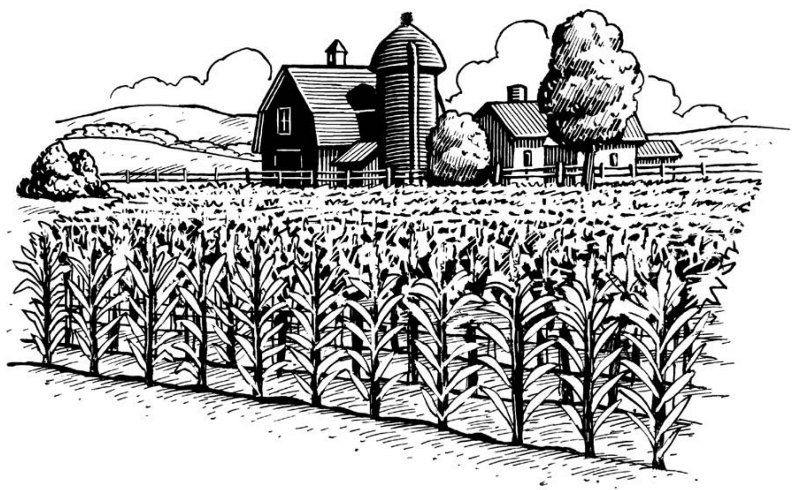
2015 Proceedings

60th New Jersey Agricultural Convention and Trade Show

February 3-5, 2015



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Session Organizers

Tuesday, February 3

Pest Management – Joe Ingerson-Mahar, Vegetable IPM Coordinator, RCE

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

State Policy Issues – Brian Schilling, Extension Specialist in Agriculture Policy, RCE

Organic I – Joe Heckman, Extension Specialist in Soil Fertility, RCE

Workshop For New Wine Grape Growers I – Gary Pavlis, Agriculture Agent, Rutgers NJAES Cooperative Extension of Atlantic County

High Tunnels – A.J. Both, Extension Specialist in Ag Engineering, RCE

Peppers – Andy Wyenandt, Extension Specialist Vegetable Plant Pathology, Rutgers NJAES Cooperative Extension

Specialty/Ethnic/Greens/Herbs – Jenny Carleo, Agricultural Agent, Rutgers NJAES Cooperative Extension of Cape May County

Organic II – Bill Sciarappa, Agricultural Agent, Rutgers NJAES Cooperative Extension of Monmouth County

Workshop for New Wine Grape Growers II – Dan Ward, Extension Specialist in Fruit Crops, Rutgers NJAES Cooperative Extension

Wednesday, February 4

Energy – A.J. Both, Ext. Specialist in Ag Engineering, Rutgers NJAES Cooperative Extension

Retail Marketing & Agritourism – Bill Hlubik,, Agricultural Agent, Rutgers NJAES Cooperative Extension of Middlesex County

Field & Forage Crops – Bill Bamka, Agricultural Agent, Rutgers NJAES Cooperative Extension of Burlington County

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

Tomatoes – Kris Holmstrom, North Jersey IPM, Rutgers NJAES Cooperative Extension

Marketing in the Garden State – Richard VanVranken, Agricultural Agent, Rutgers NJAES Cooperative Extension of Atlantic County

Food / Safety – Meredith Melendez, Senior Program Coordinator, RCE

Alternative Crops – Steve Komar, Agricultural Agent, Rutgers NJAES Cooperative Extension of Sussex County

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

Vine Crops – Michelle Infante-Casella, Agricultural Agent, Rutgers NJAES Cooperative Extension of Gloucester County

Thursday, February 5

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

Basil Downy Mildew Workshop – Andy Wyenandt, Extension Specialist in Vegetable Pathology, RCE

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PEST MANAGEMENT

FALL ARMYWORM MIGRATIONS AND IMPLICATIONS FOR NJ FARMERS

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The fall armyworm is an important agricultural pest of vegetable and row crops in the Western Hemisphere. In the United States, infestations in sweet and field corn plantings extend from the Mexican to the Canadian border. Because fall armyworm does not survive prolonged freezing, the infestations annually affecting most of North America are migrants from southern Texas and southern Florida, where winter temperatures are mild and host plants are available. A molecular method was developed that can distinguish between these two geographically distant overwintering populations, with the potential to identify the associated migratory pathways.

Several years of moth collections from major corn-producing areas in the southern, central, and eastern US were used to map the geographical distribution of fall armyworm populations. From these profiles, it was possible to develop the most detailed description yet of the annual northward movements of fall armyworm. Generally, moths from Texas infest areas west of the Appalachians and into the western and northern areas of the northeastern states. For example, populations in northern and central Pennsylvania and northern New Jersey have the Texas markers. Florida populations stay mostly east of the Appalachians along the Atlantic Coastal Plain up to the southern and coastal areas of the northeast. However, there appears to be mixing of the Texas and Florida populations in the southeast (eastern Alabama and western Georgia) and in the mid-Atlantic areas, including the Delmarva Peninsula, southern New Jersey, and southern New York. The amount of mixing depends on the time of year, as collections in August differ from those in October.

A better understanding of fall armyworm populations and their movement is critical for the development of strategies to predict infestation levels and eventually control this pest in the US. Some populations in Florida have developed resistance to genetically-engineered corn (Bt corn). These populations appear to be able to move north and thereby can make management decisions more difficult for growers along the Atlantic seaboard. This includes vegetable growers in New Jersey who may want to apply Bt insecticides on their sweet corn or other crops. The impact of the resistant populations is currently being studied.

NEW INSECTICIDES FOR VEGETABLE CROPS

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In recent years, several new insecticides have been registered for use on vegetable crops in the U.S. (see Table 1). Most of these new products offer a reduced risk, more-IPM friendly option for controlling specific insect or mite pests. In addition, because they often have a novel mode of action, they are excellent choices for insecticide resistance management. Some uses of these products and their performance in recent field efficacy trials in Virginia will be discussed in this presentation.

Table 1. Some relatively new insecticides and miticides registered on vegetables.

Insecticide	General Comments	Signal Word	MOA[1]	Typical Target Pests	Crops
Beleaf 50SG flonicamid	contact & ingestion; rapid feeding cessation	Caution	9C	aphids	Brassica (Cole) Leafy Veggies, Cucurbit Veggies, Fruiting Veggies, Leafy Veggies, Tuberous and Corm Veggies, Root Veggies
Belt SC flubendiamide	long residual; rapid cessation of feeding	Caution	28	caterpillars	Brassica (Cole) Leafy Veggies and turnip greens, Cucurbit Veggies, Fruiting Veggies, okra, Leafy Veggies, Legume Veggies (except soybean), sweet corn, strawberry
Coragen chlorantraniliprole	Very long residual, can be applied to soil or foliar; systemic	None	28	caterpillars, some beetles, whiteflies	Bulb Veggies, Brassica (Cole) Leafy Veggies, sweet corn, Cucurbit Veggies, Fruiting Veggies, okra, Leafy Veggies, Legume Veggies except soybean, potato, Root and Tuber Veggies, Leaves of Root and Tuber Veggies, strawberry
Closer SC sulfoxaflor	contact & ingestion; foliar	Caution	4C	Aphids, whiteflies, leafhoppers	
Exirel cyantraniliprole	Foliar; long residual; labeled for greenhouse veggies	Caution	28	caterpillars, some beetles, thrips, aphids, leafminers	Bulb Veggies, Brassica (Cole) Leafy Veggies, Cucurbit Veggies, Fruiting Veggies, okra, Leafy Veggies, greenhouse veggies
M-Pede potassium salts of fatty acids	contact activity; OMRI certified	Warning	Unk.	Aphids, whiteflies, other soft-bodied arthropods	most veggies

Movento spirotetramat	ingestion; 2-way systemic in plant; inhibitor of lipid synthesis; effective on juveniles	Caution	23	aphids, psyllids, whiteflies, mites	Fruiting Veggies, Leafy Veggies, legume Veggies, Brassica (Cole) Leafy Veggies, potato and other Tuberous and Corm Veggies
Radiant spinetoram	ingestion & contact; enters leaf but does not translocate	Caution	5	thrips, caterpillars, some beetles and leafminers	Bulb Veggies, Brassica (Cole) Leafy Veggies, sweet corn, Cucurbit Veggies, Fruiting Veggies, okra, Leafy Veggies, Leaves of Root and Tuber and Legume Veggies, watercress, Legume Veggies, potatoes and Tuberous and Corm Veggies, Root Veggies, strawberry
Requiem 25SC extract of *Chenopodium ambrosioides*	affects insect cuticle, disrupt respiration	Caution	Un	aphids, whiteflies, thrips	Brassica (Cole) Leafy Veggies, Bulb Veggies, Cucurbit Veggies, Fruiting Veggies, Leafy Veggies (except spinach), Legume Veggies, okra, potato
Rimon 0.83EC novaluron	disrupts cuticle formation in larva; no effect on adult	Warning	15	caterpillars	beans (succulent and dry), Cucurbit Veggies, Fruiting Veggies, okra, Head and Stem Brassica Veggies, potatoes, sweet potatoes, strawberry, sweet corn
Sivanto flupyradifurone	Systemic, pollinator safe		4D	Aphids, whiteflies, leafhoppers	Expected crops: cucurbits, legumes, brassica, leafy and fruiting vegetables, potatoes
Verimark cyantraniliprole	long residual, applied to soil; systemic	Keep out of reach of children	28	caterpillars, some beetles, thrips, aphids, leafminers	Brassica (Cole) Leafy Veggies, Cucurbit Veggies, Fruiting Veggies, okra, Leafy Veggies, potato, Root and Tuber Veggies
Premixes containing the above insecticides					
Besiege chlorantraniliprole and lambda-cyhalothrin	see Coragen + pyrethroid (not IPM compatible)	Warning	28 + 3A	broad spectrum	Sweet corn, Legume Veggies
Durivo SC chlorantraniliprole and thiamethoxam	Systemic; applied to soil	Keep out of reach of children	28 + 4A	caterpillars, aphids, potato leafhopper, some beetles, stinkbugs, whiteflies	Brassica (Cole) Leafy Veggies, Cucurbit Veggies, Fruiting Veggies, Leafy Veggies
Vetica flubendiamide and buprofezin	see Belt + IGR for whiteflies	Caution	28 + 16	Caterpillars and whiteflies	Cucurbit Veggies, Head and Stem Brassica Leafy Veggies, Leafy Veggies, Fruiting Veggies and okra, snap beans, strawberry
Voliam flexi chlorantraniliprole and thiamethoxam	see Coragen + neonic foliar application	Caution	28 + 4A	caterpillars, aphids, leafhopper, some beetles, stinkbugs, whiteflies	Brassica (Cole) Leafy Veggies, Cucurbit Veggies, Fruiting Veggies, Leafy Veggies, strawberry, Tuberous and Corm Veggies

Voliam Xpress chlorantraniliprole and lambda-cyhalothrin	see Coragen + pyrethroid (not IPM compatible)	Warning	28 + 3A	broad spectrum	Head and stem Brassica Veggies, sweet corn, Cucurbit Veggies, Fruiting Veggies, Legume Veggies, lettuce (head and leaf), Tuberous and Corm Veggies
Miticides					
Kanemite 15SC acequinocyl	knockdown and residual control	Caution	20B	mites	Fruiting veggies, okra, edible podded beans, strawberry
Oberon 2SC spiromesifen	inhibitor of lipid synthesis; most effective on juvenile stages	Caution	23	mites, psyllids, whiteflies	sweet corn, Cucurbit Veggies, Fruiting Veggies, Leafy Veggies, Brassica (Cole) Leafy Veggies, strawberry, Tuberous and Corm Veggies
Portal fenpyroximate	contact activity; affects energy metabolism	Warning	21A	mites, including broad mites, leafhoppers, whiteflies	Fruiting Veggies, okra, melons, strawberry
Zeal etoxazole	mite growth inhibitor	Caution	10B	spider mites	melons, cucumber, strawberry

[1]**Mode of Action codes for vegetable pest insecticides from the Insecticide Resistance Action Committee (IRAC) Mode of Action Classification. http://www.irac-online.org/content/uploads/MoA-classification.pdf.**

3A. Sodium channel modulators—pyrethroids
4A, 4C, & 4D. Nicotinic acetylcholine receptor agonists (nerve action)
5. Nicotinic acetylcholine receptor allosteric activators—spinosyns (nerve action)
9C. Selective homopteran feeding blockers
10B. Mite growth inhibitors (growth regulation)
15. Inhibitors of chitin biosynthesis, type 0, lepidopteran (growth regulation)
16. Inhibitors of chitin biosynthesis, type 1, homopteran (growth regulation)
20B. Mitochondrial complex III electron transport inhibitors (energy metabolism)
21A. Mitochondrial complex I electron transport inhibitors (energy metabolism)
23. Inhibitors of acetyl Co-A carboxylase (lipid synthesis, growth regulation)
28. Ryanodine receptor modulators (nerve and muscle action)
un. Compounds of unknown or uncertain mode of action

MAKING SOUND INSECTICIDE CHOICES

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Over the past decade, the number of vegetable insecticides (both commercial products and insecticide classes) has increased significantly. Included in these are a number of materials with novel modes of action (MOA), and high degrees of pest specificity. For example, some newer materials have efficacy against caterpillars only, while others may control caterpillars and some fly larvae. Other examples are detailed in the included table. This article is an attempt to clarify the options in the Commercial Vegetable Recommendations so that growers may make more informed choices as to the most useful product for specific pests.

The increasing number of choices for insect control in vegetable crops can lead to some confusion, but there is also great potential benefit if the options are understood (what the different compounds do, both to crop pests and beneficial insects). A number of newer compounds can manage important pests, while preserving beneficial insects, such as pollinators or natural enemies of other crop pests. These are positive factors if an integrated pest management (IPM) approach is desired by growers. In order to make the best use of available insecticides, however, it is critical that growers understand what these compounds do. Further, products combining two insecticidal compounds only increase confusion when choosing the appropriate product for a specific pest situation. Frequently, only one component of the insecticide blend has activity against the target pest. In other instances, one component may result in secondary pest outbreaks. Still other blends are redundant, in that they combine similar products. Attempting to provide more clarity, entomology editors of the 2015 Commercial Vegetable Production Guide have listed other labelled mixtures containing an insecticide component that has previously been recommended for a specific pest. For example: lambda-cyhalothrin (Warrior II) is labelled for flea beetle control in cole crops. This year, that entry is followed by the statement: "*or other labelled mixtures containing lambda-cyhalothrin, like* Voliam Xpress *or* Endigo ZC."

In the attached table of combination insecticide products labeled for vegetable crops in New Jersey, blended products are identified by trade name for ease of identification by the user. Components are listed by generic name, consistent with their appearance in the Commercial Vegetable Recommendations. Generic names are followed by the Insecticide Resistance Action Committee (IRAC) code for the compound. This will assist growers in avoiding compounds with redundant or undesirable MOA.

Know what the insecticide controls!

Example 1: If the pest is a caterpillar (European corn borer in pepper), you will see in the Commercial Vegetable Recommendations, the product Voliam Xpress. This product is the combination of chlorantraniliprole, IRAC-28, and lambda-cyhalothrin, IRAC-3. Both components of this blend are also listed separately for ECB control in peppers. Chlorantraniliprole is an excellent caterpillar material that is unlikely to harm beneficial insects. As a result, no secondary pest outbreaks would be expected from using it alone. Lambda-cyhalothrin will also control ECB, but this class of insecticide will kill predators and parasites of aphids. Use of this material as little as one time can result in an aphid outbreak. Further, this class of insecticide, IRAC-3, is acutely toxic to pollinators and contact with these beneficial insects should be avoided.

When looking in the Commercial Vegetable Recommendations Guide for insecticides, check to see whether one component insecticides are recommended. When a two component insecticide product contains a broad spectrum insecticide, its use may cause secondary pest outbreaks. In an IPM scheme, IRAC-3 insecticides are discouraged for caterpillar control because there are usually other choices that work very well without the negative impact on beneficial insects.

Example 2: A significant number of stinkbugs are found in a pepper planting, and fruit injury is appearing. Choices in the Commercial Vegetable Recommendations Guide include the same combination as in the previous example. In this case, the lambda-cyhalothrin, IRAC-3, component is the one with activity against the stinkbug. The second component (chlorantraniliprole IRAC-28) has no effect on the target pest. Lambda-cyhalothrin is recommended individually for stinkbug control in peppers. This product does kill beneficial insects, but in this instance, management of the stinkbug is the priority.

When only one component of a recommended blend controls the target pest, use the one component insecticide, instead of a blended product. There is no need to have a second material that has no positive impact on the pest situation.
When possible, avoid materials that are toxic to bees.

Example 3: The combination of thiamethoxam, IRAC-4A, and chlorantraniprole, IRAC- 28, (Voliam flexi) is in the Commercial Vegetable Recommendations Guide for control of numerous caterpillar pests of tomato. For tomatoes, chlorantraniliprole (the component responsible for caterpillar control) is also recommended by itself. The second component, thiamethoxam (as are all IRAC-4A materials) is toxic to bees and has no use against caterpillars. **Note** that most *foliar* applied formulations of IRAC-4A materials now come with pollinator protection restrictions on the label. These restrictions do not apply to formulations meant to be soil-applied.

This two-component product should be avoided for caterpillar management in favor of products that specifically target them. Chlorantraniliprole would be one product with good efficacy on caterpillars and little impact on bees.

Avoid redundancy

Example: A combination of zeta-cypermethrin, IRAC-3, and bifenthrin, IRAC-3, (Hero) is in the Commercial Vegetable Recommendations Guide for control of cucumber beetle on summer squash. Both components are also recommended individually. They are in the same chemical class and either would be effective against cucumber beetle. There are many instances in the Commercial Vegetable Recommendations Guide where this combination is an option for specific pests while the components are also listed.

Why apply a redundant product, when the individual parts can perform the necessary task?

To summarize
Know the pest that you need to control.

Use an appropriate insecticide that will do the job with as little negative impact as possible.

Avoid broad spectrum insecticides when possible.

Avoid using redundant materials.

SWEET CORN

Trends in Sweet Corn Insect Control

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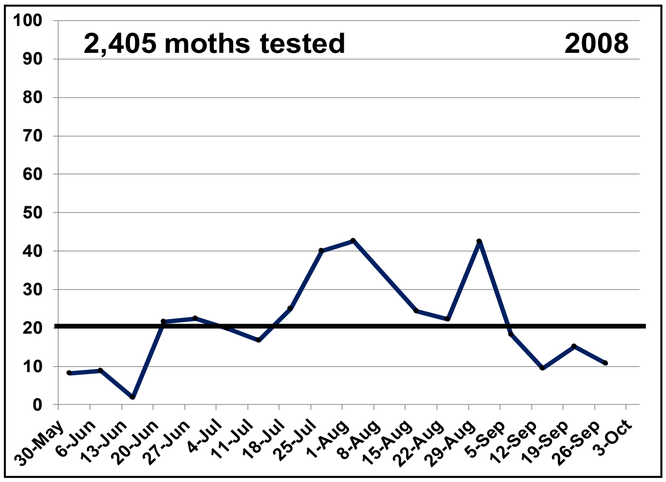
Synthetic pyrethroid insecticides (IRAC-3)* have been the primary class of insecticide used to manage lepidopterous (caterpillar) pests of sweet corn for 20+ years. Many of the insecticides in this class are still very effective, but some target pests have developed varying degrees of resistance to pyrethroids. Additionally, pyrethroid insecticides are devastating to many of the beneficial insects that control secondary pests of sweet corn. Repeated use of this class of insecticide can result in outbreaks of pests like aphids or mites, which then must be managed separately.

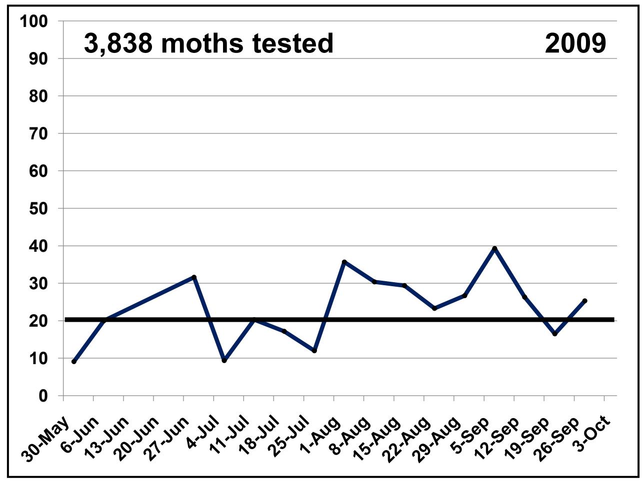
New classes of insecticides, with novel modes of action began to come on the market over 10 years ago. Among these newer materials are those based on spinosyn (IRAC-5). These include Entrust and Blackhawk (spinosad), and Radiant (spinetoram). More recently, the diamide group (IRAC-28) has entered the market. These include Belt (flubendiamide) and Coragen (chlorantraniliprole). The more recent materials are, with some variability, effective against the caterpillar pests of sweet corn. Additionally, they have reduced impact (spinosyn) or almost no impact (diamides) on beneficial insects. They do not control secondary insect/mite pests of sweet corn, except that their use does not generally eliminate insects that keep secondary pests in check. An exception would be sap beetle, which is not adequately controlled by natural enemies, and must be managed with broad spectrum insecticides.

The complex nature of sweet corn insect control has been made more so, as agrichemical companies have begun offering blended products. Chief among these are those containing a pyrethroid and a diamide (Besiege). **Note:** This same combination was also available as Voliam Xpress. Now, Besiege is the sole combination of chlorantraniliprole and lamda-cyhalothrin. Further, transgenic sweet corn varieties, expressing genes toxic to caterpillars have become more common in fresh market production. Initial releases have been effective against some pests, while newer products have improved efficacy against a wider range of caterpillar pests. This paper incorporates insecticide efficacy trials from the mid-Atlantic states, as well as insecticide resistance data and discussion of management tactics for primary and secondary insect pests of sweet corn.

Primary caterpillar pests of sweet corn.
European corn borer (ECB):
Populations trending steeply downward with increased adoption of *B.t.* transgenic field corn in ag areas where other host crops are grown.
Goal – manage ECB larval population ***in plants*** prior to ear infestation.
Resistance/Other Issues: Not significant. Pyrethroid, carbamate, spinosyn and diamide insecticides all work well.

Corn earworm (CEW):
Populations also trending generally downward, but subject to uncertainty due to occasional overwintering success and late season migrations.
Goal – manage CEW larvae on silks between egg hatch and ear infestation.
Resistance/Other Issues: Documented but variable resistance to pyrethroids. Insecticide applications ***can*** flare aphid populations. Reduced spray schedules leave room for sap beetles. Va. Tech entomologist **Ames Herbert** has conducted vial tests with live CEW moths captured in southeastern VA to determine the extent of their resistance to the pyrethroid cypermethrin. Vials contain 5 µg cypermethrin. % moths surviving have been plotted by week (when individuals were captured) for two seasons. Note the dramatic fluctuation in survival rate, indicating movement into southeastern VA of pyrethroid resistant adults.





The following data are summarized from an insecticide efficacy trial conducted by Univ. of Delaware entomologist, Joanne Whalen. The purpose of the trial was to evaluate a standard pyrethroid (Warrior) against newer diamide products combined or in rotation with pyrethroid or carbamate products. Note that Voliam Xpress (Coragen + Warrior) is now only available as Besiege. Spray regimens including Voliam Xpress provided consistently excellent control against both CEW and FAW, where Warrior II alone was substandard by comparison. It is also interesting to note the reduced control of CEW and fall armyworm (FAW) when the other diamide product (Belt) was used in this trial.

Treatment	Rate/A	App. Date	% clean ears	% CEW damaged ears	% FAW damaged ears
Belt 480 SC + LI700 Baythroid XL	3 oz + 0.25% v/v 2.8 oz	8/10,13,17,20 8/24	66.45d	29.98b	0.89b
Belt 480 SC Baythroid XL	3 oz 2.8 oz	8/10,13,17,20 8/24	78.58c	20.49bc	0.93b
Coragen 1.67 SC + MSO Lannate LV + Asana XL	3.5 oz + 0.5% v/v 24 oz + 9.6 oz	8/10,13,17 8/20, 24	91.93ab	8.07cd	0.00b
Coragen 1.67 SC + MSO Lannate LV + Asana XL	5 oz + 0.5% v/v 24 oz + 9.6 oz	8/10,13,17 8/20, 24	93.73ab	6.28d	0.00b

Coragen 1.67 SC + LI700 Lannate LV + Asana XL	3.5 oz + 0.5% v/v 24 oz + 9.6 oz	8/10,13,17 8/20, 24	90.10ab	10.86cd	0.00b
Lannate LV + Asana XL	24 oz + 9.6 oz	8/10, 13, 17, 20, 24	96.25ab	3.75d	0.00b
Warrior II	1.92 oz	8/10, 13, 17, 20, 24	87.03bc	7.20d	5.78ab
Voliam xpress Lannate LV + Warrior II	9 oz 24 oz + 1.92 oz	8/10,13,17 8/20, 24	99.11a	0.89d	0.00b
Voliam xpress Warrior II	7 oz 1.92 oz	8/10,13,17,20 8/24	98.11ab	1.89d	0.00b
Voliam xpress Warrior II	9 oz 1.92 oz	8/10, 13, 17 8/20, 24	98.28ab	1.73d	0.00b
Voliam xpress Alternate with Warrior II	7 oz 1.92 oz	8/10, 17, 24 8/13, 20	94.99ab	5.00d	0.00b
Untreated			7.35e	89.08a	11.11a

Means in the same columns followed by the same letter are not significantly different (Tukey's; P=0.05).

The following data are summarized from a 2014 insecticide efficacy trial conducted by Virginia Tech entomologists, Tom Kuhar and Helene Doughty. In this study, diamide products (Belt and Coragen) as well as spinosyn products (Radiant (spinetoram) and Blackhawk (spinosad)) were rotated with Hero, a combination of two pyrethroids (bifenthrin and z-cypermethrin). The two component pyrethroid performed well in this test, underscoring the unpredictability of pyrethroid resistance in CEW populations. Notably, the spinosad product Blackhawk did not perform as well as Radiant or diamide products in eliminating CEW from ears.

Treatment	Rate / acre	% marketable* ears	% unmarketable ears	Mean no. CEW larvae
1. Untreated Control		54.1	45.9	6.0 a
2. Belt rotated with Hero 1.24EC	2 fl. oz fb. 4 fl. oz	57.4	42.7	0.5 b
3. Belt rotated with Hero 1.24EC	2.5 fl. oz fb. 4 fl. oz	66.0	34.0	0.5 b
4. Belt rotated with Hero 1.24EC	3 fl. oz fb 4 fl. oz	75.4	24.6	0.3 b
5. Coragen rot.with Hero 1.24EC	3.5 fl. oz fb 4 fl. oz	65.0	35.0	0.3 b
6. Besiege rot. with Hero 1.24EC	7 fl. oz fb 4 fl. oz	70.7	29.3	1.3 b
7. Blackhawk rot. with Hero 1.24EC	2.2 oz fb 4 fl. oz	62.4	37.6	2.5 ab
8. Radiant rot. with Hero 1.24EC	3 fl. oz fb 4 fl. oz	61.9	38.1	0.0 b
9. Hero 1.24EC	4 fl. oz	75.8	24.2	0.8 b
P-Value from Anova		ns	ns	0.0001

The use of pyrethroid products or combination products that include pyrethroids can cause problems with aphids during the silk period. In New Jersey, the typical response to the presence of aphids has been to rotate with the carbamate product Lannate. This has worked well for us. However, in 2014, CEW pressure was so low that many growers were still on 5-6 day silk spray schedules as late as Sept. 1. Using Lannate at every other spray resulted in 10-12 days between applications, with pyrethroids in between. This was likely the cause of more frequent aphid problems in 2014. It is noteworthy that the neonicotinoid product Assail (acetamiprid) is labeled for aphid control in sweet corn. This product is also the sole neonicotinoid to not carry a bee warning on the label. While applications should be managed to avoid direct bee exposure, Assail could be an effective tool to manage aphid populations in sweet corn. Scouts should note the presence of aphids as plantings approach full tassel. An aphid population at that point warrants the use of materials targeting that pest along with materials that control the caterpillar pests.

Some growers have opted to use transgenic sweet corn varieties, especially for late season plantings when CEW pressure is highest. These hybrids express genes from the soil dwelling bacterium *Bacillus thuringiensis* (*B.t.*), which are toxic to caterpillars. Initial *B.t.* sweet corn varieties for fresh market are extremely effective against ECB larvae, but are much less effective on FAW, and have become somewhat variable in control of CEW. Newer varieties, expressing more genes, are now available for fresh market. The following data are summarized from a study conducted by Univ. of Maryland entomologist, Galen Dively in 2011. The study compares the efficacy of original *B.t.* types (cry1Ab) with newer varieties expressing Cry1Ab and Cry 2Ab genes and related non-*B.t.* varieties. Sprays were at 3-day intervals starting at fresh silk. Note that the variety expressing multiple genes for resistance provided very good, but not complete control of CEW. It is critical to know what the population pressure of CEW and FAW is at all times, as these hybrids may allow some caterpillars to survive. **The first 2-3 silk sprays are very important for clean ears.** *B.t.* hybrids do not control aphid or sap beetles.

Hybrid	Control Program	%marketable ears	%CEW damage	CEW/ear
BC 0805 *B.t.* Cry 1Ab	2 sprays	54	46	0.5
	Unsprayed	10	87	1.2
Obsession II *B.t.* Cry1Ab Cry2Ab	2 sprays	92	11	>0.1
	Unsprayed	74	37	0.4
Obsession non-*B.t.*	6 sprays	72	30	>0.1
	Unsprayed	4	96	0.9
Providence non-*B.t.*	Unsprayed	0	100	1.2

Note. Thanks to Galen Dively, Ames Hebert, Tom Kuhar, Helene Doughty and Joanne Whalen for sharing data and information contained in this article. – KH
*IRAC – Insecticide Resistance Action Committee

BICOLOR SWEET CORN VARIETIES FOR 2015
UNDERSTANDING AND DEALING WITH BIRD DAMAGE IN SWEET CORN

Raymond J. Samulis
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Background:

Through the advent of modern plant breeding combined with traditional hybridization programs, seed companies are able to produce a plethora of new sweet corn varieties. Of utmost importance in breeding programs are characteristics such as earliness, eating quality, disease resistance, yields, cold tolerance, and many other features. That being said, all varieties do not perform the same when grown under different climatic situations. The humid regions of south Florida will require considerably different varieties with different maturity dates compared to corn grown under cold soil conditions of northern climates.

Here in New Jersey we also have different climactic requirements to consider when growing under the loamy sand, low organic matter soils of Burlington county south compared to the higher organic matter, silt loam soils of Burlington County north. Not only are the needed varieties different but so are the fertility programs and timings of fertilizer applications.

This sweet corn trial was conducted at the Burlington County Agricultural center located in Moorestown, NJ. The soil texture is somewhat heavier than many areas of Burlington County and the higher organic matter content is able to hold much of the fertilizer so that it remains available to the corn throughout the growing season. The quality of the soil is also related to the extended agricultural history of being a dairy farm where regular applications of manure where applied to the soil. Varieties were planted in 400 ft. rows. The study included 16 varieties of various genetic types focusing on the synergistic and sh2 categories which are considered supersweets and capable of maintaining good eating characteristics over longer periods of time.

I would like to thank the following companies and organizations whose support made this study possible: Rutgers Cooperative Extension, Burlington County Freeholders, Burlington County Board of Agriculture, Growmark FS, Plant Food Chemical Stokes Seeds, Abbott & Cobb, Seedway, and Crookham.

Objectives of the Study

1) Determine yield potential o 16 sweet corn hybrids under New Jersey conditions.
2) Measure various horticultural characteristics such as tip fill, tip cover, suckering, and ear size.
3) Evaluate varieties for variability in nitrogen utilization rates.
4) Subjectively rate flavor and eating characteristics
5) Study the bird population dynamics in the field.
6) Determine if birds have a preference to certain bi-color hybrids.

The following varieties were included in this test:
Fantastic, XTH 20173, Awesome, XTH 2074, CAPF 12, 7112 R, ACR 2023, 7602, ACES, AP 426, Journey, Obsession, SnakPak, APS 358, Stellar, Pickett

Results:

The established yields in the trial ranged from 220 crates/Acre to 380 crates/acre. The hybrids with the best yields included Fantastic, Awesome, XTH 2074, Obsession, and ACES. However while the variety ACES was high yielding it had a very atypical kernel color contrast where the yellow kernels were very faint in color which made the ears appear more like a white sweet corn variety.

Observations made over many years in sweet corn variety trials have indicated to me that there is a wide variation between varieties regarding how green the plants are. In years past, there was not a real good method to definitively quantify these color differences and all could be said was that they existed. Fortunately, I was able to obtain a SPAD meter which is a sophisticated scientific instrument which can measure the amount of chlorophyll in the tissue as a non-destruct test. For a variety to be a normal healthy green and not showing any indication of nitrogen deficiency, a reading of 48-52 was needed. In this test however, I was able to get SPAD readings as high as 64 which expressed themselves in an extremely dark green which bordered on being nearly black in color. Farther research is needed to determine if in fact these darker green colors might provide an opportunity to lower N rates without yield reductions.

Bird damage was a constant problem at the field location where this study was conducted, the % bird damage ranged from 3% to 98%. The three varieties with the most damage were Fantastic, 20173,CAPF 12, 7602, and Stellar. Varieties with the least damage were Obsession, Journey, ACES, SnakPak, APS 358, and Pickett. Measurements of tip cover were also made to determine if this characteristic contributed to the amount of bird damage.

Conclusions: `

- Virtually all varieties tested had good commercial acceptability in areas of ear size, appearance, flag leaves, and sucker numbers.
- Some varieties had considerable yield variation by as much as 50%
- When considering bird damage, the difference of harvestable yield losses was as high as 100%.
- Bird damage ranged from near 0% all the way up to 100%
- While favored bird roosting sites did exist, there was only limited correlation between that location and what parts of the field the birds attacked the most.
- Highly significant differences existed for the birds preferences to specific hybrid varieties.
- Some varieties had significantly higher SPAD meter readings possibly indicating potential higher utilization of nitrogen.
- SPAD meter readings indicate that some varieties of sweet corn might have full yield potential when grown under reduced nitrogen rates.

- Over 5,000 lbs. of surplus sweet corn from this trial was donated to the New Jersey Farmers Against Hunger for distribution to various charities and soup kitchens. This was made possible due to the dedicated volunteer efforts of some Burlington County Master Gardners.

State Policy Issues Session

THREE DECADES OF FARMLAND PRESERVATION – A LOOK AHEAD

Brian J. Schilling
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New Brunswick, NJ 08901

New Jersey established its statewide farmland preservation program in 1983 with the passage of the Agriculture Retention and Development Act (ARDA). Since that time, more than 212,000 acres of farmland have been permanently preserved through the conveyance of agricultural conservation easements to a state, county, or nonprofit program. This equates to roughly 29% of the state's remaining farmland resources. Most often, preservation transactions are implemented through funding partnerships among the state program and county/local government and/or non-profit partners.

State funding for farmland preservation – and open space preservation more broadly – has derived largely from a series of bond referenda dating back to the early 1960s. Voter support for these referenda has remained strong, with public funding proposals twice (in 2007 and 2009) garnering support during the recent recession. In 1998, voters overwhelmingly supported the passage of the Garden State Preservation Trust Act, which authorized a constitutional dedication of sales tax revenues to fund land preservation over a ten-year period. In 2014, New Jersey voters approved a commitment of corporate sales tax revenues to provide "stable" funding for continued land easement acquisitions. In addition, all 21 counties and more than 300 municipalities have local dedicated funding sources in place to provide matching funds for land preservation, often in the form of a dedication from local property tax collections.

