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Session 1
Peppers

INSECT MANAGEMENT UPDATE FOR BELL PEPPERS

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Aphids, most notably green peach aphids, were reported as one of the most important insect pests in a recent survey of bell pepper growers and crop consultants in the northeastern and Mid-Atlantic states. However, there is very strong evidence that green peach aphids will not reach damaging numbers in peppers unless growers apply pyrethroid insecticides, which do not control the aphids, but rather kill their natural enemies and stimulate aphid reproduction (Fig. 1). Some important natural enemies found in pepper fields include minute pirate bugs, *Orius* spp., ladybird beetles, spiders, numerous parasitic wasps, syrphid flies, and lacewing larvae. Many of these beneficial species also help control other insects such as thrips, mites, and eggs and small larvae of lepidopteran "worm" pests. These natural enemies should be conserved in pepper fields if at all possible. Broadspectrum insecticides such as pyrethroids, organophosphates (Orthene), or carbamates (Lannate, Sevin, Vydate) will kill these natural enemies. For the past several years, my crew has evaluated the efficacy of more IPM-friendly insecticides on bell peppers. Early studies showed that the products Avaunt, SpinTor, and Intrepid applied for control of "worm pests", most notably European corn borer, provided comparable protection against insect damage to fruit as the commercial standards, Orthene and Warrior (Table 1). Although we tested multiple sprays of the same product for research purposes, a rotation of products is recommended for insecticide resistance monitoring and to avoid exceeding maximum allowed lbs per acre per season.

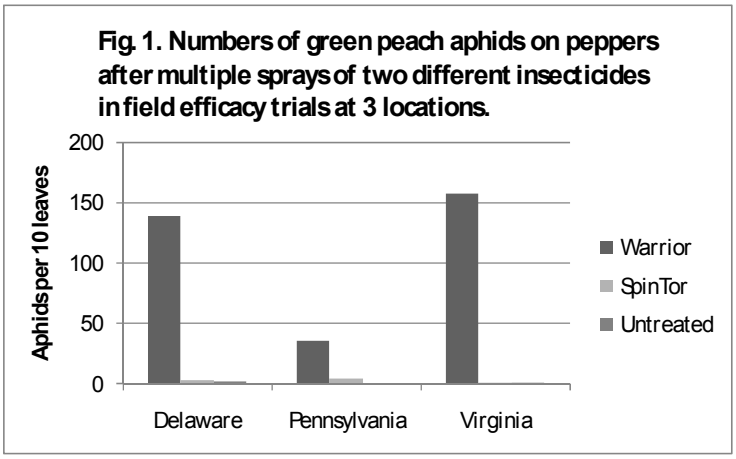

Table 1. Results of insecticide efficacy experiments conducted on 'Paladin' bell peppers. Insecticides were applied weekly beginning at first fruit until final harvest (4 to 7 sprays).

2002 Painter, VA		2004 Painter, VA	
Treatment/Rate (product/acre)	% damaged peppers	Treatment/Rate (product/acre)	% damaged peppers
Orthene 97 (1 lb)	3.2 b	Avaunt (3.5 oz)	1.9 c
SpinTor 2SC (6 oz)	5.6 b	SpinTor 2SC (6 oz)	4.5 c
Avaunt (3.5 oz)	7.2 b	Intrepid 2F (8 oz)	5.0 c
Untreated control	44.3 a	Mustang Max (4 oz)	3.8 c
		Orthene 97 (0.7 lb)	9.5 bc
		Asana XL (6 oz)	13.5 b
		Untreated control	28.4 a

In 2008, several new IPM-friendly insecticides were labeled for use on peppers, including: Radiant 1SC; Coragen 1.67SC; Synapse 24WG; Voliam Xpress; Durivo SC; Movento; and Beleaf 50SG (Table 2). These insecticides have performed very well in efficacy trials (Fig. 2) against their target pests and offer exciting new modes of action to combat some of our hardest to kill pests of peppers in the Mid-Atlantic states such as Beet armyworm; European corn borer, corn earworm; fall armyworm; green peach aphid, leafminers; and whiteflies.

Table 2. New insecticides labeled for use on peppers in 2008.

Product	*Active ingredient*	*Manufacturer*	*Target Pests*
Radiant 1SC	spinetoram	Dow Agrosciences	All lepidopteran larvae; thrips; leaf miners
Coragen 1.67SC	RynaXypyr (= chlorantraniliprole)	Dupont	All lepidopteran larvae; leaf miners; whiteflies
Synapse 24WG	flubendiamide	Bayer CropScience	Lepidopteran larvae
Voliam Xpress	Chlorantraniliprole + lambda-cyhalothrin	Syngenta	Lepidopteran larvae; pepper weevil; whiteflies; leaf miners; stink bugs; and others
Durivo SC (for soil application)	Chlorantraniliprole + thiamethoxam	Syngenta	Lepidopteran larvae; aphids; thrips; whiteflies; leaf miners
Movento	spirotetramat	Bayer CropScience	Aphids; whiteflies
Beleaf 50SG	flonicamid	FMC	Aphids; whiteflies; plant bugs

Fig. 2. Results of foliar insecticide efficacy trials conducted on bell peppers in Painter, VA. All sprays were applied weekly four times. Most fruit were damaged by European corn borer with a few corn earworm.

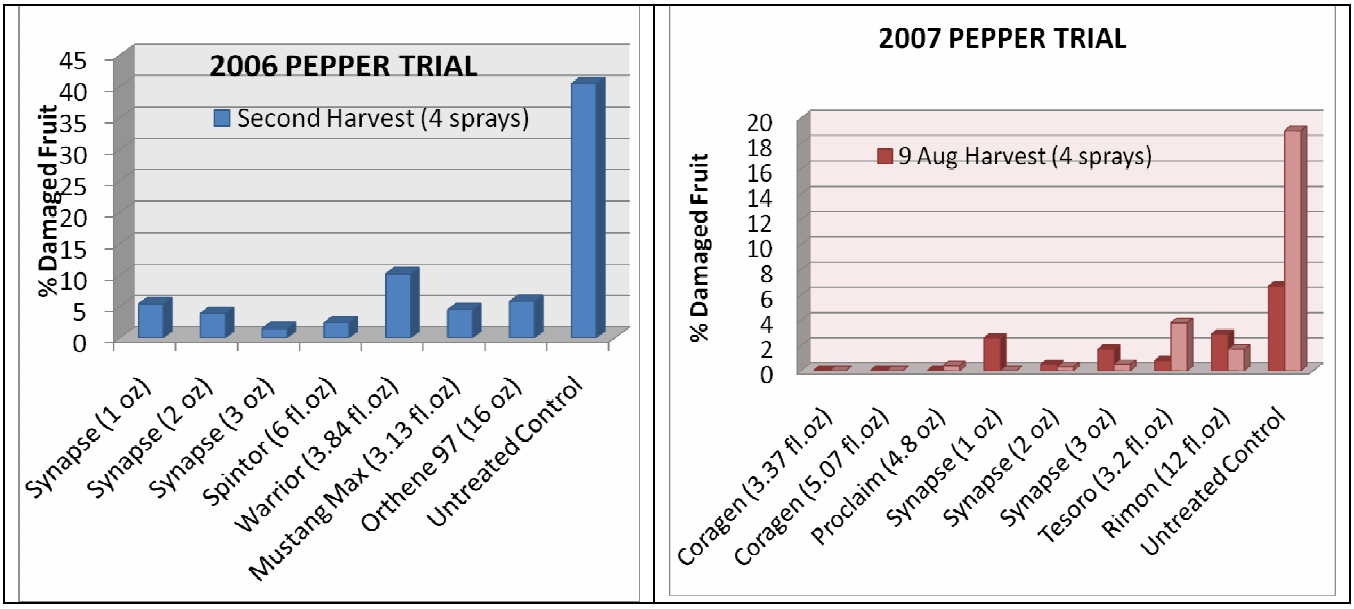

Fig. 3. Results of soil-applied insecticide trial on bell peppers, Painter, VA. Insecticides were applied to the base of plants once at flowering. Fruit were harvested and evaluated 40 days later.

Session 2
Perspectives – Ag Issues

COUNTRY OF ORIGIN LABELING; WHAT DOES IT ALL MEAN

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The Country Origin of Labeling legislation also known as COOL has finally been implemented in the United States. American Farmers have been supportive of this program to help differentiate US product from foreign product. The program took affect on September 30, 2008. The commodities that are covered by COOL include fresh meats (beef, pork, lamb, goat meat; whole muscle cuts and ground meat, not organs), chicken (excluding turkey and eggs), fish, wild and farm-raised fish and shellfish, macadamia nuts, pecans, ginseng, and perishable agricultural commodities (i.e. produce). Retailers and suppliers, as defined in the act, will be subject to the labeling requirements. Retailers are defined as those operations that are covered by the Perishable Commodities Act by invoicing more then $230,000 per year. Smaller retail establishments, such as butcher shops, exporters, restaurants, food service, salad bars, and delicatessens are exempt.

There were several concerns that delayed the full implementation of COOL for meat, fruits and vegetables. The potential liability for mistakes or absence of labeling at retail points of purchase has been diminished in the revised version of the law. The retailers will have 30 days to correct a violation and after the 30 days if the retailer has made a good faith effort to comply with the act USDA will not impose a fine. If a retailer is found to have willfully violated the Act then they will be subject to a hearing before the USDA and are limited to $1000 for each violation. The 30-day grace period and hearing will also apply to suppliers, but producers are exempt and are not subject to fines. These factors have significantly reduced the potential liability for retailers.

This new rule does not affect farmers directly. Suppliers are required to make country of origin information available to their buyers. However, retailers may require more labeling than just country of origin on the bulk box. They may require labeling of individual units for retail sale by farmers in the future if violations occur (passing the burden on to producers). For instance stickering, banding, tagging of individual fruit, bunches, containers, bags, etc. with place of production included may be demanded by retailers. Much of this is already done for certain commodities. Since retailers demanded PLU and UPC codes on products, especially produce, in the past two decades, many of the stickers, tags, bags or bands farmers use for product code number identification also have a brand name included that also lists the state and sometimes even the town where the farm is located. The new provision allows for product labeling on a U.S. state, region, or local level to meet label standards as “Product of U.S”. Therefore, under COOL standards labels like “Jersey Fresh” (since this is a recognized label indicating the product was produced in New Jersey), “Vidalia Onion” (since these onions are only grown in a certified region of Georgia), and other regional promotion labels meet labeling requirements. Such notification can be provided either on the product itself, on the master shipping container, or in a document that accompanies the product through retail sale. The USDA excluded requiring any new record keeping other than normal records kept in the regular course of business. In most scenarios the record must be kept for up to one year from time the product was labeled for consumer purchase.

Concessions have been put in place in the updated legislation to make responsibilities for labeling easier for producers and retailers. Retailers are required to notify the final consumer of the country of origin for COOL covered commodities. The COOL provisions provide suppliers and retailers with considerable flexibility in marking items offered for sale. The law allows country of origin information to be provided to consumers through a label, stamp, mark, placard, or other clear and visible sign on or near the commodity. The labels could also be on the package, display, holding unit, or bin containing the commodity at the final point of sale to consumers. When stickers are used on individual items, USDA encourages retailers to supplement stickers with point-of-purchase placards and other signage to more clearly indicate information to consumers, since stickers can easily fall off individual items or stickering machines may miss some items at the time of packing. USDA will address the issue of stickers in its compliance and enforcement procedures. Their goal is to have compliance and enforcement personnel provide uniform guidance to the industry.

The act will allow for produce to be from different countries to be commingled in a store display but there will have to be a sign designating which country the produce could be from. For example, if a store had a display of tomatoes it is possible the tomatoes could be from the U.S and Mexico mixed together, and the store would have to post signage that states “Product of the US and Mexico”.

Products that are grown and processed for fruits and vegetables or born, raised and slaughtered for livestock in the US can be label “Product of the US”. Meat products that are raised in another country and processed in the US will have to be labeled Product of Country “X” and U.S. The ground meat industry will have a 60-day threshold; if the origin of the meat is from 2 or more countries then all countries must be listed on the label. Therefore, if a processor is grinding U.S. meat and runs out of domestic product, and then decides to use Australian meat within 60 days, they must list both countries.

The Act will not require facilities such as restaurants, delicatessens or any other non-retail establishments to follow COOL mandates. This exemption also applies to processed food items sold at retail business which would include prepared food and salad bars. The definition of a processed food item includes a covered commodity that has had its character altered, or a product that has been combined with at least one other covered commodity or other food components (e.g., chocolate, breading, or tomato sauce). Cooking a product also is considered changing the character of a covered product (e.g., frying, broiling, grilling, boiling, steaming, baking, roasting), curing (e.g., salt curing, sugar curing, drying), smoking (hot or cold), and restructuring.

Unfortunately, this Act may not be perfect. It may seem to be lenient for some and too restrictive for others. Nevertheless, the fact is that we now have a rule that will distinguish domestic products is a plus. It remains to be seen whether this requirement will lead to a direct increase in farm gate prices. With a “buy local” movement by consumers there could be a spark towards larger demand for U.S. and more specifically NJ product.

MYTH BUSTER
HOW FARMERS VIEW MOTOR VEHICLE REGULATIONS

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Many farmers feel they know exactly what laws and rules apply to them regarding federal and State motor vehicle regulations. How can they be so knowledgeable? Well, they learned everything they know from their dad, their uncle, the woman at the local farm supply store, or neighboring farmers. The absolute worst time to learn how much they do not know is when law enforcement pulls over their farm truck. Here are some facts about motor vehicle regulations that farmers may need to know at one point or another.

'Farmer" & 'Farm Use' Plates: Some may view 'farmer' and 'farm use' plates as a status symbol, they let everyone know your profession. A 'farmer' and 'farm use' plate is designated a commercial plate - it is used to transport goods or merchandise. As such, NJ law requires that the name of the farm (no less than 3 inches in height) and municipality be placed on the side of the truck. You must display the gross vehicle weight rating (GVWR) if it is 26,001 pound or more. The law was modified in 2005 and farmers can now use their 'farmer' plate vehicle for personal use. Now farmers have no excuse not to run errands for the household.

There are no travel distance limits on a vehicle with a 'farmer' plate. Nevertheless, if you travel interstate with the 'farmer' plate vehicle, be certain the other state recognizes the plate as valid. Some states may not recognize New Jersey's 'farmer' plates. If you have a vehicle with a 'farm use' plate, you are restricted to a travel distance of 15 miles from the farm. In addition, these vehicles cannot be operated on the highway between sunset and sunrise, when visibility is limited to 500 feet, or when there are hazardous road conditions, such as snow or ice. "Farm use' plate vehicles do not have to be inspected but the brakes must be in operating order and the driver must follow all State vehicle operating regulations.

Registration is not required for farm tractors that cannot be operated at a speed in excess of 20 miles per hour. A farm vehicle registered with a 'farmer' or 'farm use' plate cannot be operated on a highway when the vehicle, including load, exceeds eight feet in width and/or 50 feet in length unless four red flags, one each on the outside extremities of the vehicle, are displayed on both the front and rear, the flags are no less than 18 inches square, and the top edge of the flags are no less than 48 inches from the roadway surface. Any farm vehicle, implement or machinery and/or load that exceeds 12 feet in width and/or 60 feet in length, in addition to the four flags, must have one escort vehicle and cannot be operated on the road on Sundays or holidays.

Commercial Drivers License (CDL): Farmers love to drive their farm trucks and some think they are exempt from most federal and State rules governing commercial motor vehicles (CMV) (those with a GVWR of 26,001 or more) because they are a farmer. New Jersey law states that farmers are exempt from a CDL if they drive intrastate, the vehicle is controlled by the farmer, the vehicle is not for hire, and it is being used within 150 miles of the farm. However, once you cross State lines the rules change. In order to be exempt from a CDL during interstate travel, there must be a reciprocity agreement between New Jersey and any state in which you travel. As an example: You take your CMV to New York, you will be within the 150-mile radius of your farm and you do not have a CDL. If you are pulled over by enforcement, you will be cited for failing to have a CDL and you will not be able to move your CMV until you locate someone with a valid CDL to continue the trip (NJ does not have a reciprocity agreement with NY).

USDOT Number & Unified Carrier Registration (UCR): Do you use your farm truck to travel interstate? Do you have a USDOT number on your truck and are you registered under the UCR? Well if your truck

travels interstate and has a GVWR of 10,001 or more, you are required to have a USDOT number and you must be registered with the UCR.

Medical Card: Ok, you do not leave New Jersey so you are exempt from a CDL, you do not need a USDOT number and you do not have to register with the UCR. So you think you are off the hook. Wrong! If you drive an articulated vehicle (tractor and trailer combination) interstate or intrastate with a GVWR of 10,001 or more, you are required to have a medical certificate to show you are physically qualified to drive the vehicle. You may be exempt from the CDL, but you are not exempt from the medical certificate requirement. The purpose of the physical examination is to detect the presence of physical, mental, or organic conditions of such a character and extent as to affect the driver's ability to operate a CMV safely. The certificates are good for two years. According to the Federal Motor Carrier Safety Administration, a medical certificate can be issued buy a licensed medical examiner. The term includes, but is not limited to, doctors of medicine (MD), doctors of osteopathy (DO), physician assistants (PA), advanced practice nurses (APN), and doctors of chiropractic (DC).

Inspection of Vehicle: Most farmers know that a diesel engine truck with a 'farmer' or 'farm use' plate and a GVWR of 18,000 or more is exempt from the periodic diesel emission inspection requirements. However, these vehicles are subject to inspection to insure that the vehicle is in safe and proper operating condition. Below is a chart (provided by Parsons through a Centralized Motor Vehicle Inspection facility) to determine if the truck must go to a Centralized Inspection Facility (CIF) or is subject to Self-Inspection.

Fuel Type	GVWR	CIF- Safety	Self-Inspection
Gas	ALL	YES	NO
Diesel	Up to 9,999	YES	NO
Diesel	10,000 to 17,999	NO	YES
Diesel	18,000 +	NO	YES

Self-Inspection: The regulations require that every motor vehicle registered in the State shall be systematically inspected and maintained and records maintained for each vehicle. The maintenance records must include at a minimum the following: vehicle identification (plate, make, model, vehicle identification number, number of tires, tire size, and number of ply); a record of inspection and repairs indicating the nature of the repairs and the completion date; lubrication record; systematic means of identifying for each vehicle the nature and due date of the inspection and maintenance operations to be performed; and if the vehicle is leased, the name of the lessor furnishing the vehicle. All records must be maintained for 24 months.

Daily Vehicle Condition Report: All drivers must prepare a written report at the completion of the workday and list any defects or deficiencies of the motor vehicle that would affect the safe operation of the vehicle or result in a mechanical breakdown. The vehicle owner must repair the defects or deficiencies and retain the report for twelve months.

Quarterly Inspection: At least once very three months, the following equipment must be inspected and maintained: brake lines and lining; drive lines; coupling devices; tires, wheels and flaps; springs; emergency equipment; fuel system; cooling system; lighting devices, horn and mirrors; transmission; steering equipment; axles and tie-rod assemblies; clutch; exhaust system and exhaust emissions; and glazing and wipers.

Roadside Inspection: Every State Police officer and every examiner of the Motor Vehicle Commission (MVC) may perform inspections of the vehicles on the road. If during the inspection it is found that the vehicle has a mechanical condition or loading that may cause a breakdown or an accident, the vehicle can be placed "out of service". Any vehicle marked "out of service" cannot be operated until all repairs have been satisfactorily completed. Although a diesel powered truck with 'farmer' plates and a GVWR of 8,500+ pounds is exempt from the periodic diesel emission inspection, if a State Trooper or examiner of the MVC sees evidence of the vehicle emitting smoke (smoke opacity), the vehicle can be pulled over. A citation can be issued that carries fines from $250-$1000 per day per vehicle.

International Fuel Tax Agreement (IFTA): The International Fuel Tax Agreement (IFTA) is an agreement between the lower 48 states of the United States and the Canadian provinces, to simplify the reporting of fuel use by motor carriers that operate in more than one jurisdiction (state). The carrier files a quarterly fuel tax report that is used to determine the net tax or refund due and to redistribute taxes from a collecting state to states that it is due.

Prior to IFTA each state had its own tax system, and a truck needed tax permits for each state in which it operated. Pre-IFTA trucks in interstate commerce carried a special plate ("Bingo Plates") upon which each state's permit sticker was affixed. Lots of paperwork for everyone.

Farmers are exempt from IFTA if the truck does not leave New Jersey. However, if the truck has two axles and a GVWR of 26,001or more, used in a combination that has a GVWR of 26,001or more or has three or more axles no matter what the weight and it travels interstate, an IFTA sticker is mandatory (cost $10 per vehicle).

In addition to compiling the Individual Vehicle Mileage Record (IVMR), each IFTA registrant must maintain fuel receipts. Your records must show: date of purchase, name and address of seller, gallons purchased, fuel type and price per gallon, purchaser's signature, and license plate number or unit number of vehicle into which fuel was pumped. Invoices or credit card receipts are acceptable records.

So if your farm truck never leaves New Jersey, you do not need an IFTA sticker. If your truck leaves New Jersey and meets the weight criteria, better call Trenton to enroll in IFTA.

Student Ag License: In the past, students could get an agricultural driving permit and drive a truck with a 'farmer' or 'farm use' plate and they did not have any restrictions. However, when the graduated driver license (GDL) provision was adopted, things changed. As it stands, the student can only drive a vehicle with a 'farmer' or 'farm use' plate in the pursuit of agriculture. Doing errands for the farm is OK. However, they cannot drive the 'farmer' or 'farm use' truck for personal use – that means no more driving to school, to meet their friends at the mall, or to take a drive down to the shore. The new GDL provision also mandates that they must be accompanied by an adult supervising driver at least 21 years old and licensed to drive for at least 3 years. The good news is that they are not required to have someone accompany them when driving a farm tractor (good thing since most tractors only have one seat). Other GDL restrictions shall apply (No driving between 11:01 p.m. and 5:00 a.m.; no cell phones, hand held video games or any other hand held electronic device; passengers shall be limited to persons who share the permit holder's residence and one additional passenger who does not reside with the permit holder; seatbelts must be worn; and an agriculture license cannot be used to drive any other type of vehicle. If the student wants to take their chances and are cited by enforcement, the fines are $100 per offense. In addition, if there is an incident while the student is behind the wheel and fails to follow the GDL provisions, liability can create additional worries.

Additional Information: The NJ Department of Agriculture has posted a web site that provides more details on federal and state motor vehicle regulations that affect farmers. Visit http://www.nj.gov/agriculture/divisions/md/prog/farmermotorvehicles.html for more details. For questions or more information, contact Karen Kritz at 609-984-2506 or karen.kritz@ag.state.nj.us.

Session 3
Cut Flowers

PRODUCTION OF ZINNIAS AS CUT FLOWERS

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INTRODUCTION

Zinnias are among the easiest flowers to grow needing only reasonably fertile, well drained soil and sunlight.

Zinnias make up the backbone of the cutting field, with bright pinwheel flowers that last at least a week in the vase. The colors available range from pure white, palest yellow to brightest yellow, gold and bronze, salmon, orange, scarlet, red, rose and pink, light lavender to dark purple. There is also a new zinnia with a bi-color pattern of scarlet rose centers with bright yellow tips. And just to get attention, there is a green zinnia named Envy. Zinnias are true American natives from Colorado, New Mexico, Mexico and Central America. Depending on the species, Zinnias can grow from the dwarf 6 to 10 inches tall (not suitable for cut flowers) to the giants at 3 to 4 feet high. Zinnia (*Zinnia elegans*) named for botanist Johann G. Zinn, is the species from which most of the cutting flowers originated.

Mexican zinnia (*Zinnia angustifolia)* gained popularity as 1997 All-American Select Flowers, 'Crystal White'. Because it only grows 1 to 2 feet tall with small white, yellow or orange flowers, Mexican zinnia are best as bedding plants, but can be used for filler flowers in a bouquet. Zinnias are often classified by the size and shape of the flower. Small flowers are defined as less than 2 inches wide, medium flowers range from 2 to 4 inches wide like 'Oklahoma' and 'Persian Carpet'. Giants have flowers that are larger than 4 inches wide and include 'State Fair', 'Splendor', Zowie! Yellow Flame, and the 'Benary Giants'. Flower shapes may be classified as singles (flat daisy like flowers), semi-doubles, doubles (pompon), quilled (cactus) and crested and curled (dahlia).

CULTURE

Zinnias thrive in hot weather with full sun, well drained soils and a constant source of moisture. Watering is best done as trickle irrigation which places the water in the root zone and not on the foliage. Overhead irrigation will promote foliar disease and greatly reduce flower quality. Frequent cutting of the flowers ensures the formation of more flower buds. With warmer weather the stem length and flower size will increase.

PROPAGATION

Zinnia elegans is produced from seed (2,000 - 6,000 seeds/oz, 70 to 210 per g) and will germinate in 3 to 7 days. The seeds need to be covered. Zinnias can be directly seeded into the soil after all danger of frost has passed, or can be seeded in a greenhouse and easily transplanted later. Most giant flowering Zinnias are F1 hybrids so seed can not be collected from spent flowers. To start seeds out of doors, wait until the soil temperature has warmed up consistently between 65F and of new flowers throughout the growing season. Zinnias started in greenhouses need 70F to 80F (24C) temperatures for best germination, emerging in 5-24 days. If grown too cool, the seeds will succumb to root rot. Temperatures can be lowered to 60F after germination has occurred to encourage stocky plant growth. The planting substrate, usually a soil-less peat-lite mixture or vermiculite-peat mixture, should be sterile and well drained with a pH around 6.5. Do not use wetting surfactants in the germinating medium as they damage seedlings and permanently reduce the vigor of the plants. The seeds can be planted in flats, plug trays or individual pots.

TRANSPLANTING

Zinnias grow very quickly and need to be transplanted to larger containers or out of doors 10 to 14 days after sowing, or when they have at least 2 sets of leaves. If transplanted into larger containers in the greenhouse, the night temperatures should be kept no lower than 65F and day temperatures between 70F on cloudy days and 80Fon sunny days. The plants should be well ventilated and not allowed to become water stressed. The seedlings should be fed weekly at the rate of 250 ppm N of a complete fertilizer 20-10-20 or 20-20-20. They can be transplanted out of doors as the temperatures permit.

PHOTOPERIOD

Zinnias are sun loving quantitative short-day plants. Flower bud initiation is during short days under 12 hours. If Zinnias are given three weeks of short days while in the plug trays, they will flower sooner. Long days are best for flower bud development and give the flower stems a chance to stretch

and the flowers to expand to their largest size. Continuous long day treatment can cause the flower initiation to be delayed for up to 3 weeks.

PESTS OF ZINNIAS

Aphids

Aphids are small, soft bodied insects. They feed on the plant by inserting their stylet mouthpart into the plant tissue and sucking plant sap. The feeding injury causes plant stunting, deformities, and reduced vigor. Large numbers of aphids feeding on plants can leave a sticky residue called honeydew, which, with the aphids cast skins, can reduce the salability of the cut flowers.

Control: Dormant oil**,** insecticidal soaps, systemic insecticides and stomach poisons or lady beetles, Green lacewings, aphid midges, parasitic wasps, and Entomopathogenic fungi.

Black Blister Beetle

This pest is a slender, jet black beetle that is about ½ inch long with prominent head and neck. It feeds on the flower and destroys the market value of the crop.

Control: Contact insecticides.

Four-Lined Plant Bug

The adult is similar to the tarnished plant bug in size and shape, but it is more colorful, yellow with four black stripes on the wing covers. The four-lined plant bug feeds on newly expanded foliage, causing leaf distortion. It can cause flower abortion if it feeds on unopened buds, and on mature foliage it can cause small sunken brown areas. Both the feeding and the toxin that is injected into the plant during feeding will injure the plant, making it difficult to sell.

Control: Contact insecticides.

Japanese Beetle

Both the adult and the larva are pests and can cause serious injury. The adult is a robust, greenish-bronze, metallic beetle that is about ½ inch (9 to 11 mm) long. The larva is a ground dwelling white grub that feeds on the roots of plants. The adults feed on the foliage, buds and the blooms, and can totally skeletonize a plant in a very short time.

Control: Contact insecticides.

Red-banded Leaf Roller

This small ½ inch long caterpillar is yellow to light green in color, with a red band around the body. The caterpillar feeds on the foliage after rolling the leaves and tying them together with silk thread.

Control: Horticultural oil or contact insecticides if sprayed before leaf is rolled up or *Bacillus thuringiensis* Berliner, or parasitic wasps.

Corn Borer

The European corn borer is a slender caterpillar is1 to 2 inches long and is brown with white stripes when young and grayish in color when older. The caterpillar makes a small round hole in the stem and feeds by tunneling up the stem, which causes the plant to wilt and break at the puncture area.

Control: Contact insecticides, stomach poisons or *Bacillus thuringiensis* Berliner and parasitic wasps.

Tarnished Plant Bug

This robust, coppery brown, oval bug is ½ inch long with dark brown and yellow flecks on its back. The adult makes a small hole just below the flower heads and the stalk breaks at the puncture area.

Control: Contact insecticide

Thrips

Thrips are tiny, slender insects about .039 to .078 inch long with fringed wings. The adult and larva stages both feed on flowers and foliage, damaging both and making the flowers un-saleable. Thrips are also a vector for virus diseases that will destroy the entire plant.

Control: Insecticidal soap, systemic insecticides, contact insecticides or *Amblyseius curcumeris* a predatory mite, *Orius* a predatory bug, *Beauveria bassiana* a fungus that can be sprayed on the foliage.
For the most recent insect control recommendations, contact you local Extension agent.

DISEASES

Alternaria leaf spot and blight. The leaf spot is a reddish brown or purple spot that is round or oblong. The centers can be grey or tan and often drop out leaving a hole in the leaf. When Alternaria attacks the seedling stems, the plants can be killed.

Control: Keep foliage dry with trickle irrigation, and during periods of warm wet weather spray with fungicides mancozeb, cholothalonil, iprodione or vinclozolin.

Botrytis

Grey mold is a fungus that can attack both foliage and flowers, especially when the humidity is very heavy.

Control: Protect plants with fenarimol, mancozeb, kresoxim methyl, thiophanate methyl + mancozeb.

Cercospora leaf spot

A leaf fungus that produces small, round spots with grey or white centers. With very humid weather the spots can run together to destroy the leaf.

Control: Mancozeb, fenarimol, cholothalonil.

Powdery Mildew

Powdery mildew is the most common disease problem. The fungus forms a white growth on the upper surface of the leaves, stems and sometimes the flowers when warm days are followed by cool nights.

Control: Resistant varieties, copper, mancozeb, fenarimol.

Virus

Tomato spotted wilt virus can distort the growing points of the plants and the flowers. Curly top virus causes the tops of the plants to curl drastically and the cucumber virus gives the mosaic look to the leaves. All of the viruses are transmitted to the plants by various sucking insects.

Control: All affected plants should be removed and destroyed.

Mycoplasma-like organism

Aster yellows can cause leaf-like tissue to form in place of flowers, and some flowers remain green. Affected leaves can be narrow and strap like.

Control: All affected plants should be removed and destroyed.

Nematodes

Meloidogyne incognita - root knot nematodes divert the nutrients and weaken the entire plant. Although very uncommon in Maryland, there is also *Aaphelenchoides ritzema-bosi* nematode which causes angular spots on the zinnia leaves. Late summer is the best time to test the soil for nematodes when the populations are the highest.

Control: Solarization, chemical nematicides and crop rotation will bring the populations down.

For the most recent disease control recommendations, contact your local Extension agent.

DISORDERS

High boron may delay flowering 12 to 15 days, and low boron may cause the terminal buds to blast.

WEED CONTROL

Weeds may be controlled with a black plastic mulch, an organic mulch or shallow cultivation. Contact your local Extension agent for herbicides currently labeled for zinnia production.

HARVESTING

Begin to harvest by cutting off the top two leaves when the zinnia plant has three sets of true leaves. This will promote strong branching of the plant. Zinnia flowers should be harvested in the early morning or the evening when it is coolest, but when the plants are free of dew and moisture. Wait until the flowers are fully open before cutting. Flowers can be stored at 36-38 F for 5 days and the vase life is 10 - 14 days. Most zinnia flowers are ready to harvest before the center flowers open, Zowie! Yellow flame is the exception.

Summary

Some Zinnia that are excellent for cut flower culture.

