

PROCEEDINGS OF THE

26th ANNUAL

HORTICULTURE INDUSTRIES SHOW

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FORT SMITH, AR

JANUARY 5-6, 2007



Horticulture for Food and Fun

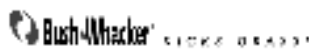


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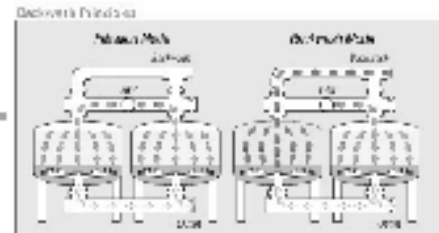
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PROCEEDINGS of the
26th ANNUAL
HORTICULTURE INDUSTRIES SHOW*
January 5-6, 2007

Holiday Inn City Center
Fort Smith, AR

Edited by:
Donna Dollins and Lynn Brandenberger

Department of Horticulture and Landscape Architecture
Oklahoma State University
Stillwater, OK

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*Formerly the Oklahoma Horticulture Industries Show from 1981 through 1997

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Oklahoma & Arkansas
Horticulture Industries Show
PO Box 1993
Stillwater, OK 74076

The 26th annual Horticulture Industries Show was held in Ft. Smith, Arkansas on January 5th and 6th, 2007. It was attended by over 300 producers and considered a great success. The conference took place at the Fort Smith Holiday Inn. Of special note, the noon meals, coordinated by Doug Walton, featured foods grown in Oklahoma and Arkansas. The meals were excellent and certainly enjoyed by all attendees. We hope to continue the tradition of showcasing locally produced foods at next year's meeting in Tulsa.

This year's theme was "Horticulture for Food and Fun". The keynote speakers for both days, Dr. Ed Mahoney and Dr. Carla Barbieri from Michigan State University, presented on this topic. Their colorful presentations excited the audience with the possibility of creating agritourism in their farming operation. They covered many aspects and showed examples of agritourism. Friday and Saturday also featured commodity programming to educate producers on the latest production practices and marketing avenues. The reception was highlighted with a wine tasting event and locally featured cheeses. The wine and juice tasting event showcased the products of Chateau Aux Arch Winery, Mount Bethel Winery, Post Familie Vineyard & Winery, and Wiederkehr Wine Cellars, and the food was provided with assistance of DeWitt Seed Company of Norman, OK. Everyone who attended the reception enjoyed the opportunity for fellowship with other conference attendees, and we hope to continue this type of event.

I want to express my sincere thanks to all the speakers, exhibitors, board members and volunteers for making this show a success and to the producers that continue to grow food in an ever changing agricultural environment.

The 2008 Horticulture Industries Show Conference will be January 4 & 5. I am looking forward to seeing you all at Tulsa Community College next year.

Sincerely,

Alan Ware
President
Horticulture Industries Show

27th Annual HIS Conference—January 4-5, 2008—Tulsa Community College

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2007 Horticulture Industries Show

Local Foods on the Lunch Menu

Friday, January 5

Beef Chuck Roast

Ozark Pasture Beef Cooperative
Tim Johnson, Fayetteville, AR

Basmati Rice Pilaf

Southern Brown Rice Co.
Weiner, AR

Blackeye Peas

Allen Canning Company
Siloam Springs, AR

Sauteed Cabbage with Pecans

Flat Dutch Cabbage from Ranalli Farms
Christ Ranalli, Tontitown, AR
Pecans from Whipporwill Ranch Pecan Co.,
Okmulgee, OK

Mixed Salad Greens and Cherry Tomatoes

Wynn Gardens,
Candy & Dwight Wynn, Prairie Grove, AR
Edible Flowers from Wren Thicket Gardens,
Debra Elam, West Fork, AR

Saturday, January 6

Baked Free-Range Chicken with Rosemary Wine Sauce

Chicken from Walters hatchery,
Mike Walters, Stilwell, OK

Chardonnay Wine from Wiederkehr Wine Cellars
Wiederkehr Village, AR

Egg Noodles with Wilted Winter Greens

Pasta from Ranalli Farms,
Chris Ranalli, Tontitown, AR
Winter Greens from Wynn Gardens,
Candy and Dwight Wynn, Prairie Grove, AR

Roasted Winter Squash with Apples

Squash from David Dickey, Springdale, AR
Arkansas Black Apples from Fred Vanzandt,
Lowell, AR

Marinated Turnips and Tomatoes

Turnips and Tomatoes from Wynn Gardens,
Prairie Grove, AR

Mixed Salad Greens and Cherry Tomatoes

Wynn Gardens, Prairie Grove, AR
Edible Flowers from Wren Thicket Gardens,
Debra Elam, West Fork, AR

Bran Rolls

Ranalli Farms, Tontitown, AR

Christmas Tree

Nantucket Pine Tip Moth

Amy Brothers, Horticulture Extension Educator
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Amy Brothers is the Horticulture Educator at the Oklahoma County OSU Extension Center. Amy is an Oklahoma State University graduate and, while at OSU, studied Landscape Contracting within the Horticulture Department. Not only does Amy have skills in plant and disease identification, but she also has the knowledge needed to keep landscapes thriving. Amy began her career in Horticulture by working part-time in the greenhouse and landscaping industry in Southeastern Kansas.

Nantucket pine tip moth, *Rhyacionia frustrana*

Nantucket pine tip moth has been found from Massachusetts to Oklahoma all through the Southeastern US to Florida. It has also been found in three counties in southern California. It affects nearly all species of native and exotic pines, but most generally trees less than 15 feet tall.

Some of the more favored varieties include:

- Loblolly pine
- Shortleaf pine
- Pitch pine
- Virginia pine
- Scots pine
- Monterey pine

Eggs are laid on shoot tips and are white when laid, but turn yellow when they become mature. Eggs will typically hatch within 5 to 10 days. Five days in summer when temperatures are high, and ten in spring and fall with cooler temperatures. Newly hatched larvae are cream colored with a black head, and construct a small silken web in the axil formed by a needle and the stem.

The larvae feed for a few days on the base of the needles and on the surface of the stem. Later, they migrate in to the shoot tips, construct a protective web, and tunnel into the stem or bud. Larvae continue to feed inside the stem until fully grown. This takes about two to four weeks. They pupate within the cavities, and begin to emerge as adults in about 10 days.

The first sign of damage is browning of the shoot tips. The pupa will overwinter in the shoot tips and emerge as adults in March or April. Tip dieback may occur as far back as 8 inches. Secondary shoots may grow, but many times this will result in deformed trees, and new shoots will likely just be infected later. Not only is this devastating to Christmas tree farms because of forked, or crooked central leaders, but also to seed orchards because this often destroys female flowers.

Recommended treatment begins with healthy trees. Fertilization and irrigation will promote health as well as speed up growth the first few years when trees are most susceptible.

Chemicals are available for treatment, but may or may not be economical. It is important to monitor population with pheromone traps. The greatest number of larvae will be affected if the insecticide application is made five to ten days after the peak number of moths is recorded as captured in the traps.

ALWAYS CONSULT LABELS FOR APPLICATION RATES AND PROPER USE OF INSECTICIDES.

Pine Wilt

Amy Brothers, Horticulture Extension Educator
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Pine wilt is a problem that has been around for at least 20 years, but has recently been very devastating to Oklahoma landscapes. It affects Scots Pine *Pinus sylvestris*, Loblolly Pine *P. taeda*, Austrian Pine *P. nigra*, Japanese Black *P. thunbergiana*, Japanese Red *P. densiflora*, and Mugo Pine *P. mugo*. However in the midwest 90% of infected trees have been Scots pine.

Pine wilt usually only affects trees at least 10-12 years old. Scattered branches on a tree may only be affected initially, with the remaining branches turning brown later. Tree color may gray slowly.

Pine wilt is introduced to trees through a process involving several different things. First the Sawyer beetle feeds on shoot tips of pine trees introducing the pine wood nematode to the trees. The nematode then feeds on living tissue of the tree thus killing portions of the vascular system. This reduces resin flow in the tree. The nematodes would typically die when the tree is dead, but do not because of blue stain fungi.

Dead trees attract Bark beetles which then infect the tree with blue stain fungi. Blue stain fungi is especially detrimental to the lumber industry because of the very visible “blue stain” it leaves in the wood. Since the nematodes killed the tree, they now feed on the blue stain fungi.

Tree is now dead.

It is infested with healthy nematodes feeding on the blue stain fungi.

The Sawyer beetle females will lay eggs in the dead tree. They beetle larva hatch and feed on the dead wood. After they pupate and emerge as adults the nematodes crawl into their trachea. The beetles then exit the tree as adults ready to feed on healthy pine trees introducing the nematode and completing the cycle.

Insecticides and nematicides have so far proved ineffective. Dead pines should be cut down and burned buried or chipped to remove all breeding grounds for vectors.

Fire Ants

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Red Imported Fire Ants are thought to have invaded the United States at the Port of Mobile, Alabama, in the 1930's. Since that time, they have spread to infest more than 260 million acres, from North Carolina to Texas, with isolated infestations in New Mexico and California. The red imported fire ant was first reported in Oklahoma in the mid 1980's, but was probably present in the state before that time. As of 2006, the red imported fire ant has been found in approximately 33 counties. Many infestations are thought to be the result of ants being transported by sod and nursery stock.

Imported fire ants cause damages in several ways. Their activity causes electrical shorts, voltage drops and burn outs in electrical equipment and supply sources. Their tunneling activity can remove soil from under roadways and sidewalks, causing cracking or collapse of concrete and pavement. Large mounds found in farmland causes damage to equipment. The primary concern of most people living in infested areas is the harm from the ant's sting. A small percentage of people may experience anaphylactic shock as a result of the stings. During hot, dry periods of the year, fire ants may enter homes and businesses in search of food and moisture.

In controlling the fire ants, it is important to understand the situation demands of that specific location. Example, homeowners would treat their areas different from a recreational park or cemetery. It is recommended to first treat with a bait product first to get a good control of the ants. Bait products are cost effective and give excellent control. It is important to read and follow label instructions. Before applying the bait product, monitor for the foraging ants, using a food attractant, such as, corn chips or small piece of meat product, hot dog or bologna. After applying a bait product wait about three days and treat individual mounds that are a problem. Some bait products are insect growth regulators and control may take several weeks.

Oklahoma has been involved with USDA-ARS research in establishing biological controls for the red imported fire ants. Most of this work has been in the release of the Phorid fly. Oklahoma has released two species of the fly. *Tricupus* has not been successful in over wintering, but has completed several life cycles during the summer months. *Curvatus* has been released in Bryan and LeFlore counties with success in over wintering and spreading up to fourteen miles in Bryan county. Research cooperation will continue with more releases as other biological controls found.

Christmas Tree Sales Report – 2006 Season

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Introduction

In December, 2006 a total of 37 survey questionnaires were mailed to Oklahoma Christmas tree growers. Of the surveys mailed, 21 were returned by growers. Three growers indicated that they sold no trees in 2006. Eighteen growers reported sales and other information as requested. Sixteen growers did not respond in time for inclusion in this report, could not be contacted, or declined to be interviewed.

Oklahoma-Grown Tree Sales

Table 1 provides a summary of survey results from 1989 through 2006 for trees grown in Oklahoma.

Table 1. Oklahoma-grown tree sales (live trees included), 1989 - 2006.

Year	Number of Growers	Total Sales	Sales per Grower Total (CC sales)
1989	NA	8,769	NA
1990	42	11,527	274 (197)
1991	48	11,989	250 (186)
1992	54	14,145	262 (185)
1993	55	18,002	327 (230)
1994	63	20,102	319 (223)
1995	64	21,071	329 (234)
1996	59	20,795	352 (248)
1997	55	18,982	344 (224)
1998	34	13,131	386 (237)
1999	41	14,564	355 (242)
2000	44*	15,699	356 (226)
2001	28*	7,590**	NA (271)
2002	35*	8,591	245 (251)
2004	25*	8,496	340 (319)
2005	19*	6,863	361 (347)
2006	18*	7,543	419 (402)

Notes for Table 1.

*Does not include growers who responded, but had no sales, who did not market trees, or who did not report exact figures.

**Choose-and-cut (CC) only-other years are all methods for Oklahoma-grown trees.

In 2006, total reported sales were higher (approximately 10%) than in 2005. Likewise, both the total sales and the choose-and-cut sales on a per grower basis showed an increase.

Sales Methods

The primary sales method used for Oklahoma-grown harvested trees is choose and cut (Table 2). Virginia pine continues to be the dominant choose-and cut species offered by Oklahoma growers, comprising approximately 83 percent of the trees sold. Scots pine and Austrian pine each held about 8 percent of the choose-and cut market. Other species included Leyland cypress, Arizona cypress and eastern white pine.

Table 2. Oklahoma-grown harvested tree sales by sales method 1989 – 2006*.

Year	Choose-and-Cut	Wholesale	Retail	Total
1989	6,662	1,625	482	8,769
1990	8,111	2,641	775	11,527
1991	8,762	1,969	1,228	11,989
1992	9,852	3,294	999	14,145
1993	12,459	4,586	957	18,002
1994	13,848	5,460	796	20,104
1995	14,766	4,893	1,432	21,071
1996	14,394	4,270	2,131	20,795
1997	12,103	5,483	1,342	18,928
1998*	7,833	3,383	193	11,409
1999*	9,697	3,080	521	13,298
2000*	9,736	4,931	None **	14,667
2001*	7,590	Not available	None **	7,590
2002*	7,448	426	265	8,139
2004*	7,969	120	None**	8,089
2005*	6,468	123	None**	6,591
2006*	7,228	Not available	None**	7,228

*Only cut trees

** Does not include retail sales of imported trees at growers' farms.

Live Trees Sales

Live trees sales continue to demonstrate a decline as a percentage of total tree sales (Table 3). In 2006, major live trees species were Austrian pine, Scots pine and Leyland cypress.

Table 3. Live trees sold from 1990 – 2006.

Year	Live Trees Sold	Percent of Total Sales
1990	1,177	10.2
1991	2,030	16.9
1992	1,825	12.9
1993	2,810	15.6
1994	2,247	11.2
1995	1,251	13.2
1996	4,038	19.4
1997	3,001	15.9
1998	1,722	13.1
1999	1,266	8.7
2000	1,184	7.6
2001	541	NA
2002	456	NA
2004	407	3.5
2005	272	2.7
2006	227	2.1

Sales of Imported Trees

Approximately 55 percent of growers now sell pre-cut, imported trees from other states at their farms. This number is up substantially from 30 percent in 2001. Imported tree sales of 3197 in 2006 equated to about 30 percent of total tree sales for the state. True firs comprised approximately 85 percent of total imported sales. Noble fir was the most popular imported tree species, followed by Fraser fir and grand fir.

Sales of Christmas-Related Products

Sixty-seven percent of the growers reported sales of wreaths, memorial blankets and other greenery products, both from Oklahoma-grown and imported materials. Estimated sales of these products were \$35,774. Eighty-three percent of survey respondents reported sales of other holiday items such as ornaments, toys and tree stands. Total sales of non-greenery items was \$38,423. Tree stands were the most common holiday accessory item sold. Thirty-nine percent of growers have other non-Christmas crops such as you-pick berries and pumpkins.

Tree Prices

Tree prices reported in 2006 were only slightly higher than those reported in 2005. The majority of growers who price by the foot for choose and cut trees charged \$ 5.00 to \$6.00 per foot. Those who sell on a per tree basis generally charged from \$30 to \$50. Virginia pines tended to occupy the lower end of the price range, with Austrian and Scots pines usually selling for higher prices.

Imported, pre-cut trees sold from \$40.00 to \$70.00 per tree, or \$5.00 to \$10.00 per foot.

Live trees were generally sold from \$60 to \$80 per tree.

Discussion

Growers responding to the survey were mixed in their reviews of the season. Some reported excellent sales, whereas others characterized sales as flat or even below last year.

Seven-two percent of the responding growers reported losses from drought, insects or disease. They quantified losses as approximately \$40,500. The major problem in 2006 was reported as drought, resulting in significant loss of tree growth and quality.

Acknowledgements

Results from 1989-1997 were compiled by Dr. Steven Anderson, Extension Forestry Specialist, and Champe Greene, Renewable Resources Extension Specialist. Bill Ross, Extension Forestry Specialist and Clark Perry, Senior Secretary at OSU Extension Forestry and Wildlife, collected data and prepared the report in 1998-2002. Thanks also to the Oklahoma Christmas Tree Association and all growers who took part in this survey.

Plant Stress: What Is It, and Can We Do Anything About It?

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Plant Stress

As a general definition, plant stress results from any external factor that negatively influences growth, productivity, reproduction or survival.

Plants respond to stimuli, and all plant responses are indicative of some physical or chemical event - for example, stomates closing during periods of drought. Plant stress is the result of some of those responses.

Plant stress is broadly divided into two main categories, 1) abiotic or environmental and 2) biotic or biological. Some of these stresses are highlighted below.

Abiotic (Environmental) Stresses

1. Drought

Drought stress is generally due to lack of rainfall during the growing season. However, low precipitation during the non-growing (winter) season may have an effect should sufficient moisture be unavailable as plant growth begins.

One thing to be aware of - trees dying immediately after planting may have been dead when planted. This problem is often wrongly classified as drought-caused. Proper handling of seedlings through lifting, storing and planting will help avoid this problem.

To alleviate drought stress, several techniques are available: 1) Remove competing ground vegetation, 2) Remove excess foliage (perhaps by shearing), provide supplemental watering as available and appropriate, and 3) utilization of water conservation/retention practices.

2. Low Temperature

Stress from low temperatures usually results from freezing, with the roots being more sensitive than above-ground tissues. The most critical time for freezing of roots is at time of planting. Trees should not be stored or planted when the temperature is below 32 degrees F. The major symptom of frozen roots is that the tree dies – with the appearance of drought stress.

If trees are being grown in pots, insulation with sawdust, bark, etc. is recommended to prevent the media from freezing, resulting in loss of water for the plant.

After plant establishment, roots should not be exposed by tilling, etc. late in season.

3. Nutrient Deficiencies or Excess

Nutrient deficiencies may be the result of lack of nutrient availability or lack of effective plant uptake. Determination of the specific cause requires soil and/or foliage tests. Likewise, too much fertilizer often results in “salt burn”, which actually causes a form of drought stress.

To avoid nutritional problems, appropriate soil/foliage testing and application of fertilization at the suggested rates and methods are recommended.

4. High Temperature

As air and soil temperatures increase, chemical processes within the plant are accelerated (sometimes too much). High temperatures frequently occur with drought, but plant responses are not always the same.

Night-time air temperatures may be more important than daytime temperatures relative to stress from high temperatures. This effect has been observed in agricultural crops, and in North Carolina, at least one grower was able to maintain survival and growth of Fraser fir at lower elevations with night misting.

5. Other Abiotic Stresses

Other abiotic stresses may result from such factors as: 1) excess water, 2) air pollution, and 3) mechanical injury.

Biotic (Biological) Stresses

1. Plant Viruses

Plant viruses generally consist of RNA in a protein coat that infect living cells. At least 400 viruses are known to attack plants. Clonally propagated plants tend to accumulate viruses, whereas viruses are usually lost in the process of seed formation.

To date, viruses have not shown to be a significant problem in Christmas trees.

2. Bacteria

Bacteria are single-celled organisms, which tend to cause spotting of leaves, stems or fruits. Sometimes bacteria cause soft rots in which tissue becomes a slimy mess.

Generally speaking, bacteria cannot invade healthy plant tissue, and need a wound or an area of dead or dying tissue to start an infection.

Bacterial infections can be controlled with antibiotics, but such control is normally not economically feasible. To date, bacteria have not been a major problem in Christmas trees.

3. Fungi

Fungi are a common problem in plants, with several major fungi attacking Christmas trees. Fungal damage may mimic other conditions, such as drought, salt burn or freezing. Likewise, stress by fungi often leads to stress from other factors.

A key to a reduction in fungi occurrence is by managing the environment (cleaning under trees, etc.). Should economic damage be sustained, fungi control is either mechanical (removal) or chemical.

4. Insects

A number of insects are major problems in Christmas trees. Insects are usually rather specific to species or genera necessitating somewhat specific control measures. To reduce insect impact, management of the environment (no place to over-winter, etc.) is recommended. At higher levels of infestation, insect control is usually by mechanical or chemical means.

The best approach to insect and other biotic stress control is through Integrated Pest Management (IPM).

Integrated Pest Management (IPM)

By definition, IPM is the coordinated use of pest and environmental information with pest control methods to prevent unacceptable levels of pest damage by using the most economical means and with the least possible hazard to people, property, and the environment.

IPM involves inspecting crops and monitoring crops for damage, and then using a one or several control measures. Some of these measures include: mechanical trapping devices, natural predators (e.g., insects that eat other insects), insect growth regulators, mating disruption substances (pheromones), and chemical pesticides.

The secret to success with any IPM program is the use of both timely and accurate monitoring, and then applying the appropriate treatment at the proper time.

Summary

To summarize the points covered:

- Plant stress is due to responses to stimuli, both biotic and abiotic, and can be the result of many factors.
- Often, these factors act together to increase plant stress.
- Management of plant stress requires knowledge of the species, environmental effects, and biotic influences that are present.
- The implementation of an Integrated Pest Management Program (IPM) is the best approach for control of many plant problems.

Moving from Product Differentiation to Product Positioning in Advertising

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What distinguishes one product from another?

How can we use these different features in our advertising?

1. What is product differentiation?
2. What is the purpose of product differentiation?
3. How can product differences be used in advertising?

1. What is product differentiation?

Product Differentiation

Creating and designing products so that consumers perceive them as different from competing products.
-Pride-Ferrell Marketing, 2006

Difference in:

Form-brand

Design and features

Image

Styling

Price

Service

Support services

Product Quality

2. What is the purpose of product differentiation?

To accomplish marketing objectives such as:

- To introduce products
- To improve or innovate products
- To Increase sales volume
- To turnover inventory
- To make a profit
- To increase market share
- To set effective prices
- To improve distribution
- To develop an effective advertising campaign
- To accomplish employee training activities
- To build long- and short-term relationships with clients

The survival of the product depends on product differentiation.

Companies ***must*** consider product differentiation when creating and offering products for sale.

Class Exercise:

1. *Take a product out of the bag.*
 2. *Look at your neighbor's product, and look at your product.*
 3. *Spend a few minutes and think about how your product is different from the competition.*
 4. *Jot down 1 or 2 key selling features about your product.*
 5. *Explain to the class what ideas you have come up with.*
-
3. How can product differences be used in advertising?
 1. Take your key selling features and select the best one.
 2. With the best selling feature, think of a short phrase that best describes that feature.
 - i. Examples:
 - a. "Just Do It?"
 - b. "Finger Lickin' Good"
 - c. Nike
 - d. KFC
 3. This is the phrase that should be used on the package and in every ad piece which leads to
 - i. *Product Positioning—Creating and maintaining a certain concept of a product in customers' minds.* —Pride-Ferrell Marketing, 2006

To summarize, I have covered:

What is product differentiation. *Creating and designing products so that consumers perceive them as different from competing products.*

What is the purpose of product differentiation. *To accomplish marketing objectives such as introducing new products or highlighting product improvement.*

How product differences can be used in advertising to position the product.
By focusing in on the key selling idea and using that phrase in your ad.

Farmer's Market/Sustainable Agriculture

Where Fun Grows: Bringing Folks to the Farm

Cathie Greene, Wild Things Farm
Pocola, OK

Introduction: Small family farms are losing their identity in our culture as more and more people move to the cities. Agritourism is a means of providing “city folks” a connection with the land for a price.

Why do it

Money: (farmers do not have to depend completely on the competitive agricultural products marketplace to survive).

Educate public

Provide farm experience

Getting started

Insurance: Liability insurance is essential and can be difficult to obtain.

Personnel: Employees can be difficult to find, esp. for seasonal work.

Advertising: There are many means of advertising, but word of mouth is number one.

Services

Activities: are as diverse as your imagination
Added value items

Food
Gifts/souvenirs

Pricing

Gate fee
All inclusive

Parking
Per activity participation

Advantages

Added income
Shared farm values
Personal satisfaction

Family destination
Community pride
Increased property value

Disadvantages

Injuries
Liability
Crop damage

Facilities
Parking
personnel

What experiences can you provide?