While public funding authorizations signal continued support for farmland preservation, less is known about the disposition of farmland owners. Recent USDA-supported research offers some insight into the perceptions of the farm community toward farmland preservation, providing some indication of the issues that may influence the future willingness of farmland owners to sell their development rights and the use of preserved farmland for agricultural production.

Are Farmland Owners Satisfied with their Preservation Decisions?

A USDA grant supported a survey of preserved farmland owners in New Jersey, Maryland and Delaware, three leading farmland preservation states. Collectively, these three states account for 28% of preserved farmland acres protected under the 27 state-sponsored conservation easement programs created in the U.S. A total of 507 landowners were asked to evaluate their experiences as owners of preserved farmland.

- Overall, 92% of owners are satisfied with their experiences with preservation; however, only 56.4% were “very satisfied" (35.8% said they were "satisfied"). Among (n=190) New Jersey respondents 49.5% were "very satisfied" while 41.6% were "satisfied."
- Owners were asked whether they made the right decision when they preserved their farmland (or acquired already preserved farmland). Among the (n=352) owners that sold develop rights, 70.4% said "definitely yes" while another 23.7% said "probably yes". Among (n=52) donors of development rights, 90.4% felt they definitely made the right decision, while another 5.8% said they probably made the right decision. Among the (n=102) purchasers of preserved farmland, 70.6% felt they definitely made the right decision when they acquired deed-restricted land (22.5% felt they probably made the right decision). Responses were less favorable among the (n=72) owners that inherited preserved farmland. Only 52.8% felt that their successor made the right decision when s/he preserved the land; another 20.8% felt they successor probably made the right decision. More starkly, nearly 1 in 5 (18.1%) felt their successor definitely did not make the right decision when preserving their land.
- Further probing reveals that several factors impact reported satisfaction levels. Statistical analysis shows several factors detract from landowner satisfaction with farmland preservation experiences, including being a second generation owner (those that purchased or inherited preserved farmland), encountering an unexpected deed-easement restriction that limited the use of the land, and experiencing administrative delays or hurdles. Concerns were expressed about how deeds of easement will be interpreted in the future as the agricultural industry continues to evolve.

Will Preserved Farmland Remain in Agricultural Production?

Another measure of the sentiment of the farm community toward farmland preservation is the extent to which deed-restricted farmland is being transferred to new owners interested in using the land for agricultural production. New Jersey’s deed of easement does not require that preserved farmland be kept in active farming, only that it remain “available for” agricultural use. The longevity of farmland preservation programs in NJ, MD, and DE allows for the examination of how land has been used and transferred over time.

- Across the three states, there is no evidence that "second generation" owners are systematically diverting preserved farmland from agricultural production (some preserved land, of course, is not farmed because of slopes, wetness, etc.). Overall, 74% of preserved farmland owned by first generation owners and 69% of preserved land owned by second generation owners (the difference is not statistically significant) is reported to be in agricultural production.

- A higher percentage of second generation preserved farmland owners were considered "young" farmers at the time they first owned deed-restricted land, as compared to first generation owners (15% versus 8%, and the difference is statistically significant).
- 39.3% of first generation owners have identified a successor that "definitely" or "probably" will farm the preserved land in the future. Reflecting, in part, the younger age of second generation owners, only 27.0% of the respondents in this subgroup have identified a likely farmer-successor.

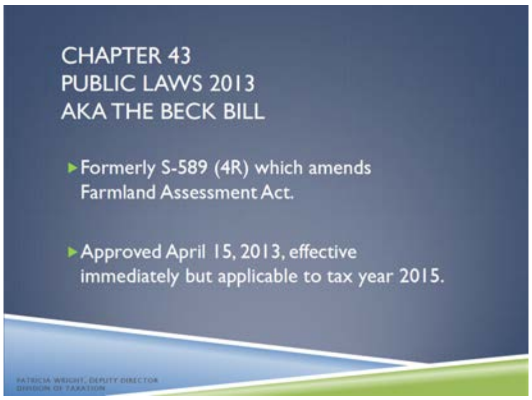
Views from the Front Line – What do Program Administrators Think?

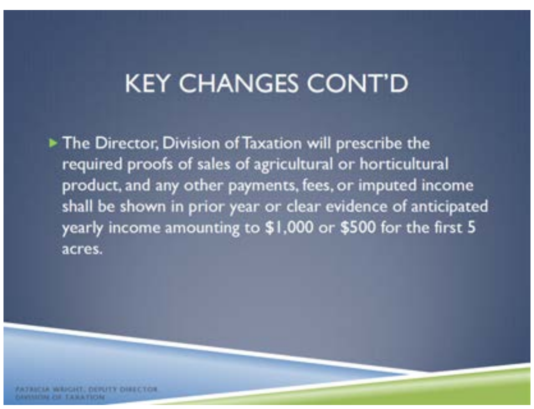
In May 2014, a national farmland preservation conference was organized in Hershey, PA. Conference attendees included more than 120 State, county, and non-profit farmland preservation program administrators, farmers, and related experts. During a capstone session, attendees were asked to rank the importance of issues expected to affect "the success of farmland preservation efforts with which [they] are most closely involved" using a 10-point (1 = not at all important to 10 = extremely important). The top five issues identified are:

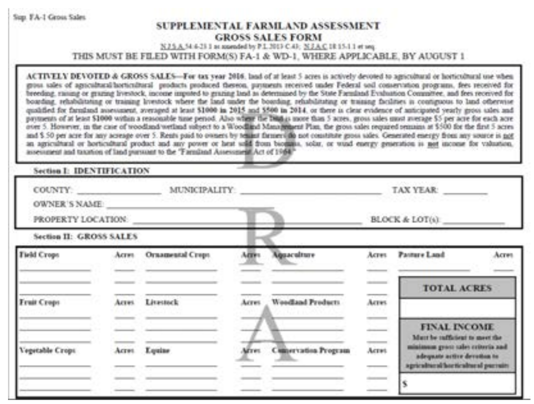
- Funding for continued farmland preservation (mean score: 9.06/10),
- Stewardship/post-preservation monitoring of preserved properties (8.80),
- Deed of easement interpretation/retaining business flexibility (8.60),
- Promoting the economic viability of preserved farms (8.22), and
- Coordinated planning for land preservation (8.11).

A REVIEW OF THE NEW FARMLAND ASSESSMENT CHANGES FOR 2015

Patricia Wright
Deputy Director, Division of Taxation
50 Barrack Street, P.O. Box 240
Trenton, NJ 08695-0240







Sup. FA-1 Gross Sales

SUPPLEMENTAL FARMLAND ASSESSMENT
GROSS SALES FORM
N.J.S.A. 54:4-23.1 as amended by P.L.2013 C.43; N.J.A.C. 18:15-1.1 et seq.
THIS MUST BE FILED WITH FORM(S) FA-1 & WD-1, WHERE APPLICABLE, BY AUGUST 1

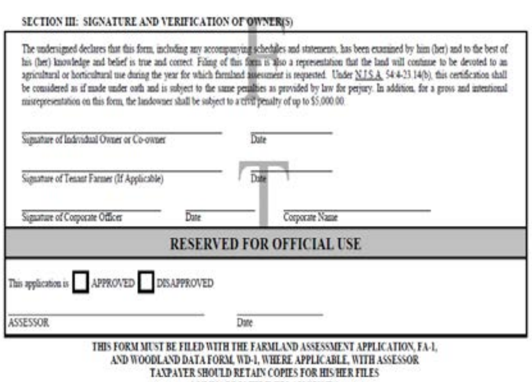
ACTIVELY DEVOTED & GROSS SALES—For tax year 2016, land of at least 5 acres is actively devoted to agricultural or horticultural use when gross sales of agricultural/horticultural products produced thereon, payments received under Federal soil conservation programs, fees received for breeding, raising or grazing livestock, income imputed to grazing land as determined by the State Farmland Evaluation Committee, and fees received for boarding, rehabilitating or training livestock where the land under the boarding, rehabilitating or training facilities is contiguous to land otherwise qualified for farmland assessment, averaged at least **$1000 in 2015 and $500 in 2014**, or there is clear evidence of anticipated yearly gross sales and payments of at least $1000 within a reasonable time period. Also where the land is more than 5 acres, gross sales must average $5 per acre for each acre over 5. However, in the case of woodland/wetland subject to a Woodland Management Plan, the gross sales required remains at $500 for the first 5 acres and $.50 per acre for any acreage over 5. Rents paid to owners by tenant farmers do not constitute gross sales. Generated energy from any source is not an agricultural or horticultural product and any power or heat sold from biomass, solar, or wind energy generation is not income for valuation, assessment and taxation of land pursuant to the "Farmland Assessment Act of 1964."

Section I: IDENTIFICATION

COUNTY: ______ MUNICIPALITY: ______ TAX YEAR: ______
OWNER'S NAME: ______
PROPERTY LOCATION: ______ BLOCK & LOT(s): ______

Section II: GROSS SALES

Field Crops	Acres	Ornamental Crops	Acres	Aquaculture	Acres	Pasture Land	Acres
						TOTAL ACRES	
Fruit Crops	Acres	Livestock	Acres	Woodland Products	Acres		
						FINAL INCOME Must be sufficient to meet the minimum gross sales criteria and adequate active devotion to agricultural/horticultural pursuits	
Vegetable Crops	Acres	Equine	Acres	Conservation Program	Acres	$	



SECTION III: SIGNATURE AND VERIFICATION OF OWNER(S)

The undersigned declares that this form, including any accompanying schedules and statements, has been examined by him (her) and to the best of his (her) knowledge and belief is true and correct. Filing of this form is also a representation that the land will continue to be devoted to an agricultural or horticultural use during the year for which farmland assessment is requested. Under N.J.S.A. 54:4-23.14(b), this certification shall be considered as if made under oath and is subject to the same penalties as provided by law for perjury. In addition, for a gross and intentional misrepresentation on this form, the landowner shall be subject to a civil penalty of up to $5,000.00.

Signature of Individual Owner or Co-owner ______ Date ______

Signature of Tenant Farmer (If Applicable) ______ Date ______

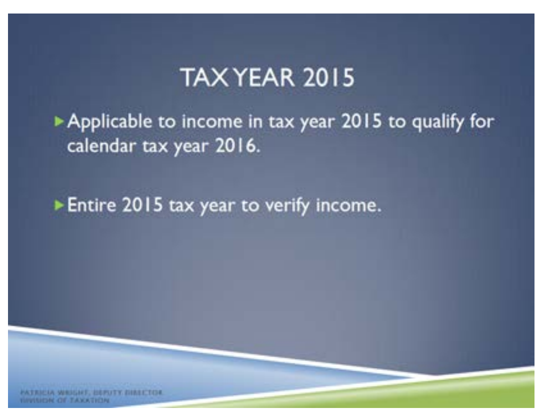
Signature of Corporate Officer ______ Date ______ Corporate Name ______

RESERVED FOR OFFICIAL USE

This application is ☐ APPROVED ☐ DISAPPROVED

ASSESSOR ______ Date ______

THIS FORM MUST BE FILED WITH THE FARMLAND ASSESSMENT APPLICATION, FA-1,
AND WOODLAND DATA FORM, WD-1, WHERE APPLICABLE, WITH ASSESSOR
TAXPAYER SHOULD RETAIN COPIES FOR HIS/HER FILES
ANNUALLY FILE BY AUGUST 1



STATE BOARD OF AGRICULTURE AND THE DEPARTMENT OF AGRICULTURE

- Within one year of Chapter 43's enactment, guidelines are to be developed identifying "generally accepted agricultural and horticultural practices" to assist in determining "active devotion".

PATRICIA WRIGHT, DEPUTY DIRECTOR
DIVISION OF TAXATION

GUIDELINES AND APPLICATION

- Division of Taxation shall review guidelines and upon approval adopt them as regulations.
- The Director, Division of Taxation must include with each application an explanation of new changes to program requirements that occurred in the prior tax year and that will affect the year for which the application is filed (July 2014).

PATRICIA WRIGHT, DEPUTY DIRECTOR
DIVISION OF TAXATION

GUIDELINES FOR GENERALLY ACCEPTED AGRICULTURAL/HORTICULTURAL PRACTICES UNDER FARMLAND ASSESSMENT

- Pursuant to N.J.S.A. 54:23.1 et seq. as amended by Chapter 43, Laws of 2013

PATRICIA WRIGHT, DEPUTY DIRECTOR
DIVISION OF TAXATION

CHAPTER 43 ROLL BACK TAXES

- Land previously qualified as actively devoted to agricultural or horticultural use but failing to meet the additional requirements on gross sales shall not be subject to Roll Back taxes provided that the land remains in agricultural or horticultural use.

PATRICIA WRIGHT, DEPUTY DIRECTOR
DIVISION OF TAXATION

IMPORTANT NOTE FOR HORSE FARMS

- The boarding, training, and rehabilitating of horses and ponies only qualifies for farmland assessment if the land on which these activities occur is contiguous to 5 acres that independently qualify for farmland assessment
- With the increase in minimum gross sales, imputed grazing value for 5 acres will no longer cover the minimum
- Farms that currently qualify for the minimum $500 income on imputed grazing value of pasture land should be encouraged to diversify their products to meet the new $1,000 income minimum

PATRICIA WRIGHT, DEPUTY DIRECTOR
DIVISION OF TAXATION

SOIL CONSERVATION

- Land qualified as actively devoted to agricultural or horticultural use as of the day before the enactment (4/14/13) of Chapter 43 due to the use of payments and fees and under a soil conservation program agreement with any agency of the federal government shall continue to qualify until the end of the soil conservation program agreement period.

PATRICIA WRIGHT, DEPUTY DIRECTOR
DIVISION OF TAXATION

CONTINUING EDUCATION

- On or before January 1, 2018 and at least once every 3 years thereafter, all municipal and county assessors with farmland assessed property in their district are required to have completed a continuing education course on farmland assessment for the renewal of the CTA certificate.
- Courses will become available after July 1, 2015.

FARM LESS THAN 7 ACRES

- Where a farm's acreage is less than 7 acres, a descriptive narrative of the agricultural / horticultural uses, a sketch of their location and the number of acres devoted is required to be submitted by the landowner with the application.

FARM LESS THAN 7 ACRES

- Farm Management Unit means a parcel or parcels of land, whether contiguous or non-contiguous together with agricultural or horticultural buildings, structures and facilities producing agricultural or horticultural products, and operated as a single enterprise.
- Narrative Describing agricultural or horticultural uses
- # of acres devoted to those uses
- Sketch of the location of those uses

NO CHANGE – NEW WOODLAND TRACTS

- For lands not previously qualified under the Farmland Assessment Act, you must:
  - Submit with application a map of land use classes and soil groups that conform with standards established by the Division of Taxation in consultation with the State Board of Agriculture.

LAW – FOREST STEWARDSHIP

- Forest Stewardship – no proof of income, but documentation needed to demonstrate implementation of forest stewardship plan including:
  - Documentation of scheduled activities
  - A forest inventory and yield parameters to document forest productivity
  - And inspections performed in accordance with DEP rules and regulations

CONTINUING EDUCATION

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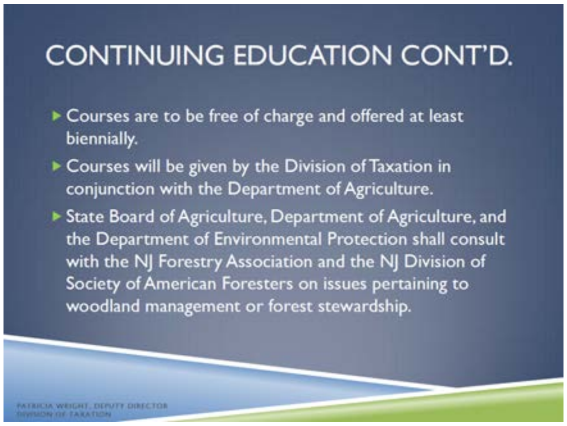
CONTINUING EDUCATION CONT'D.
Courses are to be free of charge and offered at least biennially.
Courses will be given by the Division of Taxation in conjunction with the Department of Agriculture.
State Board of Agriculture, Department of Agriculture, and the Department of Environmental Protection shall consult with the NJ Forestry Association and the NJ Division of Society of American Foresters on issues pertaining to woodland management or forest stewardship.
PATRICIA WRIGHT, DEPUTY DIRECTOR
DIVISION OF TAXATION


FARMLAND EVALUATION COMMITTEE (FEC)
The State Farmland Evaluation Advisory Committee (FEAC) is renamed the State Farmland Evaluation Committee (FEC) and is authorized to review the minimum Gross Sales amount and adjust it as needed.
Increases would not be enforced until the third tax year following adoption of an increase.
Also every 5 years the Committee is to review application forms and make recommendations to the Director, Division of Taxation.
PATRICIA WRIGHT, DEPUTY DIRECTOR
DIVISION OF TAXATION


FARMLAND EVALUATION COMMITTEE (FEC)
The State FEC shall meet from time to time on the call of the Secretary of Agriculture or the Director, Division of Taxation.
Continues to set the farmland values by land use and productivity.
PATRICIA WRIGHT, DEPUTY DIRECTOR
DIVISION OF TAXATION


FARMLAND EVALUATION COMMITTEE (FEC)
The State Farmland Evaluation Advisory Committee (FEAC) is renamed the State Farmland Evaluation Committee (FEC) and is authorized to review the minimum Gross Sales amount and adjust it as needed.
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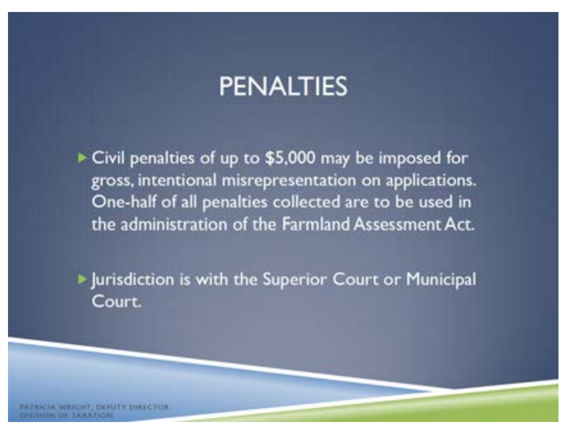
Also every 5 years the Committee is to review application forms and make recommendations to the Director, Division of Taxation.
PATRICIA WRIGHT, DEPUTY DIRECTOR
DIVISION OF TAXATION


CERTIFYING FACTS ON APPLICATION
Facts as set forth on FA-1 and WD-1 are true.
Statements certified shall be considered as if made under oath.
Subject to the same penalties as provided by law for perjury.
PATRICIA WRIGHT, DEPUTY DIRECTOR
DIVISION OF TAXATION


PENALTIES
Civil penalties of up to $5,000 may be imposed for gross, intentional misrepresentation on applications. One-half of all penalties collected are to be used in the administration of the Farmland Assessment Act.
Jurisdiction is with the Superior Court or Municipal Court.
PATRICIA WRIGHT, DEPUTY DIRECTOR
DIVISION OF TAXATION

FARMLAND ACCESS/LEASING INITIATIVES AND DEMONSTRATION OF NEW FARMLAND LINKING WEBSITE

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Office of Research Analytics
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Erica Evans
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State Agriculture Development Committee
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A three-year collaboration between the Northeast Organic Farming Association-New Jersey (NOFA-NJ) and the State Agriculture Development Committee (SADC) using grant funds provided by the U.S. Department of Agriculture's National Institute of Food and Agriculture (USDA-NIFA), *Plowing Ground in New Jersey: Growing New Farmers and Generating Alternative Land Linkages* tackled several issues endemic to sustaining agriculture in the nation's most populated state. Specifically, the project addressed the paucity of beginning farmers and programs to support them as well as access to land in the state with the highest cost of farmland per acre.

Due to the difficulty in securing fee simple ownership, particularly for young and beginning farmers, the project focused on the leasing of farmland and developing the land linkage infrastructure needed to facilitate it. Accordingly, the project consisted of four major components: developing a leasing resource guide for landowners and farmers, organizing and holding informational meetings for landowners, developing the curriculum for and holding educational courses for landowners, and enhancing online linking capacities for farmers and landowners. Tangible outcomes included the publication of *Leasing Farmland in New Jersey: A Guide for Landowners and Farmers* and associated leasing worksheets -- one for landowners and one for farmers -- to help clarify goals and needs of both parties when planning for a lease and how to evaluate potential leasing opportunities.

This presentation will briefly summarize the outcomes of the project and will focus on the last major component of the grant -- enhancing online linking capacities for farmers and landowners. Through a contract between NOFA-NJ and the Office of Research Analytics at the New Jersey Agricultural Experiment Station, Rutgers University (NJAES), with conceptual framework developed by SADC, an innovative online mapping approach is being developed to bring a spatial component to an otherwise one-dimensional farm link paradigm. Through this web-based system, landowners looking to lease or sell land or farmers looking to lease or buy land will be able to submit listings in a tabular format, which in turn will be joined to a mapping program that will display all listings around the state that meet the search criteria. For instance, a beginning rancher looking to lease a minimum of 200 acres in the townships of Hope, Blairstown, Knowlton, and White in Warren County that have an existing farmhouse and barn can simply input the search parameters and quickly view the properties that meet his or her criteria. Listings will include aerial photography and parcel boundaries, and future features such as Category 1 streams, wetlands, and soils maps are planned in order for prospective tenants to make informed decisions. The presentation will demonstrate the beta site that is currently being developed for eventual release later in 2015.

AGRICULTURAL CONFLICT RESOLUTION - UPDATE ON THE AGRICULTURAL MEDIATION PROGRAM

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With a robust agricultural economy evidenced by the second-highest net farm income among states, yet with the highest population density of any state, it should come as no surprise that New Jersey administers one of the nation's most active Right to Farm (RTF) programs. RTF routinely handles conflicts between agricultural producers and neighbors or municipalities and conflict resolution takes two forms. Most often, a formal process is undertaken whereby an individual or municipality aggrieved by the operation of a commercial farm is required to file a complaint with the appropriate County Agriculture Development Board (CADB), or the State Agriculture Development Committee (SADC) in counties where no CADBs exist, prior to filing action in court. However, an alternative conflict resolution process is available to settle disputes through the state's Agricultural Mediation Program. In contrast with formal RTF complaint proceedings, mediation enables farmers and others to discuss and resolve their issues more quickly and informally. The mediation process is less adversarial, allows parties to shape their own solutions and agreements, and helps maintain better relationships and prevent additional conflicts in the future. Most RTF-related mediations involve a single mediation session. Additional or follow-up sessions may also be scheduled depending on the nature of the issues or the parties' interests. The mediation process is voluntary, confidential, and free.

This presentation will provide an overview of this underutilized resource, review a few case studies of specific conflicts and how mediation successfully resolved them, and describe recent efforts by the SADC to promote this program through advertising and outreach.[1] In addition to discussing how mediation can bring about a resolution of RTF issues, a synopsis will also be provided as to how the New Jersey Agricultural Mediation Program dovetails with the U.S. Department of Agriculture's (USDA) Agricultural Mediation Program to resolve agricultural credit issues between farmers and private lenders as well as resolve adverse determinations associated with USDA's agencies and their respective programs.

[1] The names of the parties involved in the case studies will be kept confidential.

ORGANIC 1

Food Safety Considerations for Organic Farms

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Food safety affects all growers no matter their production philosophy, their operation size or their distribution methods. Food safety is a part of producing a quality product and good growers instinctively include this in their daily practices. A number of organic and conventional farm food safety walk thoughs have been conducted in New Jersey to assess the level of risk for human pathogens. It was found that while tweaks may be needed farms are already reducing the risk of cross-contamination on many levels. Farms, third party audit or not, should have a farm food safety plan in place. The creation and the annual review of this plan will offer growers the opportunity to focus on farm activates with food safety in mind.

Extensive farm sampling has taken place annually starting in 2012. Twenty-three New Jersey farms have participated in the sampling of: irrigation water sources, end of line water, animal based composts, soils, produce surfaces, and product contact surfaces. The objective of this sampling is to evaluate human pathogen risk in New Jersey farm environments. The presentation of the collected data will help ensure that future development of risk metrics is both effective and appropriate for all scales and styles of production.

Results showed no difference in generic *E. coli* levels on organic or conventional farms. Sampling results combined with farm walk throughs allowed the Rutgers Farm Food Safety team to identify the most critical areas for risk reduction on farms in New Jersey.

Irrigation Water Sources

Well water sources showed no evidence of generic *E. coli* while all surface water sources showed evidence of generic *E.coli*. Generic *E. coli* counts, when found, varied greatly. Generic *E. coli* is expected in surface water and this was shown during our sampling. Growers, especially those working with small acreage, have limited water resources and many farms rely only on surface water. Those using a surface water source for overhead irrigation should keep in mind the potential for contamination of their product. Drip irrigation is an excellent method of keeping water off of the harvestable crop and a reasonable solution to reducing cross-contamination on the farm. Many samples had generic *E. coli* levels above the currently accepted recreational water thresholds. On farms where the water source tested positive for generic *E. coli* the *E. coli* was also found in the end of the line samples. Time and distance travelled did not eliminate the generic *E. coli*. Growers are encouraged to evaluate the risk involved with their irrigation water source and consider options to reduce risk.

Animal Based Composts
Five New Jersey farms were sampled monthly during the summer months in 2014. The compost piles represented varying methods of management including a stagnant pile, a pile mostly conforming to the National Organic Program Standards (NOP), and piles which conformed to the NOP standards. Piles conforming to or mostly conforming to the NOP standards were found to have very low levels of salmonella and lower levels of generic *E. coli* than the static pile. Ingredients of each pile varied but generally included horse, sheep and goat manure, wood chips, municipal leaves and/or mushroom compost. Growers are encouraged to conform to the NOP standards when composting with animal waste and to document their composting activities. Attention should also focus on locations of animal manures on the farm. Crops should be uphill from manure storage areas, pastures and animal housing. Crop rotations and existing structures can limit your options, but some sampling results showed the possibility of *E. coli* movement from one area to another during a rain event.

Produce Contact Surfaces
Three organic farms participated in swab sampling of product contact surfaces in the packing area. Generic *E. coli* and ATP (molecules that pathogens can use as an energy source) were assessed. Swabs were taken when the packing area was actively in use and after the packing surface had been cleaned using the farms standard cleaning practice. Swabs were taken during the packing of tomatoes, leafy greens, onions, and apples. In most cases generic *E. coli* and ATP numbers were what we would expect to see during the packing of fresh produce. When cleaning was done appropriately it was effective, provided a sanitizer was used, at reducing the generic *E. coli* number to zero and the ATP to acceptable levels. Diluted bleach was found to be the most effective sanitizer used. All farm operations had designated an individual responsible for overseeing the cleaning of the product contact surface. When that individual was not present during the cleaning of the surface it was found that the cleaning was not as effective. Growers are encouraged to develop a Standard Operating Procedure (SOP) detailing the materials needed for and the steps required to effectively clean the product contact surface. The SOP should be used for employee training and posted in the packing area.

Risk Assessments
Risk assessments are a in depth look at various areas of the farm to identify the potential risk involved with them. A complete risk assessment involves identifying the hazard, the potential risk of that hazard, what existing control measures are in place, and determining the actual risk of harm being done. Organic farms may want to create the following written risk assessments, depending on the location of and practices that are specific to the farm:

- Adjacent land
- Prior land use
- Farm water source and use
- Wild and domestic animal activity
- Soil amendments used
- Packing area

- Transportation methods (on and off farm)
- Produce distribution area

Standard Operating Procedures
Standard Operating Procedures (SOPs) are written documents that detail every aspect of an activity or procedure. They are written by someone familiar with the task, reviewed by someone not familiar with the task, and are updated as activities change or are modified. A well written SOP should include: title, date of creation, table of contents, standards or regulatory information, definitions (if needed), materials needed, sequential procedure, equipment used, and safety considerations. Suggested SOPs, depending on the activities conducted, for organic farms are:

- Hand washing
- First aid response
- Harvest tools and equipment cleaning and storage
- Produce washing
- Produce contact surface sanitation
- Pre-harvest risk assessment
- Antimicrobial use
- Product transportation vehicle cleaning
- Traceability

Research has shown that consumers have greater confidence in fruits and vegetables produced at local farms. We expect with the implementation of the Food Safety Modernization Act and continued media focus on food safety that you the grower will be faced with questions from your consumers about your food safety practices. Having a farm food safety plan, including risk assessments and SOPs, is an excellent way to show consumers that you are committed to providing a safe quality product.

For more information on small farm food safety visit:
Rutgers Vegetable Crops Online
http://njveg.rutgers.edu/

Rutgers Plant and Pest Advisory
http://plant-pest-advisory.rutgers.edu

The Produce Safety Alliance
http://producesafetyalliance.cornell.edu/psa.html

ORGANIC FARMING WITH COVER CROPS

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Cover crops garner attention for the ecosystem services they offer, but adoption rates are still challenged by the trade-off between the potential yield gains of the cash crop and the demand for space and time of cover crops. The nutrient management benefits of cover crops have been well established, with reports of up to 200 pounds of nitrogen per acre scavenged by winter annual cover crops, and trapped in the aboveground biomass, in fields fertilized with manure, and legume cover crops, depending on growing conditions and species, producing over 100 pounds of nitrogen per acre. Positive effects on weed management, rated as the biggest challenge in organic production by many farmers, have also been observed in the literature, although the economic impacts of cover crop weed suppression are less established. Combining nutrient contributions with weed suppression creates a persuasive argument for the extra expense and time of managing a cover crop during the crop production season. In addition, future benefits from cover crop carbon contributions to the soil should be considered when examining the trade-offs of such a system. In this talk, we will look at ways to value the long-term effects of cover crops and different strategies for incorporating cover crops into the production plan, including while cash crops are growing. The summer fallow, a weed management strategy, will be re-examined with cover crops such as sunn hemp.

Glyphosate Issues and Remediation

February 3, 2015
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Glyphosate is the active chemical ingredient in Roundup and many other brand name herbicide(s) that are designed to kill every living plant they touch. Whether a farmer is using these herbicides on his land or not glyphosate is very likely affecting every crop production system in the US. The presence of glyphosate in the air, the rain, the rivers and most types of manure is something that all farmers need to be aware of. The use of glyphosate herbicide in broad acre crop production as well as in specialty crop production that is not organic is also affecting organic producers.

This brief session will explain how glyphosate kills a plant as well as how it is causing a new spectrum of weeds to fight in crop production. A variety of crops from apples to wheat are being adversely affected by glyphosate and the subsequent diseases that follow the herbicide's use closely. Learn how to recognize the signs of glyphosate damage in a plant and what is needed to address these problems with successful solutions. Micronutrient foliar applications and biological amendments offer solutions to glyphosate toxicity and improved plant performance for better crop production and better quality crops.

Glyphosate is also affecting many mammals and you will be shocked when you learn how widespread the issues are that you could very likely be witnessing and not even realize it. There will be a limited time of Q & A after the presentation.

WORKSHOP FOR NEW WINE GRAPE GROWERS 1

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

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

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

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

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

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

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

High Tunnels

COVERING MATERIALS FOR GREENHOUSES AND HIGH TUNNELS

Blair Busenbark
Adaptive Plastics Inc.
COO/Sales
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Salem, OR 97303

Choosing a greenhouse/high tunnel covering option is not always an easy task. There is no one-size-fits-all selection that is the best choice for everyone. Multiple variables affect the decision process - including which crops you grow, the location of your facility and a variety of variables that are unique to your situation. Often the primary factor in the selection process is how much you can afford to spend. Human factors also impact the decision process including access to trained labor, managements' willingness to change and tolerance for risk.

Impact on Cost of Production: For both short-term and long-term viability of your business, the primary criteria in selecting the appropriate greenhouse covering for your business should be the covering's impact on your cost of production. The cost of production needs to include costs associated with the entire lifetime of the covering being considered. A covering option may have a lower initial cost, but may have higher overall costs over the lifetime of the covering.

Budget: Depending upon covering option selected, the expenditure to recover a greenhouse could either be expensed immediately, or treated as a capital expenditure. Typically, a capitalized greenhouse covering purchase or a large immediately expensed purchase is a budgeted purchase. From that standpoint, the development of a budget is probably the first step in the greenhouse covering purchase process.

Energy Efficiency: A 2014 Greenhouse Grower survey indicated that energy costs were the number one production cost for today's greenhouse growers. Your selection of the type of greenhouse covering is an important factor in determining the energy efficiency of your operation. This factor is compounded based on the energy source you use. Fuel oil and propane usage tend to increase the impacts of energy efficiency efforts due to their higher cost. The benefits of energy efficiency projects are still there when lower cost energy options like natural gas are used, but it often leads to a longer term return on investment.

In the northern latitudes, we know cold weather is inevitable. Therefore choosing a greenhouse covering that promotes good heat retention is critical. This point is true whether you **actively heat** or **passively heat** your greenhouse. Selecting a greenhouse covering with a high R-value is critical for improved energy efficiency. A material's R-value measures the capacity to insulate and or resist heat flow. The higher the R-value, the greater the insulating power. The following table outlines some common greenhouse covering options and their corresponding R-values. The column on the right illustrates the improved percent performance of selecting Solexx™ 5.0 mm, the highest R-value option. For example Solexx 5.0 mm is 26% better at insulating than 6.0 mm double polyethylene film.

Greenhouse Covering	R-Value	% Improvement with 5.0 mm Solexx
5.0 mm Solexx*	2.30	
3.5 mm Solexx*	2.10	9%
8.0 mm Triple Wall Polycarbonate**	2.00	13%
Double Pane Window	2.00	13%
10.0 mm Twin Wall Polycarbonate**	1.89	18%
6.0 mm Double Polyethylene Film***	1.70	26%
8.0 mm Twin Wall Polycarbonate**	1.60	30%
6.0 mm Twin Wall Polycarbonate**	1.54	33%
5.0 mm Double Polyethylene Film***	1.50	35%
4.0 mm Twin Wall Polycarbonate**	1.43	38%
3.0 mm Single Pane Glass	0.95	59%
Corrugated Polycarbonate	0.88	62%
6.0 mm Single Polyethylene Film	0.83	64%
Corrugated Fiberglass	0.64	72%

* With caulked flutes
** With tape sealed flutes
*** Requires constant inflation to maintain R-Value

Cooling performance is another important factor to consider. How much will the greenhouse heat up in warmer weather? Manufacturers typically report a solar heat gain coefficient to answer this question. The lower the number, the less heat is transferred into the greenhouse through solar radiation. Products that produce diffused light provide additional help to reduce greenhouse temperatures. And finally, you should also consider if you will need to whitewash the greenhouse covering. If you do, include those costs in your evaluation. Additionally, it should be noted every time you apply whitewash to your greenhouse covering, you lower the long term light transmission for your greenhouse covering.

Product Durability: Another critical criteria to consider is product durability. How long is the product warranted? What does the warranty cover? Not all warranties can be considered equal. How easy is it to damage the covering? And simply how is the product repaired if there is any damage? Technical Guides, websites and an informed sales/customer service team should be able to supply you with this information.

Climatic Performance: Recently, this area of the U.S. has experienced both a hurricane and the impact of a polar vortex. These kinds of events raise awareness of how critical, weather performance is for a long-term greenhouse covering. Wind performance is a combination of greenhouse covering product traits, installation method used and structural strength. Look for greenhouse covering products that are more solid, attached more firmly and improve the strength of the structure. The simple question to ask about **hail** damage is; "How pliable is the product?" If the surface is rock hard, small hail will bounce off and possible cause a small marks. Larger hail will break the hard surface. Extremely pliable products typically get damaged with a larger range of hail sizes. If the greenhouse covering product is in the middle, and it allows the hail to bounce off the pliable surface without causing damage to the surface, this option is probably your best choice.

