has infested fruit has a high population, and should be treated either at the second crawler stage and/or at the dormant stage during the following spring. Infested fruit can be recognized by the small bumps with white “heads”. Heavily infested fruit can be deformed and unmarketable. Crawlers which have settled on foliage will produce a yellow/dark spotting that accompanies the scales (Figure 2).

Reference: Polavarapu S., J. Davidson & D. Miller. 2000. Life history of the Putnam scale, Diapidiotus ancylus (Putnam) (Hemiptera: Coccoidea: Diaspididae) on blueberries (Vaccinium corymbosum, Ericaceae) in New Jersey, with a world list of scale insects on blueberries. Proc. Entomol. Soc. Wash. 102(3): 549-560.

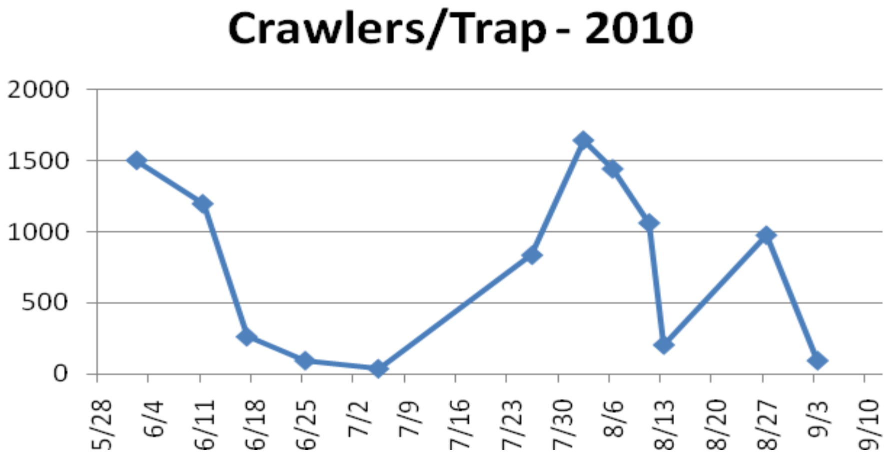

Figure 1. Crawler activity record on a highly infested farm during 2010.

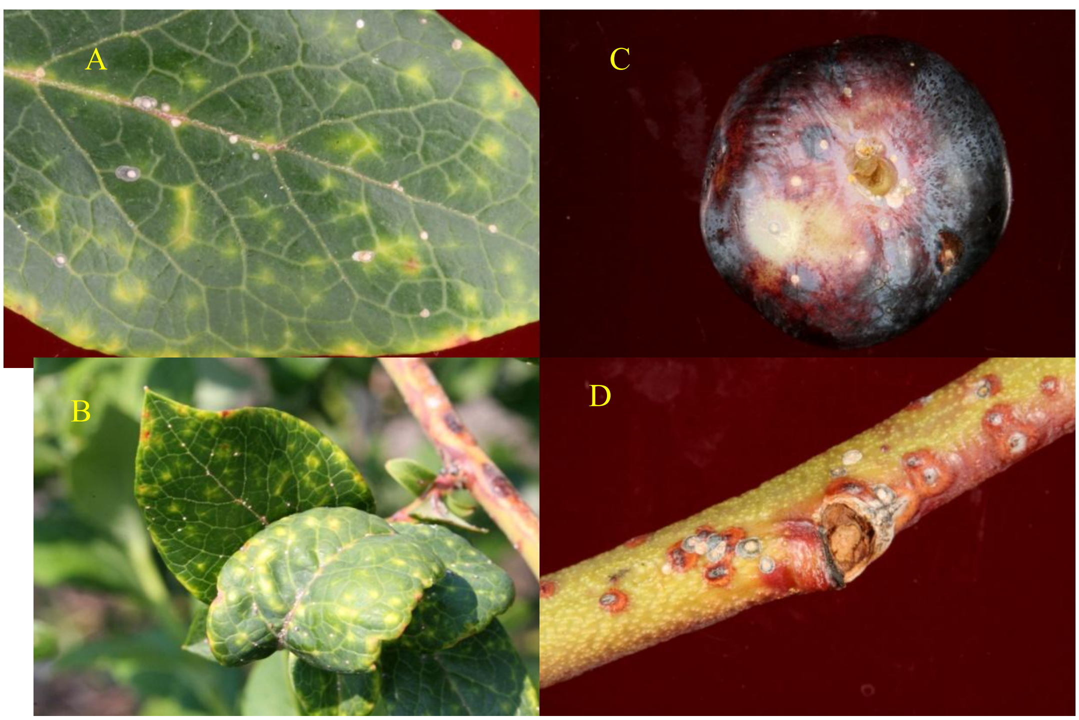

Figure 2. Scale and yellow markings on infested leaf and severely infested curled leaf (A and B), Putnam scale settled on fruit and on new wood (C and D).

Effect of Nitrogen Regime on Blueberry Overwintering, Stem Blight and Phomopsis Susceptibility and Aphid Population Density

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Introduction: Highbush blueberries (*Vaccinium corymbosum*) are currently the most valuable fruit crop grown in New Jersey. This fruit is also increasing in acreage throughout the country. Current production for NJ is between 7000 and 8000lb/acre and the maximum attainable yield is over 20,000lb/acre. At the national level, NJ is second in production to Michigan and second in productivity (lb/acre) to Oregon. However California has initiated an aggressive planting schedule and if successful will compete directly with NJ farmers. Improving farm efficiency will likely help our growers remain competitive in blueberry production. One of the most important yield constraints is related to the optimization of N (nitrogen)-fertilizer usage, not only from a purely annual point of view, but more importantly the impact of N-status of the current season on the productivity for the following season. Recently, there have been a variety of issues that have developed that we perceive as related to N-status and now require additional research.

Blueberries are a significant initial investment. From initial planting to production requires 3-5 years at which point individual plants represent an investment of $15-$20 each. Losses at the establishment phase can severely delay the time required to bring a field into production and will greatly increase the investment. Thus, to remain sustainable, growers must be able to avoid the factors that shorten the life span of a field and prevent rapid re-establishment.

The most common newly planted cultivar in NJ is 'Duke'. This cultivar is early bearing and highly productive, however, it is also susceptible to stem blight (fungal), Phomopsis twig blight (fungal), scorch (viral), and bud damage (environmental). We believe these problems are exacerbated through the improper use of N-fertilizer. However, supporting data is lacking. Stem blight can kill significant numbers of plants in a new planting. This disease often develops in inflorescence buds that have been damaged due to low winter temperatures and can spread into the crown of the plant very quickly. Similarly, Phomopsis twig blight appears to infect the plant primarily through winter-damaged buds. Bud damage is likely due to a lack of hardening off of the buds which is affected by N-status from the previous season. We believe that the impact of bud damage is currently underestimated. N-status can also affect the resistance of blueberry plants to aphid attack. Since aphids transmit virus diseases (especially scorch, BBScV) this can shorten the life span of a blueberry field.

Objectives: Blueberry culture in NJ requires additional information on the impact of N-fertilizer use on overwintering bud survival, impact on expression of stem diseases and vulnerability to insect attack. To address these issues we have two objectives

1. To investigate the effects of nitrogen fertilizer use on bud development, winter survival and disease susceptibility in blueberry plants.
2. To investigate the impact of nitrogen fertilizer use on aphid susceptibility in blueberry

Methods: Two field trials were established at the Marucci Center in Chatsworth, NJ in 2008. The first field trial utilized a 2-year old planting that contains twelve cultivars with four replications. Each replicate has 20 plants so that individual treatments will have three or more plants per replicate. The second trial was conducted on a 1.3 acre field of 'Duke' (approximately 1600 plants) that was planted in 2000. In both cases, the plantings were managed according to the standard production recommendations (i.e. pruning, and harvesting but no insect or disease management) and received specific treatments for N-fertilizer. Tables 1 and 2 summarize the experimental treatments and designs to be used for each trial.

Table 1. Treatments for Trial 1 utilizing a two year old planting with twelve cultivars. The treatments will be made to groups of five plants with four replications. The experiment is designed as a Split-Plot with two treatment factors (12 Cultivars by 4 nitrogen regimes = 48 treatments).

Treatment	Pre-bloom application		Post-bloom application		Post-harvest application	
	Formulation	Rate	Formulation	Rate	Formulation	Rate
Grower Standard	100 lb	10-10-10	100 lb	10-10-10		
High	100 lb 50 lb	10-10-10 21-0-0	100 lb 50 lb	10-10-10 21-0-0		
Late 1	100 lb	10-10-10	100 lb	10-10-10	50 lb	21-0-0
Late 2	100 lb 50 lb	10-10-10 21-0-0	100 lb 50 lb	10-10-10 21-0-0	50 lb	21-0-0

Table 2. Treatments for trial 2 utilizing an eight year old planting of 'Duke'. Four treatments will by tested in a randomized complete block design using six replications. Treatments will be made to groups of ten plants.

Treatment	Pre-bloom application		Post-bloom application		Post-Harvest application	
	Formulation	Rate	Formulation	Rate	Formulation	Rate
Grower Standard	300 lb	10-10-10	300 lb	10-10-10		
High	300 lb 200 lb	10-10-10 21-0-0	300 lb 200 lb	10-10-10 21-0-0		
Late 1	300 lb	10-10-10	300 lb	10-10-10	150 lb	21-0-0
Late 2	300 lb 200 lb	10-10-10 21-0-0	300 lb 200 lb	10-10-10 21-0-0	150 lb	21-0-0

The trials were initiated in the spring of 2008. All parameters measured are given in Table 3. In most cases measurements were taken by sub-sampling for each plot.

Treatment evaluations began during the summer (June and July) months for growth rate and spectral reflectance. Tissue sampling was initiated in August which is the normal time for this practice. Aphid susceptibility was assessed during the period of active shoot growth. For this aphids contained in small plastic cages were fitted around suitable growing branches. The rate of population growth within each cage was monitored during the evaluation period. Yield components measured include berry weight, number of clusters per unit of branch and number of berries per cluster. Stem blight and Phompsis inoculations were conducted in August by spraying individual branches in each treatment with a conidial suspension of the causal agent, *Botryosphaeria dothidea*. Inoculated branches were bagged for 24hr to enhance infection. Inoculated and control branches were tagged for evaluation the following growing season. Samples for inflorescence bud hardiness were collected at three time points (early, mid and late dormancy). The samples (branches with several buds each) were subjected to freezing temperatures in an ethylene glycol bath and injury was assessed by examining internal morphology for damage.