Name	Flower Shape and Size	Disease Resistance
Benary's Giant Series	Dahlia flowered 4-5"	Powdery Mildew
Oklahoma Formula Mix	Dahlia flowered	Powdery Mildew
Ruffles Hybrids	Fully Doubled 3-3 ½"	Powdery Mildew
Sunbow Mix	Fully Doubled - single 2-3"	Slight Powdery Mildew
Profusion Series	Fully Double	Slight Powdery Mildew
Cactus Flowering Mix	Fully Double	None
Summer Pinafore	Fully Double	None
Persian Carpet	Fully Double	None
Envy	Single & Double 2 ½ -2"	None
Yoga Giant	Fully Double	None
State Fair	Fully Double	None
Aztec	Fully Double	Slight Powdery Mildew
Red man	Fully Double	Slight Powdery Mildew
Candy striped	Fully Double	None
Zowie! Yellow Flame	Semi Double	Slight Powdery Mildew
Crystal White (species)	Single	Powdery Mildew
Bonita (species)	Single	Powdery Mildew
Starbright Mix	Single	Powdery Mildew

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Keeping Flowers Fresh, Healthy and Strong

Jenny Carleo, Agricultural Agent
Rutgers, the State University of New Jersey
New Jersey Agricultural Experiment Station
Cooperative Extension of Cape May County

Good crop health:
Soil fertility, crop nutrition and care- a healthier plant with balanced nutrients will:
1) Be less susceptible to disease and insect damage
2) Live longer after cuttting

Harvesting
1) Sharp tools
2) Clean tools
3) Clean water
4) Removing any field heat rapidly

Temperature Control
Different crops have different temperature requirements
1) Water- roses, zinnias and woody crops need hot water, other flowers warm, all bulbs need cold water
2) Harvesting- All crops should be harvested while cool and preferable dry

Leaf removal
1) Goal is to prevent transpiration (evaporation of the water from inside the plant). Transpiration will expend the flower's energy and cause it to die more quickly

Preservative- It is a NECESSITY, use a commercial brand because they have the precise balance of ingredients that includes:
1) Antimicrobial agent
2) Food source for the flower so it does not have to photosynthesize its own
3) pH change

Storage
1) Temperature
2) Humidity

Remember:
Flowers are like fish: They're freshest at harvest; it's all downhill from there.

Session 4
Tree Fruit

Session 5
Getting Customers To Your Door

SELLING YOURSELF --DOING WHAT THEY AIN'T

Chuck and Tami Mohler
Sweet Corn Charlie Produce, LLC
Own and Operate 8 Farm Markets in Northern Indiana 1020 N. Huntington St.
Syracuse, IN 46567

The best advertising begins when customers come into your business.
In selling yourself, you need to relate to your customer that you know what you are doing, by being organized, clean, uncluttered, and in good repair. Plus your sales people are knowledgeable about their product -- "Good Hiring and Training Practices".

Target your customer. What type of people are you trying to reach, then dress your employees to attract and please that crowd. We have a lake and picnic base. So most of our employees wear short shorts and t-shirts with their name on. We create a laid-back backyard atmosphere. Our motto is, "No shirt, no shoes, no problem. Bring your dog, your cat, your parrot and your pet pig, but come to Sweet Corn Charlie's", and they do! If you target is organic, yuppies, young, old -- give them what they like to see and hear. Be UNIQUE.

Do what the supermarket isn't doing anymore:

- Stress fresh and local.
- Engage the customer.

Changing Times: Using Internet for Marketing

Ronny Lee
Lee Turkey Farm
201 Hickory Corner Road
East Windsor, NJ 08520

How would it be to never again have to advertise on the radio, newspapers or any other printed media and still have all the customers you would need to buy your products? The first requirement is a business web site. Today's successful businesses all have them and many unsuccessful businesses have them too. With that being said, just having a website isn't going to make it happen. Consumers don't always take the time to log on and research for a weekend activity. For most people the idea has to be presented to them in the form of a friend's suggestion, television or radio advertisement. This is the beauty of email. A very inexpensive way to deliver an idea to the consumer.

In 1998 a customer visiting my farm mentioned to me that I should look into creating a Lee Turkey Farm website. After creating the website the question was how do I get people to go to it for the information? The first thing I did was to advertise the site in my market and to print it on every piece of literature along with address and phone number. This helped a little, but I realized that I was missing something. Strawberry picking has always been our first crop of the U-Pick season. The best picking is within the first couple weeks. A few people would show up at the beginning and as word of mouth spread, more would come and we would gradually get busier. By the end of the second week there would be crowds of customers but the berries had gradually been getting smaller and the picking more challenging. Newspaper advertising had also been attempted but for a large noticeable ad it was quite expensive and a small ad would be lost among the pages of larger ones. I thought that if I could send an email to each family visiting my farm throughout the season this could make a big difference.

In 1999 I added another page to my web site. It was called the subscribe page, where customers could give me their email addresses and I would send weekly updates to let them know what was in season, different specials and farm events. I was very careful to make sure that they were sent out as a blind carbon copy (Bcc) so that their addresses were not publicly shared. At the end of the 2000 season I had more than 400 subscribers. At the beginning of the following season I sent the first 2001 email to let my subscribers know when the first day of the strawberry season would be. On opening day we had a crowd that we would normally expect to see at the end of the second week. My customers didn't miss the best part of the season and I also benefited greatly.

Every season more subscribers were added to the list. As the numbers approached and then passed the 1,000 mark I had another problem. What was I to do if there was a limited crop? Should I not acknowledge the crop in the email or send out emails to everyone and risk having many upset customers because the crop was picked out before they arrived. My first thought was to send out emails to a portion of the subscribers, but that wouldn't be fair and who was to say which subscribers would be more interested in the particular item. I discovered that it's all about timing. Most U-Pick customers come on the weekends. The greatest response comes from emails sent out on Wednesday. I found that the closer you got to the weekend more of the subscribers have already made other plans and if the emails are sent out on Monday and Tuesday the subscribers tend to forget before the weekend comes. An example of this is cherry season. We have 36 trees and everyone seems to love cherries. It is not unusual to have all the sweet cherries picked clean in two days. I send that email on Friday night to all subscribers. Many won't read it until after the weekend and many will not come because they have already made other plans. For the ones that do come they are very happy and for the ones that come too late they are not mad at me because everyone received the email at the same time and they had chose to put off coming to the farm.

In December 2008 I sent out my last email of the season wishing every one Happy Holidays and thanking them for their business. There were 2,989 subscribers.

BUYING TO BRIDGE THE GAPS

Jim Giamarese

Why buy local?

Freshness and quality are always the main reasons when making buying decision. It's more environmentally friendly with fewer miles traveled. You know the grower.

Different ways to buy local:

- You can buy directly from grower buy you would spend time and fuel going to and from growers.
- You can buy from local broker or supplier for local or California produce, but you still have to pick up product or pay for delivery.
- You can pair up with another marketer to secure lower prices with combined purchases.
- You can buy from local Coop.

Benefits of buying from local Coop.

Why not buy from Tri County Auction Market?

- Larger selection available
- One-stop shopping
- Saves time and fuel
- Freshest produce, better taste, and quality
- Auction prices/ good – bad?
- Fun and friendships

What's new for 2009 at Tri County

Session 6
Ideas and Opportunities

AGRITOURISM AND COMMUNITY KITCHENS

Stephen J. Komar
Sussex County Agricultural Agent
129 Morris Turnpike
Newton, New Jersey 07860-4913

Agriculture has changed dramatically in New Jersey. In recent years many agricultural producers have shifted from wholesale and commodity based production to retail operations or other value-added ventures. Agritourism efforts have been steadily increasing in the state. These agritourism efforts have allowed farmers the potential to increase the profitability of their farms while providing consumers a taste of the farming lifestyle. Producers have also shown an interest in developing value-added products. By developing value-added products such as jellies, baked good and others, producers can potentially increase their income and extend the marketability and shelf life of the products produced on their farm.

While agritourism activities and value-added production both have tremendous potential to increase the viability of New Jersey agriculture, very little research has been conducted to quantify consumer interest in these activities and products. Further, the regulatory environment in the state makes the production of value-added products very difficult for small-scale producers.

In 2006, Rutgers Cooperative Extension in Sussex County, in cooperation with The Sussex County Technical School, Sussex County Agricultural Development Board and the state Department of Agriculture initiated a program to allow agricultural producers the opportunity to make value-added products in the local technical school kitchen. Producers were trained in proper food handling and processing techniques and were certified in glass closures, canning and food safety procedures. To date five individuals utilized the kitchen to make canned goods, as well as, baked products featuring farm fresh products. Although a centralized kitchen may provide a means for small-scale producers to legally produce value-added products, the products must be produced in accordance with USDA and local regulations. Legal restrictions, as well as, other concerns must be addressed in order for the concept to be accepted by producers and regulatory agencies.

In 2007, Rutgers Cooperative Extension of Sussex County conducted a survey of consumers in the Highlands region to quantify the level of participation in agritourism activities and to quantify the effectiveness of current agritourism promotional activities. The results from this survey demonstrated that consumers are very receptive to supporting agriculture in the state. The survey also demonstrated that marketing and promotion of these activities is a crucial component for success.

FREEZING JERSEY FRESH EGGPLANT

Kevin & Sharon Flaim
Owner-Operators
Flaim Farms Panther Brands
Panther Rd.
Vineland, NJ 08360

Kevin and Sharon had an idea for a new product to market their fresh produce year round, but had no idea what they were in for when they started exploring what it would take to get the product to market. They will discuss their experiences going from concept to product and now, the fun of getting on store shelves.

I SCREAM, YOU SCREAM – WHAT TO DO WITH SO MUCH CREAM?

Phyllis Kilby
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kilbycream@zoominternet.net
www.kilbycream.net

"From cow to cone in 2 days" – Kilby Cream is the creation of Lisa Kilby with a little help from Phyllis and Megan. The dream was to create a farm fresh quality product and offer it to the public in a family friendly farm setting—a place apart, where customers could enjoy a treat and have fun at the same time.

Kilby Cream will be celebrating its 4th anniversary in the spring. As a value-added operation to the family dairy farm, Kilbys Inc., the Kilby Cream Super Scoopers have found that working with the public is quite different from working with cows.

USDA VALUE ADDED GRANT FOR BRANDING AND MARKETING

Jim Quarella
Bellview Winery
150 Atlantic Street
Landisville, NJ 08326

Bellview Winery, after several attempts, was fortunate to receive a USDA Value Added Grant. This Grant is very important to us because it will give us the extra capital needed in Branding and Marketing our Premium Wines. I will share the process and experiences that we have gone through to secure the Grant, and our projection as to how the Grant will benefit Bellview Winery. To apply for a Grant is very time consuming and demanding, but if you are awarded the grant, the time is well worth the benefits.

KEEPING UP WITH GIANTS--THE SHOPPING EXPERIENCE OF TOMORROW

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Farm markets traditionally maintain a country atmosphere to build upon the farm-fresh appeal of home-grown foods. In the Mid-Atlantic region, farm markets are in direct competition with some large, innovative and aggressive retail food giants that are incorporating new concepts and technologies in their stores to attract savvy consumers. Though high-tech may not be the way to go in a farm market, it is important to know and understand what the competition is doing to keep those consumers in their stores (and away from yours).

Elisha Sauers (2008. A grand time for grocery shoppers. The Capital Online. Annapolis, MD *www.hometownannapolis.com/cgi-bin/read/2008/11_16-15/PRI*) described how retail grocers in the Baltimore-Washington-Annapolis area of Maryland have been refurbishing their stores. She did not mention the increasing competition being felt as Wegman's has been expanding into the region from western New York with their high end stores that feature the conveniences of banking, general merchandise, outstanding produce, bakery and deli departments, as well as in-store quick meals and dining facilities.

Shoppers Food and Pharmacy changed from "a small warehouse with stark colors" to a brighter decor with higher-end fixtures to allow shoppers to "buy with their eyes." Soft lighting, top-of-the-line fixtures from the shopping carts to the freezer displays, and a greater offering of ethnic produce varieties appeal to a diverse customer base.

Safeway, an international chain with stores in the US and Canada, followed the Wegman's model a little more closely, razing a small store to build one three times the size of the original. In addition to the conveniences described above, this store also has on-site dry-cleaning service and an underground parking lot.

In addition to upgrading lighting and decor, Giant incorporated some exciting new shopping technologies in its store. A "deli vision digital computer kiosk" lets shoppers order their deli items on a touch-screen computer and continue shopping. When their order is filled, it is announced over the intercom. That's one time saver. The next is the personal scanner. Shoppers scan the barcode of items as they pick them off the shelves and place them directly in shopping bags in their carts. When finished shopping, they pay the total on the scanner without having to unload, pack and reload their groceries.

While these concepts and technologies might not seem to fit the country motif of most farm markets, think about it:

- The personal scanner relies on the honor system that the shopper will scan everything put in the shopping cart, just like the tin can on the un-manned cart full of produce left at the end of the farm driveway.
- WaWa convenience stores started as a farm dairy store and today there are deli kiosks in every store.
- Some farm markets include restaurants or Bed & Breakfasts, taking value-added from field to fork.

Session 7
Pollination

Session 8
Grain and Forage

CEREAL RUST MITES IN TIMOTHY

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The New Jersey Department of Agriculture reports over 90,000 acres of grass hay grown in the state each year. Half this acreage is in timothy (*Phleum pratense* L.). Timothy hay production for the equine industry represents one of the more profitable commodities for field and forage crop producers. A problem faced by producers is a relatively new pest, the cereal rust mite (*Abacarus hystrix*), sometimes referred to as timothy mite. Virtually every acre of timothy in the state is infested with cereal rust mite (CRM).

CRM reduces yields by 30 to 70 percent and reduces visual quality of hay because of brown discoloration caused by CRM feeding. Currently, Sevin XLR Plus is the only insecticide control labeled for CRM. There is concern that CRM will develop resistance to this insecticide. There have been reported failures from the field by growers attempting to control CRM using Sevin XLR Plus. The situation has reached a critical point; if we are unable to develop control strategies for CRM it may not be economically viable to produce timothy hay in New Jersey.

The fruit and ornamental industries both use horticultural oil sprays for control of various mite species. Oil is effective against insects and mites because it suffocates or causes cell membrane destruction of pests as well as their eggs. Another advantage of oil is that no pest has been known to become resistant to its killing action. The forage industry does not use horticultural oils sprays for insect control. One of the CRM control strategies of this study was to use horticultural oil in the early spring to control CRM in the egg stage.

A timothy field was planted at the Rutgers Snyder Research and Extension Farm during the spring of 2007 to conduct research on control strategies for CRM. By the fall of 2007 a significant population of CRM was established in the timothy field. Research treatments were initiated during the spring 2008 growing season. The experimental design used is a randomized complete block design with seven treatments and four blocks. The experimental plots are approximately 10' x 50'. Treatments consisted of applications of 1 and 2 % horticultural oil and Sevin XLR Plus applied at two different times (early and late) and applied separately or in combination. Overall, the study contained seven different treatments.

At two weeks and 4 weeks after initial treatment visual ratings of mite injury were recorded using a 1 to 5 scale (1= no injury, 5 = 100% injury). Mite counts were also conducted to evaluate the success of treatments. Mite counts were conducted by collecting 10 random plants from each plot. The upper most leaf was removed from each plant. The number of mites from a 3 cm section of each leaf was counted with the aid of a microscope. Finally, timothy was harvested and dry weight yields were calculated for all plots. Data was subjected to analysis of variance and mean separation was conducted using Fischer's LSD at the 0.10 level (SAS, 2007).

The data showed that all treatments provided numerical reduction in mites and increased timothy yield ($P = 0.001$). The data also showed a correlation ($R2 = 0.80$) between the number of mites and yield. Generally, the lower the number of mites the higher the yield of timothy. The current recommended early application of Sevin XLR Plus out yielded the check by 925 lbs/ac. Under current economic conditions spraying resulted in a $160/ac return to the grower. The application of 1% oil early + late Sevin application resulted in the best overall yield. This treatment out yielded the check by over 1,300 lbs. /ac. This may suggest a dual approach of attacking mite eggs early followed by a late Sevin application may be most beneficial. Late application of horticultural oil did not appear to improve mite control or timothy yield.

It is clear from the data that timing of oil and Sevin XLR Plus treatments appears to impact efficacy.

SPATIAL DISTRIBUTION OF BLACK BEAR DAMAGE IN CORN

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INTRODUCTION

Black bear (Ursus americanus) populations have been steadily increasing in New Jersey since the 1980's. Current research estimates the bear population at more than 3,000 bears in the prime bear region of northwestern New Jersey. This region is also home to a great deal of rural and agricultural land. Agricultural producers have reported an increase in bear sightings and subsequent crop damage in recent years. Although anecdotal evidence suggests that damage to agricultural crops has increased, limited studies have been conducted to quantify bear damage in New Jersey agricultural crops or to determine where damage is most likely to occur in a field. A research trial was initiated during the 2007 growing season to quantify bear damage and to determine the spatial distribution of bear damage in corn.

METHODS

An experiment was conducted during the 2007 growing season to evaluate the spatial distribution of bear damage to agricultural crops in Sussex County, New Jersey. Spatial analysis using Global Positioning Systems GPS was conducted in corn (Zea mays). Corn was selected in response to a producer survey conducted during the 2006 growing season which reported bear damage to corn as a serious concern for agricultural producers in the region. Fields with a past history of bear damage were selected and assessed prior to harvest. Damage was quantified by evaluators walking through selected fields and locating the characteristic bear damage. Individual "bear rolls" were measured using a Trimble ProXR, submeter GPS unit. The perimeter of each roll was walked with one point being geo-referenced per second. Resulting polygons were mapped using ESRI ArcView 9.2. The spatial join feature was utilized to calculate the distance from the center of each bear damage polygon to the edge of the closest land characterized as forested (NJDEP Land Use/Land Cover data set, 2002). The multiple ring buffer feature was utilized to differentiate polygon distances. Means were subjected to analysis of variance and separated using Duncan's Multiple Range test (SAS, 2007).

RESULTS

18 fields were scouted totaling 124 acres. More than 600 individual bear damage polygons were created. Damage was variable by field ranging from less than 1% of the total field area to nearly 8% with an average loss of 2.24% (data not shown). Crop loss was not determined since fields were evaluated as much as six weeks prior to harvest in certain situations. Damaged areas would likely grow the longer the crop remained in the field (figure 2). Differences in the linear distance from individual rolls to areas classified as forested were observed (P=.0003) with the majority of the rolls occurring between 0 and 200 feet (figure 3). Numerical differences were observed in the total acres of crop damaged with the highest losses occurring between zero and two-hundred feet from forested areas (figure 4).

CONCLUSIONS

Bear damage in agricultural crops can impact yield and ultimately profitability for agricultural producers in northwest New Jersey. Wildlife damage to crops is variable by field and several factors such as weather, crop load, availability of mast crops or other available foods will change the impact wildlife has on crop yield. More research is needed to determine spatial distribution of bear damage and to quantify the relationship between bear population, crop damage and land use classification.

Fig 3. Bear Damage Frequency by Distance

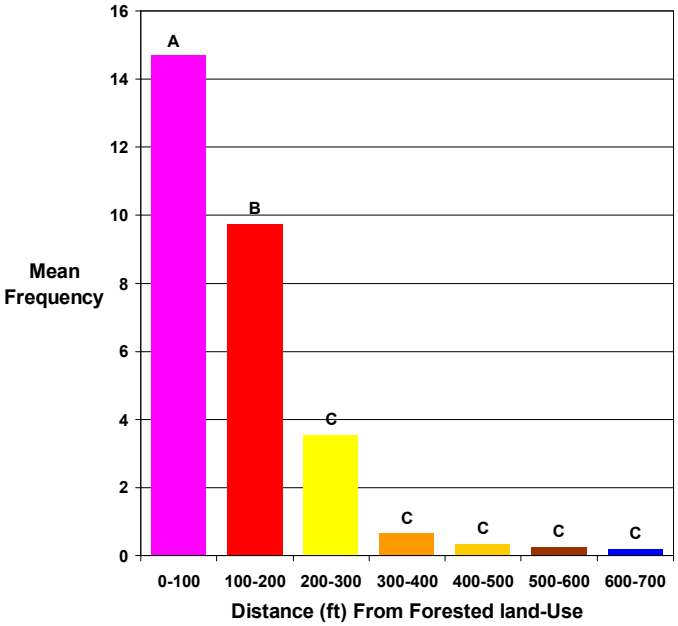
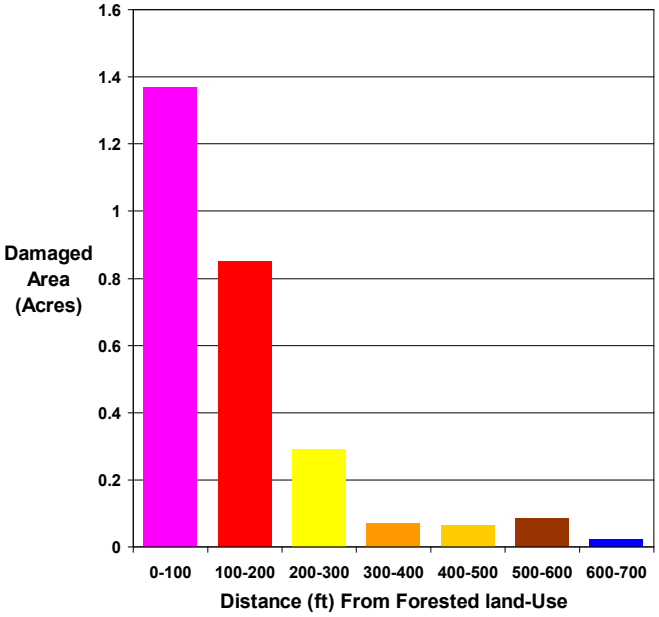
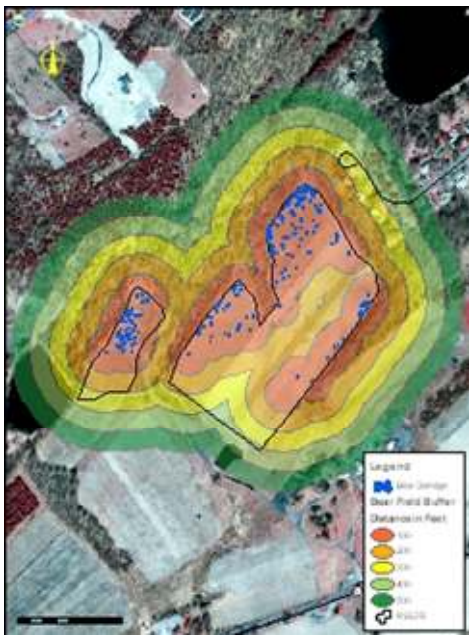


Fig 4. Total Area Damaged by Distance





Distribution of damage from forested land

Figure 2. Change in crop damage over time

Session 9
Small Fruit

STRAWBERRY VARIETIES FOR THE ANNUAL PLASTICULTURE SYSTEM
WHY WE PREFER CHANDLER

Michael J. Newell
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For many in the mid-Atlantic region, the annual plasticulture system for growing strawberries has proved to be an economically viable system. Others have become frustrated with this high-input, high-management system, because success relies on timely inputs, coordination with plant suppliers and dealing with whatever Mother Nature throws at us. The annual system is a package deal starting with site-selection, field rotations or fumigation, optimum planting dates and plant density, variety selection, Fall and Spring fertility management, floating row cover (FRC) management for Fall growth, Winter cold and Spring frost protection. Improper management in any of these areas leads to lower yields. Depending on an individual growers circumstance, it is possible to have nearly $10,000.00/acre invested before the first berry is harvested.

Variety selection is an important component for success with the annual system. Plants need to produce several side-branch crowns by growing later into the Fall and resuming growth in the early Spring. Varieties need to be cold-hardy. The annual system is usually planted as a raised-bed. The raised-bed, covered tightly with black plastic is required to promote the extended plant growth required to achieve high yields. Varieties need to continue to grow at lower temperatures and light levels and sustain minimal cold damage to leaves and crowns. However these raised beds can make the plants more susceptible to cold injury compared to the traditional matted-row with straw mulch. Varieties also need to be selected based on the desired harvest season, marketing options (direct sales or shipped) and consumer preference.

Presently, most mid-Atlantic annual plasticulture success stories have come from growers who grow varieties developed from breeding programs in Florida or California. Varieties such as Chandler, Camarosa and Sweet Charlie have been bred specifically for the annual system for conditions in those states. We are fortunate that research in the mid-Atlantic and cooperating plant suppliers have been able to adapt these varieties for some of the mid-Atlantic growing conditions.
In comparison, most all of the eastern bred varieties are developed for the perennial matted row system and using these varieties in the annual system do not always produce the high quality and high yields that we see with the Florida or California varieties.

Transplants made from runner tips (plug plants) have been the preferred plant type for the annual system. Established transplants make for ease of planting, rapid field establishment and can be held over until field planting conditions are ready. However, plug plants for September planting are the single most expensive component in establishment of the annual system. Other transplant types such as fresh-dug and cut-off plants can sometimes be substituted for plug plants at a reduced cost, but these plant types are generally not available until later in September/early October. Although less expensive than plug plants, planting and post-planting management is more involved, and more research is needed to evaluate the use of these plant types in the mid-Atlantic.

Another approach to the annual system using plug-plants is the use of dormant bare-rooted plants. In many ways this system is similar to the plug–plant system, except that the dormant bare-rooted plants are planted in July instead of September. Many plant nurseries that supply the matted-row growers have these plants available into the summer, and many more varieties are available. If having varieties with unique varietal characteristics for direct sales is important, this system may be a viable alternative. The major drawbacks would be the hand-setting of the bare-rooted plants on plastic in the heat of July and the possibility of significant plant mortality. Although these plants are much less expensive than plugs to purchase, the economics of the additional labor cost would need to be considered.

Summarized in the following tables are yield results from past years variety trials conducted at the University of Maryland Wye Research and Education Center in Queenstown. All trials were replicated four times, planted in a randomized fashion and each plot consisted of 6 or 8 plants per replication. All trials were planted according to the “Chandler model” with the exception of a trial utilizing summer planted dormant bare-rooted plants (Table 3).

The “Chandler model” for our region consists of these criteria;
*Fumigated or long rotation fields
*Pre-plant fertilizer of 60 lb nitrogen + 30 lb Phosphorous + Potassium + Boron based on soil test.
*8 inch x 30 inch firm ,crowned-shaped beds with a single drip tape and black plastic.

*30 day plug-plants, planted in early September in a double staggered row 12 inch x 12 inch apart using a water-wheel transplanter .
*Overhead irrigation for plant establishment immediately after planting
*Monitor/treat for leaf disease and insect pest
*Runners removed in late November
*1.2 or 1.5 oz/sqyd FRC deployed in mid December,
*FRC removed late February for plot clean up and insect pest evaluation.
*At first leaf push, begin spring fertility program and continue based on foliar nutrient analysis. Total nitrogen rarely exceeds 100 lb/a
*Overhead sprinkler and/or FRC used for frost/freeze protection when buds first visible or sooner.
*Fungicides for Botrytis beginning at 10% bloom, monitor for insect pest.
*drip irrigation management for plant health and berry flavors.

Historic Yields (lbs per plant)
of Common Plasticulture Varieties
Queenstown, MD

						Year									
Cultivar	**93**	**94**	**95**	**96**	**97**	**98**	**99**	**01**	**02**	**03**	**04**	**05**	**06**	**07**	**Avg**
Chandler	0.9	0.78	1.33	0.57	1.22	1.76	0.61	1.3	1.75	0.98	1.3	1.2	0.90	1.28	1.13
S. Charlie	-	0.34	-	0.69	1.3	1.06	0.49	0.66	0.76	0.73	-		0.68	-	0.74
Camarosa	-	-	-	0.98	1.14	1.62	0.53	1.32	1.14	-	1.3		1.03	1.69	1.19
Allstar	-	-	-	-	1.85	1.08	0.53	-	1.12	-	1.1			-	1.13
Planting Date	9/19	9/23	9/22	9/7	9/5	9/5	9/4	9/12 ch 9/4 sc	9/3	9/5	9/9	9/1	9/8	9/8	

"-" not all varieties planted each year Table 1.

Annual Plasticulture System Yields over the past 4 seasons.

2006-07	Lbs/plant	Fruit size (oz)	First harvest
Raratan	1.10	0.42	5/14
Carmine	1.46	0.40	5/10
Vantana	1.46	0.54	5/10
Albion	0.53	0.57	5/10
Evie 2	1.84	0.48	5/14
Daraselect	1.19	0.40	5/14
Chandler	1.28	0.41	5/10
2005-06			
Galletta	0.81	0.75	5/1
Azara	0.89	0.59	4/25
Ovation	0.96	0.77	5/11
Bish	1.12	0.61	4/28
Chandler	0.90	0.62	5/1
2004-05			
Treasure	1.90	0.65	5/16
Bish	1.62	0.70	5/16
Gemstar	1.54	0.82	5/19
Strawberry Festival	1.20	0.62	5/13
Chandler	1.28	0.65	5/16
2007-08			
Galletta	1.06	1.02	5/9
Chandler	0.88	0.58	5/9

Table 2.*Most of these varieties are available as plug plants from southern plant suppliers

First Year Harvest Yields from Annual Plasticulture System using Dormant Bare-Rooted Plants 2007-08

Variety*	lbs/plant	Fruit size (oz)	First harvest
Bish	0.86	0.60	5/9
Allstar	0.33	0.48	5/9
Jewell	0.67	0.45	5/15
Ovation	0.65	0.55	5/27
Chandler	1.04	0.60	5/9
Daraselect	0.68	0.68	5/9
Eros	0.83	0.56	5/15
KRS-10	1.14	0.70	5/27
Galletta	1.06	1.02	5/9
Seascape	1.4	0.58	5/9
Chandler plug**	0.88	0.58	5/9

Table 3. *Dormant plants planted July 23 **Chandler plug planted August 31

Top reasons to grow Chandler:

- Available locally as plug plant from late August–early October (ease of establishment)
- Responds well to Fall applied light weight FRC to promote crown development
- Responds well to Spring applied FRC to advance harvest
- Fruit is produced on long trusses (ease of harvest)
- Four-six week harvest season (longer than most eastern-bred varieties)
- Good to excellent berry size, firmness, color and flavor (high consumer acceptance)
- Early, but not the earliest berry (avoidance of frost)
- Relatively cold hardy
- Most studied plasticulture variety

Session 10
Energy

ALTERNATIVE ENERGY USE

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I'm sure we all agree that decreasing our dependence on oil, either foreign or domestic, is an important goal. Along with decreasing our oil and gas use we should also give consideration to lowering our greenhouse gas output. There are many alternatives to help achieve these goals. I will discuss two of these alternatives, corn furnaces and solar electrical production, and give my personal experience using them.

Looking at CO2, burning corn is considered to be neutral since it can release no more than it absorbed while growing. Additionally since only the kernels are burned, the CO2 tied up in the stalk and cobs are still not released. As an energy source corn compares quite well with other fuels. For comparison, 1 bushel of corn at $3.75 has the energy of about three gallons of fuel oil at $1.25 or four gallons of propane at $.94. One of the pitfalls of this calculation concerns the fact that an outdoor corn stove has more heat loss since it is operating outside. Additionally, there is some efficiency lost in the interconnection to the existing heating system. Costs for the boiler and connection runs about $8000 for a 1500 Sq. ft. dwelling. With all these considerations savings in fuel costs will be about 1/3. My heating cost in 2007, before my corn boiler was installed, ran about $1700. Using these numbers payback will take 14.5 years.

Along with this long payback corn boilers and furnaces require daily and weekly maintenance and cleaning. My system requires wire brushing the tubes in the boiler weekly. I check the fire and ash daily, but only have to clean the ash out every 5 or 6 days. If there is a mechanical problem you will most likely have to deal with it yourself, although technical support from the company is readily available. After all this does it make sense? Only if you want to cut your dependence on oil or propane and become more self sufficient. Personally I find a lot of comfort knowing that my heat is not being generated from fossil fuel.

Along with the corn furnace we installed solar panels to generate electricity for our farm stand and greenhouses. The system installed on our farm is a ground array consisting of 120 panels using 3000 sq. feet of ground space. The design indicated a system capable of producing 21,600 kwhrs. Installation took about three months and the system went online March 8, 2008. The total cost of the system was $180,000 and I was fortunate to be included in the rebate program at 50%. The area of the system is quite small for the power produced. I chose a ground array primarily because none of my buildings had a roof that had a southern exposure. Because the system is on the ground any problems are easily reached and no consideration had to be given to building design to support the system. Maintenance of the system should be minimal. Life expectancy of the panels is twenty years and minimum problems have been encountered with the inverters.

My out of pocket costs amounted to $90,000. The company that installed the system, Sun Farms Network, has a program that would have reduced this amount to $33,000 and the repayment terms deal with the electricity generated by the system. I originally calculated the recapture of my investment to take 7-8 years. This was based on a Federal Tax credit of 30% on renewable energy installations leaving $63,000 to be recouped. My electricity cost for 2007 was $4800 and based on the system design I expected to generate 21 or 22 SREC'S which I estimated to be worth $200 each. SREC'S are generated through the New Jersey Clean Energy Program and a credit is given for each 1000 kwhrs. produced. In 2008 my system has outperformed its design and in the 9 months it has been in operation it has produced 25,000 kwhrs. My electricity bill for 2008 amounted to $1200. Additionally the value of SREC'S has risen and the system has generated $11000 in income. These numbers show that the system will be repaid in just over 5 years.There are alternatives to buying the panels outright as well as rebates from the Board of Public Utilities available for installing these systems. The programs are constantly changing so anyone considering solar as an alternative source should check the current programs being offered.

This is just a sample of alternative energy sources and gives my limited experience. Although I am happy with my corn furnace and its performance, I would only recommend it to those that are mechanically inclined and that don't mind the work involved. My solar panels have performed exceptionally and I would encourage anyone to participate in this form of energy production.

Session 11
Organic Production

NORTHEAST ORGANIC FARMING ASSOCIATION OF NEW JERSEY

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The Northeast Organic Farming Association is a unique collaboration among the stakeholders in our food system. Our members include farmers, consumers, retailers, processors, educators and researchers. NOFA-NJ serves the NJ/PA region as a catalyst in the development of a sustainable organic agricultural system; educates diverse audiences about the significance and meaning of organic practices for food and the environment, and helps organic and progressive conventional farmers build and maintain sustainable operations. NOFA-NJ is a membership-based 501(c)(3) corporation.