- AGRICULTURAL CLASSES
- SPECIAL EVENTS
- U-PICK OPERATIONS
- SUBSCRIPTION FARMING
- FARM OPERATION TOURS
- FARM MUSEUMS
- SEMINAR CENTERS
- PLANT/PRUNE/HARVEST FESTIVALS
- AGRICULTURAL BASED RESTAURANTS
- FARM ENVIRONMENT ACTIVITIES
- FARM ACTIVITY PARTICIPATION
- ROADSIDE STANDS

AGRITOURISM RESOURCES

Candy cannon, corn cannon, cow train	www.cajuncountrycorn.com
Characters Unlimited	www.charactersunlimitedinc.com
Cold River Mining Company	www.coldrivermining.com
Corn Mazes	
American Maze Company	www.americanmazes.com
Maize Quest	www.cornmaze.com
Precision Mazes	www.precisionmazes.com
Eckert AgriMarketing	www.eckertagrimarketing.com
North American Farmers Direct Marketing Association	www.nafdma.com
Prime Pedal Karts	www.primepedalkarts.com
Pyramid Publishing	(262)275-3384
Signs of the Season	www.signsoftheseason.com

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Success With Farmers' Markets & On-Farm Sales: Lessons Learned from National Research

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Farmers and ranchers across the U.S. are using a wide variety of direct marketing strategies to reach their customers. Retailing on farmers' markets and on-farm stores are two types of direct marketing strategies that farmers are increasingly using in response to greater customers' concerns and demand for fresh, locally-produced foods. Direct marketing is beneficial to small farmers because they can directly sell their products to local final customers, retaining a greater share of consumer expenditures that are diluted in longer sales channels. Local customers also benefit from direct purchases because they gain access to local fresh products. Finally, local communities also benefit by enhancing local commerce, food access in urban settings where healthy foods are often scarce, and providing a venue for promoting nutrition education and better eating habits. In some instances they encourage visits to downtowns and contribute favorably to the experiences of people visiting the communities where they are located.

Research Methods:

The little information regarding the use of direct marketing by farmers and ranchers and the significant growth of farmers markets in the U.S. over the past several years seemed to demand greater exploration. To accomplish this, the Recreational Industries Research Center at Michigan State University developed two web-based surveys. The first one, sponsored by the Marketing Services Branch of USDA's Agricultural Marketing Service, surveyed Farmers Markets in the U.S. to develop a current profile of this industry. The survey included questions regarding the operational characteristics of the farmers market; their vendors/producers; types of products sold; promotional and administrative practices; managerial challenges, as well as other characteristics. USDA provided the contact information for 3,743 farmers markets nationwide. The survey was launched on May 2, 2006 and it remained opened until June 30, 2006. An invitation letter was either emailed (when email address was available) or mailed. Participating markets represented almost a forty percent (38.4%) response rate. The majority of respondents (35.9%) were located in the North Central Region, followed by the Far West (13.8%) and the Northeast (13.7%). The Southwest region (Arkansas, Oklahoma, Texas and Louisiana) represented 4.9% of the respondents.

The second survey was developed in partnership with the North American Farmers Direct Marketing Association (NAFDMA). It surveyed farmers and ranches involved in direct marketing and agritourism in North America. This survey collected information about the characteristics of the farm or ranch and the operator; the products, services and enterprises that generate farm/ranch revenues; farm/ranch sales and different revenues, including the total gross value of sales, the percent of revenues coming from different product categories and enterprises; and the assessment of the profitability of the diversified operations. This survey was launched on July, 2005 and remained opened for 42 days. NAFDMA provided the contact information of 853 members, including farms and extension agents. The invitation letter invited farmers and ranchers to take the survey and other members to spread the word among diversified farms and ranches. The survey produced 1,135 completed answers, including 192 (44.5%) farmers from the original NAFDMA list. The majority of the diversified farms/ranches that responded to the survey were located in the U.S. (77.5%), followed by Canada (22.4%) and Mexico (0.1%).

About Farmers Markets:

Over a third of the participating farmers markets (34.3%) have been in business less than 6 years. On average, American farmers markets have been in operation 14.7 years (median=10.0). Similarly, southwestern markets reported an average of 13.3 years (median=10). Interestingly, 19% of Southwestern markets have between 16 and 20 years in operation, compared to only 9.8% nationwide. More farmers markets located in the Southwest region (22.2%) operate year-round than the all responding markets (13.1%). However, this was expected due to the benign weather of this region compared to others (e.g., North Eastern and North Central regions). The number of days that markets were open increased slightly (2.4 days) in 2006 compared to the previous year. The same increase was evidenced in Southwestern markets.

Market sales averaged \$245,674 during 2005 and half of all markets reported sales of \$40,000 or less. In comparison, the Southwest markets that responded to the survey had average sales of \$209,551 in 2005 and half reported sales of \$20,000 or less. As expected, farmers markets sell the majority of their products directly to end-users. On average, they reported that over ninety percent (96.9%) of their sales in 2006 were conducted directly with consumers.

Farmer markets around the country report not being able to attract enough vendors and sufficient product to meet demand, while others indicate problems attracting enough customers. The survey reveals the majority (52.6%) of the Southwest markets need more vendors. About a quarter (23.7%) of markets experience a balance between the number of vendors and customers they have. For about a quarter (23.7%) of the markets there is a need to attract a larger customer base -- grow their markets. As previously reported, bringing about a balance between vendors and customers is important in the successful operation of farmers markets (Brown, 2002).

About a third of the farmers markets operate in some type of permanent facilities (32.2% of U.S. markets and 36.7% of Southwest markets). Of these, more than half own the facility. Over a third (39.5%) of the responding markets across the U.S. has a paid manager in comparison to 27.1% of the Southwest markets that returned a survey. The majority of paid managers in the U.S. are part-time seasonal employees (50.3%). In comparison, the majority of paid managers in the Southwest markets are either part-time seasonal employees (34%) or part-time year-round employees (34%).

The average operating budget for all farmers markets is \$21,336; half have operating budgets of less than \$2,000. The average budget among Southwest markets is \$10,991 and half reported budgets of \$700 or less. The average amount that farmers markets spent on advertising in 2005 was over \$3,000 (\$3,915 across the U.S. and \$3,329 in the Southwest). Half the markets in U.S. spent \$500 or less on advertising compared to \$300 or less in the Southwest region. On average, the majority of the revenues generated by markets across the U.S. (80%) and in the Southwest (75%) come from vendor fees.

About the Producers and Farmers/Ranchers that Participate in Farmers Markets:

The majority (77.4%) of Southwest responding markets host between 5 and 49 vendors/producers annually. On average, 31 vendors sell their products at Southwest markets but not necessarily all at the same time. Across the U.S. and in the Southwest, the majority (89%) of the vendors/producers are white. About only 10% are Hispanic farmers.

The majority of vendors in farmers markets only sell what they grow or produce themselves (38.9% in the U.S. and 49.2% in the Southwest region). On average, about three quarters (71.6% of U.S. markets and 78.0% of markets in the Southwest) of the markets vendors exclusively sell what they grow/produce. As it would be expected, the most frequently sold products at farm markets across the U.S. are fresh produce (99.6%), herbs, flowers and plants (88.2%), honey, nuts and preserves (84.2%), baked goods (79.0%), and crafts (54.1%).

There is considerable and growing interest in organically-grown foods and this interest appears to be creating new markets and marketing opportunities for producers (Dimitri and Green, 2002). These surveys provide some confirmation regarding these opportunities. Almost half (46.9%) of the participating markets reported selling some certified organically-labeled items. This percentage is smaller among Southwestern markets (30.4%). The most frequent organic products sold in these markets were fresh produce (92.4%), followed by herbs, flowers and plants (46.8%) and meats/poultry (30.5%). Similarly, the majority of respondents (69.0% in U.S. markets and 53.4% of markets in Southwest regions) reported selling “other than organic” labeled items. In these U.S. markets, the most frequent labels used were “locally grown” (88.3%), followed by “chemical free” (47.7%) and “natural” (47.1%).

Farmers and ranchers that sell at farmers markets also are engaged in tourism, recreation and hospitality related enterprises, such as recreational self-harvest (you-pick-up), hayrides, school tours, bed and breakfasts, and restaurants. In addition, over half of farmers and ranchers across the U.S. that sell their products in farmers markets are planning to add more recreation, lodging and restaurant enterprises in their farms within a short time (less than 2 years). There is also a relationship between agriculture and culture. Over a third (38.2%) of the farmers that sell at farmers markets but not retail on their farms are preserving some type of heritage. This percentage is even greater (44%) among farmers who besides selling on farmers markets have a market on their farms.

Final Comments:

The number of farmers markets throughout the U.S. is steadily increasing (USDA:AMS, 2006). The relatively high proportion of new markets that have been in existence less than six years confirms this national trend. The majority of U.S. markets are attracting enough vendors to accommodate consumer demand, indicating that growers are considering farmers markets a convenient and effective way to distribute their products directly to the consumers. However, this is not evident in the Southwest, where the majority of markets need to increase their number of vendors.

These studies suggest that farmers and ranchers are responding to market changes. The high percentage of organic and other sustainably grown products sold at farmers markets suggests that vendors selling in farmers markets are capturing the growing number of consumers more concerned about the quality (e.g., freshness) and origin (e.g., locally produced) of their food. Also, farmers and ranchers using direct marketing (e.g., farmers markets and on-farm retailing) to sell their products are attracting an increasing number of Americans who seek recreational activities in rural settings.

This study also identifies some operational issues that are in need of immediate improvement. Over three quarters of the farmers markets that responded to the survey require assistance to enhance their advertising and publicity strategies, increase their customer numbers as well as their sales per vendor.

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Farmers' Markets as a Destination

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Fayetteville Farmers Market
Fayetteville, AR

For most farmers market shoppers, the top priority for the market is probably that it has fresh, locally-grown, high-quality fruits and vegetables. For the farmers market devotee, that may be enough. Throw in a bit of convenience, and you've got a good recipe.

But to attract folks to your market who aren't already sold on farmers market, or to turn an occasional shopper into a regular shopper, you may have to offer a bit more. If you can attract people who don't have shopping your products as a high priority, giving them exposure to what you offer, the quality products and the pleasant experience of interacting with your vendors will bring them back again and again.

Attracting a crowd won't be good for every market. There are some negatives, such as pedestrian crowding, increased noise level, competition for parking, and the time and effort required to make it happen.

Creating a destination market requires creating and sustaining a fun and welcoming atmosphere, an increased peripheral activity level, promotion in the broader community, and getting other people to talk about your market. Besides shopping, you can draw people who want to socialize (visit with friends, and see and be seen), and be entertained (both watch and participate in fun activities.)

How you accomplish this depends on your physical space, the size and nature of your market and your community, and on whom you want to attract. Careful thought to these elements should influence you plans. Activities for kids are good to attract parents and grandparents. Retired and older adults are attracted by different facilities and activities than are young adults.

At the Fayetteville Farmers' Market, key elements are the beauty of the market; ready-to-eat food, like coffee and muffins; enticing areas to congregate and visit with friends, and music. We also organize a variety of special activities and special events in conjunction with the market. We try to keep these closely related to the primary market purposes of selling fresh produce and locally-produced art and crafts. Cooking demonstrations and competitions, salsa tasting, and special farm and garden-related activities for kids are popular.

In planning special events, you should remember that the local media are a target audience as well as the potential customers you want to attract. Be sure to build in plenty of photogenic aspects. Since your market has a long season, rather than just a one-time event, media attention after the event – i.e. reporting on the event – is as important as media attention before the event. You want to create “buzz”, where people are telling their friends what a great place your market is to go, take the family, have fun, and shop for great fresh, locally-grown, high-quality fruits and vegetables.

Hardin Farms: Community Supported Agriculture in Central Arkansas

By Jody Hardin

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Website: www.rivermerc.com and www.hardinfarms.com

Introduction and Background

Hardin Farms is a fifth generation family farm located in Grady, Arkansas. The Farm produces over 35 vegetable and row crops each year, and hosts one of the largest agriculture tourism events in South Arkansas with over 20,000 visitors in the month of October since 1992. The farm headquarters is in a newly constructed facility above a farm market store and restaurant offering lunch and dinner Tuesday through Sunday eleven months of the year, provides catering, and hosts community meetings and events on the farm.

Hardin Farms markets its produce through an on farm restaurant and market, u-pick programs, agricultural recreation, two local farmer's markets, and Hardin's River Mercantile, a year-round retail store in the River Market District of downtown Little Rock adjacent to the states largest farmer's market. The store, with the support of a handful of small grass fed meat and vegetable farmers, opened in 2004. Its mission: to profitably market local, grass fed meats, and organic or naturally raised produce, as well as value added products from local producers.

Community Supported Agriculture begins in Central Arkansas

In 2004, Hardin's River Mercantile began its first Community Supported Agriculture Program called the Farm to Family CSA. It allowed customers to prepay \$700, and receive a \$60 basket each month from products of their own choosing from the retail store. The main incentive was that they could only purchase locally grown produce with the \$60 credit each month. They would receive a 10 percent discount on all purchases in the store any time they made purchases at Hardin's River Mercantile. After one year, the program produced only moderate gains in sales and abandoned the program and began the Basket a Month CSA.

The BAM CSA program is a subscription agriculture program where participants are required to subscribe to a minimum of three baskets valued at \$60 each, or \$180. The products in the basket are all local, preferably from small organic or grass fed farmers. The BAM program began in December 2005, and has run at the date of this publication, for 13 consecutive months, and grown to over 200 members by the summer of 2006. Members are required to pickup at our downtown location in the River Market once per month. Members are notified by email on the Monday prior to the three day pickup window, which is typically a Thursday, Friday, and Saturday the week of the 20th each month. The buyer, however, should reserve the right to move these days around according to harvest dates that suit the season and farmers of unusual products that are freshly in season. This allows members to get the first picking of certain seasonal products such as strawberries, sweet corn, etc..., that tend to be limited or best eaten when early in the season. BAM buyer works with at least 10 to 15 different farmers each month, one or two local chefs, and one or two value added producers to provide a exciting assortment to its members.

BAM is managed utilizing a custom web based database that tracks the number of baskets each member has subscribed to, and how many they have picked up. Some members are so happy with the program they ask if they can subscribe annually. These members are offered a five percent discount for annual prepayment. As an additional marketing and information tool, the buyer of the program provides a newsletter and recipes in each basket, as well as offering once monthly cooking classes from local

celebrity chefs. In the early stages BAM held the first annual Farmer-Chef Summit, and later that same year launched the Iron Chef of the River Market competition, where chefs were presented with a mystery basket of only local foods and asked to prepare a full course meal using every item in the basket. This was a very successful event and increased subscriptions by 10 percent in one weekend.

BAM is GOOD FOR FARMERS

BAM is a useful tool to incubate other CSA farms, allowing farmers to get on a regular monthly production schedule, and then slowly increase to a weekly harvest and delivery schedule before launching their own subscription program. The central Arkansas BAM program is coordinated by Jody Hardin, a long time vendor in Arkansas farm markets, and fifth generation farmer who is well connected to many of the states small farmers. Although this was an asset when forming this group of farmers to supply a year-round basket to urban families, it is not a necessity. However, anyone, especially those with a good pickup location and abilities, can start a BAM program around their local farmers markets. Word of mouth advertising, several television appearances, and a good retail location are the primary advertising tools used to grow the program.

Basket A Month CSA (BAM) is a multi-dimensional cooperative marketing tool that helps farmers help each other. Urban families are offered a means to stay connect to the season's and put money directly in the hands of the small organic producers. As an economic development tool, it puts money into local communities and builds a more robust network of food producers who are our ultimate food security.

More information is available for those who are interested in starting their own Basket A Month community supported agriculture program by email, csalittlerock@yahoo.com.

Enhancing Your Farmer's Market Sales through Market Display

Judy Kavan, The Ugly Bunny Garden
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Judy Kavan is the owner of The Ugly Bunny Garden. She sells specialty vegetables, cut flowers and culinary herbs at the Fayetteville Farmer's Market.

When considering the physical structure of your display you must consider the space confines of your market, also consider the set up and tear down time involved and how much room you have available for hauling your display. Try to take up as much of your space allowed as possible, even if you don't have the product. One lonely card table with a few items often goes completely unnoticed. Your structure may be as simple as a folding table with a cloth cover filled with boxes or stacks of fresh produce. Try adding interest by creating shelves to lift product closer to your customer's eye. A bench or crates in front of and below the table will allow extra display space and create more visual interest. Express your own personal style and creativity. Have fun with it.

Plastic pints and quarts really let the color and shape of your product show through. Try experimenting with different colors of containers to showcase your product. Besides individual containers one should try using baskets, crates or jars. Clean bushel baskets are great for bigger items like winter squash, try tipping them on their side with produce spilling out. Have smaller baskets on hand to downsize your display to keep your containers looking as full as possible. Always make sure your containers are as clean as your product.

The look of abundance is always the best display you can create. Reset your table as often as possible to keep it neat and stocked. When there are only a few of any one thing left it is difficult to move that item. Try to trick the eye into seeing more than one container...leave several set up even when empty and move the last full container toward the front or in the middle...maybe elevate it by turning a container upside down and setting it on top. If you are displaying in a basket to being with move your product to a smaller basket, stuff the basket with newspaper or some kind of filler and put a cloth over so the product is setting on top and not lost in the basket. Group 'one of a kinds'. Display as a ready made salad...one tomato, one head of lettuce, one pepper, one cucumber, etc. Do this also with stir-fry ingredients. Customers will love the idea and the convenience.

Signs are a way for you to communicate to your customers. Make sure your signs are in good shape, clean, and easy to read. It is important to make sure that your customers can easily see the price of your product. You can be informative, tell the variety, where it is grown, the vase life, etc. Use signs to explain to customers your growing philosophy...certified organic, naturally grown, no pesticides...whatever you want to convey. If you find your customers asking the same question about the same product you may want to make a sign explaining how to prepare or serve the product. Customers love recipes so make them available especially for an unfamiliar product. Use signs to tell customers your farm/garden/business name. Make signs from the computer, a chalkboard, ceramic tiles, write or paint on unusual objects. Again, let signs represent your own personal style.

Market Sales through Market Display

Peggy Maringer, Giraffe Gardens
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Peggy Maringer is a Fayetteville Farmer's Market vendor of vegetables, herbs, flowers and bamboo. A former art teacher, she still paints and sculpts. 15 years experience in selling cutlery at custom knife shows coast to coast and working in a craft gallery has added to her experience of how customers interact with sales displays. Her 5 acre urban farm, Giraffe Gardens, is located in Springdale, Arkansas.

A good Farmers' Market display helps to fulfill the dream your customers are looking for -- to eat fresh, buy local, and to have a good time. Your customers are looking for fresh, locally grown, abundant, clean, colorful produce sold by an interesting person in a welcoming community setting. How can you best communicate at a glance that you have what they are looking for?

Set your table to catch the eye. Select a table cover that will set off your merchandise to best advantage. You may find that dark colors like black, blue, burgundy or violet work best with red, green, orange and yellow produce. The darker colors are easy on the eyes and allow you to make use of bright lighting for your merchandise. Using a black underskirt on your table to hide the pavement helps to set off your table. Notice how many grocery stores are using black as their background color for produce. Go ahead and take some produce into a fabric store to shop for just the right colors to make your product really stand out in contrast. You will find that "neutral" colors like beige or pastel yellow make most produce look sickly. Beware of patterned material that will confuse the issue or bed sheets which may not look sanitary. Vinyl tablecloths always look and feel sticky, avoid them. Unlike woven cotton fabric, a synthetic knit will not ravel at the edges, wrinkle in storage, or hold stains and can be an excellent choice for your main table cover. Think about using smaller pieces of another colored fabric when displaying merchandise of differing colors, or to throw over a box or basket, highlighting specialty items. When displaying produce, alternating colors will help customers notice what you have. For instance, would the potatoes stand out more next to the green beans because they aren't as noticeable next to the onions?

Use the light to your best advantage. Dark colored or opaque canopies and umbrellas soak up available light. A translucent, light colored cover will shade you and your produce while lighting it to best advantage. A dark colored table covering keeps glare to a minimum. As the position of the sun shifts, use it to highlight items that can take the heat. A red onion in full sun is irresistible. Shade only those items that need protection.

You can use form to your advantage in creating a noticeable display. Produce stacked in a repetitive pattern, like rows of cucumbers all oriented the same way, will catch the eye. The human eye is naturally drawn to circles. Display spherical objects, like onions, at the leading edge of your display. Use rounded display platforms or containers whenever possible. Round umbrellas are more appealing than square canopies. Faces are the most compelling to the attention and are widely used in advertising. You may find using the image of a human face printed on a sign very helpful to draw attention to your merchandise. Never forget that you yourself are a major aspect of your display. You can't afford to be shy. Acknowledge a customer's presence as soon as possible. You have approximately 3.5 seconds to catch a customer's attention with your product, your display, lots of color, or your personality before their attention has moved on to the next booth. Give people a reason to strike up a conversation with you by using interesting objects in your display. Take an interest in your customers and they will find

you interesting. If they appear to be scowling, they are most likely concentrating intently on what they see and will still be open to a friendly greeting.

Pay attention to which areas of your table people seem to notice first. Use these “sweet spots” to display the most eye-catching item. Leaving an open space on the table top for customers to set a purse or bag helps customers slow down enough to look around. Surround this space with merchandise that might otherwise be overlooked. Customers will eventually look up at you, so display some interesting merchandise on the pathway their eyes would take on the way up to your face. Seeing a vendor holding, reshuffling, or making an item creates interest. Try displaying items in two places at once to learn where it is more likely to be noticed. Items laid horizontally may be easier to spot than ones hung from above. Take a walk out front occasionally to look at your table through their eyes. Are signs or containers obscuring the view or helping to sort it out? Do you look approachable or are you busy reading, visiting, or eating? Never snicker or make disparaging comments about anyone at the market, vendor, customer, or passerby! Keep your snacks and drinks off the table and out of view. When closing a sale, ask if there is “anything else you would like today?”

Customers often misinterpret recycled produce boxes that you may be using. They assume you are reselling vegetables grown elsewhere so keep them covered or paint over the lettering. If you sell out of the back of your vehicle, it becomes the visual backdrop to your table so keep it clean and neat or use it for extra display space.

Be kind to kids and dogs. Parents feel extra good when you make their kids feel special. Spending a dollar on a bag of plastic animal toys to tuck into your display and hand out to kids who notice them can create very loyal repeat customers. You can attract appreciative customers by setting out a water bowl if pets are visiting the market.

People long for generosity rather than stinginess. Throw in something extra, like a small bunch of parsley that is not moving anyway, for happy, repeat customers. Make it a pleasant, colorful, interesting, personal experience for everyone to shop at your table and you will be rewarded with increased sales.

Fruit

Business Planning for Small Farmers

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Presentation outlines the process and discusses the importance of business planning for businesses. The presentation provides an overview of the components of a business plan as well as providing detailed description of the various components. Discussions also address the strategic planning process which drives the planning process. The presentation concludes with brief discussions of some business areas for small farmers to consider, which include production costs, pricing, irrigation, insurance, and produce safety issues.

You have a business idea that you believe has the potential to succeed. Whether it's a new venture or an added activity of your on-going business, there are some questions that must be answered and some issues that must be addressed before you start the process of implementing your strategy. An excellent resource that summarizes these areas in an organized format is a business plan. A business plan provides an outline to combine all of these issues and questions in an orderly framework. It allows you to effectively evaluate the viability of your enterprise.

Basically a business plan is a road map for your business. It provides direction for the owner and management as well as individuals/entities outside the firm. The business plan has two purposes (1) to assist the management team in making business decisions to achieve goals and objectives, and (2) discusses the firm's feasibility and viability to lenders, potential investors, and business partners.

There are numerous formats for a business plan, but most contain the following components: executive summary, business description, business proposition, market situational analysis, action/market plan, financial analysis, legal and liability issues, and evaluation.

Executive Summary: The executive summary sums up the entire business plan. It should be short and concise providing the reader with a quick but complete picture of your business. The summary should adequately address all of the components within the plan, but should be limited to one or two pages. The summary should be brief because interested parties may perform an initial evaluation of your project within a short-time frame. By providing a quick snapshot of your proposed project, you allow interested parties to easily assess the merits of your venture.

Business Description and Objectives: The first component of the business plan is the business description. This portion describes the history of the business, location, products, services, and the business's organizational structure. The business description provides a detailed overview of your operation. In addition, this section summarizes the business' strength's, weaknesses, opportunities and threats. This assessment of business assets is referred to as SWOT analysis and includes a complete evaluation of the business' existing resources.

In terms of the business organization, this section details the organization and management structure. Organization refers to the business formation. Is the business a sole proprietorship, partnership, or corporation? The management discussions detail the structure of the management team including employees, lending arrangements, and other hired consultants (accountants, lawyers, etc.). The section includes a listing of individuals and their requisite skills and responsibilities.