Table 3. Parameters to be measured for both trials 1 and 2.

Parameter	Method
Growth	Measurement of shoot growth taken in cm.
Nitrogen status	Measured by spectral reflectance using a spectral radiometer
Nitrogen status	Sampled plant tissues will be sent out for analysis
Inflorescence bud hardiness	Determine the lethal temperature where 50% of buds are damaged
Aphid susceptibility	Caged aphids placed on stems of treated plants will be monitored for population growth
Yield components	Cluster size, berry weight and number of clusters per bush will be evaluated by direct measurement
Stem blight and Phomopsis susceptibility	Bud inoculations followed by disease assessment the following growing season

Trial 1 will be analyzed as a 2-factor split-plot experiment. Trial 2 will be analyzed as a randomized complete block design.

Results: Preliminary results from this experiment demonstrate the impact of nitrogen status on yield, winter hardiness, disease, and insect susceptibility. Specifically: 1. N treatments have affected leaf senescence with higher levels of N resulting in later leaf drop, 2. Spectral reflectance indicates that red color develops later as N levels increase, 3. Stem blight infection was highest with the highest level of N, 4. Yield was highest with the grower standard of N, 5. The highest levels of N resulted in higher levels of aphids later in the season, 6. High levels of N decreased bud hardiness however the grower standard had the highest bud hardiness. It is anticipated that the results will provide a strong basis on which to develop recommendations for blueberry growers' nutrient management regime. Specifically, we will be able to demonstrate linkage between fertilizer usage, nutrient status and winter injury.

NEW TECHNOLOGY SESSION

NEW DEVELOPMENTS IN WATER MANAGEMENT

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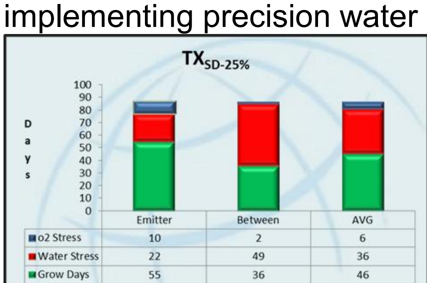
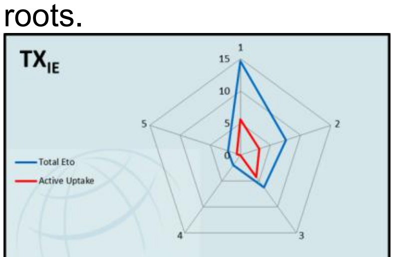
In today's world of agriculture precision is becoming more of a necessity rather than a luxury. We currently see precision used today on the farm with GPS auto steer tractors, yield monitoring during harvest and use of variable rate seeders, fertilizer equipment and sprayers. These precision practices have made huge advancements in agriculture.

With the water issues that are going on around the world and as it becomes more important in our agricultural community, our company has been focusing on water management for over six years now. Water Management is precision agriculture underground. If we know what is going on underground during a crop season we then can better understand on how to manage water precisely. Different irrigation practices like drip and low pressure center pivot irrigation are considered good practices of water management. What we have found is that by using these types of efficient irrigation systems it is easier to control and manage the delivery of water but not necessarily meaning the best way to manage water.

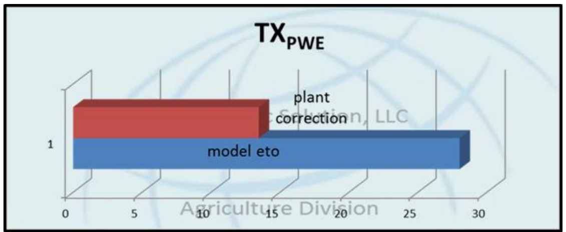
During a crop season we monitor moisture and ion's in the soil on how it moves and also how the crop responds to what is taking place underground. We currently use Adviroguard^{TM} software from Earthtec Solutions to analyze and present the data. The following are just some of the data analysis that is currently being done when implementing precision water management;



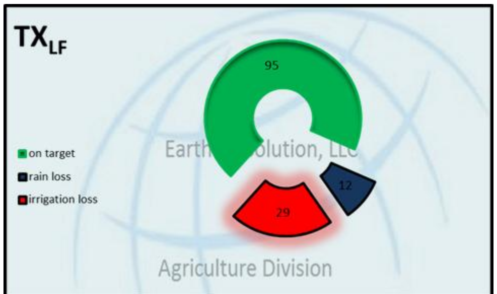
TX-SD^{TM} – Stress Days shows the number of days where the crop is either water stressed (where the % soil water is too low for the plant roots to overcome the water bonding to the soil) or oxygen stressed (where the % soil moisture is too high, displacing oxygen from the soil environment and limiting uptake of nutrient ions by the roots.



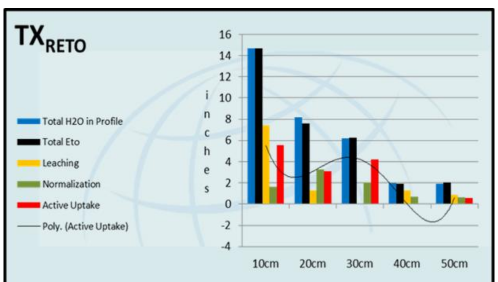
TX-IE^{TM} – Irrigation Efficiency is the ratio of total water applied to total water withdrawn by the crop.



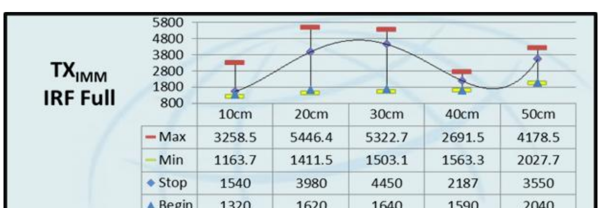
TX-PWE™ – Plant Water Efficiency tells us how well the plant used water compared to Eto. If the plant used less than Eto, then the plant had resistance to water movement into and through the plant. If the plant used greater than Eto, indicates that the plant takes up water well.



TX-LF™ – Leaching Factor illustrates the percentage of water that is moving past the active root zone. Water that is leached is not available for plant uptake. It also determines what was leached due to rainfall or irrigation.



TX-RETO™ – Root derived Eto is calculated from the water leaving and entering each zone in the soil profile over the entire cropping season, describing the complex movement of water throughout the soil profile as produced by Adviroguard™ software.



	10cm	20cm	30cm	40cm	50cm
Max	3258.5	5446.4	5322.7	2691.5	4178.5
Min	1163.7	1411.5	1503.1	1563.3	2027.7
Stop	1540	3980	4450	2187	3550
Begin	1320	1620	1640	1590	2040

TX-IMM™ – Ion Minimum and Maximum represents the beginning, ending, minimum and maximum the volumetric ion content of the soil at specific depths over a season.

TX_{IDD} Distribution	10cm	20cm	30cm	40cm	50cm	Ions Below Root Zone
Begin	1,320.00	1,620.00	1,640.00	1,590.00	2,040.00	44%
Stop	1,540.00	3,980.00	4,450.00	2,187.00	3,550.00	37%
Drift	17%	146%	171%	38%	74%	

TX-IDD™- Ion Distribution and Drift describes the levels of ions present in the soil at specified depths in the soil profile over the cropping season.

Automation of irrigation this is one of the most important parts if wanting to maximize yields and efficiencies on a commercial farm operation. It allows plant control of the irrigation instead of personnel time.

Here are some examples of research projects that used Adviorguard™ software to increase yield and maximize efficiencies;

Clemson University - Watermelon Project

State avg. is 40,000 lbs. per acre using 14" total irrigation at applying 1" per week. 2008 was a dry year there with automated the irrigation system and using the same exact fertilizer program the 15% depletion used 13" of water and yield 133,000 lbs. per acre. The 50% depleted yield 80,000 lbs. per acre. Same study was done in 2009 and 2010 but waiting for findings to be published.

Irrigation Research Foundation in Colorado – Corn Project

Normal amount of water applied is 20 – 25 inches per year. Study was to see what happens at 15" and at 9" applying water based on Et once per week. The 15" plot average was 196 bushel and the 9" plot averaged 145 bushel. Another study at the same time was irrigation triggered based on the plants needs (when the plant said it had depleted what was available now put it back). The total water used was 14" and the average yield was 318 bushel. This was a record at this research farm.

University of Florida – Orange Tree Water Usage Project

The published water requirements were 40 gallons per day. With the continuous monitoring and letting the tree tell us when to put the water back used 20 gallons per day. Yield was the same from both water applications.

For more information you can go to www.earthtecsolutions.com to see latest news and research projects on water management.

More Crop per Drop®
Advancements of Drip Irrigation

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Senior Product Marketing Manager
JAIN Irrigation, Inc
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Fresno, CA 93721

Water, one of our most precious resources, continues to make headlines both in the United States and around the globe. Although water spans approximately 2/3 of our planet, it is estimated that only 2% is currently available for use.

As farmers and ranchers continue to provide the world with safe and affordable food, they are tasked with managing some of the most limited resources such as water and energy. In efforts to manage these valuable resources, and strive for increased productivity, drip irrigation has made its way to the stage, one drop at a time.

Once thought as a system to provide water only to high value fruits and vegetables, drip irrigation is found in a variety of fields crops such as corn, cotton, and soybeans. Two of the main reasons for this progression to drip irrigation into field crops are due to the increased yields and substantial savings in both water and energy. In some cases, growers have seen water savings as high as 20% with an added benefit of reducing the overall fertilizer application through the drip tape.

Drip irrigation technology has continued to keep pace with the complex and dynamic industry of agriculture. With the advent of turbulent technology, which increases the velocity and uniformity of the water, the industry has seen exponential rates of growth over the past several decades. Even with the increased acres converting to drip irrigation, it still only represents less than 5% of the total irrigated acres for farm-land.