The Northeast Organic Farming Association of New Jersey is a twenty two year-old, membership based educational nonprofit organization. We are a unique collaboration among the stakeholders in our food system; our members and our governing board include farmers, consumers, retailers, processors, educators and researchers. We serve as a catalyst in the development of a sustainable organic agricultural system; provide assistance to both organic and progressive conventional farmers to help build and maintain sustainable operations; educate diverse audiences about the significance and meaning of organic practices for food and the environment; and provide independent, third-party certification to organic farms and processors.

Founded in Pennington, NJ in 1985 as the Natural Organic Farmers Association of New Jersey, NOFA-NJ is an affiliate of the Northeast Organic Farming Association, a seven-state coalition of sustainable agriculture organizations. From 1989 until 1994, NOFA-NJ operated as part of the Sustainable Agriculture Program of the Stony Brook-Millstone Watershed Association. In 1994, NOFA-NJ obtained its own 501(c)(3) status, although it remained a tenant at the Watershed until 2000.

From the earliest days, NOFA-NJ has published a newsletter, the Organic News. It was soon joined by other educational publications, including our "Eating Good Guides." From 1991 through 1997, NOFA held an annual Organic Country Fair on the grounds of the Stony Brook-Millstone Watershed, sharing the bounty and goodwill of the harvest season with like-minded neighbors. Other projects undertaken in the nineties included an organic tomato cooperative, two book publishing ventures (Organic Market Guide and Eating Fresh from the Organic Garden State), an apprenticeship program and the first all-organic farmers market in New Jersey. Ongoing projects and events include an annual winter educational meeting for farmers and

At the request of organic farmers, NOFA-NJ instituted an organic certification program for farms in 1990. Since 1994, NOFA-NJ has also offered independent, third-party certification services to organic handlers and processors. As the only organic certifier headquartered in New Jersey, NOFA-NJ works closely with the New Jersey Department of Agriculture (NJDA) to ensure that locally-based certification services remain available to organic producers in New Jersey and the NJDA has provided both technical and financial support for NOFA's certification activities. In October 2001, NOFA-NJ applied to the USDA National Organic Program for accreditation as an organic certification agency, and will be certifying to the uniform federal standards starting in 2002.

Today, certification remains the single most visible NOFA program. Yet NOFA-NJ also offers a range of educational, technical support, and information services to both organic and progressive conventional farmers; reaches out to public opinion makers, policymakers and the general public; participates in numerous research projects; and organizes community building activities. Through member services, outreach, education, and advocacy, NOFA is working to see that we become "An Organic Garden State."

NOFA-NJ is building on its long history of certifying organic farms, organic handlers, and organic food processors to establish two new programs.

1) NOFA-NJ is partnering with Duke Farms one of the largest, privately-owned open spaces in the State of New Jersey, rich in agriculture, horticulture and ecological resources. Through this partnership NOFA is preparing and implementing a detailed land management plan which will be a model for ecological stewardship. A central aspect of the plan will be the development of a comprehensive educational program for both aspiring, new and existing organic farmers as well as the general public.
2) NOFA-NJ is in the start-up phase of a new venture which provides planning and design services to public and private landholders in the area of conservation-based agriculture. Conservation-based farming is based on the idea that an interconnected relationship between agriculture, native species, and wild habitats like grasslands, forests, and wetlands will broadly benefit our ecosystem as well as

our food system. NOFA-NJ will assist landholders in establishing goals, assessing the character of the site, and then developing a tailored approach from a wide range of possible food and agriculture projects that are both economically and regenerative. Using regenerative design, we seek to preserve what is healthy, repair what is unhealthy, restore what is depleted, and ensure strong productive natural systems not only survive but thrive.

Current Projects and Programs

Organic Certification Program:

- USDA Accredited, third-party certification services for farmers and processors

Outreach Program:

- NOFA-NJ exhibits at agricultural & environmental events
- Quarterly newsletter, Organic News and quarterly newspaper, The Natural Farmer (interstate project with other NOFA chapters)
- Speaking engagements, Op-ed pieces, press relations
- Summer Sunday Organic Farm Tours for general public
- *Garden to Table* conference for gardeners and consumers
- www.nofanj.org

Farmer Education Program:

- Annual winter educational conference (last Saturday in January)
- Twilight educational meetings for organic & sustainable farmers
- Information and referral to resources in sustainable and organic agriculture
- Mini-grant program for farmer-initiated education activities
- Grower-to-Grower newsletter
- Agricultural incubator and farmer mentoring program (developmental)
- *Exploring the Small Farm* Dream program
- Walkill Watershed Rotational Grazing/IPM Project
- Precision Agriculture/mobile computer technology for organic producers

Research Activities:

- Southern program coordinator, Northeast Organic Network, USDA/IFAFS project
- The Greenhouse Project, w/Cook College, NESARE
- Land Tenure Project/Farm Incubator Feasibility Study, w/Intervale Foundation, EPA Region I
- Regenerating Small Family Farms, w/Rodale Institute, USDA/IFAFS

Advocacy Program

- NRCS State Technical Committee, including AMA and EQIP subcommittees
- Cook College/NJAES Board of Managers Statewide Advisory Committee
- Animal Agriculture Alliance
- NJ Agricultural Convention delegate
- Campaign for Sustainable Agriculture, NESAWG, Mid-Atlantic Coalition for Farms and Food

Community & Leadership Development

- NJ Women in Agriculture (sponsor)
- Scholarships for organic participants in NJ Agricultural Leadership Development Program
- Annual Community Barn Dance

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Producing Naturally Grown Vegetables

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Small farms relying on direct marketing and local or specialty production can succeed in developing respect and demand for their products without being certified organic. Consumers are often confused or uninformed as to the differences between certified organic and other farming approaches. Environmental and food safety concerns are the primary reasons for the current popular demand for the organic label. Sustainability, product safety, soil fertility, disease, weeds, and plant health can all be addressed without using restricted label products or impacting beneficial soil, plant, or animal organisms. Consumers want to know and an informed sales staff is key.

GROWING ORGANIC HERBS IN THE NORTHEAST

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The production of organic herbs is never easy but the profitable production of organic herbs is even more challenging. With increased production costs going into fuel and all other agricultural supplies, the increased efficiency and improved management practices are two cornerstones in organic herb production. The selection of the best yielding and top quality varieties is another major management factor that impacts profitability and the success of organic herb production particularly as new diseases and stresses seem to continually appear. Our ongoing studies with culinary herbs and specialty ethnic crops in New Jersey have focused on identifying those commercially available herb varieties that are high yielding, provide excellent quality, have consumer interest, and may be disease tolerant. Our other studies compliment our annual herb variety trials by seeking to develop new varieties of herbs which are not commercially available but which could be of value to commercial growers. In this area, we have focused on fusarium resistant basils; chilling tolerant basils; and now we face a new disease problem in basil, that of downy mildew, which may be of increasing concern in the future. This presentation will highlight some of our variety trial results on organically produced herbs, some of the organic pesticides we use and their associated costs and present several ideas from our studies and that from other commercial producers that may be useful in your own commercial organic production strategies. All our field plots were grown using an organic production systems.

Sweet Basil Varietal Evaluations: Field studies comparatively trialed over 20 commercial sweet basils for their yield and quality. These trials have been ongoing for about five years. Results of these trials which highlighted the traditional Italian or Sweet Basil varieties; other trials which focused on the Thai Basils, and a third which highlighted the Exotics (purple pigmented basils, and others including but not limited to those with distinct aromas and flavors such as lemon and cinnamon and Tulsi basils) were also assessed. There are many new Sweet Basils to consider and the increased consumer interest in the Tulsi Basils (distinct from the Thai basils) should be noted as it may provide production opportunities. We also continued to evaluate our Rutgers chilling tolerant basils that we have been breeding and developing since 2001 which looked at overall growth and appearance, disease and insect damage as well as chilling damage; and several continue to look acceptable and are now ready for trialing on farm sites. We also sought to develop sister lines to our OP fusarium-tolerant basil and from this identified two very promising lines.

This years' basil trials were successful. Results showed significant differences in growth, yield, aroma and taste among the Sweet Basil varieties and several newer commercial varieties appear promising for the fresh market growers and home gardeners. Several promising specialty basils were also identified. Among the Rutgers chilling tolerant basils all performed better than the control lines, variation in overall quality (leaf size and shape and aroma) was noted and several of these advanced lines and hybrids are now ready to be trialed at remote locations around the country and to test for chilling injury in concert with commercial shipping and storage. Additional fusarium tolerant basils (sister types also OP lines) to the Rutgers OP released cv. Poppy Joe's grew well and exhibited the desired quality. This past summer, in concert with the annual tomato fest, we conducted a basil consumer taste test with over 100 consumers informing us as to which was their favorite. These results will be discussed and also guide our future basil work.

Chive Variety Evaluation Trials: Chives are a popular culinary herb used fresh and dried. Selection of chives for its visual appearance, leaf shape, flavor and taste are among the most important criteria. Home gardeners and commercial growers value traits such as high vigor, absence of yellowing at the stem tips, re-growth after harvest, late flowering, and disease resistance. Field trials at Snyder farm comparatively evaluated a wide selection of chive varieties for growth and quality. We looked at direct seeding and transplanting chives and evaluated 18 varieties including traditional chives and 6 Korean (or Asian/Chinese) flat-leaf chive varieties. Some of the lines include Garden Chive and Nira; Fine-Leaf, Purly, Staro, Chinese leeks, New Belt, Garlic; and Grolau, Wilau, Garlic, and Mauve garlic chives from several USA and European commercial seed companies. The chive varieties grew well in these trials, high yielding and varied in their leaf size, shape, taste and degree of yellow tip discoloration, this latter trait being undesirable for fresh market or processed chives. Chives established by transplanting rather than direct seeding had higher yields in the first year, but unexpectedly also had higher yields in the second season. Korean chives look very promising for commercial production in the Northeast.

The Perilla (Perilla frutescens): A Specialty Asian Culinary Herb: In Korea and Japan, the use of perilla leaves, both the green and purple types, are popular in a wide variety of dishes. Perilla seed oil is also used in Korean cooking. The foliage is used as both an herb and garnish in Japan. The seeds are consumed in several Asian countries such as Japan and Korea, and the seed oils expressed from this species also find their use as industrial oil. More recently, this species has been grown as an aromatic ornamental. Perilla is highly aromatic herb and Korean plant breeders have developed an array of commercial varieties specifically for foliar consumption of which we evaluated. In past years, perilla varieties offered by US seed companies which sometimes found to unacceptable by the Korean community. To overcome this issue we brought into the US several promising commercial varieties of perilla direct from South Korea seed companies, and conducted an extensive study on Perilla over the last couple of years. We can now recommend three true perilla varieties, which are well adapted, high yield and excellent quality for production.

For more information, copies of these and other papers can be obtained upon request:

2007. Ribeiro, P. and J.E. Simon. Breeding Sweet Basil (*Ocimum basilicum* L.) for Chilling Tolerance. In: Janick, J and Whipkey (eds), The 6P^{thP} **New Crops Symposium: Creating Markets for Economic Development of New Crops and New Uses**: 302-305.

2007. Park, C.H., P. Tannous, H.R. Juliani, Q.L. Wu, W.J. Sciarappa, R. Vranken, P. Nitzsche, D. Dalponte and J.E. Simon. Catmint (*Nepeta spp*.): A Source of Essential Oils. In: Janick, J and Whipkey (eds), The 6P^{thP} **New Crops Symposium: Creating Markets for Economic Development of New Crops and New Uses**: 311-315.

2007. Wang, M., K.W. Cheng, Q.L. Wu and J.E. Simon. Quantification of nepetalactones in catnip (*Nepeta cateria* L.) by HPLC coupled with ultraviolet and mass spectrometric detection. **Phytochemical Analysis: 18 (2): 157-160.**

2007. Park, C.H., P. Tannous, J.E. Simon, T.O. Kwon, W. Sciarappa, L.E. Craker, R.V.Vranken, W. Kline, P.J. Nitzsche, H.R. Juliani and R. Govindasamy. Chives and Perilla, Korean Greens for Emerging Ethnic Markets. In: Janick, J and Whipkey (eds), The 6P^{thP} **New Crops Symposium: Creating Markets for Economic Development of New Crops and New Uses**:228-232.

FREEDOM TO EAT FARM FRESH FOODS FROM FERTILE SOIL, ORGANIC RAW MILK, VEGETABLES, ETC.

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Farm fresh foods nourished humanity since the dawn of agriculture, but in our modern culture the freedom to eat traditional foods that have not been pasteurized, homogenized, hydrogenated, irradiated, fumigated etc., is being increasing challenged. Over sixty years ago, Sir Albert Howard declared "fresh food from fertile" soil the birthright of humanity. He, along with other organic pioneers, ignited the organic agricultural movement that continues to build momentum. To simply highlight here the remarkable growth in the demand for organic food would not do justice to the movements less recognized undercurrent: the rebirth of the human craving for truly authentic traditional foods straight from the local organic farm.

The new consumer hunger for traditional, organic nutrient-dense foods is exemplified by the raw milk movement. Raw milk was part of the organic agricultural movement from its inception. The early organic pioneers Walter Northbourne, Eve Balfour, and Jerome Rodale were all advocates for raw milk. In 1958, Jerome Rodale spoke out loudly for organic raw milk: "It is not organic to produce milk organically, and then to pasteurize it**."** However, in 2003 when the USDA national organic program (NOP) standards were established, it allowed for organic milk to be pasteurized. This heat process, which denatures enzymes, kills beneficial bacteria, and lowers the nutritional value of the milk, arguably undermines the traditional values of the organic system of food and farming.

Raw milk today continues as an unresolved and contentious issue. Although, the USDA-NOP standards which allow milk to be pasteurized and labeled "USDA Certified Organic", it is not the end of the battle for organic raw milk. Originally the USDA-NOP also allowed organic foods to be irradiated. The policy regarding irradiation, however, was eventually reversed after a huge public outcry from the organic community. At the time of this policy reversal, the organic raw milk movement was less well-organized to resist pasteurization. The already existing laws mandating that all milk be pasteurized, before sale, in many states also created an insurmountable obstacle to maintaining the integrity of organic milk as a fresh food under the "USDA Certified Organic" label. Another limitation to resolution of this issue is that many people are not well-informed about the nutritional value and safety of organic raw milk.

In the early decades of the organic agricultural movement the USDA and Land Grant Universities ignored or shunned organic agriculture but the movement continued to grow despite the skeptics. It was the 1980 USDA Report and Recommendation on Organic Farming that seemed to initiate the needed change in attitudes towards organic. While much has changed today with the organic agriculture experiencing growth, and a higher level of institutional acceptance, the raw milk movement continues to face major educational and legal challenges.

Some universities have begun to organize educational and research programs on raw milk. For example, in 2006 the University of Nebraska held a round table on raw milk which was summarized into an Extension fact sheet on Raw Milk Use and Safety. In the spring of 2008, the Rutgers New Jersey Agricultural Experiment Station organized and hosted a seminar series on raw milk to bring the latest science and objective discussion to the public. Excellent summaries of some of the Rutgers University sponsored raw milk seminars have been posted on the web by the Rodale Institute (titles and links below). While these progressive educational programs were important events to draw attention to the raw milk issue, much more research and extension programming is needed to overcome a persistent institutional bias against raw milk. Beyond academia, The Weston A. Price Foundation is the most active organization involved in raw milk educational programs.

Many people, including scientists, have little knowledge about the historic and economic circumstances that lead to the pasteurization of milk in the first place. One of my Extension programs for Rutgers Cooperative Extension is an ongoing effort to collect scientific literature and news articles about raw milk and to share this information electronically with other scientists at Rutgers University, and the public as requested. The best general reference work on the subject of raw milk that I am aware is *The Untold Story of Milk, Green Pastures, Contented Cows and Raw Dairy Foods*, by Dr. Ron Schmid, ND. This book chronicles how the feeding of whiskey swill to cows in inner city dairies lead to unhealthy cows

and poor quality of milk produced under very unsanitary conditions. Two different approaches were used to deal with this milk crisis.

One approach enlisted farmers to produce clean high quality Certified Raw Milk based on exceptional standards of hygiene established by a Medical Milk Commission. This effort, lead by New Jersey physician, Dr. Henry Coit, MD, won the praise of health officials. Unfortunately, the higher costs (4X) that were associated with producing Certified Raw Milk put it at an economic disadvantage. Although Certified Raw Milk predated developments in organic farming, the concepts are analogous to special farming practices and standards employed in organic agriculture for producing high quality certified organic foods for a premium.

The alternative approach for dealing with the milk crisis was pasteurization. It won easy acceptance as pasteurization facilities were subsidized with the financial support of philanthropist Nathan Straus.

For a while consumers had a choice between Certified Raw Milk and pasteurized milk but eventually laws were enacted to mandate pasteurization. Currently sales and distribution of raw milk is illegal in about half of the states including New Jersey. Permits to sell raw milk are allowed in Pennsylvania, New York, and Connecticut. Dairy farmers able to direct market raw milk find it to be more profitable than selling milk to a processor. Direct marketing of pasteurized milk from the farm is a less profitable option for small dairy farmers due the large investment required for pasteurization equipment.

Considering that milk pasteurization laws were introduced about a century ago and given today's level of technology (milking machines, modern refrigeration, stainless steel, animal disease testing, etc.) and greater knowledge of food microbiology to ensure sanitation, it is now possible to achieve an acceptable level of food safety to enable informed consumer choice with respect to milk. In states where raw milk sales are allowed, there is already a good track record of safety. When raw milk is produced with careful attention to sanitation and good livestock health, the incidence of illness attributable to raw milk consumption is rare. Even with the rapid growth in the demand and consumption of raw milk over the last decade, there does not appear to be a corresponding increase in incidence of food borne disease associated with raw milk consumption.

Members of the organic community already familiar with the history of the organic agricultural movement will know that many scientists and people in positions of authority have over the years made false and misleading statements about organic agriculture that did not stand up to the reality witnessed daily on the organic farm. With this in mind, any intelligent freedom-loving person that passionately cares about food quality can make an informed choice about high quality organic raw milk versus pasteurized milk. Or they can simply submit to the dictates of authorities and accept their pronouncements about raw milk at face value. Unfortunately, many of the pronouncements by "authorities" against raw milk are uninformed and based on a selective review of scientific literature.

A summary of my own analysis of the raw milk literature follows:

1) There is a considerable body of scientific literature reporting that raw milk is superior in nutrition to pasteurized milk. For example, raw milk supplies more vitamin C than pasteurized milk. Raw milk has been found to be more effective at preventing or helping children recover from scurvy than pasteurized milk. Raw milk has active enzymes that aid in the digestion and assimilation of nutrients from the food. These same enzymes are destroyed by pasteurization. Several animal and human feeding trials have demonstrated better growth and performance with raw milk compared to pasteurized milk. While the published literature gives many examples for superior nutrition with raw milk over pasteurized, I am not aware of a single study showing that the nutritional quality of milk is improved by pasteurization.

2) Raw milk contains many antimicrobial properties that inhibit the growth of pathogens. Most of these antimicrobial properties are destroyed by pasteurization. Although pasteurization can destroy many pathogens, the process has no benefit for preventing the growth of newly introduced pathogens post-pasteurization. Based on this information, it may be argued that the antimicrobial properties of raw milk may in some circumstances make raw milk inherently safer than pasteurized milk.

3) A recent study in Europe found that children consuming fresh farm milk are much less susceptible to asthma and allergy. This finding is consistent with antidotal observations that children with asthma benefit from switching from pasteurized to raw milk.

4) Public health officials always warn about the dangers of consuming raw milk but rarely at the same time due they acknowledge that records show that thousands people have contracted food borne illnesses from consumption of pasteurized milk. It must be acknowledged that pasteurization does not always ensure food safety. Even properly pasteurized milk is sometimes directly linked to illness and death. In 2007, for example, Listeria from properly pasteurized milk caused the deaths of several people in Massachusetts.

Vegetable and fruit growers and other farmers may wonder about the relevance of the raw milk issue to their farming operation. For one, many people from New Jersey go to neighboring states to

purchase raw milk and while there also purchase other farm fresh products including meat, eggs, vegetables, and fruit. The current situation with raw milk in New Jersey is unsustainable in terms of energy consumption and it is inequitable to New Jersey farmers that could profit from this growing niche market. It's the milk that brings customers to the farm market each week. Got Raw Milk? For another, food processing strategies, such as pasteurization, fumigation, and food irradiation, intended to ensure food safety may initially begin as a voluntary program but they may eventually become mandated. Such has been the case with raw milk, raw almonds, and raw apple cider. Irradiation has recently been permitted for salad greens. Irradiation of organic foods is currently not allowed under USDA-NOP standards and organic consumers do not want irradiated foods anyway. But what if this irradiation treatment were to become mandatory?

The current situation with raw almonds may be instructive. In 2007, the USDA imposed a "pasteurization" (processed as steam treatment or fumigation with propylene oxide) mandate on all domestically produced almonds. Imported almonds are exempt from the rule. The mandate is causing economic hardship for organic almond producers that could supply truly raw almonds that are in demand by many consumers. The Cornucopia Institute is providing support to fifteen almond farmers who filed a lawsuit seeking to overturn the raw almond treatment mandate.

The movement to mandate that apple cider be pasteurized is just as controversial. Some consumers prefer raw apple cider and some apple growers want to provide this truly fresh product.

Placing a warning label on raw foods to indicate that they may contain pathogens may be an acceptable approach to both farmers and consumers, but new mandates and 'technological fixes' to control food borne disease are generally not in the interests of small organic farmers and customers. Farmers that want to provide fresh raw foods must be aware that excellent farm management practices are required to ensure cleanliness and safety in production of such foods. Organic farming systems are generally more reliant on cultural practices to prevent diseases. Pasture based organic dairy farms, for example, typically have healthier cows than confinement dairies and these cows generally produce higher quality milk. Good organic farming practices, that prevent disease in crops and livestock, also apply by extension to the production of safe organic foods such as raw milk, almonds, cider, or salad greens.

People who have a passion for truly farm fresh foods are willing to go the extra mile to satisfy their desire for farm fresh foods. This was illustrated on the 4th of July 2007, when there was a most remarkable coming together between farmers and consumers on an Amish farm in Lancaster County. Over 550 people participated in the founding of, The Farm to Consumer Legal Defense Fund, www.farmtoconsumer.org. This organization was formed for the purpose of defending "farmer rights to sell grass-based meats, raw dairy, fresh produce, and other nutritious products directly to consumers". It also "supports the consumer's right to obtain such products from farmers." The organization provides legal advice and legal representation, when farmer and consumer rights are in question.

Today organic food is in greater demand and more popular than ever, but food policy that mandates unnecessary processing is increasingly restricting consumer freedom to enjoy truly authentic fresh organic foods. Much concern has focused on how long distance-transport impacts food freshness, yet industrial food processing may be doing even greater harm to food quality. One of the ecological philosophies of the organic system is that only natural unrefined raw materials be used to "feed the soil" and build soil fertility. Another is the production of compost through the biological process of fermentation. In general, these same principles carryover to the management of organic foods in that they are ideally fresh, raw, minimally processed, or fermented. Thus, whether it is fertilizer or food, the same general philosophy of avoiding harsh industrial types of processing applies. Sir Albert Howard predicted that soil fertility would one day be the foundation of the public health system of the future, but such a vision requires that "fresh food from fertile soil" not be mishandled in its pathway to the people.

References

I invite anyone with a serious interest in the issue of raw milk to read the volumes of literature I have collected on this subject.

Rutgers University Raw Milk Seminars:

1) Raw Milk, Mother Nature's Inconvenient Truth by Mark McAfee, Organic Pastures Dairy: http://www.rodaleinstitute.org/20080515/n1

2) Raw Milk Wars, Government's Attempt to Dictate What Foods We Can Consume, David G. Cox, Attorney at Law, Lane, Alton & Horst LLC: http://www.rodaleinstitute.org/20080612/nf1

3) Raw Milk, A Microbiology Primer, Dr. Mark Gebhart, MD, Wright State University http://www.rodaleinstitute.org/20080717/n1

4) A Risk Assessor Takes a Look at Raw Milk, Dr. Don Schaffner, http://www.rodaleinstitute.org/20080911/n1

Session 12
Tomatoes

Building a Better Tasting Jersey Tomato

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The good old days of local production, vine-ripe harvest, and supermarket buyers caring about flavor were replaced during the 1960s and 70s by distant production, gas-green harvests, and buyers caring only about price and shelf life. The major chain stores neglected to check with consumers about this trend towards cost consciousness vs. quality, however, and a backlash has driven a resurgence of vine-ripe flavor as a desirable attribute of fresh market tomatoes. Contemporary varieties have been pushed in the direction of durability and shelf-life, and while they taste better if left on the vine to ripen, most never achieve the standard of the consumer's memories. Part of the reason is that ripening inhibition genes are used extensively to arrest the softening process, so red tomatoes will remain firm for longer periods of time during distribution and display. A large part of the reason is because consumers also don't have a very realistic recollection of "old time tomato flavor".

Can a better flavor profile be attained by simply growing heirloom tomato varieties? The overall results of an extensive study conducted at Rutgers lead to the conclusion that certain heirloom varieties exhibit highly favorable flavor profiles. Many heirloom varieties are not genetically pure, however, and are known to exist in a plethora of selections or strains. As a group, heirloom varieties are not well-adapted to modern vegetable farming. Yields and fruit uniformity are greatly reduced as compared to contemporary hybrids, and the smaller harvests are much more prone to damage during packing, distribution, and display. Heirloom varieties, therefore, are more adapted to a direct-marketing business than to wholesale operations.

Is it possible to tread a genetic middle ground between contemporary and heirloom varieties? Many fresh market tomato products have appeared in retail venues that exhibit fruit characteristics common to heirloom varieties, including better flavor. These same varieties appear to have horticultural attributes more akin to contemporary than to indeterminate heirlooms. Since these products are not available from seed companies, and remain the proprietary property of growers, it is not clear what the genetic origin is, but it is reasonable to presume that an heirloom x contemporary cross is in the pedigree somewhere.

During the mid 1960s, Dr. Bernie Pollack of Rutgers introduced the new hybrid variety 'Ramapo', that remained in seed catalogs for several years, ultimately disappearing as newer releases appeared. Over the ensuing years after 'Ramapo' disappeared, Rutgers has been inundated with requests to promote a re-introduction of the variety, particularly to home gardeners who had come to value the sharp, sweet flavor imparted by the variety. Attempts to recruit a partner in the seed industry were unsuccessful, so in 2007 a campaign was mounted within the university to have new seed produced. This project has been enormously successful, as seeds were distributed to hundreds of delighted gardeners in Spring, 2008.

What is so special about the flavor of 'Ramapo'? Following several years of scientific consumer taste-testing, it is clear that nothing is very clear at all. Different consumers value different aspects of tomato flavor in different ways, so it is not surprising that no single variety always rises to the top. In general, 'Ramapo' always fares well among the competition, however.

The scientific literature has much information on determination of flavor in tomato. The primary factors are sugars and acids that condition fruit sweetness and tartness. Tomato flavor is much more complex, affected by hundreds of organic compounds collectively known as volatiles, since they readily transform from liquid to gaseous phase. The genetic basis of variation in fruit sugars, or soluble solids, is well established in processing tomatoes to be controlled by many genes with small individual effects. The genetics of fruit organic acids is not as well understood.

'Ramapo' is a relatively acidic tomato. The pH level, or concentration of H^+/OH^- ions in fruit juice, is very low as compared with other fresh market tomatoes. The concentration of dissolved organic acids, as measured by titration (titratable acidity or TA), is relatively high. In contrast, fruit sugars, or soluble solids (SS), are in the intermediate range as compared to other fresh market tomato varieties. Fruit acidity and soluble solids have been observed to vary tremendously with growing conditions and plant age, however.

Since 'Ramapo' is a hybrid variety, it is comprised of two inbred parent lines, in this case 'KCA' and 'Abbie', that were originally identified by Dr. Pollack. TA and SS were found to be similar in 'KCA' as compared with 'Ramapo', and different in 'Abbie'. An examination of the segregation of TA and SS in F_2 and backcross populations during Summer 2008 showed that TA has a simple basis of inheritance, probably a single dominant gene, while the inheritance of SS is more complex. Thus, it may be possible through crosses with 'KCA' to transfer high TA to many different genetic backgrounds.

The Rutgers tomato breeding program currently consists of two full generations per year. During the winter, crosses between lines carrying desirable genes are made in greenhouses at RAREC. Over the summer production seasons, breeding nurseries are grown on RAREC test sites to identify populations that have the best horticultural promise, in combination with fruit quality. A better overall balance of fruit flavor, texture, and color with horticultural plant type is sought through breeding, and possibly molecular biology. Populations that exhibit high flavor profiles, intermediate firmness, and high lycopene in combination with determinate, early plant types will be selected. Thus, it will be possible to introduce better tasting, high-yielding 'Jersey' tomatoes into retail supermarket chains.

REDISCOVERING THE NEW JERSEY TOMATO PROJECT

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New Jersey has been known for years as a state which produces great tasting tomatoes. Unfortunately this reputation seems to be tarnished recently with some consumers expressing dissatisfaction with the taste and texture of tomatoes produced in NJ. This dissatisfaction may arise from many factors including the harvest of immature fruit, poor post-harvest handling, confusion in the market between NJ and out of state tomatoes, fertility and irrigation practices, etc. In order to help prevent further erosion of the New Jersey tomato reputation a team of Rutgers NJAES faculty and staff have began developing research trials and extension projects to address the issue of tomato flavor.

One component that is known to strongly impact tomato flavor and texture is variety selection. Recent breeding programs have released tomato varieties with increased emphasis on yield, shelf life, fruit quality and ship-ability; however, these programs have not always focused on flavor and eating texture. Comparing the flavor of tomato varieties recommended today with those recommended in years past will help indicate what role variety selection may be playing in recent consumer dissatisfaction.

Field trials were conducted the Snyder Research and Extension Farm in Pittstown, NJ as well as at the Rutgers Research and Extension Center (RAREC) in Bridgeton NJ. Current commercial varieties of fresh market tomatoes were planted as well as past recommended varieties and newer varieties being touted for improved flavor. The following varieties were planted in the trial: Amelia, BHN 589, Big Beef, Celebrity Supreme, Florida 47, Jet Star, Ramapo, and Scarlet Red.

The tomatoes were grown using standard commercial production methods with the exception of 6’ foot stakes being utilized for some of the varieties that grow taller than standard determinant types. Tomato fruit was harvested from the plots vine-ripe graded and weighed. Fruit samples from the plots were ripened at room temperature and evaluated for internal and external characteristics. Ripe fruit samples were made available for flavor evaluations at public tasting event held at RAREC and Snyder Farm.

Yield, fruit quality, and flavor data collected from these trials will be presented and used to make recommendations to growers on which varieties excel for both horticultural characteristics, as well as in taste in future years.

Session 13
Pricing

WHAT'S VALUE GOT TO DO WITH IT? – A GUIDE TO PRICING

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The basic functions of pricing are to determine profit and to determine demand. What price you place on the product determines how many you sell. Therefore, since (sales price – costs) x number of units sold = profit, price determines profit. Because the law of supply and demand applies i.e., the higher the price, the lower the quantity demanded, price also determines demand.

Price should be based on the value of the product to the consumer, not necessarily on the cost to the producer. The consumer does not care what it costs you to produce a product; consumers only care what a product is worth to them. Thus, taking your costs and adding a specific profit margin means nothing to the consumer. We are moving to a market driven economy, so as a producer, you need to look at your products from a consumer's perspective. You need to think what it is consumers want, how much can you supply, and can you supply it at a price that will still make a profit for your business?

Profit maximization then depends on pricing a product to satisfy the consumer's needs. If it costs you $5 to grow a box of tomatoes, but consumers are only will to pay $3, you cannot expect to charge $5.50 to make your desired your 10% profit. Nobody will buy it. The law of demand says that as the price increases, demand decreases because consumers have diminishing utility for each additional unit they buy. They will pay a higher price for the first tomato than they will for the fortieth.

The law of supply works the opposite – the higher the price, the more will be supplied. You know that as a producer you will supply a lot more of a particular crop if you are getting a high price than if you are receiving a low price. And there will be also be new suppliers who will jump into the market if the price goes up.

Price elastic (price sensitive) items are items where consumers mainly shop for price and where consumers are very sensitive to changes in price. If the price goes up very much, consumers will reduce their purchases of that item. If price goes down a little, they will buy a lot more. These very price competitive products are the type of products large discounters sell. These products often are easily identifiable. Therefore, consumers can shop around for price, and they know if a product is a good bargain or not.

If you try to raise the price on something that is very price competitive, competitors will jump in and offer it at lower price. Mass markets are very price competitive and a nickel price difference means a lot to them. You can lose a customer in the mass market if you are not price competitive.

Often commodities, like potatoes and meat, are very price sensitive because those products are difficult to differentiate. However, even those products have seen a lot of product differentiation recently. For example water used to be the most ubiquitous product around, but now you have numerous brands of bottled water, some generic, and others at premium prices. Branding, as in the water example, adds value because people recognize that product and know it has a consistent quality.