Depending on where you grow, **snow/ice** performance could be vital in the selection process. It is important to point out that the snow load of a greenhouse is determined by its physical structure, not the greenhouse covering. However the choice of covering can improve your greenhouse's performance. You should avoid products that allow snow/ice to accumulate and that are easily damaged when snow/ice move during a thaw. Insurance policies typically require that you run your heaters (even if the greenhouse is empty) if you suspect the snow load on your structure could take your greenhouse down. Your insurance typically will not cover the cost to heat your greenhouse in this circumstance. Ideally you want a greenhouse covering that allows the snow/ice to easily slide off and does not get easily damaged by sliding snow and ice. It's wise to check with your insurance agent or broker to confirm the extent of coverage that you have in place.

Light Transmission: Many growers use a manufacturer's reported light transmission percent as their most important factor in selecting a greenhouse covering. This one number does not fully answer the light transmission question. Consider several. How was the documented light transmission measured? Was it independently measured? How was it measured? Through an ASTM test, and if so, which one or a portable light meter test? How does the covering's light transmission decrease with age? Does the manufacturer have information to support their claims about the loss of light transmission with age? Does the product yellow with age? Is the product know to yellow with age? And finally what will be the impact of whitewashing on light transmission over time?

Diffused Light: Numerous studies have shown the value of diffused light in plant production. Generally, better plants are produced in diffused light. There is a balance you need to consider between light transmission and percent diffused light. A grower needs to evaluate what ratio of light diffusion and light transmission is best for your circumstance and adjust their production practices to match what covering option they have chosen.

Installation: Other factor to consider that are often overlooked include installation costs, and product versatility and limitations. You need to ensure you evaluate comparable installation costs. For example, when comparing a four year product to a ten year material, you should consider three times the installation labor for the four year product. What weather conditions do you need to install? Can it be windy? Extremely hot or cold? Can you consider a mix of covering options? And finally, can the greenhouse covering option cover your style of greenhouse?

It is important to include all costs when considering several covering options. Often overlooked costs include **shipping** and installation costs; double polyethylene film inflation costs; insurance costs including replacement costs vs. depreciated costs; maintenance costs and the cost to recycle or waste disposal when the covering is replaced.

Other considerations: If you choose a covering option that can be recycled, how does it impact your sustainability score you might have with a customer? Does the new covering qualify for a USDA REAP grant or a local utility energy credit? And finally what is the return on investment when you choose a covering option? If you perform an energy audit using the USDA Virtual Grower software you have the ability to evaluate greenhouse covering options under a variety of scenarios and their impact on energy usage. In addition to the energy saving generated by Virtual Grower, you should include all of the other costs factors previously mentioned to generate a true return on investment.

And last, but not least, consider how your primary crops perform when grown under the greenhouse covering. What role do factors like heat retention, cooling performance, light quality and light quantity play in your efforts to produce a quality plant?

As you can see the process in selecting a greenhouse covering is complex. The following table includes generalized information about some of the more common options.

In summary one covering option does not work for everyone, but the variety of options allows growers to select which is best for their operation.

	Single Polyethylene Film	Double Polyethylene Film	Twin-walled Polycarbonate	Glass	Solexx™
Heat Retention	Minimal	Varies, good to very good (IR Film)	Varies, good to very good	Varies, minimal to good	Excellent
Longevity	3-5 years, 1 year available	3-5 years	10 plus years	10 plus years, durability issues	10 plus years
Snow/Ice Performance	Poor	Poor to average	Very good	Good	Very good
Wind/Hail Performance	Poor	Poor to average	Good	Poor to average	Very good
Light Quantity	Varies, good to very good, decreases with age, white wash affect	Varies, good to very good, decreases with age, white wash affect	Varies, good to very good, decreases with age, white wash affect and yellowing	Excellent, white wash affect	Good
Light Quality	Varies, poor to good	Varies, poor to good	Varies, good to very good, decreases with age due to yellowing	Varies, poor to good	Excellent
Cooling Performance	Poor	Varies, poor to average	Varies, good to very good	Varies, poor to average	Very good
Overall Costs (assume heated)	Low initial, higher overall	Low initial, good overall	Higher initial, average overall	Higher initial, higher overall	Higher initial, good to very good overall
Best Uses	Single season, frost protection, No heat, Cut in summer	Shorter term needs, Known standard	Known standard	Popular for high light crops, known standard	Energy Saving, Diffused Light, Flexibility of product

COOL SEASON CROP PRODUCTION IN TUNNELS

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In Northern New England, expanding winter marketing opportunities have increased growers' interests in harvesting cool-season crops throughout the winter using various methods of season extension. I will share conclusions drawn from 1) our own experiments in unheated high tunnels and low tunnels, 2) our own experiments growing greens in minimally heated greenhouses, and 3) commercial growers that are successfully growing cool season crops in tunnels. This work has been done in partnership with colleagues at University of Massachusetts (Ruth Hazzard, Amanda Brown and others) and the University of New Hampshire (Brian Krug), as well as many collaborating growers.

Crop growth constraints

The two main constraints to growing crops throughout the winter in cool climates are temperature and light.

Temperature – Low temperatures affect plants in a couple of ways. Growth rate slows as temperature decreases, and when temperature reaches a certain point (the base temperature of a plant species), growth ceases completely. Plants also can experience several kinds of damage from low temperatures, including freeze damage (which can rupture cells), dessication (because water is lost from plant tissues faster than it is taken up), and frost cracks (because plant tissues expand when they warm up and contract when they cool down).

Plant species vary in their response to low temperatures. Base temperatures vary between 40-65F, meaning that some plants continue to grow even under relatively cool temperatures. Some species are hardier than others, meaning that they are more resistant to chilling and cold injury. Hardier plants acclimate to cold temperatures, meaning that they respond to gradual exposure to low temperatures by becoming more resistant to freeze damage.

Light – Daylength fluctuates throughout the year. The amount it varies depends on latitude, but for central NH, there are fewer than 10 hours of daylength between approximately Nov 11 and Feb 3. In addition, the low angle of the sun further reduces light incidence on growing crops. As a result, without supplemental light, photosynthesis is very limited during the late fall and early winter months.

In practice, winter growers cope with these environmental challenges using several strategies: using a range of season extension structures, choosing hardiest crops, minimal heating, and stockpiling.

Season extension structures

Season extension strategies range from applying rowcover over field crops to using fully automated greenhouses with supplemental heat and light. Three strategies that fall somewhere in-between (low tunnels, high tunnels and minimally heated greenhouses) are most commonly used among winter growers in New England (zones 4-7).

Low tunnels are small tunnel structures built over crops growing in-ground. These may be covered with rowcover and/or plastic, depending on the intended harvest time frame. Because of difficult access once ground is frozen, low tunnels are best suited for crops that are harvested in the late fall, or ones that are overwintered and harvested in early spring. For more information, see our reports *Using low tunnels for overwintering crops,* at http://extension.unh.edu/resources/files/Resource004419_Rep6301.pdf, and *Effects of low tunnels on winter temperatures, at* http://extension.unh.edu/resources/files/Resource004242_Rep6077.pdf.

High tunnels offer more temperature protection than low tunnels, and allow access and harvest throughout the winter. For winter production, it's important to use structures that are meant to withstand snow load. Without supplemental heat, the use of additional layers of rowcover supported over the crops is important for quality and survival. Growers are divided on the importance of daily removal of rowcover and ventilation.

Greenhouses (or tunnels with supplemental heat) allow more production during the coldest months; but the important question is whether increased production offsets the additional costs. We have done some work investigating the productivity of benchtop production systems in greenhouses like those used for ornamental bedding plant production during spring, and have generated an enterprise budget spreadsheet to help growers assess the potential profitability of this system. The enterprise budget is available at: http://extension.unh.edu/resources/files/Resource004050_Rep5728.xlsm.

Crop choice

For unheated high tunnels, spinach is the most common winter crop among winter growers. While spinach is relatively slow growing, it is very hardy. Individual leaves are harvested, leaving the growing point, which continues to produce new leaves that can be harvested over a long period of time. If established in early fall, spinach can be re-harvested throughout the winter. Growers report yields in the range of 0.4-0.7 lbs per square foot over the entire winter. Varieties differ in terms of productivity, earliness, leaf shape and ease of harvest. Many growers find that prioritizing varieties with resistance to many races of downy mildew is good insurance for winter production.

There are several members of the brassica family hardy enough to survive in unheated tunnels. These can be harvested either as baby leaf/salad size or as larger braising greens, and include kales, mustards, arugula, mizuna, Tokyo bekana and tatsoi. Two unrelated greens, claytonia (miner's lettuce) and mache (Valerianella spp.), are also well suited to production in unheated tunnels, but both are very slow growing. You can read more about different varieties' in *Salad*

green varieties for benchtop production, at
http://extension.unh.edu/resources/files/Resource003798_Rep5413.pdf

There are many other crops that can survive and perform well in unheated tunnels, but that are less commonly grown. In comparison to spinach, they generally have lower potential yields per unit of time that they occupy valuable tunnel space. These include purple and green sprouting broccolis (cv. Santee and Happy Rich), garlic scallions (fall-planted bulbils), cilantro, summer-planted carrots and fall-planted onions. Lettuce and chard are two species that may suffer damage from freezing temperatures, and that are better suited for late fall harvest than for production through the coldest winter months.

Minimal heating

Many growers that aim to harvest greens through the entire winter in cold climates use minimal heat in their tunnels/greenhouses to prevent the air temperature inside the structure from falling below 32F. The goal is to prevent freeze damage to greens crops, increasing crop quality. Common set points are 35, 37 or 40F. Depending on the type of structure, heat source, climate and weather, the costs of heating to these temperatures can vary widely.

We conducted several experiments in side-by-side greenhouses heated to minimum temperatures of 40F and 50F to determine whether additional supplemental heating would increase rates of growth enough to be economically feasible. Our graduate student, Claire Collie, did this by seeding over a large range of dates in two years, for three species: lettuce, mizuna and spinach. She found that, as you would predict, higher temperatures made greens reach harvestable maturity faster. In our conditions, however, the cost of heating, especially during the coldest months, was high enough in the warmer house that the faster growth did not make up for the increased costs. Further, for mizuna, it appeared that the greens grown in 40F were heavier than those grown in 50F, resulting in higher yields under cooler temperatures.

Stockpiling

A common strategy for winter growers in cold climates is "stockpiling", or establishing plantings in the early fall before growth rates slow precipitously. This is particularly important for those producing without any supplemental heat (common for in-ground spinach production), to maintain high quality harvestable greens throughout the winter. Throughout December and January, the unheated tunnel essentially acts as a large refrigerator, preserving the crops in place. Once established, plants may be harvested as needed in late fall or early winter, and some have the potential to regrow as temperature and light increases in the spring.

High Tunnel Construction and Operation Update

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High tunnels are relatively inexpensive structures that allow growers to extend the growing season and to increase the level of protection from adverse weather conditions (e.g., cold temperatures, heavy precipitation). Some growers are using these structures year-round by growing cold hardy crops during the winter season. But most growers halt production during the winter months because heating these structures is usually not economical. The typical single layer of plastic film that covers most high tunnels provides little insulation to shield the crop(s) from cold outdoor conditions. As season extenders, high tunnels allow for earlier plantings compared to field production and can they support a crop later into the fall season. This extension of the growing season can increase the overall yield and can deliver crop yields during harvest windows not available to field production. These yield advantages can significantly boost the economic return from an investment in a high tunnel production system.

In order to maximize crop yields from high tunnels, optimum growing conditions should be maintained throughout the growing period. Maintaining optimum conditions requires labor (in case the necessary adjustments are done manually), or some amount of technology (e.g., sensors and activators). As more technology is introduced in high tunnels (e.g., for environmental control, irrigation), the system starts resembling a more high-tech greenhouse environment. But adding technology can be expensive and requires oversight and maintenance. Since most growers that use high tunnels are keen on minimizing investment costs and (where possible) labor requirements, most high tunnels are designed for and operated with minimal technology. As a result, high tunnel construction should be well thought out and implemented with care for local conditions (e.g., ground slope, prevailing wind conditions, access, nearby structures and vegetation) and constraints (e.g., investment budget, size and shape of the structure, soil type, pest and disease issues, availability of water and electricity).

In this presentation, I will review the challenges involved in the design, construction and operation of high tunnels. Some of the information that will be presented was learned from a high tunnel research project conducted at Rutgers a few years ago. Other information was made available by researchers at several other universities across the US that have done extensive research on high tunnel production systems.

Peppers

MANAGEMENT OF BACTERIAL LEAF SPOT ON PEPPERS: WHERE HAVE WE BEEN AND WHERE ARE WE GOING?

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Bacterial leaf spot (BLS), caused by the pathogens *Xanthomonas euvesicatoria and Xanthomonas campestris pv. vesicatoria*, remains one of the most destructive diseases of peppers worldwide, but particularly in moist, humid climates such as Florida. Favored by hard driving rains that wound the plant and assist in infection, it is capable of inflicting severe foliar necrosis as well as cankerous lesions on the fruit, leaving them unmarketable. Defoliation may also contribute to significant incidence of sunscald. While significant advancements have been made in fungicides and the management of fungal diseases, there has been very little progress in chemical control of this disease over the last half century. For this reason, a comprehensive management strategy is recommended to significantly limit BLS. This presentation will focus on some of these management tools.

Symptoms

Bacterial leaf spot first appears as small, water-soaked lesions on pepper leaves. These spots enlarge and turn dark brown to black over time and are sometimes but not always delimited by leaf veins. When severe, bacterial lesions often coalesce to form large blighted areas and leaves may drop prematurely. Defoliation usually starts in the lower canopy and works its way up. Although less susceptible than the foliage, the bacterium may also infect pepper fruit. Causing a blister type canker, fruit exposure due to intense sunlight caused by leaf dehiscence may also render peppers unmarketable.

Epidemiology

BLS is a warm temperature disease, being favored by temperatures of 24 to 30 C. Bacterial in nature, it relies on natural plant openings (i.e. stomates and hydathodes) and/or wounds for host entry. There, the pathogen multiplies, usually relying on splashing rains, irrigation, or mechanical means for spread to additional areas. A seed-borne disease, the disorder is frequently spread long distances on infected seed or transplants.

BLS Disease Management

Starting Clean

Since controlling an outbreak once it has begun is difficult to do, growers should make a concerted effort to start as clean as possible. Intended fields should be rotated from a non-related host (i.e. not tomato, eggplant, or pepper) and be free of plant debris and weeds. Hot water treatment or even bleach may be used to decontaminate infected seed and only disease-free transplants should be planted in the field. However, it is important to follow established seed treatment procedures carefully so as not to reduce seed viability.

Host-plant Resistance

Varietal selection may be the most important management tool in the tool box for BLS. While most chili pepper types are still susceptible to BLS, breeders of bell peppers have made tremendous progress in incorporating genes for BLS resistance. Commercial bell pepper hybrids range widely in terms of susceptibility, with some being extremely susceptible while others are nearly immune. Since there are numerous races of the bacterial spot pathogen, it is important to select varieties with sufficient genetic resistance for that region. Contacting your local extension service may help in this regard.

Eliminating or Limiting Primary Inoculum

While good land prep and even soil fumigation are sometimes used to reduce or eliminate the BLS pathogens, growers may inadvertently reintroduce the pathogens by recycling wooden stakes from old plantings. In cases where the time period between uses is only a matter of weeks, consider disinfecting wooden stakes by soaking them in a disinfectant such as bleach. A timed soak is preferable to a simple dip.

Foliar Spray Applications

For many years, pepper growers have sprayed copper and maneb (now mancozeb) for BLS control. At best, these compounds have demonstrated limited efficacy in controlling bacterial spot and therefore they should not be solely relied upon. Being protectants, they work best when applied in a preventative manner and when disease is still at low levels. Due to the frequent use of copper fungicides, some strains of BLS bacteria are now copper resistant. In such cases, copper fungicides may actually increase disease by eliminating non-pathogenic epiphytes or microbial competitors. A few alternative compounds that have demonstrated *suppression but not total control* of BLS are the fungicides Quintec and Tanos, and the antibiotics Agrimycin and Kasugamycin. Plant activators, such as Actigard, Regalia and Vacciplant have also shown limited suppression, as have several biologicals, Serenade, Sonata, and Agri-phage. The efficacy of a number of these products is shown below in Fig. 1, data courtesy of Dr. David Langston, formerly with the University of Georgia.

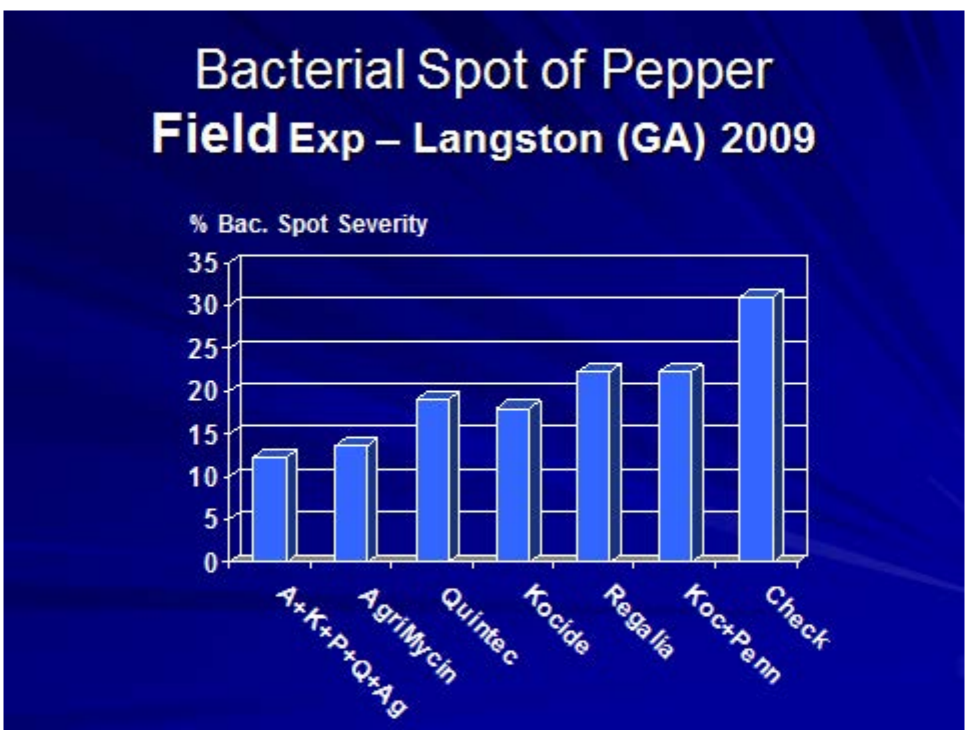

Figure 1. Relative efficacy of an antibiotic, two solo fungicides, a plant activator, and several combinations for control of bacterial spot of pepper.

Limiting Secondary Spread

Since bacterial pathogens rely on natural opening or wounds for entry, procedures that reduce routine wounding of plants may prove helpful in limiting secondary spread once the pathogen is established. Examples of this would be wind-breaks to limit wounding caused by blowing sand, or use of drip irrigation instead of overhead to reduce leaf wetness. Limiting thinning, staking, and harvesting operations to periods when the canopy is dry, along with disinfecting worker hands and tools have also proven beneficial.

Summary

Given disease favorable conditions, control of bacterial leaf spot frequently proves to be a real and costly challenge. But doing nothing may prove to be even more costly, producing significant yield losses. There is no one perfect solution and for that reason, growers should consider using combinations of the preceding management strategies that make logistical and economic sense for their operation.

SUMMARY OF PEPPER WEEVIL RESEARCH IN NEW JERSEY AND THE RESULTS OF THE 2014 GROWING SEASON

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The Rutgers Vegetable IPM Program was able to receive two NE-SARE grants (2012 and 2013) and a grant from the Charles and Lena Maier Fund, New Jersey Vegetable Growers Association (2013), to study the movement of pepper weevil within New Jersey and how it arrives here. This article summarizes our findings from 2012-2013 and what the situation for pepper weevil was for 2014.

How they get here

Pepper weevils are brought into the state in peppers that were grown in the southern tier of states (Florida, Texas, New Mexico, and Arizona), Mexico and other locations of the American tropics. Because of the biology of the weevil, the peppers often do not show external damage so fruit from heavily infested fields can be picked, packaged and transported to unsuspecting markets. Weevil adults escape into the local environs of the produce handling facility via the placement of refuse or damaged fruit into open dumpsters or spread on fields.


Open dumpster with pepper refuse

If there are no pepper fields or other solanaceous crops nearby, then the presence of weevils is of little consequence. However, in southern New Jersey we have nearly 7,000 acres of food plants (tomato, potato, eggplant, peppers and weeds) and reproductive hosts (peppers) concentrated in a small area. The number of vegetable farms and their proximity to each other and the movement of produce bins and equipment help the weevils move farm to farm. Pepper weevils are good fliers and may be able to fly about 1 ½ miles. Prevailing winds and storm fronts may help move the weevils. They can be transported on vehicles – a 1935 research article noted that a pepper weevil adult was transported on a car's windshield 15 miles, and we also have demonstrated that this is possible.


Pepper weevil on fruit

Once the weevils find blooming pepper plants they begin to reproduce, laying eggs singly in flowers or developing fruit. The smaller infested fruit is usually aborted by the plant, but as fewer developing fruit remain, the more the females will lay eggs in larger fruit which will not be aborted. Their short, three-week life cycle allows for multiple, overlapping generations in our growing season. With each female being capable of laying about 200 eggs in flowers and developing fruit, large populations can develop quickly. Pepper weevil is a subtropical insect that cannot overwinter in New Jersey because it requires a constant food supply through the winter months. Currently registered insecticides are unable to exterminate field infestations. Therefore this insect pest should be considered to be more like a plant disease – you know you have the 'pathogen', therefore you cannot stop spraying or risk economic loss.

Management options

There are no easy remedies to preventing the introduction of pepper weevils into New Jersey. While produce handlers may be able reduce the number of weevils escaping, it is unlikely that we will be able to completely keep weevils out. Farms that are near processing plants, produce distributors, repackers, produce auctions, and terminal markets, or, share or swap produce bins with these businesses are especially vulnerable to pepper weevil infestations.

We are recommending to farmers that have pepper fields close to a produce handling facility to use pheromone traps to help monitor for the presence of pepper weevils. At the first indication of their presence, a recommended insecticide should be applied as soon as possible in order to prevent the establishment of an infestation. Otherwise, sanitation is critical. Produce bins being brought to the farm should be power-washed or steam-cleaned before going to the packing shed or field. After the last harvest of fruit, pepper fields and other solanaceous crops should be destroyed as soon as possible to prevent the build-up of weevils. Cull piles should be either composted or destroyed.

There are a number of insecticides that can kill the adults, but there are none currently registered that can effectively kill the larvae. For this reason, farmers are unable to exterminate established infestations. There are new chemistries being developed and it's hoped that these will control PW. We will provide more information on these materials as they progress.

What was the situation for 2014?

Overall counts of weevils were much lower in 2014 than for 2013, which was the worst year for pepper weevil activity in the state's history:

	Number of weevils caught in traps	Number of infested fields
2013	>10,000	25
2014	323	9

Reasons for the lower number of infested fields and lower overall trap counts include: fewer pepper fields and other solanaceous crop fields planted close to produce handling businesses, better awareness and improved pest management by farmers, lower numbers of infested fruit brought in from southern locales (?), and the attempt of certain produce handling businesses to reduce the number of escaped weevils from their premises.

In both years several fields had only minor infestations that occurred late in the season causing sub-economic crop loss. In 2013, however, there were fields that were abandoned early due to disease and pepper weevil infestations. As far as known, no fields were abandoned in 2014. Yield losses to pepper weevil can be 80% or more. The earlier the weevil infestation occurs in a field during the growing season, the greater the potential loss of yield.

Monitoring for weevils through the Vegetable IPM Program

Pepper weevil pheromone trap

Grant money provided the support needed to determine the sources of pepper weevil into NJ farms. Given that the sources have been identified, grant funding cannot be used to support continued monitoring. We must now charge for the traps that we set out. Our base fee is $450 per farm and then $100 for weevil monitoring. If we are already doing insect trapping or field scouting at a farm, then the only additional cost is for the weevil pheromone traps. We suggest that one trap be set in a high traffic area near the packing shed and then at least one trap per field.

It is highly beneficial for facilities that import peppers from southern regions to monitor their own processes to assess the practicality and ease for limiting the release of the insect to the neighboring farm community. We are available to monitor for pepper weevil at facilities, or to train company personnel in recognition and control of the insect.

For more information or to sign up for weevil monitoring, contact Joe Ingerson-Mahar, phone – 856-889-5718, or email, mahar@aesop.rutgers.edu

UPDATE ON DISEASE CONTROL IN PEPPERS - 2015

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Controlling anthracnose fruit rot in bell and non-bell peppers.

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 critical to controlling anthracnose fruit rot.

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

Alternate:

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

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

Quadris (azoxystrobin,11) at 6.0-15.0 fl oz 2.08SC/A, or
Cabrio (pyraclostrobin,11) at 8.0-12.0 oz 20EG/A, or
Priaxor (boscalid + pyraclostrobin, 7 + 11) at 4.0 to 8.0 fl oz 4.17SC/A.
Quadris Top (azoxystrobin + difenconazole, 11 + 3) at 8.0 to 14.o fl oz 1.67SC/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 reducing control. Growers have had success in reducing the spread of anthracnose by finding 'hot spots' early in the infection cycle and removing infected fruit and/or entire plants within and immediately around the hot spot.

UPDATE ON PEPPER PHYTOPHTHORA TOLERANCE RESEARCH RUTGERS AGRICULTURAL RESEARCH AND EXTENSION CENTER

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Phytophthora research has been carried out in the Rutgers Agricultural Research and Extension Center since the 1980's. The initial research centered around finding chemicals that could control the disease. This led to recommendations for soil fumigation. It became obvious that fumigation was not the silver bullet to control Phytophthora. Dr. Steve Johnson began screening breeding lines with possible tolerance to the disease. This was combined with developing a management system to "live with the disease." The management checklist includes the following:

- Field Preparation
  - Produce peppers in a field that has not had peppers, cucurbits, eggplants or tomatoes in at least the last three years
  - Select a field with excellent drainage
  - Avoid planting in low lying areas
  - Subsoil or "V-rip" fields prior to planting preferably when the soil is dry to break up hard pans.
  - Construct drainage ditches or waterways to allow excessive soil water to leave fields.
- Soil Fumigation
  - There are a few fumigants labeled for use in New Jersey, but before a fumigant is used the field must be protected from water intrusion since the field may be reinfested from washing into the treated field. Equipment can also reinfest the field if not cleaned properly.
- Bed Construction
  - Transplant beds must be constructed properly to hold its shape and not allow any depressions in the bed where water may collect.
  - The bed should be at least 9 inch high
  - Once the beds are made make sure to keep the ends of rows open to allow excess water to drain from the field. If the water collects Phytophthora may infest the plants.
- Variety Selection
  - In fields with low-lying or wet areas, plant only Phytophthora –tolerant varieties such 'Paladin', 'Aristotle', 'PS0994-1819', 'Intruder', 'Declaration' 'Revolution' and 'Archimedes'. If the field is known to have Phytophthora plant the resistant variety 'Paladin'. This is the only variety that is resistant to the crown phase of Phytophthora. 'Paladin' has been on the market since the late 1990's and has started to exhibit a breakdown of the resistance in some areas.

- Transplanting
    - Make sure the entire root ball is pushed into the soil and the soil mounted around the plant. If a depression is left around the plant, water may collect which will encourage Phytophthora infestation.
    - Inject mefenoxam (i.e. Ridomil Gold, Ultra Flourish, Metastar) at planting or shortly after through the drip system. The application can be repeated 30 days later, but do not wait longer. Between mefenoxam applications inject Presidio and Ranman. Note there is mefenoxam-insensitivity in some fields. Do not apply mefenoxam or metalaxyl if the field has this insensitivity. A resistant variety should be planted.
- Fungicide Applications During the Production Season
    - For aerial stem and fruit rot of Phytophthora apply Ridomil Gold Copper with Presidio, Revus, Ranman or Forum on a rotating basis.
- Cultural Practices During the Production Season
    - Continually grade the soil at the ends of rows to allow the water to leave the field. If the water dams up, Phytophthora will move up the rows.
    - If a hot spot is seen in the field, remove the plants from the field and remove at least a two foot wide section of the plastic between infected and healthy plants. This will allow the soil to dry and reduce the chance for continued spread.
    - If needed cut ditches across beds to remove water from low lying areas. Anything a grower can do to reduce standing water the better chance they have to reduce Phytophthora spread.

Variety evaluation has been an important part of research since the early 1990's. The program has screened over 400 breeding lines and varieties for tolerance to Phytophthora. Up until recently there were few varieties that had both Phytophthora tolerance and good horticultural characteristics. This year we screened 18 varieties and breeding lines were screened for tolerance. The trials were transplanted in double rows 12 inches between rows and 12 inches between plants on beds 5 ft center to center on May 22 and a hail storm that night destroyed 87% of the plants. The trial was replanted on May 30 with up to 18 plants/plot. Weekly plant stand counts were made to determine plant survival from Phytophthora. Plots were harvested seven times from July 11 to October 1. Fruit was harvested by plot, divided between silver and non-silver, classified by size and weighed.

Yield was low compared to a commercial field because of early weather conditions and these plots are placed under heavy Phytophthora pressure to select the very best varieties. Table 1 shows the marketable yield for both silver and non-silver fruit. 'Camelot' and 'Alliance' are considered the susceptible checks and 'Paladin' the resistant check. All other varieties and lines should be assessed against those varieties. 'Archimedes had the highest total marketable yield, but was not statistically different than 'Paladin', 'Declaration', 'Revolution', '1819', 'Intruder', 'FPP1718', 'Aristotle' or 'Tomcat'. Snapper had the lowest yield, but was significantly different than 'FPP9006', 'E209', 'Camelot', 'Karisma', 'JPR1107' or 'Alliance'. The order was similar when comparing the different fruit sizes.

Table 1. Marketable Yields (28 lbs/box) for eighteen varieties and breeding lines – Rutgers Agricultural Research and Extension Center – 2014.

Variety	Marketable Yield (Boxes/A)			
	Total	Extra Large	Large	Medium
Archimedes	866 a*	117 a	583 a	166 ab
Paladin	777 ab	62 a-e	557 ab	157 a-c
Declaration	700 a-c	119 a	468 a-e	114 a-d
Revolution	687 a-d	85 ab	473 a-d	129 a-d
1819	686 a-d	52 b-e	505 a-c	129 a-d
Intruder	607 a-e	119 a	383 a-f	105 a-d
FPP1718	605 a-e	48 b-e	434 a-e	123 a-d
Aristotle	570 a-e	78 a-c	370 a-e	122 a-d
Tomcat	552 a-e	50 b-e	376 a-e	126 a-d
E…032	505 b-f	25 b-e	323 b-f	157 a-c
Alliance	417 c-g	69 a-d	270 c-f	78 c-e
RPP31123	409 c-f	65 a-d	299 c-g	46 de
JPR1107	362 d-g	3 e	174 fg	185 a
Karisma	359 d-g	37 b-e	255 d-g	67 de
Camelot	339 e-g	17 de	234 e-g	89 b-e
E…209	222 fg	22 c-e	155 fg	46 de
FPP9006	219 fg	31 b-e	129 g	59 de
Snapper	139 g	23 c-e	98 g	18 e

* Same letters within a column are not statistically different from one another

Fruit silvering or skin separation is a physiological disorder that has been observed in our trials for many years. All fruit is evaluated for silvering since it can be considered a defect in grading. Some loads of peppers have been rejected in the market with silvering symptoms. ‘Paladin’ had significantly more silvering than any other varieties except ‘FPP9006’ and ‘E209’. Varieties with the least amount of silvering included ‘Camelot’, ‘Alliance’, ‘FPP1718’, ‘JPR1107’, ‘Tomcat’ and ‘Declaration’.

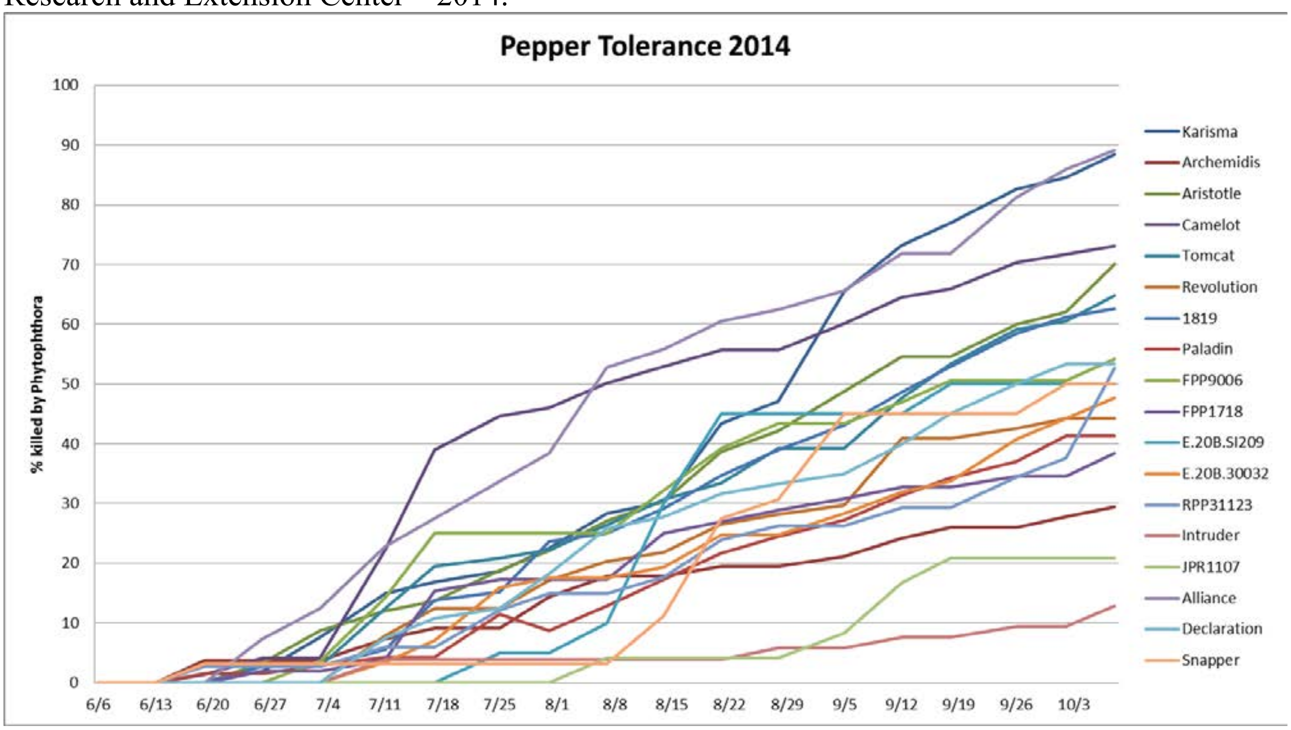
Table 2 lists the percent of pepper plants killed due to Phytophthora by the end of the production season (October 8, 2014). Intruder had the least number of plants killed (13%) and Alliance the most (89%). Note that some varieties even with substantial plant loss were able to compensate and produce fruit.

Figure 1 shows the progression of Phytophthora over the production season. Intruder and JRR1107 were able to maintain their plant populations until early September compared to Camelot and Alliance which started to lose plants in late June.

Table 2. Percent of Plants Killed Phytophthora by the end of the season (October 8) – Rutgers Agricultural Research and Extension Center – 2014.