Drip irrigation efficiency ranks among the highest methods of irrigation when compared to sprinkler or flood. Even with great emission uniformity, there is still plenty to be learned to ensure that a drip irrigation system is designed and implemented correctly. The ultimate goal for the grower is to maximize the efficiency of inputs while reducing the overall consumption of water and energy. At JAIN Irrigation we call this “more crop per drop®.

FIELD CROPS SESSION

FORAGE RADISH: NEW MULTI-PURPOSE COVER CROP FOR THE MID-ATLANTIC

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Introduction. Forage radish (*Raphanus sativus* var. *niger*) is a unique fall/winter cover crop that is relatively new to the Mid-Atlantic region. It is a member of the *Brassica* family that also includes rapeseed, canola, mustard, cabbage, and the like. Forage radish is also known as 'Daikon' (sometimes spelled 'Dichon') radish or 'Japanese' radish and is used as a vegetable in many types of Asian cuisine. When planted by early September in the Mid-Atlantic region, forage radish exhibits a number of unique and desirable characteristics that distinguish it from other types of cover crops more commonly grown in the region.

Alleviation of Soil Compaction. Forage radish cover crops are used by many farmers as a biological tool to reduce the effects of soil compaction, leading some farmers to refer to this cover crop as “tillage radish” or “radish ripper.” The roots of all cover crops can penetrate compacted soils in fall to some extent because they are growing when soils are relatively wet and soft. Forage radish roots can penetrate plow pans or other layers of compacted soil better than the other cover crops (such as rye and rapeseed) tested in our research. The thin lower part of the taproot can grow to a depth of six feet or more during the fall. The thick, fleshy upper part of the taproot grows 12 to 20 inches long and creates vertical holes and zones of weakness that tend to break up surface soil compaction and improve soil tilth. After the cover crop dies in the winter and their roots decompose, the remaining root channels are used by the growing roots of following crops to penetrate compacted deep soil layers.

Suppression of Weeds. A good stand of early-planted forage radish produces a dense canopy that all but eliminates weed emergence in the fall and winter. This action produces a virtually weed-free seedbed in early spring. To obtain this near-complete weed suppression forage radish should be planted by September 15 (in Maryland) with a stand of 5 to 8 plants per square foot.

The near-complete weed suppression can be expected to last until early April, but does not extend into the summer cropping season. The low amount and fragility of residue and weed-free seedbed conditions in early spring make it possible to plant the summer crop without any seedbed preparation tillage or application of a burn-down (pre-plant) herbicide. In Maryland research where in-season (post emergence) weed control was applied, yields of corn planted after a forage radish cover crop were not affected by skipping the burn-down herbicide before planting.

Enhancement of Seedbed. Unlike most other cover crops commonly used in the Mid Atlantic, forage radish won’t complicate or delay spring field operations. Because it winter-kills, it does not need to be killed or incorporated to prepare a spring seedbed. When conditions are favorable, the field will be ready for direct planting. Because forage radish leaves the soil surface weed free, punctured by large root holes, and covered by very thin and sparse residue, the seedbed soil warms up and dries out considerably faster in early spring than do soils covered by either winter weeds or a growing cover crop.

The warmer, drier soil and the elimination of the need for tillage can allow earlier spring planting. The earlier planting may be important for effective utilization of the N released from the forage radish residue in early spring.

Early Release of N and Increase in Topsoil Fertility. Unlike rye and other cereal cover crops whose residues decompose slowly and immobilize N in the spring, forage radish residue decomposes rapidly and releases its N early. In fact, on sandy soils it is important to plant as early as possible, following forage radish cover crops, to take advantage of this flush of N before it leaches out of the rooting zone. Forage radish recycles large amounts of N taken up from the soil profile in fall and can reduce the need for N fertilizer in spring.

Because forage radish cover crops do not immobilize N, they are unlikely to slow down growth of the next crop as small grain cover crops sometimes do. In fact, crops often show an early boost in growth and N uptake similar to a planting time N application.

Building of Soil Organic Matter. With typical dry matter production of 5,000 lb/acre shoots plus 2,000 lb/acre of root dry matter, a good forage radish cover crop adds significant quantities of easily decomposed organic material to the soil. Microbially active organic matter and soil aggregation have been observed to increase after using forage radish for several years.

Effects on Crop Yields. In about half the trials that included a good stand of forage radish, corn (with normal N fertilizer rates) and soybean yields following the forage radish cover crop were significantly higher than those after fallow or winter rye. These yield increases may be due to improved N fertility, alleviation of soil compaction or other effects.

Seeding. Establish a good stand of pure forage radish by seeding at 8 to 10 lb/ac using either a conventional or no-till drill (typically in a small seed box) or by broadcasting at 12-14 lb/ac. When using a drill, seeds are best planted ¼ inch deep when moisture conditions are good, but can be planted as deep as 1 inch during dry conditions, if this is necessary to place seed in contact with soil moisture. When broadcasting, germination will be best if seeder is followed by a corrugated roller or very light disking to encourage some seed-soil contact.

Planting Date. In the Mid-Atlantic, forage radish grows best when planted in late August or early September but significant amounts of N can be captured by this cover crop when planted as late as October 1. Forage radish planted in late September may be less susceptible to frost and more likely to overwinter. When planted in late March as a spring cover crop, forage radish did not emerge quickly or grow as well as when planted in fall.

Frost. Forage radish is tolerant of frost until temperatures dip below 25 ^{o}F. It takes several nights of temperatures in the low 20's ^{o}F to kill forage radish. If mild temperatures resume and the growing point is intact, green leaves may grow back. Usually in Maryland forage radish is damaged by frost by early December but does not die completely until the longer cold spells of January. Under the freeze-thaw winter conditions of the Mid-Atlantic, forage radish tissues (shoots and roots) decompose rapidly once killed by frost and leave only a thin film of residue by March.

Crop Rotations. Forage radish winter cover crops fit well into corn silage and vegetable crop rotations that have openings for cover crop planting by the end of August. To follow grain corn harvest, if forage radish can be planted by September 30, you will not achieve effective biodrilling and weed suppression, but significant amounts of N can be captured.

Cover crop mixtures. Many farmers are experimenting with cover crop mixtures that combine forage radish with other cover crops that fix N or provide N immobilizing residues in the spring. Because forage radish can out-compete most other plants in early fall, seed forage radish in two feet wide rows to allow enough space for a companion cover crop to grow in between. Taping-off alternating openers in the small and large seed boxes of a no-till drill is one way to create alternating rows of forage radish and the companion crop. Alternatively, reducing the forage radish seeding rate by half also allows other cover crop species to compete and stay in the cover crop mix.

Spring oats and sorghum-Sudangrass (Sudex) compete well with forage radish, winter kill in the Mid-Atlantic, and provide longer lasting residues to immobilize some of the N released from forage radish residues in the spring. These additional residues may also help maintain soil moisture, reduce weed growth, and reduce erosion during the next growing season. When rye is mixed with forage radish, the rye overwinters and grows into the spring when it can take up the N released by the decomposing forage radish. Hairy vetch is an N fixing cover crop that overwinters and has performed well when mixed with forage radish.

Problems to avoid. Forage radish does not tolerate very wet soils, so avoid planting it in low spots that collect standing water. Nitrogen deficiency will limit forage radish growth and may limit its ability to compete with weeds or grow through compacted soil. Nitrogen deficiencies have been observed when planting after silage or grain corn on sandy soils or soils that do not have a history of manure application Nitrogen deficient plants have also been observed to be less susceptible to frost and are more likely to overwinter. If they survive the winter, forage radishes may be attacked by harlequin bugs and flea beetles. Also, be warned that during warm spells in winter, rotting forage radish residues may produce a rotten egg-like odor.

A full fact sheet on forage radish is available from University of Maryland Cooperative Extension at: http://www.hgic.umd.edu/content/documents/FS824ForageRadish_NewMultipurposecovercrop.pdf

SEED TECHNOLOGY AND INSECT MANAGEMENT - ITS USE AND LIMITATIONS

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Corn varieties incorporating insecticidal toxins from the soil bacterium *Bacillus thuringiensis* (Bt) were introduced in 1996 to combat European corn borer. Varieties of Bt corn were later introduced against corn rootworms. Generally speaking, these transgenic Bt varieties can provide high levels of control and do a nice job protecting corn yield. Growers must realize, however, that these lines do not necessarily yield better in absence of pest pressure. Therefore, to better understand the value of the Bt traits (and the higher cost of Bt seed) growers need to understand their local pest populations to help determine the value of Bt traits to their production system.

Recent research has illustrated that widespread adoption of Bt varieties has lead to drastic reductions in European corn borer populations. This phenomenon has been well documented for Midwestern corn-growing states and has also been noticed in the Mid-Atlantic region. Reductions in European corn borer populations mean that this pest does not pose the same risk to corn fields that it once did and that the value to Bt lines targeting European corn borer may have changed. Moreover, because corn rootworms can easily be managed in the eastern United States with crop rotation, Bt varieties against rootworm are not likely to have the same value here as they do in the Midwest.

Our recent research efforts have found that Bt varieties can yield similarly to non-Bt varieties in the absence of pest populations. Moreover, European corn borer populations appear to be quite variable, with some areas seeing low, likely sub-economic, populations while other areas are maintaining higher populations levels. Other caterpillar species that can damage corn, such as black cutworm and armyworm, show similarly patchy distributions. Therefore, our recommendation for growers is that they should endeavor to assess their local pest population to determine the threat that pests actually pose to their crops and then make informed decisions about the value of Bt varieties to their production systems.

TOMATOES & GRAFTING WORKSHOP

ORGANIC GRAPE TOMATO PRODUCTION IN THE SOUTH GEORGIA AREA

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Bainbridge, GA 39819

Pacific Tomato Growers Ltd. Is recognized by American Vegetable Grower Magazine as being in the top 100 (top 4 in southeast) as far as vegetable production goes. They specialize in tomatoes, peppers, squash and beans. They grow about 475 acres of tomatoes in the south GA area and are split between the spring and fall crops. Of the 475 acres, 275 acres are in grape tomato production with 50 acres being certified organic. They have been growing organic for the past 5 years. All materials utilized in production of the organic crop are OMRI approved and certified through their certifying agent (Quality Certification Service). Detailed records must be kept of all steps in production and for all materials used in production. Land that was selected for production had been idle for past 3 years with no conventional materials applied.