Business Proposition: The business plan should discuss why the business exists and management's future direction. This is accomplished through discussion of the firm's mission statement. The mission statement outlines the business's purpose and is the basis for business goals and objectives. "Objectives define what the business will look like in the future, while goals are targets to be met in order to achieve the objectives and ultimately fulfill the mission statement."¹

There are many publications that address business planning and setting goals. An often noted approach is the utilization of SMART goals. This acronym refers to goals that are Specific, Measurable, Attainable, Rewarding, and Time-specific. Strategies and tactic are used to achieve business goals and objective. Once a firm has determined their business goals, management will outline specific strategies to accomplish those goals. Tactics are the specific processes and programs that you will utilize to execute a strategy.

Market Situation and Analysis: The market research section is usually quite extensive. The analysis provides a complete examination and discussion of the existing market or market potential. The section emphasizes the specific advantages the firm has to be successful in this market. There are two components to the market analysis: internal assessment and external assessment.

The internal assessment examines only the firm's resources and factors that are controllable by the firm. The assessment not only inventories resources but also examines the assets and liabilities as they relate to the proposed venture. Specific areas examined include organizational structure, management experience and expertise, technology, access to inputs/resources and marketing skills/networks.

The external assessment examines factors that are beyond the control of the firm. These factors, while outside of the firm, have the potential to significantly impact the firm's activities. Areas to examine include industry conditions, market trends, legal and regulatory issues, consumer analysis, and competitive firms.

Action/Market Plan: This section addresses the marketing plan of the firm. Typically the areas addressed include the four P's- product, pricing, place, and promotion.

Financial Analysis: The financial plan illustrates the financial well-being of the firm. Financial records typically included in this section are balance sheet, income statement and cash flow. The records describe the firms past performance and predict how the firm will perform over a specific time period. The analysis typically includes 2 years of past financial performance and 3 years of projected (pro forma) statements. Using this information, allows the estimation of cash-flow, profitability and solvency.

Legal and Liability Issues: This portion of the business plan addresses specific risks that can affect the business. There are many risks that businesses face, but there are general areas that all those risks fall under. USDA's Risk Management Agency categories risk into five main areas: production, marketing, financial, legal and human resources. The plan should address insurance needs, legal liability and the succession of the operation. In addition, this section should address any regulatory or compliance issues.

Evaluation: How do you gauge whether the venture will be a success? This is an issue that should be addressed on the front-end in order to effectively manage the process. Planning should be given for how the firm's performance will be measured and monitored. What criteria will be used to evaluate the firm's performance? Once the criteria are selected, an acceptable standard must be determined to define what is "acceptable". The important issue is to have an evaluation process in your business plan. It is also important to note that the process should coordinate with the firm's short and long term goals and objectives.

References

Holcomb, Rodney B., Glenn Muske, and Phil Kenkel. "Developing a Business Plan for Value-Added Agricultural Products." Oklahoma Extension Facts Sheet, F-909.

McCorkle, Dean and Stan Bevers. "Business Plans for Agricultural Producers". Texas Cooperative Extension, The Texas A&M University System.

Small Business Administration. http://www.sba.gov/starting_business/index.html

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The Latest in Small Fruit Weed Control

Paper for HIS Proceedings, Supplementing Attached Power Point Presentation
2007 Oklahoma / Arkansas HIS Horticulture Industries Show, Ft. Smith, Arkansas
January 5 & 6, 2007

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This presentation outlines typical weed problems faced by small fruit growers. It also details site preparation/prevention, mechanical control strategies, chemical control strategies, and simple, small-scale application methods.

Identifying Typical Weed Problems

Growers need to identify the nature of their weed problems before mapping out a plan for control. One needs to identify if the weed is a grass or broadleaved plant or a sedge. If it is a grass, is it an annual grass, such as crabgrass, or a perennial grass, such as Bermuda grass? Broadleaved plants can be annuals, such as the summer annual, pigweed; winter annuals, such as henbit and dandelion or perennial broadleaves, such as poison ivy, etc.

Sedges are neither of the above. Many herbicides labeled for control of the above weeds will not control a sedge. Yellow nutsedge is the most common sedge encountered in low, wet spots of berry plantings. Sedges are identified by a triangular stem.

A digital camera and a ruler can be used to photograph a weed for e-mailing to the local cooperative extension service office for identification. Weeds that are mailed in should be pressed between sheets of stiff paper. Live samples for hand delivery should be gathered early in the day, kept in plastic bags and stored in a cool area.

General Weed Control Strategies

Prevent weeds before planting, use mulches whenever practical, consider cultivation in young plantings, consider flaming or use of herbicidal soaps or vinegars on organic/sustainable plantings, and, if using synthetic herbicides, take time to understand how they work, being sure to apply only labeled products on the crop.

Considerations Based on Crop

Strawberries are a short lived crop, sensitive to many herbicides. Grown on sandy or rocky soils we must take care in selecting herbicides that will not leach into groundwater.

Strawberries grown on plasticulture will still require weed control between rows if sod middles are not employed. Due to their sensitivity, make sure strawberries are on the label of any product used nearby.

Grapes are a long-term crop that is very sensitive to phenoxy (2,4-d) herbicides. This material can volatilize and move long distances from neighboring farms. Be sure to register the vineyard with the Oklahoma Department of Agriculture so that aerial spray applicators will know it is in the area that they may be treating. Cultivation is an option in vineyards, just be sure to use a grape hoe or rotavator that has a break-away feature to avoid damaging trunks.

Blackberries form colonies resulting in suckers in the row middles. Mow these off before applying herbicides that may translocate back to the mother plant. Roots are very shallow, so be sure to use herbicides at the proper rate.

Blueberries are generally heavily mulched and, therefore, probably have the fewest weed problems. However, Bermuda grass can easily creep over and under the mulch from neighboring areas. Be sure this is killed out completely before planting any small fruits. A non-creeping grass, such as fescue is better to use as a crop for the row middles.

Prevention/Soil Preparation

One year before planting, either cultivate and plant a fast-growing cover crop to out-compete with perennial weeds, or use a herbicide. Bermuda grass and Johnson grass should be sprayed, possibly two times, with a herbicide, such as glyphosate. These weeds are much more expensive to eradicate from a planting, so eliminate them during the previous growing season well-ahead of planting.

Planting a cover-crop before planting, such as hybrid sudangrass, helps choke out perennial weeds and adds organic matter ahead of planting. A fall cover crop of ryegrass or a grass/legume mix will be beneficial.

Choose a crop for row middles. A permanent grass cover crop, such as tall fescue, should be sown during spring or fall planting time. Legume mixes may add nutrients, but beware of flowering times that may compete for pollination by honeybees.

Mulching

Sawdust, pine shavings, or hardwood mulch all serve well to mulch blueberries or blackberries. Local, low-cost sources are the chief consideration. Mulch spreaders are available or can be retro-fitted from old manure spreaders. Strawberries and grapes are generally not mulched, but woven polyester can be used between grape vines and plasticulture is common to strawberries.

Cultivation

Grape hoes, rotavators and rototillers are commonly used in grape vineyards. Use breakaway features to protect trunks and be aware that rototillers can cause plow pans to develop in finer textured soils. Perennial weeds are best controlled by rototilling at least three inches deep, while annuals only need about one to two inch deep cultivation if the weeds are still small.

Flaming, Soaps and Vinegars

These function by burning weeds down to the surface. They need to be applied up to four times to control perennial weeds. Flamers are not to be used during burn bans and they melt irrigation lines. However, these are good options on organic operations.

Synthetic (Chemical) Herbicides

Synthetic herbicides are classified several ways: selective vs. non-selective; soil-applied vs. foliar applied; systemic vs. contact. Be sure the product selected is labeled for use on your crop and for controlling the weed that is the main problem. No herbicide kills all weeds equally well, so decide which weeds are the worst problem and make controlling them a priority. The worst weeds in Oklahoma small fruit plantings are commonly Bermuda grass, Johnson grass, crabgrass, pigweed and nutsedge. These problems are highly regionalized, meaning the weeds will be different in other states. Also be sure to check the correct pre-harvest interval (number of days after spraying one must wait before harvesting fruit).

Product labels can be pulled up and reviewed at the following website: www.cdms.net
Each state university also has grower guides with herbicide advice for small fruits. In Oklahoma see the OSU Extension Agent's Handbook of Insect, Plant Disease and Weed Control, Publication E-832, available for review in Extension offices. The small fruit weed control section is reviewed and updated annually.

The University of Arkansas publishes “Recommended Chemicals for Weed and Brush Control”, MP-44. It is updated annually and has weed response ratings to help growers select the most effective product for their weed problem in their crop category:

http://www.uaex.edu/Other_Areas/publications/HTML/MP-44.asp

Another useful reference that covers both our states is: “Midwest Commercial Small Fruit and Grape Spray Guide”: www.hort.purdue.edu/hort/ext/extpubs.shtml

Growers must still consult the label as the legal document to follow for proper application and disposal.

Pre-emergent herbicides are applied before weed seeds germinate, must be applied to a weed-free soil surface and usually have to be watered in to be most effective. Post-emergent products are applied to weeds in active growth and are most effective when weeds are small. See attached power point presentation for detailed lists of typical products.

Problems to Avoid When Using Herbicides:

Under-application resulting in poor control, over-application resulting in crop injury or residue problems, unintended applications, as in applying glyphosate to blackberry suckers. Avoid using herbicide tanks that have had 2,4-d in them. This chemically binds with the plastic and can impact future applications with other products.

Small-scale application methods:

All three documents listed above have basic information in the front section on calibration of equipment. The 1/128 method for calculating amounts needed for small areas using small back-back or hand held sprayers can be found at the following University of Wyoming site:

http://ces.uwyo.edu/PUBS/MP93_Series/mp93-4.pdf

####end####

Biology and Control of the Raspberry Crown Borer in Blackberry

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The raspberry crown borer, *Pennisetia marginata* (Harris) (Lepidoptera: Sesiidae) is native to North America and was first reported in New Hampshire (Harris 1839). This borer is a destructive pest of cane fruits in the genus *Rubus*. Adults lay eggs on the undersides of leaves near the margins. Newly hatched larvae crawl down the canes and bore into the cambium of the crown or canes to overwinter (Breakey 1963). Damage to plants occur by larval feeding throughout the crown and canes in the spring and summer. Nutrient flow is often reduced to the canes of plants, causing wilted canes with a shepherd's hook appearance in non-trellised plantings. Because these larvae tunnel through the crown, open galleries can let in pathogens, which cause the crown to decay (Lawrence 1904). Within a few years, this pest will cause loss of 30% or more of plants and significantly reduce yield (Lovett 1921). The raspberry crown borer has a 2-yr life cycle in more northern locations in the United States but has not been determined in Arkansas or any other more southern locations. It is necessary to understand the life cycle of a pest species in order to exploit weak points for control tactics. Raspberry crown borer larvae had been controlled by a soil drench of Azinphosmethyl (Guthion) insecticide applied around blackberry plants in late October. This labeled use on caneberries was cancelled in late 2005.

The objectives of these studies were to describe the biology of raspberry crown borer in Arkansas, to evaluate effectiveness of control tactics against raspberry crown borer, and to determine the optimum timing for these tactics (Published McKern et al. 2007).

Methods

Biology. The life cycle study was conducted at a commercial raspberry crown borer infested blackberry planting in Conway, AR. The study plot consisted of 7-yr old 'Arapaho' blackberries, planted 0.3 m apart in eight 60 m long rows with 3.6 m between row spacing. On each sample date, ten 'Arapaho' blackberry plants were excavated from the perimeter row of the plot beginning in April and ending in October 2004. Sampling was biweekly from May to August then variable from mid-August through October. Pruners and loppers were used to dissect each plant and record the number of larvae and pupae per plant. The location of the larvae was noted as either cambium, crown or in a cane. After pupae were found in the plants, we counted adults on leaves of blackberry plants for 2 hours after 10am every other week.

Control. The purpose was to determine the most effective treatments and the best time of year to apply a treatment to achieve $\geq 90\%$ control of raspberry crown borer larvae. Treatments were applied to the cane base of 5 to 8-yr-old, 'Arapaho' blackberry plants in Conway, AR, spaced 1 to 2-ft apart and 10-ft between rows. Most of the experiments had treatment solutions were applied to the lower cane and crown area of plants in 4 to 6-plant treatment plots (3 or 4 replicates) in a randomized complete block design. On 23 October 2003, the following treatments in 200 gal water/acre were applied: 8 oz Guthion Solupak ai/A (Bayer CropScience, Research Triangle Park, NC); 1.6 oz Brigade WSG ai/A (FMC Corporation, Agricultural Products Group, Philadelphia, PA); solution of nematodes, *Steinernema feltiae*, at a rate of 540 million IJ/ha (220 million IJ/A); one nematode *S. feltiae*-infested greater wax worm cadaver placed next to the crown and covered with 2.5 cm of soil; and an untreated control. On 6 May 2004, the following treatments in 200 gal water/acre were applied: Guthion Solupak; Brigade; *S. feltiae* at a rate of 220 million IJ/A; and an untreated control. On 3 November 2004, the following treatments in 100 gal water/A were applied: 0.8 oz Brigade ai/A; and an untreated control. On 7 April 2005, the following treatments in 100 gal/A were applied: 1.6 oz Brigade ai/A; nematode *Heterorhabditis bacteriophora* (Poinar) at a rate of 220 million IJ/A; nematode *S. carpocapsae* (Weiser)

at a rate of 220 million IJ/A; and an untreated control. An additional study was conducted to determine the optimal volume of water per acre to deliver a 90% lethal dose of insecticide. On 7 April 2005, a solution of 50, 100 or 200 gal/A each containing 1.6 oz Brigade ai/A was applied to the lower cane base and crown area. All plants treated were excavated in June or July. All plant crowns and lower canes were dissected with pruners and loppers and counts made of the number of larvae per plant. Data were analyzed using SAS PROC GLM procedure to separate means using the Waller-Duncan k-ratio t-test (SAS 2004).

Results

Biology. In 2004, the total number of raspberry crown borer larvae found per ten plants decreased throughout the summer. Totals for larvae found in the ten plants dissected biweekly ranged from 63 in May to 22 in August (Fig. 1). Later in the summer, it became more common to find larvae in the same galleries attacking one another. In Arkansas, these larvae appear to be in the last instar as early as May. In comparison, two distinct larval head capsule widths can be found in blackberry plants in northern locations where this pest is reported to have a 2-yr life cycle. On the first collection date on 13 May 2004, 95% of all larvae were found in the cambium of the plant and 5% were found in the crown. By 8 June, 71% of larvae were found in the crown; 22% had moved into canes, and 7% were in the cambium. After 23 June, larvae were not found in the cambium; 30% were found in the crowns and 70% had moved into canes. Pupae were found in early August through September 2004. Adults were found to emerge from 16 September to early October. The adults were easy to follow during the day in blackberry plantings. Females landed on a terminal leaf, then the ovipositor was curled over the leaf edge and an egg was laid on the margin on the underside of the leaf. Quickly, females flew to another leaf, usually within close proximity to the first, sometimes on the same plant and deposited the next egg. Eggs were found from September through early November 2004. Egg hatch began in early October and continued through November. By 21 October, 45% of eggs in the field had hatched.

Control. The percentage reduction in the number of raspberry crown borer larvae per blackberry plant was highest when insecticide or nematode treatments were applied between October and early April (Table 1). Soil-drench treatments of Brigade (Capture 2E) applied to blackberry crowns on 23 October 2003 or on November 2004 achieved > 98% larval control whereas little control was achieved by May treatments. Percentage control of larvae caused by *S. feltiae* nematode infested-cadaver was 46% and 31% by the nematode solution. After early May, most larvae were located within the crown which minimized the potential for exposure to an insecticide or nematode.

The optimum time to apply insecticide or nematodes is after egg hatch in late October until early April. At this time, the overwintered larvae occur under the cambium (bark) at the cane base and have less plant material shielding them from insecticides or nematodes.

On 7 April 2005, treatments of *S. carpocapsae* and *H. bacteriophora* nematodes provided intermediate control of 53 and 33% larval reduction, respectively (Table 1). Nematode treated plots were not irrigated on a regular basis. Temperature is important, but blackberry crowns should be irrigated to increase soil moisture to optimize nematode mobility and efficacy. Since *S. feltiae* is more effective in cooler soils than other nematode species, it is expected to provide better control of raspberry crown borer larvae in Arkansas when given adequate soil moisture necessary for nematode movement, establishment, persistence and infectivity (Koppenhoffer et al. 1995 and 1997). Our study conducted on 7 April 2005 showed that you could control raspberry crown borer by applying Brigade insecticide in as little as 50 gal water/A as that by 100 and 200 gal water/A (Table 1). Therefore, we recommend that the correct rate of insecticide/A can be applied as a blackberry crown drench using 50 gal water/A. This lower volume/A is more acceptable to growers in terms of time and water required for an application. As of October 2005, EPA approved Capture 2EC (Brigade) as the only compound registered against raspberry crown borer on caneberries (blackberry and raspberry). In the southern U.S. where this pest has a one-yr life cycle, the current recommended treatment is to spray the lower cane and crown area of blackberry plants with as little as 50 gal water/A in late October to early November or as late as 7 April.

This timing ensures that the larvae located just under the cambium will be exposed to a lethal dose of insecticide.

Future treatments will be conducted with nematodes like *S. feltiae* or *S. carpocapsae* that attack insect larvae in cool soil as found in Arkansas in early April. Applications will be followed by irrigation to achieve acceptable control of raspberry crown borer larvae.

Acknowledgements

We thank E. Johnson, R. Yingling, N. Singh, B. Slamons, and J. Williamson for assistance with field and laboratory work. Many thanks to R. Garris for providing our research plots. Funding for this research was provided by the IR-4 project and the University of Arkansas Agricultural Experiment Station.

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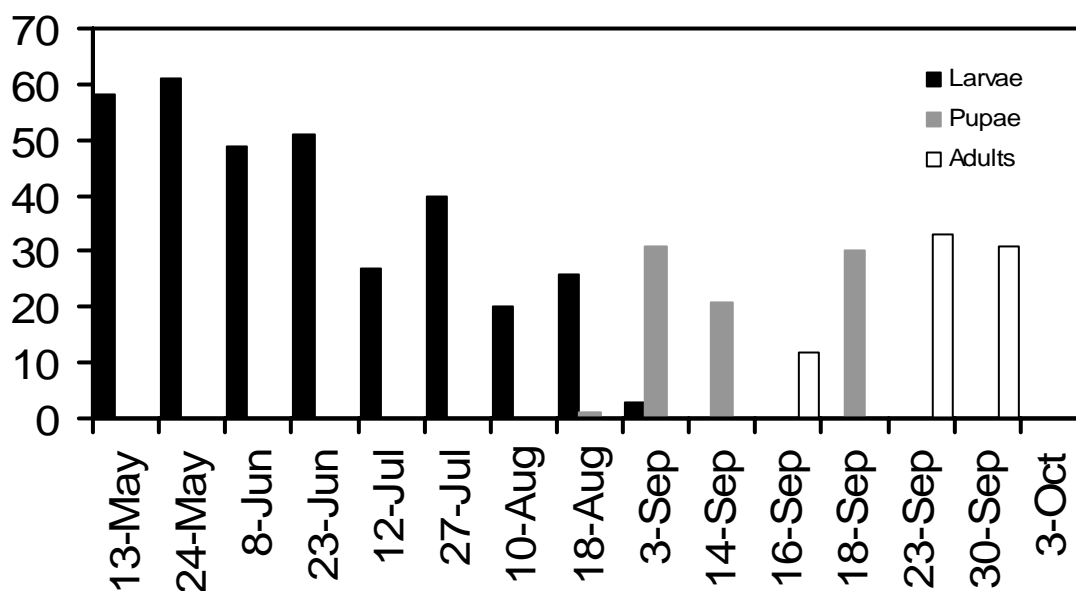
Table 1. Percentage control of raspberry crown borer larvae by treatments applied in 200 gal water/A on as a drench of lower canes of 'Arapaho' blackberry plants (Conway, AR).

Treatments	Rate Amt form./A	% Control			
		23 Oct. 2003	6 May 2004	3 Nov. 2004	7 April 2005
<i>S. feltiae</i>	220 million IJ ^a	31	17	--	--
<i>S. feltiae</i>	1 cadaver/plant ^a	46	--	--	--
<i>H. bacteriophora</i>	220 million IJ ^a	--	--	--	33
<i>S. carpocapse</i>	220 million IJ ^a	--	--	--	53
Guthion	8 oz ai	89	40	--	--
Brigade	1.6 oz ai	99	33	100 ^b	--
Brigade	1.6 oz ai in 50 gal	--	--	--	86.7
Brigade	1.6 oz ai in 100 gal	--	--	--	83.3
Brigade	1.6 oz ai in 200 gal	--	--	--	90.0

^a *Steinernema spp.* or *Heterorhabditis spp.* nematode in solution of infective juveniles (IJ) or an infested cadaver

^b 3 Nov. 2004, Brigade applied at rate of 0.8 oz ai/A in 100 gal water/A

Figure 1. Seasonal changes in the number of raspberry crown borer larvae and pupae in ten blackberry crowns and adults found by a 2-hr late morning inspection of a 'Arapaho' blackberry planting in Conway, AR (2004)



Health from Horticulture: What Fruit Can Do for You!

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In the U.S., diet and nutrition have become important topics in medicine. Adult-onset diabetes (type II) is considered epidemic, and many diseases leading to major causes of death or considered age related are now thought to be at least partly diet-related. Changes in this attitude can be seen in the food pyramid, used for many years by nutritionists and dieticians as a guide for developing a balanced diet. Fruits and vegetables are now considered an important part of the U.S. food pyramid.

The sweet, satisfying taste of fruits has provided a low calorie dessert for many years. Some fruits, such as raspberry and strawberry, have a long history of medicinal use. Others are recognized for their contributions of daily required vitamins and minerals, like vitamin C, vitamin A, and dietary fiber (Table 1). More recently, researchers have found that many fruits contain properties and compounds that help with cancer prevention and cardiovascular health (Table 2). These compounds are often referred to as secondary metabolites, and include plant pigments (carotenoids, flavonoids) or plant defense compounds (tannins). A partial list of these compounds is given in Table 2, and web sources of information on health and health properties of fruit are provided below.

TABLE 2. PHYTOCHEMICALS FOUND IN FRUITS

Compound	Used for:
Flavonols (quercetin, kaempferol, rutin)	Esophageal cancer
Stilbenes (resveretrol, ellagic acid)	Cardiovascular protection
Flavanones (Hesperetin, naringin)	Prevent colon, breast cancer cell proliferation, lower cholesterol
Tannins (gallic acid, catechin), vascular endothelial growth factor	Burn/wound healing (seeds, skin) Stops diarrhea Anti-microbial
Anthocyanins/anthocyanidins	Esophageal cancer, macular degeneration, rectal cancer, reduced blood sugar
Carotenoids (beta carotene, alpha carotene, lycopene, lutein, zeaxanthin)	Prevent macular degeneration, prevents blindness, aids wound healing, aids nerve function, antioxidant, cancer prevention, cardiovascular protection

WEBSITES OF INTEREST

HEALTH –RELATED INSTITUTES

American Cancer Society:

<http://www.cancer.org/docroot/home/index.asp>

American Heart Association:

<http://www.americanheart.org/presenter.jhtml?identifier=1200000>

National Cancer Institute:

http://www.cancer.gov/cancer_information/

National Institute of Health:

<http://www.nih.gov/>

National library of medicine:

<http://sis.nlm.nih.gov/>

NUTRITION AND SCIENCE

Pubmed (abstracts on medical/scientific studies) (set up by National Library of Medicine and National Institute of Health)

<http://www.ncbi.nlm.nih.gov/entrez/query.fcgi>

USDA National Nutrient Database:

<http://www.nal.usda.gov/fnic/foodcomp/search/>

USDA Food & Nutrition Information Center

http://fnic.nal.usda.gov/nal_display/index.php?tax_level=1&info_center=4

U.S. Food and Drug Administration Center for Food Safety and Applied Nutrition Food Labeling Guide:

<http://www.cfsan.fda.gov/~dms/flg-7a.html>

USDA Database for the Flavonoid Content of Selected Foods

<http://www.nal.usda.gov/fnic/foodcomp/Data/Flav/flav.pdf>

FRUIT-RELATED

Washington red raspberry commission:

<http://www.red-raspberry.org/>

Oregon caneberry commission:

<http://www.oregon-berries.com/>

California strawberry commission:

<http://www.calstrawberry.com/health/NutRFP.asp>

Researchers working on berries and human health aspects (has links to other small fruit sites as well): <http://berryhealth.fst.oregonstate.edu/index.html>

TABLE 1. COMPARISON OF FRUITS FOR DIETARY REFERENCE INTAKES (DRI)

FRUIT	1 CUP SERVING SIZE/ WEIGHT (G)	DIETARY FIBER (G)	POTASSIUM (G)	VITAMIN C (MG)	VITAMIN A (MG)	CALCIUM (MG)	VITAMIN K (Microgram)
	DRI amount	25.0	3500	60.0	250 RAE	1000	80
Strawberry	144	2.9 (12)	220 (6)	84.7 (141)	1 (<1)	23 (2)	3.2 (4)
Blueberry	148	3.6 (14)	114 (3)	14.4 (24)	4 (2)	9 (1)	28.6 (35)
Blackberry	144	7.6 (30)	233 (7)	30.2 (50)	16 (6)	42 (5)	28.5 (36)
Grape (red)	151 *	1.4 (6)	288 (8)	16.3 (27)	5 (2)	15 (2)	22.0 (28)
Raspberry	123	8.0 (32)	186 (5)	32.2 (54)	2 (1)	31 (3)	1.5 (2)
Apple	110	2.6 (10)	118 (3)	5.1 (8)	33 (13)	7 (1)	2.4 (3)
Mango	165	3.0 (12)	257 (7)	45.7 (76)	63 (25)	16 (2)	6.9 (9)
Banana	150	3.9 (16)	537 (15)	13.1 (22)	4 (2)	8 (1)	0.8 (1)
Peach	154	2.3 (9)	293 (8)	10.2 (17)	25 (10)	9 (1)	4.0 (5)
Cantaloupe	177	1.6 (6)	473 (14)	65.0 (108)	299 (120)	16 (2)	4.4 (6)
Orange	180	4.3 (17)	326 (9)	95.8 (160)	20 (8)	72 (7)	0
Watermelon	154	0.6 (2)	172 (5)	12.5 (21)	43 (17)	11 (1)	0.2

% DRI in (). If DRI is greater than 10%, considered a good source of the nutrient. If greater than 20%, an excellent source. Vitamin A is based on retinoid precursors beta carotene, lutein, zeaxanthin, alpha carotene. All fruits are low in sodium, low in fat and have no cholesterol. RAE=retinoic acid equivalents. *Seedless

Factors Affecting Cold Hardiness in Grapevines

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Thanks to Deke Arndt for supplying the weather data.