Variety	Seed Company	% Plant Killed
Intruder	Syngenta	13
JPR1107	Johnny's Selected Seeds	21
Archimedes	Monsanto	29
FPP1718	Sakata	38
Paladin	Syngenta	41
Revolution	Harris Moran	44
E…032	Enza Zaden	48
E…209	Enza Zaden	50
Snapper	Enza Zaden	50
RPP31123	Syngenta	53
Declaration	Harris Moran	53
FPP9006	Sakata	54
1819	Monsanto	63
Tomcat	Monsanto	65
Aristotle	Monsanto	70
Camelot	Monsanto	73
Karisma	Harris Moran	88
Alliance	Harris Moran	89

Figure 1. Progression of Plant Death Due to Phytophthora Over Time- Rutgers Agricultural Research and Extension Center – 2014.



SPECIALTY/ETHNIC/ GREENS/HERBS

EMERGING DISEASES ON POPULAR HERBS AND THEIR CONTROL

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In the not-too-distant past, commercial herb growers used to plant herbs in the field, make certain that they had sufficient water and nutrients, and then would wait for the harvest. And depending on the herb, such as parsley, growers could count on multiple cuttings. Thoughts and actions regarding disease management were nearly non-existent. Things have changed. Over the past several decades, numerous pathogens have wreaked havoc on large and even small scale herb growers, sometimes producing devastating crop losses and significantly increasing production costs. The primary objective of this presentation is to familiarize herb growers with some of the new and emerging diseases occurring on popular herbs to prevent these losses. This list is by no means all-inclusive, emphasizing recent disease outbreaks.

Basil

Basil Downy Mildew

Caused by the fungal pathogen *Peronospora belbahrii*, basil downy mildew (BDM) was first reported in the U.S. in 2007. Thought to have entered on contaminated seed, it is now present wherever basil is grown. While some basil types such as spice basil, cinnamon basil, and lemon basil demonstrate tolerance or even immunity, virtually all sweet basil varieties are highly susceptible. The disease first appears as a yellowing of the older leaves, resembling a nutrient deficiency. However, the yellow lesions are frequently delineated by major veins, and examination of the underside of the leaf reveals a grey to black powdery appearance. This is the prolific sporulation produced by the fungus. These spores are dislodged by the slightest of air currents, allowing them to disseminate widely to infect other plants. Favored by cool to moderate temperatures and long periods of leaf wetness, the disease may cycle every 4-7 days, building to epidemic levels very quickly. Downy mildew will render a crop totally unmarketable if not controlled. In controlled environment conditions (greenhouse or tunnels), growers should minimize leaf wetness and humidity to prevent infection and sporulation. In the field, basil growers will almost certainly have to use fungicides on a preventative basis to obtain economic control. Fungicides currently registered for use on basil are limited but include azoxystrobin, cyazofamid, mandipropamid, and some phosphorous acids (potassium phosphites). Given the high risk of developing fungicide resistance with BDM, these should be alternated or tank-mixed in a comprehensive program for long term success. This disease is extremely explosive, so prevention is key. Once an outbreak has occurred, it is very difficult to obtain a marketable crop of sweet basil.

Bacterial blight

Incited by *Pseudomonas viridiflava*, this disease shows up as angular water-soaked spots which quickly turn black but remain vein-delimited. This disease rose to importance during the early 2000s, and occasionally still rears its head. Most likely seed-borne, it is difficult to control when conditions are favorable. Hard splashing rains and overhead irrigation favor its spread. The best control is to plant disease-free seed and to destroy any infected plant debris between crops.

Cilantro (Coriander)

Alternaria Leaf Spot and Blight

This disease is a relatively new disorder and is caused by a species of *Alternaria*. The disease first appears as a small light brown lesion on the leaf which eventually enlarges. Frequently, lesions have a distinct white spot in the center. Given long periods of leaf wetness (rainfall and dews), the disease spreads rapidly and may cause significant portions of the leaf to turn light brown and die. An early outbreak of this disease left uncontrolled may totally prevent second or third harvests, which are usually routine. Fungicide trials have demonstrated strobilurin fungicides as the compounds of choice, and these have a short pre-harvest interval (PHI). A triazole, propiconazole, is also registered and is also effective. This should be used in rotation a bit earlier, having a longer PHI.

Bacterial Leaf Spot

During the 2000s, a bacterial leaf spot of cilantro has occasionally caused significant yield losses in cilantro. Favored by hard driving rains which wound the plant and invite ingress, the disease is caused by *Pseudomonas syringae* pv. *coriandricola*. This disease is seed-borne and it appears as a dark brown to black lesion, frequently delineated by veins. It can be differentiated from Alternaria leaf spot by its darker color and the absence of any fungal sporulation structures on the lesion surface. Growers should plant high quality disease-free seed and, if disease is present, minimize canopy disturbance when the foliage is wet. Bacterial diseases are commonly spread by free moisture in low-lying areas, by workers, and equipment. Good field sanitation (incorporating crop debris to speed decomposition) and crop rotations should prove beneficial for future crops should an outbreak occur.

Dill

Stemphylium Leaf Blight

Dill usually has very few problems but a yellowing of the older foliage has appeared in recent years and has been caused by the fungus *Stemphylium vesicarium*. While this genus is usually linked to senescent or weakened tissue, this pathogen has been a strong pathogen, infecting apparently healthy foliage. Infected leaves turn progressively brown and die, and the disorder may preclude additional cuttings if left uncontrolled. Strobilurin applications have demonstrated efficacy in reducing spread. Also, old crop debris should be destroyed to prevent carry-over to the next planting.

Cercosporidium Leaf Blight

This disease usually affects the older foliage and under high moisture conditions can be very severe. Leaf tips turn dark brown, wither, and die. The fungus (*Cercosporidium punctum*) will also actively attack the stem, producing what appear to be clusters of small, discrete black pustules. Examination of these pustules will reveal the elongated spores of the causal agent. Growers should use disease-free seed and rotate with non-related hosts, destroying any carryover from an infected crop.

Powdery Mildew

Caused by the fungus *Erysiphe heraclei*, this disease affects both dill and parsley. It appears as a white powdery growth on the surface of the leaf. Favored by dry conditions, applications of sulfur and azoxystrobin have proven to be effective in its control.

Oregano, Rosemary, & Thyme

Anthracnose

Preliminary research suggests that this disease is caused by a species of *Colletotrichum*, most likely *C. truncatum*. On oregano, the disease first appears as a small brown fleck, circular in form, which enlarges to form dark, almost black spots that may range up to 5-10 mm in diameter. It usually appears on the older foliage first and under wet conditions, may affect much of the canopy. Anthracnose has been responsible for total crop failures in some instances. Rosemary and thyme appear somewhat less susceptible but the fungus has been recovered from these related hosts. Lesions on these herbs are less round due to the narrower leafs, and leaves may just turn brown entirely, usually in the lower canopy first. Growers propagating with cuttings should be certain to use disease-free stock to avoid outbreaks. Since this is a water-splash disseminated fungus, overhead irrigation should be avoided or minimized. Research on fungicidal control is being initiated.

Sage

Downy mildew

Over the past three growing seasons, a downy mildew pathogen has been observed attacking sage. It remains uncertain whether this is the same downy mildew pathogen currently causing problems on basil, but they appear similar in the environmental conditions that favor their progression. The disease appears to be a cool to moderate temperature disease, but appears capable of surviving hot Florida summers, similar to BDM. Sage downy mildew starts in the lower canopy as small yellow flecks on the leaf blades. As the disease progresses, these small flecks enlarge and turn brown and necrotic, typically delineated by the sharp leaf veination. Severely affected leaves soon dehisce, dropping to the ground. Management is still exploratory, but foliar applications of phosphites may assist in slowing mildew development. Research is being initiated to gain additional fungicide options.

Summary

Historically, herbs as a group have been relatively disease-free. In fact, oils from a number of them have been marketed as pesticides (i.e. Timorex Gold, Thymol, etc). However, the global expansion of seed production and marketing has resulted in the introduction of some new diseases to the U.S., such as basil downy mildew. Herb producers should concentrate on buying high quality seed and/or vegetative cuttings from reputable sources to minimize some of these disease risks. Similarly, cultural practices such as crop rotation, minimizing overhead irrigation, destruction of old crop debris, time of planting, etc. can be helpful in limiting damage. While fungicides can also be of assistance, there are currently very few compounds registered for use on herbs due to their small acreage. Therefore, it is advised that producers scout early and frequently to avoid disease buildup, and to use all of the management tools at their disposal. There is truth to the saying, “An ounce of prevention is worth a pound of cure”.

Figure 1. Basil downy mildew (left), Cercosporidium leaf blight on dill, and powdery mildew on dill (right).

ORGANIC II

Weed and Insect Control in Organic Vegetable Production

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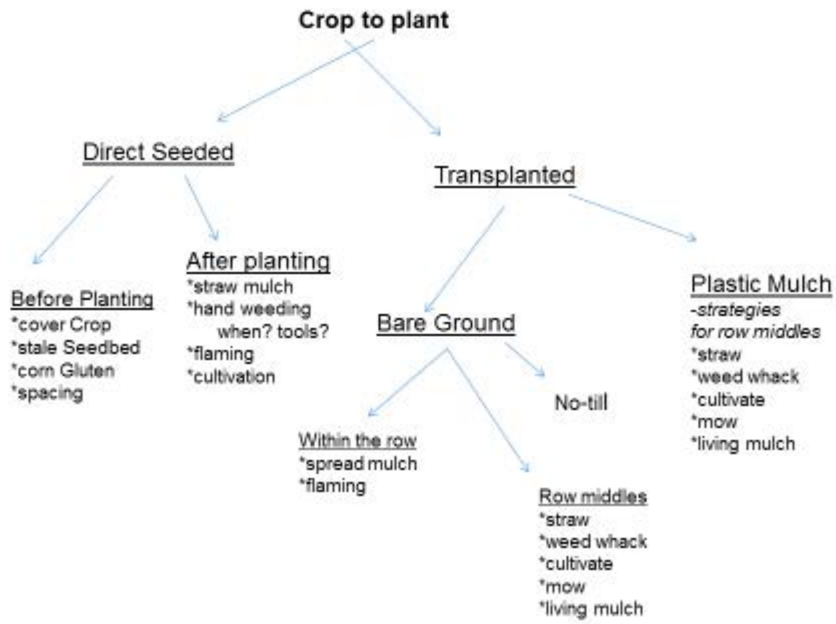
Pest control in organically produced vegetables is challenging. There is no "one size fits all" solution to these issues given the different crops, pests, and individual farm conditions. However, by planning ahead for pests and a "toolbox" of pest control methods and information, growers can successfully meet these challenges efficiently and inexpensively.

Weed control is often an organic grower's biggest headache. Weeds compete for light, nutrients and water and if left unchecked can decrease yield. Sometimes intense weed infestations encourage insect and disease problems. There are a number of strategies organic growers can use for both prevention and control of weeds. It is important to realize that successful organic weed management is a <u>long term</u> process as you deplete the <u>weed seed bank</u> so as to prevent future weeds. In the short term it is desirable to have the crop out-compete the weeds as well as prevent them from going to seed. Correct identification of weeds is important to devise appropriate strategies based on whether they are winter or summer annuals, biennials or perennials. Some farmers will design their production system to minimize weed control issues. For example, having production beds with permanent grassy middles or transplanting crops like sweet corn or beets that have traditionally been direct seeded.

Sound management practices such as crop and cover crop rotations are critical for good weed control. Some crops like sweet corn are easier to cultivate than a crop like onions or carrots, so choose rotational crops based on family AND ease of cultivation. Be aware that certain cover crops can have an inhibitory effect on weed seed germination; this is a phenomenon known as allelopathy. Other cover crops such as buckwheat do an excellent job smothering out weeds but you have to vigilant about making sure the buckwheat does not go to seed.

One of the most important things an organic grower can do is to plan for weeds. So often all of the important planning for a crop is and harvest is mmmm by a severe weeds infestation. Planning for weeds provides a grower with a both preventative and reactive solutions during the height of the growing season when things are extremely busy and there is not the time to plan and react. The diagram below demonstrates the planning thought process a grower can use to plan for weeds and how those weeds might be prevented or controlled once they have germinated:



Having a plan and being aware of the tactics and tools available is important especially for new growers or new-to-organic growers. There are a variety of mulch materials that can be used to prevent weed germination, and the stale seed bed techniques can be effective. There are also many cultivation tools such as basket weeders, brush weeders and finger weeders that work well on small, delicate crops. Often it requires multiple cultivations until the crop is established and new weed germination decreases. Hand cultivation or hoeing is often part of an organic farm's weed management practices, but this task will be much easier and more effective with good tools that are kept sharpened.

On organic farms, insect pests are often managed rather than eliminated, and it requires knowledge of the insect, the particular crop and the ecology of the entire system including season and climate. The National Organic Standards state that preventative measures (including cultural, physical and mechanical means) must be used as the primary defense, followed by biological controls and ultimately, if needed, the application of approved products.

Preventative cultural practices include all modifications to the crop and the surrounding environment so as to make them less suitable to the pest and crop itself better able to withstand pest attack. Maintaining a healthy crop through soil and fertility management; providing an adequate water supply; crop and cover crop rotation; and sanitation (including weed control) are all important. Many growers will adjust the planting/harvest time for certain crops to avoid insect pest infestation; for example, only growing kale late in the season to avoid cabbage worms. Trap crops can be effective for certain pests; cucumber beetles prefer Hubbard squash, so that can be planted around cucumbers to keep beetles out. There are also varieties that are pest resistant, and use of reflective mulches can decrease infestation of thrips, whiteflies and aphids.

Physical/mechanical methods of insect pest control are directed towards the pest. Exclusion with barriers such as floating row covers or low tunnels can be used. Close scouting of the crop (including the undersides of the leaves) and the field is important to determining if a pest infestation may occur. Any leaves with insect eggs should be picked and discarded outside the field. An important tool to own is an insect sweep net, which can be used for scouting or to capture pests such as cabbage moths. The use of pheromones for mating disruption and mass trapping is generally not cost effective for vegetable growers.

Biological control of insect pests is the use of natural enemies including predators (which eat the insect pest); parasitoids (which lay eggs into the pest, and once the eggs hatch, the pest is destroyed) and pathogens (they cause insect diseases and are often called microbial insecticides). Many of these are naturally occurring and should be conserved through appropriate farmscaping with buffers and hedgerows. When purchasing these products, be sure to know your supplier and follow all directions for handling – these are live creatures and will not be as effective if not handled correctly.

Microbial insecticides can contain bacteria, viruses, fungi, and nematodes. They do not contain any chemicals. The most commonly used product in organic systems contains Bt (<u>Bacillus thurigiensis</u>). There are a number of commercial formulations (be sure to check with your certifier as to which are allowed) and these are effective at controlling lepidopteran pests. Products containing spinosyns (the fermentation product of soil bacterium <u>Saccharopolyspora</u>) have been found to be very effective against a number of pests. Another product contains <u>Beauvaria bassiana,</u> a soil fungus that will kill certain insect pests. There are also many other new products that are presently or soon will be available as the field of biocontrol expands.

There are many insecticides made from plant materials that may be used in organic systems once other methods have not been successful controlling pests. Active ingredients include pyrethrum, neem, and citrus oils. Other materials often found in organically approved insecticides are chitin, clay, plant or fish based oils, soaps, and diatomaceous earth.

Growers need to become knowledgeable about insect pest biology and behavior in order to manage potential infestations. An integrated insect pest management program that includes preventative cultural measures, physical and mechanical pest interference, active scouting, and the use of natural enemies and approved insecticidal products can be successful.

PROTECTING CROPS FROM DISEASE WITH SOIL FERTILITY

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Organic farming systems rely on an integrated approach to manage plant diseases. Healthy crops are regarded as a natural function of a well-designed organic farm plan that includes biodiversity, crop rotation, careful variety selection, field hygiene and fertile soils. In the organic system, soil fertility is foundational for growing healthy crops. Both biological and mineral balance is critical to soil fertility. Biological soil fertility is associated with the humus and organic fractions which are derived from plant and animal residues, cover crops, and compost amendments. Mineral soil fertility is evaluated by soil testing and plant tissue analysis. The supply and balance of essential plant nutrients is interpreted in the context of soil pH and exchange capacity. This combination of soil conditions influence susceptibility of plants to disease.

Besides the usual list of essential plant nutrients some minerals are recognized as beneficial but not so far as we now know as essential. Silicon (Si), currently classified as a beneficial substance, will be the main focus of this presentation. Powdery mildew is a challenging disease for both organic and conventional growers but adding plant available silicon to the soil can suppress or at least delay the onset of this disease.

New research conducted at Rutgers NJAES has identified wollastonite as among the best materials for applying plant available silicon to soil. This naturally occurring mineral is mined from the earth from sites within New York and Canada. As a finely ground and otherwise unadulterated material, it should be allowed for use as a soil amendment for organic farming. However, wollastonite, as with any substance used in organic farming needs confirmation with an organic certifier.

Our experiments comparing silicon sources have shown that wollastonite is most effective for increasing silicon uptake into pumpkin vine tissue. Wollastonite is also associated with good suppression of powdery mildew disease on pumpkin.

Because wollastonite is by chemistry, calcium silicate, it acts as a liming material much the same as common agricultural liming materials composed of calcium carbonate. On acid soils wollastonite can serve as an alternative to agricultural limestone for raising soil pH and adding calcium to the soil. In contrast to limestone, wollastonite has the additional advantages of supplying plant available silicon and suppressing powdery mildew disease on a variety of crops, including pumpkin, winter wheat, and Kentucky bluegrass.

For further information on silicon and plant disease visit The Soil Profile, statewide newsletter, on the Rutgers NJAES website: http://njaes.rutgers.edu/

GMO Concerns

February 3, 2015
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Genetically Modified Organism (GMO) Crops were introduced in the US in 1996. The rapid adaption and implementations of the growing of these crops has caused many to ask questions about them.

What is the real motivation and push for their use?
Do they really work as well as they are advertised?
Who gains the most from their use?
Are there any possible side effects?
What does science say and what is happening on the farm?
Could there be any ill side effects to the consuming public?

Learn the answers to these questions and more. Learn about 10 plus years of anecdotal adverse health effects to livestock that lead to conducting the lifetime feeding study on pigs. Learn both the scientific results of the study and the anecdotal.

Learn how glyphosate herbicide (the world's most widely used herbicide) is affecting the soil, the environment, plants, animals and people. See the connections that will cause you to view crop production, food quality and human health in whole different light.

You will leave this presentation either shocked, amazed, infuriated or all of the above.

WORKSHOP FOR NEW WINE GRAPE GROWERS II

ENERGY

On-Farm Energy Audits

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An energy audit is the process of assessing energy consumption of equipment or of a facility. Farm energy audits are a useful tool for operators to reduce the total energy used on their farm. The American Society of Agricultural and Biological Engineers (ASABE) has developed a standard for agricultural energy audits that provides a general framework for audits on farms (ASABE Standard S612). The Natural Resources Conservation Service (NRCS), a unit of the United States Department of Agriculture (USDA) requires an energy audit (or Energy Management Plan) before participation in certain of their programs.

In conducting audits, energy used in all forms is quantified and evaluated to identify seasonal trends in energy use, inefficient energy use and specific opportunities for conservation. This paper explores the basics of conducting an audit and some specific places on the farm where energy uses should be examined. The techniques used in conducting an audit vary according to the scope and complexity of the survey, but can include:

- Visual Inspection / Walk-through
- Compilation of energy records
- Characterization of equipment and systems
- Interviews
- On-site measurement and testing
- Simulation and modeling

A walk-through of a building or facility is an opportunity to quickly appraise the condition and operation of energy using systems. By itself, a walk-through audit can often identify serious shortcomings, but will not uncover many opportunities for energy savings and improved efficiency. A review and analysis of energy records (e.g. fuel and electric bills) can be very informative in finding areas for potential improvement. When combined with building plans and basic information regarding mechanical systems and equipment, a detailed analysis of energy use and costs, preferably over a period of a year or more, can often identify significant opportunities for energy savings.

An inventory and detailed description of equipment and systems within a facility often helps provide a clear picture of the overall condition and performance potential of an operation. Interviews and discussions with owners and operators can help identify specific features of an operation that sometimes uncover inefficient or wasteful energy use.

On-site measurement and testing is often an essential aspect of a detailed audit, and can serve several purposes. Measurement of performance over a period of time can help identify both short and longer term trends that are easily overlooked in a site visit. Similarly, idiosyncratic equipment performance that may only occur in particular circumstances is more likely to show up in data recorded over a period of time. Additionally, direct measurement of equipment or system performance is often more reliable and accurate than manufacturer's data or engineering analyses. Examples of measurement and monitoring methods that might be part of an audit include using a blower door to estimate infiltration in a building, monitoring electrical power over time for a facility or individual systems or equipment, and using infrared imagery to identify poor thermal performance of building components or equipment.

Simulation can be a valuable tool in validating estimates of energy performance and evaluating the impact of changes and improvements. Many of the general simulation tools, particularly those designed for evaluating heating and cooling energy use in buildings, are not always applicable to agricultural buildings. The building design, type of occupancy and range of environmental conditions are often too different from more typical commercial and institutional facilities for the models to produce reliable forecasts. On the other hand, there are models and simulation tools developed for specific applications in agriculture that can be useful. Both USDA-NRCS[i] and the Sustainable Agriculture Research and Education (SARE) program[ii] have online tools that can assist in verifying and projecting energy use in farm operations.

Purpose of Energy Audits

The main purpose of an energy audit is to characterize the energy use profile of a facility or operation and develop prioritized opportunities for reducing energy consumption and associated costs. An energy audit should produce at least some of the following:

- Summary of energy use by energy resource
- Summary of use by application or location
- Identification of peak demands
- Compilation of energy use per unit
- Identification of trends
- Summary of energy costs
- Inventory of equipment and systems
- Comparison to established norms
- Identification of conservation opportunities

Energy resources include electricity as well as a variety of fuels. The table below presents the approximate energy content of different energy resources in common units. For a comparison of the relative importance of different energy resources in a particular operation it is generally useful to convert the more common units of measurement into consistent energy units such as BTUs or Joules. Although in most cases electricity is supplied to the end user by a regional electric grid, electricity can also come from on-site solar photovoltaics, generation or combined heat and power systems using conventional or other fuels such as biomass, wind or other sources. Energy for heat and other uses can also come from solar thermal systems, biomass combustion, direct use of geothermal energy, waste heat, etc. Accounting for these energy inputs can be more complicated than for energy resources purchased directly from utilities.

METHODOLOGY

The following sections discuss specific techniques and methods for evaluating energy use in farm operations.

Electrical Supply: Determine the type of electrical supply, including number of phases, main current capacity in amperes and main voltage. Inspect main panels to determine their condition and capacity for supporting current and future needs. Summarize monthly electrical use, including cost, usage (kilowatt-hours or kWh) and demand (kilowatts or kW). For each month, calculate the average cost of electricity in cents per kilowatt-hour.

Fuel Resources: Identify the types of fuels used, storage capacity (where applicable) and condition of fuel storage and distribution equipment.

Major Equipment: Inventory large equipment, both electrical and combustion driven. A detailed inventory will include manufacturer's identifying information (make and model) and faceplate data for all major equipment. Where possible, determine the efficiency of motors, heaters, air conditioners, refrigerators, freezers and other machinery. Evaluate the condition of equipment and identify all immediate and near term maintenance needs.

When building energy is a significant portion of total operating expenses, consider an audit by a professional or, where available, auditing services provided by utility companies. A self-audit of building heating systems may include an appraisal of the following:

- Insulation (attic/ceilings, walls, basement, pipes and ductwork)
- Condition and insulating properties of windows and doors
- Weatherization (caulking, weather-stripping, seals and astragals, etc.)
- Leaks (in steam or hot water systems and ductwork)
- Temperature controls (use of electronic thermostats, temperature settings, setbacks, etc.)
- Age and condition of heating and cooling equipment.
- Equipment maintenance needs
- Efficiency of heating and cooling equipment
- Lighting

Evaluation of lighting includes an inventory of lighting fixtures, noting the total wattage, bulb and ballast type and condition. Further appraisal of lighting systems includes verification that light levels are appropriate and an assessment of lighting controls.

In general, energy use for specific equipment can be estimated by multiplying the energy use rate of the device by the hours of operation. Note that this method is not reliable for equipment that has changing power use, such as variable frequency drives. Various forms of energy monitoring may be useful in situations where energy consumption rates are determined by the load. The following sections explain how to quantify energy use in particular areas around the farm.

Field Operations

The production of any crop in the field requires the use of cultivation machinery as well as chemical inputs. The energy used by machinery is primarily in the form of diesel fuel and gasoline. If the farm has a fuel storage tank with a metered outflow, records should be kept for an entire year of the total use each month. In quantifying the energy used in specific field operations, the fuel used by a specific piece of machinery must be established. The machine's fuel tank should be topped off before the operation begins, and topped off again after it ends. Record the total volume of fuel used in all fill-ups during the operation and in the last fill after it, along with the acreage covered and the hours operated by the machine. This can be compared to the Nebraska Tractor-Test Laboratory data[iii].

Similarly, fertilizer, pesticide and other chemical inputs can be quantified by recording the total acreage to which a particular product was applied and, as accurately as possible, the total pounds or gallons of that chemical applied.

Irrigation

As with field equipment, energy use by diesel-powered irrigation equipment can be quantified by measuring fuel. The energy use of electrically-powered equipment can be quantified as with ventilation motors, multiplying the faceplate amperage by line voltage and time the motor is estimated to be running.

Farm Heating

The energy used by heating devices is often difficult to quantify. If heating systems are the only devices on the farm fired by a particular source of energy, such as natural gas, the farm's natural gas bill can be used. Similarly, individual tanks of Liquid Petroleum Gas (LPG) tanks powering only heating devices can be checked for fluid level on a monthly basis and the total gallons of LPG calculated. Otherwise, calculate the energy use by multiplying the specified energy consumption rate of the device by the time it has been in operation. Keeping records of weather during the operation of heating systems will help differentiate energy attributable to weather-related conditions from other energy uses.

Ventilation

Estimate the energy use for fans and ventilators by multiplying the nameplate amperage of motors used by voltage and the time these motors run. Where possible, checking for proper voltage at the motor terminals during motor operation can help to identify significant losses due to poor wiring.

Lighting

Farm lighting can be a large consumer of energy. Because it is rare for lighting systems to be metered separately from other energy-consuming systems, quantification of energy used in lighting can be estimated by multiplying the energy consumption rate (typically in watts) of all lighting devices by the total time those devices are on during a given period.

Greenhouses

Greenhouses tend to be very energy intensive. There are many available audit checklists that can be used to conduct detailed evaluations of greenhouse operations. Depending on the type of greenhouse, an evaluation may include any or all of the following:

- Basic Greenhouse Information (dimensions, type, location and orientation)
- Cropping information (crops, schedules, temperature settings and growing methods)
- Leakage and weather tightness (insulation, weatherstripping and condition)
- Glazing, Insulation and Heat performance (type and condition of glazing)
- Shade/Thermal Curtains (configuration, type and condition)
- Heating System and Maintenance (type of equipment, capacities and condition)
- Ventilation and Cooling Systems and Maintenance (type of ventilation, fan sizes and condition)
- Control Systems (type and capabilities)
- Insect Screening (type, installation method and condition)
- Supplemental Lighting (type, layout and total wattage)
- Electricity, general maintenance and miscellaneous

REFERENCES

[1] United States Department of Agriculture, Natural Resources Conservation Service, "Energy Tools", <http://energytools.sc.egov.usda.gov/> (as of January 13, 2009)

[1] SARE, "Clean Energy Farming", <www.sare.org/publications/energy>, January 2009

[1] Nebraska Tractor-Test Laboratory. http://tractortestlab.unl.edu/testreports.htm

LINKS

NRCS NJ Energy page: http://www.nrcs.usda.gov/wps/portal/nrcs/main/nj/energy/ (contains fact sheets and links to a greenhouse audit video).

On-Farm Cold Storage Facilities

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The use of on-farm cold storage is important for removal of field heat and short term storage for summer crops but can also be used to extend the marketing season into the fall and winter for root and other storage crops. Fall harvested crops can be stored in bins or bulk and may be storable for 2 to 3 months up to 12 months if the correct environmental conditions are maintained. Different crops require different storage conditions which will affect the number of storage rooms and the size of a storage facility. The investment the grower can afford also affect the type, number and size of storage facility. Material handling and equipment, material and personnel movement are important facets when planning and siting a storage facility to minimize handling and labor costs.

Storage temperature and humidity will affect the length of time a crop can be held and remain marketable and the amount of storage losses. Most root crops store best at 32ºF and high relative humidity (RH) (>95%). This includes beets, carrots, turnips, parsnips and cabbage. Onions and garlic need cold and dry conditions after being cured, 32ºF and 65-70% RH. Irish Potatoes need storage temperatures between 40-50ºF at 95% RH with the temperature varying by variety and end use. For fresh market potatoes, 40 to 42ºF is best. Other crops store best in warm and dry conditions like winter squash (50-55ºF at 50-70% RH) and sweet potatoes (55-60ºF at 80-85% RH). Besides temperature, other factors such as ethylene production / sensitivity and odor transfer can affect long term storage. Apples and pears are ethylene producers and shouldn't be stored with other vegetables. Onions can impart flavors in other products and meats should never be stored in the same coolers as fruits and vegetables. Most growers will need 3-4 coolers to segregate all the crops properly. The length of storage varies with the crop, storage conditions and quality at harvest. Marketing the crop within the typical storage life is important to keep losses low.

Root cellars have been used through the ages and are energy efficient, using the ground as a heat sink and outside air for cooling but don't have the capacity to remove field heat and are not usually design to facilitate handling large bins of produce with pallet jacks or fork trucks. A modern version of the root cellar would be an earth contact structure that has an entrance at ground level. It doesn't necessarily have to have the roof covered with earth. A ceiling to support the load of 3 or 4 feet of earth is very expensive and the earth will freeze down to the roof anyway. A less expensive method is to use a well-insulated conventional roof system. The sidewalls should be insulated about 2 feet below grade and then insulation be position horizontally along the wall extending out 4 to 8 feet to keep the frost away from wall. Active outdoor air cooling using a computer control and temperature sensors, can open and close dampers and operate fans to provide temperature control to different rooms in a root cellar. The example in the presentation has 3 rooms each controlled at different temperatures. The squash room has a heater to maintain the temperature high enough.

Refrigerators can be a low cost option for small growers. They are self-contained and great for small quantities but have no humidity control and limited capacity to remove field heat. Retired truck or trailer reefer units are often available at reasonable costs. The main disadvantage is thin walls leading to higher heat loss/gain and limited access for material handling depending how they are located. If they come with the original refrigeration unit, it may not have enough capacity to remove field heat.

Walk-in coolers are the workhorse of the industry and can be purchased as a prefab unit or built-in-place. They feature well insulated walls/ceilings, temperature control, washable interior and a lockable, self-closing door. The typical rule of thumb for sizing is 2.5 to 3 cubic feet of cooler per bushel of produce which represents a 50% utilization of space. Prefab panels have a metal or plastic skin and the core is filled with foam insulation with thicknesses from 2 to 12 inches. The edges of the panels are tongue and groove so they fit tight together tight and have a locking cam device built-in to fasten panels together. A small cooler being installed on a level concrete floor can be assembled and ready to use in a few hours. A cooler can also be constructed using conventional stud framing methods but the wall cavities must be filled with foam insulation (urethane, extruded polystyrene, polyisocyanurate) not fiberglass to prevent condensation in the wall cavities. The interior wall should be covered with a washable, preferably non-corrosive material such as fiber reinforced plastic, aluminum or steel panels. A floor drain is highly recommended for easy cleanup.

The refrigeration system must be size to remove field heat, heat of respiration, heat conduction through the walls, air exchange from opening doors, equipment (lights, fans, fork truck) and people working in the cooler. The removal of field heat is typically the largest component and occurs over a short duration. This can increase the size and expense of the refrigeration system considerable. Using some type of precooling will reduce the refrigeration requirement. The type of precooling will depend on the crop. The heat of respiration is a smaller component and decreases as the holding temperature decreases but varies greatly between crops. The needed refrigeration capacity will be the sum of the worst case values of all components above plus an allowance for defrosting and a service (fudge) factor. A table in the presentation is an example of the calculated refrigeration loads for different conditions. Note the 35ºF room has less wall insulation and a higher loading rate than the 30ºF which affects the refrigeration load.

Service for refrigeration systems must be done by a certified technician which adds to the cost of installation but there are several option that don't require a technician. The first option is called a CoolBot which is used with a residential window air conditioning (AC) unit to override the AC unit's controls so it can cool to lower temperatures than design. These units won't have the name plate rated capacities when used at lower temperatures and may not have the capacity to remove field heat. Generally they can be used to about 38ºF and can't reach 32ºF that is required for many root crops. Several refrigeration manufacturers offer small commercial self-contained refrigeration units that can basically be mounted in a hole in the cooler and plugged in. They do cost more but have a known capacity and a warranty. They can be roof or side mounted.

Humidity is the second most important parameter to control in a cooler. Crops are about 90% water so if you lose water you've lost sales since most crops are sold by weight. Humidity is easy to control with the use of a humidifier and a humidistat. Evaporative pad coolers are used in bulk storage facilities. As the air passes through the pad, it is cooled and humidified. A centrifugal atomizer has a spinning disk that water is dropped on and thrown by centrifugal force through small holes or hits a vane that breaks the water up into tiny droplets that evaporate quickly into the air. Ultrasonic atomizers work similarly but use ultrasonic vibrations to atomize the water droplets. Growers who have a mix of products in a cooler could pack crops requiring high humidity in or covered with plastic bags with vent holes to create a humid micro-climate. This reduces heat transfer rates so the crop needs to be near the storage temperature before being covered. Humidistats are used to control the humidity. A high humidity environment should not be as close to 100% as possible without dripping. Ideally the humidifier should run at a low rate for long periods of time rather than a visible fog for short durations.

The bins and racks in a cooler should allow 12 to 18 inches of clearance overhead and 6 to 10 inches of space along the walls for proper air movement. All the refrigeration evaporator units should be blowing in the same direction or set up to create a circular flow of air – across the ceiling, down the far walls, through the produce and back up the near wall. Using a plenum wall inside a cooler and bins with 2-way fork slots can provide a more positive air flow than the traditional cooler and could be used for precooling.

Material handling is an important consideration to keep labor cost low. The selection of bin size must accommodate the crops requirements but also fit into the cooler without wasting space. Bins or tots can be made of wood or plastic with plastic being preferred because of the ease of cleaning, rated for the expected load, stackable without lids, 10% vent bottoms and be able to handle with a fork truck or pallet jack. Racking in a cooler can help with organization, especially with smaller volume crops, keeping container off the floor and providing better air flow. A pallet jack and fork truck or pallet lift is essential for handling heavy crops but a hard level surface is required.

When selecting the cooler size, one also needs to consider the size of bins that will be used and how they will be arranged, the interior dimension of the cooler and where the door is located. If the cooler accommodates 2 bins wide but is 6 inches too narrow to fit a third row or the second to the last bin is placed in the cooler but the last bin can't be put in because there is a bin obstructing half the door, you have wasted space. Considering these factors ahead will maximize storage space. Most coolers only come with one door but depending on how the cooler will be used, it may be advantageous to have 2 or 3 doors, especially if you need to rotate stock - first-in-first-out. The key is planning ahead so the mistakes are made on paper and not found after construction. The cooler location should usually be located adjacent to your washing, processing and packaging area to reduce material handling.