Preparation for spring crop begins in January with land preparation and mulch laying starting in early February. Planting starts in mid-March. For fall crop, mulch is laid in late June to early July with planting starting in mid-July and extending to early August. Preparation for crop is basically the same as for our conventional crop except the equipment must be cleaned before going into a certified organic field. Documentation must be kept as when it was cleaned and with what and materials must be approved for use. Metalized (Al coated) mulch is used for both seasons to help with insect problems due to thrips and aphids in spring and whiteflies and aphids in the fall. Crops are drip irrigated. Fertilization consists of a bed mix at 5000 lb/A of composted chicken manure that has been blended with feather meal (7-2-2) applied to the bed area and mixed. A hot mix (6-0-30) consisting of sodium nitrate and potassium sulfate is banded on bed surface at 1500 lbs/A. In addition fish emulsion is applied through the drip system during the production period. Lime application is based of soil test results. Lime source, even if local must get certified. Variety used is ‘Sweet Hearts’. Organic produced seed is not available, so conventionally produced untreated seed is used. Greenhouse where plants are produced is certified for organic production and all materials used in production of transplants must be approved. Shortly before or after planting stakes are put in the field and plants are tied as needed.

Weed control of middles is through cultivation until the stakes are put into the field. Later weed control is through custom propane burners designed not to burn the edges of the mulch. At times nutsedge is removed by hand pulling. The scouting report must show that there is a need before pesticide(s) can be used for insect or disease control. Preventative applications are not allowed. Primary materials used for insect management are metalized mulch, Bt products and diatomaceous earth. Disease management is through rotation of following: Cu based materials, Serenade Max, Sonata, Agriphage and Regalia SC. Cover crops are used to help reduce weeds and prevent erosion and nutrient loose. Brown Top millet is used after spring crop and oats and hairy vetch after fall crop.

Pick buckets used for harvest are cleaned each day after harvest is finished. Organic fields are picked first to prevent any contamination to crop. Bins used to hold crop are colored coded to prevent and co-mingling of crops. In packing house the lines must be cleaned each night, and the organic crop is run first before the conventional crop.

PHYSIOLOGICAL, NUTRITIONAL AND OTHER DISORDERS OF TOMATO FRUIT

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The following attempts to describe, give possible causes or explanations and possible controls for certain tomato fruit problems. Colored photos along with text of below can be found at http://edis.ifas.ufl.edu/hs200.

Blossom-End Rot. Blossom-end rot (BER) is caused by a localized Ca deficiency in the developing fruit. It begins with light tan, water-soaked areas which can then enlarge and turn black and leathery in appearance. Most often the problem occurs at the blossom end of the fruit, but on occasion can occur on the side of the fruit. It may also occur internally with no visible symptoms on outside of fruit. Many factors can influence BER. The following conditions may increase BER: low soil Ca, high N rates, using ammoniacal sources of N, high concentrations of soluble K and Mg in the soil, high salinity, low humidity, inadequate soil moisture, damage to root system by nematodes, disease or mechanical means or heavy pruning. In greenhouse production not cycling the irrigation system at night can increase BER, since night is an important time of Ca uptake. In Florida, adequate soil Ca is considered to be 300 ppm or higher by Mehlich-1 index. Foliar applications of Ca materials have not proven to reduce BER since very little Ca is taken up by the fruit and that taken up by the leaves cannot be translocated to the fruit. Control is through proper fertilization and good water management.

Catface. Catfacing is a generic term used to describe a tomato fruit that has a gross deformity and is usually not marketable. The defect is usually located on the blossom end of the fruit. The deformity is caused by something (internal or external) that occurs during the formation of the flower that results in the fruit not developing normally. There is little published information as to the exact cause and there actually may be more than a single cause. Cool or cold temperatures that occur about 3 weeks before bloom can increase the amount of catfacing. In general, jointless varieties are more prone to catfacing than jointed varieties. Heavy pruning in indeterminate varieties has shown to increase catfacing but this has not shown to happen in our short-stake varieties. In indeterminate varieties, this is thought to be related to reduction in auxins in the plant from removing the growing points. Drifts of herbicides such as 2,4-D can cause fruit to catface. Heavy thrips feeding on young fruit can cause a type of catfacing. Also fruit on plants that are mildly affected by Tomato little leaf (See EDIS Publication HS-883 for more information) are severely catfaced. There is not much that can be done for the control. Varieties should be selected that historically have had little problem for catfacing. Try to prevent spray drift from undesirable chemicals and in the case of little leaf, prevent soils from becoming waterlogged.

Cracking. Two different forms of cracking occur in tomato fruit. Radial cracking originates from the stem end and progresses toward the blossom end. Concentric cracking occurs in a ring or rings around the stem scar. It is possible to have both types on the same fruit. Cracking occurs when the internal expansion is faster than the expansion of the epidermis and the epidermis splits. Varieties differ greatly in their susceptibility to cracking. Cracking can occur at all stages of fruit growth but as fruit matures they become more susceptible, especially as color develops. The more resistant a variety is, the later in maturity of the fruit cracking may occur. Control is through selecting tolerant varieties or by reducing fluctuations in soil moisture. Cracking may also be reduced by maintaining a good foliage cover, since exposed fruit are more susceptible. Wide fluctuation in air temperature can also increase cracking. Cracking is more of a problem in a vine-ripe operation versus a mature green operation.

Graywall (blotchy ripening). Internally graywall is characterized by dark necrotic areas usually in the vascular tissue of the outer walls. The necrosis is sometimes present in the cross-walls and very infrequently in the center pith area of the fruit. Outward symptoms show up as grayish appearance caused by partial collapse of the wall tissue hence the term graywall. It typically develops on green fruit prior to harvest but can show up later. Fruit affected are typically not marketable due to blotchy appearance as fruit ripens. Cause is not completely understood. There are varieties differences in susceptibility. Graywall is more of a problem during cool and short days. High N may increase problem and adequate K may reduce the problem.

Internal White Tissue. Fruit affected by this disorder usually show no outward symptoms. When ripe fruit are cut, white hard areas especially in the vascular region are present in the outer walls. Under severe conditions, fruit may also show white tissue in cross-wall and center of fruit. The problem is more of a concern with vine-ripe or u-pick producers since fruit picked mature-green and gassed rarely show the problem. High temperatures during the ripening period in the field seem to trigger the problem. Adequate K fertilization has shown to reduce but may not eliminate it. Some varieties are more resistant to the problem, especially the high colored varieties. Problem at time may be so severe that fruit are unmarketable.

Pox and Fleck. In most cases when a fruit is affected both disorders are found together but are considered separate problems. Pox is described as small cuticular disruptions found at random on the fruit surface. The number can vary from a few to many. Fleck, also known as Gold Fleck, shows up as small irregular shaped green spots at random on the surface of immature fruit which turn to a gold color as fruit ripens. Number of spots can vary from few to many. Fruit severely affected with pox and fleck is not marketable. Both conditions seem to be genetic in nature, but are difficult to breed out of a variety since the conditions only show up under certain environmental conditions. There seems to be some differences of opinion as to the conditions for the problem to show up. There are differences between varieties as to susceptibility to pox and fleck.

Puffiness. When this problem is slight, it may be impossible to detect puffiness until fruit are cut. Severe puffy fruit will appear to be flat sided or angular in nature. When fruit are cut, open cavities open cavities are observed between the seed gel area and the outer wall. Fruit are also very light in relation to size. This problem is caused by any factor that affects fruit set. This can be due to inadequate pollination, fertilization or seed development. Most common causes in Florida are too low or high of temperatures during fruit set. Use of “hot set” varieties can reduce the problem but even these have limitations when night temperatures get above about 75 F. Other factors such as high N, low light or rainy conditions can also cause seed set problems.

Rain Check. Rain check can be described as tiny cracks that develop on the shoulder of the fruit. These cracks can vary from just a few to almost complete coverage of the shoulder. The cracks feel rough to the touch and affected areas can take on a leathery appearance and not develop proper color as fruit ripens. Green fruit are most susceptible, followed by breakers and ripe fruit are not affected at all. Damage occurs most often on exposed fruit after a rain. Exact cause is not known, but appears to be related to exposure of the fruit to water. Problem is more severe when heavy rains occur after a long dry period. There are differences among varieties to susceptibility to rain check. Also varieties with good leaf coverage usually have less rain check.

Sunscald. Sunscald can be broken down into 2 types, they are sub lethal and lethal. Sub lethal sunscald can be described as a yellow, hard area usually on the shoulder of the fruit. This occurs when tissue temperatures rise above about 86 F. The high tissue temperatures will not allow the red pigment to develop nor flesh to soften but allows the yellow pigments to develop. With lethal sunscald, the tissue turns white and dies. Many times the dead tissue will turn black from fungi that are feeding on the dead tissue. Lethal sunscald occurs when tissue temperatures rise above 104 F. Damage usually occurs when fruit are suddenly exposed to sunlight. This most frequently occurs after a harvest or a storm when leaves are moved around and fruit exposed. Over pruning can also increase sunscald problems especially with fruit in the upper part of the plant. Also good spray programs to ensure good foliage cover can reduce problem. Growers at times may use a sun screen material such as Snow or Surround to help reduce sunscald.

Tomato Spotted Wilt Fruit Damage. When infection is early in season, fruit fail to set or are severely deformed and may have cracks or concentric rings on fruit. If disease hits later in season it may be impossible to see any damage on green fruit, but after ripening, yellow rings or blotches may show up rendering the fruit unmarketable. This is a severe problem when fruit are picked mature green, gassed and shipped out, since the discoloration may not show up until it reaches terminal market and load is rejected because of discolored fruit. The discoloration is only on the surface and center of fruit will ripen normally. Control of fruit problems is through control of virus of vector. Research has shown that control of primary infection is not possible with insecticides but control of secondary infection is possible through good spray schedule and selection of materials that will control thrips. Recent research has shown that primary infection can be reduced with production on highly UV-reflective (metalized) mulches and use of Actigard in production system. Resistant varieties are available but at times the foliage may not show symptoms but the fruit may, rendering it unmarketable.