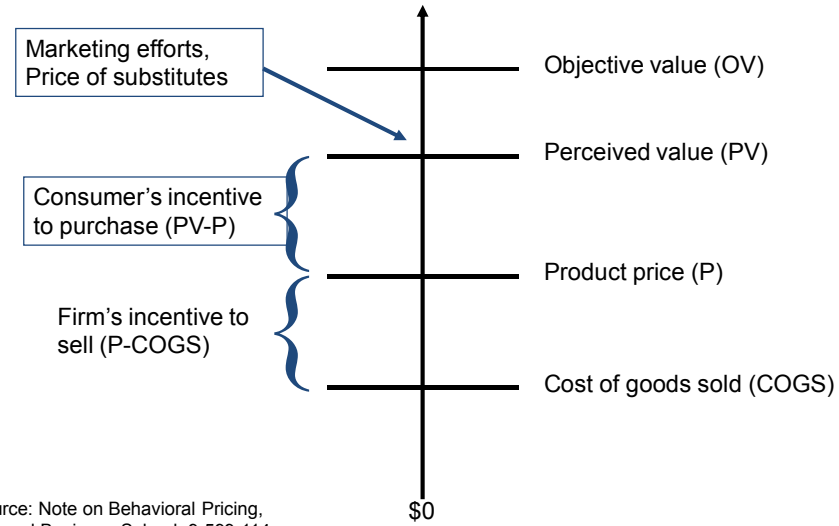
Price inelastic (price insensitive) items usually are governed by factors other than just price. While price is important, consumers pay more to get a better quality product. The quantity demanded will shift with changes in price, but not by as much as it will with price sensitive items. Price inelastic items have been the major portion of the tradition vegetable industry. However, many specialty items exist where the price is not as sensitive. Examples include baby vegetables, bagged salads, and unique fruits and vegetables.

Vegetable farmers have often been thought of as price takers. Price takers cannot determine the price; they have to accept the market price. This assumption is based on a commodity type product that is very identifiable and where no one producer has a large share of the market, allowing consumers to shop from place to place looking for the best price. Such commodity items are potatoes, onions, and traditional tomatoes.

Price sensitive items compete mainly on price. Therefore, marketing methods for them depend on price competitive strategies. Price insensitive products can compete using non-price competitive strategies that add value to the product.

The following model shows the concept of value prices. The Cost of Goods Sold is the cost of producing the product. The product price is the market price. The perceived value is how much the consumer thinks the product is worth. The objective price is the price if all of the value of the product is included. A fair market price is usually considered to be somewhere the Cost of Goods Sold and the Perceived Value. If you cannot cover the cost of goods sold with the market price, then it is time to consider growing other crops or differentiating your product. As shown in the diagram, marketing efforts will help to consumer to value the product.

Value Pricing and the Economic Perspective



Source: Note on Behavioral Pricing, Harvard Business School, 9-599-114.

You can add value to a product by **differentiating** it, thus increasing the quality image that your product has to the consumer. One way to differentiate vegetables is to have your own brand. You can also add value by grading the higher quality vegetables and charging a higher price for them, and letting customers know that you have a premium product. Make sure you follow changes in consumer tastes and preferences. For example, the market may be shifting toward organic, sustainable and green. Look what Frank Purdue has done with chickens. A commodity that was once thought of as price sensitive and not easy to differentiate now commands a premium.

Another way to get people to buy from you versus somebody else is to add **service** to the product. Ways of adding service are credit, delivery, and special packaging.

Another non-price competitive strategy is **location.** This is particularlty true if you are a retail grower. But today, a good location can also be a good website, whether you are a retail or wholesale grower. Physical location can work even for wholesale growers who can move out to a place that is less expensive, but also have access to a major transportation route. This will reduce your costs so you can compete more competitively on price.

Other factors to consider are advertising and promotion, and competent, informative sales people.

Remember, use **COSTS** to determine **PROFITS**, but **VALUE** to the consumer to determine **PRICE.**

PRICING, CROP MIX AND OTHER MARKETING STRATEGIES FOR GROWING FOR PROFITS

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Overview of the Horticulture Industry

Horticultural production is the most capital and labor intensive agricultural activity in the United States. Horticultural production includes ornamental plants, flowers, turf, vegetables, fruits, and nuts. Horticulture has become one of the fastest growing sectors of agriculture with total farm cash receipts of $48.9 billion in 2004 (USDA, 2004). The horticultural industry is facing many challenges such as stronger competition from less expensive imports, considerable price variation, availability of labor and seasonal consumption patterns. A recent survey by Perry and Stacks (2006) showed that the top five industry concerns are: (1) rising input costs (74%), (2) government regulation/legislation (56%), (3) availability of workers (49%), (4) pest management (33%) and (5) recruiting new professionals (23%).

Basic Marketing Introduction

There is a general tendency to associate marketing with selling our products; however marketing is a process that starts even before we plant our crops in the soil. Marketing is one of the most important factors in determining the success of any fruit and vegetable farming enterprise. Marketing includes all the operations and decisions made by producers. These decisions range from determining the most marketable crops for production to deciding how to best deliver quality produce to the consumers at a profit. However, contrary to popular belief, marketing does not begin after a crop is produced. Instead, marketing alternatives need to be considered even before production takes place.

Fruit and vegetable growers in the US have numerous alternatives for marketing fresh produce. Each alternative has characteristics that make them more advantageous for different types of producers. Volume of produce grown, location of the grower, time available for marketing activities and quality of the produce are a few of the important factors to consider when choosing a market or combination of markets to use. Producers may be better able to use or develop more alternatives if they know the major characteristics of each marketing alternative. Fruit and vegetable marketing alternatives may be classified as direct or non-direct markets. Direct markets involve producer interaction with consumers on a one-on-one basis, and include pick-your-own operations, roadside stands, and farmers markets. Non-direct markets involve producer interaction with market intermediaries. The non-direct markets include terminal market firms, shipping point firms, processors, grower cooperatives, brokers, and retail outlets.

Understanding your Customer

In order to understand our customers we need to investigate their current trends in tastes and preferences; their visiting patterns to their buying locations, in terms of days of the week and hours; demographic composition and profile preference by these characteristics; eating and gardening habits; entertainment styles and their price sensitivity for the products we grow.

For many decades, fresh fruits and vegetables enjoyed a reputation as the healthiest products full of essential vitamins, minerals, and other beneficial substances for a balanced diet. Per capita fruit and vegetable consumption increased more than 20 percent from 1970 to 2000. Since 2000, we have seen a stabilization in the consumption per capita for the main fruit and vegetables. Total consumption however is increasing, mainly because of major trends, including higher demand throughout the whole year, increasing consumption of exotic fruits and vegetables, and a substantial increase in population and high disposable income. There has also been an increase in the popularity of "green" products, which includes organic, local, natural, whole, environmentally friendly, pesticides free, and others. It is well documented that customers are willing to pay more for some of these products that they "perceived" to be different.

Know your Costs

Cost of production analysis or budgeting is the next tool that may be used to help make product mix decisions. In general terms, cost analysis or budgeting can be defined as a plan to allocate resources among alternative uses. That includes labor, water, capital, and any other resources that may be scarce or limited. Budgets

can also be used to provide a basis for planning labor needs and for financing -deciding when to borrow and how much. They also provide a plan for when to buy supplies and when to sell your products.

Cost analysis budgets are especially effective when a record system designed for managing is already in place. Records are especially important in that they provide feedback for evaluating performance and provide information for developing and refining budgets. Thus, the effectiveness of budgeting is a function of how good your record keeping system is. Tax records are the most common type of records kept by horticulture managers. They provide a good picture of the costs and returns of your entire business from a tax accounting standpoint. However, since most producers grow numerous crops, tax records will not provide information on the costs and returns from any individual crop that you produce. Only through cost accounting procedures can you allocate cost involved in operating your business to specific crops.

Though cost accounting and record-keeping are valuable managerial tools, they require time to maintain and therefore represent a cost themselves. These costs of preparing and maintaining budgets and records must be included in the total cost of the business. But if they aid the manager in making sound management decisions, then the benefits certainly outweigh any costs involved.

Pricing Strategies

One of the most important uses of cost accounting budgets is that they help establish a minimum selling price based on production costs. There are many different ways of pricing horticultural products; some are good, and some not so good. Probably one of the most frequent pricing methods is to check what your competitors are charging for similar products and ask about the same price for yours. However, if you do this, you are assuming that (1) your competitors know their production costs and are pricing their products to cover these costs and (2) that your production costs are the same or less than your competitors. If either of these assumptions is incorrect, the possibility of losing money exists.

Another popular pricing strategy is to increase prices on all products a given percentage every year or so. This strategy assumes that any changes in costs of production affect all enterprises similarly, which is simply not true.Probably the best pricing strategy is one based on costs of production that are determined through cost accounting procedures. Once the total costs of an enterprise are determined, then you know the base minimum price that should be charged to that product. The final selling price you charge ultimately depends on what you feel is a fair return on your investment and the risks associated with producing horticultural crops. Again, by using costs of production as guide to pricing your products, you are at least guaranteeing that all your costs are covered and you are not producing products which are not profitable.

Please keep in mind that every business faces different costs. Do not assume that your costs are the same to general budgets in the area or other firms. Every grower faces unique set of circumstances and, thus, its own unique set of costs. Cost vary from grower to grower because of differences in climatic location, size, managerial skill and style, market channel, time of year, space utilization, wage rates, age and condition of facilities, and many other factors. Comparing your costs to industry averages will reveal areas where your costs are too high or other areas where your costs are too high or other areas where your costs are low and you have a market advantage. However, looking at industry averages is no substitute for doing your own cost accounting.

Crop Mix

One of the most important decisions facing the horticulture manager is determining the optimal product mix -- which plants will be grown and how many of them? But what determines whether or not a product mix in optimal or not? This question is complicated by the fact that an optimal product mix for one grower may not be the optimal product mix for another grower. In reality, optimal may encompass many things including:

- Utilizing resources in their most efficient and productive manner
- Providing favorable cash flows
- Satisfying "attractiveness" constraints of buyers
- Maximizing profits in the short and long run
- Satisfying current demand trends and preventing oversupply situation

The real challenge is to find a product mix that accomplishes all or most of these things. It is certainly not easy. But there are procedural steps that horticultural managers can follow to determine an optimal product mix for their particular operations. These steps include: (1) analyzing current demand trends, (2) performing a cost of production analysis, and, if possible and if the appropriate records and expertise are available, (3) developing a linear programming analysis to aid in product mix decision making.

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United States Department of Agriculture. 2004. Economic Research Service. Fruit and Vegetable Background.

Session 14
Irrigation and Water

Injection of Insecticides in Drip Irrigation for Insect Control

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Plastic mulches and drip irrigation have been used by vegetable growers since the early 1960's, and their usage is still increasing. Drip irrigation has many benefits, including the capability to conserve water. As drip irrigation systems developed, researchers examined the injection of agrichemicals through the drip irrigation system. Some of the very first 'chemigation' trials involving drip irrigation and vegetables were conducted at RAREC, Bridgeton, NJ with tests involving fertilizers and bell peppers in 1979 (Dr. J. Patterson) and with insecticides and bell peppers in 1980 (Dr. G. Ghidiu).

The early insecticide trials involved the application of either oxamyl, methomyl or carbofuran through the drip irrigation system for control of European corn borer in bell peppers. These 'older' insecticides, all carbamates, were the only insecticides available that were labeled in peppers and were soluble enough for use in a drip system. However, results were inconsistent with borer control. The technologies necessary for trouble-free injection of insecticides in smaller research plots utilizing drip irrigation were still lacking. Injection equipment improved over the next several years, and trials with insecticides injected through the drip irrigation for corn borer in bell peppers increased in the late 1980's and early 1990's. However, the insecticides available for use in pepper were limited, and rates necessary for reduction of borer damage caused phytotoxicity to the plants. New insecticides were needed that were labeled and effective at low rates in controlling the corn borer (or other pepper pests), were highly systemic but not phytotoxic, and were highly soluble in water so they would not plug the micro-emitters in the drip tape.

New chemistry insecticides were developed in the 1990's that were well-suited for use in drip irrigation systems. Materials such as dinotefuran (Venom), imidacloprid (Admire), rynaxypyr (Coregan), and thiamethoxam (Platinum) received labels for use in many vegetable crops with specific drip-irrigation application instructions on the label.
These materials are very soluble in water, highly effective at low rates against either aphids or worms, highly systemic, and non-phytotoxic. Insecticide trials were conducted at RAREC with drip-irrigation and some of these new materials in bell peppers every year from 2004-2008, effectively controlling green peach aphid and European corn borers with just one or two applications thru the drip system (no foliar sprays needed).

Growers who already use the drip system to inject ferilizers will be all set to inject insecticides – no additional equipment should be necessary. For growers setting up injection equipment, remember that it is necessary to have the proper safety equipment, such as a back-flow preventer, pressure regulator, and a sand filter.

Session 15
Soil Fertility

FOOD SAFETY CONSIDERATIONS WHEN USING MANURE AND COMPOSTS

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Introduction: The United States Department of Agriculture considers animal manure as a significant source of potential contamination for produce. This does not mean manure should not be used to improve soil structure or nutrition only that it must be handled properly. Untreated, improperly treated or recontaminated manure that enters surface or ground water through runoff, may contain pathogens that taint produce. Crops in or near the soil (i.e. carrots, lettuce, radishes, herbs, etc) are most vulnerable to pathogens which may survive in the soil. Low growing crops that may be splashed with soil during irrigation or heavy rainfall are also at risk. Produce where the edible portion of the crop generally does not contact soil is less at risk of contamination if produce that does contact the ground (e.g., windfalls) is not harvested.

Growers using manure need to follow good agricultural practices to minimize microbial hazards. Growers also need to examine their specific growing environment to identify obvious sources of fecal matter that could be a source of contamination.

Apply manure in the fall or at the end of the season to all planned vegetable ground or fruit acreage, preferably, when soils are warm, non-saturated, and cover-cropped. If applying manure in the spring, spread the manure two weeks before planting, preferably to grain or forage crops. Incorporate manure immediately after application by either disking or plowing.

If it is necessary to apply manure or slurry to vegetable or fruit ground, incorporate it at least two weeks prior to planting and observe a 120-day pre-harvest interval. If the 120-day waiting period is not feasible, such as for short season crops like lettuce or leafy greens, apply only properly composted manure. Remember to document rates, dates, and locations of manure applications.

Treatments: There are various methods used to treat manure so that it is safer as a fertilizer than raw manure. The following information is from various sources.

Passive: Passive treatments rely primarily on the passage of time, in conjunction with environmental factors, such as natural temperature and moisture fluctuations and ultraviolet (UV) irradiation, to reduce pathogens. Note that this treatment minimizes microbial hazards, but does not necessarily kill pathogens since temperatures do not rise sufficiently. Growers relying on passive treatments should ensure manure is well aged and decomposed before applying to fields. Holding time for passive treatments will vary depending on regional and seasonal climatic factors and on the type and source of manure. In general, passive treatments, such as aging, will require a significantly longer period to reduce microbial hazards compared to those which expose pathogens to lethal conditions, such as high temperature or high pH.

Active: Active treatments generally involve a greater level of intentional management and a greater input of resources compared with passive treatments. Active treatments include pasteurization, heat drying, anaerobic digestion, alkali stabilization, aerobic digestion, or combinations of these. Composting is an active treatment commonly used to reduce the microbial hazards of raw manure. Organic materials are digested, aerobically or anaerobically, by microbial action in a controlled and managed process. When composting is carefully controlled and managed, and the appropriate conditions are achieved, the high temperature generated can kill most pathogens in a number of days. Thus, the risk of microbial contamination from composted manure is reduced compared to untreated manure.

Temperatures above 131F for a minimum of three days are required to destroy most pathogens and weed seeds. However, temperature must be combined with other factors such as natural competition, predation and antibiotic effects within the pile. Compost piles should be turned and allowed to reheat until temperatures no longer reach the 140F range. This may take 10-12 weeks depending on management.

Some pathogens tolerate higher temperatures than others. Management practices required achieving the time and temperature necessary to eliminate or reduce microbial hazards in manure or other organic materials may vary. Seasonal and regional climatic factors (such as ambient temperature and rainfall) and the specific management practices of an individual operation will determine the timeframe.

Protecting manure and compost: When compost is delivered to the production site and stored for future application, it must be properly stored to reduce recontamination and the likelihood of contaminating the production area or adjacent fields. Growers may use the following methods to reduce potential contamination.

Consider barriers or physical containment to secure manure storage or treatment areas where contamination from runoff, leaching, or wind spread is a concern. Physical containment may include concrete block or soil berms, pits, or lagoons. Practices such as storage on concrete slabs or in clay-lined lagoons may reduce the potential of leachate entering groundwater. Such storage must be away from irrigation, spray dilution or any water source.

Consider good agricultural practices to minimize leachate from manure storage or treatment areas contaminating produce. Rainfall onto a manure pile can result in leachate, potentially containing pathogens. Growers may want to consider covering manure piles, such as storing manure under a roof or covering piles with an appropriate covering.

Alternatively, growers may consider collecting water that leaches through manure that is being stored or treated. Collecting leachate allows the grower to control its disposal (e.g., on a vegetative grass way) or use (e.g., to control moisture during composting). Leachate may pose a microbial hazard similar to the manure from which it originates.

Growers using manure leachate or manure tea in fresh produce production areas should follow good agricultural practices, such as maximizing time between application and harvest to minimize microbial hazards. Manure teas are not the same as compost teas. If using manure teas they should only be applied in the same way as fresh manure (two weeks prior to planting and 120 days from harvest). Compost teas can be used if prepared properly. Use only properly composed manure that has been tested for E. coli and Salmonella. If additives are mixed with the compose tea during preparation the mixture should be tested prior to use. Some additives may be contaminated with pathogens or if pathogens are present at low levels in the tea, it may stimulate growth.

Conclusion: Natural fertilizers, such as composted manure, and fertilizers containing natural components, should be processed and handled in a manner to reduce the likelihood of introducing pathogens into produce production areas. Growers and manure suppliers should apply good agricultural practices that ensure that all materials receive an adequate treatment, such as thorough mixing and turning outside edges into the center of a compost pile. Cold spots or other pockets that do not receive an adequate treatment can cause recontamination of the rest of the batch. Growers treating or composting their own manure should have a documented procedure to follow. Growers purchasing manure should obtain a specification sheet from the manure supplier for each shipment of manure containing information about the method of treatment. Remember, as with any other good agricultural practice recordkeeping is required.

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ORGANIC AMENDAMENTS AND SOIL TESTING TO MANAGE NITROGEN FOR VEGETABLE CROPS

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Nitrogen (N) has become an expensive crop production input and as a consequence farmers are looking for ways to purchase less of this nutrient. Growers can reduce the need to purchase N fertilizer by developing a farm plan that builds soil organic matter content. Including cover crop legumes and grasses in the farm crop rotation cycle is one of the most cost effective ways to build soil organic matter content and supply farm grown N to the other crops in rotation. Adding livestock to a farming operation is another way to build soil organic matter content but it may not fit well into every farming operation. In the absence of on-farm livestock, manures and compost can be imported from neighboring farms with animals. Application of city shade tree leaves is another excellent way to build soil organic matter content. The amount of N supplied by a six inch layer shade tree leaves may be equivalent to about 400 pounds of N per acre, but the N is released very slowly over a period of years.

Adopting farming practices such as these can be an effective way to supply N to crops with minimal purchased N. However, to make the best use of on-farm sources of N, growers need to know when the soil is capable of supplying enough N to meet the needs of crops. Soil testing for N is the key to meeting this challenge. Measuring nitrate-N during the early growing season has shown a good track record of success. This approach to soil testing for N is often referred to as the pre-sidedress soil nitrate test (PSNT). The PSNT is especially useful in fields where there is a reasonable probability of on-farm N sources being sufficient to grow the crop. Use of the PSNT in these fields helps growers know when there is enough N so they can forgo the expense of applying unnecessary N fertilizer.

When using the PSNT soil test, it is very important to collect soil samples at the appropriate time because the concentration of nitrate in soil can change rapidly and the crop is poised for rapid growth. The PSNT soil test is based on sampling the soil to a depth of 12 inches during the early growing season of an annual crop. In the case of sweet corn, soil sampling should be performed when the plants are about 6 to 10 inches tall. The PSNT is also useful with vegetable crops, such as cabbage, squash, pumpkin, peppers, and tomato when sampling is performed at an early growth stage. Collected soil samples need to be handled carefully or dried quickly to prevent changes in nitrate concentration.

Soil testing laboratories must report results to farmers rapidly so that they can take timely action with the growing crop. Soil test PSNT sufficiency/decision levels may vary somewhat among regions and crops, but in general, when the PSNT soil test level is more than 25 ppm nitrate-N, the soil is considered N sufficient and supplemental N fertilizer is not recommended. If, however, the PSNT test is less than 25 ppm, the soil will probably not supply sufficient N and supplemental N fertilizer may be recommended. In fields where the PSNT level is more than 50 ppm, the soil is clearly over supplying plant available N. In such cases of excess N supply, soil fertility practices should be adjusted (reduce application rates of compost or manure) to prevent such build up. The PSNT can be especially helpful to organic growers that want to evaluate the performance of their soil fertility building program in an organic farming system.

Further information about how to use the PSNT soil test is available on the web: http://www.rcre.rutgers.edu/pubs/publication.asp?pid=E285

USING FERTILITY TO SUPPRESS VEGETABLE DISEASES

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Introduction

One of the fundamental strategies for maintaining plant health and suppressing disease in vegetable production is to manage nutrition. Proper nutrition can often govern the fine line between host susceptibility and resistance. Plant pathologists commonly refer to the "disease triangle" to illustrate how a disease may occur. Three factors of the triangle have equal importance. They are: a susceptible plant, a conducive environment, and the presence of virulent pathogens. Altering any of the three components directly affects the severity of the disease or whether disease occurs. For example, many diseases caused by *Pythium* spp. or *Phytophthora* spp. can be suppressed by manipulating the environment component by changing drainage and moisture in the soil. Additionally, certain nutrient regimes can suppress *Fusarium, Verticillium, Thielaviopsis*, and powdery mildews by increasing the resistance of the host. This handout will briefly discuss the governing role of nutrition in minimizing plant susceptibility.

Complete and balanced nutrition should always be the first line of defense. One major problem in providing proper nutrition is that many vegetables vary in their nutritional requirements and that nutrition can affect disease differently. Crops such as cucumbers, cantaloupe, and tomato require heavier fertilization than crops like carrot, sweet potato, and watermelon. In light of these diseases, nutritional requirements need to be understood on a "case by case" basis. Furthermore, the fertilizer regimes necessary to maximize plant health when a pathogen is present can differ from the fertilizer regimes required when the pathogen pressure is absent.

In many cases, the amount of a particular element needed to suppress disease far exceeds the plant's nutritional requirement for that element indicating that many elements may function in multiple mechanisms for disease suppression. Chemical interactions with the soil, pH, and/or with specific communities of microorganisms can, in turn, influence the development of disease. For example, the form of nitrogen can have striking effects on plant disease through root-mediated changes in pH, microbial profiles in the rhizosphere, and alterations in the availability and function of micronutrients. For example, Ca only composes approximately 0.5% of the dry weight of most plants, yet Ca is routinely applied in great quantities to container potting mixes and field soil to affect soil pH and to suppress certain plant diseases. Other misunderstood elements are chloride and silicon that can be absorbed in quantities that far exceed the plant's requirement for essential physiological functions.

Micronutrients directly and indirectly affect defense mechanisms in plants. Many of these pathways utilize enzymes that require Mn, Cu, Zn, Mo, and B as cofactors or activators. Direct effects include metabolic pathways that lead to the production of lignin, phenol, phytoalexins, and other defense-related compounds. Elements like K and Cl influence osmotic relations, water cycling, and root exudation, which, in turn, influence beneficial microbes. Indirect mechanisms include effects on nitrification, soil pH, and chemical transformation of micronutrients like Mn. As follows is a discussion Below we will discuss each element's effect on plant disease, but with a caution to growers it is important to recognize that nutrition must be viewed holistically since all elements affect the uptake and function of other elements and can ultimately increase or decrease plant disease.

Nitrogen

Nitrogen is the fourth most abundant element in plants and is an essential component of amino acids, enzymes, hormones, phenolics, phytoalexins, and proteins, all of which can have direct effects on disease development. Although symptoms of N deficiency are generally recognized, most growers do not recognize the role that N-form may play in enhancing or suppressing disease. Nitrogen is available as the oxidized anion NO_3^- or the reduced cation NH_4^+. Most vegetables can use either form, but due to phytotoxicity associated with NH_4-N, especially with seedlings, most growers apply N in the NO_3-N form. However, excess nitrate can increase diseases by increasing salt stress and producing succulent tissue.

Nitrate-N and NH_4-N are metabolized differently and can have opposite effects on diseases. In fact, many of the conflicting reports found in the literature regarding the role of N and plant disease may be due to a failure to recognize and/or report the N-form (Table 1). However, when the form of N is known, some general rules can be made for certain diseases. For example, Fusarium wilts and root rots of tomato are usually less severe when the N is applied as NO_3-N and more severe when applied as NH_4-N. The opposite is true for Verticillium wilt and Thielaviopsis diseases. Studies have shown that applying ammonium-N provided good suppression of Verticillium wilt on eggplant and potato. In addition, growers should pay attention to the ion that accompanies N. Depending on the plant and the disease, the companion ion (Ca, K, Cl, and SO_4) may enhance or decrease protection from disease. The role of these elements is discussed below.

Phosphorus

Phosphorus is the second component listed in the analysis of fertilizers due to its vital role in cell division, energy transfers, and its regulatory role for transport of sugars and starches within the plant. Although there are exceptions, most reports on P and plant disease suggest that increasing P above that which is necessary for proper growth, may be associated with increased disease. In fact, those cases where P reduced disease may have been in situations where the element was deficient. Cases where the disease became worse following P application might have been in soils where excess P decreased the availability of other elements, which, in turn, increased the plant's susceptibility. In most soils, maximum availability of P would be expected in the slightly acid to neutral pH range. In acid soils, P reacts with Fe, Al, and Mn to form insoluble products, making P less available. In alkaline soils, P reacts with Ca and reduces P availability. Therefore, maintenance of soil pH is very important to maximize availability of P and plant health.

Table 1. Some vegetable diseases influenced by nitrogen*

			Nitrogen form**			
Disease	**Pathogen**	**Host Plant**	**N**	**NH_4**	**NO_3**	**Reference**
Blossom-end rot	Physiologic	Tomato	--	I	--	Sandoval et al., 1999
Crown rot	*Rhizoctonia solani*	Beets	--	I	D	Elmer, 1997
Crown/root rot	*Fusarium oxysporum*	Tomato	--	I	D	Duffy and Defago, 1999
Club root	*Plasmodiophora brassicae*	Cabbage	D	D	--	Klasse, 1996
Corky root	*Rhizomonas suberifaciens*	Lettuce	I	--	--	van Bruggen, et al., 1990.
Corky root	*Pyrenochaeta lycopersici*	Tomato	I	I	I	Workneh et al, 1993; 1994
Damping-off	*Rhizoctonia solani*	Snap/Lima bean	I	--	--	Sumner et al 1986
Early blight	*Alternaria solani*	Potato	D	--	--	Mackenzie, 1981
Root rot	*Sclerotium rolfsii*	Carrot	D	--	--	Punja et al., 1986
Root rot	*F. oxysporum, F. moniliforme*	Asparagus	--	I	D	Elmer 1989
Root rot	*Phytophthora parasitica*	Tomato	I	--	I	Workneh et al., 1993
Root rot	*Fusarium sp.*	Pea	D	I	D	Sagar & Sugha, 1998
Soft rot	*Pseudomonas marginalis*	Broccoli	I	--	--	Canaday and Wyatt, 1992
Stem rot	*Rhizoctonia solani*	Cauliflower	D	--	--	Chauhan et al., 2000
Wilt	*Fusarium oxysporum*	Radish	--	--	D	Trillas-Gay et al., 1986
Wilt	*Verticillium dahliae*	Eggplant	--	D	I	Elmer, 2000; Elmer and Ferrandino, 1991, 1994;

*Compiled from Huber, D. M., and Graham, I. E. 2007. Nitrogen and plant disease. Pages 31-44 in: *Mineral Nutrition and Plant Disease*. L. E. Datnoff, W. H. Elmer, and D. M. Huber, eds. APS Press, St. Paul, MN.
** I = increase, D = decrease, -- = not reported

Alternate formulations of P salts, such as phosphonic acid and phosphonate, have been developed and marketed for control of *Phytophthora* and *Pythium* diseases of vegetables. Phosphorous acid is not naturally occurring and has a mixed mode of action involving direct toxicity to the plant pathogen along with boosting the plant's natural defense system. These products do not provide any appreciable P nutrition and their mode of action is not through normal pathways associated with P metabolism. Similarly, mono-potassium phosphate (MKP) has been marketed as a foliar spray to induce local and systemic protection against some foliar pathogens in several crops.

Another important consideration is the role of beneficial mycorrhizal fungi in P nutrition and disease development. Mycorrhizae are beneficial fungi that form a symbiotic relationship with the plant's roots. These fungi improve plant health and reduce disease damage. Many vegetable plants have mycorrhizal associations that are likely interrupted during propagation cycles. If mycorrhizae are present or have been added, there may be a need to alter the P applications since mycorrhizal infection can be inhibited by increased P availability. Commercial applications of mycorrhizae are available and may have value in vegetable production for management of soilborne

diseases. Their use may allow other nutrients to be more available since added P could lead to the precipitation of other elements. Much research is still needed to identify the P demands of vegetables that respond to supplemental applications of mycorrhizae.

Potassium

Potassium is absorbed in large quantities by plants and may exceed nitrogen levels for certain plants. Many diseases can be increased or decreased on the basis of K nutrition alone or when combined with other elements. Unfortunately, no patterns have emerged with K and plant disease that would allow for generalizations. For example, investigators have noted that applying K suppressed bacterial diseases on carnations and geraniums, but increased bacterial leaf blight on philodendron. Many times these discrepancies are a result of investigators not mentioning the form of K. Potassium is most often applied as KCl, K_2SO_4, or KNO_3 and the form can be of great importance in disease management. The accompanying ion can often dictate the response of a plant to K, and this factor may explain the large number of discrepancies regarding K and plant disease. Although studies on vegetables are rare, there are a number of reports on other crops that show that the positive response to K fertilization was only associated with the KCl form and not any other K forms. The role of Cl will be discussed below.

Calcium and Magnesium

Calcium and Mg are the second and third most abundant basic elements in a plant. Calcium concentrations in plants are usually twice that of Mg. Calcium is extremely important in normal cell growth where it forms Ca pectate in the middle lamellae of the cell and functions in many enzymatic reactions involved in defense mechanisms. Calcium is commonly applied as $CaCl_2$, $CaSO_4$, or $Ca(NO_3)_2$. The role of Ca in the management of plant disease has received much attention (Table 2).

Many previous studies investigating the role of $Ca(NO_3)_2$ credited all of the plant disease suppression to the NO_3, and failed to recognize the Ca ion. Unfortunately, most studies do not examine different sources of Ca and its companion ion to demonstrate the contribution of Ca to plant disease control. Calcium applications to carrot infected with *Sclerotium rolfsii* reduced damage and increased yield. Many times the influence of Ca on soil pH is more important than the actual concentration of Ca in soil. For example, a reduction in the incidence of cavity spot disease of carrot by *Pythium coloratum* was achieved with lime whereas gypsum ($CaSO_4$) amendment of the same soil at the same rate had no effect on the incidence of disease. Reduction in the incidence of cavity spot appeared to be related to the increase in soil pH associated with the application of lime. The role of pH and Ca in the suppression of club root or cabbage caused by *Plasmodiophora brassicae* was recognized in 1878 and liming of the soil for control of clubroot has been practiced for more than 200 years. For example, liming to achieve a soil pH of 7.0 is currently recommended in California. The severity of Fusarium wilt of tomato caused by *Fusarium oxysporum* f. sp. *lycopersici* is also reduced with calcium concentrations. Greenhouse and field experiments in Florida found that amending Fusarium-infested soil with gypsum ($CaSO_4$) did not increase the soil pH and did not reduce the occurrence of tomato Fusarium wilt. In contrast, the Ca content of tissues of plants grown in soil amended with hydrated lime ($Ca(OH)_2$) was increased, which did reduce the occurrence of wilt.

Table 2. Reports of disease reduction in vegetables with calcium applications*

Crop	Disease	Causal organism	Calcium source	Reference
Broccoli	Clubroot	*Plasmodiophora brassicae*	Calcium carbonate	Campbell et al., 1985
Cabbage	Clubroot	*Plasmodiophora brassicae*	Calcium carbonate	Fletcher et al., 1982
Carrot	Southern blight	*Sclerotium rolfsii*	Calcium nitrate	Punja et al., 1986
Carrot	Cavity spot	*Pythium coloratum*	Calcium oxide	El-Tarabily et al., 1997
Carrot	Black root rot	*Chalara elegans*	Calcium propionate	Punja and Gaye, 1993
Cucumber	Root rot	*Pythium splendens*	Calcium carbonate	Kao and Ko, 1986
Cucumber	Gray mold	*Botrytis cinerea*	Calcium sulfate	Elad et al., 1993
Eggplant	Gray mold	*Botrytis cinerea*	Calcium sulfate	Elad et al., 1993
Melon	Fruit rot	Myrothecium roridum	Calcium chloride	Lima et al., 1998
Pepper	Gray mold	*Botrytis cinerea*	Calcium sulfate	Elad et al., 1993
Tomato	Wilt	*Fusarium oxysporum f. sp. lycopersici*	Calcium chloride	Corden, 1965; Edgington, 1958; Jones and Woltz, 1967; Standaert et al., 1973

*Compiled from Rahman, M. and Punja, Z. K. 2007. Calcium and plant disease. Pages 79-93 in: Mineral Nutrition and Plant Disease. L. E. Datnoff, W. H. Elmer, and D. M. Huber, eds. APS Press, St. Paul, MN.