Storage crops can be profitable but there are some additional costs that aren't incurred for summer produce. First, there is the cost to build and operator a storage unit. A new prefab 6-foot x 8-foot by 7-foot 6-inch high cooler with refrigeration will cost about $5200 while a 20-foot x 30-foot x 12-foot high cooler is approximately $23,000 with refrigeration. This doesn't include the floor or installation or additional items such as lights, humidifier or racking. A used cooler with refrigeration is often about half the cost of new but varies with condition. The cost to operate a cooler is $2 to $4 per day for a 12 x 12 x 8-foot cooler. Another important cost for storage crops is "shrink." Shrink is the amount of product that is unsalable after sorting out that portion of the harvest that is not fit for your market. This includes culls based on quality characteristics (size, shape, uniformity, etc.)—which will be similar to product harvested for immediate sales—but also the amount of product that spoils during storage or needs to be trimmed (cabbage leaves). Shrink can range from 3% for carrots up to 40% for winter squash and cabbage based on a survey of growers. Anecdotal evidence suggests that storing vegetables through the winter may result in a 20% increase in costs that need to be factored into your pricing. Marketing through the winter does have the advantage of providing cash flow during normally low times and may allow keeping a valued employee or not needing to find an off-farm winter job. A study of four organic growers calculated gross sales of $8 to $18 per cubic foot of cooler volume.

LED LIGHTING

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Light emitting diode (LED) technology is rapidly penetrating (and overtaking) a variety of lighting applications, including automotive lighting, traffic lights, billboards, as well as consumer and residential lighting. The phase-out of incandescent (INC) lamps resulting from their low efficiencies (typically less than 10% of the electric energy consumed is converted into useful light; the remainder is converted into heat) has certainly helped the almost meteoric rise of LED lighting systems. LED lamps have several advantages, including their ability to produce a variety of colors, the low amount of radiant heat energy produced allowing for closer placement to the target surface (LEDs still produce heat, but the heat is typically dissipated by conduction into a heat sink, followed by convection to the surrounding air), a small form factor (allowing for novel lamp and fixture designs), and last but not least an energy conversion efficiency (from electricity into useful light) that well exceeds the efficiency of INC lamps, often exceeds the efficiency of fluorescent (FL) lamps and is beginning to exceed the efficiency of high-intensity discharge (HID) lamps.

Greenhouse growers who grow plants during the darker months of the year often use supplemental lighting to keep plants productive when natural sunlight conditions limit adequate growth and development. There are two types of supplemental lighting: photoperiod lighting and assimilation lighting. Photoperiod lighting uses low intensity lighting to induce a flowering response in plants that need a longer daylength to start flowering. Assimilation lighting uses high intensity lighting in order to stimulate photosynthesis, and thus primarily promotes plant growth. Successful photoperiod lighting depends on the light quality (color or spectrum) as well as the duration and timing of the lighting. Prior to the availability of LED lamps, INC and compact FL lamps were used most commonly for photoperiod lighting applications. On the other hand, assimilation lighting requires high intensities (i.e., a high energy input) as well as a spectrum that matches the sensitivity of the light harvesting pigments in the plant leaves. Up until the availability of LED lamps, high-pressure sodium (HPS) and metal halide (MH) lamps have been the preferred lamps for assimilation lighting. Because the plants' light harvesting pigments are most sensitive to light in the blue and red wavebands, assimilation lighting will be most effective if the light source used produces most of its light in the red and blue regions of the spectrum. This is the main reason why many of the novel commercial LED lighting systems for horticultural applications that are available today produce most if not all of their light using red and blue emitting LEDs.

In this presentation, I will review the various light sources used for horticultural applications, discuss the potential advantages of LED lamps and show some of the ongoing research at Rutgers and elsewhere.

RETAIL MARKETING & AGRITOURISM

PERSONALIZING YOUR RETAIL FARM BUSINESS TO KEEP CUSTOMERS COMING BACK – *MY ADVENTURES IN CSA'S!*

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This talk will focus on things that we have done and strategies we have pursued to keep our CSA members engaged, satisfied, and willing to renew their farm share from year to year!

Fernbrook Farm CSA started in 2007 on the grounds of Fernbrook Farm – a third generation farm owned by the Kuser family in Chesterfield, NJ. Larry Kuser and his family already managed a wholesale tree nursery, bed and breakfast and a non-profit education center on the farm and they wanted to add a CSA to the mix. We started in 2007 with 70 shares on 4 acres and have grown to over 400 shares plus a winter share on about 18 acres in 2014. Every year we strive to retain a high percentage of our membership while setting a share price that reflects the needs of our farm and farmers. At the end of the day, we have found that most members renew their farms share because they felt that everything they gained during the 6 month season made their membership a good investment for them and their families. We survey our members every fall and receive what we feel is valuable and honest feedback which leads us to that conclusion. We have also seen a pretty consistent renewal rate regardless of our production and distribution numbers. That is, we don't see drastically higher renewal rates following very abundant growing years compared with years where families received less food. However we have seen slightly better renewal rates following "good" growing and distribution years and share renewals coming in at a faster rate.

So we know that the food is the main reason people join the farm and renew their memberships. When we have an abundance of fresh, beautiful, diverse produce to distribute, people in our farmshop are happier and obviously feel better about their 'investment' in a farm share. We receive lots of great feedback and positive comments when the food is terrific. Conversely we hear it from our members if the tables are relatively sparse or lacking in a major crop (i.e. poor tomato production in blight years). We can tell from our members how we're doing food-wise! And at the end of the day people are paying for food. Fresh, chemical-free, tasty, interesting, healthy produce. If they are feeling short-changed, they won't renew regardless of the other positive attributes of their farm experience. So even in our poorer production year, the total amount of food over a 26 week season has been sufficient enough for most people to renew. But even though the food we distribute is our (pardon the pun…) bread and butter, it isn't the only thing people come for and look forward to and find valuable at the CSA. Here are some others based largely on our surveys and unprompted feedback received over the years: This point always gets good reviews in our surveys

1. Choices - We distribute our produce using a ‘Mix and Match’ system that gives the shareholders as many choices as possible in determining what food they will take home (as opposed to a pre-boxed or limited choice system). This aspect always receives overwhelmingly positive feedback and I think we have learned to manage this distribution method well. In 2014 we added a third weekly pick-up day and we don’t hold shareholders to a certain day every week. Again, folks appreciated this flexibility. We also have extended u-pick hours to make it easier and less stressful for folks to get their u-pick crops.

2. Events - Like many farms, we organize a host of events / activities during the year - workshops (food preservation), events, tastings, guided walks, tours, volunteer days, an end of the year party and seasonal potlucks. Most of these are free and some are better attended than others. But in surveys people often mention how much they like that these extras are available even if they didn’t get to take full advantage of them. Of course it adds some time and effort on our end but it adds to the good vibe and overall attraction of being a member at the CSA.

3. Communication - Good back-and-forth communication helps our members feel connected, listened to and lets them help to shape the direction of the CSA. We send out a weekly email about the upcoming food and events. We publish a paper newsletter (most months!) during the season with pictures, fun farm news, recipes etc as well as a longer winter newsletter that gets mailed out in January. And we give everyone a survey to complete every fall. We work very hard to engage our members when they come to the farm. Our shop keepers are gregarious, enthusiastic about the farm and food and get to know many of the members during the season.

4. Other – during the presentation I’ll talk about other things we do to make our members on-farm experience very positive and to give them a sense that the farm is in some way truly theirs. These include having livestock where people can visit them, access to wooded trails, a pastured pork sale and farm store.

ON-FARM DIRECT MARKETING SWOT AND RISK MANAGEMENT ANALYSIS FOR RUNNING A SUCCESSFUL OPERATION

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Members of the Rutgers NJAES Agritourism Working group were awarded funding from the USDA, Sustainable Agriculture Research and Education program to conduct risk management analysis on farms in New Jersey offering on-farm direct marketing. Part of the analysis includes a Strength, Weakness, Opportunity and Threat (SWOT) analysis; a commonly used tool in business management. Up to six farms a year will receive assistance and guidance from this leading team of 5 Rutgers faculty. The project team includes Michelle Infante-Casella, Brian Schilling, Bill Bamka, Stephen Komar and Jack Rabin. A key component of this project it to teach other agricultural service providers to assist farmers with risk management tools developed by this team. Tools utilized by this group for this educational program can be found at http://agritourism.rutgers.edu/training/.

On this site, farmers can find training videos on farm safety, easy-to-use checklists (found under supplemental materials) to help cover multiple aspects of farm management related to on-farm direct marketing, an online budget calculator for a corn maze, fact sheets and webinars for on-farm direct marketing. Another important tool for farmers is the “Farm Accident/Incident Report Form”. Each farm business that the team visits for SWOT and risk management analysis receives a packet of information that includes these useful materials. When the team arrives at the farm, they work to collect general background information about the farm. The following information is useful for the initial visit:

1. What activities and products does the farm offer?
2. How many employees are hired and what are their duties?
3. What type of training and contracts (if used) do you provide your workers?
4. What are the roles for each family member on the farm?
5. How many acres are under production and what areas are used for public access?
6. Are you in good communication with your insurance company and are they aware of your public and production activities on the farm for adequate coverage?
7. Do you offer ancillary items and activities?

8. What are the concerns on the farm regarding public safety?
9. Who on the farm is in charge of safety checks?
10. How many people on a given day come through the farm for public sales/events
11. Do you feel you have enough employees to cover the amount of customers?
12. Is traffic and parking handled properly and planned for during peak times?
13. What is the plan for clean-up and sanitary conditions during and after hours?
14. What is the farm's relationship with the municipality/neighbors?
15. What are the future short term and long term goals of the enterprise?

These initial questions often times bring more questions than answers. If topics listed have not been addressed, the process can begin and an action plan to cover missing items can be implemented. Some of the items on educational check lists help organize farm management topics for on-farm direct marketing into categories that cover items like, animal safety, emergency response and liability, employee management, food safety, general farm safety, hayride safety, parking and traffic assessment, and marketing assessments.

Often, farmers are so busy keeping up with crop production, pest control, harvesting, packing, and cleaning up areas for the public to visit, that some aspects of safety can be overlooked. One thought to remember is, not only are farms providing products for public sales, they are also providing an experience. Farmers, their families and their employees may be familiar with the "farm experience". However, most public visitors are not used to farm terrain or other hazards. Some visitors may not be familiar with everyday nature hazards like hornets, poison ivy and sunburn. Things that are common to farmers like walking over irrigation pipe, not touching electric fence around pastures or for deer exclusion, or keeping out of hedgerows with poison ivy may not be "known hazards" to visitors. It is important to do your "due diligence" in educating visitors about the "farm experience". Having proper signage, discussing hazards with visitors (verbally and through written materials), and perhaps having visitors sign disclaimers that they understand the farm rules, are some ways to protect your farm from liability claims. Keeping production areas and public areas as separate as possible are good ways to prevent accidents and avoid hazardous areas.

The best means for safety precautions and improvement to sales are your employees. Having well trained, motivated, polite and friendly employees can be your biggest asset. When hiring, do your best to select employees who are willing to learn, who will follow your direction and who are responsible. Finding these employees is often a challenge, especially when hiring seasonal labor. Remember, you are not just selling farm products, you are selling an experience when inviting the public on your farm. What type of experience do you want people to have and what do you want those customers telling others about your farm? When inviting the public on to your farm you are now in the "hospitality" business. Think about how you feel when going to a restaurant. Was the service friendly? Was the atmosphere pleasant? Were the prices fair? Was the food tasty? Was the restaurant and restrooms clean? Would you return and tell your friends this is a great restaurant and recommend it to others? This is the same way people will look at your farm when visiting and you want them to answer yes to those types of questions. Positive word of mouth advertising and repeat customers will help the farm be a success.

Having the farm be that happy place where people want to visit is important. However, what if an accident occurs on the farm when the public is visiting? What will your employees do? Who do they contact? Who is in charge? What records should you keep of the incident? No matter how hard we try to avoid and prevent accidents on the farm, they may still occur. Farming is a dangerous industry and we should keep the public away from areas that are too dangerous. However, a tractor rut in a pick-your-own orchard can cause ankles to twist, lifting and carrying a very heavy pumpkin can cause back strain and tripping over weeds in a corn maze are all ways accidents may occur. Thinking ahead to prevent these situations can mean less accidents and happier customers. If an accident does occur, having written information with details of the incident, who was involved and witnesses will assist in the event of future litigation. One tool to use is the “Farm Accident/Incident Report Form” that is available on the website previously mentioned. Even the smallest incident should be documented. What seems like a small sprained ankle at the time, may grow to be an injury that prevents someone from being able to go to work, mental anguish, etc., etc. and eventually a law suit. Protect yourself by educating guests, having proper signage, and documenting the incident.

Being prepared for accidents, excessive traffic, crowds, irate customers, inclement weather, neighbor conflicts, regulations, municipality relationships and the many other issues that can come along with on-farm direct marketing can help farmers be prepared. Preparation and prevention are the keys to managing public access to your farm operation. For more information on this USDA, SARE sponsored project being conducted by the Rutgers NJAES contact Michelle Infante-Casella, at minfante@njaes.rutgers.edu.

GROWING YOUR AGRITOURISM AND DIRECT MARKETING BUSINESS AND HARVESTING THE PROFITS

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VonThun Farms direct marketing and agri-tourism business has been one of continual improvement and growth over the last 20 years. Our operation is very diverse and includes the production of fruits and vegetables sold in our home farm stand, local supermarkets and farmers markets, through pick-your-own, and through our CSA program. We also offer spring and fall school tours and offer fall weekend activities, including hayrides, pumpkin & apple picking, and a corn maze.

With such a diverse operation we try our best to cross promote our different seasons and aspects of the business through banners and flyers. If our customers are at the farm for vegetables or U-pick we hope to have them back in the fall time as well. We believe the best way to grow the business is by word of mouth, and because of that a major focus of ours is to ensure that all of our customers have the best experience possible and that we keep our displays and facilities clean and inviting.

Our CSA program has provided us a great opportunity to sell and market our homegrown produce. The program helps remove some financial uncertainty going into the year as we have CSA members money upfront before the CSA program even starts. The program also lets us grow some different crops that might not normally be very popular in our regular markets. As of result of the CSA we have seen an increase in our U-Pick sales as well as the sales in our farm market on our CSA pick up days because of the increased foot traffic at the farm.

Our fall operation changed quite a bit in 2012, as we switched from an a la carte or carnival ticket system to a one price admission. This has resulted in higher profits for us and our customers have a more enjoyable time as the entire family gets to partake in more of the activities we offer. Each year we try to add 2-3 attractions to our fall line-up to keep things fresh and new. The one-price admissions has also allowed us add smaller, less value-added activities that we would not have been able to charge for in the past.

HOW TO MAKE A CORN MAZE THAT WILL DRAW CROWDS

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6 keys considerations to a great corn maze:

- **Theme** – Something relevant and exciting
    - Coming up with a successful theme can take a lot of time. Our Derek Jeter Tribute maze design was not decided until July 3rd last year.
    - A relevant and exiting theme can help reduce the amount of advertising you have to do by drawing free press

- **Interactive** – Include games/fun facts
    - You want your customers to feel like they got their moneys worthwhile going through your maze. Adding interactive games, and fact sheets will engage your customers and add to their maze experience. These games/facts can be there to help them though the maze or just be something to keep them entertained.

- **Pricing** – Charge enough to make it worthwhile and to reap a profit, while keeping the price reasonable so your customers are enticed to want to do it!

- **Promotion** – Radio, Billboards, Newspaper, Press releases, Website, Email, & Social Media
    - We use all of the above methods to promote our corn maze and fall events. Social media is the cheapest and can create a lot of buzz. Email lists take quite some time to develop, but are well worth it! More traditional forms like Radio, Billboards and newspapers can be successful at reaching a large number of people but it is hard to determine the impact they are having.

- **Other activities** – Apple & pumpkin picking, hayrides, kids activities
    - Your offering other activities may be the deciding factor between someone going to your farm or another farm. There are a lot of different combinations that can work and it comes down to your budget, what you want your focus to be, who your clientele is, and what area you are in.

- **Night Time** – Haunted/Moonlight
    - We open our maze the last weekend in October at night as a moonlight maze and customers go in with flashlights. A lot of farms have very successful haunted corn mazes and hayrides.

FIELD & FORAGE CROPS

MANAGEMENT OF SCLEROTINIA WHITE MOLD AND SOYBEAN SUDDEN DEATH SYNDROME

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Overview: Sclerotinia white mold or stem blight (SSB) and Sudden Death Syndrome (SDS) are two important diseases of soybeans, particularly those grown in moderate climates. Often the symptoms of these diseases occur at a point in time much later than the time of infection, making within season management difficult. This talk is aimed at a range of growers and consultants of varying experience level, and addresses basics of the pathogen lifecycles, diagnostics, and best management practices. More information on field crop disease management can be obtained by signing up for updates from the Field Crops Disease Management Blog located at: http://extension.udel.edu/fieldcropdisease/

Sclerotinia stem blight

Disease Cycle: In order for SSB to develop, three things must occur simultaneously: an environment favorable for infection and disease development, 2) a susceptible, flowering soybean plant, and 3) spores of SSB. SSB starts with the overwintering structure (sclerotia), which can overwinter in soils for at least 5 years. When the soil is shaded, moist (16-48h wetness), and cool (50-68°F), sclerotia germinate and produce mushroom-like structures (Figure 1). These structures produce millions of spores over several days' time. Spores are dispersed locally and colonize decaying, senescing flower petals. Spores cannot penetrate tissue directly-**this is important when discussing fungicides later on**. Under some conditions sclerotia may germinate produce thread-like hyphae, which infect plant roots, crowns, and other low-lying plant parts; however, this is a rare event.

Figure 1. A Sclerotia germinating to produce mushroom-like apothecia. A single apothecium can produce millions of spores. Photo obtained from http://bulletin.ipm.illinois.edu/photos/apothecia.jpg

After petals are colonized, the fungus can easily infect the flower and stem. Once inside the plant, the fungus grows and produces stem lesions that eventually girdle the stem, resulting in a blight or rapid wilting. SSB only produces one set of infective spores per season. Development of SSB ceases when temperatures reach around 90^0F or the environment dries out. Yield loss is often associated with disease incidence in the field. For every 10% increase in incidence at R7, yield is reduced by 2-5 bu / A.

Sclerotia form in or in plant tissues, where they eventually fall from plants or overwinter inside senesced stems on the soil surface (Figure 2). Sclerotia are resistant to extremes in temperature, moisture, and UV radiation and can persist in soils for more than 5 years. The SSB fungi have a wide host range.

Sclerotinia spp. can infect crops such as alfalfa, snap beans, potato, pepper, and tomato. In addition, weeds including amaranths, lambsquarters, Shepard's purse, ragweed, and pigweed can serve as hosts

Disease ID: Diseased plants are typically found in patches, often in wet or shaded areas of the field. Upper leaves are often dead or plants appear wilted. Upon closer examination, these plants may have a white, fuzzy to granular growth on stems. During dry periods these areas appear bleached and when split open, hard, black structures resembling mouse droppings (sclerotia) can be seen on and inside of stems (Figure 3). These sclerotia serve as the overwintering structure of the fungus. Areas that prolonged periods of dew and fog, such as along tree lines, tend to be the most severely affected as well as high-yield potential environments (i.e. narrow rows, high fertility, high plant populations).
Factors that favor disease: 1) Susceptible cultivar, 2) early canopy closure, 3) dense plant canopy, 4)cool wet temperatures around flowering. Moderate air temperatures, frequent rain or irrigation, and high humidity from flowering through pod development further favor disease development.

Figure 3. A soybean stem with lesions and sclerotia characteristic of SSB. Photo by C. Whaley, UD.

Best Management Practices: SSB requires an integrated program for management. In high-risk fields, growers should consider the following: **1) Variety selection.** In infested fields select <u>SSB tolerant varieties</u>. Although no resistant varieties are yet on the market, varieties will differ in their performance under high SSB situations. Rutgers conducted a variety trial this season that has data that can help guide you in your variety selections. **2) Cultural Practices.** Consider <u>long rotations (2-3 years) to corn or sorghum</u>. Planting small grains before soybeans may cause sclerotia to sporulate early, thus reducing inoculum potential for the following crop. Growers should avoid planting susceptible crops such as those mentioned earlier. Deep tillage is not effective, as this practice buries sclerotia in the upper surface while pulling up buried sclerotia to the soil surface. No-till (zero till) may reduce SSB due to minimizing the amount of sclerotia in the upper 2 inches of the soil, but results are inconsistent. Irrigation should be monitored and <u>excess irrigation during flowering should be avoided</u>. Therefore, spacing should be increased as wide as possible to maintain maximum yields (>15 inches). Plant between 150 and 175k seeds / A. Avoid overfertilization. Stay on top of weed management. Powerwash equipment after working in SSB infested field. **3) Chemical control.** Fungicides must be applied preventatively to be economical. A followup application 10-14 days later may be required to achieve adequate suppression in severely infested fields. Canopy coverage and penetration is essential. The first application generally should occur at R1. Remember the disease cycle: Once you see symptoms it is too late- the sclerotia have already fired off, colonized petals, and infected plants. See **Table 1** for recommended fungicides. Remember that the label is the law. **4) Biological control.** There are limited data on the efficacy of many biological agents on white mold suppression in soybeans. Some examples follow. Contans ® should be incorporated at least 3 months before flowering and applied to the upper 2 inches of the soil. Care must be taken to not disturb the soil. This is because the product degrades sclerotia and requires time to do so. Disturbing the soil may bring unaffected sclerotia to the surface. Other products such as Plant Shield® are labeled but field data are lacking at this point in time.

Table 1. Current recommended fungicides for white mold suppression in soybeans. Other products may be labeled for white mold suppression but require additional field testing.

FRAC Group	Active Ingredient	Product
1	Thiophanate Methyl	Topsin® and generics
7	Boscalid	Endura®
11	Picoxystrobin	Aproach®

Soybean Sudden Death Syndrome (SDS)

SDS is a disease that is easily confused with other, more common diseases. In our region, SDS isn't considered to be a major problem like in the Midwest where entire fields can succumb to the disease. However, we do see it pop up and it is important to understand what your options are if you ever have a severe issue with SDS. *Disease Cycle:* SDS is caused by the fungus *Fusarium virguliforme*. *F. virguliforme* overwinters in the residue or free soil as chlamydospores, which are resistant to a wide range of temperatures and stresses. Changes in soil temperature signal the fungus to emerge from chlamydospores and infect roots of young seedlings. Initial infection occurs in seedlings planted cool, moist soils, and cortical infection occurs between V1 and V6. More infection and root rot occurs with earlier infections. When plants reach early reproductive stages the pathogen colonizes the cortex and toxins are produced that are translocated to foliage. These toxins are responsible for the characteristic interveinal necrosis often seen in leaves of SDS infected soybeans. Symptoms often appear during heavy rains during the reproductive stages and disease is favored by high soil moisture. Consequently, the disease typically is present in areas of the field that are poorly drained (low lying or compacted areas). For every 10 unit increase in disease severity, there is a 7% reduction in yield. The disease is spread short distances on mechanical equipment, workers boots, etc), and spores can be disseminated very short distances in rain.

SDS is often found in association with Soybean Cyst Nematode and the pathogen can be isolated from within cysts of SCN. Disease severity is most severe when SCN and SDS are found together. This is likely because stress caused by SCN feeding on roots further weaken the plant, predisposing it to SDS infection.

Disease ID: Plants suffering from SDS typically do not present symptoms until after flowering (R1). Early symptoms of the disease include mottling and crinkling of the leaves. As the disease progresses the leaf tissue between the veins turns yellow/brown, while the veins remain green (Figure 3a). Soon thereafter the leaves shrivel and fall from the plant, but the petioles remain intact. If the plant is removed from moist soil tiny blue structures may be visible at the base of the stem. These are spore masses produced by the fungus. In most cases diagnosis is completed by sectioning the lower portion of the stem lengthwise. The cortex of a stem infected with SDS will be streaked with tan/light brown lesions, and pith of infected plants retains a white coloration Figure 3b.

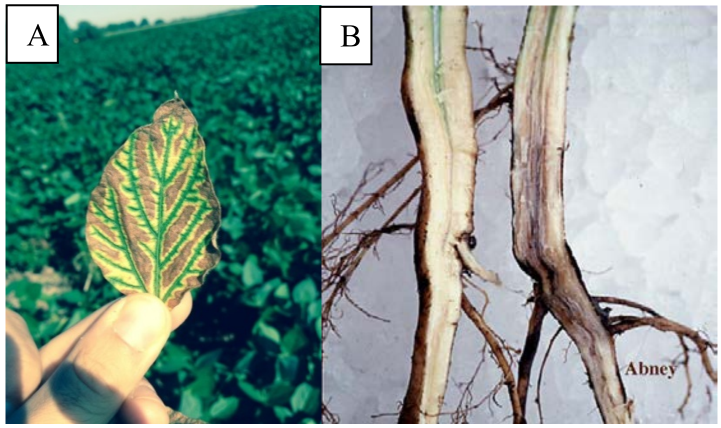

Figure 3ab. a-foliar symptom of SDS. Photo by N. Kleczewski b- Internal discoloration characteristic of SDS

Best Management Practices. As with SSB, SDS requires an integrated management approach to achieve sufficient reductions in disease in severely affected fields. **1) Resistant Cultivars.** Some soybean cultivars are more tolerant to SDS than others and resistance ratings can be obtained from seed dealers or directly from seed companies. A variety should be used that has both SDS and SCN resistance. **2) Cultural Practices.** Because SDS is most severe when seeds are planted into cool, wet soils, planting full season beans later in the spring or planting double crop beans may reduce levels of SDS. Disease severity is related to time of infection, being most severe when seedlings are infected at early vegetative stages. Therefore practices that enhance the establishment and growth of seedlings may reduce SDS. SDS is often most severe in wet areas. Improving drainage in wet areas and reducing soil compaction can help reduce the effects of SDS and improve yields. Some research indicates that reduced tillage can reduce levels of SDS. In these studies, the greatest levels of SDS reduction occurred when minimal tillage was combined with crop rotation. Crop rotation used alone is not likely to have an effect on SDS because of the ability for chlamydospores to survive in soil for several years. **3) Chemical Control.** lLeVO® is a new seed treatment that includes a group 7 fungicide, Fluopyram. Field data has shown promising results in terms of reducing SDS and SCN numbers. Current data show that this seed treatment can result in 3-4 bu/A in infested fields.

SMALL FRUIT

UPDATE ON RUTGERS NJAES STRAWBERRY BREEDING PROGRAM

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Many years of traditional breeding by Dr. Gojko Jelenkovic has resulted in new selections of strawberries which exhibit unique characteristics. Over the past five years the evaluation of these strawberry selection has been expanded and expedited to determine which of them might benefit local farmers and consumers. The selections have been tested in replicated university field trials at two sites in New Jersey and also through cooperative partnerships at North Carolina State U., the U. of Maryland, Pennsylvania State U., Ohio State U, and U. of Florida. Observation trials of the selections have been conducted on thirteen local conventional and organic strawberry farms. The research and farm trials have focused on identifying selections with superior fruit flavor and adaptability to eastern U.S. environmental conditions. Fruit from the trials has been utilized in blinded taste panels to determine consumer preference of the selections compared with commercial standards.

Consumers participating in the taste panels and farmer cooperators have been pleased with the consistent flavor and fruit quality attributes of the NJAES strawberry selections. These results have led to plant patent applications for three of the selections and the release of the variety ‘Rutgers Scarlet’™ to two commercial nurseries. Limited trial quantities of ‘Rutgers Scarlet’ ™ will be available to growers for the 2015 planting season. The plan is to release a series of new strawberry varieties from the program and make them available to farmers over the next several years.

This research and extension project has been supported by grants from the Walmart Foundation and administered by the University of Arkansas System Division of Agriculture Center for Agricultural and Rural Sustainability, as well as by funding from the Specialty Crops initiative through NJDA and USDA. Initial funding to help launch and continue to maintain this research was provided by Rutgers NJAES and the NJ Small Fruits Council.

BEACH PLUM- A NEW COMMERCIAL SMALL FRUIT CROP

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What is a beach plum?
Latin name: *Prunus maritima*. A maritime *Prunus* shrub native to northeastern North America. The typically purple fruits are the size of cherries with a similar pit. The texture is similar to plums or blueberries. The taste is tart, acidic and fruity. Beach plums are high in antioxidants and are a novelty crop in coastal areas such as Cape May and Cape Cod.

Beach plum production has been increasing in Cape May County since about 2005. Each year, commercial beach plum farmers are making more progress on developing growing systems and techniques. Almost 100% of the fruit sold is processed for a retail market. Some processed (or "value-added") products include jams, jellies, salad dressing, syrup, fruit wine, wine-blends and flavored gin. Restaurants familiar with the fruit are also eager to purchase some so that they may make their own creations in-house.

The Cape May County Beach Plum Association has been awarded the NJ Department of Agriculture's Specialty Crop Block Grant for 2015. These funds will be used to produce clones of selected plants and to educate others on the improved and developing growing systems.

Benefits and Disadvantages to the Grower:

Cons	**Pros**
Lack of available, high quality varieties to grow.	Customer interest- the demand currently exceeds the supply.
Lack of standard mechanized harvesting equipment in existence. No standard pruning method is established.	Tree fruit growers with existing equipment can capitalize on their knowledge and resources to grow a new crop
Extreme genetic variability, leading to spray application concerns and quality irregularity.	The genetics are diverse, so a total crop loss in any given year is unlikely.

Unpredictable genetic inheritance makes seed propagation for fruit production very slow	New clones will be developed in the near future
Pit inside the fruit.	Cherry pit-removing technology already exists.
Uneven ripening, unless the customer wants mixed ripeness (some do) it makes harvesting more challenging.	All of the plums do not ripen at the same time so that there is steady work in August/September for farm hands.
Limited registered plant protection materials available	Plant is native, so readily withstands our local climate. Relatively few pests or diseases for a fruit crop.

Current Soil and Fertility Recommendations:

- Soil pH of 6.5-7.0.
- Annual fall maintenance applications of 400 lbs./A of K-Mag (0-0-22-11)
- Nitrogen application of 40 lbs./A in March depending on plant vigor
- Annual foliar sprays of Solubor (1 lb. / 100 gallons of dilute spray) combined with 9% EDTA-Zinc chelate (1 qt. / 100 gallons) at ½" green tip.
- Foliar spray(s) of manganese sulfate in early summer where needed as indicated by foliar symptoms of Mn deficiency.

Pruning and Training:

Dormant Season:

Each beach plum plant is so different from the next that they may vary in size from small woody, low-lying shrubs with numerous shoots to medium-sized trees with one apparent central leader. The fruit forms on previous season terminal or lateral shoot growth and on short spurs on two-year and older wood. Pruning should be done during winter or early spring while the plant is dormant. At this time (early 2015) there is no specific recommended pruning form for beach plums. Some plants may lend themselves to a central leader and others to open-vase. Some growers choose a denser, blueberry type form. The most common form currently used by growers is the open-vase. But a trellised, central-leader system has also been developed.

Beach plums appear to survive in their harsh native-environment by bending and leaning permanently according to the prevailing wind direction. Due to the high winds in Cape May County a trellis system is sometimes required to maintain upright plants in commercial production, but only when the plants are young. In an experiment, 2-year old plants were trellised vertically. Posts were installed with 3 wires- one at 3', one at 5' and one at 7' trees were pruned to 7' maximum height. Although costly, advantages to this system include 1) better crop-protection material coverage, 2) ease of harvest, 3) condensed ripening time, 4) securing plants in an upright position. Before implementing this system a cost-benefit analysis should be done that includes the costs of materials and the reduction in labor.

Summer Pruning:
Pruning during mid-summer should be done to remove excessively vigorous shoots, root suckers, and new shoots that develop below the lower scaffold limbs. Some plants will produce many suckers (or "water sprouts") and others will produce none. The pruning style you choose should depend on your proposed production practices.

Note on Alternate Bearing:
Most beach plum plants produce excess fruit, making the alternate bearing problem worse. Therefore, it is best to reduce fruit-load during a heavy crop year in order to minimize this problem. Pruning off 25 - 30% of the fruiting wood is one method. The goal is to moderate the heavy crop while also producing new shoots.

Plant Protection:
At this time we are recommending following the spray schedule for plums in the Rutgers NJAES New Jersey Commercial Tree Fruit Production Guide.

Insects:
Care must be taken for pollinators but thankfully, beach plums do not have a large amount of insect pests associated with them. Most plants require cross pollination, but since there are no clonal varieties yet available this has not been of great concern to the commercial producers to date. The primary insect of concern is plum curculio. There are some non-detrimental insects that are associated with beach plums such as the cecropia moth larvae. Others are not well known, such as calico scale.

Diseases:
The predominant diseases are brown rot and occasionally plum pockets.

Weeds:
It is important to have all perennial weeds in the field under control before planting. After beach plums are in place use a fall application of an herbicide labeled for controlling the remaining perennial weeds in plums. Spring/summer applications of a non-selective herbicide may be made to control newly emerged weeds.

Follow-up Materials:
- Pruning Beach Plums for Fruit Production (Rutgers NJAES Fact Sheet FS1180)
- Rutgers NJAES Commercial Tree Fruit Production Guide

TOMATOES

UPDATE ON TOMATO PEST MANAGEMENT

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In the mid-Atlantic U.S. tomatoes are attacked regularly by several key insect pests that can seriously impact crop yield and quality. These include tomato fruitworm (= corn earworm), brown marmorated and other stink bugs, aphids, and thrips. Occasional pests also include beet armyworms, spider mites, Colorado potato beetle, hornworms, leafminers, flea beetles, whiteflies, and tomato pinworm. To control this complex of pests, most commercial tomato growers rely on a variety of insecticides. Even organic tomato producers may find it necessary to apply OMRI-certified natural insecticide products to protect their crops from the aforementioned pests. Because there are more insecticide products on the market than ever before and because the spectrum of pests that each controls is quite variable, it is important that we continuously test the efficacy and pest spectrum of insecticides and disseminate this information to those who can use it the most, the growers and crop consultants.

Results of some recent insecticide efficacy trials conducted on tomatoes in Virginia are presented below.

CONTROL OF POTATO APHIDS IN SPRING TOMATOES

Location:	HRAREC, Virginia Beach, VA
Variety:	Florida 47
Transplant Date:	24 Apr 2013
Experimental Design:	7 treatments arranged in a RCB design with 4 reps – 1 row x 20 ft. (6-ft row centers)
Treatment Method:	All foliar treatments were applied with a 3-nozzle boom equipped with 45 cores and D3 spray tips and powered by a CO_2 backpack sprayer at 40psi delivering 38 GPA.
Treatment Dates:	8 and 22 May

		Mean no. potato aphids			
Treatment	**Rate / acre**	**15-May**	**21-May**	**29-May**	**5-Jun**
Untreated Control		50.3 a	91.8 a	8.8 a	18.8
Sivanto	7 fl. oz	0.8 b	2.5 b	0.0 b	3.0
Sivanto	10.5 fl. oz	0.0 b	1.3 b	0.0 b	0.3
Closer SC	1.5 fl. oz	3.0 b	13.3 b	0.0 b	2.0
Closer SC	2 fl. oz	1.5 b	2.3 b	0.0 b	1.3
Movento	5 fl. oz	8.3 b	13.5 b	0.3 b	1.5
Exirel	13 fl. oz	0.0 b	0.0 b	0.0 b	0.0
P-Value from Anova		0.0001	0.0001	0.0001	ns

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).

CONTROL OF LEPIDOPTERAN INSECTS IN FALL TOMATOES WITH FOLIAR SPRAYS

Location:	Eastern Shore AREC, Painter, VA
Variety:	HBN602
Transplant Date:	22 Jul 2013
Experimental Design:	7 treatments arranged in a RCB design with 4 reps – 1 row x 20 ft. (6-ft row centers)
Treatment Method:	All foliar treatments were applied with a 3-nozzle boom equipped with 45 cores and D3 spray tips and powered by a CO□ backpack sprayer at 40psi delivering 38 GPA.
Treatment Dates:	26 Aug, 2 Sep, 9 Sep, 16 and 25 Sep.