Western Flower Thrips Oviposition Damage. This injury is characterized by a small dimple often with a white halo around the dimple. The injury is caused by the female Western Flower Thrips (*Frankliniella occidintalis*) (WFT) inserting an egg into the fruit when the fruit is very small. Many times the bloom has not yet shed the corolla when the injury occurs. The number of dimples can vary from a few to very many. Numerous dimples can result in the fruit being reduced in grade. Damage is mostly on the surface and does not go very deep into the fruit (Figure 35). Dimple does persist throughout the life of the fruit but halo area may go away when fruit ripens. Control is through management of WFT.

Zebra Stripe. Zebra stripe can characterized as a series of dark green spots arranged in a line from the stem end to the bloom end. At times it seems the spots coalesce together and form elongated markings. Many times the dark green areas will disappear when fruit ripens. This problem seems to be variety related. It is probably a genetic defect that only shows up under certain environmental conditions. Zebra stripe may be linked to pox and fleck.

Zippering. Zippering is described as a fruit having thin scars that extend partially or fully from the stem scar area to the blossom end. The longitudinal scar has small transverse scars along it. At times there may be open holes in the locules in addition to the zipper scar. Cause is usually by an anther that is attached to the newly forming fruit causing the zipper scar. Some people feel that a zipper is formed when the “blooms” stick to the fruit and does not shed properly but this may not be a cause. Only control is to select varieties that are not prone to zippering.

UPDATE ON INSECT PEST MANAGEMENT FOR TOMATOES

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Insect pest management is critical to successful tomato production in the Mid-Atlantic U.S. Important pests each year often include the tomato fruitworm (= corn earworm), thrips, stink bugs, aphids, and spider mites. Occasional pests also include armyworms, Colorado potato beetle, hornworms, cabbage looper, and leafminers. To control this complex of pests, insecticide usage is often intense on commercial farms. For instance, in Virginia, tomato growers make an average of 7 to 10 pesticide applications per crop. Most of the insecticides used are pyrethroids, organophosphates or carbamates, which have a broad spectrum of activity. Often, growers include an insecticide with fungicide applications (tank-mix) as an insurance measure to protect against insect damage, regardless of whether an insecticide is actually needed. Although IPM and biological control programs have been demonstrated, insecticides continue to be the chief management tool by which damaging insect pests can be controlled immediately and economically for conventional tomato producers. Because strict quality standards for produce coupled with high production costs are unlikely to change significantly, current and future tomato pest management strategies are likely to include an insecticide component.

A number of novel insecticides have recently been registered for use on vegetables in the U.S. to combat these pest insects (Table 1). Most of the new chemicals are considered reduced risk and more IPM-friendly control options than the more traditional broadspectrum insecticides. Results of some recent efficacy trials with these products in Virginia are presented below.

Table 1. Some new insecticides registered in recent years in the U.S. for use on tomatoes

Product (company)	Chemical name (AI)	Application Method	Pests Controlled	Rate / acre	PHI (days)
Acramite (Chemtura)	bifenazate	Foliar	mites	0.75 to 1 lb	3
Belay (Valent)	clothianidin	Foliar / Drip / Soil	Thrips, Aphids, bugs, beetles, leafminer	3 to 4 fl. oz (foliar) 9 to 12 fl. oz (soil)	21
Beleaf (FMC)	flonicamid	Foliar	Aphids, plant bugs		0
Coragen (Dupont)	chlorantraniliprole	Foliar / Drip / Soil	Caterpillars, potato beetle, leaf miner	3.5 to 5 fl. oz	3
Durivo (Syngenta)	thiamethoxam + chlorantraniliprole	Soil	Aphids, caterpillars, thrips, potato beetle, leafminer	10 to 13 fl. oz	30 (soil only)
Movento (Bayer)	spirotetramat	Foliar	Aphids	4 to 5 fl. oz	1
Oberon (Bayer)	spiromesifen	Foliar	Mites, whiteflies	7 to 8.5 fl. oz	1
Portal (Nichino)	fenpyroximate	Foliar	Mites, whiteflies	32 fl. oz	1
Radiant (Dow)	spinetoram	Foliar	caterpillars, thrips, leafminers	5 to 10 fl. oz	1
Synapse (Bayer)	flubendiamide	Foliar	caterpillars	2 to 3 oz	1
Venom (Valent)	dinotefuran	Foliar	Aphids, leafminer, bugs	1 to 4 oz (foliar) 5 to 6 oz (soil)	1 (foliar), 21 (soil)
Vetica (Nichino)	flubendiamide + buprofezin	Foliar	caterpillars	12 to 17 fl. oz	1
Voliam Flexi (Syngenta)	chlorantraniliprole + thiamethoxam	Foliar	caterpillars, thrips, potato beetle, aphids	4 to 7 fl. oz	1
Voliam Xpress (Syngenta)	λ-cyhalothrin + chlorantraniliprole	Foliar	caterpillars, stink bugs, thrips, beetles, aphids	5 to 9 fl. oz	5

TRIAL 1: TOMATO INSECTICIDE EFFICACY TRIAL, PAINTER, VA 2010

VARIETY:'Solar fire' tomatoes; PLANT DATE: 12 Jul 2010; TREATMENT APPLICATIONS: 29 Jul (Durivo Soil only); Foliar treatments were applied 4 times: 20 Aug, 7, 13, 20 and 27 Sep with a 3-nozzle boom powered by a CO_2 backpack sprayer at 40 psi delivering 31 GPA.

Treatment	Rate / acre	Mean no. Colorado potato beetles / 10 plants 24 Aug (4 DAT)	% lepidopteran damaged tomato fruit	
			16-Sep	27-Sep
Untreated Control		8.5 a	53.8 a	35.0 a
Synapse 24WG + NIS	3 oz + 0.25% v/v	10.8 a	8.8 cde	16.0 bcd
Durivo (SOIL APPLICATION)	10 fl. oz	0.0 c	17.5 cd	15.0 bcd
Voliam Flexi + NIS	7 oz + 0.1% v/v	0.0 c	6.3 de	5.0 e
Voliam Xpress + NIS	9 fl.oz + 0.1% v/v	0.0 c	1.3 e	10.0 cde
Monitor	32 fl. oz	6.5 abc	27.5 bc	29.0 ab
Hero	5.12 fl. oz	0.0 c	17.5 cd	11.0 cde
Hero	6.4 fl. oz	0.0 c	17.5 cd	21.0 bcd
Hero	10.3 fl. oz	0.5 bc	22.5 cd	14.0 bcd
Brigadier	5.12 fl. oz	0.0 c	12.5 cde	19.0 abcd
Radiant	8 fl. oz	0.0 c	12.5 cd	11.0 de
P-Value from Anova		0.009	0.0002	0.0037

TRIAL 2: TOMATO INSECT CONTROL WITH INSECTICIDE TRANSPLANT DRENCHES, PAINTER VA 2009

VARIETY:'BHN602' tomatoes; TRANSPLANT and TREATMENT DATE: 22 May 2009;

Treatment	Rate/acre	Mean no. thrips / 10 compound leaves (34 DAT)		Mean no. thrips[1] / 20 blossoms (41 DAT)		Mean no. blossoms / 2 plants	% thrips fruit damage (66 DAT)	% stink bug fruit damage (66 DAT)	% lepidopteran larvae fruit damage (66 DAT)
		Larvae	Adults	Larvae	Adults				
Untreated Check		9.8 a	0.8	0.5	4.8	30.3	31.7	10.8 ab	7.5 a
Venom	5.6 oz	5.3 ab	0.8	0	4.5	41	43.3	3.3 b	5.0 a
Durivo	12.6 fl. oz	0.5 b	0.8	0.3	4	34.3	27.5	6.7 ab	0.0 b

29% western flower thrips, 23% tobacco thrips and 48% eastern flower thrips.

All data were analyzed using analysis of variance procedures. Means were separated using Fisher's LSD at the 0.05 level of significance. Means followed by the same letter within a column are not significantly different (P>0.05).

Trial 3: Control of lepidopteran larvae in tomatoes via drip Chemigation, Painter, VA 2009

VARIETY:'Phoenix' tomatoes; PLANT DATE: 17 Jul 2009; TREATMENT APPLICATIONS: All drip chemigation treatments were applied just before flowering with the use of chemilizers. Irrigation events for approximately one hour always followed chemical application (irrigation was run at least 3 times weekly for a minimum of 1 hour for each event). The foliar treatment (Warrior II) was applied with a Co2 backpack sprayer with a 3-nozzle drop-down boom. Dates for all treatment applications are found on the table.

Treatment	Rate / acre	Application Dates	Mean no. lep larvae[1] / 2 beat sheets (3 Sep)	% lepidopteran fruit damage			Total yield (in lbs)
				% small fruit damage 3-Sep	14-Sep	24-Sep	
Untreated Control			10.3 a	32.5 a	35.0 a	39.2 a	54.1
Durivo	10 fl. oz	14 Aug	0.0 c	2.5 bc	1.7 c	5.8 c	51.9
Durivo	13 fl. oz	14 Aug	0.0 c	5.0 bc	3.3 c	4.2 c	48.4
Coragen 20 SC	5 fl. oz	14, 28 Aug	0.8 c	5.0 bc	5.0 c	0.0 c	47.3
Coragen 20 SC	7 fl. oz	14 Aug	0.3 c	7.5 bc	1.7 c	2.5 c	60.4
Admire Pro	7 fl. oz	14 Aug	6.8 b	32.5 a	23.3 ab	27.5 ab	51
Lannate LV	48 fl. oz	14, 28 Aug	1.3 c	2.5 bc	15.8 b	20.0 b	49.2
Vydate L	64 fl. oz	14, 28 Aug	6.3 b	15.0 ab	35.8 a	25.0 ab	44.5
Warrior II (foliar)	1.9 fl. oz	4 times	0.0 c	0.0 c	6.7 c	1.7 c	56.2

80% cabbage loopers, 10% beet armyworm, 8% corn earworm and 2% yellow-striped armyworm
All data were analyzed using analysis of variance procedures. Means were separated using Fisher's LSD at the 0.05 level of significance. Means followed by the same letter within a column are not significantly different (*P*>0.05).