Spraying calcium salts, like $CaCl_2$ and $Ca(NO_3)_2$, on tomatoes reduced powdery mildew colonies. These studies revealed that Ca-salt treatments that were effective in the single-application series were as effective as multiple applications. Although surfactant itself significantly reduced mildew colony numbers, all combinations of Ca salts, or Ca salts plus elemental S, significantly reduced mildew colony counts compared with surfactant alone, which clearly explains the role of Ca in powdery mildew suppression on tomato foliage.

Magnesium is usually applied as $MgSO_4$ or $MgCl_2$ and has been associated with both increased disease and disease suppression of plants. Of 46 studies investigating the role of Mg on plant disease, 22 found that Mg decreased disease, 18 found that Mg increased disease, and 6 found that there was little or no difference. Since the data are so conflicting, no real patterns can be discerned. It may be that many of these studies corrected a Mg deficiency and the result was a healthier plant with more vigor and disease resistance. When Mg was applied in excess of what is required for normal growth, a nutritional imbalance developed that promoted plant stress and more disease.

Chlorine and Sulfur

For centuries, Cl has been routinely applied as a companion ion for NH_4-N, K, and Ca fertilizers. Historically, Cl applications were thought to have little value in improving plant growth because Cl was thought to be highly available in soils and not essential. However, the role of Cl has long been misunderstood in crop production. Even in the last decade, the benefits of Cl are still mistakenly being ascribed to the accompanying cation. For example, while it is well documented that proper K nutrition will suppress some plant diseases, many subsequent studies that examined different forms of K found that the ameliorating effects on disease were restricted to KCl amendments, suggesting that Cl was the active ion.

Nutritionally, Cl is regarded as a micronutrient, yet, as in the case of Ca, benefits are achieved with rates that far exceed the plant's nutritional requirements. High rates of Cl salts have marked effects on inhibiting soil nitrification, enhancing availability of Mn and other micronutrients, and on increasing beneficial microorganisms. As an element, Cl^- is the only inorganic anion that is not structurally bound to a metabolite. Its major role is to serve as a charge-balancing ion. When a cell absorbs Cl^-, it accumulates in the cell vacuole and lowers the cell water potential below that of the medium surrounding the cell. Water then flows into the cell and increases hydrostatic cell pressure so it maintains a pressure that exceeds the force exerted by the plasmalemma. The cells remain turgid and are able to grow even when drought conditions prevail. Theoretically, plants that get root diseases in wet soils might be protected by supplying sufficient Cl to the plants so that they could still grow normally in soils with lower moisture deficits. Studies are needed to validate this theory. Chloride ions also alter the quantity and quality of organic solutes that are exuded into the rhizosphere, thus reducing the germination of and infection from root pathogens. Another major role of Cl in disease suppression comes from its effect on increasing the availability of Mn, which has direct effects on host resistance. Diseases of asparagus, beets, and celery are three vegetables that are suppressed with chloride fertilization (Table 3).

Table 3. Vegetable plants, diseases, and pathogens suppressed by chloride*.

Host plant	Disease	Pathogen(s)	Reference(s)
Asparagus	Fusarium crown and root rot	*Fusarium oxysporum* *F. proliferatum*	Elmer, 1989; 1992; Reid et al., 2001
Beets (Table)	Rhizoctonia root and crown rot	*Rhizoctonia solani*	Elmer 1997, 2000
Celery	Fusarium yellows	*Fusarium oxysporum* f. sp. *apii*	Schneider 1985, 1990

*Compiled from Elmer, W. H. 2007. Chlorine and plant disease. Pages 189-202, In: *Mineral Nutrition and Plant Disease.* Eds. Datnoff, L. E., Elmer, W. H., and Huber, D. N. 2007 APS Press. St. Paul, MN.

Sulfur is an essential element and a component of proteins, and it is the oldest recorded fungicide in use on vegetables. Sulfur has been used for over a hundred years to suppress powdery mildew and many other rust diseases of vegetables. However, the significance of soil-applied S on plant disease only recently became evident when S deficiency symptoms were noted following the drastic decrease of SO_2 emissions from coal-burning facilities. Most growers do not consider S nutrition as a component in their fertility programs. However, it is frequently applied as $NH_4(SO_4)_2$, Ca_2SO_4, or $MgSO_4$. These salts are almost exclusively applied with the aim of supplying the cations N, Ca, or Mg. When manipulating the pH is the sole objective, elemental S and $AlSO_4$ are often used. At the time of this writing, there is scant information on how sulfur nutrition affects vegetable diseases but, on field crops, several studies have shown that proper sulfur nutrition can induce resistance to plant pathogens through its effect on the function and availability of S-containing amino acids. Cysteine, methionine, and glutathione play roles in protein synthesis of many defense products. As air quality improves and atmospheric S decreases further, it is possible that growers will need to be more attentive to S nutrition.

Effect of micronutrients on diseases

The metals Fe, Mn, Zn, Cu, Mo, and B have diverse but essential roles in plants, functioning as cofactors or activators of enzyme systems. Many of these enzyme systems play pivotal roles in disease resistance in the production of defense barriers. In general, the concentrations that correct visual deficiency symptoms in plants are often far below the levels needed to ensure proper health and defense against disease. Most micronutrients become less available as the pH rises, so growers should be aware that although crops that favor alkaline soils may not show deficiencies, they may be more susceptible to attack from pathogens. One quick method to correct aboveground deficiency symptoms and boost resistance to foliar diseases is to apply foliar applications of micronutrients. However, since micronutrients are not translocated basipetally to the roots, these type of applications would not suppress a root disease.

Proper Fe nutrition not only boosts plant vigor and health, it indirectly affects disease in the rhizosphere where its availability may limit the growth of pathogens. A rich body of information exists on the role of Mn nutrition on plant disease. Manganese affects the production of many host defense products such as lignin, tannins, and phytoalexins. Zinc nutrition is associated with important plant defense pathways against fungal and bacterial pathogens. Zinc protects plant cells from toxic oxygen radicals and plays an important role in the production of disease resistance signalling proteins. Although inorganic Cu was used as one of the earliest fungicides, nutritionally it functions as a component of several polyphenoloxidases that produce phenols in cell walls. These phenols become the precursors to lignin and melanin defense barriers. Molybdenum nutrition is involved in nitrate metabolism and may influence many of the same disease suppression mechanisms that NO_3 affects. Boron plays a crucial role in cell wall integrity and phenol metabolism. Studies on field crops have found that minor B deficiencies can lead to increased plant susceptibility. Although most vegetable growers lump micronutrient deficiencies all together, future research may allow for prescribed applications to optimize and balance micronutrient fertility to increase protection from disease.

Effect of beneficial elements on diseases

As stated above, not all elements (eg. Silicon, nickel, and aluminum) are viewed as essential, but a growing number of experiments have shown that many nontraditional elements can suppress a number of plant diseases. It is interesting that the ameliorating effects of these elements are frequently only realized when the plant is under disease pressure, which, once again, implicates their association with host defense mechanisms.

Silicon is not taken up by all plants, but plants that accumulate Si have shown marked resistance to certain plant diseases (Table 4). Si is absorbed by the roots as monosilicic acid and most grasses will absorb this element in great quantities (between 1 and 10%). Although Si is available in many kinds of soils, peat-based soilless mixes are usually deficient in Si. This may suggest that many vegetable transplants might gain early protection from diseases caused by mildews and rust if adequate Si was added to the growth medium. Although research on some vegetables has begun, most vegetables have not been assessed for the role of Si nutrition on disease. Of the vegetables examined, the cucurbits have shown the most protection from biotic and abiotic diseases following applications of Si. The underlying mechanisms that govern disease protection are not clear, but data have shown that Si can affect disease via enhancing physical barriers to infection in the tissue as well as by alterating host defense responses. Given the low Si content found in most horticultural media, it would seem prudent to consider Si amendments as simple, inexpensive methods to reduce plant disease.

Nickel has been regarded as an essential element due to its direct role in activating urease in plants, but Ni fertility has received no attention among vegetable growers. Nickel is absorbed as Ni^{+2} and is taken up in minute quantities. The mechanisms are not clear, but the metal may boost defense mechanisms, induce

Table 4. Host, disease and plant pathogen response to silicon*.

Host	Disease	Pathogen	Effect[a]	Reference(s)
Corn	Stalk rot	*Pythium aphanidermatum* and *Fusarium moniliforme*	+	Sun et al, 1994
	Corn smut	*Ustilago maydis*	+	Tamini and Hunter 1970
Tomato	Fusarium wilt	*Fusarium oxysporum*	-	Rodrigues et al. 1996
	Fusarium crown rot	*Fusarium oxysporum*	-	Menzies et al. 2001
	Powdery mildew	*Oidiopsis sicula*	+/-	Menzies et al., 2001
	Bacterial wilt	*Ralstonia solanacearum*		Dannon and Wydra 2004
Cucumber	Powdery mildew	*Sphaerotheca xanthii*	+	Miyaki and Takahashi 1983, Adatia and Besford 1986, Menzies et al., 1991b, 1992
	Anthracnose	*Colletotrichum spp*	+/-	Kanto 2002

				Sun et al 2002
	Leaf spot	*Corynespora citrullina*	+	Kanto 2002
	Crown and root rot	*Pythium ultimum* and *Pythium aphanidermatum*	+	Chérif and Bélanger 1992, Chérif et al., 1994b
	Gray mold rot	*Botrytis cinerea*	+	O'Neill 1991, Voogt 2001
	Black rot	*Didymella bryoniae*	+	
	Fusarium wilt	*Fusarium oxysporum* f.sp. *cucumerinum*		Miyaki and Takahashi 1983
Muskmelon	Powdery mildew	*Sphaerotheca xanthii*	+	Menzies et al., 1992
Zucchini squash	Powdery mildew	*Erysiphe cichoracearum*	+	Menzies et al., 1992
Pumpkin	Powdery mildew	*Sphaerotheca xanthii*	+	Heckman et al., 2003
Pea	Leaf spot	*Mycosphaerella pinodes*	+	Dann and Muir 2002
Lettuce	Pythium root rot	*Pythium* spp.	-	Menzies et al., 2001

* Compiled from Datnoff, L. E., Rodrigues F. A., and Seebold, K. W. 2007. Silicon and plant disease. Pages 333-346, In: *Mineral Nutrition and Plant Disease.* Eds. Datnoff, L. E., Elmer, W. H. and Huber, D. N. 2007 APS Press. St. Paul, MN

resistance to disease, and directly inhibit the pathogens. The use of Ni in vegetable disease management is yet to be explored.

Recent research has shown that Al is similarly taken up in plants at low levels and may be associated with plant health. It has been a long-held practice to lower soil pH with $AlSO_4$, which is accompanied by disease reductions for many plant diseases caused by *Verticillium* and *Thielaviopsis*. However, evidence may suggest that the Al ion is partially responsible for suppression of disease through its effect on the germination of fungal spores in soil. Applications of different forms of Al to peat soils at pH 4 and 6 were followed by reductions in the growth of *Phytophthora parasitica*. Additional research on Al amendments is definitely warranted and may lead to another simple, environmentally-safe management strategy for disease control.

Summary

Mineral nutrition has marked effects on plant diseases and manipulating their levels often serve as the first line of defense against disease. However, this management strategy is still in its infancy due to a lack of information. A few examples have been highlighted where manipulating the mineral nutrition can reduce disease. Another more important goal was to underscore the paucity of information on how fertility could advance a major strategy for disease control and how that could have an immediate impact on the greenhouse industry. Unfortunately, the fractionation of the data and disarray of concepts have hindered a working plan for disease management. Experimental studies that focus on one plant, one element, and one disease in isolation of other variables provide only "snapshots" of information. This dearth of experimental data on vegetables, combined with different plant species whose fertility requirements differ widely from each other, make the development of this strategy a daunting task. Growers are encouraged to consider their fertility regimes against the aforementioned information and make adjustments, first on a small scale, then on an expanded scale as the results are warranted. Researchers are encouraged to explore a vegetable's horticultural and disease response to a wide array of elements applied in many combinations. The role that each element plays in disease must be viewed in the greater context of its numerous interactions with other elements, the host, soil type, and with beneficial and pathogenic microorganisms.

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Session 16
Employee Management

MANAGING YOUR WORKFORCE: LEGAL ISSUES AFFECTING THE HORTICULTURE INDUSTRY

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Introduction

This presentation will give an overview of important legal issues affecting the horticulture industry. When dealing with the law, and compliance issues, it is important to note that this is an area that is constantly changing; growers and other agricultural producers should do their best to keep current to all new requirements by law. In the next sections we will present some of the key points of several important immigration and labor issues, along with the responsible agencies and contact information. More complete and detailed information can be found in the immigration and labor handbook, which can be downloaded from the horticulture business information network at http://hbin.tamu.edu. The information contained in this paper does not have the force or intent of law. It is for informational purposes only.

Immigration Reform and Control Act of 1986

The Immigration Reform and Control Act of 1986 (IRCA) seeks to control illegal immigration by eliminating employment opportunity as an incentive for unauthorized persons to come to the United States. It prohibits the hiring or continued employment of aliens whom employers know are unauthorized to work in the United States. Some of the key provisions of the IRCA included legalization of illegal aliens residing in the US since January 1, 1982; creation of sanctions prohibiting employers from knowingly hiring, recruiting, or referring for a fee aliens not authorized to work; increased enforcement at US borders; and created a new classification of seasonal agricultural workers.

To comply with the law, all U.S. employers must verify the employment eligibility and identity of all employees hired to work in the United States after November 6, 1986 by completing Employment Eligibility Verification forms (Forms I-9) for all employees, including U.S. citizens. Employers who hire or continue to employ individuals knowing that they are not authorized to be employed in the United States may face civil and criminal penalties.

Verifying Employment Eligibility

To comply with the law, you must verify the identity and employment eligibility of each person you hire. You must complete and retain a form I-9 for each employee, and refrain from discriminating against individuals on the basis of national origin or citizenship. Upon request, you must be able to provide the Form I-9 to authorized officers of the Department of Homeland Security (DHS), the US Department of Labor (USDOL), or the Office of Special Counsel for Immigration Related Unfair Employment Practices (OSC) for inspection. The list of documents that prove identity and employment eligibility is included with the instructions of the I-9 form. It is also included in the immigration and labor handbook.

Social Security No-Match Letters

A No-Match letter is a letter issued by the Social Security Administration (SSA) that notifies of a "no-match" of the names or Social Security Numbers (SSNs) listed on an employer's form W-2 and the SSA 's records. SSA sends three types of no match letters:

1. A letter sent directly to workers at their home address;

2. A letter sent to an employer about an individual worker when SSA does not have the worker's correct address; and
3. A letter to an employer about multiple employees when at least 10 employees during the year, or one half of one percent (1 out of 200) of the employer's workforce, are the subject of a no-match.

In June 2006, the Department of Homeland Security (DHS) issued a regulation requiring employers to take certain actions with respect to employment eligibility upon receipt of a Social Security No-Match letter. After providing a period for comments, a final rule was issued on August, 2007. This proposed rule was challenged in a federal court prior to it taking place in September 2007. A new proposed rule, with very little changes, addressing some procedural questions was released in March 2008. For additional information on the status of this law, please visit the Department of Homeland Security website. Employers who fail to comply with the new rule could be considered as knowingly hiring an illegal worker and could face fines of up to $10,000 per worker and incident.

Responsible Agencies:

Department of Homeland Security
U.S. Immigration and Customs Enforcement,
425 I Street, NW., Room 1000; division 3
Washington, DC 20536.
Tel. (202) 514-2844
http://www.ice.gov/
Social Security Administration
Office of Public Inquiries
Windsor Park Building
6401 Security Blvd.
Baltimore, MD 21235
Tel. 1-800-772-1213
http://www.ssa.gov/

H2-A Temporary Workers Program

The Immigration Reform and Control Act of 1986 created the H-2A Program, under which employers may bring agricultural workers into the country on a temporary, non-immigrant basis. The purpose of the H-2A Program is to ensure agricultural employers have an adequate labor supply while protecting the jobs, wages and working conditions of domestic workers.

An agricultural employer who anticipates a shortage of domestic workers needed to perform agricultural labor of a seasonal or temporary nature. "Temporary or season nature" means employment performed at certain times of the year for a limited time period of less than one year when the employer can show that the need is truly temporary. The employer may be an individual, a partnership or a corporation. An association of agricultural employers may file as a sole employer, a joint employer with its members or as an agent for its members. An authorized agent may file an application on behalf of an employer. Associations may file master applications on behalf of their members.

A signed application should be sent to the U.S. Department of Labor (DOL), Certifying officer, Employment and Training Administration in the region of intended employment. At the same time, a copy must be filed with the State Employment Service Agency in the area of intended employment.

Responsible Agency:

U.S. Department of Labor, ETA
Certifying Officer
200 Constitution Ave., NW
Washington, DC 20210
Phone: 1-866-4-USA-DOL
http://www.dol.gov/

MATCHING PROFITABLE PRODUCTION WITH LABOR NEEDS

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One problem on vegetable farms is when your crops do not generate enough income at season margins to retain quality, stable employees. Some growers plant crops they almost invariably know will lose money just to provide hours of work at certain times of season.How can you match profitable crops with labor needs?

The first step it to know your costs of each crop produced. A production budget can tell you the cost of producing each crop as well as help you determine how much labor is used for each crop. Let's use sweet corn sold at a retail market as an example. Table 1 shows the costs broken into variable and overhead costs. The variable cost section also provides information on dates, and cost of labor.

Table 1. New Jersey Production Schedule for one acre of Early Sweet Corn – IPM – Retail Sales.*

Operation	Date	Labor	Materials	Fuel & Lube	Repairs	Total
VARIABLE COSTS						
Set up Irrigation Eq.	March					$ 225.00
Soil test	March	$ 5.08	$ 1.00			$ 6.08
Apply lime	April 1	$ 10.15	$ 19.00	$1.80	$0.90	$ 31.85
Plow	April 1	$ 20.30		$3.60	$1.80	$ 25.70
Disk	April 1	$ 15.23		$2.70	$1.35	$ 19.28
Apply Pre-Plant Herb.	April 1	$ 14.50	$ 19.19	$1.80	$0.90	$ 36.39
Apply Pre-Plant Fert.	April 1	$ 10.15	$ 84.00	$1.80	$0.90	$ 96.85
Plant	April 15	$ 10.15	$ 60.75	$1.80	$0.90	$ 73.60
Apply Fertilizer	April 15	$ 10.15	$ 80.00	$1.80	$0.90	$ 92.85
Applylinsecticide	April 15	$ 14.50	$ 24.23	$1.80	$0.90	$ 41.43
IPM Scouting	June-July					$ 21.00
Apply Herbicide Early	June	$ 14.50	$ 3.19	$1.80	$0.90	$ 20.39
Disk	May	$ 15.23		$2.70	$1.35	$ 19.28
Apply insecticie	June	$ 29.00	$ 11.24	$3.60	$1.80	$ 45.64
Apply insecticide	July	$ 14.50	$ 5.62	$1.80	$0.90	$ 22.83
Harvest & Grade	July 1-20	$160.00	$260.00			$ 420.00
Selling Charge 10.00%						$ 660.00
INTEREST ON OPERATING CAPITAL						$ 44.31
TOTAL VARIABLE COSTS						$1,091.25
FIXED COSTS						
Farm Stand						$ 50.00
Tractors						$ 13.00
Implements						$ 10.00
Land Charge						$ 100.00
TOTAL FIXED COSTS						$ 173.00
TOTAL FIXED AND VARIABLE COSTS						$2,074.25
MANAGEMENT FEES		7.00%				$ 138.20
TOTAL COSTS						$2,212.44
SALES Sweet Corn 400 crates @ 16.50/bag						$6,600.00
NET RETURNS						$4,387.56

*Developed by Dr. Robin G. Brumfield, Specialist in Farm Management, Raymond Samulis, County Agricultural Agent, Kristian Holmstrom, Program Associate, Vegetable IPM, Joseph Ingerson-Mahar, Vegetable IPM Coordinator

Planning and Scheduling for Labor Needs

Gantt Charts can help you work out the order in which tasks need to be carried out; and, allow you to identify the resources needed to grow and sell a crop, along with the times when these resources will be needed. When production is under way, Gantt Charts help you to monitor whether the crop is on schedule. If it is not, they help you to pinpoint the remedial action necessary to put it back on schedule.I

have modified Gantt Charts for vegetable growers and have incorporated information on costs and labor needs so you can match profitable production with labor needs.

How to Use the Tool:

To plan a project using a Gantt Chart, follow these steps:

1. List all activities in the plan. The first step is to list all of the tasks that need to be completed to produce and sell your crop. For each task, show the earliest start date, how many hours of labor it will take, the type of labor (Operator, Regular, or Seasonal), and the cost for each task.

Table 2 shows the task list taken from the budget for producing sweet corn using IPM for the retail market in Table 1.

Table 2. Modified Gantt Chart Example: Growing sweet corn using IPM for the retail market.

Task	Description	Date	Hours	Type*	Cost
1	Set up Irrigation Equipment	March	0.5	O	
2	Test Soil	March	0.5	R	$5.08
3	Apply lime	April 1	1	R	$10.15
4	Plow	April 1	2	R	$20.30
5	Disk	April 1	1.5	R	$15.23
6	Apply Pre-Plant Herbicide	April 1	1	O	$14.50
7	Apply Pre-Plant Fertilizer	April 1	1	R	$10.15
8	Plant	April 15	1	R	$10.15
9	Apply Fertilizer	April 15	1	R	$10.15
10	Apply Insecticide	April 15	1	O	$14.50
11	Disk	May	1.5	R	$15.23
12	Apply Post-Emergent Herbicide	Early June	1	O	$14.50
13	IPM Scouting	June-July	1.5	O	$21.00
14	Apply insectide	June	2	O	$29.00
15	Apply insectide	July	1	O	$14.50
16	Harvest & Grade	July 1-20	20	S	$160.00
	Total		**37.5**		**$364.44**

*O = Operator Labor @$14.50/hour, R = Regular Labor @$10.15/hour and S = Seasonal Labor @ $8.00/hour.

2. Make a chart for the year and schedule the labor activities. Next, draw up a Gantt Chart. Plot each task on yearly calendar, showing it starting on the earliest possible date. Indicate the hours of labor required for each task. Take the information from Table 2 and use it to schedule actions. Schedule them in such a way that sequential actions are carried out in the required sequence. A scheduled version of the sweet corn budget is shown in Table 3.

Table 3. Gantt Chart Example. Sweet Corn – IPM – Retail showing hours of labor required by type for each month.*

Task	Month											
	Jan	**Feb**	**Mar**	**Apr**	**May**	**June**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
1			0.5	O	Set up Irrigation Equipment							
2			0.5	R	Test Soil							
3				1	R	Apply Lime						
4				2	R	Plow						
5				1.5	R	Disk						
6				1	O	Apply Pre-Plant Herbicide						
7				1	R	Apply Pre-Plant Fertilizer						
8				1	R	Plant						
9				1	R	Apply Fertilizer						
10				1	O	Apply Insecticide						
11					1.5	R	Disk					
12						1	O	Apply Post-Emergent Herbicide				
13						1.5		O	IPM Scouting			
14						2	O	Apply Insecticide				
15							1	O	Apply Insecticide			
16							20	S	Harvest and Grade			
Total			**1**	**9.5**	**1.5**	**4.5**	**21**					
Total O			**0.5**	**2**		**4.5**	**1**					
Total R			**0.5**	**7.5**	**1.5**							
Total S							**20**					

*O = Operator Labor @$14.50/hour, R = Regular Labor @$10.15/hour and S = Seasonal Labor @ $8.00/hour.

By drawing this Gantt Chart, you can see that:

- Labor is only required March through July.
- If all goes according to schedule, you need:
    - 20 hours of seasonal labor all in July.
    - 8 hours of operator labor starting in March.
    - 9.5 hours or regular labor starting in March.

3. Make a chart each of your other crops and other farm activities for the year and schedule the labor activities as above.

Pay particular attention to which crops look the most profitable and also, what crops or activities can extend that labor to slack months.

4. Make a master Gantt chart

You may want to start by writing down how many workers you think are needed. Then, how many weeks, and finally how many hours of that labor will you have? Next, what crops do you intend to grow? Make a budget and a Gantt chart for each one.

How do the labor needs of the crops you intend to grow match the hours of labor you expect to have? This will allow you to look at the big picture to see how much labor you anticipate needing in each month. Can you modify work schedules or crops and other activities to utilize available labor in slack months? For example, can workers be trained for multiple tasks so that the regular labor crew who fertilize in April can work in a farm stand in July?

Key points:

The starting point is to develop a budget for each crop. Gantt charts are useful tools for planning and scheduling crops. They help you to assess how long a crop will take to grow and sell and determine the resources needed, When a crop is being grown, Gantt charts are useful for monitoring the labor you are actully using. If you include a budgeting component, you can see how you actually did compared to the projection. This can be essential to successfully and profitably manage labor. The Rutgers Greenhouse Cost Accounting Program now includes outdoor crops. Contact me at Brumfield@aesop.rutgers.edu for more information.

Session 17
Greenhouses

Greenhouse Energy Conservation and Efficiency

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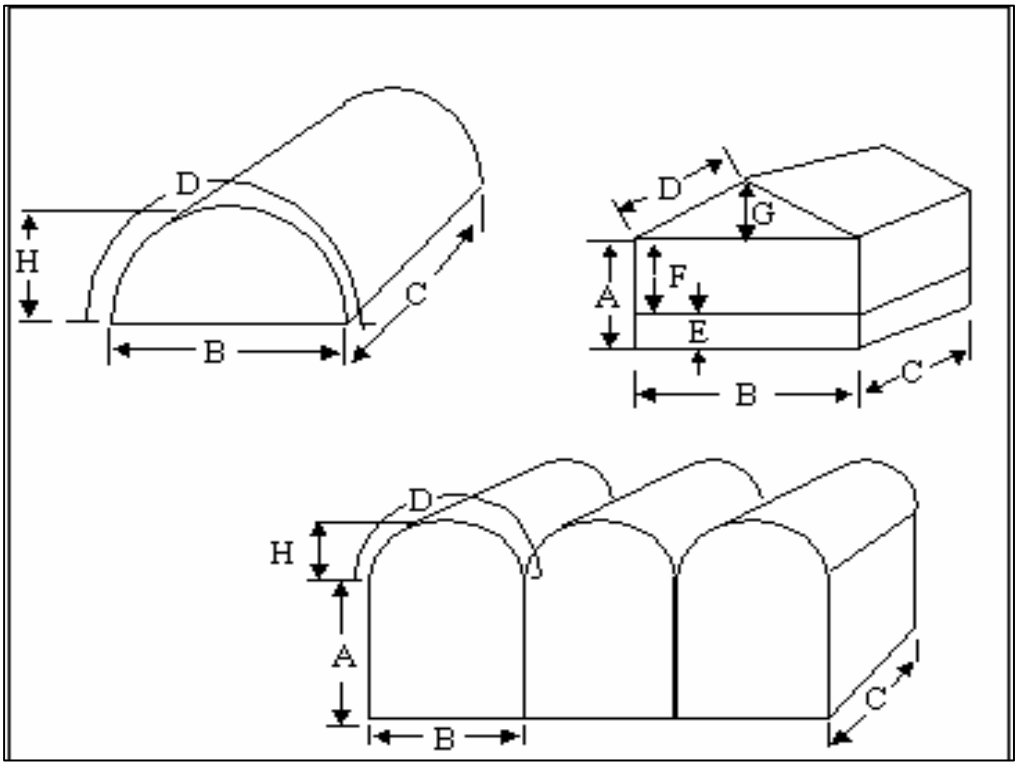
Greenhouse Heat Loss Calculations
In order to determine the heater/boiler capacity needed to maintain the desired greenhouse set point temperatures, the greenhouse heat loss needs to be calculated.



Step 1: Determine greenhouse dimensions (in feet).
Wall height A =
House width B =
House length C =
Rafter Length D =
Lower wall height E =
Upper wall height F =
Gable height G or H =
Step 2: Calculate surface areas (in ft^2) and perimeter distance (in ft)
Note: N is the number of greenhouse bays. N = 1 for a single bay greenhouse.
Lower side wall area: 2N(E x B) + (E x 2C) =
Upper side wall area: 2N(F x B) + (F x 2C) =
Or, Single material side wall: 2N(A x B) + (A x 2C) =
Gable-style greenhouse roof surface area: 2N x D x C =
Gable-style greenhouse gable area (end wall above gutter): N x B x G =
Curved-roof style greenhouse roof surface area: N x D x C =
Curved-roof style greenhouse gable area (end wall above gutter): 1.1N x B x H =
Hoop-house end wall area: 1.5N x B x H =
Perimeter: 2[(N x B) + C] =

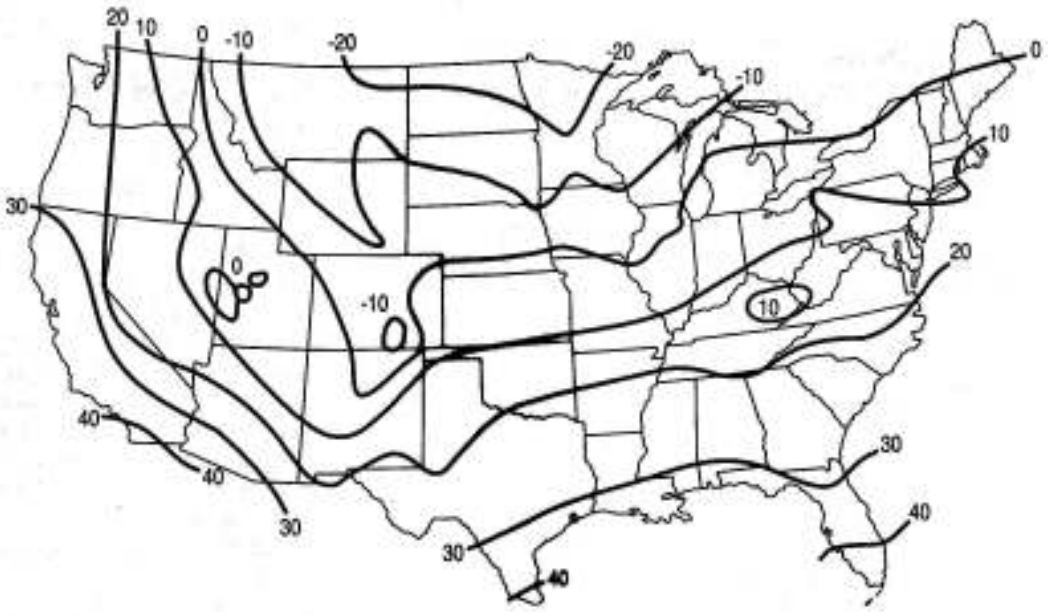
Step 3: Determine U-values for each material used for the various surface areas.
Lower wall area: U_1 =
Upper wall area: U_2 =
Single material wall: U_3 =
End wall area: U_4 =
Roof: U_5 =

The U-values (heat transfer coefficients) can be determined from the data shown in the table below.

Material	*U in Btu/hr per ft^2 per °F*
Single (double) layer of glass	1.1 (0.7)
Single (double) layer of poly	1.1 (0.7)
Double layer plus energy curtain	0.3 – 0.5
Double layer acrylic	0.6
Double layer polycarbonate	0.6
½" plywood	0.7
8" concrete block	0.5
2" Polystyrene	0.1 (R = 10)

Step 4: Calculate the structural heat loss (Q_{STRUC} in Btu/hr)
$Q_{STRUC} = \Sigma(U_i \times A_i) \times \Delta T$ (i.e., the sum of all applicable heat losses)
Heat loss from lower wall area: Lower side wall area x U_1 x ΔT =
Heat loss from upper wall area: Upper side wall area x U_2 x ΔT =
Or, Heat loss from single material wall area: Single material side wall area x U_3 x ΔT =
Heat loss from gable or curved-end area: Gable or curved-end area x U_4 x ΔT =
Heat loss from roof area: Roof area x U_5 x ΔT =
Total Q_{STRUC} =

ΔT (pronounced 'delta T') is the temperature difference between inside and outside, or the difference between the nighttime temperature set point (inside) and the local minimum design temperature (outside). This minimum design temperature can be determined for a particular location from historical weather data, or estimated from the figure shown below (temperatures in °F). Some outside design temperatures for NJ: Atlantic City, Newark, and Trenton: 10°F, Vineland: 8°F, New Brunswick: 6°F, and Phillipsburg: 1°F.