Introduction

Cold hardiness is a major limitation to growing the highest quality European grape cultivars in Oklahoma. Mid-winter low temperatures coupled with wildly fluctuating temperatures in the fall and spring can cause significant injury. In order to maximize conditions to give grapevines the best opportunity to survive, prudent decision making is a necessity. Several factors go into maximizing cold hardiness in grapes.

Stages of Dormancy in Grapes

Three main physiological stages exist related to dormancy and cold hardiness in grapes. The first stage in the dormancy process is acclimation, which is the ability to adjust to climate change. This begins after the vine has ripened its crop and shoot growth has ceased (Rombough, 2002), which is usually late summer into early fall. In order to reach full acclimation a period of cool weather is required before the first freeze. Acclimation occurs mainly during the fall months of October and November, although it begins in August. The weather during October and November can be difficult in some areas of Oklahoma because damaging temperatures may occur prior to full acclimation. Areas in the northern regions of Oklahoma (Table 1) are much more likely to experience harmful temperatures than those in southern Oklahoma.

The second stage, mid-winter hardiness, is the ability to survive particular climatic adversities, especially freezing temperatures during dormancy. This occurs in Oklahoma from December through February. There is a limit as to how cold hardy a particular cultivar can be based on its genetic background. Exposure to temperatures below 20 °F over a period of several days ensure maximum hardiness (Rombough, 2002). Mid-winter temperatures below 0 °F are considered to be potentially damaging to *V. vinifera* grapes (Fennell, 2004). These temperatures are prevalent only in northern areas of Oklahoma where the average occurrence is more than once per year (Table 2). However, damaging freeze events are common enough throughout the state to warrant caution when growing *V. vinifera* grapes.

The third stage is called deacclimation. It is the process of breaking dormancy and readjusting to warmer temperature conditions. This process is caused by periods with temperatures above 32 °F and it occurs fairly quickly (Rombough, 2002). It usually occurs in the spring, but warm temperatures in winter can cause deacclimation leading to severe damage when cold weather returns. Timing of deacclimation is likely the most worrisome for Oklahoma grape growers. This is particularly true for cultivars with early budbreak, such as ‘Chardonnay’. Northern regions of Oklahoma average many potentially damaging weather events during the normal deacclimation period of March through May (Table 3). Even areas in the southern part of the state will experience a handful of freeze events during

spring. At best, minimal bud and/or green shoot damage is experienced. At worst, trunk splitting and permanent trunk and cordon damage can occur.

Genetic Factors Affecting Cold Hardiness

Grapevine genetics play an important role in the level of cold hardiness a particular cultivar can achieve. Species have different abilities to withstand cold temperatures and that ability is determined by evolutionary factors such as its area of origin. The lineage of a particular cultivar, especially a hybrid, can give clues as to its potential cold hardiness. Many grape species have been used in breeding of winegrapes. Most of the cold hardiness genes come through American grape species such as *Vitis labrusca*, *V. aestivalis*, and *V. riparia* (Fennell, 2004). Other American species (*V. rotundifolia*, for example) are not cold hardy at all. *Vitis vinifera* is the most common winegrape species and originated in the Mediterranean areas of Europe. Its ability to withstand cold mid-winter weather is not great. Also, it is highly susceptible to fluctuating fall, winter, and spring temperatures that lead to deacclimation. Therefore, knowledge of the genetic background of a cultivar is a key component to choosing genotypes that are adapted to a particular climate.

Environmental Factors Affecting Cold Hardiness

Several environmental factors are involved in determining the eventual mid-winter hardiness of grapevines, including: elevation, temperatures, light levels, daylength, soil conditions, and disease pressure (Fennell, 2004). Elevation is important because height and slope are needed for proper air and water drainage. Drainage of cold air should not be impeded by trees or other obstacles. Northern slopes will shorten the growing season whereas south slopes will lengthen the growing season. Therefore, early ripening cultivars should be planted on north slopes and late ripening cultivars on south slopes. Ambient temperatures interact with the genetic background of a cultivar to determine its ultimate cold hardiness. Fluctuating temperatures can delay the vine from reaching full cold hardiness. Light exposure is essential for maximum cold hardiness. Shade during the growing season leads to reproductively unproductive vines (unbalanced vine growth – too much vegetative and not enough reproductive) that do not harden off as well as those exposed to full sunlight. American species are responsive to changes in daylength, and coupled with decreasing temperatures, promote more rapid acclimation response than found in *V. vinifera* that responds primarily to decreasing temperatures (Fennell, 2004). Highly fertile soils can lead to excess vigor and poor soils can stress vines due to lack of essential nutrients and water availability. Rootstock selection can compensate for some of these deficiencies. Diseased vines are weak and cannot develop enough carbohydrates through photosynthesis during the growing season to harden wood thoroughly.

Management Factors Affecting Cold Hardiness

Many decisions made by a would-be grape growers can significantly impact cold hardiness. One should choose an optimal site, match cultivars to the climatic conditions, select an appropriate training and trellis system, choose rootstocks wisely, fertilize and irrigate prudently, and also manage the cropping levels of the vine (Howell, 2003). Training and trellis systems should ensure maximum sunlight exposure while balancing vegetative and reproductive growth. Cultivar growth habit needs to be matched with appropriate trellis system. Rootstock selection has a direct influence on scion biochemistry and it may have a direct or indirect impact on cold hardiness levels (Fennell, 2004). The main impacts are due to the rootstock influence on vine size, canopy shading, and cane maturity. Fertilization, when done correctly, has little impact on eventual winter hardiness. However, late season N fertilization can induce vigorous growth that will not harden off in time for cold weather. High levels of irrigation during the growing season can delay acclimation of vines and mild water stress at the end of the season may affect secondary and tertiary bud cold hardiness. Cropping levels are extremely

important to maintain vine health. Excessive crop loads can delay acclimation whereas low crop loads have greater cold tolerance during the fall acclimation period.

Ramifications of Cold Injury

Grapevines can experience three types of injury: bud injury, trunk injury, and vine death. Bud injury can usually be corrected with compensatory pruning. Trunk injury is more severe. There are three levels of trunk damage (Amberg, 1994). The first is not severe with only a browning of the phloem in early spring and full recovery. The second level is more severe and is a permanent injury, with death of phloem tissue that leads to some trunk die-back (Fig. 1) and potential entry for crown gall. The most severe injury is cambium death followed by vine collapse to the ground level. The vine will need to be regrown from the root system. The impact of vine death is obvious as the vine needs to be replaced altogether. Sometimes trunk damage and vine death is not immediately noticeable when pruning is done in the late winter or early spring. The vine may appear normal at pruning, but fail once normal growth is initiated. This could be due to root injury from severe cold or, more likely, from cambial damage. The essence of the problem is that the vine cannot pump water and nutrients from the storage system (roots) to the growing portion of the vine (cordons, trunk, etc.). The inhibition of water and nutrient movement up the trunk due to damaged cambial tissues result in vines being unable to sustain cordon and trunk well-being.

Crown Gall

Many strains of *Agrobacterium* exist, but only one is responsible for tumor development (Amberg, 1994). While inactive in healthy tissue, the bacteria proliferate when associated with winter injury and mechanical damage (Fig. 2). Frequent development of crown galls is the result of trunk injury and not the cause of it. There are a few tools for managing crown gall. The best and most effective is to use appropriate cultivars and rootstocks that have resistance to the bacteria and are well adapted to the region where they are grown. Also, make sure nursery stock is disease free and try to eradicate infected vines if possible. Chances are grapevines grown in Oklahoma will get crown gall at some point because of the harshness of the environment. However, attentive vine management, especially sanitation and eradication, can minimize the detrimental effects.

Concluding Statements

Good site and cultivar selection along with sound vine management are keys to having success in growing grapevines. Protection of the graft union in grafted vines can provide some insurance against winter injury as well. The use of multiple trunks may help in areas where very cold temperatures are common because research has shown that both trunks will not have the same level of hardiness (Fennell, 2004; Howell, 2003). And most of all, healthy vines are happy vines. Sound management will create the best environment for establishing full winter hardiness in grapevines.

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Table 1. Number of freeze events below 28 °F at nine locations within Oklahoma for the months October and November from 1950-2005 when fall acclimation occurs.

Location	Total Freeze Events	Average/Year
Boise City	875	16
Buffalo	558	10
Pawhuska	470	9
Webbers Falls	346	6
Hobart	74	5
Enid	268	5
Chandler	254	5
Durant	97	4
Ardmore	112	2

Table 2. Number of freeze events below 0 °F at nine locations within Oklahoma for the months December-February from 1950-2005 when mid-winter hardiness occurs.

Location	Total Freeze Events	Average/Year
Boise City	157	3
Buffalo	115	2
Pawhuska	89	2
Chandler	38	<1
Webbers Falls	35	<1
Enid	34	<1
Hobart	3	<1
Durant	3	<1
Ardmore	5	<1

Table 3. Number of freeze events below 28 °F at nine locations within Oklahoma for the months March-May from 1950-2005 when deacclimation occurs.

Location	Total Freeze Events	Average/Year
Boise City	969	18
Buffalo	597	11
Pawhuska	483	9
Enid	375	7
Hobart	23	6
Webbers Falls	308	6
Chandler	269	5
Durant	162	3
Ardmore	125	2



Fig. 1 Symptoms of winter injury on ‘Sangiovese’. Cordons have been killed back to the trunk where re-growth has been initiated.

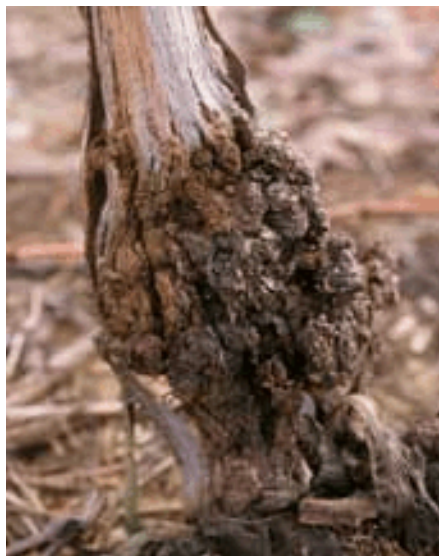


Fig. 2 Severe crown gall symptoms at the base of a grapevine.

Performance of Grafted and Own-rooted Vinifera, Hybrid, and American Grapes at Three Locations in Oklahoma

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Introduction

The emerging Oklahoma grape industry needs grape cultivar performance data localized as much as possible to facilitate decision making by present and prospective grape growers. Likewise, as grape acreage increases, information on rootstock performance will be needed to allow growers to make informed decisions relative to best management cultural practices.

The purpose of this study was to compare winter hardiness, yield, and quality of various grape cultivars (Vinifera, American, and Hybrids) either grafted or own rooted, under various vineyard conditions in Oklahoma.

Materials and Methods

The trial was established with grower cooperators at Woodland Park Vineyard near Stillwater in Payne County, Prairie Wind Vineyard near Burns Flat in Washita County and at Rohrer Farm near Buffalo in Harper County, Oklahoma.

Red and white Vinifera, American, and Hybrid varieties listed below were selected to allow comparison of hardy with less hardy varieties in varying Oklahoma climates.

Cultivar	Color	Type
1. Riesling	White	<i>V. vinifera</i>
2. Chardonnay	White	<i>V. vinifera</i>
3. Cabernet Franc	Red	<i>V. vinifera</i>
4. Cabernet Sauvignon	Red	<i>V. vinifera</i>
5. Vignoles	White	Hybrid
6. Chardonel	White	Hybrid
7. Chambourcin	Red	Hybrid
8. Frontenac	Red	Hybrid
9. Cynthiana	Red	American
10. Sunbelt	Red	American
11. Traminette	White	Hybrid
12. NY 62 (Valvin Muscat)		White Hybrid
13. NY 70 (Corot Noir)	Red	Hybrid
14. NY 73 (Noiret)	Red	Hybrid

Vines were established in plots, 3 vines each, arranged in a split block design with 4 replications. The first planting at all three sites in April, 2002 consisted of green plants of varieties 1 to 4 from Duarte Nursery, Hughson, California and rooted cuttings of varieties 5 to 10 from Double A Vineyards,

Fredonia, NY. The second planting in April, 2003 consisted of grafted plants (3309C rootstock) of varieties 1 to 10 and rooted cuttings of varieties 11 to 14 all from Double A Vineyards, Fredonia, NY.

Vines at all locations were trained to double trunks. The Buffalo site used a modified high curtain system with 10' between rows, and 7' within row spacing. At Burns Flat, a modified VSP system was used with 10' between rows and 8' within row spacing. Vines at Stillwater were trained to GDC with 12' between rows and 8' within row spacing.

Data collection began in 2003 including bud break, vigor, fruit yield, and quality. Fruit was harvested when a random sample of 100 berries from each treatment tested 22 degrees Brix for red cultivars and 20 degrees Brix for white cultivars. Bud break ratings were made according to Eichorn-Lorenz Grape growth charts. At harvest a random sample of 10 clusters and 100 berries were weighed to determine cluster and berry size, respectively. Data at the Buffalo site were limited to vine growth and survival.

Juice analysis

Grape berry samples of about 100 berries were harvested as described above, placed in plastic bags, and frozen within 24 hours of harvest for subsequent analysis. Frozen berries were held at approximately -15°C (5°F) until analyses were conducted. Juice samples were prepared for analysis by holding a sample bag at room temperature until the berries were completely thawed, then gently crushing the berries in the bag to express the juice. Duplicate 5 ml samples of juice were then removed from the sample bag and evaluated for soluble solids, pH, and titratable acidity. Soluble solids were measured using a Leica model 10500-802 Auto Abbe Refractometer (Leica, Buffalo, NY). Titratable acidity and pH values were measured with a Fisher model AB15 pH meter (Fisher Scientific, Pittsburgh, PA). Samples were titrated to an endpoint pH of 8.2 with 0.1 N NaOH and titratable acidity was calculated as percent tartaric acid. Duplicate values were averaged to give final reported values.

Results and Discussion

Early bud break followed by rapid growth predisposes vines to injury from late spring frost during March and April in Oklahoma. This tendency is most prominent in vineyards located in low-lying sites or sites surrounded by tall trees or other structures which block air drainage. Vines grafted on 3309C rootstock tended to initiate growth slower in the spring in comparison to vines on their own roots. This difference was most apparent on 'Cabernet Franc', 'Chardonnay' and 'Chambourcin' in the frost susceptible Stillwater trial. (Figure 1).

Winter cold injury is a persistent threat to wine grapes especially in northern Oklahoma. A cold spell in 2005 dropped December temperatures to -3 and -4°F on successive nights at the Stillwater site and -3, -6, and -4°F on successive nights at Buffalo. The lowest temperature recorded at the Burns Flat site was +1°F during the same event. Freeze injury ratings at the Stillwater plot (Figure 2) indicated the most severe effect of the freeze was on 'Chardonnay' on its own roots, 'Cabernet Sauvignon' and 'Cabernet Franc'. The least affected of the Vinifera varieties was 'Riesling' on its own roots. Hybrid and American varieties were little affected by the freeze.

Winter temperature was a major factor in plant survival at Buffalo. Growth rating of vines in the Buffalo plot indicate the hardiest of all varieties were 'Frontenac', 'Vignoles', 'Traminette' and NY70. The least hardy were 'Cabernet Franc' and 'Chardonnay'. The hardiest of the Vinifera in the Buffalo trial were grafted 'Riesling' and 'Cabernet Sauvignon' (Figure 3).

Grapes at Burns Flat matured earlier with higher sugar, smaller clusters and berries, and higher pH, than those at Stillwater. There was no significant difference in yield at the two locations after 4 years (Table 1). The highest yielding varieties in the trial were ‘Chambourcin’ and ‘Tramintette’ followed by ‘Frontenac’, NY73, NY70 and ‘Chardone1’. The highest yielding *V. vinifera* variety in the trial was ‘Riesling’ (Figure 4). Late spring frost and winter injury reduced yield from Vinifera varieties in the trial.

Grafted vines yielded more fruit with lower acid content than own rooted vines (Table 2). Grafted vines at Stillwater yielded significantly more fruit than own rooted or grafted vines at Burns Flat (Table 3).

Conclusions

Results of this trial suggest that vines grafted on 3309C tend to delay growth in the spring which can reduce crop loss to late spring frost events. Oklahoma grape growers should consider the benefits of grafted vines against the risk from winter freeze injury. Periodic winter and spring cold damage is to be expected on grapes in Oklahoma. Hybrid and American grapes are less susceptible to cold injury than *V. vinifera* and should be considered for planting especially where risk of winter injury is high. Hybrids also offer yield advantages over *V. vinifera* and American types.

Acknowledgements

The Kerr Center for Sustainable Agriculture, Producer Grant Program, Poteau, OK for funding this project.

Ivol and Jeanette Hane, Woodland Park Vineyard, Stillwater, OK

Leon and Beth Ledbetter, Prairie Wind Vineyard, Burns Flat, OK

Len Rohrer and Ed Rohrer, Rohrer Farms, Buffalo, OK

Table 1. Effect of Location on grape yield and juice composition in Oklahoma 2004-2006.

Location	Hvst. Date (Julian)	Yield/acre (lbs)	Yield/plant (lbs)	Berry Wt. (g)	Cluster Wt. (g)	pH	Acid (%TA)	Brix (%)
Burns Flat	213 b ^z	4119 a	7.6 a	11.6 b	72.2 b	3.6 a	0.82 a	21.8 a
Stillwater	223 a	4576 a	8.4 a	14.7 a	82.0 a	3.4 b	0.77 a	19.4 b

^zValues followed by the same letter within a column are not significantly different ($P \leq 0.05$).

Table 2. Effect of rootstock on yield, fruit quality, and juice composition in Oklahoma 2004-2006.

	Hvst. Date (Julian)	Yield/acre (lbs)	Yield/plant (lbs)	Berry Wt. (g)	Cluster Wt. (g)	pH	Acid (%TA)	Brix
3309C	220 a ^z	5830 a	10.7 a	12.9 a	83.2 a	3.4 a	0.67 b	20.1 a
Own Root	220 a	3853 b	7.1 b	14.0 a	77.1 a	3.4 a	0.81 a	19.7 a

^zValues followed by the same letter within a column are not significantly different ($P \leq 0.05$).

Table 3. Effect of location and rootstock on yield of 11 wine grape varieties in Oklahoma 2004-2006.

Location	Rootstock	Yield/acre (lbs)	Yield/plant (lbs)	Cluster Wt. (g)
Stillwater	3309C	6647 a ^z	11.8 a	91.7 a
Burns Flat	3309C	4450 b	8.2 b	62.6 b
Burns Flat	Own Root	3993 b	7.3 b	75.6 b
Stillwater	Own Root	3783 b	7.0 b	77.9 b

^zValues followed by the same letter within a column are not significantly different ($P \leq 0.05$).

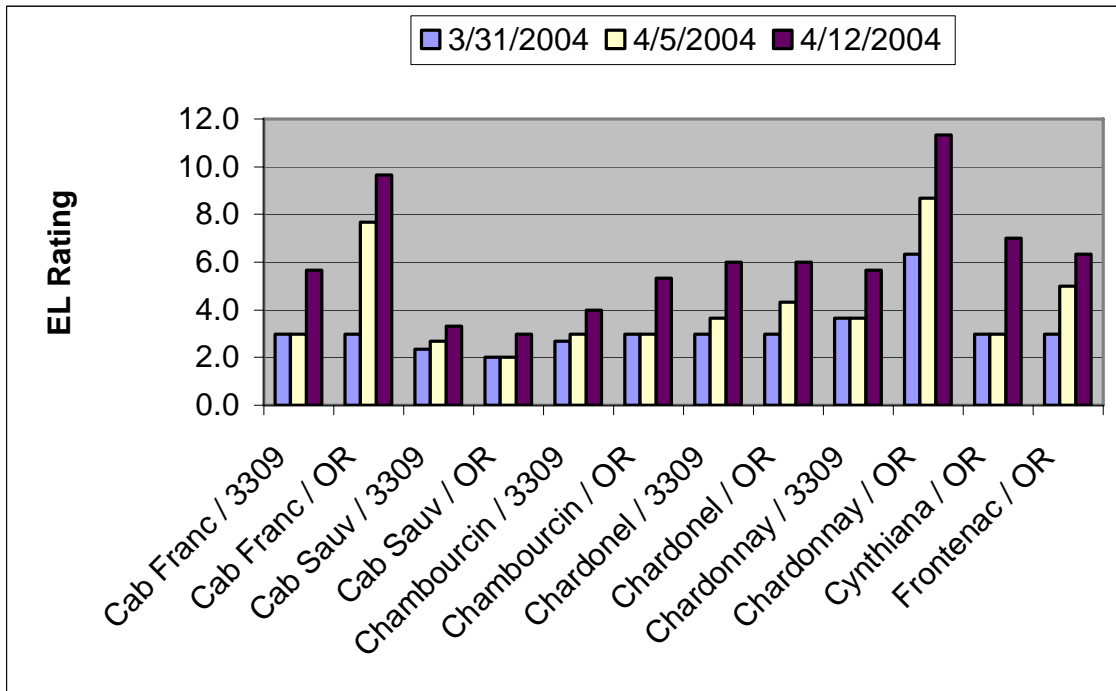


Figure 1. Effect of 3309C rootstock on bud break (Eichorn-Lorenz rating scale) of various Vinifera, American, and Hybrid grape cultivars, Woodland Park Vineyard, Stillwater, OK.