Trial 4: Insecticide Trial in fall tomatoes, Painter, VA 2009

VARIETY:'Phoenix' tomatoes; PLANT DATE: 17 Jul 2009; TREATMENT APPLICATIONS: Foliar treatments were applied 3 to 5 times (see dates below) with a 3-nozzle boom powered by a CO_2 backpack sprayer at 40 psi delivering 31 GPA.

Treatment	Application dates	Rate / acre	Mean no. lepidopteran larvae[1] / 3 beat sheets (3 Sep)	% lepidopteran damaged small fruit (7 Sep)	% lepidopteran damaged fruit at harvest (17 Sep)	Yield (in lbs)	Mean no. aphids / 20 leaves (17 Sep)
Untreated Control			2.0 a	17.5 a	30.8 a	9.0	40.3 abc
Cyazypyr 10SE	19, 25 Aug, 1, 8, 15 Sep	6.75 fl. oz	0.0 b	2.5 b	5.8 b	12.6	2.0 c
Cyazypyr 10SE	19, 25 Aug, 1, 8, 15 Sep	13.5 fl. oz	0.0 b	0.0 b	5.0 b	10.7	2.0 c

Coragen 20SC	19, 25 Aug, 1, 8, 15 Sep	5 fl. oz	0.5 b	0.0 b	2.5 b	10.0	95.0 a
Radiant	19, 25 Aug, 1, 8, 15 Sep	8 fl. oz	0.0 b	0.0 b	2.5 b	11.9	23.3 bc
Vetica + Biosurf 80/20	19, 25 Aug and 8 Sep	13.7 fl. oz + 0.25% v/v	0.0 b	0.0 b	1.7 b	11.5	55.8 abc
Synapse + Biosurf 80/20	19, 25 Aug and 8 Sep	3 oz + 0.25% v/v	0.0 b	2.5 b	0.0 b	12.6	22.3 bc

50% beet armyworm and 50% tomato fruitworm.
All data were analyzed using analysis of variance procedures. Means were separated using Fisher's LSD at the 0.05 level of significance. Means followed by the same letter within a column are not significantly different (*P*>0.05).

TRIAL 5: EVALUATION OF SOIL AND FOLIAR INSECTICIDES IN FALL TOMATOES, PAINTER, VA 2009

VARIETY:'Phoenix' tomatoes; PLANT DATE: 17 Jul 2009; TREATMENT APPLICATIONS:All soil treatments were applied once (19 Aug) using a one nozzle boom with no tips, powered by a CO_2 backpack sprayer at 40 psi and delivering 50 ml of water at the base of each plant. Foliar treatments were applied 3 to 5 times (see dates below) with a 3-nozzle boom powered by a CO_2 backpack sprayer at 40 psi delivering 31 GPA.

Treatment	Rate / acre	Application Dates	Mean no. aphids / 20 leaves (18 Sep)	Mean no. lepidopteran larvae[1] / 3 beat sheets (3 Sep)	% lepidopteran damaged fruit (3 Sep)	% lepidopteran damaged fruit (7 Sep)
Untreated Control			48.8 a	4.3 a	12.5 ab	24.2 a
Durivo (soil)	10 floz	19 Aug	0.5 c	0.5 bc	2.5 c	12.5 ab
Durivo (soil)	13 floz	19 Aug	1.0 c	0.0 c	7.5 bc	8.3 b-e
Coragen 20SC (soil)	5 floz	19 Aug	37.0 ab	0.3 bc	2.5 c	12.5 ab
Coragen 20SC (soil)	7 floz	19 Aug	19.3 bc	0.5 bc	2.5 c	14.2 abc
Admire Pro (soil)	7 floz	19 Aug	1.8 c	2.3 b	25.0 a	22.5 a
Synapse 24WG + Bio-surf 80/20 .25%	3 oz	19, 25 Aug, 8 Sep	0.8 c	0.0 c	0.0 c	5.8 b-e
Alverde	16 floz	19, 25 Aug, 1, 8 and 15 Sep	15.0 c	0.0 c	0.0 c	4.2 cde
Voliam Flexi	7 floz	19, 25 Aug and 8 Sep	2.5 c	0.3 bc	0.0 c	1.7 e
Voliam Xpress	9 floz	19, 25 Aug and 8 Sep	0.0 c	0.0 c	5.0 bc	1.7 de
Lambda-Cy	3.2 floz	19, 25 Aug, 1, 8 and 15 Sep	1.8 c	0.3 bc	2.5 c	9.2 bcd
Warrior II	1.9 floz	19, 25 Aug, 1, 8 and 15 Sep	1.0 c	0.0 c	0.0 c	12.5 abc

45% beet armyworms, 45% tomato fruitworm and 10% yellow-striped armyworm
All data were analyzed using analysis of variance procedures. Means were separated using Fisher's LSD at the 0.05 level of significance. Means followed by the same letter within a column are not significantly different (*P*>0.05).

WHY AND WHEN SHOULD YOU CONSIDER GRAFTING TOMATOES?

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Until recently, grafting vegetables for commercial production in the United States (U.S) was rare. In contrast, the practice of grafting vegetables has been going on for many years in Japan where almost 95 % of the watermelons, oriental melons, cucumbers, tomato, and eggplant crops are grafted for field or greenhouse production. Japan has very limited land area to farm, limiting the ability of farmers to rotate and creating soil borne disease problems. Japanese farmers have learned to use disease resistant rootstocks and grafting to manage diseases where rotation is not possible. As greenhouse and high tunnel vegetable production has increased in the U.S., growers have also turned to grafting with promising results.

High tunnel and greenhouse tomato growers are often not able to rotate the ground under these intense high value production areas. Some farmers are also growing heirlooms and other specialty tomatoes varieties which command a high price in the market, but have little to no disease resistance in their genetic background. Research has shown there are tomato rootstocks resistance to several diseases including: *Pyrenochaeta lycopersici* (Corky Root), most common species of nematodes, *Verticillium sp, Fusarium oxysporum* races 1 and 2, F*usarium oxysporum fsp, Radicis-lycopersici* (crown rot), and *Ralstonia solanacearum* (bacterial wilt). Growers are now grafting susceptible varieties of specialty and heirloom tomatoes on these disease resistant rootstocks and seeing reduced losses to disease and increased yields. The decrease in disease, however, may not be the only reason growers are seeing increased yields.

Research has shown that certain tomato rootstock varieties impart enhanced growth and vigor on the grafted scion variety. This increased vigor would help explain yields in grafted plants grown in clean hydroponic greenhouses which do not expose the plants to soil-borne diseases. Similarly some high tunnel growers are reporting enhanced yield when growing grafted disease resistant varieties on another root stock compared to growing same variety on their own roots. Farmers are also reporting grafted plants growing longer and producing fruit over a longer period of time leading to increased yields.

Additional research has shown that grafting can have an influence on fruit quality. Grafted plants had different levels of sugar and acidity compared to non-grafted plants. These intriguing results indicate that in the future, growers might be able to use grafting to improve tomato fruit flavor.

With the successes reported so far, there is a lot of research occurring around the U.S. looking at grafting for vegetable production. This research is screening genetic material for use as rootstock and examining rootstock influence on disease resistance, vigor, yield and fruit quality. There has been limited work examining the economics of utilizing grafted tomato plants. Grafting adds costs to producing vegetable transplants which must be recouped to make grafting worthwhile for growers. In one recent study of two farms (one in PA and one in NC) grafting added $0.46 and $0.74 per tomato transplant plant, respectively. This additional cost could be recouped quickly if grafting leads to a 5-10% increase in yield.

The grafting of tomatoes is likely to continue increasing in the U.S.. Growers utilizing smaller, intense production systems such as greenhouses and high tunnels should consider using this technique on their farms.

References and more information on grafting tomatoes:

Grafting for Disease Resistance in Heirloom Tomatoes
http://www4.ncsu.edu/~clrivard/TubeGraftingTechnique.pdf
http://www4.ncsu.edu/~clrivard/Rivard_Hortscience_2008.pdf

Grafting Greenhouse Tomatoes
http://www.uvm.edu/vtvegandberry/factsheets/graftingGHtomato.html

Grafting To Improve Organic Vegetable Production In Field And High Tunnel Systems
http://www.oardc.ohio-state.edu/graftingtomato/graft.htm

Vegetable Grafting Information Website
http://cals.arizona.edu/grafting/
An Economic Analysis of Two Grafted Tomato Transplant Production Systems in the United States
http://horttech.ashspublications.org/cgi/content/abstract/20/4/794

AGRIBUSINESS SESSION

PREVENTING CATASTROPHIC FAILURES OF POLY TANKS

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High density polyethylene tanks have been used successfully by growers and commercial pesticide application businesses for years. They are less expensive than stainless steel and fiberglass tanks and offer ease of movement when empty, along with rust resistance. Polyethylene tanks are low maintenance and relatively reliable for storing and transporting agricultural and commercial liquids.

While the benefits of poly tank ownership are well established, the risk of tank failure is real. Like any piece of equipment, poly tanks need to be inspected and maintained to ensure that the benefits of use outweigh the risk of tank failure and product release.

Experience has shown that environmental, management and design factors determine how long a tank will last, and that annual or biannual inspections help prevent the unexpected and potentially catastrophic release of contents due to tank failure.

These maintenance strategies help extend a poly tank's useful life:

- Selection of the right tank for the intended use, based on specific gravity.
- Use of the tank as intended -- vertical tanks for storage, horizontal tanks for storage or transportation.
- Protection from UV radiation.

Never purchase a used tank without knowing its history. If you intend to buy a used tank or an inexpensive one that appears in good operating condition, take the time to conduct a proper inspection; and secure information from the manufacturer if at all possible. Without exercising these precautions, you may encounter sudden tank failure resulting in an expensive spill and cleanup, reporting obligations and costly downtime.

The information in this presentation is intended to assist you in making an informed decision on the purchase, maintenance, inspection and ultimate disposal of poly tanks.