Step 5: Calculate the perimeter heat loss (Q_P in Btu/hr)
Q_P = Perimeter heat loss factor x Perimeter x ΔT
For perimeter heat loss factor, use a value of 0.4 or 0.8 Btu/hr per linear foot of perimeter per °F depending on whether the perimeter is insulated or not.
Step 6: Calculate the greenhouse volume (in cubic feet)
Gable-style greenhouse volume: N[(A x B x C) + (B x G x C/2)] =
Single curved roof greenhouse volume: 2H x B x C/3 =
Multiple curved roof greenhouse volume: N[(A x B x C) + (2H x B x C/3)] =
Step 7: Calculate the infiltration (exfiltration) heat loss (Q_A in Btu/hr)
Q_A = 0.02 x Greenhouse volume x Air exchanges per hour x ΔT =

For air exchanges per hour use the following table.

Type of construction	*Air exchanges per hour*
New, glass	0.75 - 1.5
New, double poly	0.50 - 1.0
Old, glass and in good condition	1.0 – 2.0
Old, glass and in poor condition	2.0 – 4.0

Step 8: Calculate the total heat loss (Q_T in Btu/hr)
$Q_T = Q_{STRUC} + Q_P + Q_A$ =

Adjustment to the heat loss calculations should be made for situations with a large ΔT and/or locations with high average wind velocities: If ΔT is larger than 70°F, and if the average wind velocity is larger than 15 mph, multiply the calculated total heat loss by: (1 + 0.08) for every increase in ΔT of 5°F above 70°F and (1 + 0.04) for every 5 mph increase in average wind velocity above 15 mph. For example, if ΔT = 80°F and the average wind velocity is 25 mph, multiply the calculated total heat loss by a factor of: 1 + (0.16 + 0.08) = 1.24.

If the greenhouse heating system is designed properly, the capacity of the heating system should match the calculated total heat loss Q_T (that is the predicted heat loss on the coldest night). Make sure that the heating system has an output rating that equals the calculated total heat loss. When the heating system is rated by input, multiply this value by the efficiency of the system (generally in the 70-80% range) to determine the rated output.

Useful References

Aldrich, R.A. and J.W. Bartok. 1994. Greenhouse Engineering, NRAES Publication No. 33. Natural Resource, Agriculture, and Engineering Service. P.O. Box 4557 Ithaca, NY 14852. http://www.nraes.org.

Bartok, J. W. 2001(revision). Energy Conservation for Commercial Greenhouses. NRAES Publication No. 3. Natural Resource, Agriculture, and Engineering Service. P.O. Box 4557 Ithaca, NY 14852. http://www.nraes.org.

Useful Web Sites

http://www.njveg.rutgers.edu
(check out High Tunnels en Greenhouses under Vegetable Farm Resources)

http://www.hrt.msu.edu/Energy/Notebook.htm

http://www.ofa.org/energy.aspx

http://www.ars.usda.gov/Research/docs.htm?docid=11449
(link to the free software 'Virtual Grower' that simulates energy costs for different greenhouse designs and cropping scenarios)

http://aesop.rutgers.edu/~horteng

Session 18
Organic Marketing

ORGANIC WORLD CONFERENCE REPORT

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The sixteenth Organic World Congress was held from June 15th to 25th in a global collaboration among ISHS (International Society of Horticultural Scientists), IFOAM (International Federation of Organic Agriculture Movements), ISOFAR (International Federation of Organic Agricultural Research), and AIAB (Associazione Italiana Agricoltura Biologica). Over three thousand ag scientists, university faculty, growers, agri-business, administrators, and policy makers registered. Many thousands more participated in associated food events like the annual Cherry Harvest Festival, cheese tasting, organic olive oil evaluations and an organic wine conference.

The hub host city of Modena, Italy is an agricultural bread basket for Europe with a diverse crop and animal production that is primarily organic certified. It's interesting to note that the number of certified organic farmers in Italy has risen within 15 years from only 50 to approximately 50,000. A coordinated effort among farmers, officials and university researchers developed legislated links to public food services like elementary schools which created a stable market. Despite the countries relatively small size and population (ca. 120,000 square miles and 60 million people – similar to the northeast), organic Italian farmers far outnumber organic American farmers while their agricultural climates and soils are fairly comparable.

Some key themes and papers included topics in organic agriculture, environmental sustainability, climate change, international cooperation, women in organic agriculture, organic animal breeding, organic fish foods, organic cosmetics and government supported Ag policies. This author was invited to provide the two presentations summarized below and to participate in selected farm tours and international ag sessions.

Developing an Organic Production System for Highbush Blueberry

Four significant developments have occurred that amplify opportunity for certified organic growers to successfully grow highbush blueberry (Vaccinium corymbosum). First, there is the 2002 USDA national organic standard that defines organic production practices and crop labels which creates clarity and evens competition. Second, we have the continued increase of smallfruit and vegetable sales related to nutritional and human health reasons and the related market perception valuing organic produce more highly. Third, new tools are becoming available to organic growers that reduce the risk from pest problems such as the recent Organic Materials Review Institute (OMRI) listing of spinosad registered as a wettable powder (Entrust®) and a fruit fly bait (GF-120 NF Naturalyte). Finally, the Rutgers Blueberry Working group has made considerable progress in refining IPM practices and in developing new tools for organic production systems. This "Work in Progress" is investigating alternative approaches to some current agricultural practices in soil building, fertility, cultural approaches and pest management. Our seven-year program has demonstrated organic methods in managing new sources of mulch, two key insect pests, two common diseases and several weed species in establishing a commercial organic production system for highbush blueberries. As a programmatic result, organic acreage in New Jersey has increased from 0 to over 175 acres in seven years time and over 60 organic growers have adopted parts of this holistic production system in North America, South America and Africa.

When blueberries were first selected from the forests of New Jersey and cultivated in the early 1900's, the traditional culture of this native smallfruit was essentially organic in nature. Commercial examples of organic horticulture being used today include selection for resistant varieties, adding organic amendments in building soil such as peat and humus, raised mounds for disease suppression, mulching for weed control and water conservation, rogueing of infected plants, pruning for canopy ventilation to reduce disease incidence, and the use of natural plant protection products which are relatively safe to beneficial insects (Childers and Lyrene 2006, Eck 1988).

In contrast to other cultured fruits that have been introduced from foreign countries, the blueberry is one of the few native American fruits. This indigenous crop has relatively good natural resistance to pests and an inherent vigor because it has been domesticated for less than 100 years. Thus, there is this strong historic baseline for succeeding in the return to organic production although some key risk factors remain to be solved. To achieve this holistic vision of an integrated organic system, specific obstacles to commercial production were addressed in conjunction with the Rutgers research team at the Philip E. Marucci Cranberry and Blueberry Research Center.

Curriculum Development for Organic Horticulture in the United States

With a steady growth rate about 20% during the last decade, organic agriculture has emerged as a mainstream activity. The number or organic growers continue to grow thereby creating the need to train organic farmers, extension agents, advisors and consultants . A strict respect of the organic standards is critical for organic growers. The necessity to follow these rules furthered the need to develop courses on "organic principles and practices".

Organic agriculture requires a new set of skills that are not taught at traditional agricultural programs (Delate 2006) and therefore new and more appropriate curricula need to be created.

In a recent survey conducted in the US and foreign countries, Borsari and Vidrine (2005) and Borsari et al. (2002) found a general consensus toward the emergence of sustainable agriculture as a cornerstone despite the large diversity in the different curricula. This interest has lead to the creation of many programs on sustainable agriculture across the countries in the last decade. As a part of the new trend there has been a renewed interest in organic agriculture. The organic production segment has maintained the fastest growing rate in agriculture over the last decade. Students from numerous American Universities have joined the trend and are demanding or initiating the discussion on developing specific curriculum for organic production. As a result, several universities throughout the nation have engaged in a profound curriculum transformation to satisfy the emerging need of students in organic production. A workshop was organized to bring together experts that are working on different organic and sustainable agriculture curricula throughout the country to share their experiences and lessons learned. The American Society for Horticultural Sciences (ASHS) through its working group on Organic Horticulture (ORGH) organized a workshop titled "Curriculum Development for Organic Horticulture". Speakers at the workshop recognized several factors that justify the need for organic curriculum. These included growth of organic agriculture, linkage with sustainable agriculture, natural resources and the environment, new generation of students and student involvement in the training process. A table of American Universties for organic ag education is summarized below.

University	Program Name -Facility	Type					
		Major	Minor	Certificate	Under-grad	Grad	Other
Univ. of Florida	Interdisciplinary Minor in Organic and Sustainable Crop Production (Center for Organic Agriculture	Proposed	Yes	-	Yes	-	-
MichiganState University	Name of program SOF - (Student Organic Farm)	-	-	Yes	Yes	Proposed	_
N.CarolinaState University	Interdisciplinary Agroecology** /Center for Environmental Farming Systems	Proposed	Yes	-	Yes	Yes	Yes
Univ. of Cal. Davis	Sustainable agriculture/SEF (Student Experimental Farm	Yes a	-	-	Yes	-	-
Univ. of Ca. Santa Cruz	Organic & Sustainable Courses	-	-	-	-	-	-
Iowa State University	Graduate Program in Sustainable Agriculture/	Yes	Yes	No	No	Yes	Yes
Kansas State University	Growing Growers Training Program	-	-	Yes	Yes	-	Yes
Oregon State University	Proposed	-	-	Yes	-	Yes	-
University of Idaho	SustainableFarming Education Program	No	No	Yes	-	-	-
Univ. of Minnesota	Student Organic Farm	-	-	-	-	-	-

Final Comment – Increasing capacity of organic producers worldwide coupled with the rising need for food security and quality, an enhanced environmental consciousness and an emphasis on nutrition and health may allow the optimistic economic projections for organic product growth and market share amidst a global recession to be achieved.

One Acre and Independence

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East Palo Alto, CA 94303

Surviving and thriving in today's marketplace requires a multi pronged approach. Discussion will include; small lot production of peppers, niche marketing, unique product offerings, consistent quality and supply, name recognition, website design/ internet presence, sales outreach, and simple market display techniques. All aspects of production and sales become critical to successful small lot farming.

BRANDING IDEAS FOR HERBS

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The production of herbs is challenging and the ability to market one's own production and in particular the ability of growers to differentiate their products has become increasingly complex yet needed in an increasing competitive marketplace. Growers have become increasingly professional in product quality, post-harvest handling and grading and packing using their own farm logo's whenever applicable for the wholesale marketplace. For those growers that have the potential of wholesale packaging and marketing as well as for retail sales, we illustrate two different case studies that involved branding of herbs. The first branding concept focuses on the production of herbs as seedlings for the spring transplant sales markers and brands herbs with a logo that can reflect your farm, your state or region and provide a story while assembling a variety of herbs together for consumers to make their decision in purchase easier and presumably favorable in the selection of your product. The branding also facilities premium dollars received by packaging the product in a manner that needs no further repackaging or work on the retail or wholesale shelf.

The second branding examples uses a completely different orientation and approach yet keeps a focus on a history and story behind the product, not unlike Jersey-Fresh, Jersey Blues and other more familiar branding concepts that are successfully used in the marketplace. This provides a branding that could be used for fresh, processed and value-added products not unlike what one may encounter in a fresh farm retail stand which labels all their products in a consistent manner to reflect the farm and/or stores operation.

Both case studies are presented to illustrate ways in which you as a grower may use branding as a tool to increase your sales and hopefully increase repeat customers by providing an 'easy-to-use final sales pack that can be displayed both at large or small wholesale and retail venues.

The Hoosier 6-Pacs:

This concept of branding fresh herbs was developed by Purdue University (Jules Janick, Jim Simon and David Swain) years ago when we were trying to provide support to growers to create some excitement and increased visibility for their fresh herbs. With increasing competition from other regions we identified the seedling and transplant sales market as one market window in which growers may be able to develop a local competitive advantage. With support by the State of Indiana's Department of Agriculture, we had come up with what is now a trade-marked name and concept to sell herbs grouped and packaged together to highlight their similar uses (culinary kitchen herbs, medicinals, flavorings for herbal teas and more). We used the name Hoosier to reflect the Indian origin as this nickname refers to people from the state of Indiana. The 6-pac concept literally came from the recognition that so many beverages are 'picked-up and carry-away'. Thus, we recognized that such 6-pac containers that can hold beverages must be available and with the correct waxiness and strength should work for the packaging of all sorts of herbs for direct final sales. From the NewCROPS web-site, the following information (http://www.hort.purdue.edu/newcrop/6pac/hbcards) was downloaded and can be seen:

Herbs for Health & Delight™ 6 Pacs

Herbs are easy to grow, add zest and delight to your food, provide a source of health for your body, and are beautiful and exotic in your garden. They have a long history in many civilizations and remain as important today as ever. They are "silent partners" to cooks everywhere. We have assembled an array of

popular and exotic herbs, based upon their many uses, for your delight in a convenient 6 Pac form. Each Pac contains assorted herbs ready for transplanting into your garden or containers. Each variety was selected by Herb Authorities. Plants were then carefully grown by Hoosier Herb Growers without the use of synthetic pesticides, in a sustainable and environmentally friendly manner.

FlavorPac™: A collection of edible, flavorful, aromatic herbs for those seeking an adventurous culinary experience.

HealthPac™: An assortment of popular yet hard to find herbs used to promote health.

PestoPac™: An array of basils for lovers of Italian cuisine.

TeaPac™: Herbs for brewing delightful, invigorating, natural teas, non-caffeinated of course; can be sipped hot or cold.

In addition, special individual plastic labels were made to identify each herb within each 6-pac and associated detailed consumer production recommendations were provided. Details of the individuals herbs in each 6-pac will be provided. Special considerations include ensuring that the actual package can withstand watering and thus it shelf-life is sufficiently long to meet retail and consumer needs prior to the consumer actually taking the herbs out of their plastic pots and transplanting. Also, we found that growers need to carefully schedule the production so that most of the herbs appear to be at the same plant height and growth stage for greater aesthetic appeal during sales. The concept can naturally be modified to meet your own needs, and given the plethora

The Mpuntu Brands of Spices

The Mpuntu (from the Twi Language meaning Progress in Development) was developed for the wholesale and retail branding of herbs, spices and medicinal plants from sub-Sahara Africa for the socioeconomic empowerment of rural African entrepreneurs through the sustainably product natural plant products. This brand is being used for the final packaged product (dry and ground, dry and whole seeds, etc.) and has achieved some degree of recognition having received awards for product quality and last year being listed in the Food and Wine Magazine as one of the new flavors you should try. For details and design logos, see: www.pfidnp.org and www.asnapp.org

WHAT'S ORGANIC WORTH AND WHERE'S THE MARKET GOING?

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For the past several years we've seen report after news article after television story talking about the rapid growth in the market for organic foods. The percentage growth rates have been impressive and the actual dollars involved are finally getting large enough for "organic" to register a share of the commercial food market. Trendy. Popular. In step with the desires of several different demographic subcategories.

Then came "local." And a recession. And a cheaper dollar.

Where's that leave the market for organic foods? What is it that consumers were really saying as they created enough demand to bring organic products from specialty shops and farmers' markets into the mainstream grocery complex?

This session uses consumer trend and attitude data to isolate some of the values consumers found in "organic" that drove this growth. We'll talk about how those attitudes both complement and compete with the current "buy local" movements. Willingness-to-pay data gives us some idea of the relative importance of organic, local, freshness and other product attributes. We'll talk about how to gauge your market's willingness and, more importantly, understand the types of customers you have and how to target their wants and needs. Our discussion will be based on major studies we've done, some research by colleagues elsewhere, and my observations as an educator, eater, producer and observer of consumer behavior.

Additional information from our work and my thoughts will be available online in the research and extension programs section at http://aede.osu.edu/people/ernst.1.

Session 19
Blueberries

BIOLOGY AND MANAGEMENT OF CRANBERRY FRUITWORM IN BLUEBERRY

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Cranberry fruitworm (CBFW) is a key pest of blueberries especially in the Great Lakes region, causing damage and potential contamination of harvested fruit. It is important that effective strategies for fruitworm control are developed, transmitted to the industry, and adopted by growers. This presentation will report on some of the recent research at Michigan State University that aims to provide blueberry growers with effective IPM programs for fruitworm control. This will be divided into four sections:

1. Fruitworm biology and monitoring
2. Degree days for timing important events
3. New insecticides and their performance
4. Program comparison at commercial farms

1. Fruitworm biology and monitoring – how to monitor fruitworms

Cranberry fruitworm overwinters in and around blueberry fields and the moths become active during bloom. After mating, the female moths are ready to lay eggs, and they search for fruit and can lay eggs in the calyx cup immediately after the first petal fall. Because fields may take some days to move completely through petal fall, and may contain varieties with overlapping bloom periods, and because bees may still remain in fields until well after petal fall, it is important for blueberry growers understand when to best time bee-safe insecticide applications during bloom. The first step to taking the guesswork out of this is to identify the start of the flight. To do this, moths should be monitored using pheromone monitoring traps. I consider the Large Plastic Delta, or triangle, trap made of corrugated white plastic to be the superior trap for this use. It may cost more to purchase, but they can survive rain, sun, irrigation, and even a harvester, and can be used for multiple years.

Traps should be placed in the crop before bloom, with one or ideally two traps per field. Hang the traps high in the bush, ideally in the top third, and bait each trap with a lure specific for the target pest. Placement of one trap at the field perimeter with another inside the field will provide a grower with information on timing and distribution of the pests, and the perimeter traps should always be placed in the site most likely to get fruitworm pressure. This will be the site of greatest infestation last year, or up against woods especially those with wild blueberry. Be careful to avoid cross-contamination of pheromone if you are monitoring other pests.

Once the traps are out in the field, they must be checked twice a week to identify the start of moth flight. We have found that the first CBFW moths are caught at approx. 400 GDD base 50 (see below) after March 1, so traps must be out before then. Once they are in place, regular checking is needed. Checking twice a week or more is ideal to help pinpoint the date of biofix. To set the biofix for CBFW, you must identify the a period of sustained moth capture, i.e. moth captures on more than one successive check, and set biofix as the trap checking date <u>immediately before sustained catch</u>. See the Table to learn how to set this date. Because spring weather can rapidly change from a period of cool to warm weather, it is important to include some common sense in your approach to checking traps and setting biofix. If there are multiple days between trap checks in the period of first sustained capture and you experience a period of warm weather with evening temperatures above 50 ^{o}F, the beginning of this period is likely to be the timing of first moth captures.

Table 1. Biofix for CBFW is the date of trap checking immediately before a period of sustained moth capture, i.e. moth captures on more than one successive check. Boxes below in gray indicate when the biofix should be set for each of these four sites.

Trap check date	Site 1	Site 2	Site 3	Site 4
1	0	2	0	0
2	0	0	0	3
3	1	0	0	0
4	0	0	0	**10**
5	0	**2**	0	17
6	**1**	5	0	25
7	2	9	0	10
8	4	0	**5**	4
9	10	0	17	2
10	25	2	11	1

2. Degree days for timing sprays during bloom – how to time sprays

For all insects, development happens faster at warm temperatures than at cool temperatures. This property can be used to relate temperature to insect development and allows timing of key events. In the case of CBFW, we are most interested in when egglaying by this pest starts because eggs and young larvae are key targets for insecticides. Our research has shown that egglaying by CBFW is predicted to start at 85 GDD (base 50) after Biofix. This means that growers should plan to make applications of bee-safe insecticides such as Intrepid at 50-100 GDD after biofix. This is usually during bloom, but this is a highly effective timing for this spray to control CBFW since an insect growth regulator insecticide (Confirm or Intrepid) applied at this timing targets both the eggs and larvae. GDD accumulation can be tracked using a max-min thermometer, and if you have any questions about how to calculate them contact your local Extension educator or crop consultant.

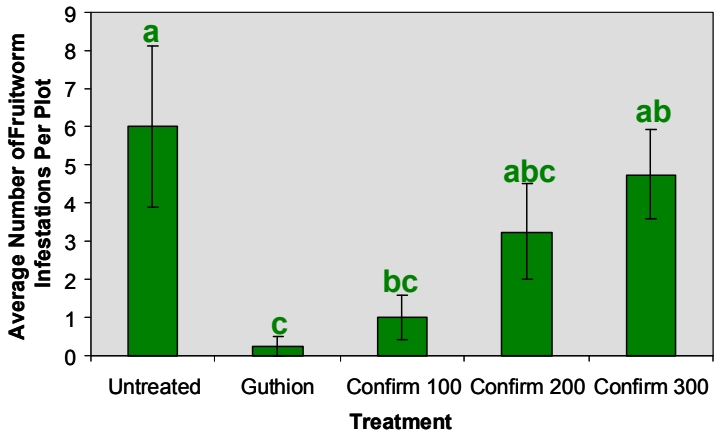

Figure 1. Control of fruitworms with Confirm applied at three different GDD timings, 2007.

Our 2007 trial in Michigan demonstrated greatest activity from Confirm (16 oz/acre) when it was applied at at 100 GDD after biofix compared with 200 or 300 GDD (see Figure 1). The Confirm treatments were all followed 14 days later with another spray of the same material/rate, and the Guthion was applied at petal fall at 1 lb/acre and followed 14 days later with the same material/rate. Only the 100 GDD treatment was significantly lower than the untreated, and it was similar to the Guthion treatment.

3. New insecticides for fruitworm control – which insecticides work best? In recent years we have seen a large amount of activity from manufacturers, the IR-4 Project, and EPA resulting in registrations of new insecticides for fruitworm control in blueberry. This is in large part due to the efficacy and residue testing program run at MSU's Trevor Nichols Research Complex (TNRC) under the direction of Dr. John Wise. The fruits of this program are seen in the list of new insecticides listed for control of fruitworms. These are in addition to the insecticides that growers have had longer experience with such as Guthion, Imidan, Sevin Malathion, Lannate, Asana, Confirm and B.t. The list of recently registered insecticides includes Intrepid (growth regulator), Assail (neonicotinoid), Delegate (spinosyn), Danitol, Brigade, and Mustang Max (all pyrethroids).

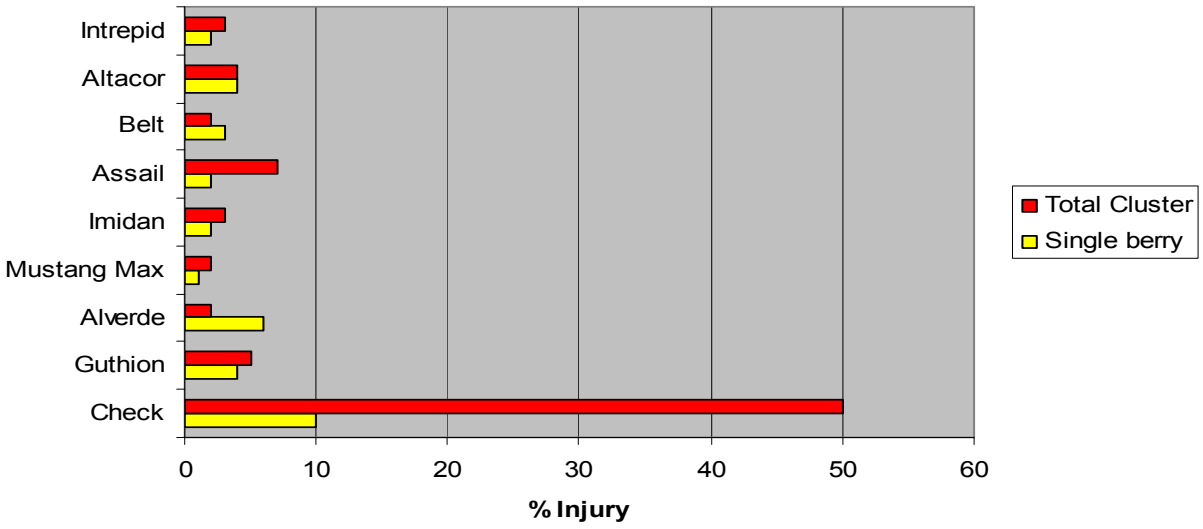

Figure 2. Control of fruitworms with insecticides, each applied three times against fruitworms at TNRC, 2008. Note that Altacor, Belt, and Alverde are not yet registered for use in blueberry

Our trials of standard and new insecticides over recent years, such as our 2008 trial of fruitworm insecticides (Figure 2), shows that growers have some alternative insecticides available for controlling fruitworms. Many of these are more expensive than Guthion, may require more accurate timing to achieve control, and may be more damaging to natural enemies. However, they provide options for growers to integrate into their IPM program as Guthion use is restricted further by EPA in advance of the phase-out in 2012.

4. Program comparison at commercial farms – what programs work against fruitworms?

Fruitworms are typically controlled using a combination of insecticides that combine a bee-safe insecticide used during bloom with broader-spectrum insecticides used after bloom once bees are out of the field. We have performance of registered insecticides against fruitworms was tested this past season by treating three 5-10 acre fields with one of the following programs at four commercial farms:

1) Guthion–based program
2) Asana-based program
3) Reduced-Risk Program including Intrepid during bloom and Delegate and Assail after bloom.

We found no statistical difference between programs in the form of single-berry damage or multiple-berry damage during the season. We also found no fruitworm hibernaculae emerging from hibernaculae collected during harvest from each of these fields. These results provide confidence that alternative programs can provide similar efficacy to a standard Guthion program.

SUMMARY

Fruitworm management is challenging due to the early timing of activity during bloom, and because identifying the start of egg laying and egg hatch can be difficult. However, by using a well-maintained trapping program, tracking degree days, making applications of effective insecticides at the right time and with good coverage, growers can have effective control of this early-season pest.

Set traps out at the start of bloom, check them regularly, if moths are trapped set the biofix and apply a bee-safe insecticide at ~100 GDD after biofix and reapply if needed. After bloom and honey bees are removed, apply an effective insecticide to protect fruit from fruitworm larvae.

This talk will review these and other issues related to effective control of fruitworms in highbush blueberry, and if there is time remaining I will spend some time discussing insecticide options for other key blueberry insect pests.

For more information, contact me at isaacsr@msu.edu, or look online at MSU's Blueberry Website: *www.blueberries.msu.edu*

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Within-plant and within-field distribution of blueberry thrips

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Several species of thrips have been reported to infest blueberries. In New Jersey, *Frankliniella tritici* and *Scirtothrips ruthveni* have been identified as the most common species infesting highbush blueberries. Thrips injury in blueberries can be recognized by tight curling of leaves, accompanied by malformation of leaves (Figure 1). In addition, and more importantly, some of these thrips species preferentially feed on flowers. Feeding injury to flowers can affect fruit set. Previous studies conducted at the Rutgers Blueberry/Cranberry Research Center (Chatsworth, NJ) showed that white sticky traps are more suitable for thrips population monitoring than yellow or blue in highbush blueberries. However, these studies were unable to explain the high variability observed among three sampling methods: white sticky traps, beating trays, and leaf analyses.

Figure 1. Typical tight curling of leaves observed in trhips-infested blueberries

The main goal of this study was to determine the within-plant and within-field distribution of thrips. These studies may help clarify the observed seasonal differences among sampling methods.

In 2006, thrips distribution within a bush was studied at two sites in a commercial blueberry farm. From the 1st week of April until the last week of August, the population of thrips was monitored in eight randomly selected blueberry bushes (4 bushes per site). White sticky traps were placed within each bush at three heights (low, medium, and high). In addition, from bud formation/elongation until flowering, five flower and leaf buds were collected weekly from each height and examined for thrips. During flowering, five flower clusters were collected at each height per bush. From fruit maturation until harvest, five fruit clusters were collected weekly per height/bush. Leaf samples were also collected weekly from bloom until the end of August from five terminals per bush at each height. Buds, flower, leaf, and fruit samples were taken from eight bushes, randomly selected around each sticky trap.

The highest numbers of thrips were found in the “high” sticky traps while the lowest numbers were found in the “low” traps. Abundance of thrips in sticky traps

peaked soon after flowering. In contrast, the highest numbers of thrips in bushes were found in the “low” leaves. Only few thrips were found in flower and leaf buds, flowers, and fruit.

In 2007, we determined the distribution of thrips in a blueberry field. A total of 50 sampling sites were selected, in an evenly-spaced grid, in a blueberry field near the forest at the Rutgers Research Center. The field was ~0.3 ha, and received no insecticide sprays. At each sampling site, a white sticky trap was placed near a bush at canopy level. Also, beating-tray samples were taken from a lower branch of a bush near the sticky traps. Number of trips in sticky traps and on bushes was recorded weekly from bud formation/elongation until fruit maturation. Fruit samples were taken from each site at the end of the study.

Trap and on-bush counts did not share any spatial structure, i.e., there was no correlation between number of thrips on traps and on bushes. Early in the season, counts were in general higher on traps near the forest. This, however, was not the case for counts on bushes or for trap counts for the later part of the season, where there was no clear forest “edge” effect. The percent damage was correlated with the thrips counts on bushes, but not from counts on traps. In general, fruit damage by thrips was very low (< 6%).

In summary, we found thrips reaching highest peak abundance soon after fruit set in New Jersey blueberries. Thrips were mainly found feeding on young leaves in the lower parts of bushes. Our studies on within field distribution of thrips identified two possible sources of infestation. Sticky traps revealed migration of thrips from wild hosts in the forest into a field. We found no correlation of thrips counts on traps and on bush. Thrips counts on bushes revealed an on-field “resident” population. Counts of thrips on sticky traps were several magnitudes higher than on bush counts. Furthermore, thrips damage to berries was only correlated to numbers of thrips on bushes. This indicates that data of thrips from sticky traps need to be interpreted with care.

DEVELOPING A CRANBERRY WEEVIL MONITORING STRATEGY FOR HIGHBUSH BLUEBERRIES

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There is cumulating evidence for the successful incorporation and utilization of pheromones and host plant volatiles in integrated pest management (IPM) programs. These volatile chemicals are often used as attractants in traps, thus increasing trapping and monitoring efficiency.

The flower bud feeding cranberry weevil (a.k.a. blossom weevil, *Anthonomus musculus* Say, Coleoptera: Curculionidae) (Fig. 1) may use volatile chemicals to locate a suitable host plant and potential mates. In early spring, adults migrate from overwintering hosts in the woods to adjacent blueberry fields. After colonization, adults aggregate along the edges of the fields and mate. Eggs are deposited into developing flower buds and subsequent larval feeding causes the greatest economic losses: flower buds in which larvae complete their development fail to produce fruit. The immature stages develop protected by the buds; therefore, management strategies typically target the mobile adults. The presence of this pest causes economic losses to commercial cranberry and blueberry growers in many areas where these crops are produced. Adult weevils actively move around plants on sunny days, and can be monitored in highbush blueberries with beat trays. On cloudy days, visual assessment of blossom damage provides an alternative monitoring technique. Both of these techniques are labor intensive, unreliable, and inaccurate because of the patchy distributions of the pest. Furthermore, weevils tend to drop to the ground when scouts disturb plants while searching for adult weevils. A cost effective and reliable method is needed for monitoring this pest and timing of insecticide applications.

To date, chemical attractants have not been identified for the cranberry weevil; therefore, the goal of this study was to identify the presence and role of pheromones and host-plant volatiles in the behavioral manipulation of this pest. Our specific objectives were to: 1) evaluate the behavioral responses of adult weevils to intact and damaged host plant parts, such as buds and flowers; 2) isolate and identify host plant volatiles from blueberry buds and open flowers; and 3) identify the cranberry weevil pheromone.

Response to host plant parts was different for male and female weevils, which seems to be a common pattern among related *Anthonomus* species. Females of the cranberry weevil were attracted to open blueberry flowers while males were deterred by damaged flower buds and were attracted to healthy flower buds. This indicates that male cranberry weevils might be more attracted to host-plant volatiles earlier in the blueberry season than females. The differential responses between the sexes also suggest that both host plant odor and pheromones may serve as attractants for host-plant colonization.

Our volatile analyses indicate that there is a substantial difference in the number of chemicals released from healthy and damaged blueberry buds, and their blend proportions varied depending on the plant's developmental stage (buds versus flowers). The spring emergence of cranberry weevils coincides with the first stages of bud development in its blueberry host, thereafter adults continue to damage buds, flowers, and leaves. Consequently host plant volatiles in early as well as in late phenological

stages of the host plant could play a role in host location. Since the cranberry weevil thrives on both the bud and the flowering stages, host plant recognition in this species depends on a blend of more ubiquitous plant volatiles as opposed to the presence or absence of stage specific compounds.

Pheromones are chemicals emitted by insects to communicate with other members of the same species and have been effectively employed in pest management to attract insects. We were able to verify for the first time the presence of male and female produced pheromones in the cranberry weevil. This discovery opens the way for the development of a potent lure that - when used with a sticky trap - will increase the monitoring efficacy of this insect.

In the future, we will continue to test plant volatiles alone and in combination with pheromones to design lures that achieve effective monitoring of cranberry weevils (Fig. 2).

Fig. 1. Cranberry weevil adult on a

Fig. 2. Bubble (left) and Splat (right) lures used in field trials for attracting cranberry weevils to yellow sticky traps.

YIELD, BERRY WEIGHT, AND SEED SET OBSERVATIONS IN 'DUKE' AND 'BLUECROP' HIGHBUSH BLUEBERRIES

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Yield is influenced by many factors, but relatively few studies have tried to dissect the components of yield. This talk is part of ongoing studies evaluating yield interactions in blueberry. It discusses concepts regarding berry weight and seed set (pollination) that contribute to yield. Among some of our pertinent observations:

Berry weight and yield. Q: Are they correlated? **A:** Across a 10 year period, in our experimental plots, no correlation whatsoever was observed. **Q:** Does low berry weight mean that yields will be poor? **A:** No, low berry weight does not necessarily mean that pollination was poor nor that yields will be reduced. In fact for 'Duke', some of the highest yielding years had small fruit at first harvest.