		Mean no. lepidopteran larvae / 5 plants		Mean no. potato aphids / 5 plants	% lepidopteran damage to fruit	
Treatment	**Rate / acre**	**2-Sep**	**9-Sep**		**4-Oct**	**16-Oct**
Untreated Control		1.5 a	3.5 a	0.8	25.0 a	4.2
Coragen 20SC	5 fl. oz	0.0 b	0.0 c	0.0	3.3 b	0.0
Avaunt 30WG	3.5 oz	0.0 b	0.0 c	93.0	0.0 c	0.0
Belt	1.5 fl. oz	0.0 b	0.0 c	0.0	3.3 bc	0.0
Radiant + NIS	6 fl. oz + 0.25%	0.0 b	0.5 bc	1.3	2.5 bc	0.0
Voliam Xpress	9 fl. oz	0.0 b	0.0 c	0.0	0.0 c	0.0
Fastac	3.8 fl. oz	0.0 b	0.8 b	0.0	32.5 a	1.7
P-Value from Anova		0.0002	<0.0001	ns	<0.0001	ns

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).

CONTROL OF STINK BUGS IN TOMATOES – TEST 1, BLACKSBURG, VA - 2012

VARIETY: 'Carbon' tomatoes; PLANT DATE: 7 June; TREATMENT APPLICATIONS: All foliar treatments were applied on 26 July, 2, 8, and 15 Aug with a 3-nozzle boom equipped with D3 spray tips and powered by a CO_2 backpack sprayer at 40 psi delivering 38 GPA. HARVEST: 20 and 28-Aug.

Treatment	**Rate oz/ acre**	**% cumulative stink bug damage to fruit (2 harvests in Aug)**
Untreated control	-	31.8 a
Danitol 2.4EC +NIS	10.0	3.8 c
Belay 2.13SC +NIS	4.0	6.3 c
Belay 2.13SC + Danitol 2.4EC +NIS	2.0 +10.0	8.2 c
Endigo ZC	4.5	8.2 c
Leverage 360	3.8	8.8 c
Baythroid XL	2.8	10.7 bc
Actara 25WG	5.5	11.9 bc
VoliamXpress	9.0	16.2 b

CONTROL OF STINK BUGS IN TOMATOES – TEST 2, BLACKSBURG, VA - 2012

VARIETY: 'Carbon' tomatoes; PLANT DATE: 7 June; TREATMENT APPLICATIONS: All foliar treatments were applied on 26 July, 2, 8, and 15 Aug with a 3-nozzle boom equipped with D3 spray tips and powered by a CO_2 backpack sprayer at 40 psi delivering 38 GPA. HARVEST: 20 and 28-Aug.

Treatment	Rate oz/ acre	% cumulative stink bug damage to fruit (2 harvests in Aug)
Untreated control	-	25.7 a
Hero EC	7.1	7.5 b
Brigadier 2SC	8.0	7.8 b
MustangMax + Lannate LV	4.0 + 16	9.4 b
Athena	16.0	10.0 b
MustangMax	4.0	11.9 b
Vydate L	32	11.9 b
Hero EC	6.4	13.7 b
Lannate LV	48	20.7 a
Beleaf 50SG	2.8	27.5 a

DRIP-CHEMIGATED INSECTICIDES FOR CONTROL OF LEPIDOPTERAN LARVAE IN TOMATOES, PAINTER, VA

VARIETY: 'Phoenix' tomatoes; PLANTING DATE: 17 July; 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 for 1 hr after each event).

				% lepidopteran fruit damage		
Treatment	**Rate fl oz/ acre**	**Application Dates**	**Mean no. lep larvae[1] / 2 beat sheets (3 Sep)**	**3-Sep**	**14-Sep**	**24-Sep**
Untreated Control	-	-	10.3 a	32.5 a	35.0 a	39.2 a
Durivo	10.0	14 Aug	0.0 c	2.5 b	1.7 b	5.8 b
Durivo	13.0	14 Aug	0.0 c	5.0 b	3.3 b	4.2 b
Coragen 20 SC	5.0	14, 28 Aug	0.8 c	5.0 b	5.0 b	0.0 b
Coragen 20 SC	7.0	14 Aug	0.3 c	7.5 b	1.7 b	2.5 b
Admire Pro	7.0	14 Aug	6.8 b	32.5 a	23.3 a	27.5 a

[1]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).

MARKETING IN THE GARDEN STATE

MARKETING TO THE BIG GUYS – IS SUSTAINABILITY THE NEXT HURDLE?

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With the quality of the produce department cited as the number one reason for selecting and continuing to shop at a particular retail grocery store, it is no wonder that a game of fruit and veggie one-upmanship has been playing out among grocers. What started as simply having the freshest, cleanest or greatest variety of products in the section has turned into a contest to see who can add another hurdle or raise the bar to the highest standards.

The starting shot was fired in the late 1980s when the Ralph's supermarket chain in California adopted the NutriClean certification program to claim their produce was inspected and found to be pesticide free. That initial hurdle was cleared, with much industry protest and clarification from growers to competing chains that it was not a legitimate claim. No longer providing a competitive advantage, it faded in importance.

Then came increasing reports of links between fresh produce and food borne illnesses, and a new set of hurdles were placed. For the past 15 years, there have been great advances in improving production, monitoring, handling and certification systems in order to minimize the chances for contaminating fresh produce from field to fork, it still remains subject to a system without a uniform set of standards leveling the playing field. Certain retailers accept the now 'harmonized' audit, but have an added set of questions to meet their specific criteria.

In the meantime, while the dust has yet to settle around the food safety hurdles, several retailers have been working on a new set of directives to allow them to stand out from the crowd. Wal-Mart as the largest player in the industry is now pushing traceability to the forefront, with the hopes that one day, if needed, a fruit or vegetable could be tracked back from the consumer to the field in which it was grown with the push of a computer key, or a scan of a barcode.

Another set of criteria, which will likely require another certification audit, has emerged with both Wal-Mart and Wholefoods leading the way. Both have adopted 'sustainability' as the next attribute that they hope will set their produce departments (as well as the rest of the store) ahead of the competition. These new directives will be discussed.

While it turns out that in some cases, standards required by retailers may be superficial, unobtainable, or highly subjective, if you want to play the game and sell to these merchants, or the buyers that supply them, you have to play by the rules.

And as we all know, the customer rules.

FOOD/SAFETY

ON-FARM FOOD SAFETY DECISION TREES: HELPING FARMERS ASSESS RISKS, PRIORITIZE RESOURCES, AND IMPLEMENT PRACTICES EFFECTIVELY

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Food safety is every growers' responsibility; however, identifying and prioritizing food safety risks on the farm is often difficult. Small and medium scale growers often have limited time, money, and resources to implement food safety practices on the farm. While there are many food safety resources and templates offering guidance on practices to reduce risks, most do not explain how to assess risks or how to prioritize which food safety practices should be put in place first. Not all risks are the same and farm resources are limited. Understanding how to prioritize the implementation of food safety practices that reduce the biggest risks is important to farm viability and safety.

This project developed Decision Tree Portfolios to help fruit and vegetable growers assess on-farm risks and develop farm food safety plans that guide and prioritize the implementation of Good Agricultural Practices (GAPs). A documented food safety plan is required by some produce buyers (i.e. for a third party food safety audit) so this resource will aid growers in maintaining and growing their markets. Microbial contamination of fruits and vegetables in the field and packinghouse can come from many sources, such as wild and domestic animals, water, soil amendments, workers, and adjacent land. To address the diversity of risks, nine Decision Tree Portfolios were developed including: Worker Health, Hygiene, and Training, Wildlife and Animal Management, Land Use, Agricultural Water for Production, Postharvest Water, Soil Amendments, Sanitation and Postharvest Handling, Transportation, and Traceability. Each Decision Tree Portfolio contains an overview of the topic, a decision tree for assessing risks, food safety template language, sample standard operating procedures, sample log sheets for recording food safety practices, and references for additional resources. Initial development and review of the Decision Trees was guided by an advisory group of growers, extension educators, topic-specific experts, and government personnel. Focus groups were conducted with growers in Minnesota, New York, and Tennessee to evaluate the final Decision Tree Portfolios for usability and functionality.

Join this session to learn how to use this resource and get started on writing your food safety plan today! This session applies to all fruit and vegetable growers, with particular emphasis on small and medium scale farms, including the Plain community, organic, and direct-to-market growers. The Decision Trees are available online for download at http://www.gaps.cornell.edu/tree.html or can be purchased in print form from the Cornell GAPs Bookstore: http://www.gaps.cornell.edu/educationalmaterials.html#decisiontree.

FOOD SAFETY AND GREENHOUSE PRODUCTION

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Greenhouse production of vegetables has increased dramatically in the past two decades due to a number of factors, including advanced technology, demand for fresh local food year round, and improved specialized crop varieties, among others. Tomatoes are by far produced in highest volume, although cucumbers, peppers and lettuce are also widely produced under controlled environments. High tech greenhouses in Canada, the US and Mexico with ranges of 40 acres or more now produce about 65% of fresh tomatoes sold in supermarkets. However, small/very small greenhouse vegetable operations, less than 5 acres in total size, produce vegetables for local and regional markets.

Vegetables produced in greenhouses are shielded from many microbial threats, both plant and human pathogens. Plants are protected from rainfall and wind, wild animals are mainly excluded and crop nutrition is regulated. Pesticide use is generally much reduced compared to open field production, due to reduced disease and insect pest incidence and improved efficacy of biological control programs under protected culture. However, the moderate temperatures and high relative humidity typically encountered under greenhouse conditions are also conducive to foodborne pathogens such as *Salmonella* spp., *E. coli* and *Listeria monocytogenes*, as well as certain bacterial, fungal and virus plant pathogens (Ilic et al., 2015).

Many greenhouse vegetable operations, particularly high tech, high volume operations, have intensive sanitation programs and food safety management plans. However, there is significant variation among greenhouse operations in knowledge and management of microbial food safety and plant health risks. Protection of vegetables in controlled environments from microbial hazards is complex and a systematic approach addressing both plants and foodborne human pathogens during all phases of production is needed. The first step is to understand the risks associated with various practices, followed up by development and implementation of effective management programs. Food safety risk management programs are generally focused on the four Ws: Water, Workers, Wildlife/livestock, and Waste. A systems-based approach to identify risks, particularly points of pathogen entry, growth and dispersal within these focus areas can lead to development of appropriate and effective co-management strategies.

On-site surveys of 26 small/very small ($\leq$ 5 A) and large (>5 A) tomato production greenhouses in North America resulted in the identification of 293 propagation, growing and post-harvest practices (Ilic et al., 2012). Knowledgeable stakeholders ranked risks for the foodborne pathogens *Salmonella* spp., *E. coli*, and *Listeria monocytogenes*, and the plant pathogens *Clavibacter michiganensis* subsp. *michiganensis* (Cmm), Botrytis gray mold (*B. cinerea*), Pepino mosaic virus and emerging tomato viroids. Points of pathogen entry, dissemination and proliferation were identified throughout the seed-to-retail production cycle.

We used the Delphi expert elicitation method (Cuhls, 2003) to identify and rank food safety and plant health risks for tomatoes in small and large greenhouses (Ilic et al., 2015). Sources of contamination, value of testing and potentially effective management practices were identified. Comprehensive microbiological sampling of eight small/medium and large North American greenhouses three times over a tomato production cycle was conducted to validate critical points for pathogen entry, dissemination and control (Ilic et al. 2014; Lewis Ivey et al. 2014).

Water: Irrigation water was identified as an important potential source of contamination with both human and plant pathogens. Testing of irrigation water was considered a valuable tool for management of human pathogens and Cmm, causal agent of tomato bacterial canker. Experts did not agree on the value of testing for generic *E. coli*/coliforms as an indicator of human pathogen contamination. Generic *E. coli* was found in 15% of irrigation water samples from six of eight greenhouses, and on tomatoes in two of eight greenhouses. *Listeria monocytogenes* was detected in irrigation water in two of the greenhouses. Cmm was also detected in irrigation water in two greenhouses.

Workers: Experts identified workers as a source of contamination of human and plant pathogens but did not agree as to the frequency. Hand washing was ranked as the most effective management strategy, while enforceable health policy, restricted access, and use of gloves and designated footwear were also considered effective. However, in on-site surveys of 26 greenhouses, 50% did not have a hand washing policy in place and most employees (78%) did not wash their hands prior to harvesting. *Listeria monocytogenes* was detected on tarp floor covers, plant debris containers, doorknobs, workers' shoes and several surfaces in contact with produce, including harvest bins, packing boxes and scales. It was not detected on tomato fruit in any greenhouse sampled, however. Cmm was also detected on a number of these surfaces. Clearly development and enforcement of hand washing policies, the use of designated footwear, and appropriate sanitation practices should be a priority to reduce the risk of entry and dissemination of human and plant pathogens. Disinfectants vary in efficacy against different groups of pathogens: for example, 2% Virkon and 10% Clorox regular bleach have been shown to be effective in preventing transmission of *Pepino mosaic virus*, *Potato spindle tuber viroid*, *Tobacco mosaic virus* and *Tomato mosaic virus* (Li et al 2015) and Cmm (Baysal-Gurel et al. 2015). Virkon was not effective against Botrytis, but 10% Clorox and several quaternary ammonium compounds were effective against this pathogen. Workers in the Netherlands recently reported that a quaternary ammonium compound was more effective against *Listeria monocytogenes* than a chlorine-based disinfectant, but neither was highly effective against the bacteria in grooves in stainless steel designed to simulate scratches (Chaitiemwong et al, 2014).

Not all disinfectants are labeled for use on surfaces in contact with food; labels must be read carefully and followed to avoid exposure of foods to non-approved products.

Wildlife and Waste: Experts agreed that livestock and poultry operations are potential sources of contamination with human pathogens and should be further than 250 ft from vegetable production greenhouses. Rodents and birds were ranked as the highest risks, and raccoons and domestic cats were also considered a high risk. In general animals were not considered a significant risk for introduction and spread of plant pathogens, with the exception of insect vectors of certain diseases caused by viruses and bacteria. The practice of dropping pruned tomato foliage onto the floor beneath hydroponic tomatoes and leaving it in place for days or weeks was commonly observed in on-site surveys. However, this practice provides cover for rodents and serves as source of plant pathogens, particularly *Botrytis* (Carisse and Van der Heyden, 2015).

Greenhouse vegetable productions systems, whether large or small, are complex and present numerous opportunities for challenge by plant and foodborne human pathogens. Understanding each system in its entirety and the risks of pathogen introduction and dissemination at critical points in the production cycle can lead to improved co-management of plant and human microbial threats. There are no magic bullets for the production of pathogen-free, safe fresh produce, but products, strategies and policies can be utilized to significantly reduce risk.

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WHAT AUDITORS ARE FINDING ON NEW JERSEY FARMS

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This winter as you review your food safety manuals try to answer the questions listed below. If you cannot answer some of these relevant questions, you may want to make additions and revisions.

Food Safety Training – All personnel shall receive food safety training. This means everyone from the field workers to office workers and all owners. Did all employees at least receive basic food safety knowledge as it pertains to their jobs? Did the owners receive food safety training? Remember to record the training sessions.

Water/Microbiological Testing – Water testing is microbiological testing. Are your water sources and their uses documented (Water System Risk Assessment/Water Management Plan)? If a water source is being used for potable (drinking) water, make sure the testing company isn't doing an irrigation water test that has less restrictive allowances. Water used in the packinghouse must be potable (below detectable levels for total coliform). When testing for irrigation water, an acceptable level is 126 cfu/100 ml of generic E. coli. It the auditee's responsibility to have the sources tested for the right application at the right frequencies.

The food safety plan must contain a water system description for both the field and packinghouse. These can be photos, hand drawn maps, etc. Make sure to include risers, backflow devices, underground main, etc.

When water is reused (re-circulated) in the packinghouse, is there a water change schedule? How often the water is changed in the tanks must be recorded and be at acceptable intervals. In other words, you cannot wait until the end of the season to change the water. Also, the water must be treated with an Environmental Protection Agency approved chemical and be monitored.

Traceback – Is there a documented traceback system in place? Does your food safety plan explain in detail how the product is traced from the field to the buyer? Each operation must have their own traceback system for that operation and it must be written in the food safety plan. The plan must be followed up with records that demonstrate the plan is implemented.

A recall program is different than a traceback program. A recall program is the ability to show that if there was a food borne illness outbreak that could be traced to your operation that you could notify the next buyer concerning the recall. A grower must be able to demonstrate the ability to carry out the recall program. This can be done over the phone with a buyer. A grower needs to know how much product the buyer still has on hand and what was moved forward. You do not need to know where the product went that was not on hand. It is the buyer's responsibility to notify and follow-up with the other purchasers. Have the buyer fax a copy of the conversation on their letterhead including summary of the conversation, date, time and person. This should be kept on file for the auditor.

A recall team should be established and the information recorded in the food safety plan. The team members do not necessarily just include people on the farm. You may want to include a lawyer, accountant, etc.

Glove Use – This was the biggest issue of the 2013-14 audit season. Do you have a glove policy? If so, are your employees trained on what type of gloves are acceptable and the proper use? Where do employees obtain the gloves; how often do they need to be changed; where to dispose of used gloves, etc. If re-usable gloves are acceptable, how are they cleaned and sanitized and where to store the gloves at the end of the day or shift. Review your glove policy and make sure everyone understands it before next season.

Preharvest Assessment – There are five risk assessments in the harmonized audit. They are: Land use history, water systems, animal activity in the production areas, soil amendments and pre-harvest. There are different assessments that need to be carried out each year. As the name implies the pre-harvest assessment is done just before harvest. This can be done the day before to make sure everything is ready the next morning. Auditors are seeing risk assessment logs stating no risk present! Is there signs of wildlife; does your neighbor have a horse or cow across the fence; is there a diesel tank for the irrigation pump at the edge of the field; or is the portapoty too close to the field? These are just some examples. Remember the auditor will be looking at the field. It is not good if an auditor observes risks when there are none noted in your assessment report.

Food Contact Containers – Does your policy state how your company stores product containers? Can they be in direct contact with the floor/ground? What types of containers are acceptable for the product? These are just a few examples. Containers should be stored in a covered area away from birds, rodents, etc. If they cannot be stored in that manner then cover them with plastic to reduce the chance of contamination. They should always be stored off the ground on pallets.

Sanitizers/Water Treatment Chemicals – Chemicals used for cleaning and sanitizing must be labeled for that use. Some chemicals have short labels on the container, but if you check their website an expanded label can be found. For example, Clorox Ultra has a fruit and vegetable label on their website. You must have those labels at the time of the audit or be able to access them. This also, is true for chemicals used in re-circulated water for hydrocoolers and dump tanks.

Toilet Facilities – Do you have the adequate number of field toilets for the number of employees? Review the N.J.S.A. 34:9A-1 et seq. Migrant Labor, Seasonal Farm Labor Act to ensure you are within the acceptable limits. Make sure next season that the toilets have a wash station outside the toilet, soap and water, single use towels and a place to dispose of the grey water and towels.

ALTERNATIVE CROPS

BLUEBERRIES

UPDATE ON VALDENSINIA LEAF SPOT

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Valdensinia leaf spot, caused by the fungus *Valdensinia heterodoxa* Peyr., can cause leaf spots which can result in complete defoliation in some ericaceous species, including lowbush blueberries (*Vaccinium angustifolium*), cranberries (*V. macrocarpon*), and highbush blueberries (*V. corymbosum*). In lowbush blueberry fields in Nova Scotia, complete leaf drop has caused decreases in yields up to 60% (Hildebrand and Renderos, 2007). It has spread throughout northeastern lowbush blueberry growing areas and is a threat to highbush blueberry and cranberry production in the Northeast and other blueberry growing areas. Valdensinia leaf spot was first recognized in commercial blueberries in Nova Scotia, Canada in lowbush blueberry fields in 1997 and over the past 18 years has spread west and south into the United States. In 2009, Valdensinia leaf spot was found in Maine and by 2014, has been identified in 28 locations in Maine and also has been found in Quebec, New Brunswick, and Prince Edward Island. It has not spread out of Maine at this time.

Valdensinia leaf spot disease causes extensive leaf drop of many ericaceous plants, including most *Vaccinium* species. In susceptible hosts, *V. heterodoxa* will cause leaf spotting within 48 hours of infection and single lesions can cause leaf drop of young leaves within a couple of days and, with increasing severity of infection, complete defoliation. We have observed complete defoliation of lowbush blueberry plants in commercial lowbush blueberry fields by late June. Defoliated plants can utilize stored reserves to recover and form a flush of new leaves but this greatly decreases flower bud set and fruit production. Since lowbush blueberry has a two-year crop cycle, defoliation in the vegetative year causes a reduction in flower bud set and in the crop year directly reduces yield. In field experiments to determine the effect of defoliation on yield, P. Hildebrand (personal communication) found an 80% decrease in yield if plants were completely defoliated in the middle of July in the vegetative year and a 38% decrease in yield when defoliation occurred 37 days before harvest in the crop year of the two year crop cycle. If older leaves become infected with *Valdensinia* later in the season, they remain attached and may have approximately 10-40% of their leaf area affected by lesions. Extensive leaf drop from this disease can cause crop failure in lowbush, but the extent of possible damage to other cultivated blueberry types (highbush and rabbiteye) and cranberry is not yet fully known.

In lowbush and highbush blueberry, and possibly in cranberry, the fungus can produce multiple rounds of spore production and continue to spread after wet periods throughout the growing season. New spore production occurs on infected leaves within 4-5 days. In highbush blueberry (S. Annis, personal observation), spores are produced on infected leaves that remain attached to the plants, providing a scaffold to move the infection farther up the plant. Lesions have been observed as high as 67 inches into the canopy of infected highbush blueberry plants. The fungus produces an unusually large (0.5mm), asexual spore which can be shot 12 inches up from a leaf lesion (P. Hildebrand, personal communication). Spores that impact on a leaf stick to the surface and then "punch" their way into the leaf tissue using numerous penetration hyphae. The large asexual spores remain attached to lesions for at least a few days after infection and can be seen with a hand lens, serving as a diagnostic sign of this disease. The dispersal mechanism of these large asexual spores allows for localized spread of the fungus. It has been suggested that the large size of the spores prevent their long distance spread by wind or water, but wind may aid in localized spread amongst plants. We, and other researchers, have not as yet found sexual reproduction in lowbush blueberry fields which would preclude spread by windborne sexual spores. The fungus produces survival structures called sclerotia along the veins of infected leaves, which allows the fungus to survive over winter and produce new asexual spores in the spring after a wet period. If this fungus is only reproducing asexually than the fungus alone would not have a mechanism to rapidly spread to non-adjacent new areas.

V. heterodoxa has been identified in 28 locations in Maine and over 40 fields in Nova Scotia and numerous sites in Quebec, New Brunswick and Prince Edward Island. It is still not clear how the pathogen is moving to new sites, but the primary hypothesis is by movement of infected leaves on farm vehicles and other equipment. A second hypothesis would be the pathogen is present in native understory stands of lowbush blueberry and is spreading into managed commercial fields when conditions are favorable. We are currently studying the genetic similarities of populations of Valdensinia in various infected field in Maine and Canada to see if we can find patterns to explain how this fungus is spread.

We are conducting GIS analysis to look for field characteristics that may increase the chances of a field becoming infected with Valdensinia. We have assembled all known Maine locations that Valdensinia has been found into a GIS database with data on field characteristics. We have found that blueberry fields with Valdensinia have significantly more agricultural land, deciduous forest and are less blueberry land in the surrounding landscape and are closer to roads compared with random fields with no history of Valdensinia. Valdensinia infection is often found near roads into fields and along the edges of fields which are shaded by trees. This pattern may be from the introduction of the fungus by contaminated farm equipment and that shaded areas tend to be wetter longer allowing for more spore production by the fungus and more infection. We are continuing to look at more landscape features that may affect the introduction or spread of this fungus.

Other research is examining possible resistance to the fungus. We do not know if there is some level of resistance to the fungus present in lowbush blueberries and other ericaceous species. The infection is typically patchy in a field, which makes it difficult to assess differences among genotypes in the field. We are currently carrying out laboratory experiments to determine if there is variation in infection amongst genotypes of lowbush blueberries. If variation is found this may help explain how the fungus spreads in the field. Studies on possible resistance in other ericaceous species, such as highbush blueberry and cranberry, will be conducted in the future.

In lowbush blueberries, Valdensinia leaf spot can be eradicated by burning all above ground portions of the plant and leaf litter. This hard burning has eliminated the fungus from infected fields and has not caused damage to the plants. If the fungus is not eradicated, it can be suppressed by yearly applications of fungicides in May and June to decrease early infections and prevent early leaf drop. Due to the expense of the fungicide applications necessary for control and the risk of spread of the fungus, lowbush blueberry growers in Maine have been advised to eradicate the fungus by burning if possible. Many growers continue to struggle with this fungus in their fields, and some fields have been removed from production due to high levels of Valdensinia infection and the difficulty and cost of burning and cost of fungicide control.

Valdensinia leaf spot is currently affecting commercial lowbush blueberry in Maine and has not been found in other states. This disease has the potential to be a serious threat to other commercial blueberries and cranberries. Any plants with symptoms of early leaf drop should be checked for the presence of this fungus. Early detection can allow the fungus to be eradicated and prevent further spread and a larger problem for growers.

THE SOIL MICROBIOME- WHAT DOES IT TELL US?

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When young blueberry bushes are planted in an established field that already contains mature blueberry bushes, the young bushes tend not to perform well. Similarly, when mature blueberry fields are completely renovated and replanted with young plants, the whole field may sometimes not perform well. The poor-performing plants may have limited root growth and remain stunted years after planting. This syndrome is similar to apple replant disease. Although more intensely studied, the causal organisms for apple replant disease vary by geographic region and usually involve soil microbes such as fungal and bacterial pathogens. Plant pathogenic nematodes can also be involved.

One of the treatments for replant disease is fumigation. However fumigation is not possible when planting individual bushes as replacements into a mature field. Furthermore, even when possible, i.e. when an entire field is being renovated, fumigation is non-selective and can destroy beneficial soil microorganisms. If the specific causal agent(s) of blueberry replant can be identified, this will allow more targeted approaches to mitigation.

The microbiome is defined as all of the microorganisms that are present in a particular environment; in this case, we are interested in all of the microorganisms that inhabit the root zone of blueberry plants in commercial fields. To do this, we isolated DNA from the root zones of blueberry plants. The extracted DNA should contain genetic material from all of organisms present in the soil sample. We then amplified potions of the DNA that when sequenced, are diagnostic. Specifically, we amplified the 16s ribosomal DNA to identify bacteria and the intergenic spacer (ITS) region of the ribosomal DNA to identify fungi. The millions of sequences generated are separated into bins (each bin contains similar sequences) and these are clustered into operational taxonomic units (OTUs). The OTUs are then identified to various taxonomic levels by comparison to known sequences from each organism. This technique is also semi-quantitative in that the relative abundance of each identified microorganism can be determined.

We collected paired soil samples from several commercial blueberry farms where one sample contained ‘good’ soil and the other contained ‘bad’ soil (soil where replant disease is a problem). We also sampled soil from the forest. DNA was extracted from all samples and subjected to the analysis described above. We hypothesized that comparison of the organisms in the soil samples would provide to clues to which might be involved as causal agents of replant disease as well as which might be beneficial. Approximately 400 fungal genera from 180 families were represented in these samples as well as 558 bacterial genera from 226 families. Further analyses of these data will be discussed.

EVALUATION OF A NOVEL ATTRACT-AND-KILL TECHNOLOGY FOR CONTROL OF ORIENTAL BEETLE

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SUMMARY

A 2-year study was conducted in commercial blueberry farms to evaluate the potential of SPLAT™ attract-and-kill technology for maintaining efficacy of mating disruption in oriental beetle while lowering amount of pheromone input. In 2011, SPLAT™-OrB-MD containing 1% (*Z*)-7-tetradecen-2-one, the major sex pheromone component of oriental beetle, and SPLAT™-OrB-A&K containing the pheromone with additional 2% cypermethrin were tested at 100 and 200 dollops per acre with dollop size uniform at 1 g each. Pheromone-baited trap male captures in all plots treated with SPLAT were lower compared with captures in untreated control plots, and all had similar Disruption Indices (DI) over 95%. In 2014, the same materials were tested at 100 dollops per acre, but with dollop sizes of 0.25 and 0.5 g each. Pheromone-baited trap captures in all plots treated with SPLAT were lower compared with captures in untreated control plots. SPLAT-MD at 100 dollops of 0.25 g was the only treatment with a DI below 90%. The addition of 2% cypermethrin in a corresponding SPLAT-OrB-A&K treatment maintained a DI above 95%. These studies indicate that efficacy of mating disruption in the oriental beetle can be maintained even at pheromone rates as low as 0.25 g AI per acre with the addition of a toxin such as cypermethrin as an attract-and-kill method.

BACKGROUND

The oriental beetle, *Anomala orientalis* (Waterhouse) (Fig. 1), is a major pest of blueberries in New Jersey. The sex pheromone of oriental beetle has been identified as a 9:1 blend of (*Z*)- and (*E*)-7-tetradecen-2-one (Zhang et al. 1994). Sex pheromone-mediated mate location and copulation typically occurs near soil surface, shortly after emergence, close to the emergence site (Facundo et al. 1999). Previous studies evaluated the feasibility of point-source dispensers of the major pheromone component (*Z*)-7-tetradecen-2-one, which now have a tolerance exemption for use on food crops (Sciarappa et al. 2005, Rodriguez-Saona et al. 2009). Sciarappa et al. (2005) evaluated rates of 20-30 ChemTica dispensers/acre containing 1g of (*Z*)-7-tetradecen-2-one per dispenser while Rodriguez-Saona et al. (2009) evaluated densities of 10-20 dispensers/acre and loading rates of 0.05, 0.1, and 0.5g of (*Z*)-7-tetradecen-2-

Fig. 1. Oriental beetle adults.

one per dispenser. In both studies trap captures in blueberry plots treated with pheromone were reduced by over 90% compared to untreated controls. Mating rates were also found to be lower in treated plots compared to control plots. Later, Rodriguez-Saona et al. (2010) found SPLAT-OrB-MD, an emulsified wax pheromone formulation (Fig. 2), to be effective as dispensers at reducing trap capture and mating in treated plots compared to control plots. To lower cost of SPLAT for mating disruption it is necessary to determine a minimal effective density of point sources and minimum effective dollop size. It may be possible to maintain disruption efficacy of SPLAT-OrB while lowering point-source density and dollop size by adding a toxin as an attract-and-kill method. The objective of this study was therefore to find a lower threshold of dollop density and size for effective disruption of the oriental beetle, and to evaluate any effects of the additional toxin in the attract-and-kill formulation.

METHODS

Fig. 2. SPLAT-OrB.

Laboratory Assay 2011. We evaluated 24 h mortality of male beetles when kept in Petri dishes with 1g dollops of SPLAT of various ages: 0, 15, 21, and 30 day old. Three treatments were assessed: SPLAT-Blank (control), SPLAT-OrB-MD, and SPLAT-OrB-A&K.

Field Trial 2011. We evaluated two point-source densities for SPLAT-OrB-MD and OrB-A&K: 1) 1 g dollops at 200 dollops per acre (2 g AI/acre) (500 dollops per ha), 2) 1 g dollops at 100 dollops per acre (1 g AI/acre) (250 dollops per ha), and an untreated control. SPLAT was applied to 6” wooden plant stakes with a modified caulking gun set to deliver 1 g dollops then stuck into the soil close to the base of a bush to avoid trampling by workers.

Field Trial 2014. We evaluated two rates (dollop size) for SPLAT-OrB-MD and OrB-A&K at a density of 100 dollops/acre (250 dollops per acre): 1) 0.50 g dollops (0.5 g AI/acre), 2) 0.25 g dollops (0.25 g AI/acre), and an untreated control. The SPLAT dollops were measured by weight with syringes applied onto squares of newspaper and allowed to dry for 24 h before being deployed in the field. Dollops were placed near the base of bushes to avoid trampling.

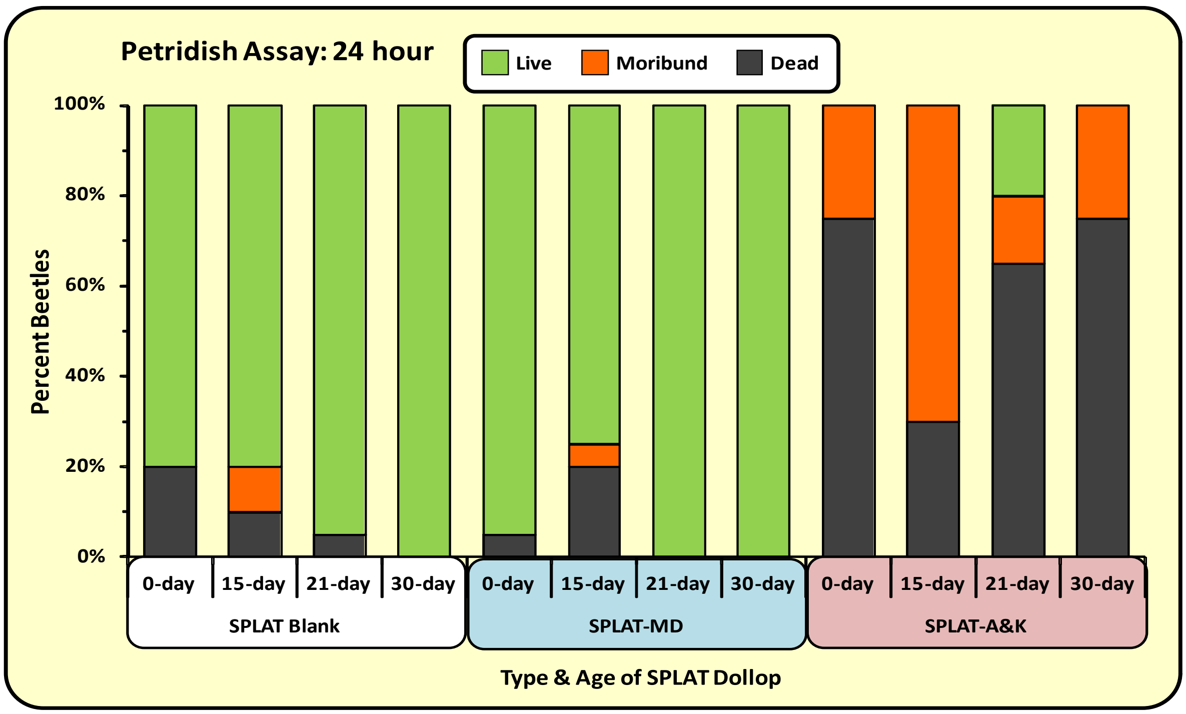
Both experiments were conducted on commercial blueberry farms in Hammonton, NJ. Experimental plots were 1 ha (2.5 acres) in size with 3 replications. Reduction of weekly beetle captures in monitoring traps baited with 300 µg of (*Z*)-7-tetradecen-2-one was used to assess efficacy of disruption. There were three traps in the interior of each plot. Reduction of beetles caught in female-mimic traps baited with 0.3 µg of the pheromone was used as another method to test the effectiveness of disruption treatments. For each treatment replicate, four female-mimic traps were placed in each plot and retrieved after 3 days.

RESULTS AND DISCUSSION

Oriental beetle males had higher 24 h mortality when in proximity to all ages of SPLAT-OrB-A&K compared to SPLAT-OrB-MD and SPLAT-Blank (control). Even the 30 days old SPLAT-A&K effectively caused 100% mortality in Petri dish assays (Fig. 3).