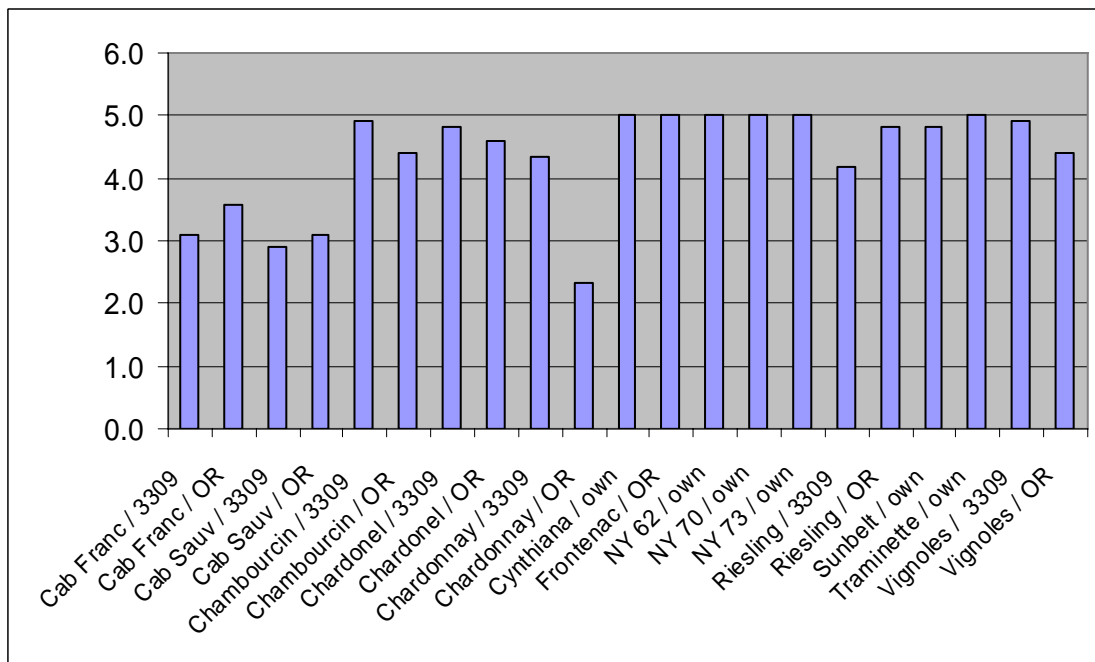


Figure 2. Cold injury ratings for grafted and own-rooted grape vines at Stillwater, OK 2006. 1 = dead; 2 = new growth from root or above graft; 3 = New growth on trunk below cordon; 4 = new growth on cordon \geq 1/2 total cordon alive; 5 = no damage.

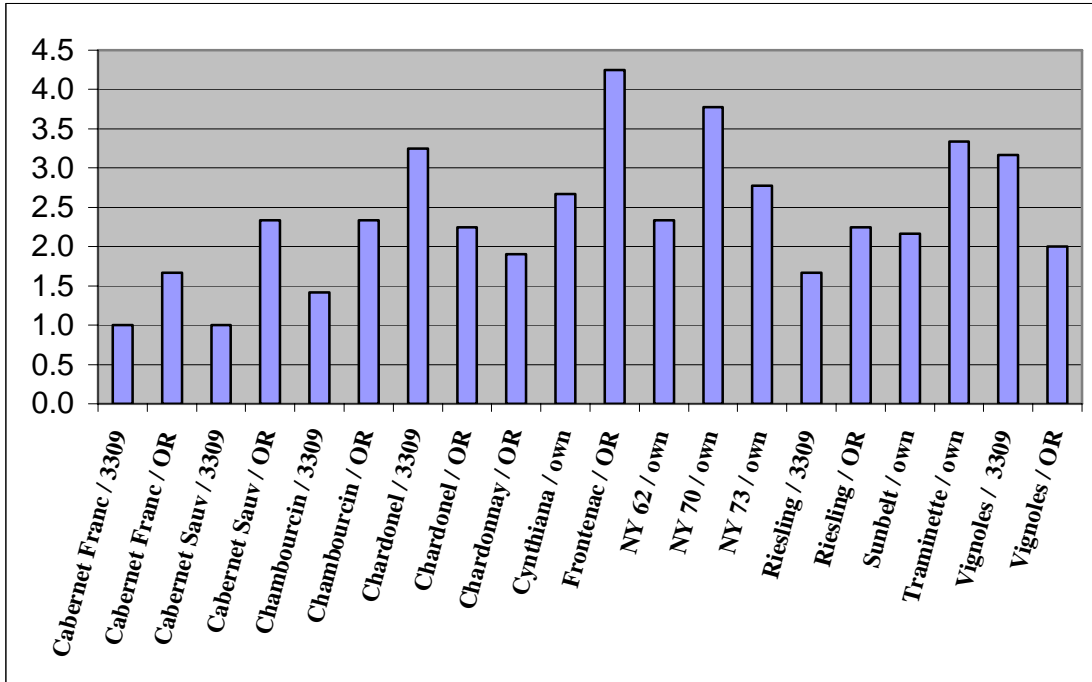


Figure 3. Growth ratings for grafted and own rooted grape varieties, Buffalo, OK 2002-2006.
 1 = dead; 2 = new growth from root or above graft; 3 = New growth on trunk below cordon;
 4 = new growth on cordon \geq 1/2 total cordon alive; 5 = no damage.

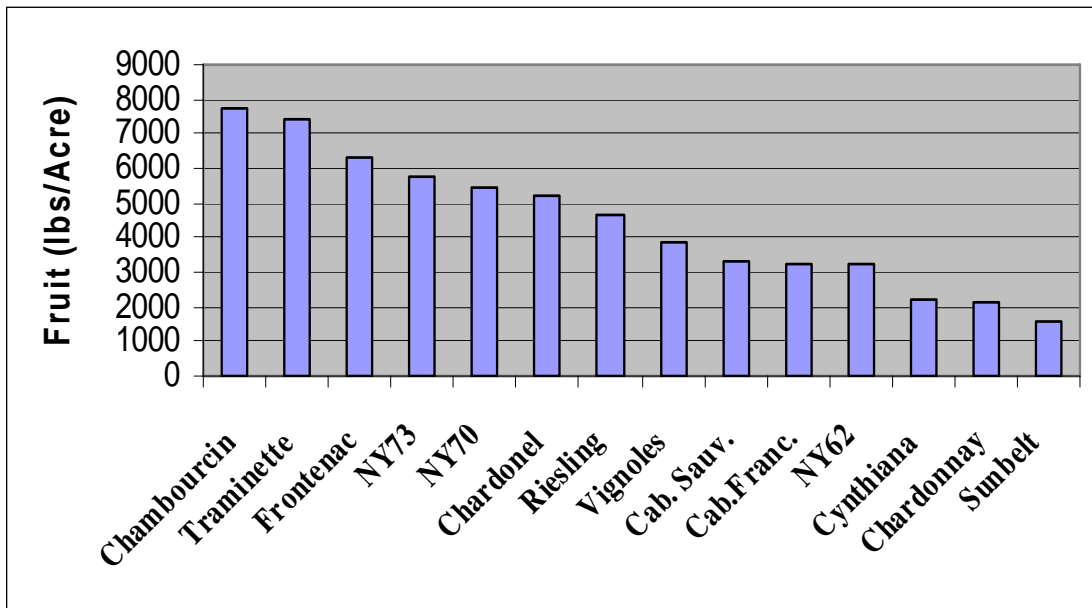


Figure 4. Effect of variety on grape yield in Oklahoma 2004-2006.

Figs, Brown Turkeys and Confusing Nicknames

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ABSTRACT

Figs are an under-utilized fruit crop in our region that could fit into a small farm operation on a limited basis, especially as a base for value-added products. Conventional wisdom in Extension holds that there are only two reliable cultivars for Arkansas and Eastern Oklahoma: ‘Brown Turkey’ and ‘Malta’ (commonly called ‘Celeste’). In the Fort Smith region alone there are at least 5 cultivars that have been in landscape plantings for more than 10 years, and there is every indication that there are at least 5 more that can be grown. Two cultivars that show promise are ‘Negronne’ and ‘Latturula’. More work needs to be done to assess the ripening dates and yield potential for an array of cultivars.

As a Californian I have always tended to take figs for granted. Their ubiquity and long harvest season made them an easy target for a quick snack. On most of the farms I worked, there would be a few Mission fig trees planted for everyone’s enjoyment.

Notice I said trees. In Northern California figs are generally small trees that get about 20-30 feet tall. It never occurred to me that there were figs in Arkansas since winters are cold, and obviously I wasn’t seeing any trees! Naturally I was surprised to discover that we do in fact have figs here: they are just big bushes.

I didn’t think much of it again for several years, but a client asked which figs we can grow here so I was compelled to find an answer. In our files were lots of articles extolling the virtues of our two fig varieties* here: ‘Celeste’ and ‘Brown Turkey’. Perhaps a week before, my landlord showed me a fig she had brought from Long Island 20 years ago and it was neither ‘Celeste’ nor ‘Brown Turkey’. This made me wonder which other cultivars would grow here.

Eventually two of my Master Gardeners put in a home orchard and volunteered to be my fig testers. That’s how my interest in figs began.

Why would anyone care about figs? Figs are perhaps the easiest fruit crop to grow. Their only real pests are birds and Green Junebugs (and occasionally nematodes). They are drought-tolerant and need little care. And they are nutritious. The ease of growing figs could be one reason why fig culture predates growing grains by 1,000 years.

Figs can be propagated, royalty free, from virtually any asexual propagation technique you can think of. Hardwood cuttings are very simple, and softwood cuttings are very fast. Grafting works if you need nematode-resistant rootstock.

I don't see anyone in our region making a living on growing figs; however, as part of a PYO operation or small farm with a local market, figs represent an untapped market. They are especially amenable to value-added products such as spreads and are known to extend the shelf life of baked goods containing them.

Figs come in four types: Common, San Pedro, Smyrna, and Caprifigs. Common figs are the type we grow in most of the US. Only common figs can grow in Arkansas and Oklahoma as they require no pollination. Smyrna figs are the famous ones from Turkey that require pollination from a specialized *Blastophaga* wasp that does not survive here. The San Pedro figs fall in between the two. Caprifigs, so called because only goats would eat them, are the pollen parents. Fig reproduction is exceedingly complicated, but makes for good reading. In the short version, branches of caprifigs infested with the wasp are brought to Smyrna figs for pollination.

Figs bear potentially two crops per year. The first is called the breba crop and it is borne on last season's wood. The main crop develops on current season's wood. Each cultivar varies in the importance of either. Some have breba and main crops, others only main crops. Many times the fruit looks different for each.

Figs have always been a minor crop in North America and so there are little research available, and virtually no current breeding efforts. The last (and really only) serious fig breeder was Dr. Ira Condit of what is now University of California, Riverside. He characterized dozens of fig varieties and had an extensive breeding program. One of his greatest contributions was to standardize the nomenclature of fig cultivars.

Today, many figs have an official name that was decided by Dr. Condit, and a more common variety name that most people use. For example the popular variety 'Celeste' is also known as 'Tennessee Mountain' and 'Sugar' but it is correctly called 'Malta' from its place of origin. Because of this, there is a lot of mislabeled material and plenty of confusion. Some Brown Turkeys will not grow here like 'California Brown Turkey' which is really Condit's 'San Piero' or what we would call 'San Pedro'. Confused?

Generally most fig sources list Condit's name and the common name so we are in luck. Think of this as analogous to trade names and common names with drugs and pesticides (Roundup vs. glyphosate).

In 2005 a fig trial was planted in Witcherville, Arkansas to assess hardiness of 11 cultivars (it turns out we ended up with 12). As we have had mild winters there is not much to be said about hardiness at this point, but some interesting developments have been noted.

The cultivar 'Violette de Bordeaux' (really 'Negronne') has easily the best-tasting fresh fruit of the bunch and is very attractive, but I have some concerns about its hardiness.

I was also pleased with 'Italian Honey' ('Latturula') and 'Marseilles'. It turns out that 'Latturula' is probably a bud sport of 'Marseilles'. The flavors are very similar, but 'Latturula' seems to be about 10 days later and has more vigorous vegetative growth. Either could be the variety old-timers here call 'Lemon'. The flavor has a distinctive lemon-honey quality that is of course difficult for anyone but a sommelier to put into words.

I have tasted dozens of 'Brown Turkey' fruits and I can say that it ranges from bland to moderately palatable. There appears to be a lot of variation in this cultivar. Perhaps it is truly a variety in the

botanical sense. The fruit all looks similar, but the fruit size and acidity seems to vary. ‘Celeste’ is every bit as easy to grow and tastes much better, so I don’t recommend ‘Brown Turkey’ for that reason.

Currently, the best overall varieties seem to be ‘Italian Honey’ and ‘Celeste’, but if you’re willing to take a slight gamble, I highly recommend trying ‘Violette de Bordeaux’.

There really isn’t much known about fig culture in our climate. A grower interested in planting figs must rely on some experimentation at this point. We do not have data on hardiness, yield, storage, or harvest time. In addition, there seems to be some clones of ‘Celeste’ that are primarily breba-fruiting and others that are main-crop fruiting which seems to add to the confusion. In our trial, the clone we have bears main crop fruit, but many reports warn about the damage a severe winter can cause to next year’s crop.

A replicated trial with good data collection could remedy this deficiency.

As confusing as figs can be, I encourage you to try a few in a sunny place. Few things in life that require such little work are so rewarding, which is perhaps the true reason I like figs.

For more information on figs see the following...

Alabama Cooperative Extension Fact Sheet on Figs is excellent and can be found online.

Ray’s Figs website. Ray Givan is a fig connoisseur and has a lot of varietal information.
<http://home.planters.net/~thegivans/index.html>

There are two good fig resources in the defunct journal *Hilgardia* by Ira Condit: “Fig Varieties: A Monograph” (Vol. 23, No. 11, Feb. 1955), and "Fig Characteristics Useful in the Identification of Varieties" (Vol 14, No 1 May 1941, 1-69).

North American Fruit Explorers has some excellent information: www.nafex.org/figs.htm

Finally, the site “Wayne’s Word” (no connection to Saturday Night Live) has several articles on fig biology. waynesword.palomar.edu

*I use variety and cultivar interchangeably, although I realize they are not the same thing. Cultivar is just too ugly a word to repeat ad infinitum.

The Organic Production Program at the University of Arkansas: A Research Update

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Speaker Biography

C.R. Rom grew up on a fruit farm in Northwest Arkansas. He attained a BS of Agriculture studying Horticulture and Business from the University of AR and earned his MS and PHD degrees from The Ohio State University. He was a horticulturist at the Washington State University prior to becoming a professor at the University of Arkansas in 1989. He has broad responsibilities for horticulture education, and research on fruit crop physiology and management, and organic and ecologically-based production systems.

Introduction

Organic production globally has grown dramatically during the past two decades. In the US, the growth in consumption of organic produce has grown at a 10-15% increase per annum rate since the year 2000. Much of the growth has occurred since the adoption of the National Organic Program (NOP) rules in 2002. In the Arkansas-Oklahoma region, there are currently a relatively small number of certified organic producers. However, based upon our survey research, there are both significant opportunities and interest in organic production for the region.

Among the opportunities in our region are traditional roadside and on-farm markets, and community-based farmers' markets. As I have sold at these markets, I believe there is strong consumer interest in locally grown, organically produced crops.

However, because the NOP rules and marketing standards are relatively new, research to support organic growers, especially fruit and vegetable producers of the southern region, is scarce. We have determined from our survey work that a limitation to organic production is a lack of regionally tested, scale-appropriate technology for organic production. This limitation may be manifest in the fact that very few Arkansas producers have applied for and used the NOP certification cost-sharing program through the state of Arkansas in order to establish organic production systems.

At the University of Arkansas, our group has initiated several projects to develop technology for to stimulate and support organic production in the region. The work is multidisciplinary and incorporates effort from other scientists including Dr. Elena Garcia (Horticulture), Dr. Donn Johnson (Entomology), Dr. Jennie Popp (Agriculture Business), Dr. Mary Savin and Dr. David Miller (Crops, Soils, and Environmental Sciences), and Dr. Ron Rainey (Cooperative Extension Service). Several graduate students in our lab have contributed to the work including Vikramjit Bajwa, Jason McAfee, and Kristen Patterson. A visiting scientist, Dr. Zimian Niu, has also contributed. We have received significant

contributions and assistance from staff members at the Fayetteville NCAT/ATTRA office. The research has been funded by a number of agencies and companies including the Organic Farm Research Foundation, the Colorado Organic Crop Management Association, the Washington Tree Fruit Research Foundation, Gerber Products company, the Sustainable Agriculture Research and Education (SARE) program of the USDA, and the USDA-CSREES Organic Crop Production program. The organic research activity is only a portion of the institution's greater commitment to sustainability. This paper presents an update on the status of the research efforts.

Perceptions and Needs

Prior to initiating the production research program we felt it necessary to prioritize challenges, opportunities, and information and technology needs of various clientele groups. In 2002 we surveyed organic tree fruit growers on their reasons for producing organically and their technology needs. In 2004, we coordinated and conducted a 7-state survey of organic producers, potential producers, marketers, processors, and information providers on the challenges to and opportunities for organic production. Again in 2004 we conducted a survey of University faculty scientists on their perceptions and interests in sustainable and organic agriculture and research. In 2006 we just completed a survey of Cooperative Extension Service personnel of their perceptions of sustainable and organic production in Arkansas and their information and programming needs to support these production sectors.

Information on these surveys has been published in previous Horticulture Industries Shows Proceedings. Recently, as part of Master of Science thesis project, we have published through the UA Cooperative Extension Service, the "*Organic Resource Manual*" which may be found on-line at, http://www.aragriculture.org/horticulture/Organic_Resource_Manual.pdf.

Organic and Alternative Crop Load Management Strategies

As has been reported at several of the past HIS meetings, our lab group has been working to develop organic alternatives for fruit thinning. Our research evaluated chemicals to be used as both bloom-time and post-bloom thinners. Most of the studies have been laboratory studies to develop an understanding of the mechanisms which affect thinning, and to develop simple laboratory models to screen a large number of chemicals. To date, we have screened approximately 70 different chemicals as bloom or post-bloom thinners. Of those, about a dozen, seem to have promise and will move to the next stage of research; field-based tests. After preliminary field testing, additional studies of farm-scale testing must be completed to understand the specifics of rates, dilutions, application timing, cultivar response, and potential negative or phytotoxic side-effects.

The Interaction of Ground Cover Management and Nutrition in Organic Apple Orchards

Based upon a grant from the USDA Southern SARE program, we initiated a trial in spring 2006 to evaluate the complex interactions of ground cover management and nutrient application in organic orchards. The overall goal of the study is to understand the effects that ground cover management and nutrient sources have on tree growth and productivity, and the orchard ecosystem biodiversity, including the soil biodiversity, arthropod and insect diversity, and animal diversity within the orchard.

A modern, high density orchard of the disease resistant cultivar Enterprise/M.26 was planted in spring 2006. Prior to planting, the orchard site had not been in cultivation for four years. In the fall before planting (Sep - Oct 2005) the orchard site was leveled correcting surface drainage issues. The ground was fertilized with approximately 4 tons of barnyard manure which was incorporated by cultivation. Afterward, a cover crop of winter wheat and K-31 fescue was sown. A trellis system for a tall (10') vertical axis system was installed. Trees were planted in April 2006 at a 6' x 12 spacing, or 600 trees per acre density.

After planting, four ground cover management systems were employed (described in more detail below): 1) a mow-and-blow system, 2) municipal green compost, 3) wood chips, and 4) shredded office paper. The mow-and-blow system was designed to capture all of the field biomass growing between rows to the edge of the trees and to blow it under the trees during the mowing. Therefore all of the mulch would be produced on-site. The municipal green compost was purchased from the City of Fayetteville. The wood chips came from several sources and had been partially composted about 1 year. The shredded office paper was gathered as part of the University of Arkansas paper recycling program. The compost and wood chips were applied to about a 4" depth in May. The shredded paper was applied by soaking the paper in water, then applying by pitch-fork to a depth of about 2". The ground cover management treatments are to be applied to control competitive weeds without the application of synthetic herbicides.

Overlapping the ground cover management treatments are three different nutrient source treatments; 1) a control, 2) composted poultry litter and 3) pelletized commercial poultry-based organic fertilizer. For the control, the nutrients in the treatment system would be derived from the ground cover treatments, e.g. decomposing mowings, compost, wood chips, and paper. The poultry litter and pelletized fertilizer were both applied at the same rate of N per tree (approximately 1/10 lb of N/tree).

The effects of treatments on soil chemistry and structure, weed density, soil microbiology, tree growth, nutrient content, insect and animal populations, and cropping, both fruit quantity and quality. This study is planned as a ten-season study. Trees will not be allowed to crop in the first two seasons and thus the first cropping year will be in 2008, the 3rd leaf. Much is yet to be learned from this study. Field days and workshops for growers will be planned.

Alternative Season Berry Production

With the development of fall-bearing blackberries from Dr. Clark's breeding program there is a significant opportunity to expand the fruit production season for the region. However, it has been observed that fall-bearing blackberry production in Arkansas may be temperature limited; it is too hot in August and early September to form flowers and the first average frost (approximately 20-October) limits the flowering and fruiting season only to three or four weeks. However, with the use of high-tunnels, minimally structured greenhouses without temperature control, it may be possible to extend the fruit production season of these new genotypes.

With funding from the USDA Organic Grants program, we have established collaboratively with the University of Georgia, studies of high-tunnel berry production for the southern region. In fall 2006 we established three different trials: 1) extended fall production, 2) early spring production, and 3) both fall and early spring production. Both primocane and florican blackberries and raspberries, three cultivars of each, were planted in late spring 2006. In September high tunnels were constructed for studies to begin in 2007.

Fall primocane production will be extended by closing the high tunnels on any nights temperatures are forecast to go below 40°F. These will be covered in the fall, until approximately December 1, and then opened so that plants may go dormant. After plants are dormant or early in the spring, canes will be mowed and/or removed to force new primocanes. We estimate that we may be able to, in most years, keep tunnels sufficiently warm to allow fruit production to continue through November, giving a grower possibly 6-10 weeks of fall berry production. For the second trial, three cultivars each of florican blackberries and raspberries were planted. Tunnels over these plants will be closed approximately 1-February after it has been calculated that plants have satisfied their physiological dormancy (rest)

requirements. Plants will be protected on any night temperatures fall below 40°F. It is estimated that plants would begin fruiting approximately 15-April, advancing the traditional blackberry season by about six weeks. In the third trial, the primocane bearing cultivars used in first study will be covered in both the fall for fall production, and again in the spring to allow floricanes to produce. In each trial, there is an uncovered, traditional plot for statistical comparison. The 2007 season will be the first harvest season and so at this time, there are no results. In Georgia, blueberries were planted for winter and spring production.

A fundamental idea of these studies is that insect and disease pests can be minimized by growing the fruit crops out of the “normal” growing season. Further, by producing these fruits at a time when maximum prices may be received at market, the additional costs of the structures and labor to grow fruits organically can be recouped and a profit gained.

Other activities of our group are ongoing. Recently, a student group, the Student Organic Farm, was initiated where students can experiment with and grow garden crops organically. Our research group is also beginning studies on alternative organic crops for farmers’ markets including vegetables and ornamentals. With these studies, it is our premise that we will gain much needed experience and develop data for understanding the production systems for organic fruit production. If the information is applicable, and proves economic, these systems may be useful to growers in our region.

Alternate Bearing in Fruit Crops

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Alternate bearing is a severe problem associated with fruit production. Alternate bearing, also called biennial and irregular bearing, is high production of fruit one year followed by low production the next. On some fruits this low production can occur more than just one year. For instance, in pecans there may be two or three years of low production before a heavy crop is set. Therefore, understanding what causes alternate bearing and ways of controlling it is very important in fruit production.

Almost all stone fruits (peaches, apricots, nectarines, cherries, plums, etc.), pome fruits (apples, pears, etc) and nut crops are affected by alternate bearing. There are several theories to what causes alternate bearing. One of the most researched theories is the carbohydrate theory. Carbohydrate (energy) is produced by the leaves and transported to the developing fruit. More carbohydrates are required for excessive fruiting which leaves fewer carbohydrates for the plant to store for the next year's fruit production. Other theories that have been investigated are nutrient depletion during the heavy crop year, as in pistachio, which has a depletion of nitrogen caused by the heavy crop. Hormones are also believed to cause alternate bearing. For example, it is well documented that apples produce the hormone gibberellin, which causes reduced crop set the following year. Environmental conditions can also cause alternate bearing as well. When a freeze kills all fruit on a tree, the tree will produce a heavy crop the following year. This, in turn, may start an alternate bearing cycle.

Research has shown different ways of controlling alternate bearing in most crops. With proper variety selection consistent production can be achieved. Healthy trees have better production; therefore properly fertilizing trees is important. Another option for regulating alternate bearing is fruit thinning.

Fruit trees often set heavier fruit loads than needed for a full crop. There can be several undesirable side effects from heavy crop production. The weight of the extra fruits can cause damage to the limbs from breakage. Fruit size will be lessened and flavor can be diminished. The benefits from thinning are reduced alternate bearing, reduced limb breakage, improved fruit size and color, tree vigor and better air movement through the tree for disease and insect control.

Fruit thinning is generally most effective when completed shortly after fruit set, while the fruit is small and little carbohydrates are used by the fruit. Thinning can be done throughout the season. However, there is a point where thinning will no longer benefit the following year's fruit production. Different fruits have different physiological development that controls production.

Pruning and hedging can be utilized to thin fruit. This is accomplished through the removal of whole limbs that would bear fruit. Thinning can also reduce the spread of diseases by keeping the fruit from touching and increasing air movement during pesticide spraying.

Pecans require thinning with a trunk shaker, in order to remove a portion of the heavy crop. The fruit is removed during water stage before the shell hardens. Thinning is done at this time because when using a mechanical shaker the fruit has to be heavy enough to shake off the tree. If thinning occurs after the water stage (dough stage) then the following years crop is not affected by thinning.