Berry weight and pollination. Q: Is berry weight reflective of pollination? **A:** Only to a degree. In general, within any given year higher numbers of seed stimulate bigger final fruit size and lower numbers of seed result in smaller fruit. But observations of relatively lower berry weight don't necessarily mean that pollination was poor. For 'Duke', berries with similar seed numbers (e.g. having equivalent pollination) varied in weight as much as 86% between years. 'Bluecrop' was less variable; nonetheless, for 'Bluecrop', berries with similar seed numbers varied in weight as much 39% between years. Hence for both cultivars, reduced berry weight was not necessarily due to poor pollination (but it could be in some cases).

Berry weight across sequential harvests. Q: Does berry weight always decrease from 1st harvest to final harvest? **A:** This was very consistently true for 'Bluecrop'. For 'Duke' yearly patterns of berry size were inconsistent, and some years showed increases in fruit size from 1st to 2nd harvests.

Predictability of yield ?? Q: Are yields predictable in any way? **A:** Disasters may occur at any time that might ruin yield in any given year, but in our plots, both 'Duke' and 'Bluecrop' showed indications of 3 year cycles for peak harvests, with 1999, 2002, and 2005 being peak years. 2008 showed an increase over 2007, but it is unclear if it will truly be a "peak" year. At the time of this writing it is unclear if this periodicity is an artifact or a real trend. Surprisingly, the cycles across this observed period appeared to be descending cycles (h-m-l), rather than ascending cycles (l-m-h). The reasons for these putative cycles are, at this point, unknown and may represent environmental effects, cultural practices, or some combination of the two.

A TRANSGENIC APPROACH TO UNDERSTANDING COLD TOLERANCE IN BLUEBERRY CULTIVARS

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Cold or freezing tolerance, often referred to as cold hardiness, is an important trait in plants that grow in temperate climates. Freezing damage can directly or indirectly reduce yield through damage to vegetative and floral plant parts and the resulting 'wounds' provide an entry point for pathogens. Cold hardiness is genetically controlled and involves many aspects of plant growth and metabolism. Cold hardiness also changes throughout the year. As cold weather approaches, plants 'acclimate' and become more cold hardy. Similarly, as the weather warms, plants 'deacclimate' to begin another growth season and in the process become less cold hardy. One of our goals is to better understand which specific genes are important and how changes in the expression of those genes relate to cold or freezing tolerance. Expression of the key genes involved, or the products of those genes (usually proteins) could be monitored in breeding populations to enhance selection of cold or freezing tolerant plants.

A group of genes known to be induced when plants are exposed to the cold has been identified in blueberry and other plants. These genes are typically referred to as COR (Cold Responsive), but the function(s) of the gene products are varied and some are unknown. There are overlaps between the cold tolerance induction pathway and the dehydration tolerance pathway since some of the physical features of both conditions are similar (i.e. loss of available water). Some of the COR genes are 'turned on' by a common regulatory element called CBF (C-repeat binding factor). We studied the expression of CBF in flower buds of the cultivars Bluecrop (cold hardy) and Tifblue (less cold hardy) during the cold acclimation and deacclimation process. Our data show that CBF expression levels were higher in Bluecrop than in Tifblue at all times tested. Furthermore, CBF expression was highest at the first time point (late September) and declined as chilling hours accumulated. As deacclimation began in the spring (mid-March), CBF levels again increased. These data suggest that the acclimation process starts before exposure to very low (between 0 and 7 C) temperatures. This may due to fluctuating day/night temperatures, dehydration, shortening day length, or some other factor.

In conjunction with this project, we also cloned and sequenced the blueberry CBF gene from 'Bluecrop'. The coding region of the gene was modified for high-level expression in transgenic plants. The gene was transferred into Arabidopsis as a model plant system to determine the effects on cold tolerance and COR gene expression. Our data show that overexpression of the blueberry CBF gene in Arabidopsis increases the freezing tolerance of non-acclimated plants. Of the six COR genes evaluated, only two showed modest increases in expression due to the expression of the blueberry CBF gene in the transgenic Arabidopsis. It is possible that the blueberry gene product does not efficiently bind to and activate some of the Arabidopsis genes. Alternatively, there are several CBF genes known in some plant species, including Arabidopsis, and there is growing evidence that each gene has specific functions. Thus, other CBF genes may be required to activate the full complement of COR genes. It is noteworthy, that although we did not detect activation of all COR genes tested, we were still able to increase freezing tolerance. Thus the cloned blueberry CBF gene can be utilized to increase freezing tolerance in transgenic plants. Furthermore, expression of these genes could be monitored and compared among seedlings in a breeding population to predict those that will be more freezing tolerant.

Session 20
Sweet Corn

Dealing With Insect Pests of Sweet Corn

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Corn Flea Beetles

Corn flea beetles can be a serious pest of sweet corn as they transmit bacterial wilt disease (also called Stewart's Wilt disease). These beetles and bacterial wilt disease problems increase after a mild winter, so much depends on the severity of the winter weather conditions January-March 2009. Because flea beetles are usually more numerous after mild winters, predictions of beetle populations can be based on weather patterns and these predictions are available thru the Rutgers IPM program. One of the best management options is to plant varieties that are resistant to bacterial wilt disease, or those listed in the Sweet Corn varieties table of the 2009 Commercial Vegetable Production Recommendations for New Jersey. If susceptible varieties are planted, pre-treated seed or at-plant insecticides effectively control flea beetles (be aware that cool spring temperatures will reduce the effectiveness of at-plant insecticides). Or, as another option, growers can treat susceptible varieties at spike stage of corn growth when 5% of the plants are infested with flea beetles. There have been no reports of insecticide resistance by corn flea beetles, thus growers have many different insecticides to select from, including pyrethroids, carbamates, organo-phosphates, and neonicotinoids. Apply foliar treatments early in the morning when beetles are less active.

Corn Sap Beetles

Sap beetles are small beetles that invade the ear tips and deposit eggs among the ear tip kernels. Small white beetle larvae hatch from the eggs and feed on the kernels, often rendering the ears unmarketable. Use tight-husked varieties to reduce sap beetle invasion of the ear tips, and reduce damage to the ear tips as much as possible: bird and animal damage opens the tips up to beetle invasion, as Japanese beetles often chew the silks down which allows easy access by sap beetles. Remember that the current Bt (*Bacillus thuringiensis*) corn varieties control the worm pests but do not control sap beetles or Japanese beetles. Control of sap beetles must be obtained before the beetles enter the ear tip. Insecticides applied for worm control generally control sap beetles, including the labeled pyrethroids, methomyl, and carbaryl or encapsulated methyl-parathion.

European Corn Borers, Corn Earworms, Fall Armyworms

European corn borers, corn earworms and fall armyworms are 'worm' pests of sweet corn that growers usually find in their fields each year. Corn borers overwinter in this area, corn earworms may overwinter around us (in mild winters), and fall armyworms migrate into NJ each year from southern areas. All of these pests attack both the whorl stage of sweet corn as well as the ears.

In trials conducted throughout the area (Long Island, Delaware, Pennsylvania, and Virginia), several materials were effective against all 3 of these pests, including methomyl (Lannate), spinosad (SpinTor/Entrust), spinetoram (Radiant), and thiodicarb (Larvin). The pyrethroids were especially effective against the corn borer and corn earworm, but were less effective against larger instar fall armyworm (pyrethroids controlled small fall armyworm larvae very well, though). Although there were a few reports from growers that frequent applications of pyrethroids did not reduce worm damage, all research trials throughout the northeast showed very good to excellent worm control using pyrethroids.

Timing of application and spray coverage of the ears is very important for both sap beetles and worm control, as control is not possible once these pests enter the ear. Use high volume, high pressure and direct the sprays to cover the ear zone for best results. Follow the Rutgers IPM Sweet Corn spray program for effective management of sweet corn insect pests.

Session 21
Water Issues, New Research & 3rd Party Audits- Food Safety

A NOVEL APPROACH TO FUNDING PRODUCE SAFETY RESEARCH

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In early 2007, Fresh Express initiated an innovative process for stimulating produce safety research by making available $2 million for research and setting up an independent Scientific Advisory Panel to guide the program and select projects for funding. The panel consisted of Dr. Michael Osterholm (chair), Dr. Robert Gravani, Dr. Robert Buchanan, Dr. Craig Hedberg, Dr. Jeff Farrar, and Dr. Robert Tauxe. The initiative had two main objectives: (1) to fund rigorous, innovative and multidisciplinary research addressing the safety of lettuce, spinach and other leafy greens, and (2) to share research findings as widely as possible to help stimulate the development of advanced safeguards within the fresh-cut produce industry.

In January 2007, Fresh Express announced a call for proposals directed at five priority areas of research. In response, the Scientific Advisory Panel received 65 proposals from academic, government and industry researchers across 27 states and Canada. The panel reviewed all proposals against a rigorous set of criteria to identify the most innovative and promising projects. Nine projects were awarded one-year research grants and all are at or very near completion. An overview of results from the following projects will be highlighted in the presentation:

Subsurface Contamination and Internalization of *E. Coli O157:H7* in Pre-Harvest Lettuce
Principal Investigator: Michael Doyle, University of Georgia
Movement of *E. Coli O157:H7* in Spinach and Dissemination to Leafy Greens by Insects
Principal Investigator: Jacqueline Fletcher, Oklahoma State University
Interaction of *E. Coli O157:H7* with Fresh Leafy Green Produce
Principal Investigator: Jorge Girón, University of Arizona
Factors that Influence the Ability of *E. Coli O157:H7* to Multiply on Lettuce and Leafy Greens
Principal Investigator: Linda Harris, University of California, Davis
Fate of *E. Coli O157:H7* on Fresh and Fresh-Cut Iceberg Lettuce and Spinach in the Presence of Normal Background Microflora
Principal Investigator: Mark Harrison, University of Georgia
Determining the Environmental Factors Contributing to the Extended Survival or Regrowth of Foodborne Pathogens in Composting Systems
Principal Investigator: Xiuping Jiang, Clemson University
Quantifying the Risk of Transfer and Internalization of *E. Coli O157:H7* During Processing of Leafy Greens
Principal Investigator: Elliot Ryser, Michigan State University
Novel Approach to Investigate Internalization of *E. Coli O157:H7* in Lettuce and Spinach
Principal Investigator: Manan Sharma, Agricultural Research Service, USDA
Sanitization of Leafy Vegetables by Integrating Gaseous Ozone Treatment into Produce Processes
Principal Investigator: Ahmed Yousef, Ohio State University

FECAL CONTAMINATION OF IRRIGATION WATER: KEEP IT OFF THE DINNER TABLE

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Contamination of fresh, ready-to-eat fruits and vegetables with pathogens is a significant issue for U.S. agriculture. In many cases, fecal-oral pathogens such as toxin-producing *E. coli*, *Salmonella spp.,* and norovirus are the causative agents (Heaton and Jones, 2008). Traceback analysis, to identify when contamination occurred in the production chain, can be a daunting task (Doyle and Erickson, 2008). Fecally contaminated irrigation water frequently is indicated as either a possible source, or as the likely source, that leads to contamination of fresh, ready-to-eat fruits and vegetables with pathogens (Liefert and others, 2008). According to the Centers for Disease Control and Prevention (CDC) (www.cfsan.fda.gov/~dms/prodpla2.html, accessed 02 December 2008), at least 12 percent of foodborne outbreaks in the 1990s were attributable to fresh produce, and the economic cost of foodborne illness is $10 to $83 billion per year.

Once pathogenic microorganisms contaminate fruits and vegetables, ambient conditions influence whether they die, persist, or grow. Key factors that affect pathogen survival on plant surfaces include microbe-microbe interactions (competition with native bacteria, collaboration with invasive fungi), plant-microbe interactions (both positive and negative), exposure to sunlight (germicidal ultraviolet irradiation), and desiccation (Heaton and Jones, 2008). Relatively few studies have investigated the effects of these phenomena (reviewed in Aruscavage and others, 2006; Steele and Odumeru, 2004). Representative survival statistics are summarized in Table 1.

Various produce sanitation practices (washing, disinfection, and other treatments) can reduce but not eliminate contaminating pathogens from plant surfaces. Stringent disinfection treatments can reduce pathogen loads by 99.9%, but many treatments are less effective (Aruscavage and others, 2006; Bassett and McClure, 2008). Depending on the level of contamination, health risk from residual pathogens may be unacceptable. Washing and disinfection practices are less effective against pathogens that succeed in penetrating the plant interior (Aruscavage and others, 2006). For these reasons, prevention of contamination is considered a primary means to control health risk from foodborne pathogens (Leifert and others, 2008).

"Food Safety Begins on the Farm: a Growers' Guide" lists the following sources of fecal-oral pathogens that contaminate produce (Rangarajan and others, 2003):

- Soil
- Irrigation water
- Animal manure (untreated manure, inadequately composted manure, or direct contamination by animals in the field)
- Field workers
- Equipment (harvesting and transport)
- Wash and rinse water
- Produce handlers (during packing, wholesale and retail operations, and at home)
- Ice, cooling units, contact with other contaminated products, and other cross-contamination vectors

Among these potential sources, the role of irrigation water is perhaps the least well understood. Traceback analysis after outbreaks, by definition, is a historical analysis that takes place weeks or months after crops were last irrigated. Because water conditions change rapidly, especially for surface water, assessment of water quality used for irrigation is extremely difficult—often impossible—so long after the irrigation event. Published reports only rarely give information about the sanitary quality of water used for irrigation, although a few that have done so are reports from Ontario, Canada (Steele and others, 2005), and Arizona (in Gerba and Choi, 2006). No information is available about the quality of irrigation

water that was used for crops that ultimately led to outbreaks of foodborne illness. Lacking this information, informed decisions about acceptable quality of irrigation water are difficult to make.

Though no comprehensive survey of fecal contamination levels in irrigation water has yet been accomplished, information from the U.S. Geological Survey (USGS) National Water Information Network (NWIS; available online at http://waterdata.usgs.gov/nwis) can be useful when evaluating source-water quality. For example, the USGS analyzed nearly 3,500 surface-water samples from Ohio for *E. coli* density between April 1992 and September 2005. This sample set was not designed to be representative of irrigation-water quality, and it may be biased toward contaminated samples because specific sites were targeted for intensive monitoring. Nevertheless, the characteristics of these data have interesting implications with regard to irrigation-water quality. Overall, 35% of the samples contained fewer than 126 colony-forming units per 100 mL (CFU/100 mL), 13% contained between 126 and 235 CFU/100 mL, 20% contained between 235 and 576 CFU/100 mL, and 32% contained more than 576 CFU/100 mL *E. coli*. The breakpoints in this analysis represent criteria promulgated by U.S. Environmental Protection Agency for recreational water quality (USEPA 2004).

The USEPA recreational-water quality criteria have been put forth for potential incorporation into the Commodity Specific Food Safety Guidelines for the Production and Harvest of Lettuce and Leafy Greens (current version available at www.cfsan.fda.gov/~acrobat/lettsup.pdf) by the California Leafy Green Products Handler Marketing Agreement (www.caleafygreens.ca.gov). The June 2007 draft document recommends at least monthly sampling of irrigation water sources. Acceptance criteria for preharvest foliar application are similar to the criteria for designated swimming beaches (rolling geometric mean of 5 samples less than or equal to 126 CFU/100 mL and no single sample higher than 235 CFU/100 mL). For preharvest nonfoliar applications, the acceptance criterion for single measurements would be relaxed (rolling geometric mean of 5 samples less than or equal to 126 CFU/100 mL and no single sample higher than 576 CFU/100 mL). For postharvest applications such as equipment cleaning and product rehydration and cooling, the water-quality criterion would be similar to that for potable water (drinking water; that is, less than 1 CFU/100 mL *E. coli*).

Water-quality criteria promulgated by USEPA, such as the recreational-water quality criteria cited above, are based on a target risk level. Calculation of the recreational-water quality criteria was based on the desire to meet a risk level of 8 cases of gastrointestinal illness per 1,000 swimmers per year (Dufour, 1984). The relation between *E. coli* density and gastrointestinal illness is complex and depends on many factors, including

- the relation between the indicator (*E. coli*) and the density of pathogens capable of causing gastrointestinal illness
- the amount of contaminated water ingested
- the susceptibility of the subject to disease
- the infectivity of the pathogen.

One would expect each of these factors to differ for water recreation and consumption of irrigated crops. Thus, it is exceedingly unlikely that the risk posed by swimming in water with a particular level of fecal contamination is equivalent to the risk posed by consuming produce that was irrigated with the same water source.

Gerba and Choi (2006) proposed a risk target of 1 illness in 10,000 persons per year, the same target used for drinking water in the United States. Microbial risk assessment models have been used to estimate the maximum density of specific pathogens in water corresponding to this risk level (Stine and others, 2005); however, extrapolation of these values to *E. coli*- or other indicator-based water quality criteria has, thus far, not been accomplished. Extensive evaluation of irrigation-water quality, both in terms of fecal-indicator bacteria density and occurrence of key pathogens, will be a necessary first step for eventual science-based criteria for irrigation-water quality. Until these criteria are developed, it remains difficult to judge the level of irrigation-ater quality necessary to keep produce contaminated with fecal-oral pathogens off of the dinner table.

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Table 1: Survival of pathogens on contaminated fruits and vegetables

Location	Pathogens	Survival statistic	Notes	Citation
Carrot and radish roots, grown in irrigated soil	*Salmonella typhimurium*	Initial 5-log decline (28 days), followed by persistence in soil to >180 days.	Detected on field-grown radishes >80 days and carrots >180 days after irrigation.	Islam and others, 2004
Lettuce, overhead irrigated	*E. coli* O157:H7	Detected on edible leaves >20 days after irrigation.	Plant growth conditions not fully described (exposure to solar irradiation, rainfall, desiccation).	Solomon and others, 2003
Various (review article)	*E. coli* O157:H7 and *Salmonella spp.*	Persistence ranging from 20 to 161 days on plant surfaces (leaf and tomato).	Information included in Table 1 of citation, summary of 12 references.	Aruscavage and others, 2006
Various (review article)	Summary of many bacterial and viral pathogens	Bacteria generally survive fewer than 15 days. Enteroviruses generally survive fewer than 15 days.	Summarized from prior reports, many of them obscure.	Steele and Odumeru, 2004

Methods to Treat Irrigation Water for Pathogens

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Food Safety has become an important marketing and health issue for the produce industry. Buyers are demanding assurances from growers that their produce is safe. It will become more difficult for growers to market their fruits and vegetables if they don't have a Good Agricultural Practices (GAPs) program in place to make sure their products are at a reduced risk of contamination.

Good Agricultural Practices = Are based on the USDA's Guidelines to Minimize Microbial Food Safety Hazards in Fresh Fruits and Vegetables. This is a voluntary framework and is not currently a regulation.

In any fresh produce farming operation contamination can occur at several points during the production and handling cycle. Using good agricultural practices can help minimize the risk of contamination of your product. Focus on areas over you have control and take action to prevent possible contamination.

GAPs Actions to reduce risk of contamination:

1. Prevent microbial contamination vs. trying to correct a contamination problem
2. Start a program of GAPs on your farm
3. Avoid human/animal feces contamination
4. Test your water source
5. Be aware of animal manure (proximity to fields and application timing)
6. Train workers in hygiene/sanitation
7. Follow all applicable laws (pesticides, etc)
8. Maintain Traceback/recordkeeping/documentation

Remember:

- Your operation should have a food safety officer
- The officer has the authority to stop production in order to ensure compliance
- You should have a WRITTEN plan and make it fit your operation
    - Remember what you put in the plan you MUST do
    - Check that your plan is being used and works!
- Test your water for standard indicators (fecal coliform, generic *E. coli*)
- Hand washing, personal health, and training for employees
- Document training for workers

The Strategy to Reduce Risk:

Identify crops and procedures most likely associated with food borne illness
Develop procedures to reduce outbreak
Monitor procedures to keep produce safe
Verify that produce is consistently safe

Protect Your Water Source

Vegetated buffers
Grassed waterways
Diversion berms
Use groundwater

Irrigation – Best Practices

Water System Description
Sanitary Survey
Test Water at Point of Use
Appropriate Microbial Quality for Use
Document Test Results

Water Testing

During Irrigation Season (Monthly)

Generic *E. coli*
Quantitative Test

Recreational Water Quality

5 Sample geo-mean <126 MPN/100 ml
Individual Samples <235 MPN/100ml (if contacting foliage)
<576 MPN/100 ml (if not contacting foliage)

Contamination Detected!

Stop Use and Retest
Identify Source of Contamination
Remediate water if necessary

Irrigation Disinfection

Greenhouses and Nurseries – for Plant Pathogens
Drip Irrigation Systems – For emitter Clogging – Not usually continuous feed

Chlorine – Factors influencing effectiveness

Organic matter in the water
Contact time with the water
pH of the water

Ultraviolet Radiation – UV

Has been done for Plant Pathogens (254 nm)
Duration and Intensity
Turbidity (clarity) of water

Hydrogen Peroxide

Strong Oxidizer
Breaks Down Readily
Industrial/Food Grade 35%

Other Methods

Copper Ionization
Ozone

Technology	Pros	Cons
UV	Good disinfectant	No residual disinfection
	No added Chemicals	Need relatively clear water (filtration)
		Field-adaptability
Ozone	Good disinfectant	Off-gases if not under pressure
	"people-friendly"	Subject to organic matter (indiscriminate). Need to measure ORP
		Field Adaptability?
Chlorine	Good disinfectant	Can be hard on system parts
	Cheap	Some forms have limited shelf life
Cu Ionization	No "chemicals" per se	Unknown broad-spectrum disinfection capabilities

Please see the website for the North Carolina Fresh Produce Safety Taskforce:
www.ncfreshproducesafety.org
For information, resources, links and articles pertaining to fresh produce safety!

Session 22
Asparagus

Working With the Rutgers Food Innovation Center Incubator: The Packaged Asparagus Experience

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As of October, 2008, construction of the new Incubator facility of the Rutgers Food Innovation Center was completed. Since then, FIC personnel have moved into the building, and operations will be starting during the early months of 2009. FIC has been in existence since 2001, and serving clients during the period to the present, but the availability of the sophisticated Incubator facility will enhance the level of services available to clients tremendously. The presentation given at the VGANJ Educational Meeting will discuss the new paradigm for client engagement with FIC and the Incubator, using the packaged Sheppard asparagus product as an example.

The packaged asparagus product is one in which Sheppard Farms and FIC have partnered from its inception. The product concept is fresh asparagus spears that are harvested, trimmed, and double-washed, and then sealed in a gusseted polyfilm bag. The bag has special properties that enable it to be microwaved, and the asparagus inside to be cooked by the steam created by superheated water. The film is also engineered with microperforations to develop a modified headspace environment and prolong the shelf life of the asparagus inside. The concept was devised as a way to develop a value-added asparagus product that catered to consumer trends in quality and convenience.

Since Sheppard Farms has been a traditional vegetable grower/packer and shipper, they previously had no special expertise in the processed/packaged food arena. By teaming with FIC, Sheppard was able to gain access to the same capabilities possessed by Fortune 500 food companies at a fraction of the cost. First, FIC was able to validate the product concept with consumers by collaborating on consumer preference tests in a set of focus group studies. These were essential to better define the properties of the finished product.

FIC then assisted Sheppard in the development of the package design and package graphics. Nutrition labeling, food preparation methods, and UPC coding were devised with the assistance of FIC. With the availability of the Incubator Facility, FIC will be better able to assist in technical areas such as package design, and particularly automated packaging efficiency.

The next phase was the preparation of a detailed business plan to serve as a road map for the new product. FIC worked with Sheppard Farms to obtain a USDA/VAP grant totaling $60,000 to fund the development of the plan. While the plan was being written, FIC assisted Sheppard with a limited test market of the product in a northern NJ supermarket chain, providing critical information on the outcome of the test during spring 2006.

Since the Incubator Facility was completed only recently, Sheppard Farms was forced to build their own production capabilities at their packing shed in Cedarville. With the availability of the Incubator, however, it would have been possible to begin the early stages of production at the facility, where state-of-the-art processing capabilities are coming on line, and site certifications for USDA, organic, kosher, etc. are already being established. Capabilities within the Incubator will be available to potential clients such as Sheppard on a lease-basis, where square footage, equipment, storage, shipping, and time units may be acquired on an as-needed basis. Thus, no up-front investment into sophisticated processing and packaging equipment is necessary until the size of the business warrants a move from the Incubator into a larger through-put situation.

In summary, FIC will be an important resource to agricultural entrepreneurs in the Mid-Atlantic region. Services are available to devise and test new value-added product concepts. Once a concept is off the ground, resources can be found to assist with the development of detailed business plans. These plans will likely include a start-up phase in the Incubator Facility, where sophisticated food processing and packaging capabilities can be accessed without the need for costly up-front capital investment.

Impacts of Trade Sanctions on Peruvian Asparagus Imports

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The US asparagus industry faces increased competition from asparagus exports from Peru. The increased competition is in part the result of several trade agreements between the two countries. In 1991, the US enacted the Andean Trade Preference Act (ATPA) which eliminated tariffs on a number of products from Peru, Bolivia, Colombia, and Ecuador, and continued the practice under the Andean Trade Promotion and Drug Eradication Act (ATPDEA) in 2002. Under the ATPDEA, the US eliminated all tariffs on asparagus from Peru. The zero tariffs encouraged Peruvian exports of asparagus to the US. In 1995, for example, Peru exported about 10,000 tons of asparagus compared to 13,000 tons of asparagus exported by the US. By 2004, Peru was one of the world's top exporters of the vegetable exporting more than 73,000 tons compared to less than12, 000 tons for the US. Peruvian exports of asparagus are projected to increase to over 200,000 tons in 2008. The US and Peru signed the US-Peru Trade Promotion Agreement (PTPA) upon the expiration of the ATPDEA in 2006. These agreements will continue to mean losses in asparagus market share for US producers. In recognition of those losses, the Farm Bill includes $15 million for the market loss assistance program for asparagus growers.

While the US allows over 99 percent of Peru's exports duty-free access to the US markets, less than 2 percent of US agricultural exports enjoy such access. The ratification of the PTPA by the Peruvian Congress on June 28, 2006; the US House of Representatives on November 2, 2007 and by the US Senate on December 4, 2007 means that US exporters will receive duty-free access on about 90 percent of current trade and witness an elimination of all tariffs over time on remaining products. Both countries need to modify their legislation to abide by the treaty so that it can take effect. The agreement includes volume-based safeguards to protect products from a surge of imports for a limited number of products.

The current pattern of signing trade agreements continues an effort by US administrations to forge trade alliances among countries where possible. These alliances foster economic integration through trade liberalization by replacing quantitative restrictions with tariffs, reducing tariffs and increasing transparency in trade policymaking. These measures, when implemented, generally spur economic growth and are intended to create a credible environment that facilitates free trade and encourage new investment into export industries to take advantage of reduced trade barriers. This growth is likely to mean an increase in consumer demand for high-value US imports that provide an opportunity for businesses to explore avenues for trade.

To be sure, the most important impacts in terms of market opportunities for US agriculture in general and the New Jersey agricultural community in particular, are the income growth and consumption effects that result from continued economic growth in Peru that is spurred by preferential trading arrangements that reduce barriers to trade, promote economic reform and economic integration. Indeed, the Commission on International Trade, Development and Cooperation concludes: "If developing countries continue to liberalize trade and investment policies and incomes of their citizens continue to increase, U.S. agriculture will find ever expanding markets abroad. But if these economies stagnate, the effect will be felt at home as agricultural productivity increases but demand does not exist "(NCFAP, 1997, p.7).

ASPARAGUS DISEASE MANAGEMENT IN THE NORTHEASTERN US

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Keeping asparagus production profitable in the northeastern US requires vigilant management to optimize production and minimize inputs. Diseases reduce profits every year by the direct loss of marketable spears or through the reduced vigor and stand longevity. Profits are further eroded by the cost of fungicides and the efforts to apply them. This paper presents an overview of the major diseases of asparagus that routinely cause losses in the northeastern US and reviews their management strategies.

FOLIAR DISEASES OF ASPARAGUS

Asparagus Rust

Asparagus rust, caused by *Puccinia asparagi*, was originally described in France in 1805, and appeared in New Jersey in 1896. Within a few years, rust had spread to every region where asparagus was grown. *P. asparagi* is an autoecious (single host) pathogen, that produces four spore types (basidiospores, aeciospores, urediniospores, and teliospores) in succession. Early spring infections of young spears occur with basidiospores. These infections, in turn, produce oval, light-green lesions about 6 x 19 mm in size. One to 2 weeks later, cream-colored aecia are produced. The wind-blown aeciospores initiate early rust epidemics and then give rise to the brownish-red uredinial stage. The uredinial cycle repeats every 10 to 14 days during July and August and causes the majority of fern damage. In early fall, the telial stage replace uredinial stage and is responsible for the over-wintering stage. The teliospores over-winter and start the cycle again by producing basidiospores. Because first-year fields are not harvested, the aecial stage on the spear is not removed and the inoculum remains on the crop, which can lead to greater severity than in fields being cut. In the northeastern US, asparagus rust typically varies from mild to moderately severe due to the use of the Jersey all-male hybrids that have some tolerance.

Management of rust in the US has been achieved using an integrated approach of resistant cultivars, fungicides, and sanitation practices. Breeders have since made great improvements in incorporating stable, quantitatively inherited resistance into commercial lines. However, the current level of resistance is insufficient to completely control severe outbreaks. Cultivar improvements are still needed. Because damage thresholds have been determined, fungicide applications could be timed to suppress outbreaks during periods when conducive weather conditions prevail. The current dilemma in rust management is the loss of registered products and/or the processors' refusal to accept asparagus treated with EBDC fungicides such as mancozeb and maneb.. The products Bravo WS (chlorothalonil), Dithane DF (mancozeb), and Nova 40W (myclobutanil) can suppress outbreaks and are registered for use after spears are harvested.

Purple Spot

Purple spot, which is caused by *Pleospora herbarium* (anamorph *Stemphylium vesicarium*), was first reported in the US in 1981. The disease has since been reported in all major asparagus-growing regions in the US. Initially, the damage from purple spot was cosmetic, but became more damaging over the years. It was first reported as small (1-2 mm), elliptical, slightly sunken, purplish spots that blemished the spears and lowered their marketability. Today, the major damage from purple spot is on the fern growth. Damage results from defoliation of the needle-like cladophylls, which reduces the flow of carbohydrates to the roots and lowers next year's yield. It is not known if the resistance to purple spot has been inadvertently reduced through breeding or if the inoculum levels have reached threshold densities. No-till asparagus culture may have contributed to the increase in purple spot since colonized residues remain in the field.

Spear infections are favored by wet, cool weather and by wounding from wind-driven sand. During one harvest period in Connecticut, spears were free of purple spot until two days of wet and cold weather occurred, after which the incidence increased to 100%; when weather conditions improved, new spears remained disease-free. Current management of purple spot has focused on sanitation and fungicides. Removing the previous year's fern growth can reduce severity of purple spot on spears during harvest by reducing levels of over-wintering inoculum. Chopping and incorporating the stalks in the fall can prevent ascospores and conidia from becoming airborne, but the practice does not result in decomposition of the pseudothecia before the spring harvest. However, this practice must be weighed against the potential damage caused to the roots and crown that can favor *Fusarium* infections. Cover crop mulches and wind barriers that reduce blowing sand need investigation. The products Bravo WS (chlorothalonil), Dithane DF (mancozeb), and Nova 40W (myclobutanil) are registered for use against purple spot after spears are harvested. Additionally, studies in Michigan showed that Bravo WS (chlorothalonil) was effective when applied to the fern using the FAST (Forecasting *Alternaria solani* on Tomato) disease forecasting system, which monitors leaf wetness and estimates the probability of infection periods. Savings between $1,000-$2,000 per ha have been documented in Michigan using this system. A further reduction in inputs could be achieved by increasing cultivar resistance to purple spot.

Cercospora Blight

Another foliar disease that contributes to losses in asparagus in warm, humid environments is Cercospora blight, caused by *Cercospora asparagi*. It has been severe in eastern Oklahoma and North Carolina, but does not cause appreciable damage in cooler or dryer climates. Still, growers should be aware that this disease could increase in the Mid Atlantic regions if summers become more humid and hot. Lesions are small, oval, grayish-tan in color, with purple borders, and can be confused with those caused by *P. herbarium*. Blighted ferns turn yellow to brown and eventually die prematurely. Since there are no known sources of resistance to Cercospora blight, management must include sanitation and fungicide applications. Fall removal or burial of the year's fern residue can delay the onset of disease development.

Fungicides are also an important component of an integrated approach and can increase spear production the following year. The products Bravo WS (chlorothalonil), Dithane DF (mancozeb), and Nova 40W (myclobutanil) can suppress outbreaks and are registered for use after spears are harvested. The inclusion of disease forecasting models may reduce the number of applications.