Oriental beetle male captures in treatment plots in both 2011 and 2014 were not significantly different prior to application of SPLAT. Post-treatment trap captures were significantly lower in plots treated with SPLAT-MD and SPLAT-A&K compared to trap captures in untreated control plots. Pheromone trap male captures remained low throughout the season in all SPLAT plots compared to control plots in both 2011 (Figure 4A) and 2014 (Figure 4B). Tables 1 and 2 summarize the data on trap shutdown. Fewer males were found in both monitoring traps and

Fig. 3. Residual activity of aged SPLAT dollops on oriental beetle males after 24 h exposure



female-mimic traps from SPLAT treated plots compared to those in untreated control plots. Our 2011 data indicate that 1 g SPLAT dollops at densities of 100 and 200 per acre were equally effective in shutting down oriental beetle pheromone communication. The 2014 data indicate that at a density of 100 per acre, dollop sizes of 0.25 and 0.5 g are also equally effective. Since there was no significant difference between 2014 SPLAT treatments in the number of beetles caught, there is no significant difference in the calculated Disruption Indices (DI). The DI's were greater than 95% for almost all SPLAT treatments in both 2011 and 2014, with the exception of the lowest SPLAT-MD treatment from 2014 (100 dollops/acre at 0.25 g/dollop) which had a DI lower than 90% (Table 2). While not significant, this lower DI suggests we may be approaching an effective minimum rate of SPLAT-MD. It is important to note that the same rate in SPLAT-A&K had a DI>95%, which suggests the possibility that the attract-&-kill method of adding a toxin to SPLAT may indeed help maintain disruption efficacy when lower point-source densities or smaller dollop sizes are used to make applying SPLAT-OrB for oriental beetle control more cost-effective

Table 1. Oriental beetle attract-&-kill vs. mating disruption using SPLAT™ in Blueberries, 2011.

Treatment Label	%AI Pheromone	%AI Cypermethrin	No. Dollops (units/ac)	Dollop Size (gram)	Phero Rate (g/ac)	Monitor Traps [1] Beetles/Trap (mean ± SE)[3,5] Pre-Treat[4,7]	Post-Treat[7]	DI (%)[6]	Female Mimic Traps [2] Beetles/Trap (mean ± SE)[3,5] 1st Deploy[8]	2nd Deploy[8]
A&K : 200/ac	1%	2%	200	1.0	2.0	10 ± 3	26 ± 6 A	(96.7)	1.3 ± 1.1 A	0.0 ± 0.0 A
A&K : 100/ac	1%	2%	100	1.0	1.0	9 ± 3	35 ± 12 A	(95.6)	1.0 ± 0.8 A	0.3 ± 0.2 A
MD : 200/ac	1%	-	200	1.0	2.0	13 ± 6	26 ± 8 A	(96.7)	3.3 ± 1.2 A	0.2 ± 0.2 A
MD : 100/ac	1%	-	100	1.0	1.0	10 ± 4	34 ± 14 A	(95.7)	1.2 ± 0.4 A	0.5 ± 0.5 A
Control	-	-	-	-	-	10 ± 5	783 ± 502 B	-	29.2 ± 5.1 B	6.2 ± 1.6 B

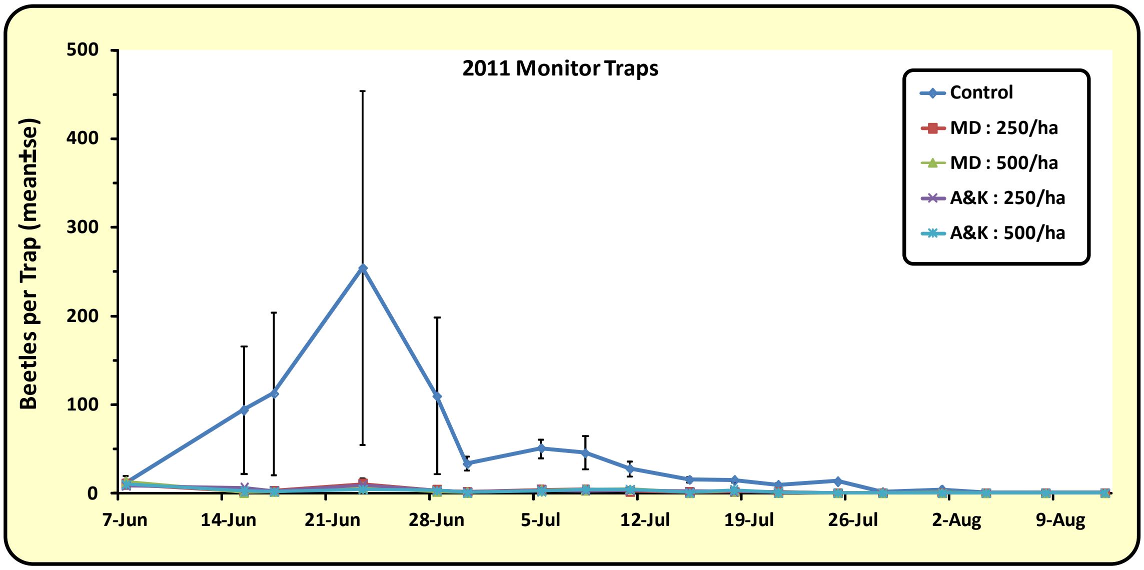
1 Monitor traps: 300ug lures. 2 Mimic traps: 0.3ug lures. 3 Data displayed as means ± SE (n=3 replicates). 4 Pre-Treatment counts not significantly different.
5 Means within a column with the same letter are not significantly different (Fisher's test, P>0.05). 6 Disruptive index (DI) =[1-(Treatment/Control)] x 100.
7 Pre-Treatment trap catch from 2-June to 7-June, Post-Treatment catch from 8-June to 12-August. 8 First Deployment: 8-July, Second Deployment: 26-July.

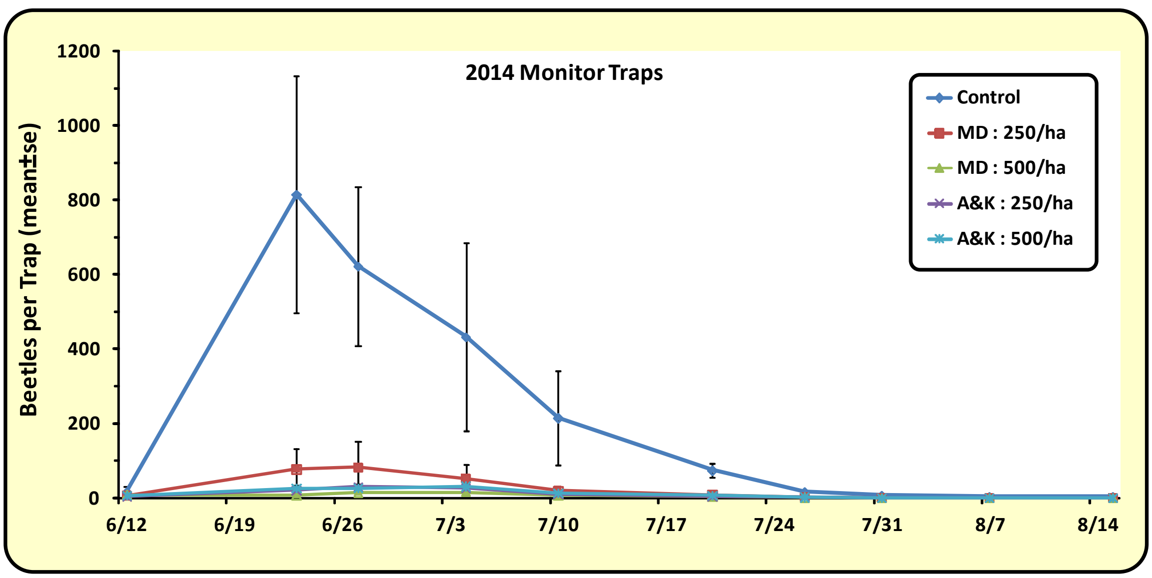
Table 2. Oriental beetle attract-&-kill vs. mating disruption using SPLAT™ in Blueberries, 2014.

Treatment Label	%AI Pheromone	%AI Cypermethrin	No. Dollops (units/ac)	Dollop Size (gram)	Phero Rate (g/ac)	Monitor Traps [1] Beetles/Trap (mean ± SE)[3,5] Pre-Treat[4,7]	Post-Treat[7]	DI (%)[6]	Female Mimic Traps [2] Beetles/Trap (mean ± SE)[3,5] 1st Deploy[8]	2nd Deploy[8]
A&K : 0.50g	1%	2%	100	0.50	0.50	6 ± 4	104 ± 35 A	(95.3)	3.1 ± 1.1 A	4.3 ± 2.2 A
A&K : 0.25g	1%	2%	100	0.25	0.25	4 ± 1	91 ± 13 A	(95.8)	1.2 ± 0.3 A	3.3 ± 0.7 A
MD : 0.50g	1%	-	100	0.50	0.50	8 ± 6	50 ± 3 A	(97.7)	1.0 ± 0.8 A	3.3 ± 0.4 A
MD : 0.25g	1%	-	100	0.25	0.25	6 ± 2	241 ± 176 A	(89.0)	4.1 ± 1.6 A	5.3 ± 0.8 A
Control	-	-	-	-	-	17 ± 11	2188 ± 467 B	-	29.8 ± 22.8 A	27.0 ± 1.2 B

1 Monitor traps: 300ug lures. 2 Mimic traps: 0.3ug lures. 3 Data displayed as means ± SE (n=3 replicates). 4 Pre-Treatment counts not significantly different.
5 Means within a column with the same letter are not significantly different (Fisher's test, P>0.05). 6 Disruptive index (DI) =[1-(Treatment/Control)] x 100.
7 Pre-Treatment trap catch from 5-June to 12-June, Post-Treatment catch from 13-June to 15-August. 8 First Deployment: 30-June, Second Deployment: 18-July.

Fig. 4. Oriental beetle male captures in 300 ug-baited monitor traps from plots treated with SPLAT-OrB-MD and OrB-A&K in 2011(A) and in 2014 (B).





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UPDATE ON SPOTTED WING DROSOPHILA RESEARCH AND MONITORING PRACTICES

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SUMMARY

The spotted wing drosophila (SWD), *Drosophila suzukii* is a known pest of small fruit in North America. Currently it is found in blueberry fields in New Jersey. In order to make practical integrated pest management recommendations, proper monitoring is necessary. To determine how to best monitor for the SWD two research studies were conducted over the 2014 blueberry growing season. The first study was conducted between June 6 and August 20, 2014 at 5 locations that used minimal pesticide applications. Six attractants (Kombucha, Cowles, Suzukii, Apple cider vinegar (ACV), Trecé, and Kerr) were evaluated. Each treatment was poured into a red solo cup with clear lids and hung in the blueberry fields (pictured to the right). The total number of male and female SWD was counted and recorded each week and the seasonal accumulated number of SWD was calculated for each treatment. In addition, from July 31 to August 20, non SWD found in each trap were also counted to determine how species specific each attractant was.

The second experiment evaluated 3 attractants, Trecé + ACV, Suzukii, and ACV in clear containers with clear lids positioned on stakes 2.5 ft high, and placed under bushes at row ends or edge rows by a wooded or hedgerow border. Traps were placed at 31 locations, from May 28 to August 22, 2014. A second objective in test 2 was to mark the first emergence of SWD, giving growers a warning for when to start SWD insecticide programs. The majority of the trap locations were in treated plots under regular commercial conditions. The total number of SWD in each trap was counted 2 times a week and the seasonal accumulated number of SWD was calculated.

RESULTS

Results from the first study show that the attractants Suzukii and Trecé were the most attractive to the SWD throughout the 2014 season, capturing 771 and 816 SWD, respectively (Figure 1). These results indicate that the commercial lures are more effective at capturing SWD compared to homemade attractants. In addition, all of the attractant traps accumulated less than 100 non SWD (Figure 2). The first catch of SWD was recorded during the week of June 29, 2014.

The second experiment resulted in the Trecé trap having the highest seasonal accumulation of SWD (908) compared to ACV and Suzukii (Figure 3). Similar to the first experiment, the first catch of SWD occurred during the week of June 29, 2014.

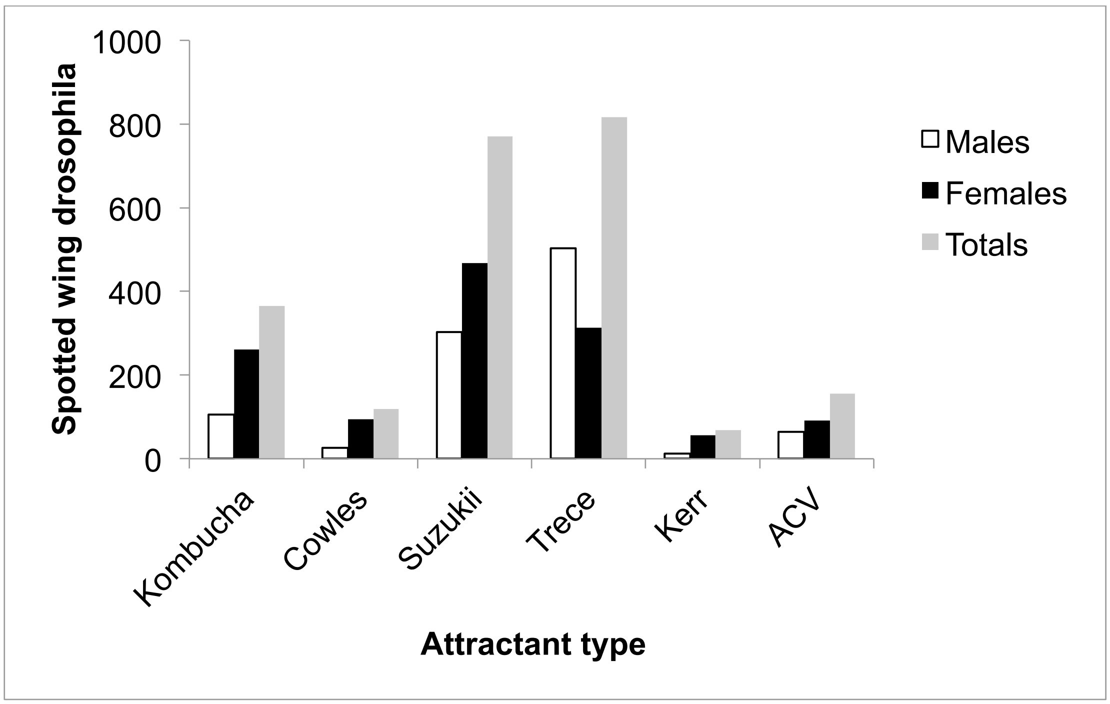

Figure 1. Seasonal accumulated number of male, female and totals (male + female) of the spotted wing drosophila, *Drosophila suzukii* found in traps from the first study at 5 locations from June 6 to August 20, 2014.

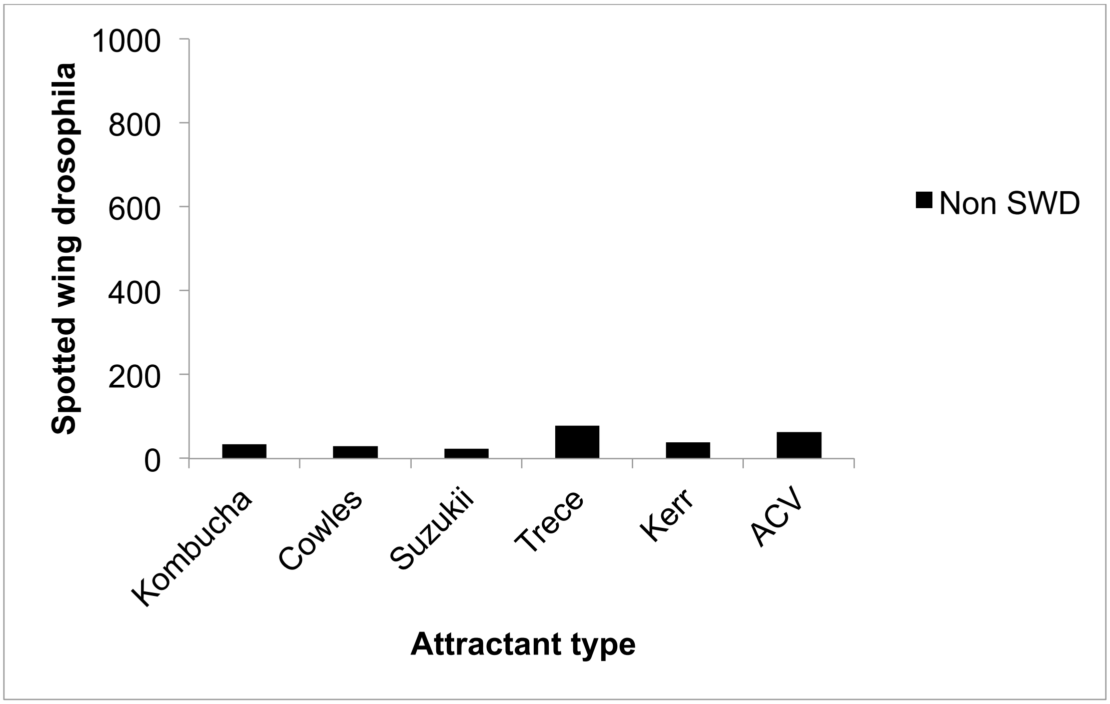

Figure 2. The total number of species found in the traps from the first study that were not the spotted wing drosophila (SWD), *Drosophila suzukii* from July 31 to August 20, 2014.

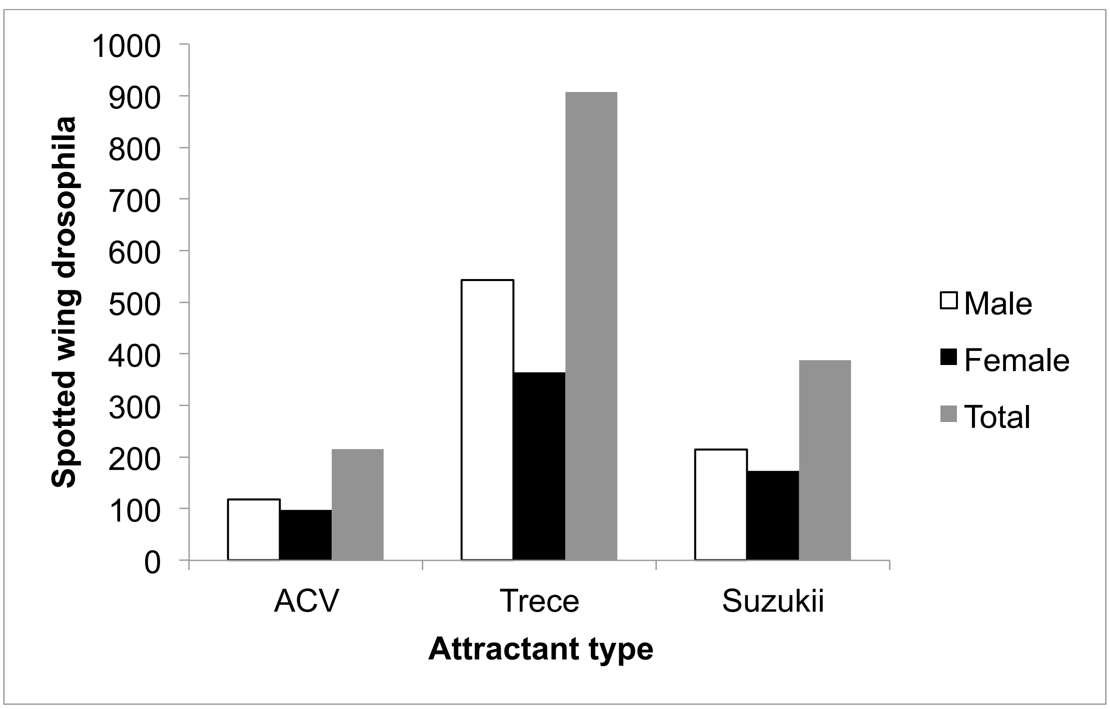

Figure 3. The seasonal accumulation of male, female, and total (male + female) spotted wing drosophila, *Drosophila suzukii* from the second study conducted from May 28 to August 22, 2014.

VINE CROPS

Managing Cucurbit Downy Mildew with Disease Monitoring, Cultivar Resistance and Effective Fungicide Programs

Sponsored by the 2014 Charles and Lena Maier Vegetable Research Award presented by the NJ-VGA

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In 2014, five different fungicide programs with varying fungicide inputs were evaluated at the Rutgers Agricultural Research and Extension Center (RAREC) in Bridgeton, NJ on three different cucurbit crops. The five fungicide programs with either no fungicide input (untreated control), a low fungicide (protectant fungicides only) input, medium input (protectant + moderately effective downy mildew fungicides), or high fungicide input (protectant + highly effective downy mildew specific fungicides) are listed in Table 1. The three cucurbit crops evaluated were cucumber cv. 'Markermore 76', zucchini cv. 'Reward' (summer squash), and acorn cv. 'Taybelle' (winter squash). Raised beds were laid with white plastic on 5 ft center with one drip off set to one side on 25 Jun. Plots were one row 15-ft-long and 5-ft between beds and arranged in a randomized complete block design with four replications. Plots were hand seeded (2 seed/hole) at 12 inch spacing on 22 July and reseeded as needed on 29 July. The field was fertilized pre-plant incorporated with 50 lb/A nitrogen (calcium nitrate). The remainder of the fertilizer was applied through the drip system at the rate of 30 lb/A as 20-20-20 equivalent as needed during the study. Prowl at 2 qt/A + Dual Magnum at 1 qt/A + Sandea 0.75 oz/A were applied on 8 July then followed with an application of Dual Magnum at 1 pt/A + Command at 4 oz/A on 8 Aug for weed control.

The five fungicide programs were initiated on 7 Aug and applied every 7 to 10 days for a total of 10 fungicide applications (Table 2). All fungicide treatments were applied with a pressurized tractor-mounted sprayer with 3 hollow-cone D4-25, disc core drop nozzles (one over the top, one on each side of the row at a 45 degree angle) at ~43 gal/A and 58 psi. Plots were evaluated for downy mildew development on August 18, 25; September 2, 9, 17, 25; and October 2 and 10. Foliage was rated weekly on a scale of 0 to 100 (0.0 = no downy mildew; 100 = 100% of leaves infected) for downy mildew development. The Arcsine-transformed area under disease progress curve (AUDPC) values for downy mildew development were calculated for each fungicide program (Table 2). A total cost per season for each program was also calculated and presented in Table 2. No harvests were done.

Cucurbit downy mildew appeared late in the production season about 1 month after seeding and approximately 2 weeks after the first fungicide application. Importantly, during the course of study only cucumber 'Marketmore 76' became infected by the pathogen. This suggests, along with other reports in the region, that the primary host for cucurbit downy mildew in 2014 was cucumber. This suggests that cucurbit downy mildew may have different race(s) and host specificity, and predominant race(s) may emerge in any specific growing season. Area under disease progress curve (AUDPC) values varied significantly based on fungicide program

(Table 2). AUDPC values were significantly highly in the UTC and low input programs compared to the medium and high input fungicide programs for cucurbit downy mildew control (Table 2). Control was similar between the medium and 2 high fungicide input (new and old standard) programs (Table 2). Although not significantly different, both high input fungicide programs resulted in numerically lower AUDPC values (Table 2) suggesting slight better downy mildew control compared to the medium input program (Table 2). Fungicide costs were obtained from a local supplier and season-long program costs (fungicide material only) were calculated. Although not significantly different in AUDPC value, the new cucurbit downy mildew fungicide program cost was approximately $150 more than the old standard program (Table 2).

Results of this study suggest that race(s) of cucurbit downy mildew may be appearing in the region and that cucurbit host susceptibility may vary greatly from year to year. All cucurbit growers in New Jersey and the mid-Atlantic region need to follow reports of cucurbit downy mildew during the production season through the CDM forecasting hosted by NCSU at http://cdm.ipmpipe.org/. By following up-to-date reports though the CDM forecasting website and via timely reports via the Plant and Pest Alert System through NJAES during the production season growers will be able to determine which cucurbit where the pathogen is located in the US and which cucurbit crops are most at risk. Control of cucurbit downy mildew begins with regular scouting, keeping up with reporting, recognizing the symptoms, and preventative fungicide programs. In this study, the best control of cucurbit downy mildew in cucumber was in the fungicide programs that contained downy mildew specific fungicides such as Ranman, Presidio, Zampro and Previcur Flex. These fungicides in combination (and rotation) with protectants such as chlorothalonil, Gavel, or mancozeb should be used according to their respected labels along with cucumber varieties with downy mildew resistance where appropriate. Possible resistance to Presidio has been detected in the southern US and its use efficacy in the state and region should be closely monitored.

Table 1. Fungicide program name, rates, and application timing for 5 different fungicide programs for the control of cucurbit downy mildew in cucumber 'Marketmore 76' at the Rutgers Agricultural Research an Extension Center in Bridgeton, NJ in 2014.

Fungicide program	Fungicide rates and application timing
UTC	none
Low Input	2.0 pt chlorothalonil weekly (1-10)
Medium Input	2.0 pt chlorothalonil + 3.2 oz Curzate (1,3,5,7,9) alt. 2 pt chlorothalonil + 8.0 oz Tanos (2,4,6,8,10)
High Input - old standard	2.0 pt chlorothalonil + 2.75 fl oz Ranman (1,3,5,7,9) alt 2.0 pt chlorothalonil + 4.0 fl oz Presidio (2,4,6,8,10)
High input - new standard	2.0 pt chlorothalonil + 1.2 pt Previcur Flex + 2.75 fl oz Ranman (1,3,5,7,9) alt. 2.0 pt chlorothalonil + 1.2 pt Previcur Flex + 14.0 fl oz Zampro (2,4,6,8,10)

Table 2. Fungicide program name, rates, application timing, AUDPC values, and costs for 5 different fungicide programs for the control of cucurbit downy mildew in cucumber 'Marketmore 76' at the Rutgers Agricultural Research an Extension Center in Bridgeton, NJ in 2014.

Fungicide program[z]	Fungicide rates and application timing[y]	AUDPC Value[x]	Program Cost ($)[w]
UTC	none	2608 a[v]	0
Low Input	2.0 pt chlorothalonil weekly (1-10)	1933 b	$89.60
Medium Input	2.0 pt chlorothalonil + 3.2 oz Curzate (1,3,5,7,9) alt. 2.0 pt chlorothalonil + 8.0 oz Tanos (2,4,6,8,10)	1120 c	$244.00
High Input - old standard	2.0 pt chlorothalonil + 2.75 fl oz Ranman (1,3,5,7,9) alt 2.0 pt chlorothalonil + 4.0 fl oz Presidio (2,4,6,8,10)	853 c	$349.25
High input - new standard	2.0 pt chlorothalonil + 1.2 pt Previcur Flex + 2.75 fl oz Ranman (1,3,5,7,9) alt. 2.0 pt chlorothalonil + 1.2 pt Previcur Flex + 14.0 fl oz Zampro (2,4,6,8,10)	806 c	$496.75

[z] Five fungicide programs based on fungicide efficacy, mode-of-action, application timing, and rate per acre

[z y]Application timing: 1 = 8/7, 2 = 8/13, 3 = 8/20, 4 = 8/26, 5 = 9/1, 6 = 9/8, 7 = 9/15, 8 = 9/23, 9 = 9/29 10 = 10/7.

[x] Area under Disease Progress Curve (AUDPC) values for downy mildew development.

[w] Estimated total season cost for each fungicide program.

[v] AUDPC values followed by the same letter are not statistically different from each other, Fisher's Protected LSD (*P* = 0.05)

HIGH TUNNEL VINE CROPS PRODUCTION

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Many warm season (frost sensitive) vegetable crops can be grown within a high tunnel. Cucurbits are a large, diverse group of warm season plants within the Cucurbitaceae family. Cucurbits include many popular vegetables such as cucumber, gourd, cantaloupe (muskmelon), squash, pumpkin and watermelon. Cucurbits are an important dietary source of fiber, minerals, beta-carotene, and vitamin C.

Cucumbers (*Cucumis sativus*) are a popular warm season vegetable grown throughout West Virginia. Cucumbers are very sensitive to frost, so early- and late-season production can be a challenge. In previous studies, cucumbers have been shown to be a high-yielding, early-season cash crop for high tunnels. Another cropping system scenario is for an early warm season crop such as tomatoes to be grown in the high tunnel followed by a late-season crop of cucumbers. High tunnels facilitate trellising of cucumbers which maximizes yield and quality (Figure 1). Parthenocarpic varieties, in particular, may be well-suited for high tunnel production. This evaluation examined 10 predominantly parthenocarpic cultivars of cucumbers for late-season high tunnel production in West Virginia (Table 1).

Seeds from 10 cucumber cultivars were seeded in mid-August in 50-cell pro trays. Two-week-old transplants were transplanted within a high tunnel in central West Virginia on September 3, 2011. Each cultivar was spaced 12 inches between plants and 42 inches between rows for a total of three replications containing 5 plants per replication. The plants were established on black plastic mulch with drip irrigation. Fertilizer was applied at planting and thoroughly incorporated into the soil and fertigated (Table 2). Each plant was pruned to one stem and trellised on a string trellis (Figure 1). Irrigation was applied to deliver a minimum of 1.5 inches of water per acre equivalent per week On October 10, 2011 harvest began with approximately 1-2 harvests per week until the harvest season ended on November 10 due to a freeze event. Each cucumber was weighed and graded for marketability. Length and width of random samples were also measured.

Figure 1. Vine crops can be trellised on a mesh trellis or a string trellis for maximum production within a high tunnel.

Table 1. Cucumber cultivars evaluated within a high tunnel-2011.

Cultivar	Seed Source[z]	Days to harvest	Comments[y]
EXP 2856	SW; BE	56	Dark green; Excellent size and shape; Parthenocarpic
Dasher II	JS	58	Standard hybrid slicing variety. Gynoecious
Diva	JS	58	AAS Winner PM and DM tolerance; Parthenocarpic
Cucapa	SY	56	Dark green; Excellent size and shape; Parthenocarpic
Rocky	JS	46	Good for baby cucumbers PM tolerance; Parthenocarpic
Socrates	JS	52	Parthnocarpic beit alpha type. PM tolerance
Sultan	JS	56	Beit alpha type. PM tolerance
Tasty Green	SW	62	European/Dutch type; Monoecious; Seed coats in fruit.
Tyria	SW	58	European/Dutch type; Parthenocarpic; No seeds

[z] JS=Johnny's Seed; SW=Seedway; BE=Bejo Seed; SY= Syngenta Seeds
[y]PM= Powdery mildew; DM= Downy Mildew

Fertilization rates should be based on the *total effective mulched area*. Measure the width of the raised bed covered with plastic, and multiply by the row length. This product is multiplied by the number of rows within the high tunnel which equals the *total effective mulched area* per high tunnel.

Table 2. Ounces of fertilizer/100 gallons of water.

Nitrogen ppm	Fertilizer analysis			
	20-20-20 (oz.)^z	*9-45-15 (oz.)*	*15.5-0-0 (oz.)*	*15-30-15 (oz.)*
100	6.7	14.8	8.6	8.9
200	13.3	29.6	17.2	17.8
300	20.1	44.4	25.8	26.7
400	26.6	59.2	34.4	35.6
500	33.5	74.0	43.0	44.5
600	40.2	88.8	51.6	53.4

^{z}Ounces of fertilizer dissolved in 100 gallons of water.

Cucumbers:

Cucumbers were harvested over a limited, 4-week period. An infection of downy mildew moved into the high tunnel later in the season. Had the crop been established in late July, marketable yields would undoubtedly have been much greater. Nevertheless, there were significant differences between cultivars.The cultivars ‘Cucapa’, ‘EXP 2856’ and ‘Socrates’ produced the largest number of marketable cucumbers per plant or per linear foot of row (Table 1, 3). The cultivar ‘Cucapa’, had excellent quality including dark green color and a low percentage of culls per plant (Table 3). Although parthenocarpic varieties do not require bees for cross pollination, bees were present in the high tunnel. When parthenocarpic cucumbers are cross pollinated, seeds can form and the cucumbers become misshapen. Both ‘Tasty Green’ and ‘Tyria’ had more misshapen fruit as a percentage of total marketable yield. ‘Socrates’ was the highest yielding beit alpha cucumber evaluated. ‘Rocky’ is a high-yielding, small cucumber with market potential as a baby cucumber. ‘Tyria’ was seedless with excellent quality, but yield was not significantly high.

Table 3. Yield of high tunnel cucumber: October-November 2011.

Cultivar	Marketable cukes/plant (no.)	Avg. wt. (lbs.)	Unmarketable cukes/plant (no.)
EXP 2856	5.9	0.5	0.7
Dasher II	2.5	0.4	0.7
Diva	2.0	0.4	0.4
Cucapa	6.3	0.7	0.7
Rocky	6.9	0.2	1.5
Socrates	5.2	0.5	1.3
Sultan	2	0.5	0
Tasty Green	2.8	0.8	0.8
Tyria	1.6	0.6	0.7
SE (Mean)	*0.4*	*0.2*	*0.7*

'Cucapa' had uniform length greater than 8 inches (Figure 2). Although total yields are a fraction of the potential marketable yield if the cucumbers are allowed to have a longer growing season, cucumbers are a profitable double crop for high tunnels. Occupying 65 days within a high tunnel and yielding 0.75-2.5 lbs./ft^2 is a realistic yield level for high tunnel cucumbers.

Summer Squash:

Early-season production of zucchini squash (Cucurbita pepo) within a high tunnel is a potentially viable crop choice in the Mid-Atlantic region. Cucurbit pollen is very heavy and sticky and is only carried by pollinating insects. Moreover, cucurbits are monoecious, meaning there are separate male and female flowers on the same plant. Cucurbit flowers may be open for only 6 hours and pollen viability rapidly declines.

Since summer squash is a warm season crop, it must have warm air and soil temperatures for maximum production. High tunnels which are plastic-covered, solar greenhouses can provide significantly higher temperatures for early harvest. Enclosure within the high tunnel as well as early-season flowering when bees may not be active can reduce pollination and fruit set of most squash cultivars evaluated some parthenocarpic zucchini cultivars within a high tunnel. Parthenocarpic squash varieties are able to set fruit without cross pollination and therefore could be a good choice for high tunnel production. Growing space within a high tunnel is limiting. Therefore, squash cultivars with a compact growth habit are desirable.

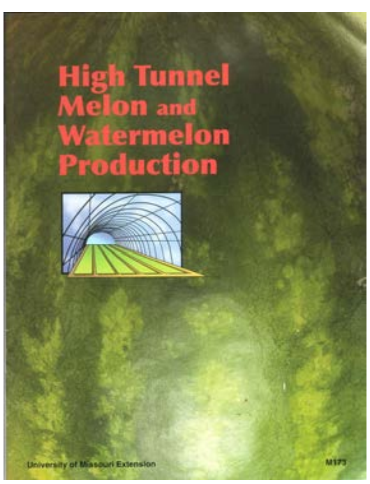
A commercial size high tunnel with approximately 2000 ft^2 of bed space can accommodate 350 summer squash plants. Squash were harvested for approximately 3 weeks. Obviously the harvest window for summer squash can be an additional 3-4 weeks. Assuming one wants to capture the early market for squash, 3-4 weeks would be the expected market window before field-grown squash becomes available and gluts the market. Thus doubling the yields in Table 1 would be a realistic estimate of high tunnel summer squash yields. Early-season squash markets for approximately $1/squash making high tunnel squash production an excellent crop choice for the first warm season crop grown within the high tunnel.