Peaches will usually produce a heavier crop than needed. Therefore, thinning peaches is very important. Thinning will reduce limb breakage do to the heavy crop load and will improve the quality and size of the fruit. One important thing to remember is that it takes fewer large peaches to make a bushel; therefore, the yield can remain good on thinned trees. For example, a peach tree producing 2-inch diameter fruit that takes 293 peaches to make a bushel will produce 3.4 bushels with 1,000 fruits. A peach tree producing 2 ½-inch diameter fruit that takes 159 peaches to make a bushel will produce 4.4

bushels with 700 fruits. A peach tree producing 3-inch diameter fruit that takes 98 peaches to make a bushel will produce 5.1 bushels with 500 fruits. Fruit on peaches should be spaced 8-12 inches between fruit for fresh market production and peaches used for processing spacing should be 6-8 inches between fruit. Peaches can be thinned by removing blooms or small fruit. This can be done by hand or mechanical methods. Normally a stick is used to beat the fruit off the tree. This will remove the weakly held fruit. Therefore, the more the tree is hit the more the fruit is removed.

Plums tend to overbear like peaches. Fruit on these trees should be spaced 4 to 6 inches apart and the fruit cluster should be broken up. Native plums do not need thinning unless heavily loaded.

Apples frequently require thinning. There is usually a naturally occurring fruit drop in June. If excessive fruit remains, the apples can be thinned to 6 to 8 inches along the limbs or 20 to 30 leaves per fruit for small varieties and 8 to 10 inches apart or 30 to 40 leaves per fruit for larger varieties. Thinning to one apple per fruiting spur can aid in disease control. Thinning in apples can be done with a chemical thinning agent. One of the main agents used is Carbaryl (Sevin). So, in orchards with other fruit trees, producers need to be careful during and shortly after bloom to not use Carbaryl around apple trees. Apples can also be hand thinned by removing fruit from the cluster, the king fruit (the middle fruit) is the fruit that you want to leave on the tree.

Pears are usually thinned only when very heavy crops are set and the trees might be damaged. Thinning is usually done a few weeks before harvest.

Persimmons are seldom fruit thinned unless a heavy crop threatens to damage limbs. Sometimes persimmons will fail to produce a fruit crop the year following a heavy crop. Fruit thinning during heavy crop years appears to reduce alternate bearing.

Grapes, muscadines, citrus, figs, blackberries and blueberries are not fruit thinned. Grapes and muscadines are pruned in the winter. This reduces the number of buds available to produce fruit clusters. Pruning is a form of fruit thinning which results in improved fruit quality and also controls the size of the vines.

Minimizing Microbial Contamination of Fruit Prior to Harvest

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Introduction:

Consumption of fresh produce has increased substantially in recent years – by about 24% between 1970 and 1997. This is good news; experts agree that a varied diet rich in fruits and vegetables has many health benefits. Unfortunately the incidence of food-borne illness tied to fresh produce has increased as well, by roughly a factor of four in a similar time frame. There are a number of possible reasons for this. These include better monitoring and reporting of food-borne illness outbreaks, the introduction of popular new products such as bagged salad mixes, the possible emergence of more virulent microorganisms, the appearance of much larger-scale processing operations, and the distribution of centrally-processed products over much larger geographic areas.

Food safety risks associated with fresh produce hit the headlines in a big way in 2006. Between August 23rd and October 6th, 2006 199 cases of illness linked to the consumption of bagged fresh spinach were reported. Ultimately three to four deaths were attributed to the outbreak, which was caused by the bacteria *E. coli* O157:H7. This outbreak caused more than tragic personal loss; serious economic losses occurred as well. Sales of bagged spinach fell by 80% and estimated losses to just growers and packers were pegged at up to 100 million dollars. Total losses for everyone in the industry were certainly higher.

Clearly we need to work on improving our fruit production and processing practices in order to minimize food safety risks. Fortunately, we have some tools already available to us. Working in cooperation, the United States Department of Agriculture (USDA) and Food and Drug Administration (FDA) have put together basic guidelines on keeping produce safe. Other researchers and educators around the country have built upon this foundation to help flesh out the elements of food safety programs for fresh fruits and vegetables. These guidelines are called Good Agricultural Practices (GAPs). They are designed to minimize the risk of contaminating fruits and vegetables with dangerous microorganisms in the field and during harvest. In addition, complementary Good Manufacturing Practices (GMPs) have been developed by the FDA and others to help control the risk of contamination during packing and processing. It's important to note that because fresh fruits and vegetables are typically eaten raw, there is no practical way at the current time to eliminate all microorganisms in fresh produce. Therefore, we need a systematic approach to minimizing the risks – this program must be comprehensive and inclusive from the field to the plate in order to be effective.

Minimizing Risk Prior to Planting:

When working to minimize the risk of microbial contamination of fruit crops prior to harvest, we need to start in the field or orchard. In fact, we often need to begin before any crops are planted. Although they normally live in the gut, some bacteria and other microorganisms of concern may live in the soil for extended period of time, perhaps four to six months or even longer under very favorable conditions. As a result, the usage history of the land, for example whether or not the land was used to graze livestock, may be important. Similarly, proper manure handling, storage, and application (if manure is used as a fertilizer) are essential because fresh or incompletely or improperly composted manure is likely to

harbor disease-causing microorganisms. The ability to control runoff or flood water may also be critical because water is an excellent carrier for spreading microorganisms. For the same reason, the availability of clean irrigation water is a concern. “Dirty” water is perhaps the most common way by which crops become contaminated in the field. The proximity of livestock or the likelihood of wild animals being present in the fields may also be an issue – many animals are carriers of *E. coli* and other disease-causing bacteria. Indeed, nearby cattle operations and feral pigs were identified as possible sources for the bacteria that contaminated the fresh bagged spinach in 2006.

A good way to become aware of and think about controlling possible sources of risk in the field is to complete a Grower Risk Assessment. Cornell University has put together an excellent tool for completing this assessment. It has 24 sections ranging from worker hygiene to petting zoos. Each section contains list of practices and a checklist that allows a grower to evaluate risks in a way that is specific to his or her operation and to develop an appropriate food safety plan that addresses those risks. This publication is available at: <http://www.gaps.cornell.edu/index.html>.

When determining risk, it’s important to keep in mind that different crops will have different levels of inherent risk. Higher risk crops include: fruits that grow close to the ground (e.g. strawberries); fruits where the skin or peel is eaten; fruits that are eaten raw; fruits that cannot be washed (e.g. blackberries); and fruits with lower acid content (e.g. melons). Lower risk crops include: fruits that grow well off the ground (e.g. most tree fruits); and fruits with a thick rind or shell that isn’t eaten (e.g. citrus). Fruits that are inherently riskier demand stricter food safety plans. For example, a grower producing strawberries that are irrigated by spray should be very concerned about the possibility of contaminated irrigation water, more so perhaps than a grower of drip-irrigated peaches.

Minimizing Risk during Production:

Recommended GAPS after planting and during production include proper manure application (if used, it should be applied at least 120 days prior to harvest), exclusion of animals (domestic & wild), and management of irrigation, spray, and drainage water. Note that surface water is more likely to be contaminated than well water and all water should be tested, generally quarterly, for possible contamination.

Minimizing Risk during Harvest:

Recommended GAPS during harvest and packing include proper harvest and handling equipment sanitation (e.g. totes, bins, bags, conveyors, etc.), packing shed facility cleaning and sanitation, employee hygiene and training programs, proper setup and maintenance of restroom and hand washing facilities in the field and the packing shed, and general post-harvest handling recommendations. General recommendations include: developing a cleaning and maintenance schedule for equipment and assigning those responsibilities to reliable individuals; cleaning and sanitizing storage facilities prior to harvest; cleaning and sanitizing harvest bins, machinery, knives etc. daily or as practical; training workers not to stand in harvest bins; and insuring that equipment used to haul garbage, manure, or other debris is not used to haul fresh produce.

Documentation:

Documentation is a key part of any food safety plan that is too often overlooked. Proper documentation is absolutely required to prove due diligence in the event of a food-borne illness incident. As the saying goes, record it or regret it. Proper documentation is also needed in order to have the ability to trace

possibly contaminated produce back to its source. Many distributors and sellers insist on having the ability to trace produce back to the field or orchard from which it came. Government regulations are moving toward requiring greater trace back documentation as well, in part because of concerns about bioterrorism. Keep in mind that documentation need not be extensive to be effective. The basic information that should be documented includes a description of the overall food safety plan, and records to indicate that someone has performed the actions described in the plan (e.g. inspections, cleaning, sanitizing, training, etc.). For example, a simple log might be created for harvest bin cleaning and sanitizing that lists the date and time of cleaning and who performed the cleaning. Along with that log, a complementary log documenting the results of sanitizing solution strength tests would be created. Generally speaking, food safety documentation should include what you plan to do, proof that you did what you said you were going to do, and a record of who did it and when it was done.

Conclusions and Resources:

In years past we didn't think of fruit as being a significant food safety risk compared to foods such as meat or dairy products. But a number of food-borne illness outbreaks associated with fruits such as strawberries, raspberries, and melons as well as with other types of fresh produce have caused changed the minds of food safety regulators and the buying public alike. Good tools – GAPs and GMPs – do exist to help minimize microbial contamination in fresh fruits. But these tools will not help us unless they are used across the board. The bottom line is that contamination often occurs in the field or the orchard and that is where we must begin to work to prevent it.

More information and planning guides include:

- Food Safety Begins on the Farm a Grower's Guide
Cornell University, CSREES, USDA, FDA
- Food Safety Begins on the Farm: a grower self assessment of food safety risks
Cornell University, CSREES, USDA, FDA
- Guide to Minimize Microbial Food Safety Hazards for Fresh Fruits and Vegetables
USDA, FDA

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Minimizing Microbial Contamination of Fruit in the Packing Shed

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Introduction:

Consumption of fresh produce has increased substantially in recent years but unfortunately the incidence of food-borne illness tied to fresh produce has increased even faster. Possible reasons for this include better monitoring and reporting of food-borne illness outbreaks, introduction of new products such as bagged salad mixes, possible emergence of more virulent microorganisms, appearance of much larger-scale processing operations, and distribution of centrally-processed products over much larger geographic areas.

The United States Department of Agriculture (USDA), Food and Drug Administration (FDA), and other educators and researchers have assembled basic guidelines to help fruit packers and processors minimize food safety risks. These include Good Agricultural Practices (GAPs) and Good Manufacturing Practices (GMPs). Because fresh fruits and vegetables are typically eaten raw, there is no practical way at the current time to eliminate all microorganisms in fresh produce. Therefore, we need a systematic approach to minimizing the risks – this program must be comprehensive and inclusive from the field to the plate in order to be effective.

Food safety begins in the field, but in many ways good food safety practices become even more critical in the packing shed. That is because contamination from a single source may be spread to large volumes of product during packing operations such as washing. There is some overlap between GAPs and GMPs for an operation such as a packing shed, which combines some of the characteristics of both a farm and a food processing operation. But regardless of the terminology used, an effective packing shed food safety program will focus on reducing risk of microbial contamination by properly managing water, equipment, facilities, people, and the fruit being packed in such a way as to avoid introducing and spreading disease-causing microorganisms.

Managing Water:

Managing water is critical to any food safety program. Water can easily become contaminated with disease-causing pathogenic bacteria such as *E. coli* 0157:H7 and *Salmonella*. And once contaminated, water may easily spread that contamination. Many food-borne illness outbreaks have been associated with irrigation water, runoff, and processing water. Water may come into contact with fruit at many points in packing and/or processing. For example, water may be used for cooling, washing, and transport of fruit via flumes. Therefore, water used in packing and processing should be sanitized and monitored. Many types of water sanitizing systems exist, including those using chlorine, ozone, ultraviolet (UV) light, and others sanitizers. Chlorine is perhaps the most common sanitizer used. Chlorine is economical and effective; water in wash tanks, cooling tanks, and so on can be chlorinated manually. Typical rates of chlorination range from about 4 to 100 parts per million (PPM) depending on the water's intended use. Whatever sanitizing method is employed, it's important to test the strength of any sanitizing dip or wash water at least daily and change the water and/or add more sanitizer as needed. Dirt and other organic material will quickly degrade the sanitizing power of chlorine. Paper test strips are available to test the concentration of chlorine and some other sanitizers in water.

Managing Facilities:

Good cleaning and sanitizing practices are the keys to a good facility and equipment food safety program. Cleaning begins with a thorough scrubbing with an effective detergent, followed by a complete rinse to remove detergent residues. Most sanitizers will not accomplish their intended purpose of killing microorganisms if they are applied to a dirty surface.

As with sanitizing water, chlorine is the most common sanitizer generally used for cleaning facilities and equipment. A 200 parts per million (PPM) mixture of sodium hypochlorite in water is an effective all-purpose sanitizing solution. A two minute contact time should be sufficient to sanitize a previously cleaned surface. One tablespoon household bleach per gallon of water will yield a 200 PPM chlorine solution.

This is suitable for use on most surfaces, equipment, and some intact produce. But note that surfaces sanitized with a solution stronger than 100 PPM chlorine must be rinsed with potable water or allowed to air dry before contacting food. Also note that the effectiveness of a chlorine sanitizing solution is greatly affected by its pH value. The optimum pH range is 6.5 to 7.5. Solutions with pH values below 6.0 are more corrosive and those with values below 5.0 begin to emit highly dangerous chlorine gas. On the upper end, solutions with pH values greater than 8.0 have greatly reduced killing power.

In addition to general cleaning and sanitizing, good facility and equipment management involves inspecting the packing shed operation for surfaces that may be hard to clean, may collect grit and abrasives, may have sharp edges, and/or may otherwise promote fruit bruising or injury. Hard to clean surfaces will often harbor microorganisms and damaged fruit are more easily inoculated with harmful microbes that are more likely to survive and grow in the damaged tissues.

Food safety activities that are recommended to be done at least once a day in the packing shed include: inspecting handling/packing areas to remove any dirt, debris, or culled fruit present; cleaning and sanitizing handling/packing areas and equipment; and cleaning and sanitizing floors, drains, waste receptacles, and bathrooms in all packing/processing areas.

Food safety activities that are recommended to be done once a month or as needed in the packing shed include cleaning and sanitizing cold rooms and other storage facilities. Be sure as to include ceilings (as needed), floors, walls, cooler/freezer condenser coils, and doors or curtains.

Pest control is an important part of facility food safety management. A good pest management program should incorporate pest exclusion, baiting, trapping, and proper disposal of trapped or dead pests. Rodent and insect traps should be inspected at least once a month.

Managing Fruit:

A sanitizing dip may be a useful food safety tool that can be used with some fruits. If a sanitizing dip is used, a prior washing will be required if the fruit is dirty. In any case, it is important to remove as much dirt as possible from fresh produce before it comes into the packing area. Following are some guidelines for chlorine sanitizing dips that can be used for certain types of fruits and vegetables:

- Apples, pears, squash, cucumbers:
~ 65 PPM chlorine (1 teaspoon bleach / gallon water).
- Leafy greens, peaches, peppers, tomatoes, asparagus, broccoli, carrots:

- ~ 130 PPM chlorine (2 teaspoons bleach / gallon water).
- Melons, citrus, root crops:
 - ~ 400 PPM Chlorine (2 tablespoons bleach / gallon water).
- Berries (strawberries, blueberries, blackberries, raspberries, etc.):
 - No washing.

Note that control of wash or dip water temperature is important. If the fruit is much warmer than the wash water, it may imbibe water and microorganisms during washing. Once the microbes are inside the fruit, no surface sanitizing treatment can reach them. The recommendation is to keep wash water no more than 10°F cooler than the fruit being washed.

Once the fruit has been cleaned, it must be held, stored, and transported so as to avoid re-contamination by unwashed produce, containers, etc. Fruit should be held and stored away from possible chemical hazards e.g. cleaning agents, pesticides, etc. Fruit should also be held and stored off the floor, away from walls, and in such a way as to avoid damage.

Note that temperature control may be important to help insure the safety as well as the quality of some types of fruit. Lower temperatures inhibit microbial growth and slow quality loss. Where appropriate, maintaining the “cold chain” from farm to sale can be a critical part of a food safety program.

Managing People:

People who handle fruit in the packing shed may be major sources of microbial contamination. These people may be the last individuals to handle the fruit before it ends up in the hands of consumers. Therefore, training in good hygiene and good sanitary practices is vital.

A separate hand washing sink must be available in the packing facility. Hand washing and toilet facilities must be maintained in a sanitary condition and workers should be trained in proper bathroom use and hand washing practices. Note that this may necessitate training materials and signage in multiple languages.

Documentation:

Documentation is a key part of any food safety plan that is too often overlooked. Proper documentation is absolutely required to prove due diligence in the event of a food-borne illness incident. As the saying goes, record it or regret it. Proper documentation is also needed in order to have the ability to trace possibly contaminated produce back to its source. Many distributors and sellers insist on having the ability to trace produce back to the field or orchard from which it came. Government regulations are moving toward requiring greater trace back documentation as well, in part because of concerns about bioterrorism. Keep in mind that documentation need not be extensive to be effective. The basic information that should be documented includes a description of the overall food safety plan. Simple records should also be kept to indicate that someone has performed the actions described in the plan (e.g. inspections, cleaning, sanitizing, training, etc.). Generally speaking, food safety documentation should include what you plan to do, proof that you did what you said you were going to do, and a record of who did it and when it was done.

Conclusion and Resources:

In years past we didn't think of fruit as being a significant food safety risk compared to foods such as meat or dairy products. But a number of food-borne illness outbreaks associated with fruits such as strawberries, raspberries, and melons as well as with other types of fresh produce have caused changed the minds of food safety regulators and the buying public alike. Good tools – GAPs and GMPs – do exist to help minimize microbial contamination in fresh fruit. Packing shed operations are a very important link in the food safety chain.

More information and planning guides include:

- Food Safety Begins on the Farm a Grower's Guide
Cornell University, CSREES, USDA, FDA
- Food Safety Begins on the Farm: a grower self assessment of food safety risks
Cornell University, CSREES, USDA, FDA
- Guide to Minimize Microbial Food Safety Hazards for Fresh Fruits and Vegetables
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- T.V. Suslow
- R.B. Gravani
- M.P. Pritts
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Herbs

Farm to Market Horticulture in the School with Fresh Local Food

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Good Food for Good Health

Farm to School has twin goals, both aimed at getting more Oklahoma-grown food on the cafeteria trays of Oklahoma school kids. On the one hand, it encourages farmers to sell their fresh produce to schools; on the other, it encourages schools to fill part of their fresh fruit and vegetable needs by buying from farmers within the state.

The Oklahoma Farm to School Project was developed by the Oklahoma Food Policy Council (a joint project of the Kerr Center for Sustainable Agriculture and the Oklahoma Department of Agriculture, Food & Forestry), the State Department of Education and the Oklahoma Department of Human Services to address issues of childhood obesity, diabetes among youth and the need to develop local opportunities for our farmers along with local food systems.

In 2004, a pilot project was established that delivered locally grown seedless watermelons to 4 school districts in the state in an effort to gauge the response of the schools and growers and to also work through the delivery logistics. The program was a huge success and was expanded to 6 school districts the following year.

In Fall 2005, the Farm to School program was chosen as a main legislative agenda with the Oklahoma Institute for Child Advocacy and the Fit Kid Coalition to help develop legislative support for a statewide farm to school program. A bill was sponsored by Rep. Susan Winchester and Senator Daisy Lawler and the Oklahoma Farm to School Program Act was signed into legislation by Governor Brad Henry on June 7, 2006.

The Oklahoma Farm to School Program Act, HB 2655, is a win-win for Oklahoma children and Oklahoma farmers that focuses on linking schools and farmers to provide fresh local farm products for the school lunch and snack program with initial priority in fresh produce links. The bill also supports all activities of a statewide farm to school program, which includes gardening, hands-on education and nutritional curriculum and hired a full time administrator to expand the program.

During the summer of 2006, workshops were done in partnerships with the Oklahoma State Department of Education Child Nutrition Services and the 113 school districts that attended the workshops have expressed an interest in farm to school. The legislative bill tells the schools that it is 'OK' to purchase from local growers and they encourage the schools to purchase when possible when all other factors are equal, (ie. quality, price, etc).

Beginning the second week of August, 35 school districts began receiving seedless watermelons from Bob Ramming and honeydew melons from Bruce Price and Marlin Unruh, all from Hinton, OK. The schools loved the melons and they also received watermelon information packets that were provided by

the National Watermelon Promotion Board with additional information supplied by Ag in the Classroom and the OK Dept of Health 5-A-Day program.

School districts participating in Fall 2006 Farm to School:

Beggs Schools, Bethel Schools, Binger-Oney Schools, Bishop Schools, Bristow Schools, Broken Arrow Schools, Comanche Schools, Davenport Schools, Dewey Schools, Edmond Schools, El Reno Schools, Kingfisher Schools, Liberty Schools, Luther Schools, Midwest City-Del City Schools, Moore Schools, Mooreland Schools, Morrison Schools, Noble Schools, Norman School, Oklahoma City Schools, Ponca City Schools, Pond Creek - Hunter Schools, Shawnee Schools, Sperry Schools, Stillwater Schools, Thackerville Schools, Tulsa Schools, Tupelo Schools, Wellston Schools, Western Heights Schools, Turner Schools, Mustang Schools.

In Oklahoma we have 540 school districts that range from one small school within the district to large school districts like Oklahoma City & Tulsa with every size in between. That means that there are opportunities for all sizes of growers.

Potential crops that can be grown in Oklahoma during school year

- Melons – watermelons, cantaloupe, honey dew, winter melons
- Greens – lettuce, spinach, greens
- Asparagus
- Strawberries
- Tomatoes
- Peppers
- Broccoli
- Sweet potatoes
- Cucumbers
- Cabbage
- Pears
- Radishes, beets, turnips, kohlrabi
- Winter squash – butternut, acorn, etc.
- Fall blackberries in the future

There are many hands-on interactive activities that can and will be developed with the program as it grows. In addition to locally grown produce served in school cafeterias there are plans for school gardens, farm & farmer's market visits, tasting parties, cooking classes, and curriculum along with workshops for Food service personnel, teacher and growers. Nutrition education and hands-on learning can result in a significant increase in fruit and vegetable consumption. These results were documented by a study done by the University of Illinois and Loyola University looking at salad bar use by Kindergarten and 1st graders combined with nutrition education in the classroom that included fruit and vegetable identification, container gardening and discussing the importance of the produce to your health. I have seen kids get excited about tasting beets, turnips and radishes because they helped harvest them and then wanted to taste them.

One afternoon, I was working with 20 children, ages 6 –12, in the garden and we were getting ready to dig sweet potatoes. I asked the group if any of them know how sweet potatoes grew and also asked how many in the group had tasted sweet potatoes. One child had an idea about how the potatoes grew and only 2 of the 20 had tasted sweet potatoes. We proceeded to the garden and I taught them about how the potatoes grew and what to look for when harvesting a few potatoes. The group located the potatoes that they wanted to dig. We dug the potatoes and then one of the helpers took the potatoes to the kitchen and

cooked them while we finished in the garden. Some of the potatoes were baked and others were cut into French fries, then sprinkled with seasoned salt and baked. Since the kids had a part in harvesting the sweet potatoes, they all were excited to taste the potatoes and 19 of the 20 loved the sweet potatoes!

There are several resources available for nutritional and educational curriculum to tie into farm to school through Oklahoma Department of Agriculture “Ag in the Classroom” & National Watermelon Promotion Board, Health curriculum by health partners both private and public and Nutrition curriculum by the Oklahoma Dept of Education to mention a few. There will also be future workshops for farmers, school food service personnel and teachers.

Everyone Can Be Involved in Farm to School

Superintendents and school board

Principals

Teachers

Child Nutrition Personnel

Parents, Grandparents & Guardians

Children

Healthy and Fit School Advisory Committee

Nutrition Educators

Helpful Resources & websites:

Resource Guide for Food Service – Dept of Education website

Resource Guide for Farmers – contact farm to school administrator

www.kerrcenter.com - information on farm to school

www.sde.state.ok.us - go to the child nutrition section & then to the farm to school section - resource guides & more

www.agclassroom.org/ok - Oklahoma Ag in the Classroom

www.deq.state.ok.us/pubs/lpd/ediblegardens.pdf - planning guide for edible school gardens

www.farmtoschool.org - National farm to school website

www.attra.ncat.org/attra-pub/farmtoschool.html - Bringing Local Food to Local Institutions

www.foodsecurity.org/farm_to_school.html

www.cookingwithkids.net - Hands on foods and nutrition education

<http://www.madeinoklahoma.net/Okgrown/farmmkt.asp> - list of farmers markets in Oklahoma

www.caff.org/programs/f2sManual.shtml - Farm to School Farm Visit Manual

<http://pods.dasnr.okstate.edu/docushare/dsweb/Get/Document-1075/F-6402web.pdf> - Children’s Garden in Which to Learn & Grow

www.kidsgardening.com - National Gardening Association

www.actionforhealthykids.org/index.php - Action for Healthy Kids Program

www.greatplainsrcd.org/farm_to_school.php - SPARC program

www.schoolmeals.nal.usda.gov/index.html - Healthy School Meals Resource System

<http://www.ecoliteracy.org/publications/index.html> - various publications from the Center for EcoLiteracy on school gardening, nutrition, education, etc.