The only way to truly assess tank deterioration and damage is to conduct routine inspections each fall and spring. Base your decision to replace a tank on the findings -- or on the warranty expiration date, if feasible. The following factors contribute favorably to tank longevity:

- High specific gravity rating
- Infrequent refilling
- Protection from UV radiation
- Stationary placement

Whether a tank is a few years old or 20 years old, the only way to be sure it is structurally sound is to perform inspections before use in the spring and again at the end of the application season. The spring inspection, prior to filling, provides reassurance that the tank can safely store or transport the fertilizer or pesticide that you intend to place in it. Fall inspections are particularly recommended to provide forewarning of the need to purchase a new tank before spring; i.e., if your tank is found to be defective or deemed unserviceable, you have ample time to consider a replacement.

It is difficult to visually determine a good tank from a bad tank. Three simple inspection techniques -- writing with water-soluble ink, candling with light, and hitting with a baseball bat -- can pinpoint weakened walls and stressed areas around the fittings.

It is important to know the difference between surface *scratches*, *crazing* within the tank wall, and *cracks* that extend through the tank wall. Crazing is the development of very fine cracks within the tank wall, usually appearing as a network of fine lines that cannot be felt with a fingernail. The tank will still hold liquids, but its structural integrity is significantly reduced. Crazing occurs in both high density and cross-linked poly tanks; it can be a sign of serious deterioration within the plastic, which leads to cracks and fractures. Cracks can be felt with a fingernail. It is common for the poly material around the crack to appear whiter than the surrounding polymer. Most scratches displace minute amounts of polymer, but remain superficial.

- *Scratches* are open to the surface; displaced material is evident on the tank's surface; fingernail catches.
- *Crazing* is displayed as a patchwork of fine lines.
- *Cracking* causes no displaced material; very abrupt lines may run parallel or cross at right angles; UV cracking has a dry-rot or alligator-skin look in advanced stages; fingernail may catch.

Crazing may signal UV damage. UV crazing, which is very difficult to see, forms in areas where the tank gets maximum sunlight exposure; the lines become more visible when you "color" the tank with a water-soluble marker. The inspection is performed by rubbing the marker over several six-inch by six-inch sections on the sides of the tank exposed to sun, on its top, and around fittings. Quickly rub off the ink with a dry cloth or paper towel. The ink left behind has penetrated the surface of the tank.

Crazing is one of the first signs of deterioration, so tanks with crazing should be checked often. Consider using crazed tanks for water only.

If rubbing the ink off reveals no obvious signs of crazing or cracking, the tank probably is good for another season of use. If the ink reveals cracking or spider webbing where the lines go in all directions, classic UV radiation damage is indicated. Advanced deterioration to the plastic presents a checkered or "dry rot" appearance, indicating loss of elasticity. A tank displaying such symptoms should be replaced -- or at least not used for fertilizers or chemicals.

The appearance of parallel lines signal early UV damage and the need for continual inspections. Tanks with parallel lines in the plastic around fittings should be replaced immediately or used for water only.

Candling consists of placing a bright, cool light source inside a poly tank while conducting a visual inspection from the outside (do not use a hot lamp, as it could melt the tank). Defects and cracks usually show up as areas or lines of different light intensity.

Repeat this procedure with the light on the outside of the tank and someone looking through the fill neck or manway. Do not enter the tank. A camera, camcorder or other optical device may be helpful in recording the inspection from the top of the tank.

An empty tank showing UV cracking can be further evaluated by striking it with a baseball bat. Most people are afraid to hit their tank with a bat, fearing that they might break it, but that's just it: if it breaks, it should not be in service. Cracking an empty tank with a bat is a better option than risking it breaking when filled with fertilizer or pesticide.

A good tank has the flexibility to bend outward as it is filled and inward as it is emptied. Tanks that are brittle (i.e., that exhibit excessive or advanced cracking) have lost the ability to flex under pressure and to rebound when impacted. The brittleness of an empty tank can be tested with a solid swing of a baseball bat where signs of cracking were discovered during the water-soluble ink inspection. Hit the tank along the sides and top where they receive the most sunlight; then check the tank for signs of breakage. It is impossible to crack a good tank using this method because the polymer is strong and resilient; if the tank cracks or breaks open when hit by a bat, you may have saved yourself from disaster.

The above text is from the publication "Poly Tanks for Farms and Businesses…preventing catastrophic failures," Purdue Extension PPP-77, which served as the basis for this presentation.

New Jersey Agricultural Statistics

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National Agricultural Statistics Service

Commodity Cash Receipts totaled $1.00 billion for the 2009 calendar year, the third highest on record. This compares with the record $1.10 billion set in 2008 and the $1.08 billion set in 2007, the second highest record year. The 2009 cash receipts declined $101.3 million (-9.2 percent) from 2008. This is the first annual decline in total cash receipts since 2001.

The Total Fruits and Nuts and Total Vegetables categories increased in cash receipts. The Total Field Crop; Total Livestock and Products; and Total Greenhouse, Sod, Nursery, and Christmas Tree categories decreased.

Vegetables had the largest dollar increase of $22.8 million, primarily due to increases by fresh tomatoes ($7.3 million) and fresh sweet corn ($7.3 million), despite a decrease in fresh green peppers ($1.6 million). Total Fruit and Nut totaled 158 million, up $1.01 million (apples up $5.3 million, cranberries up $2.8 million, peaches up $9.7 million, and blueberries down $16.7 million).

The Greenhouse, Sod, Nursery, and Christmas Trees showed the largest decline, at $78.2 million; followed by Livestock and Products category at $37.7 million, primarily due to the decrease by poultry and eggs ($15.4 million), horses ($12 million), and dairy products ($10.5 million). Field Crops category totaled $88.8 down $9.1 million, due to the decrease by corn ($9.2 million) and wheat ($6.1 million).

In 2009, New Jersey's value of utilized production is ranked third in cranberries and peaches, forth in blueberries, and eleventh in apples.

On January 12th, NASS will release corn, soybeans, and hay harvested acres, yield per acre, and production.

SAFE APPLICATION OF PESTICIDES

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Safe application of pesticides is important for the applicator, the public and the environment. There are many aspects of pesticide application and doing it safely. First and foremost, the intended pest must be accurately identified. Next a decision must be made on the control measures and if they are necessary. If a pesticide is necessary, select the correct pesticide to achieve the desired outcome. Also important is to read and follow the pesticide label. The label is the law! The label provides information including hazards, registered uses, dosages directions for use and other helpful information. If the product is used for reasons not listed on the label the applicator is in violation of the law. Before any application of any pesticide, first read the label.

For personal safety to the applicator, do everything possible to avoid physical contact with all pesticides. All have varying degrees of toxicity and individuals have different sensitivity to chemicals. Avoid contact with skin and clothing and protect eyes at all times. Read the label for personal protective equipment necessary for handling the pesticide. Do not spray with leaky equipment and shower thoroughly after using chemicals. Do not eat or smoke when handling chemicals. If you do come in contact with chemicals, wash immediately with large volumes of water. See a doctor immediately if symptoms of illness occur after handling chemicals and bring a copy of the label with you.

Environmental contamination is also a concern when using pesticides. When filling or flushing equipment do not allow runoff into streams, ponds, lakes, sewer drains or any water system. Make sure to always have a back-flow prevention device on water sources used to fill spray tanks. When spraying do everything possible to avoid spray drift. Use the lowest pressures possible for application, if using high pressures use an anti-drift additive in the tank mix. Do not spray when windy conditions can carry droplets out of target areas.

State and federal pesticide regulations require a licensed pesticide applicator to apply any restricted and non-restricted use pesticides (including OMRI approved pesticides) when producing an agricultural crop for sale. For each application records must e kept for the date and location of the application, the names of the applicators, and the name EPA registration number, dosage rate and total amount of pesticide used. Regulations also require that all pesticides are stored in a safe manner in a secure, locked enclosure when unattended. Also, all pesticides must remain in their original container with the label attached to the container. If a pesticide being applied is toxic to bees and there is a state registered bee yard within a half mile of the application site, the beekeeper must be notified by phone 36 hours before the application. A list of registered beekeepers can be found through the NJDEP Pesticide Control Program. Regulations also require reporting pesticide spills to NJDEP immediately if more than 1 pound of active ingredient has been spilled and a written report is due within 10 days of the spill. Additionally, labels will list any endangered species warnings and if so the US Fish and Wildlife Service must be contacted for more information and restrictions. The pesticide label will also give warnings if groundwater contamination is a potential problem and some chemicals may be prohibited if this is a problem.

The person at most risk for injury from pesticides is the person mixing the concentrated product in the tank. Eighty percent of pesticide poisonings occur from skin contact resulting from splash, spill or drift. Absorption is increased if there are cuts, abrasions or other damaged areas of the skin. Additionally, areas of the body where skin is thin increases absorption. If skin comes in contact with any chemical, wash immediately with large amounts of water and soap. Do not scrub the skin since a brush may increase absorption. Eyes are another sensitive area. Always wear goggles or a face shield when handling concentrates. If chemicals do get in the eyes wash with a gentle stream of clean running water while holding the eyelid open. Wash for at least 15 minutes. Do not use eyewashes containing chemicals or drugs since it may cause more injury. The second most common type of pesticide poisoning is through inhalation. Chemicals are quickly absorbed through the thin linings of the nose and lungs. Vapors and fine particles are most hazardous. The label will indicate if a respirator should be worn. Most moderately toxic and highly toxic pesticides require respirators. Always use protective clothing and at the least gloves when mixing pesticides. See the pesticide label for necessary personal protection equipment and use it

Pesticides come in a variety of formulations. Solid and liquid forms of pesticides are available and in most instances are mixed with water in the spray tank. Water soluble concentrates (powders), wettable powders, and granules or pellets come in dry formulations. Liquid formulations consist of emulsifiable concentrates (liquids dissolved in a chemical like oil or benzene), invert emulsions (water in oil emulsions) and oil soluble concentrates (cannot be mixed with water). Some formulations are incompatible and should not be tank mixed. One way to determine compatibility is to do a "Jar Test".