Melons:

In a high tunnel, melons and watermelons are spaced 24-36" between plants within each row, and the rows are spaced 40-48" apart on center. On a square foot basis, this is nearly double the plant density of field-grown melons and watermelons. The ability to grow the plants vertically by trellising and the dry (no rain) environment make higher plant populations feasible within a high tunnel. Thus a commercial high tunnel (≈2500 ft^2) can accommodate 200-300 cantaloupe or watermelon plants. Each transplant is planted approximately 1-2 inches deeper than the surface of the transplant root ball. The planting hole on the plastic mulch can be perforated by hand or using a bulb planter. Immediately after transplanting, a starter fertilizer solution containing nitrogen (200-400 ppm) and phosphorus should be applied to each transplant to reduce transplant shock. Planting date varies with geographical region. A reliable index for determining when to plant within a high tunnel is soil temperature. Melons and watermelons can be transplanted when the soil temperature at the 2-3" depth is ≥ 60°F.

Melons and watermelons have separate male and female flowers on each vine. Male flowers appear at least a week earlier than female flowers. Female flowers are easily distinguish from male flowers by the presence of a swollen base below the flower petals. Flowers open after sunrise and remain open for only one day. Since melon and watermelon pollen is heavy and sticky, it does not move with wind currents. Thus, physical movement of pollen is necessary before a fruit is set on the vine. Pollination of the first flush of female flowers is crucial since these flowers can develop into large, early fruit.

Training melons and watermelons to grow vertically is referred to as trellising and is one of the advantages of growing melons and cucumbers within a high tunnel (Figure 1). Most melon cultivars and personal size (< 7 lbs.) watermelon cultivars are amenable to trellising. Trellising improves light interception by the crop canopy, makes harvest easier, improves pollination and reduces damage to the vines during harvest. Trellising is necessary if the high tunnel is used to grow crops in addition to melons, since melon vines will overrun other plants if not trained.



High Tunnel Melon and Watermelon Production,
Lewis W. Jett

*Thanks to *Seedway Vegetable Seed* and *Syngenta Seeds* for providing seed for this trial.

CAUSES AND IDENTIFICATION OF ABIOTIC DISORDERS IN VINE CROPS

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Introduction:

Vine crops, also known as cucurbits, are tender, warm-season plants that are not as tough or hardy as other annual vegetable crops grown in our region. For these reasons, vine crops often suffer from abiotic disorders. What is an abiotic disorder? An abiotic disorder is damaged caused to a plant by a noninfectious source. Biotic disorders on the other hand are caused by organisms such as fungi, bacteria, viruses and nematodes. Some examples of abiotic causes are unfavorable soil conditions, fertility and pH imbalances, moisture extremes, temperature extremes, limited or extreme sun exposure, chemical injuries, and physical injuries. In addition to abiotic disorders causing damage on their own, they also leave plants predisposed to infection from biotic causes of damage. Most times farmers look for the pest and what can be applied to control what is causing the problem. With abiotic causes, taking the control route after the injury has occurred isn't the solution. Instead, prevention is the key to reducing abiotic causes that damage plants.

Soil Conditions:

Soil is one of the most crucial factors in crop production. The soil's structure influences its ability to hold water and nutrients and make these inputs available for plant uptake. Soil structure also determines how well a soil will drain and if there is pore space available for root growth. In highly compacted soils root growth will be limited. Water runoff will increase and soil drainage will decrease. Soils with poor structure are also prone to crusting and hard pans. These poor soil conditions will cause poor germination of seeds, poor root growth and will greatly reduce yields if the plant can grow to maturity. With vine crops, they already have tender root systems and will not tolerate water logged conditions. Once root respiration is reduced from lack of air in pore spaces of soil, vine crops are more prone to soil-borne pathogens like Phytophthora capsici, Pythiums, and Fusariums. Vine crops grown in poor soil conditions can have slow growth, stunting, malformation, limited root growth, and will never reach optimum yields and fruit quality.

Soil Fertility and pH:

Soil fertility is greatly influenced by soil pH. Soil pH is the measure of the H^+ ion activity in the soil solution. High amounts of H^+ ion activity results in an acidic soil atmosphere.

Some plants like blueberry flourish in slightly acidic soil conditions. Vine crops do not. The more favorable pH for most vegetable crops, including cucurbits is between 6.0-7.0. This is the reason why lime is added to soils to raise soil pH levels that fall below the optimum range. If too much lime is added and pH levels move too much towards an alkaline level (above 7.0), fertility can also be adversely affected. When soil pH falls below 5.5 plant macro nutrients like calcium, magnesium and phosphorus will drop in availability to plants. However, some elements like aluminum, iron and boron can increase in solubility in acidic soils. Although nutrients like iron and boron are essential plant nutrients, they can become toxic to plants when soil levels are overly acidic (low pH levels). Conversely, high pH levels (above 7.8) can cause deficiencies in phosphorus, boron, iron, manganese, zinc and copper. Keeping soil pH levels in the optimum range of 6.0-7.0 will prevent nutrient deficiencies and toxicities for vine crops and other plants.

Nutrient deficiencies and toxicities in vine crops will result in many different sypmtoms. Symptoms like leaf yellowing, stunted growth, burnt leaf tips, and lesions on leaves or stems of seedlings. Many of these sypmtoms can often be confused with disease symptoms. Unfortunately, there are no “quick fixes” to nutrient deficiencies or toxicities in vine crops. Addition of fertilizer can help, but the plant will never recover enough to produces maximum yield potential. Changing soil pH in the same growing season is not an option in time to help the plant. Once again, prevention is the key to fertilizer and pH abiotic disorders. Having soil fertility and pH levels at optimum levels before planting is key to any successful crop.

<u>Moisture Extremes:</u>
Water is important for growth and survival of all living organisms. Water is needed at all stages of growth for vine crops and is crucial during fruit set and development when fruit are expanding and requiring the most inputs from the plant. Water is needed for plant physiology and biochemistry functions in the plant. If water is limited or excessive, both situations can be detrimental to vine crops in all stages of growth. Vine crops may recover from short term drought or flooding conditions, but long term stresses can easily kill tender vine crops. Too much water during seed germination can rot the embryo. Too little water when seeding can keep seed coats hardened and prevent emergence. Seeds that do not germinate quickly can be prone to diseases and pests like seed corn maggot. During flowering, drought stress will prevent pollination, disrupt pollen tube growth for fertilization of the ovary and can abort both female and male flowers. Too much water will literally drown roots and will promote root and crown rots of vine crops.

Having adequate water inside the plant also keeps the plant turgid (erect and upright), allowing for maximum sun exposure for photosynthesis, shading of fruit to prevent sunscald, and support for heavy fruit loads. Water inside the plant also allows for movement of “food” in the plant for energy and fruit development, as well as, transpiration which cools that plant and drives transport and uptake of water and nutrients. Too much water will harm roots and disrupt transpiration and other plant physiological and metabolic functions.

Symptoms of drought stress and flooding stress can be similar. Both may result in wilting of leaves and stems, but for different reasons. When drought occurs, there is little water in the plant because it is not available due to lack of water in the soil. When flooding occurs there is much water in the soil environment, however root resipiration is prevented and roots die over long term exposure to flooding. Additionally, upper plant symptoms can occur. Edema can be seen on leaves and fruit. A blistering symptom can be seen because the plant cannot hold excess water in its cells and cells swell and eventually burst. Edema symptoms can be worse during cloudy and high humidity periods of weather when transpiration is at its lowest levels.

To prevent excessive soil moisture in vine crop plantings, use raised beds and run rows in the direction that fields drain. To prevent drought conditions, use irrigation. Drip irrigation systems are ideal for cucurbit plantings for many reasons. Plastic mulch can also assist in conserving water in the row and has other benefits. Providing an environment with optimum soil moisture conditions can prevent diseases and help achieve high yields.

<u>Extreme Temperatures:</u>
Temperatures that are too high or too low can cause injury to plants. Injury can be temporary or fatal to plants depending on temperature extremes and duration of exposure. Since cucurbit crops are native to tropical climates, they do well during warm weather in our region. However, excessive heat can be detrimental to vine crops if high temperatures are above 95° F for long periods. High heat can shut down plant functions and cause flowers and fruit to abort. The plant uses flower and fruit abortion as a survival method to reduce drain on plant systems, but yield potential is lost. Flower and fruit abortion are more severe when the plant is also under drought stress during high heat periods. Some ways to help protect vine crops from high heat are to use white or reflective mulches during the hottest parts of the season.

Cucurbit damage from low temperatures generally occurs in early spring when seedlings or transplants are planted too early or when late plantings are subjected to lower temperatures or the first frost of fall. Leaves that are injured from cold temperatures will often look water soaked. This is because ice crystals form inside plant cells and damage cell walls making them “leak”. Plants that have these symptoms do not recover unless new growth forms. Strategies to protect cucurbit plants from cold or frost damage include the use of low or high tunnels, individual plant caps in spring, and black plastic mulch to warm soils. Attention should also be paid to cucurbit fruit storage temperatures since low temperatures can cause pitting and discoloration of summer and winter squashes, cucumber and other vine crop fruits.

Sun Exposure:

Most vine crops do well under sunny conditions. When they are subjected to long periods of cloud cover and lack of sunlight, growth of the leaves can be thin with little cuticle (wax-like protective layer). If high sun exposure occurs after a long period of low sun exposure, leaves can "burn". This can be also true of cucurbits that are grown under floating row covers that decrease light intensity under the fabric or for transplants that were in greenhouse conditions. This protected environment causes softer plant growth and leaves to be not as "tough". As leaves grow under sunny conditions they will often "harden". Symptoms of excessive sun exposure often look like a burn and is sometimes confused with disease symptoms or chemical burns on the leaves. On vine crops with long fruit maturity, sunscald on fruit may occur if not enough foliage covers ripening fruit. This often occurs in melons and sometimes in winter squash and pumpkin. Doing everything possible to keep steady growth going and making sure plant needs are taken care of will help plants grow out of any abnormal sun exposure periods.

Chemical Injuries:

Chemical injuries to vine crop plants can come from a variety of sources. Sometimes fertilizers and pesticides applied can cause injury if not applied in recommended amounts, not under optimum weather conditions, from nearby drift from adjacent treated areas, or if these materials have an adverse interaction with another product they are combined with during application or come in contact with in the field. Always read and follow the pesticide label to help prevent chemical injuries. Still, other chemical injuries occur without clear answers. Some vine crops are susceptible to air pollution injury from gaseous air pollutants like ozone and sulfur dioxide. Air pollution levels are sometimes reported in local weather reports and if poor air quality occurs for long periods of time, injury may show up in susceptible plant species. If a field is near a roadway, de-icing materials from winter road treatments can wash into a field and cause injury to plants.

Chemical injury to cucurbit fruits can also occur in storage and transport or to plants grown in closed systems. Ethylene gas, which is also considered an air pollutant, can build up in closed areas. Ethylene gas is produced naturally by the ripening process of some fruits like apples and tomatoes, but is also produced as a byproduct of incomplete combustion of fossil fuels. This can occur sometimes with greenhouse heating systems. Ethylene gas injury to transplants often resembles herbicide injury, whereas the plants may have curled leaves, twisted stems and stunting. Injury to cucurbit fruit from ethylene gas in storage causes discoloration of fruit; generally yellowing of fruit. In hard squashes and pumpkin, ethylene gas may also cause stems to fall off of fruit. These are some reasons why cucumber, squashes and pumpkin should not be stored with ethylene producing fruit.

Physical Injuries:

Physical injuries to vine crop plants can come from many different sources. Mechanical injury from farm equipment may be one source of injury. Animals walking through a field, storm damage from heavy winds, and girdling of roots in root-bound transplants can all cause physical injury to cucurbits. Prevention from human causes of injury are more preventable than other types of physical damage. Fencing off fields to prevent deer trampling or feeding is one method of prevention. The use of natural or synthetic wind breaks is one way to lessen wind injury and sand blasting to plants during storm conditions. Physical injuries cause their own hurdles to plant growth, but this is damage results in exponential problems for the plant. Open wounds on the plant are prime areas for disease infection and often attract insect pests to a field. Reducing physical injury will also reduce pest pressure in a field.

Conclusion:

There is a great deal of attention paid to pest identification and pest control for vine crops in production. However, as important, or even more important for the success of plant growth and yield is taking into account the causes and effects of abiotic disorders in the production of cucurbit crops. This is especially true, since vine crops are tender, warm season crops that take much care to produce and do not recover as well as other annual vegetable crops from the detrimental impacts discussed.

FOOD SAFETY

FOOD SAFETY MODERNIZATION ACT AND THE IMPACT ON NEW JERSEY'S RETAIL AND WHOLESALE GROWERS

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The Food Safety Modernization Act is the biggest change to the Food and Drug Administration (FDA) for at least 70 years. There are several rules within the act (Produce Safety Standards, Preventive Controls for Human Food, Foreign Supplier Verification, Preventive Controls for Animal Food and Accredited Third Party Certification), but two may impact growers Produce Safety and Preventive Controls for Human Food in New Jersey. The final rule will be published in October 2015 for the Produce Rule and Preventive Control Rule. The Produce Rule includes standards for growing, harvesting, packing and holding of produce. This covers mainly products that are eaten raw. While Preventive Controls cover facilities that manufacture, process, pack or hold food for human consumption.

FDA had an original public comment period which closed November 2013. They opened a second comment period for the produce rule with proposed changes specifically on water quality standards and testing, manure usage, definition of a farm, which farms are included, withdrawal of qualified exemptions and wild animals. At the same time they proposed changes to the Preventive Controls for Human Food Rule. The changes included the definition of a very small business, how exemptions are processed, product testing, environmental monitoring and supplier controls. This second round of public comments closed December 15, 2014.

What is the next step? The FDA has until the end of October 2015 to publish the final rules. At that point there will be a phased implementation. For the Produce Rule, farms with an average annual monetary value of produce sold of $25,000 or less will not be covered under the new proposal. FDA considers this group as very small (less than 1% of sales) thus will not be covered. Very small businesses (sales $25,000, but no more than $250,000 in annual produce sales), will have four years to comply with most provisions. Small farms (sales over $250,000, but no more than $500,000 in annual produce sales), will have three years and all other farms will have two years after the effective date to comply. The compliance dates for water quality standards, testing and recordkeeping provisions will have an additional two years. FDA is also proposing to revise the definition of a farm so a farm would not be required to register as a food facility because it packs or holds raw commodities grown on another farm under a different ownership. This would take a farm out of the preventive controls rule for human food.

The provision for qualified exemption (direct marketers) will remain in place. If the farm sells 51 percent of their product direct (farmers market, retail establishment, etc.), has less than $500,000 in all food sales including animal feed, milk, grains, etc. on a three year average and the produce is sold within 275 miles of where it is grown the operation will be considered exempt. Since this was written into the statue it would take an act of congress to change it. The product must be labeled with name and address of the farm no matter what the sales level. If there is a foodborne illness that is traced back to an individual farm the exemption will be revoked by FDA.

How many farms in New Jersey will fall under the Produce rule? We have done some calculations and it appears approximately 46% of vegetable farms and 43% of fruit farms will fall under the rule. Each farm will need to make their own determination. FDA still has not published how they will make a determination on sales and there are some grey areas on what is a direct sale related to cooperatives.

Compliance dates for Preventive Controls for Human Food Rule are similar. A very small business defined as having less than $1 million in total annual sales of human food, adjusted for inflation, would have three years after the final rule is published. A small business that employs fewer than 500 persons and do not qualify for an exemption would have two years after the publication date. Other businesses that are not small or very small and does not qualify for an exemption would have to comply one year after publication of the final rule.

Until the final rules are published we do not know exactly what will be required by growers. However, all growers that fall under the proposed rule will need to be trained in food safety. This will be separate from any past training. The training course must be approved by FDA prior to the course. At present there is one course which is being tested.

The Food Safety Modernization Act (FSMA) provisions does not take the place of a third party audit if the organization to whom you sell requires it. Most audits will have more requirements than FSMA. FDA considers FSMA as basic food safety which every produce grower needs. The U.S. Department of Agriculture has indicated they will change their audits based on FSMA once it is implemented.

How much will the implementation of FSMA cost an individual grower? It really depends on what has been done in the past to implement food safety. FDA has put out estimates for very small farms of $4,697, small farms $12,972 and large farms $30,566 annually. The problem is these are averages and taken from reports not based on individual farms.

MICROBIAL TESTING OF WATER SOURCES IN MARYLAND: OBSERVATIONS AND MITIGATION MEASURES

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Introduction

Microbial water quality is a major component of on-farm food safety and the proposed federal Food Safety Modernization Act (FSMA). Water is used in almost every phase of vegetable production, from transplanting, irrigation, chemical applications, and postharvest washing. Since water is a known carrier of pathogenic microbes, varying uses of water can carry different food safety risks. Under FSMA, the proposed regulations will require farmers to periodically test their water sources for *Escherichia coli,* an indicator of fecal contamination. Historically the levels of *E. coli* and total coliforms in surface water sources (such as ponds and springs) tend to be higher and more variable than well sources, as surface water is subject to environmental variables and contamination. In this study we monitored chemical and physical factors (pH, turbidity, electrical conductivity, and nitrates) in addition to the biological factors (total coliforms and *E. coli*) because these can influence bacterial growth.

This study was conducted in 2013 and 2014 to develop baseline water quality information by analyzing major water sources used in Maryland vegetable operations. The information gathered in this project will help evaluate the impact of proposed food safety regulations on agricultural water sources, determine the appropriate timing of water sample collection, and will be used to train growers how to interpret water tests.

Methodology

Five geographic regions in Maryland were identified as sampling regions, each with one University of Maryland Extension (UME) collaborator. Each UME collaborator identified fruit and/or vegetable farms with diverse agricultural water sources to sample. In total, 28 water sources (12 ponds, 3 springs, 1 spring cistern, and 12 wells) were sampled monthly during 2013 and 30 water sources (12 ponds, 3 springs, 1 spring cistern and 14 wells) were sampled in 2014. Samples were taken from April through September. Each sample was sent to the Pennsylvania State University Agricultural Analytical Services Laboratory (AASL) and was tested for *E. coli,* total coliforms, pH, turbidity, electrical conductivity (in 2013) and nitrates (in 2014). The Colilert Quanti-tray system was used to enumerate total coliform and *E. coli* counts.

Since bacterial counts show high variability, the total coliform and *E. coli* count data were log transformed to obtain a normal distribution and more easily compare differences in population numbers. A constant of 0.1 was added to all bacterial counts, in order to log transform the zero counts.

Results and Conclusion

In both 2013 and 2014, the highest *E. coli* counts were found in the warmer summer months: June, July, and August. In 2014, *E. coli* counts remained high through September (Figures 1 and 2). Surface sources had the greatest amount of variability in bacterial counts (*E. coli* and total coliforms). In 2013, water source and month had a significant impact on *E. coli* counts ($p<0.001$) – statistics are still being tabulated for 2014 results to determine yearly trends.

The proposed FSMA regulations recommend that water samples used for irrigation fall under 126 MPN (colonies) of *E. coli* per 100mL sample, which equates to 2.1 log *E.coli* (MPN/100mL). When comparing the 2013 and 2014 results from each source to the recommendation for irrigation water, 50% (6/12) of the ponds and 8.3% (1/12) of the wells exceeded the 126 MPN *E. coli*/100mL recommendation during at least one point in the season. In 2013, 75% (3/4) of the springs exceeded the recommendation for irrigation water, and in 2014, 50% (2/4) of the springs exceeded the recommendation. These data show that although bacterial counts are variable in water sources, growers may need to consider mitigating their irrigation water quality during at least one point in the growing season.

With this information, we have been able to make specific recommendations on water mitigation methods to collaborating growers and other farmers. Thus far, mitigation measures have been taken on two of the water sources with high populations of *E. coli*: a UV filter has been installed on a contaminated well, and a chlorine injector has been installed on one spring at the pump. Additional recommendations are currently being developed and tried, including a chlorine tablet system that will accommodate high flow irrigation systems.

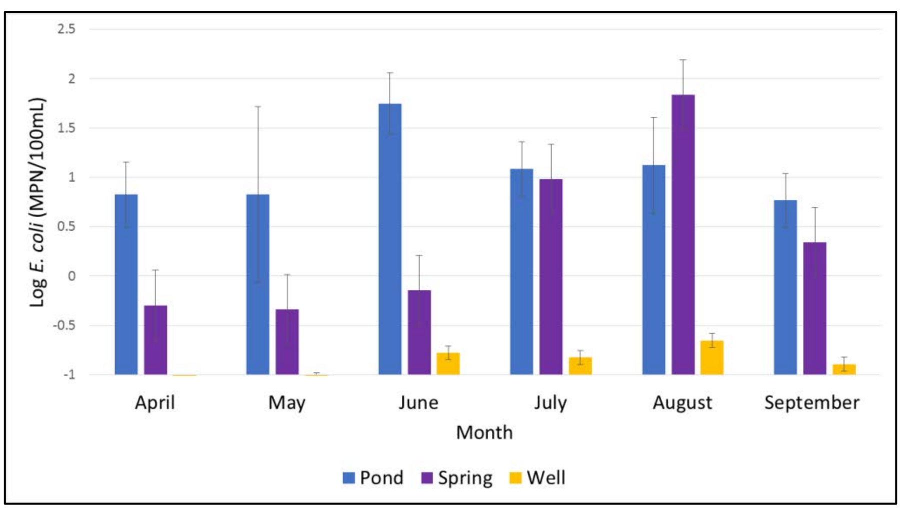

Figure 1. Mean log-transformed counts of *E. coli* in Maryland water sources, by month, in 2013.

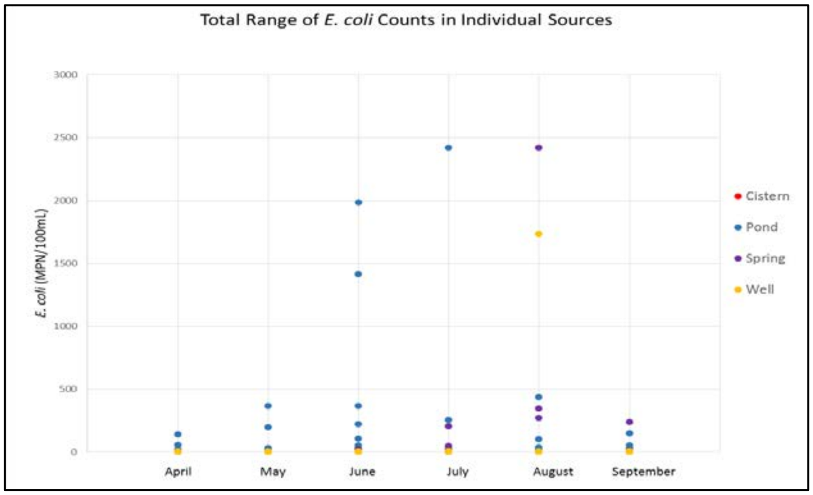

Figure 2. *E. coli* counts in Maryland water sources in 2013, organized by water source type and month.

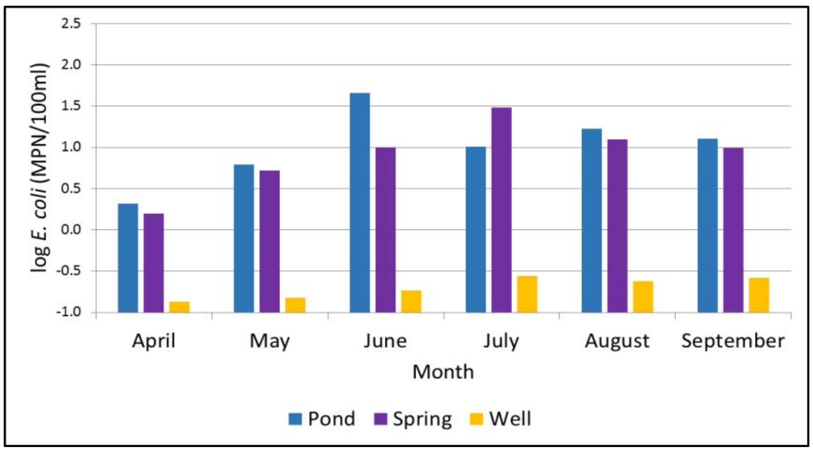

Figure 3. Mean log-transformed counts of *E. coli* in Maryland water sources, by month, in 2014.

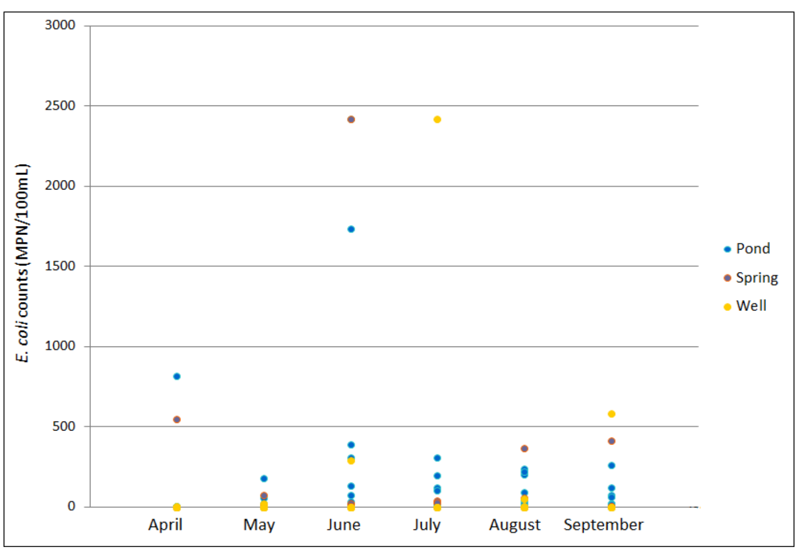

Figure 4. *E. coli* counts in Maryland water sources in 2014, organized by water source type and

BASIL DOWNY MILDEW WORKSHOP

FUNGICIDES FOR MANAGING BASIL DOWNY MILDEW – NEW JERSEY

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Sweet basil (*Ocimum basilicum*) is an economically important fresh culinary herb grown in the United States. In fall of October 2007, a new disease of basil, downy mildew (*Peronospora belbahrii*) was first reported in FL. Since then, basil downy mildew has resulted in significant losses throughout the United States. The epidemiology of the pathogen is still unknown. However, it is believed that the pathogen has spread globally via the shipment of infested seed and through natural weather cycles. Unfortunately, there are currently no effective seed treatments for basil downy mildew.

During the summers of 2010-2014 at the Rutgers Agricultural Research and Extension Center (RAREC) in Bridgeton, NJ, a number of conventional and biological fungicides were evaluated for efficacy in field trials. Our studies over the past 4 years have shown that foliar applications of phosphite products (FRAC code 33) such as K-Phite, Rampart, or Pro-Phyt provide the best season-long control if initiated before the pathogen appears in the region and/or prior to the onset of symptoms. In each year of the study none of the organic fungicides evaluated provided an adequate level of season-long control of basil downy mildew. Results of all trials at RAREC will be discussed in detail.

Growers should know the symptoms of basil downy mildew and monitor the field daily. If the pathogen is detected in the region, growers should make frequent protectant fungicide applications before the pathogen enters the field and before symptoms appear.

EFFICACY OF CONVENTIONAL AND ORGANIC FUNGICIDES FOR MANAGING BASIL DOWNY MILDEW, LONG ISLAND

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Fungicides are an important tool for managing downy mildew in sweet basil. Varieties with a good level of suppression are not commercially available yet. The disease is difficult to avoid in field-grown crops in most of the eastern USA, including the northeastern region, due to the abundance of spores produced on affected leaves that are capable of being dispersed by wind long distances. Basil downy mildew has developed in the region every summer since 2008, the first summer it was in the USA.

Replicated experiments have been conducted since 2010 under field conditions at the Cornell University research facility on Long Island to evaluate fungicides for conventionally- and organically-produced crops. Plots were single beds with one or two staggered rows of basil (variety Italian Large Leaf) at 9-inch plant spacing. Naturally-occurring inoculum was relied on. Fungicides were applied with a backpack sprayer beginning before or after symptoms were found in the field, which included basil planted before the experiments to serve as a spreader row. A boom with drop nozzles was used in 2012, 2013 and 2014 to improve coverage achieved with just a nozzle over the top of plants. Most fungicide treatments were applied on a weekly schedule. Percent affected leaves (with sporulation of the pathogen visible on the underside) was assessed rather than severity (except in 2010) because any amount of symptoms renders a leaf unmarketable. No harvesting was done to the plants. Flowers were clipped as needed to maintain vegetative growth.

In 2010, basil was transplanted into plots on 10 Aug, symptoms of downy mildew were first observed on 16 Aug on one leaf in a spreader row, applications were started on 24 Aug, and symptoms were first observed in plots on 20 Sep, which was after the fourth application. In 2011, basil was transplanted into plots on 10 Aug, applications were started on 11 Aug, downy mildew symptoms were first observed on 19 Aug in the spreader row, and symptoms were first observed in plots on 25 Aug, which was after the third application. There was a hurricane (28 Aug) and several atypical intensive rain events during the 2011 growing season on Long Island. In 2012, basil was transplanted into plots on 23 Jul, applications were started on 7 Aug, and downy mildew symptoms were first observed in plots on 16 Aug, which was after the second application. In 2013, basil was transplanted into plots on 15 Jul, downy mildew symptoms were first observed in plots on 6 Aug, and applications were started on 7 Aug. In 2014, basil was transplanted into plots on 14 Jul, foliar applications were started on 29 Jul (some treatments received soil drench applications before that), and symptoms were first observed in plots on 25 Aug.

Conventional fungicides. Products currently registered and labeled for use on basil in the USA are Ranman (cyazofamid; FRAC code 21), Revus (mandipropamid; FRAC 40), Quadris (azoxystrobin; FRAC 11), Ridomil Gold SL (mefenoxam; FRAC 4), and phosphorous acid fungicides (FRAC 33). Ridomil Gold and Quadris are the only ones not labeled specifically for downy mildew and not permitted to be used in a greenhouse. Ridomil Gold is labeled to be applied to soil for damping-off. It has excellent systemic activity and thus will be taken up by roots and moved to leaves. There are several phosphorous acid (phosphanate) fungicides labeled for this disease, including ProPhyt, Fosphite, Fungi-Phite, Rampart, pHorsepHite, and K-Phite.

Products evaluated singly were Ranman, Revus, K-Phite, ProPhyt, Previcur Flex*, Presidio*, Zampro*, and Zorvec* (*product not registered or labeled for this use). Combination programs were also tested.

When tested singly, the most effective fungicides in the 2013 experiment were Zampro*, Revus, Zorvec*, and Ranman (*not registered yet). ProPhyt was also effective. Presidio was ineffective. Only Zorvec and Zampro were effective in the 2012 experiment. This partly reflects the stringent assessment used: when assessing percent leaves affected, the severity of disease on the leaves is not taken into considered in the assessment. Best control (90-98%) was obtained with combination programs that were applied on a preventive, weekly schedule using a boom with drop nozzles in 2014. The programs included Ridomil, Quadris, Ranman, Revus, and K-Phite or Quadris, Ranman, Revus, and Zorvec. K-Phite was applied at lowest label rate with all applications of the other fungicides based on the current opinion that this is the best use pattern for phosphorous acid fungicides.

Organic fungicides. Actinovate AG (active ingredient is *Streptomyces lydicus*), Double Nickel 55 (*Bacillus amyloliquefaciens*), MilStop (potassium bicarbonate), Regalia (extract of *Reynoutria sachalinensis*), Trilogy (neem oil), and OxiDate (hydrogen dioxide) are OMRI-listed fungicides labeled for use on herbs and for suppressing foliar diseases including downy mildew. MilStop, Regalia, and OxiDate are labeled for use outdoors and in greenhouses. The Actinovate, Double Nickel and Trilogy labels do not have a statement prohibiting use in greenhouses. Double Nickel label has directions for greenhouse use for soil-borne pathogens. Products evaluated singly were Actinovate, Oxidate, Regalia, BioGuard, Companion*, Organocide*, Sporatec*, Sonata*, and Timorex Gold* (*product not registered or not labeled for this use). Combination programs were also tested.

All of the products evaluated provided little to no control based on percentage of leaves with symptoms, which is a rigorous assessment measure, but realistic reflecting the level of control needed to produce a marketable crop. All products tested singly were applied on a preventive, 7-day schedule with the exception of OxiDate, which was applied twice weekly in 2011. Applications were made with a single nozzle boom over the top of plants in 2010 and 2011, when the focus of evaluations was on products approved for organic production and other biopesticides. However, control of downy mildew was not achieved with the organic products tested singly in 2012 and the combination program tested in 2013 and 2014, which were all applied with a boom with three nozzles per plant, two of which were drops. The combination program consisted of Regalia applied to soil followed by Actinovate alternated with Trilogy applied to foliage. The foliage sprays were made twice weekly in 2014, and started 24 days before symptoms were found in the experiment. This combination program was also tested on a moderately resistant variety, Eleonora; but using this integrated program (fungicides applied to a resistant variety) did not result in successful control.

Conclusion. Downy mildew is a challenging disease to manage in basil with fungicides. This is partly due to the fact there is no tolerance for any amount of disease on leafy herb crops. Important to success of control with fungicides is using a preventive spray program and achieving good spray coverage, such as by using a boom with drop nozzles as well as a nozzle over the top of plants. In the replicated fungicide evaluations conducted in New York, downy mildew was controlled well by applying targeted, mobile fungicides in alternation (primarily Revus and Ranman) on a 7-day interval. Least symptoms were seen with the program that included a phosphorous acid fungicide at low rate in each application. None of the organic fungicides evaluated singly or combined in a program with a twice weekly application schedule provided sufficient control of downy mildew. This at least partly reflects the difficulty of delivering fungicide spray directly to the underside of basil leaves.

For more information about downy mildew of basil plus photographs, go to:
http://vegetablemdonline.ppath.cornell.edu/NewsArticles/BasilDowny.html

BASELINE SURVEY FOR PRODUCING AND MARKETING SWEET BASIL

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The survey component of the USDA-SCRI basil grant was designed to develop a basil grower profile of crop production and marketing methods for use in a cost:benefit analysis model. The survey also focused on economic effects of chilling injury and two primary diseases, Fusarium wilt (*Fusarium oxysporum* f. sp. *basilicum*) and Downy mildew (*Peronospora belbahrii*) infecting sweet basil (*Ocimum basilicum* L.). A pilot survey was begun in December 2013 at the inaugural Basil Conference at the University of Florida. Work continued remotely throughout the year with 16 producers and industry participant providing confidential production information.

User feedback indicated that the 10 page form with 72 questions and 12 tables to answer needed to be reduced in scope, size, and time in order to get better grower responses for a final survey version being readied for 2015 release. This introduction begins at the 2015 Basil Workshop at NJ-ACTS in Atlantic City, NJ.
Preliminary results from the pilot survey indicate that :

1. Participants farmed in key basil production areas of Florida, California, Texas, Washington, Virginia, New Jersey, Maine and Mexico.
2. Total vegetable and herb farmland represented in the survey was 2,907 acres.
3. Basil production represented was 1,309 acres.
4. The primary basil varieties reported were Nufar, DiGenova, Genovese, Italian Large Leaf, Martina Genovese and Aroma.
5. Ten of the operations grew organically, including several that also grew conventionally.
6. Training needs addressed were farm management, disease control, seed production, processing, and greenhouse operations. University specialists and agents were typically involved.
7. The major disease problem was controlling downy mildew, which led to several operations abandoning some farm sites or switching to greenhouse production.
8. Moderate to minor disease problems were found with Fusarium wilt, Phytopthora root rot, bacterial spot and nematodes.
9. Chilling injury was noted twice as a significant problem.
10. The main organic fungicides were Oxidate, Actinovate AG, Serenade MAX, Regalia, Trilogy, Sonata and Neem.
11. The main synthetic fungicides used in overall disease management were Ranman, Quadris, Ridomil Gold, Actigard, K-phyte and Fosphite.

Cost of Production estimates were incomplete and varied widely for location, planting year costs, labor, variety, harvest and miscellaneous costs. The revised 2015 survey will address these economic issues on a regional basis with a larger distribution

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