<http://www.chicago-botanic.org/schoolgarden/> - Welcome to School Gardening – Chicago Botanical Garden

There are many other resources available in addition to the ones listed above.

The Food Connection is a statewide listing of fruit, vegetable & nut growers across the state. Is your farm listed in the 2006 Food Connection? If not, visit the Kerr Center website at www.kerrcenter.com to signup on-line or call 918-647-9123.

There is a huge demand for locally grown fruits and vegetables by our schools and it will continue to increase and there are opportunities for all ages, cultures and expertise to be involved.

Let's work together ***"Growing healthy kids and a healthy rural economy"***!

For more information about the Oklahoma Farm to School Program and to get involved, contact:

Chris Kirby
Oklahoma Farm to School
Oklahoma Department of Agriculture, Food & Forestry
(405) 522-2106
chris.kirby@oda.state.ok.us

Handmade Herbal Paper and Cards

Monica S. Arndt, Skyridge Farm
Garden Cards <mailto:skyfarm@okplus.com>

Bio: 58 years old, Oklahoma native.

Married to Ron Arndt - high school business teacher/coach recently retired

Two sons - Derek Arndt - currently acting State Climatologist in Norman, Okla in school to get his doctorate in adult education. Daughter in law Jenifer Arndt - academic counselor at OU Grandson Spencer Arndt 4 years old, co Ambassador with Coach Bob Stoops to the March of Dimes from Norman, Okla for awareness of premature labor, preemies. John W Arndt - active military - Sergeant in the Army.

Personally I have no degree, no credentials just a passion for gardening, art, home and family. I must be in the “fun” part of for Food and Fun. What I am here today to talk about is herbal handcrafted papers made from recycled paper products in a blender in a tub in my yard with seeds thrown in and whatever organic materials I might have on hand . I will show my cards and paper and show the process, tell what I have learned that works and what doesn't work for me. I have brought paper pulp and screens and dried herbal material and fresh herbal material and seeds for wildflower gardens and herb gardens.

The blender should be plastic and with footing not flat to the table to avoid sitting in water and setting up a shock. The screens I use are picture frames with hardware cloth screening stapled on and a deckle which is a frame with no screen. Muslin or felt for couching. You can use embroidery hoops for working with kids. There is no limit to the creativity or personal inspiration here. Paper can be embossed, imprinted, thin or chunky.

Some fresh herbs I use in my paper: Dill is feathery, basil is fragrant. Chives, parsley, cilantro, tend to fade out. Salad burnet leaves are pretty. Calendula petals bleed color. Johnny jump ups, pansies , scented geranium leaves or flowers or zonal geranium blossoms, bougainvillea blossoms are great. Larkspur, salvias. Lantana blossoms, rose petals, rose leaves, tansy leaves, lavender leaves, rosemary, oregano, nasturtium blossoms, rue is nice. Thyme, zinnias. Dried rose petals, lavender, Althea blossoms, crepe myrtle, dahlia blossoms are some things that just did not work for me.

HERBED PAPER

4-5 pieces of copy paper, 1 piece of tissue paper
Deckles and screens

starch - liquid concentrate laundry, cornstarch
vegetable spray for screens optional
seeds, flowers, organic plant materials dried or fresh
cookie cutters, clay pots, tea pot lids, etc.

Tear paper into strips, put in blender almost full of water. Add tissue paper, pulse blend until the consistency of oatmeal. Add to a tub of water. Continue this process until the slurry is thickened.

Dip your screens using the deckle or not, allow to drain. Allow to dry then gently peel from the screen. You can also pour the slurry over the screen. It gives some control on color but tends to make a thicker paper. You can add flower petals or delicate herb leaves, also seeds can be added to the paper mix. If you want smooth paper you can try “felting” it, which is pressing the wet paper off onto felts or tea towels and pressing with a heavy book or block. Or you can iron it smooth. You can add starch or cornstarch to make a crispier paper and/or spray it with spray starch which can be written on. You can add a “window” using cookie cutters or jar lids, etc. during the dipping process. Experiment with different flowers and herbs and plant materials. Pansies and zinnias and scented geraniums and roses fade into the paper in different colors. Rose petals and lavender and carnations tend to give paper a tea stained look.

Seeds that can be saved for paper include basil, cilantro, chives, parsley, dill, echinacea, fennel, gomphrena, hollyhock, salad burnet, sage. Some sunflower seeds, cosmos, coreopsis, larkspur, zinnia. Seeds like morning glory seeds are too chunky.

Dried organic material bleeds color into paper. Fresh does not. Dried herbal material that bleeds color includes lavender, pansies, rose petals, onion skin, zinnias, calendula. These bleed blues and greens and yellows, dark reds, purples. Some provide a tea stained look like lavenders and zinnias dried roses, pot pourri. Some give a rustic leather look like onion skin, pine cone petals. The flowers can be randomly caught up or placed.

Use of the language of flowers - roses for love, lavender for devotion rosemary for remembrance. - birthday, weddings, sympathy, get well, graduation from high school can be incorporated into the paper.

Dried mint in paper - fragrance sells. Cinnamon basil seeds. Scratch and sniff.
Cooked corn husks on stove with lye soap. Cat nip in paper for cats, fertilizer worm dirt cards. Paper provides a way of saving memories - preserving the garden. Saving a bouquet from a special occasion. Unfortunately I have had no luck with florist flowers or I don't care for the look. I add a touch of fragrance oils to the top of the cards. Fay's flowers from the market provided more seeds and a pretty paper, preserved her harvest for her daughters. James flower bouquets from the market were loaded with seeds. Donna's roses were perfect.

Tokens for souvenirs - Oklahoma card - wedding notes for guests. Journals diaries photo mats. Christmas ornaments. Gift tags, book marks.

Seeds - Fredericksburg herb farm. My goal this year is to grow my own seeds

Recycling - not newspapers or magazines - soak heavy paper like paper sacks overnight. Construction papers and napkins don't bond well but could be added in for color. Also, paper after it has dried doesn't recycle back into new paper, it is too brittle.

Chasing Away Melancholy with Melissa

A Yarb Tale by Tina Marie Wilcox
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Tina has worked as the head gardener and herbalist at the Ozark Folk Center's Heritage Herb Garden in Mountain View, Arkansas since 1984. She is a member of the Herb Society of America, the American Botanical Council, and serves as President of the International Herb Association.

The International Herb Association proclaimed Lemon Balm Herb of the Year for 2007. Check out this organization at www.iherb.org for more information about the Herb of the Year publications, herb business members, and membership benefits.

I never saw a sprig of lemon balm until I moved from New Orleans and came to work at the Ozark Folk Center State Park in Mountain View, Arkansas in 1984. The old Country Herb Garden had many unlabeled plants growing among unfamiliar weeds, which were new to me. I was afraid to do a whole lot of indiscriminant weeding that first season because, I was sure I would be pulling some very important folk herb from that collection of plants. Oh, the melancholy of being in a new herb garden without a clue!

In the midst of the foliage, I was attracted by a lemon-scented plant with lime green, slightly curled, deeply veined, toothed leaves. I could tell from the square stems and spreading habit that it was in the mint family. The Country Herb Garden was not well drained and held moisture longer than most places around the park and so was a perfect spot for the plant to spread and survive despite the poor soil on the mountain. I think I mentally called it 'lemon mint' and went on with trying to sort out the herbs from the weeds. At night I would study books, especially Maude Grieve's *A Modern Herbal*. Mrs. Grieve listed the plant under its country name, balm. She quoted John Evelyn who wrote "Balm is sovereign for the brain, strengthening the memory and powerfully chasing away melancholy." So identifying this new plant was good and lemon balm cheered me on as I faced the challenges in my new job.

I visited the homes of many local herbal folks in my first years at the park. An elderly gardener who lived near Mountain Home, Arkansas invited me over for a visit. Her family's land was made much smaller when the Army Corps of Engineers dammed the White River and created Bull Shoals Lake between 1947 and 1951. Although she verbally mourned the loss of her family's rich bottomland, she happily led me to her garden that overlooked the lake. "Here is *Melissa*," she said as she rose up and crushed the leaves under my nose. "This herb was grown and used by early settlers to ease hard times." "Shall we have a lovely cup of herbal tea?"

Her assertion that lemon balm was grown by country people in the United States for a long time is confirmed by *A Field Guide to Medicinal Plants, Eastern and Central North America* by Steven Foster and James A. Duke. According to this invaluable reference, lemon balm is found around old barns and house sites and is even scattered around in the woods---and no wonder. The leaves were poulticed on little hurts like insect bites and stings and used to treat serious ailments such as tumors and fevers. Jethro Kloss extolled the gentle but effective virtues of balm in his herbal, *Back to Eden* first published in 1939. He wrote "A warm poultice of balm will bring a boil to a head and it will break."

In 1985, the Committee of 100 for the Ozark Folk Center, our support group, funded an apprenticeship to teach me about all those wonderful herbs and useful weeds growing in the brand new Heritage Herb Gardens. I was nervous, afraid of failing, not sure of what was expected of me, until little by little, I began to absorb the overwhelming knowledge Billy Joe Tatum, Steven Foster, and Jim Long were sharing with me. The day Billy Joe and I made lemon balm jelly in her kitchen, I thought I had died and gone to heaven. Shucks, I had never even made jelly before, much less herbal jelly. And guess what? The jelly set up, and tasted good too!

As time went along after my apprenticeship, the garden continued to grow. I relegated lemon balm to garden beds where it could spread without causing such a fuss with the people who like a neat appearance in an herb garden. “You can’t just let nature run wild”, my friend Mary Gillihan would quip at my attempts to control aggressive herbs.

I gardened in peaceful coexistence with this humble little herb for several years more. Then one year, a very dear friend of mine developed herpes as a complication of the HIV virus. Her mouth was so sore she could not eat. At the same time I read that lemon balm is strongly antiviral, and especially effective against herpes simplex virus. Desperate to do something to help her, I made lemon balm oil by macerating dried leaves in almond oil. She died soon after I got the medicine to her. *Melissa* chased away my melancholy in this way—it empowered me to do something to care for my friend.

Dealing with the public and doing performances and demonstrations presents its share of stressful ups and downs. A group in Mountain Home, Arkansas, who aptly call themselves the Ozark Herb Friends study herbs in depth. One course of study was tincturing herbs and I was gifted with a small bottle of *Melissa* tincture. Land sakes! There is nothing more bracing than a dropperful of this tincture right before presenting a Living History on a hectic day. Mind you, it is for medicinal purposes only.

When people sniff lemon balm they often remark that it smells like furniture polish. It turns out that people have polished furniture with the fresh leaves of *Melissa* in the past. I have demonstrated its cleaning abilities to groups by polishing a wooden button box during my Herbal Creature Comforts presentations. No harm has come to the box and it sure smells good for a few days afterwards.

From time to time lemon balm is called for to impart flavor to beverages, desserts and fish dishes in our Lavish Herbal Feasts. Balm just quietly survives, insidiously spreading, in out-of-the-way spaces around the park. *Melissa* always looks lush in the spring, blooms with unremarkable small, white flowers in loose bunches, and then looks unkempt and bug-bitten until one of us gardeners gets around to cutting it back. With cooler fall temperatures, the plant recovers and sends out a flush of new growth before a hard freeze knocks it back to its roots.

Time will tell how many other uses will be discovered for lemon balm. Without a doubt, sweet *Melissa* chases away melancholy and is a tried and true, reliable herbal friend.

Recipes

Lemon Balm Oil

This oil can be used in a soothing warm bath, as a relaxing massage oil, and as an ingredient for healing salves or creams. Makes about 1 1/4 cups.

1 cup dried lemon balm leaves
1 cup almond, olive or grapeseed oil
1 tablespoon vitamin E oil

Place leaves in a sterile glass jar. Pour oil over the leaves and seal with a plastic lid. Invert jar upside down several times to completely saturate the leaves. Be certain that the herbs are submerged beneath 1/4 - to 1/2 - inch of the oil. Place the jar in a sack or bag to exclude light. Place the oil in a sunny, warm window for 7 to 10 days. Shake at least twice a day. After the allotted time, strain the oil; press the herbs to extract the remaining oil. Filter out sediment. Stir in vitamin E oil and pour into a sterile, dark glass bottle. Store in a cool, dark place.

Lemon Balm Salve

Makes about 1 cup

1/2 cup lemon balm oil
1/2 cup grated bee's wax
1 tablespoon vitamin E oil

Have clean, small jars or containers ready in which to store the finished salve. Gently heat the oil in a double boiler or small crock pot. Place a small piece of wax in the oil and continue to heat until the wax melts. Add the remaining wax. Heat until all of the wax is melted. To test the consistency of the finished salve, remove a teaspoon of the liquid and cool it rapidly in the freezer. If it is too hard, add a little more oil to the infusion. If it is too soft, add a little more wax. Test again until the desired consistency is reached. Add vitamin E oil to the finished salve, before pouring. Ladle the salve into appropriate containers while still warm. Seal, label, and store in a cool dark place.

Lemon Balm Tea

1 cup not-quite boiling water
1 tablespoon dried lemon balm or 3 tablespoons fresh leaves

Place leaves into a mug that can be covered with a lid or saucer. Pour near-boiling water over the leaves. Cover immediately. Steep for 10 minutes. Add lemon juice or sweetener if desired. Sip any time of day to calm the mind, settle the stomach, and chase away melancholy.

Public Gardens and Master Gardeners

Unusually Inspired Vegetable (and Fruit) Gardening

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Abstract

Home vegetable gardens usually take the form of straight rows and tend to be planted with more produce than can be utilized by the typical family. There are alternatives to the simple row-based garden that can be creative, aesthetically appealing, and the topic of local discussion. Furthermore it is often advantageous for many gardeners to change their expectations of what a vegetable garden should be in terms of fitting in the hobby with a changing lifestyle.

In the course of advising clientele as an Extension Agent, I see a lot of gardens. Most home gardens share a few fundamental characteristics:

- They are planted in long rows
- The garden size is selected arbitrarily without regard to yield
- There is usually more planted than even the most ardent Vegan family could reasonable consume
- Individually, the plants are not performing to their full potential, but it is compensated by over planting
- Entirely too much okra and zucchini!

A major impetus to put in a vegetable garden or orchard is to have access to produce difficult to obtain at retail outlets of excellent quality grown, perhaps, in a way that satisfies one's environmental philosophy. It is rarely the case today that gardeners are raising large gardens for the purpose of preserving food for a long winter. A quick look at the decline in county fair entries in food preservation will confirm this.

This shift in paradigm provides many new opportunities for the gardener whose family's nutrition will not be adversely affected by a change in strategy.

There are essentially three ideas that I hope will inspire you to rethink how you raise crops.

1. It is not necessary to plant everything in rows of the earliest bearing variety
2. You can incorporate vegetables and fruits into a landscape theme, and in fact feature them prominently
3. Plant the amount you need to achieve a desired yield, and no more

Long rows have an important place in Agriculture. They allow easy cultivation, planting, and harvest.

In today's world, most home gardens play only a small role in providing nutrition for a family, so it makes sense that the acre garden planted in long rows may not be the only way to have a garden. The notion that a garden is a small farm does not fit well with the lifestyle of today's gardener. And this is the source of inspiration for different ways to look at a home garden.

The most prominent idea of the non-row garden is expressed in the ever-popular franchise of books by Mel Bartholomew on "Square-foot gardening." He plants everything in nice 1-foot square units. Small plants go close together; big plants take up a whole square. The idea of perfect 16 square-foot beds

divided into grids is a bit rigid for my taste but the concept is sound. It makes excellent use of space and reduces weeding. I gather he is an engineer.

If you take this idea to the next level and eliminate the shape constraints, you then have a powerful tool to turn your garden into a work of art, rather than just a place in the yard where you harvest vegetables. Aside of the edible character of fruits and vegetables, they can be considered landscape plants much like pansies or daylilies.

A vegetable garden can take on any number of shapes. It can be round, spiraling in toward the center. It can be shaped to form a picture. Perhaps a vegetable or herb garden can border a path through the landscape. I can see a labyrinth as an excellent way of doing this. Imagine meditating with the reward of a nice juicy tomato at the center for your efforts.

By the careful selection of varieties, a garden can represent an image. A garden plot can be laid out in a grid or design, and plants of contrasting colors can make a picture—a garden mosaic. In theory this could be an image of anything, but the complexity of a detailed image might scare away most gardeners. An image of the “Green Giant” for example may attract attention but would be a challenge to achieve.

From my investigation into the idea of a mosaic formed of vegetables, it seems the most likely candidates are the cool season greens. Violet, blue (bluish, really), and cream can be found in kales, lettuces range from yellowish green to deep red; and Chinese vegetables have some variability that can fill in the some of the missing colors. A full color seed catalogue is a good place to start with matching colors.

To achieve a mosaic, you can either get out a sheet of graph paper and plot out an image, or alternatively use a photo-manipulation program to reduce the color range and then “pixelate” the image into a grid.

Of course an idea such as making an image out of lettuce plants forgoes the whole idea of just picking varieties based on early harvest or name recognition. It can be an exciting challenge to put together a garden when we move past our comfort zone of ‘Early Girl’ tomatoes, ‘Clemson Spineless’ okra, and ‘Habanero’ peppers. It’s great to plant your favorites, but experimentation with new varieties can be exciting, too!

Many gardeners have a theme to their yard or even their vegetable garden. We see this usually manifested as a white garden, or maybe an heirloom garden. Ideas such as these can be extended into the vegetable garden, or out of it as well.

One idea I have long had for a garden theme is a Luther Burbank garden. Luther Burbank was a famous plant hybridizer based in Sonoma County, California who lived in the era of Henry Ford and Thomas Edison. He didn’t fully embrace Mendelian genetics, kept terrible notes, and was prone to showmanship, but he still made some incredible contributions to Horticulture. It was he who introduced the Japanese-type plum to America including the still popular ‘Santa Rosa’. The most widely grown potato in the world, the ‘Burbank Russet’ is a sport of his first “plant creation” as he liked to call them.

At any given time, Mr. Burbank would have 3,500 experiments going on at his farm where visitors would pay \$10 per hour to visit (about \$200 per hour today). Luther Burbank was a celebrity worldwide, but today he is relatively unknown. His huge legacy of plant introductions provides a rich source of plant material for a theme garden consisting of flowers, fruits, and vegetables. Most public libraries have resources on Luther Burbank including some of his varieties.

A final thought I have on gardens and orchards concerns the size of most gardens. Generally what happens is someone outlines a nice, big rectangle and plants it full of vegetables (or in the case of orchards, they plant one of everything from the catalogue). The result of this is gardens that are so large that important tasks get neglected. Horticulture by definition is intensively grown agriculture, so it is important to have a garden properly sized to a family's needs and ability to keep it up.

I often hear about 80-year-old men with an acre garden who keep it meticulously clean. But what does an elderly couple need with a ¼ ton of tomatoes? That's a lot of canning! Fortunately for his wife, the individual plants do not usually receive enough attention and do not come anywhere close to their yield potential. Planting 1/3 as many and giving them more attention will ultimately reduce work and save money spent on water and fertilizer. In fact with fewer plants, a gardener could increase the space between plants and perhaps use that as a way to help manage foliar diseases such as early blight.

If you are mostly interested in fresh tomatoes, 3 plants per adult will usually provide plenty for all the salsa, sandwiches, and salad for an avid tomato lover. No garden ever needs more than a few okra or zucchini plants, yet how many gardens do we see with 6 zucchini plants simply because they were sold in a 6-pack container. One or two will probably suffice and 6 might be enough to feed most of Fort Smith.

If after downsizing, you are still lucky enough to have more vegetables or fruit than you know what to do with, consider donating it to a local food bank.

Having fewer plants allows you to focus your efforts. One overlooked task in the garden is hand weeding. Most gardeners hate to weed and avoid it like the plague, but in a small garden it is not a major task and gives you the chance to get up close and personal with your plants. Close inspection of plants can go a long way toward eliminating problems early, before they get out of hand (which saves more work!).

All this is to say is that we are not constrained by any form of legislation to always grow the same old varieties in rows in a square garden that is often too big to manage properly. Go out and create something new!

How to Have an Award Winning Design and an Update of the University of Arkansas - Fort Smith Botanical Garden

Steve Dobbs, Plant Operations Director and Landscape Coordinator
University of Arkansas—Fort Smith, AR

About the Presenter

Horticulturist Steve Dobbs, joined the University of Arkansas - Fort Smith as Director of Grounds and Landscape in April 2002. In 2005, Steve was appointed Plant Operations Director where he coordinates the maintenance efforts related to some 34 buildings and 164 acres of grounds; which includes an arboretum and preliminary work on a 10 acre proposed botanical garden.

Steve received a bachelor's degree in Horticulture from Oklahoma State University and a master's degree in Horticulture from the University of Arkansas at Fayetteville. He is currently serving as President of the Garden Writers Association which has over 1,800 garden communication members throughout the U.S, Canada and England.

UA Fort Smith Landscape

Surroundings matter at UA Fort Smith. The goal has been to create a living, learning, and working environment that is beautiful and supporting to students, faculty, staff, neighbors and visitors alike. After several years of planning and building, the university has developed one of the most picturesque campuses to support the educational mission in the United States.

The landscape serves as the first impression to the campus and has a direct impact on student, faculty and staff recruitment. Several studies indicate that college students make up their mind on where their going to attend college within the first fifteen minutes on campus. A Carnegie Foundation Study shows that 62% of college-bound students say that the appearance of the buildings and grounds were the most important factor in choosing a college. UA Fort Smith PREP survey's continually show that over half of incoming students report that a tour of the campus was influential to very influential in their decision to attend UA Fort Smith.

UA Fort Smith is located in the heart of the natural state's river valley. Eleven grounds staff members take care of about seventy acres of turfgrass, three acres of extensively landscape shrub and perennial beds, and another acre of seasonal color beds. The 164 acre campus is also adorned with over 1,120 inventoried trees representing more than 46 species all mapped out by GPS technology. In April of 2005, the campus was dedicated as an arboretum reflecting the support and importance of the urban forest environment in relation to the overall university master plan.

To develop and maintain such a showplace requires trained and professional staff. Five of the eleven staff members have horticulture degrees and all have specialized certificates and training in their particular program area. The grounds staff also practices a "back to the basics" approach through soil testing, using slow release and/or natural products accordingly, improving annual beds with organic amendments, irrigating deep and infrequently using primarily drip irrigation in the landscape beds, mulching with cottonseed hulls, and monitoring beneficial insect populations. Mowing practices also follow the same course of action relying on soil test results, mowing high and at different directions, watering less often and more in depth, and not bagging grass clippings.

Older landscape beds are being renovated as time permits to accommodate easier maintenance practices, and all newly installed beds are designed for lower maintenance and environmental soundness. Examples are using diversified and proper plant selection according to wet, dry, sun or shade sites on campus and using ground cover perennials instead of turf under heavy shaded tree canopies. Foliage color plants are used in combination with flowering and textured plants to offer color all year long.

UA Fort Smith has been recognized numerous times for their beautification efforts. In the 2005 America in Bloom national competition, UA Fort Smith received the award for the best Floral Display among all entries and was recognized for their Urban Forestry efforts in the university category. In 2003, the Professional Grounds Management Society awarded the Grand Award to UA Fort Smith for the “Best Maintained Landscape” in the school or university category in the nation. The University was also honored with a Keep Arkansas Beautiful Distinguished Service Award in 2002.