1. Add 1 pint of water or fertilizer solution to a clean quart jar. Then add the pesticides to the water or fertilizer solution in the same proportion as used in the field.
2. To a second clean jar, add 1 pinto of water or fertilizer solution. Then add ½ teaspoon of adjuvant to keep the mixture emulsified. Finally, add the pesticides to the water-adjuvant or fertilizer adjuvant in the same proportion as used in the field.
3. Close both jars tightly and mix thoroughly by inverting 10 times. Inspect the mixtures immediately and after standing for 30 minutes. If a uniform mix cannot be made, the mixture should not be used. If the mix in either jar remains uniform for 30 minutes, the combination can be used. If the mixture with the adjuvant stays mixed and the mixture without the adjuvant does not, use the adjuvant in the spray tank. If either mixture separates, but readily remixes, constant agitation is required. If nondispersible oil, sludge, or clumps of solids form, do not use the mixture.

NOTE:

For compatibility testing, the pesticide can be added directly or premixed in water first. In actual tank-mixing for field application, unless label directions specify otherwise, add pesticides to the water in the tank in this order: first wettable granules or powders, then flowables, emulsifiable concentrates, water solubles, and companion surfactants. If tank mixed adjuvants are used, these should be added first to the fluid carrier in the tank. Thoroughly mix each product before adding the next product.

Besides compatibility, there are other considerations when mixing pesticides in a spray tank. Never pour the concentrate into an empty spray tank. Fill the tank half full first. Operate the sprayer with the nozzles shut off and by pass the spray through the tank for several minutes to ensure thorough mixing. Instructions for tank mixing can also be found on the pesticide label. Always read the pesticide label and follow the label instructions. Remember the label is the law!

PREPARING FOR A USDA THIRD PARTY AUDIT WORKSHOP

WHAT'S NEW ON THE FOOD SAFETY FRONT

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Introduction: The produce industry in New Jersey has come a long way in food safety over the last ten years. Each year more growers and wholesalers are asked to prove they have a food safety plan in place and it has been verified through a third party audit process. The biggest problem growers continue to have is writing their own food safety plan. There are many tools available to help growers with the process (see end of article), but reluctance still keeps growers from starting. Some growers think that all the "hullabaloo" about food safety will go away. This is not true. If anything, there will be more and more pressure applied for all growers to have a verifiable food safety plan in place.

All third party audits now require growers to explain how they do things by creating Standard Operating Procedures (SOPs) or Standard Sanitary Operating Procedures (SSOPs) for critical areas. These may be to describe how the packinghouse is cleaned, if using horses or mules how they are monitored in the field, etc. The SOPs should be as specific as possible. If someone is going to start working for the farm and is given the task of cleaning the packing line how should they do it? Do they wash the equipment first, swipe the floor around it, or use a disinfectant? These SOPs can be refined over time to better conform to the procedures used. Start out simple and add to it.

Growers sometimes think that once they pass the audit that is the end and they will have no problem passing it again next year. Everyone must understand this is a dynamic process and each operation should continually reevaluate his or her procedures. Do a self-assessment each year prior to the production season. This will allow for any changes that may have taken place in the operation or changes in food safety guidelines. Make a plan of how to implement the changes and stick to it. It makes no sense to wait until the week before your third party audit to make changes. Remember the changes that are made may mean changes to the food safety manual. It is easier to do both at the same time instead of trying to catch up later.

Traceback: This is one area that New Jersey struggles with to comply. Traceback is the ability to track food items, including fresh produce, back to their original source. This cannot prevent an initial food-borne outbreak, but it may help speed up the process to pinpoint the source. The faster the source is located the faster the rest of the produce industry can get back to normal. The goal is to help ensure that the public will have greater confidence in the produce industry.

A written procedure must be included in the Grower Food Safety Plan on how the farm will track individual containers one-step forward and one-step back. Maintain as many detailed records as possible including the harvesting dates, specific field, harvest crew number of packages within a lot, packing and shipping date. This means that the grower must be able to start the tracking from the field or orchard. If the produce is placed in a final container it should have a final label attached. However if the produce will be repacked in a packinghouse a field ticket can be used. This ticket should include all the information from the field (field number, harvest date, harvest crew number). The ticket would move with the load and be given to the receiver in the packinghouse so the information is included on the sticker for each container.

Each container must contain some type of identification to maintain its integrity throughout the harvesting and marketing process. The label on the box (farm name and address) generally is sufficient to trace the product to the farm or packing house, but each wholesale box must have a harvest/packing date stamp or code with the date incorporated on the box. Placing a label on the wrapped pallet will not meet this standard. If packing in more than one shed or packing under someone else's label, additional identification is needed to trace the product back to the packinghouse. A hand-labeling gun can be used to code each box where a series of numbers can identify the container. For example – 1 655616 9:

165 = (date harvested) this could be the first day a grower picked or the Julian calendar date such as 165 for June 14 or use the calendar date 614. This reserves the first three digits numbers for dates.
5 = (grower)
6 = (field picked or picker)
169 = (packing date)
The other numbers can be used for more information or be zeros. At the end of each packing day record the beginning and ending numbers in a book or computer. The code for these numbers needs to be recorded once and filed. The code is to assist the grower if there is a question about a shipment.

This is one example of a way to label the boxes. The system could be as simple as using a marker to put the date on a box or as sophisticated as a computer generated label that is automatically attached to the box. Each grower should figure out what is the best system for them and their customers. Make sure to implement a system which will be acceptable to everyone.

Mock recalls: New Jersey growers are now starting to do mock recalls. After a grower goes through the procedure once it is easy to do it the second time. Recall procedures must be included in the Grower Food Safety Plan. Mock recalls should be scheduled at least every six months or once a year, if in operation just in the summer, to ensure the system works properly. The farm must document the customers contacted, the amount of product remaining from the original shipment and the disposition of product which could not effectively be recalled. This may include sales to customers or reshipment to other customers who could be contacted if necessary. Have the customer fax the results of these conversations on their letterhead to show compliance. Auditors will review the traceback procedures and reports from the mock recall. **Note: this does not mean you take control of the product. The auditors want to see if you have the ability to take control if a recall is requested!**

Other Challenges: There are other areas in the audits which need continued attention. The following are reoccurring issues every year that must be monitored.

Worker Training – Growers train workers at the beginning of the season thinking this is sufficient for the whole year. This is not true especially as it relates to worker hygiene. A reoccurring problem is not putting the soiled toilet paper down the receptacle. This is a cultural situation where in some countries if the toilet paper is put down the toilet it will plug. Individuals are told to put it in the box or container alongside the toilet. There have been instances where growers have had audits stopped because workers put soiled toilet paper on the floor. This has also happened when workers in the packinghouse did not wash their hands prior to returning to the packing line. Growers need to continually reinforce training. This can start as formal training at the beginning of the season then followed up with small group or one-on-one sessions to encourage improvement.

Hand Washing Facilities – Place a hand wash station outside the port-a-johns and in other areas where produce will be handled. Workers must be able to be observed washing their hands. There have been situations where growers provided hand-washing stations outside the port-a-johns, but too far from the packinghouse entrance. When the wash station was moved just outside the packinghouse door or inside employees washed their hands. Remember anytime someone leaves the packing line they must wash their hands before returning.

Remember, proper hand washing must be performed. Vigorous hand washing with soap and water takes twenty seconds. I have observed individuals barely putting their hands under the water. This is not acceptable especially for anyone packing produce. The use of gloves is not a substitute for proper hand washing. Wash hands before picking up gloves.

Animals – Wildlife should be excluded from production fields as much as practical. This can be done by fencing, chasing, hunting, scare systems, etc. Not all wildlife can be excluded even if the whole area is fenced. Fencing is expensive and may not be practical. Animal activity must be monitored especially just prior to harvest. If animal activity is found in the area to be harvest a standard operating procedure must be develop on how the situation will be handled. For example:

> A worker will walk the field the morning of harvest and identify areas of contamination by placing a colored flag by any feces or heavy animal traffic area. No crops will be harvested within a 5-foot perimeter of the flagged spot.

Resources:

http://foodsafety.psu.edu/gaps
www.gaps.cornell.edu
http://njveg.rutgers.edu/html/mf-food-safety.html
http://ucgaps.ucdavis.edu

AKNOWLEDGEMENTS

Educational Program Chairman
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Session Organizers

Tuesday, January 11
Farm Safety – Raymond Samulis, Agricultural Agent, Rutgers NJAES CE Burlington County

Greenhouse Floriculture – Jenny Carleo, Agricultural Agent, Rutgers NJAES CE Cape May County

Bioenergy – William Hlubik and Bill Sciarappa, Agricultural Agents, Rutgers NJAES CE Middlesex and Monmouth Counties

Peppers – Wesley Kline, Agricultural Agent, Rutgers NJAES CE Cumberland County

General Session – Wesley Kline, Agricultural Agent, Rutgers NJAES CE Cumberland County

Wednesday, January 12
Brown Marmorated Stink Bug – George Hamilton, Specialist in Entomology, Rutgers NJAES CE

Season Extension, Vegetable and Fruit – Michelle Infante-Casella, Agricultural Agent, Rutgers NJAES CE Gloucester County

Agritourism – Steve Komar and William Bamka, Agricultural Agents, Rutgers NJAES CE Sussex and Burlington Counties

Small Fruit – Peter Nitzsche, Agricultural Agent, Rutgers NJAES CE Morris County

Blueberries – Gary Pavlis, Agricultural Agent, Rutgers NJAES CE Atlantic County

New Technology – A.J. Both, Specialist in Bioresource Engineering, Rutgers NJAES CE

Field Crops - Steve Komar and William Bamka, Agricultural Agents, Rutgers NJAES CE Sussex and Burlington Counties

Tomatoes and Grafting – Tom Orton Specialist in Vegetable Crops and Gerald Ghidiu, Specialist in Vegetable Entomology, Rutgers NJAES CE

Thursday, January 13
Agribusiness – Andy Wyenandt, Specialist in Vegetable Pathology Rutgers NJAES CE and Jenny Carleo, Agricultural Agent, Rutgers NJAES CE Cape May County

Preparing for a USDA Third Party Audit - Wesley Kline, Agricultural Agent, Rutgers NJAES CE Cumberland County