SOILBORNE DISEASES OF ASPARAGUS

Fusarium crown and root rot

The disease was first noted in 1908. Over the years, the disease has been called dwarf asparagus, wilt and root rot, seedling blight, crown rot complex, and Fusarium stem and crown rot. The disease affects seedlings and mature plants and became economically limiting in the 1950's. US acreage declined annually from 1960 to 1980 and many growers in the eastern US were forced to abandoned asparagus as a crop.

The first *Fusarium* pathogen found associated with the disease was *Fusarium oxysporum* f. sp. *asparagi* in 1941. *F. proliferatum* was later shown in 1979 to be a pathogen by Dr. Stephen Johnston at Rutgers. Both pathogens are seedborne and carried on transplants and both pathogens appear to be present in most asparagus field soils. *F. oxysporum* f. sp. *asparagi* represents a group that contains many genetically distinct members. Pathogenicity on asparagus may be an unspecialized trait that appears frequently in *F. oxysporum.* On the other hand, *F. proliferatum* appears to belong to one mating group. Because perithecia are not found in nature, it is assumed that the asexual stage of *F. proliferatum* is responsible for dispersal. Using heterokaryon tests to follow vegetatively compatible groups, one group (US5) has been found to predominate in the US and Australia. Because seed transmission is the likely method of dissemination, simple seed disinfestation alone could slow the spread of *Fusarium* pathogens to new areas. Research has shown that agitating seeds in a 1:9 household bleach:water for 30 min, followed by a thorough rinsing in tap water, can significantly reduce the amount of *Fusarium* that exists on the seed.

Management of Fusarium crown and root rot has been difficult, mainly because pathogens are ubiquitous. Preventative measures, such as choosing sandy, well-drained soils and selecting the best cultivars for the area, are very important, but growers need strategies in place when established plantings show signs of decline. The resistance in the all-male hybrids has helped to reduce the financial losses due to this disease, but improvements are still needed that will ensure greater longevity for the planting. Fungicide applications have traditionally been ineffective or impractical. Any stress factor, such as drought or weeds, will increase the incidence and severity of Fusarium crown and root rot. As a result, management programs that control insects and weeds will reduce damage from Fusarium crown and root rot. Although asparagus is drought-tolerant, small deficits in soil moisture can result in large reductions in growth and increases in infection. Over harvesting can also exert stress on a production field; consequently, extending the harvest season weakens the plant's ability to regenerate the stems and ferns, which produce the carbohydrates for next year's yield, and should be avoided.

Limited success has been achieved by broadcasting NaCl onto older, declining fields. The practice of salting asparagus beds was probably used from before 1860 to around the 1940's to control weeds and boost yields. It appears to be a practice unique to the US and was discontinued after herbicides were developed in the 1940's. About this time, the number of reports of Fusarium crown and root rot in asparagus began to increase. Research has found that rates between 560-1120 kg NaCl/ha will boost vigor, slow the rate of decline, and may allow growers to recoup some profits for a negligible cost. The mechanism of NaCl on Fusarium crown and root rot is unclear. It does not affect soil pathogens and may improve host defense. The treatment offers little benefit to healthy asparagus and may not have value as a preventative strategy. Information about timing and rates are still needed, but concern about environmental issues and salt damage has delayed its acceptance as a management strategy.

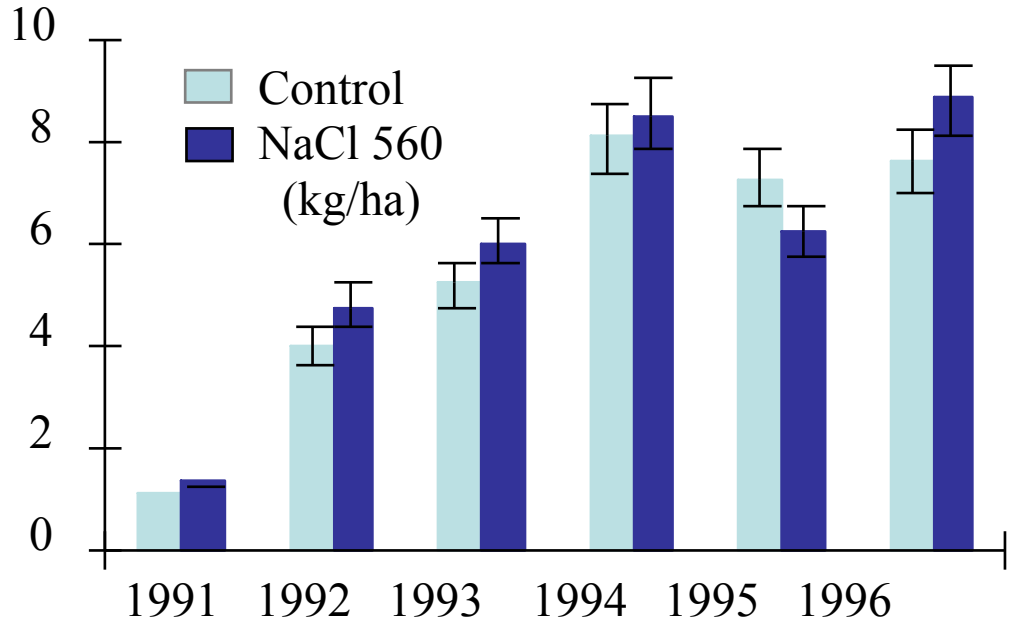

Figure 1. Effect of rock salt (NaCl) on the yield of asparagus.

Phytophthora Spear Rot

Phytophthora spear rot caused by *Phytophthora* sp. was first described in California in 1938, but was not thoroughly studied again until the 1980's when 30-54% reductions in yield were documented. It has now been reported in most asparagus-growing regions. Symptoms include soft, water-soaked lesions on shoots at, slightly above, or below the soil level. As the lesions expand, they turn light brown, collapse, and shrivel. This flattens the affected side of the spear, and the spear bends. The internal tissues of infected crowns may be a yellow-brown color.

The damage caused by Phytophthora spear rot can vary from year to year and site to site and depends on rainfall and soil drainage. Growers should avoid wet soil and areas that are poorly drained. There are no resistant cultivars and there are no thresholds available so growers should scout and consider action if and when the disease is confirmed. Fungicide applications are helpful in establishing beds when wet weather occurs. Products such as Ridomil Gold EC (mefenoxam) and Phostrol (phosphoric acid) are effective, but concerns about pathogen resistance in mefenoxam warrants the pursuit of other products and other strategies. Trials to identify resistance to Phytophthora spear rot are ongoing in California.

Viral Diseases of Asparagus

The first study demonstrating the effect of viruses on asparagus decline was done in New Jersey. A decline in productivity was correlated with the presence of viral agents in young plantings. Three viral agents are known to infect asparagus in the US. All three viruses--asparagus virus I (AV-I), asparagus virus II (AV-II), and tobacco streak virus (TSV)--appear to be widely distributed in commercial asparagus plantings. However, not all are equal in the damage they cause. None of the three viruses produces distinctive symptoms on asparagus. The damage is exhibited as reduced vigor and increased susceptibility to other diseases.

Under field conditions, AV-I infects only asparagus and is transmitted by a wide variety of aphid species in the stylet-borne manner, but efforts to suppress aphids have little effect on the spread of AV-I. The virus alone has little effect on plant growth, yield of spears, or longevity of the plant. It is an economic factor because it interacts with AV-II to produce more damage than with AV-II alone. Because AV-I is not seedborne, growers can be assured their new plantings are initially free of AV-I. Nevertheless, in Washington, a study found that all plants tend to get AV-I over time. AV-II occurs more frequently than AV-I and is more damaging. It is readily transmitted through seed from infected parents and from seed produced on healthy plants that were fertilized by AV-II-contaminated pollen. Due to routine indexing, only trace amounts of the AV-II are being found. AV-II was presumed to spread very slowly in the field. However, studies in New Zealand provided strong evidence that spread of AV-II was occurring during harvest on cutting knives. This observation warrants close attention to the possible spread of AV-II in production fields in the US. TSV, the second most common ilarvirus in asparagus, is not seedborne, but can spread presumably through thrips-mediated pollen transmission. Its contribution to yield loss is minor unless there is prior infection by AV-II. Because AV-II is the major threat, whether by itself or combined with AV-I and TSV, monitoring its presence and spread should become a routine practice. Rapid viral assays may help to index fields at risk and alert growers to use sanitation procedures during harvest.

Summary

The amount of asparagus consumed in the US will undoubtedly continue to increase as availability of the crop increases. However, the full effect of imports on the US industry may not be seen for some time. Industry-sponsored groups, such as Asparagus USA, have made progress in promoting US asparagus abroad and educating government agencies about the economic situation in the US. The imported shipments from South America have already diminished the frozen asparagus industry and have begun to make inroads into canned and fresh markets as well. It is also alarming that China committed approximately 54,000 ha to asparagus during 1992-1997. However, given the perishability of the crop, local fresh asparagus markets will still have some quality advantages, provided consumers will pay for that difference.

The development of genetically resistant material has always been a major area of asparagus research. The success of the all-male hybrids has been a tremendous asset to the industry, but increased disease resistance is still needed. As genetic modifications in plants become more advanced, the future should offer many solutions to the problems in asparagus. A concerted effort between breeders and plant health specialists must be maintained and supported to improve genetic resistance to AV-II, purple spot, Phytophthora spear rot, and Cercospora blight. Given the perennial nature of the crop, evaluations require long-term support from private and public sectors.

Prospects of the Mother Stalk Growing Method for Asparagus Season Extension

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Perishable food products were, until recent times, only available to consumers as they could be produced under local agricultural conditions. Cheap energy and modern transportation systems changed all of that, and fresh vegetables and fruits are now available to consumers throughout the year and in all locations of North America and the developed world. As fossil fuels are depleted and subject to global market fluctuations, the cost of imported perishable foods has become progressively more unstable. Local food production is desirable because it is both more secure and less dependant on energy costs.

In temperate locations such as New Jersey, climatic conditions impose clear limitations on traditional agriculture. These limitations have been circumvented in some instances via engineered structures that alter climatic parameters, for example high and low tunnels. Greenhouses are also in extensive use, but usually require substantial energy inputs to operate effectively. It is also possible to use solar or other unconventional energy sources to heat soil and surrounding atmosphere, creating a favorable environment for prolonged plant growth. Thus, it has been possible to extend the effective growing season, enabling plants to be established earlier and to be maintained in a productive state longer.

Asparagus is a perennial vegetable that has a typical production season of 6-8 weeks. During this period, axillary shoots elongate from the submerged crown to form the spears that are the harvested product. If spear harvest is allowed to continue beyond 8 weeks, the long-term health of the plant is adversely affected. Specifically, the plant will have inadequate canopy and time to garner photosynthates that will be used to replenish the crown for next year's growth.

The 'Mother Stalk' growing method (MS) was developed in Taiwan and China to allow spear harvest to continue beyond the 8-week period. The method capitalizes on the phenomenon of 'relative apical dominance', where the number of active growing shoots has an accumulated inhibiting effect on the elongation of new axillary shoots from the crown. If the number of active shoots is maintained at a certain level, new axillary shoots will continue to elongate from the crown throughout the growing season. Research results in Asia have shown that long-term crown health is not adversely affected by the MS method.

A two-year field experiment was conducted at RAREC to test the validity of the MS asparagus growing method in New Jersey, using Rutgers varieties. The MS method consisted of allowing three shoots to reach full maturity, followed by harvest of all subsequent spears. In addition to a direct MS treatment, a third regime was also tested: Harvest spears traditionally for two weeks following first spear appearance, then switch to the MS (3-shoots) method. The test plots were staked for wind protection, irrigated at regular intervals via drip, and fertilized regularly through drip lines.

During year 1 (2007), the best overall treatment was the modified MS method, with an average of 1.392 kg/m for the whole season (April-October; see Table below). The MS method alone was 1.162 kg/m and the traditional control 0.811 kg/m. Following year 2 (2008), however, the modified MS treatment had dropped to 0.946 kg/m, while the MS treatment increased to 1.353 kg/m. The control was approximately equal for year 2 as compared to year 1.

Table: Overall Seasonal Average Unit Spear Yield of Mother Stalk (MS) vs. Conventional Asparagus Growing Methods

Treatment	**Yield (kg/m) Year 1**	**Yield (kg/m) Year** 2
Modified MS	1.392	0.946
MS	1.162	1.353
Control	0.811	0.853

The dynamics of spear yield were quite distinct in all instances. A spike of relatively high productivity occurred during the Spring (April-June) following by a period of relatively reduced yields (July-August) in the MS treatments. During September-October, another high yield spike occurred in the MS treatments. Unfortunately, abstaining from harvests during the summer is not an option for the method, since new shoots must be continually removed to be effective.

Records were kept of labor and material costs associated with increased management of the MS treatments, and economic threshold data will be presented at the meeting. In general, it was concluded that the MS method of asparagus harvesting is a viable way to extend the production season, but only within economic thresholds. The standard MS procedure does not appear to have an adverse effect on crown and may even promote better crown health (due to irrigation and nutrition?), but the modified MS treatment was clearly detrimental. It is speculated that the MS method will be most applicable for direct marketing asparagus operations at present, not wholesale.

Session 23
FSA Programs and the 2008 Farm Bill for NJ Growers

Session 24 Positioning Your Market for the 'Buy Local' Crowd

WHAT'S YOUR STORY WORTH?

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An interesting movement has been gaining ground in schools, grocery stores, factories and communities of America. Blame the Food Network, aging Hippies and Boomers, globalized food markets, food safety scares, or plain ole' culinary boredom. It doesn't matter. All of a sudden people seem more interested in what they're eating.

This doesn't mean we're necessarily eating better. This "interest" isn't attributable to some new health finding. By "interested" I'm not talking about just knowing the nutritional value of a food or its position in this or that type of diet. I'm talking about what we see when we look at American society from different angles and finding that consumers are INTERESTED in their food – sure how healthy it is or isn't . But also where it came from, who grew it, and how. I don't have massive amounts of data that nails the specific reason for this observation. But data collected at Ohio State and elsewhere – as well as conversations we've had with different kinds of folks up and down the food chain – lead me to conclude that the STORY MATTERS. Think about how food is portrayed or discussed today. We're back on emotional terms with our grubstake. Social movements and communities of interest have arisen around foods, food ideologies, and food companies. In some cases legends are formed – how else do we explain Spam or green M&Ms?

Understanding these trends and what motivates them is a critical part of your marketing mix. Is it health? Hedonism? Moral values? Economic self interest? Community preservation? My answer's "Yes." We've looked at consumers' willingness-to-pay for different food product attributes and have a idea how they value certain things. We can identify types of consumers and how much they care to know about you and your story. It's not just about what you're selling and for how much. Who you are and how you are counts for a lot with a product as emotional as food. In this session we'll work with those ideas to help you can profile your customers and target your production and marketing plans accordingly. This is critical to the "local" movement. But is the whole world "local" today?

Additional information from our work and my thoughts will be available online in the research and extension programs section at http://aede.osu.edu/people/ernst.1.

South Jersey Tour des Farms

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The South Jersey Tour des Farms is a charity bike ride through farm country, where riders visit farm stands and purchase produce using coupon or farm bucks that we provide. This ride is hosted by the South Jersey Resource Conservation and Development Council and Burlington County Freeholders.

Riders purchasing produce at Lone Wolf Farm

Cyclist ride at their own pace and may chose from three ride options: a 13 mile route, a 26 mile route, and a 50 mile route. Each route contains several farm stand stops. Those on the 50 mile route have the choice of stopping at 12 farm stands in all. The Council and Burlington County assist riders by bringing all purchased produce back to the stating point.

The purpose of Tour des Farms is to acquaint riders first hand with farmers and locally grown produce. Proceeds from the ride support the Council and fund our "Farming for the Future" Mini Grant. This $500 grant funds projects that encourage youths to consider careers in agriculture.

The Council's inaugural ride was in 2007, where 191 riders participated. In 2008, tropical storm Hanna, forced us to move the ride from Saturday, September 6 to Sunday, September 7. With this change about 40 riders did not show up. Still, we had 194 riders on the rain date.

Local farm markets collected close to $1000 of farm bucks and benefited from riders digging into their own wallets to buy items. The South Jersey RC&D Council believes that the ride generated over $1400 of direct farm sales. In addition, farm markets saw close to 200 new clients, which may lead to additional future sales.watermelons, peaches, apples, pies, mums, cut flowers, and shrubs

For more information, visit out website at www.sjrcd.org. Particulars on the ride can be found at http://www.sjrcd.org/tourdesfarms/.

Every rider receives 5 Farm Bucks to buy farm stand items

Rider making purchase at Kumpel Farm stand. Photo courtesy of Burlington County Times.

To learn more about South Jersey Resource Conservation and Development, visit out website at www.sjrcd.org.

South Jersey RC&D is an equal opportunity employer and provider.

THE 100-MILE DIET—WHAT DOES THAT LOOK LIKE AT YOUR MARKET?

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When *locavore* was selected by the New Oxford American Dictionary publishers as the 2007 Word of the Year, it brought tremendous attention to a growing interest among consumers in not only how food is produced (IPM, sustainable, GAPs, organic), but where and who is growing their food. The story has been covered by no less than Time, Business Week and the New York Times. Last year also saw the publication of *The 100 Mile Diet* describing one family's experience trying to eat only what was grown within 100 miles of their home for a year. It helped define the concept of trying to eat only from the local foodshed—eating locally-grown, seasonally available foods, preferably purchased directly from the farmer. Now there are web sites (Fig. 1, 2 & 3), clubs and blogs discussing the benefits and helping consumers locate and enjoy local foods.

Farm marketers in the Mid-Atlantic Region are in a prime location to take advantage of the growing locavore movement. Pick a point in southern New Jersey (Fig. 1) and what is the first thing that stands out? Within 100 miles are some of the country's largest cities (New York City, Philadelphia, Baltimore, and just outside the circle, Washington, D.C.), and most affluent suburban communities providing a diverse, knowledgeable, hungry and motivated consumer base. In that same circle is an equally diverse agriculture created by the best of both northern cool and southern warm climate production regions. There are the specialty vegetable farms of southern New Jersey where they grow arugula to zucchini; the dairy and egg farms of Lancaster County, Pennsylvania; potato, tomato, pickle and broiler chicken farms on the DelMarVa peninsula; blueberries and cranberries in the Jersey Pines; apple, peach and other fruit orchards and vineyards

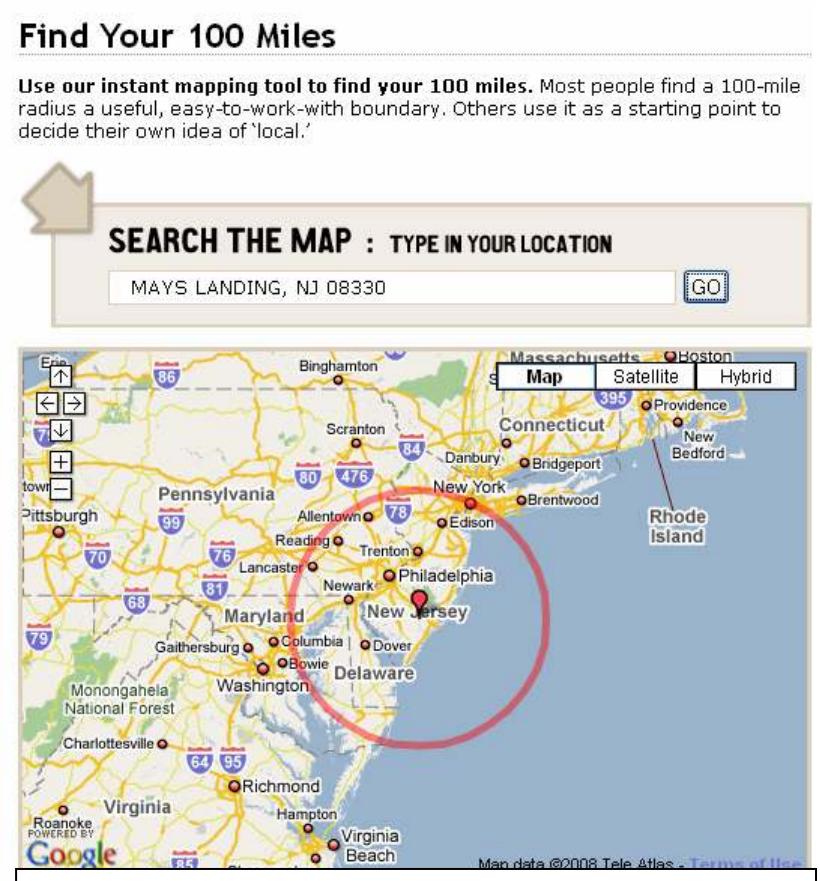

Figure 1. 100milediet.org will draw a 100-mile radius circle around your home or market, along with a pledge to commit to a year's worth of local dining.

(supplying many award winning wineries) further inland; and, not to be forgotten, the bounty of the sea from the Jersey Cape fisheries, and the Delaware and Chesapeake Bays.

While some might consider this just catering to unrealistic urbanites' "romantic dribble" and urges to "eat green" (Johnson, 2008), Mid-Atlantic farm marketers can position themselves to be the source of the best quality local produce for this largest concentration of big-city foodies. Tom Stenzel, President of the United Fresh Fruit and Vegetable Association, put it in perspective. He was questioned about the loose definition of 'local' used by many supermarkets during a recent presentation to the New Jersey agricultural community (12/3/2008, Bridgeton, NJ). He stated that some consumers may be looking for the "authenticity of the farmer" more than the miles, suggesting that pictures of a Columbian farm family above the berries they grew and displayed in the produce aisle in January might be reassuring enough to allow consumers to accept the broadened limits on their 'local' foods. He also mentioned that when he became UFFVA President almost 20 years ago, western growers were confident that East Coast produce was on its way out. Now though, he is optimistic. Whether they call themselves locavores, 100-mile dieters or they just appreciate the quality of locally-grown, fresh foods, Mid-Atlantic consumers are allowing a resurgence of the Eastern produce industry.

Figure 2. foodroutes.org website promotes locally grown and farmers' markets.

Figure 3. agri-culturehealth.com provides resources to link farmers, marketers and consumers.

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Session 25
Internet Marketing

SOCIAL MARKETING – WHAT'S THE BUZZ?

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Session Description:

Wondering how you can create a user-friendly resource and extension into the community to reach your students or clients? Are you looking for ways to teach and motivate them using the latest technology? This interactive session will get you into the world of high tech social marketing! Find out how you can use resource links, blogs, wikis and podcasts as interactive social marketing tools.

Learning objectives:

The participant will be able to demonstrate the following skills:

Assessing the use of online technology tools to reach the student/community/client.
Defining the role of blogs, wikis, and podcasts in the instructional process.
Interpreting the potential use of blogs, wikis, and podcasts as social marketing tools.

Instructional method:

This will be an interactive presentation format.

Outline:

I. Welcome & Introduction
II. How are online social marketing tools currently used to reach our target audience?
   A. Think about the online tools you currently use and rate their effectiveness.
   B. How can you more effectively reach your intended audience?
III. What are blogs, wikis, and podcasts and how do they extend your reach into the community?
   A. Define the term blog, and show 2 related examples.
   B. Define the term wiki, and show 2 related examples.
   C. Define the term podcast, and show 2 related examples.
IV. How can I adopt the use of blogs, wikis, and podcasts into my social marketing agenda?
   A. Reflection of ways in which you can adopt new Internet tools as a means of extending your social marketing network.
   B. Define what you need in order to introduce new Internet tools into your agenda.

Session 26
Food Safety 3rd Party Audit Workshop

PROBLEMS OBSERVED DURING THE 2008 MOCK AUDITS

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Introduction: Now that growers are getting third party audits for food safety it is important to point out problems that are being observed in the field. This past summer I carried out 24 mock audits to determine if produce operations were ready for a third party audit. There were some recurring problems which growers need to be aware.

Some growers who went through the audit in 2007 seem to think that everything was the same for 2008. They were correct that the audit did not change, but neither did they prepare for 2008. Everyone must understand that this is a dynamic process and someone needs to be designated to continually reevaluate the farm operation. Start prior the season, do a self-audit and think about what changes are required. Develop a plan to make the changes then stick to it. It makes no sense to wait until the week before the audit then decide, "well maybe we should clean the place up!"

Food Safety Plan – Each operation must develop his or her own food safety plan before the operation can be third party audited. Using a three-ring notebook to assemble a manual seems to be the most practical method. This manual contains all the procedures which will be used to verify good agricultural practices. The manual is a working document which can be updated any time as the operation changes. Growers must know what is in their manual and what it means. There have been instances where someone else developed the manual for the grower and when the audit was held, the grower did not know what was in it. Remember whatever is in the manual will be used as the basis for the audit. Make sure that what is written is followed. For example, if the operation has a log that states cooler fans and condensers are cleaned on a monthly basis then the log should show that the units were cleaned. If monthly is not realistic, change the standard operating procedure (SOP) in the manual and the log. The auditor will check the log then observe if the condensers and fans were cleaned.

The United States Department of Agriculture (USDA) audit is divided into sections (General Questions (GQ), Part 1-Farm Review, Part 2-Field Harvest and Field Packing Activities, Part 3-Packing House Facility, Part 4-Storage and Transportation and Part 5-Traceback). Every operation must pass the General Question section before they can be audited for other sections. However, the grower decides which sections after GQ they want audited. If the individual wants Part 1 and 3 then the food safety plan (manual) only needs to include GQ plus Part 1 and 3. Other parts can be added for the next audit when the grower is ready.

Portable Toilets – Growers who hire a service for their port-a-johns need to check that the service they pay for is actually being carried out. There were instances where the port-a-johns were supposedly serviced, but did not have toilet paper or were not cleaned. Even if the service company is doing a good job, the grower must check the port-a-johns between visits. Most companies service the farms once or twice a week. That means there are 3 to 6 days between visits. Growers can not expect the port-a-johns to stay clean especially if there are 6 days between visits. Someone in the operation should be assigned to check port-a-johns or restrooms

on a daily basis. In addition, when a service cleans the units they need record the date and persons name on the log inside the unit. If an auditor looks at the log and it is not filled out, he or she may think it is not being maintained. There have been cases in 2008 where the log had not been changed since 2007.

Locate the portable toilets away from field edges. This is sometimes difficult since space maybe limited. Portable toilets should be located so in case of a spill the effluent will not run into the field. In addition, when the service company cleans the units any water used in their cleaning process cannot flow toward the field.

Hand Washing Facilities – Place a hand wash station outside the port-a-johns and in other areas where produce will be handled. Workers must be able to be observed washing their hands. Some port-a-johns have washing stations inside, but this does not take the place of an outside station. As with the port-a-johns, wash stations should be checked each day to make sure there is water, hand soap and single use towels available. Remember the wastewater must be collected and disposed of in an appropriate matter. It cannot be allowed to run out on the ground. A covered trash receptacle must be located next to the wash area so used paper towel disposal. Some hand washing stations were located under roof eaves or other areas where birds could roost. This resulted in bird droppings on the stations. If there is not a better location, make sure the station is kept clean.

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

Eating In The Field – At many farms, food is delivered to the field either for breaks or at mealtime. That is fine if the food is consumed outside the field and the trash is disposed of properly. There were instances this summer where workers carried food into fields and dropped their empty containers among plants. After while you could easily see what had been harvested since there were rows of trash. Rubbish must be picked up and placed in a closed container or garbage bag to be collected at the end of the day. Someone in the harvest crew should be designated to do this on a daily basis. Also, make sure the lunch wagon driver cleans up area the truck.

2008 WATER PATHOGEN SURVEY – WHAT DID WE FIND?

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Introduction: Irrigation water is one of the main concerns in food safety. Water can carry many microorganisms such as pathogenic strains of *E. coli, Salmonella, Vibrio cholerae, Shigella, Crytosporidium parvum, Giardia Cyclospora,* Toxiplasma and Hepatitis A. The water source can influence the potential risk as a source for pathogens. Municipal sources are seen as a safe water supply with little chance for contamination. However, either growers do not have access to municipal water or it is not cost effective. Well water is considered a reality safe source as long as it is not a shallow well (less than 50 ft.), the casing is not cracked, soil slopes away from the well head, the pipe is at least 12 inches above the soil line and it is caped to prevent material from entering. Surface water is the least acceptable since it is open to the environment. This allows variation in quality from rain, animals and humans.

Water testing: Water testing is a critical part of any food safety plan. The source and who purchases the fruits and vegetables dictates how often water testing is suggested. With municipal water, a copy of the water test can be obtained from the municipality annually or more often if required. The municipality must sample on a regular basis and provide a copy to the state. Well water should be tested at least twice a year (first irrigation and just prior to harvest). Surface water should be tested at least three times a year in our area. The first sample is at planting, second at peak use and the third just prior to harvest. The last sampling is the most critical since if there is a contamination problem there may be time to switch to another water source for late irrigations. Some buyers require testing on a more vigorous schedule (e.g. once a month during the production season).

Indicator organism: There are different opinions as to what should be used as the indicator organism when testing irrigation water. The best indicator at present is *E. coli*. However, some auditing firms will accept fecal coliform. However, if there are high levels of fecal coliform it does not mean *E. coli* is high. I would recommend that growers test for *E. coli* then test for E. coli 0157:H7 if *E. coli* levels are high. Why not go to 0157:H7 directly? It is more expensive and not many laboratories are setup to test for it. The other question is what an acceptable level of E. coli is. New Jersey is using 200 colonies/100 ml, but some other states uses a five sample mean of less than 126 MPN/100 ml and individual samples with a value less than 235 MPN/100 ml if foliage is contacted and less than 576 MPN/100 ml if foliage is not contacted.

Research results: Samples were collected weekly from surface water at five locations in South Jersey from July 8 to August 18. Samples were analyzed for fecal coliform and E. coli at a commercial laboratory. Location 1 was a river, location 2 a spring fed pond, location 3 at a dam on the river, location 4 a spring fed pond and location 5 a pond on a stream. At most sampling dates fecal coliform was present, but *E. coli* was either absence or at the very low level (5 colonies/100 ml) at the pond locations. At only one date after a heavy rain did location 2 have *E coli* levels over 200 colonies/100 ml (390). The exception to this was the river and stream samples which ranged from 0 to 65 colonies/100 ml. After heavy rains, those locations had high levels of *E. coli* (from 190 to more than 1000 colonies/100 ml). Location 5 consistently had the highest levels of *E. coli*

Conclusion: Based on these results growers should switch to ponds not on streams if they need to use surface water. If there is no choice, but to use rivers or streams delay irrigation as long as possible after a rain especially if there has been a dry period. River and stream locations should be sampled more often than three times a year to develop a database on possible contamination.

Session 27 Weed ID and Sprayer Calibration Workshop

Session 28
Passing on the Farm Workshop

Passing on the Family Farm (Market)

Every farm family must plan for the future, which means planning how to care for your hard-earned equity. This requires an understanding of family business and estate issues, such as protecting against unexpected death or disability. And it also means bringing the next generation into the management and ownership of the family business.

Topics covered are:

- Challenges in transferring farm business management and ownership.
- Knowing and understanding farm family cycles and stages of a family business.
- Fostering sound family and business relationships.
- Having the right business arrangements for your business.
- Ownership transfer methods.
- Encouraging management succession by developing the next generation's talents.

Typical Characteristics of Stages in a Family Farm Business

The GOAL in Management Succession is to implement key transitional strategies as you go through the stages. This is critical especially when the present generation enters stage VI** and the next generation enters stage III*.

DREAMING OF EMPIRE	I	Teenager	Doesn't know what he/she wants to do.	1 snowmobile
	II	20 - 25	No commitments. Weekends free.	1 car/pickup 2 snowmobiles 4 cattle
	III*	26 - 30	Get married. Needs more money to start family.	house and personal property
BUILDING EMPIRE	IV	31 - 40	Owns 1/3 - 1/2 of farm personal property.	$100,000+ 2 children
	V	41 - 50	Owns at least 1/2 of farm personal property and recently acquired some land.	$200,000+
ENJOYING EMPIRE	VI**	51 - 60	Owns business and option to buy real estate. Likes the control, and fights before giving it up to the next generation.	$400,000+
LEAVING EMPIRE	VII	61 - 70	Gives up control. May be considering becoming banker. Wants social security. Reduces daily responsibilities. Does part-time work around the farm. "Becomes Chairperson of the Board."	$400,000+

Family and Business Relationships

Many of your farms are significantly larger and more involved now than they were 25 years ago. Many are multi-family or multi-generation businesses with more than two family members. It becomes increasingly important to define family and business relationships as the business grows, times change, and more family members become involved in the business.

Business Arrangements

It's been said that those who have a stake in a venture (those who share in risk as well as profits) will be more interested and motivated in the venture. Pride in ownership is very important. But owning a part of a family business means changing the way one conducts his business affairs. All too often, present owners are reluctant to make this change, and offer excuses against forming a business entity.

How should assets (ownership) be transferred?
The basis of any successful transfer is management ability and cash flow. The actual method or combination of methods used are varied and depend on a host of factors. There are four basic ways to transfer assets within families.

Developing the Next Generation's Talent

It has often been said that a successor must be a better manager. This can make it difficult for the present owners to be the mentor. Management must intensify because it is required to adopt changing technology, and handling shrinking margins. All of which puts extra stress on a manager's skills to survive.

Skills of the future won't necessarily be those that past and present farm owners have.

"Farming can be a great way of life, if it is run as a business."
(Don Rogers, 1991)

Session 29
E-Commerce Strategies for Direct Marketers Workshop