UA Fort Smith Premier Plants

Annuals

Angelonia	Golden Moneywort
Celosia ‘Fresh Look’	Iris pallida ‘Variegata’
Centaurea gymnocarpa	Iris pseudacorus
‘Colchester White	Jap Painted Fern
Coleus ‘Pink Chaos’	Jap Spurge ‘Green Sheen’
Duckfoot Coleus	Laurentia fluviatilis
Duranta ‘Cuban Gold’	Miscanthus ‘Adagio’
Esperanza ‘Golden Bells’	Miscanthus ‘Little Zebra’
Joseph’s Coat ‘All Gold’	Muhley Grass
Kale ‘Red Bor’	Panicum ‘Shenandoah’
Lantana ‘Anne Marie’	Purple Heart
Lantana ‘Landmark Flame’	Ruellia brittonia
Lantana ‘Sunbeam Weeper’	Salvia greggii ‘Wild Thing’
Mediterranean Series	Santolina (Green/Gray)
Periwinkle	Vinca ‘Illumination’
Million Bells	
Pentas	
Pepper ‘Chilly Chili’	
Petunia ‘Easy Wave Cherry	
Ruby Grass	
Sun Coleus	
Zinnia ‘Profusion Orange’	

Shrubs

	Arborvitae ‘Green Giant’
	Barberry ‘Bonanza Gold’
	Buckthorn ‘Fine Line’
	Crepemyrtle ‘Pokomoke’
	Heptacodium
	Inkberry
	Magnolia ‘Little Gem’
	Rose ‘Home Run’
	Rose ‘Knockout Pink’
	Spirea ‘Magic Carpet’
	Tamarix
	Viburnum
	Winter Jasmine
<u>Perennials</u>	
Acorus ‘Ogon’	
Ajuga ‘Chocolate Chip’	
Arkansas Amsonia	
Canna ‘Tropical Salmon’	
Creeping Phlox ‘Candy	
Stripe’	
Crinum Lily	
Dichondra ‘Silver Falls’	
Feather Reed Grass	

Metamorphosis: Changing Children's Lives with Butterflies

PLANTS THAT WILL EXCITE BOTH YOU AND THE BUTTERFLIES

By Gail Pianalto (ogp31@cox.internet.com) & Joyce Mendenhall (jmendenhall@uaex.edu)

Today's children have too many things such as video games, TV, and computers that entice them inside. Our program is aimed at getting the kid's outside and back to nature. This can apply to many adults also. By introducing children to the world of butterflies you not only get them back outside but teach them to love the plants that are needed to sustain the butterfly population.

We showed the many ways we have introduced the children to the world of nature's "flying flowers" with Butterfly Day at the Botanical Garden of the Ozarks, "Adopt a Caterpillar", and outreach programs brought to the schools with "Monarch Waystations".

If you want butterflies to live in your yard and not just visit you must plant their host plants along with the nectar plants. The host plants are those on which the adult butterfly lays her eggs and the food source for the soon to hatch caterpillars. An example would be *Asclepias* (Milkweed) which is the only plant on which the Monarch will lay her eggs. No milkweed, no Monarchs.

Aquilegia "Swallowtail" or "Denver Gold" LSP-EF

Gaillardia "Oranges and Lemons" LSP-F

Anemone "Party Dress" LS-F

**Poncirus trifoliata* "Flying Dragons" SP Host to Giant Swallowtail

*Snapdragon annual host to Common Buckeye

Alchemilla saxatilis MSP-ESU

Clematis integrifolia "Rooguchi" LSP-LSU

Dianthus "Dad's Favorite" SU or *gratianopolitanus* "Firewitch" SP & F

Gaura "Crimson Butterflies" ESP-F

Hesperis matronalis (the white one cause its hard to find) LSP-SU

Gaillardia "Oranges and Lemons" LSP-F

Malva sylvestris "Brave Heart" or "Merlin" LSP-EF Host to Painted Lady

Nepeta faassenii "Walker's Low" LSP-F

Phlox Carolina "Miss Lingard" or *paniculata* "Laura" variety of *Phlox* with different bloom times

Linum perenne SP-ESU Host to Variegated Fritillary

Tanacetum coccineum "James Kelway" LSP-MSU

Polemonium yezoense "Purple Rain" LSP

Viola grypoperis exilis or "Columbine" "Dancing Geisha" "Freckles" SP host to Variegated Fritillary,

Diana Fritillary,

Baptisia "Purple Smoke" LSP

Chionanthus virginicus (Fringe tree) LSP

Lindera benzoin (Spice Bush) SP Host Spicebush Swallowtail

Thermopsis lanceolata LSP

Gelsemium sempervirens (Carolina Jessamine) the fragrant one SP

Lonicera sempervirens "John Clayton" SP and repeats (not invasive) Host Spring Azure or *periclymenum* "Harlequin" SU-F

Malus SP

Prunus serotina (Wild Black Cherry) SP Host Red Spotted Purple, Coral Hairstreak, Striped Hairstreak,

Spring Azure

Viburnum SP Host Hummingbird Clearwing Moth, Baltimore Checkerspot
Wisteria frutescens "Nivea" SP Host Silver-spotted Skipper
Abelia mosanensis I have this and it smells heavenly) LSP
Blueberry (Vaccinium) any SP Host to Striped Hairstreak
Cercis cinensis "Avondale" SP Host to Henry's Elfin,
Philadelphus "Innocence" or coronaries "Aureus" SP
Syringea "Miss Kim" or Pocahontus" SP Host to Regal Moth
Clematis Various Bloom times *from* ESP-LF depending on variety Nectar Source Achillea millefolium
"Terra Cotta" SU
*Members of the carrot family bronze fennel, parsley, dill, and Queen Anne's Lace Host *for* Black Swallowtail

Aconitum cammarum "Stainless Steel"MSU

Buddleia 'Peacock' SU

Echinacea "Sundown" MSU

Echinacea paradoxa SU-F

Oenothera glazioviana "Tina James" SU

Solidago rugosa "Fireworks" LSU

Liatris ligulistylus MSU-EF

Lavandula intermedia "Grosso" or "Provence" ESU-MSU

* Aruncus dioicus (Goatsbeard) ESU-MSU host to Dusky Azure

*Cimicifuga ramosa "Black Negligee" (Black Cohosh) MSU-LSU host to Appalacian Azure

Berlandiera lyrata (chocolate flower) SU

Penstemon mexicali "Red Rocks" or virgatus "Blue Buckle" ESU-MSU

Alcea "Black Currant Swirl" or "Creme de Cassis" or "Queeny Purple" SU Host to Painted Lady

*Lantana SU-F Host to Gray Hairstreak

Astilbe "Sheila Haxton" MSU-LSU (Depending on variety you can have blooms from spring through summer)

Coreopsis vweticillata "Creme Brulee" or rosea "Sweet Dreams" SU-F

Delphinium Elatum New Zealand Hybrids ESU

Dictaminus purpureus ESU-MSU

Echinops sphaerocephalus "Arctic Glow" SU

Eupatorium purpureum "Little Joe" SU-F

Filipendula hexapetala "Kakome" MSU-LSU

Helenium "Mardi Gras" SU

Heliopsis helianthoides "Loraine Sunshine" ESU-F

Hemerocallis (anything but Stella d'Oro Depednding on variety you can Early Mid or Late Season

Heuchera "Champagne Bubbles" SU

Hibiscus moscheutos "Plum Crazy" or "Old Yell a" MSU-EF

Kniphofia "Flamenco" ESU-MSU

Leucanthemum superbum "Crazy Daisy" SU

Lilium any

Origanum libanoticum ESU-LSU

Pimpinella major "Rosea" (Pink Queen Anne's Lace) ESU-MSU

Rudbeckia hirta "Prairie Sun" or nitida "Herbstonne" MSU-F host to Silvery Checkerspot

Salvia nemorosa "Caradonna" or microphylla "Hot Lips" SU

Thalictrum flavum Illuminator" ESU

Trifolium repens "Dragon's Blood" (Clover) SU

Verbena "Shauna Ann" SP-LF
Veronica longifolia "Eveline" SU
Yucca "Color Guard" SU Yucca Moth
Cassia marilandica SU- Host Cloudless Sulphur
Monarda didyma "Jacob Cline" or "Raspberry Wine" ESU-MSU

Passiflora incarnate or caerulea or edulis "Incense" (Vine) SU-Host Gulf Fritillary, Variegated Fritillary
Ruellia carolinensis or humilis SU host to Common Buckeye
Grasses several are host plants from sedges to crab grass
Aristolochia macrophylla (vine) or durior SU Host Pipevine Swallowtail
Asimina triloba (Paw Paw) Host Zebra Swallowtail
Catalpa speciosa Host Sphinx Moth
Celtis laevigata (Sugarberry) or tenuifolia (dwarf hackberry) Host to Snout, Question Mark, Mourning
Cloak, Emperor and Hackberry Butterflies
Clethra alnifolia "September Beauty" MSU-LSU
Fraxinus pennsylvanica (Green Ash) Host Swallowtail
Itea virginica "Little Henry" SU
Physocarpus opulifolius "Summer Wine" SU
Ptelea trifoliata (Wafer Ash) Host Giant Swallowtail
Sambucus nigra "Black Beauty" ESU
Sassafras albidum Host Spicebush Swallowtail
Zanthoxylum clava-herculis (Prickly Ash) Host to Giant Swallowtail
Schizophragma "Roseum" or "Moonlight" MSU
Salix alba "Britzensis" (Coral Bark Willow) members of the willow family are host to Mourning Cloaks,
Red-spotted Purple, Viceroy, and the Luna moth
Sedum spectabile "Pink Chablis" LSU
Ulmus (Elm) host to Eastern Comma, Mourning Cloak,
Agastache "Black Adder" or "Desert Sunrise" MSU-F
Hibiscus syriacus Rose of Sharon) "Blue Satin" S U - F
Hex Host to Henry's Elfin
Kalmia latifolia "Raspberry Glow" ESU Host to Laurel Sphinx Moth
Ligustrum vicari (Golden Privet) SU Host to Laurel Sphinx Moth
Weigela florida "Midnight Wine? Or Rubidor) ESU
Senecio confusus (Mexican Flame Vine) annual vine SU-F
Thunbergia (annual vine) SU-F
Asclepias curassavica (annual one that the Monarchs seem to prefer) SU-F all members of Milkweed are
host to the Monarch
Aster novae-angliae "Purple Dome" LSU-F host to Dainty Sulphur, Gorgone Checkerspot, Pearl
Crescent, American Lady
Caryopteris clandonensis "First Choice" or "Worcester Gold" LSU-F
Aster carolinianus (Climbing Aster) Host to Gorgone Checkerspot, Pearl Crescent, Painted Lady,
American Lady, Dainty Sulphur
Humulus lupulus (Hops) Aureus Host to Question Mark
Helianthus salicifolius "First Light" MF
*Oaks are host to Sleepy Duskywing, Red-spotted Purple, Luna Moth, Oak Hairstreak

KEY TO ABBREVIATIONS FOR BLOOM TIME:: SP: Spring LSP" Late Spring SU: Summer ESU:
Early Summer LSU Late Summer F: Fall MF: Mid Fall

Adopt and Release a

1. Transfer the caterpillar to a larger container with a breathable lid.
2. Feed only fresh host plant. (Example: parsley, fennel, milkweed, etc.)
3. Add a stick to the container for the caterpillar to attach to when forming its chrysalis.
4. Clean the droppings (frass) out of the container on a daily basis.
5. The caterpillar will attach to the stick or the side of the container when ready to form the chrysalis. **DO NOT MOVE THE CHRYSALIS!** You could damage the chrysalis and the butterfly may not be able to form correctly.
6. The caterpillar will remain in the chrysalis stage for 10-15 days.
7. Line bottom of the container with paper towel. When the butterfly emerges a fluid will come out of the chrysalis. It is important to keep the butterfly dry once it has emerged. The paper towel will absorb this fluid so that it will not get on the butterfly.
8. The butterfly needs to hang in the container for about two hours before releasing it outside. This will give the butterfly a chance to transfer the fluids from the abdomen to its wings so that it can flyaway to find nectar. If the butterfly does not get the fluids it needs into the wings it may never fly. This is a very vulnerable stage for the butterflies so please do not touch it until it is ready to be released. This also gives everyone a chance to observe the butterfly up close before being released.
 - . The caterpillar does not need water in the container. It will get all of the fluids it needs from eating the plant.
 - . When it is time to change into the chrysalis the caterpillar will release a dark green colored liquid. The caterpillar is not harmed; it is part of the process.
 - . If the butterfly does not come out of the chrysalis then it is possible that it is one of the swallowtails that will be over wintering in the chrysalis. Leave the container where it can be seen and it should come out early spring.
 - . PLEASE wash your hands with soap and water before handling the caterpillar or butterfly!! Any kind of chemical (lotions, soaps, perfume) can harm a butterfly.

Hosta La Vista- Diseases in the Hosta World

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Hostas represent one of the most common accent herbaceous ornamentals grown in the South. There are numerous cultivars which create beauty to any landscape. They are sold with a wide diversity of size, foliage types, shade tolerance, and ease of cultivation. Although hosta is generally considered a pest free plant, there are a few diseases which can adversely affect the overall quality of the plant.

Hosta virus X, a previously undescribed potexvirus has been reported as the most frequently occurring virus in hostas. Symptoms of virus infection are highly variable. This fact greatly prevents making a reasonable visual diagnosis of this disease based on symptoms. Symptoms of HVX include interveinal tissue death, localized yellowing, and leaf puckering and death. The intensity of the symptoms was dependent on the cultivar. They ranged from mild to severe. The virions are filamentous particles and transmission has been identified primarily by mechanical means such as wounding and vegetative propagation of infected material. HVX may likely be spread by hands and tools during cultural operations. Virus infected plants will not recover. Cultivars respond differently to the virus. No insect vector or pollen transmission has been identified to date. Control methods include sanitation and growing resistant varieties. Other viruses that have been identified on hosta cultivars include tomato ringspot (TomRSV), impatiens necrotic spot (INSV). At present, these viruses appear to impact hostas to a lesser extent than HVX.

Southern Blight, sometimes referred to as “crown rot”, is caused by the soil inhabiting fungus *Sclerotium rolfii*. Although this disease is most common in warmer and humid climates, it has become significant in cooler areas of Illinois, Michigan, and Iowa. Symptoms of this disease may resemble other crown or stem rots, making an accurate diagnosis difficult unless examined by a professional plant disease diagnostician. Symptoms begin as leaf yellowing followed by a permanent wilt. Succulent plant will often fall over at the base of the plant. The fungus produces small survival structures (sclerotia) on infected petioles that enables the fungus to survive literally for years in the soil. This fact makes control a real challenge for the hosta grower. Prevention is the best management for Southern blight. All new plants and their associated soil should be inspected thoroughly before they are introduced into the landscape. Infected plants can introduce the fungus into the growing area. Once established in the landscape, sanitation becomes important. All suspicious plants should be removed destroyed. Sclerotia can easily be transported around the garden by infected soil.

Foliar nematodes (*Aphelenchoides* spp) can also affect hosta by feeding on the leaves. Leaf symptoms are manifested as off-color to necrotic lesions or areas often restricted by leaf veins. As a result, lesions appear as “blocky” areas on the leaves. Nematodes may swim up the petioles from the soil in a film of water and enter plant tissues through the stomates. Feeding is usually restricted to the area between the veins. Practicing good sanitation is the best method of management. Growers should grow and

propagate from nematode free plant material. Plants and soil determined to be infected by the foliar nematode should be promptly destroyed.

Growing Culinary Herbs

Nancy Reynolds — Fort Smith, AR

SUN — 5 hours a day. . . less in a hot climate

GOOD DRAINAGE — Herbs don't like "wet feet"

SOIL

- Lightly enriched, open soil
- Ph 6 to 7 (alkaline)
- Work in compost, manure, lime (lime to sweeten soil) when using manure, add bone meal

WINDBREAK

PESTS — Very few - .- use Safers Insecticidal Soap

SIZE AND TYPES OF BEDS

- Raised, narrow beds make cultivation and harvesting easier AND makes for good drainage
- Barrels, pots, hanging baskets, lining a fence

SEEDS VS. PLANTS — Seeds - basil, dill, parsley, borage, although you can easily get most any plant

WHAT TO LOOK FOR IN PLANTS — Branched plants with strong stems; new growth; clearly labeled; free of insects and disease; color

FIRST GARDEN — For culinary uses, lavender, basil, thyme, oregano, sage, dill, chives, mints, parsley, nasturtiums

Delicious Herb Combinations

Basil. Basil is great with stir-fried asparagus, tomato salad, tomato soup, "overnight pickles of carrot cucumber, squash and green pepper over salad greens. Basil and tomato were made for each other. Try using them in other combination, too.

Caraway seed. Wonderful with coleslaw or red cabbage.

Chive Blossoms. Adds a subtle onion flavor. Good with egg salad, cooked broccoli or Brussels sprouts.

Dill. Great with cooked beets or cabbage, three-bean salad, coleslaw, potato salad, poaching eggs or fish, cucumber salad.

Fennel Seed. Complements avocado, grapefruit, and mushroom salad

Floral Vinegar. Try it on fruit or cream dishes; fruit salads; use vinegared flowers to garnish winter salads. (Violets, carnations, elderberries, rose, or lavender.)

Garlic. Good in anything - especially good with green salads; vegetable salads; spinach, marinade for sauerbraten.

Lemon Thyme. Made for mayonnaise, fish and fish salad, stir-fry vegetables such as asparagus, broccoli, zucchini and pea pods.

Mint. Stir into mayonnaise or whipped cream for fruit salads, sauce for lamb, :qwt gelatin, or fruit punch.

Nasturtium. Use the flowers where peppery flavor is desired, with pickled eggs, or meats before grilling.

Oregano. Good in scrambled eggs, salads, pizza.

Red Raspberry. Peps up spinach salad, baked pears or apples, hot chicken, meat marinade, or add to yogurt for fruit salad.

Rosemary. Everybody's favorite summer AND winter. Complements pork or lamb marinade, tomato and cucumber salad, orange and onion salad, fried potatoes, or fruits. For a real treat, lift the breast skin on a baking chicken and tuck a few sprigs in.

Salad Burnet. Adds a cucumber flavor without indigestion. Good in salads, and in clear or potato soup.

Tarragon. Will help, not that they needs help, chicken, crabmeat, and tuna salads, vegetable juice cocktail, chicken gravy, hollandaise and bearnaise sauces, asparagus or artichokes, peas and onion combined, soups or chowders, tomatoes or green salad. (Mexican mint marigold is easier to grow and has a full tarragon flavor.)

Mother Nature made certain herbs to go with certain dishes. Use your own imagination and discover new combinations. — We're only limited by our imaginations!

Easy Herb Uses

1. Most common use - mint in tea or water. Can make mint leaf ice cubes or mint tea cubes.
2. Add chopped mint to sugar cookie dough. (If not strong enough, add mint extract)
3. Put lettuce leaf basil or horseradish leaf on sandwiches.
4. Line pita with lemon basil and fill with chicken salad.
5. Make strong lavender tea and use to make limeade or ice cubes.
6. Use rosemary sticks for skewers
7. Sprinkle herb flowers on salads and other dishes.
8. Use lovage stems for straws. Good with tomato juice.
9. Make herb vinegar or oil. Use oil within a few days and keep in refrigerator.
10. Line a cake pan with scented geranium leaves. Peel from bottom of cake after cooking.
(or just leave them there!)
11. Chop mint or lemon verbena or scented geraniums and add to frosting or shipped cream.

12. Make herb butter. Use 4 parts butter to 1 part herbs. Use on anything that takes plain butter.
Great on breakfast toast.
13. Put sage under the skin of breast of a roasting chicken (or try spearmint).
14. Fill chicken cavity with herbs and half a lemon before roasting.
15. Put rosemary and orange slices under turkey skin.
16. Tie up a bunch of herbs and use as a basting brush.
17. Dip cut sides of lemon wedges in chopped dill to serve with fish.
18. Make herb salt.
19. Flavor honey with herbs.
20. Put chopped basil on tomato slices and drizzle with olive oil.
21. Pierce a Spanish onion and insert herbs. Bake and eat like a baked potato.
22. Add 1/2 cup chopped herbs to bread or pasta dough.
23. Add chopped herbs to crepe batter and to sauce for crepes.
24. Make herb sugar (6-8 mint leaves to 1 cup of sugar. Blend and dry on cookie sheet).
25. Season bread crumbs with dried herbs and garlic powder.
26. Use chopped herbs in omelets.
27. Chew sprigs of parsley, spearmint or peppermint to get rid of garlic or onion breath.
28. Marinate cheese cubes in herbs and oil. Drain before serving.
29. Candy lavender - dip lavender heads in meringue powder and roll in granulated sugar (or super fine, made by putting sugar in a processor). Dry. Eat only flowers.
30. Add lemon verbena, lemon balm or orange bergamot to lemonade.
31. Make tea.
32. Make herb roll-ups. Remove crusts from thinly sliced bread. Spread with herb butter. Roll, starting at corner. Put seam-side down on cookie sheet and bake at 350 degrees oven for 30 minutes. Great with soups or salad.
33. Make Bouquet Garni. Tie a bunch of herbs together, or wrap in cheese cloth, and immerse in soups and stews to season. Most common: parsley, sage, rosemary, and thyme.

Helpful Hints

1. Herbs keep dried for one year maximum.
2. Paprika, cayenne, chili pepper, and curry are best kept in refrigerator after being opened.
3. For best flavor with dried herbs, grind large pieces with a mortar and pestle.
4. Coriander (fresh) makes chicken more flavorful if roasted inside the chicken.
5. Add savory to cooking cabbage to keep down smell and to enhance flavor.
6. Put bouquet garni in a cheesecloth bag or tea ball if dried, or between two pieces of celery if fresh.
7. Par-boil garlic to loosen skin and "tame" flavor and smell.
8. Put parsley, stems and all, into the stockpot as the stems have the most flavor.
9. Put fresh herbs in a glass of water in the refrigerator - they will keep several days this way.
10. Freeze pesto, then scrape it off the top with a knife.
11. Form herb butters into a ball with melon baller; then freeze on cookie sheets and bag up.
12. Save woody stems after harvesting your herbs and throw these stems into the fireplace for a lovely aroma.
13. Toss 'old' herbs into the fireplace for a lovely aroma.

There is only one rule to observe in cooking with herbs; they must not mask the flavor of the dish, but rather enhance it. The use of herbs can become a creative adventure which, like your preference for color, music, or lifestyle, is a matter of personal judgment. Begin by experimenting. There are wonderful

herbal cookbooks out there!

Historic Herb Uses

Herbs were an important part of the pioneer household, whether as food, as coloring and dye for gunstocks, furniture, quilts, clothes or as medicine in a time when there were few if any doctors available. A family's health depended upon the knowledge and skills of the oldest person in the household. They grew or gathered plants, dried and preserved them for winter use, kept seeds from year to year, and passed plant-starts along to the children as they were married and moved away.

Dill has been used for the past 5,000 year as a cure for the hiccups. It soothes digestion, flavors pickles, salads and relishes.

Thyme was once used by magicians to see elves.

Flax seed was once used to remove foreign things in the eye by placing a flax seed in the affected eye.

Mugwort was a dream inducer (in pillows); a traveler with mugwort leaves in his shoes was believed able to walk 40 miles before noon.

Tansy drove off moths and bugs, kept away flies and was used as a cure for freckles.

Chamomile this was the tea that Peter Rabbit was give by his mother after he'd eaten too many beans and radishes. Soothes tummies and encourages sleep.

Lavender prevented headaches, induced pleasant dreams (in pillows) and was thought to "still the passions of the heart."

Basil was used to keep flies out of houses, sometimes as snuff, and as a cure for travel sickness. Good herb with tomatoes.

Alkanet was a healing herb used before antiseptics. One old recipe for a wound dressing called for alkanet pounded with oil and mixed with dried earthworms.

Caraway was a treatment for baldness and it was once believed that items containing a caraway seed couldn't be stolen.

Bergamot was a tea and healing plant. This was the tea that replaced "English tea" after the colonists threw the imported tea overboard at the Boston Tea Party

Elderberry was used for jellies, wines, face lotions, eyewashes, fritters and cake flavorings.

Iris is a healing herb, was used as a freckle remover and is still used as a potpourri fixative and perfume ingredient.

Horehound was taken by anyone who was being poisoned by their step-mother. Used also as a gnat repellent and an ingredient in cough drops.

Vervain was used to keep away enemies and stop barking dogs.

Violets were often used as a treatment for rheumatism of the *right* wrist.

Mint treated dog bites, soothed stomachs, cured hiccups and repelled rats.

Pennyroyal repels fleas, ticks and bugs, and was once a specific for sore thumb joints.

Vegetables

New Products for Powdery Mildew Control in Cucurbits, 2005-2006

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Dennis Motes, Director
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Biography for Kelly Cartwright

Kelly Cartwright is founder and president of Agricultural Research Initiatives, Inc. (ARI) located in Fayetteville, AR. ARI specializes in development of innovative strategies for use in agricultural pest management. Dr. Cartwright received his Ph.D. in plant pathology from North Carolina State University in 1994 and, in conjunction with responsibilities at ARI, holds an adjunct position of assistant professor in the department of plant pathology at the University of Arkansas in Fayetteville. He currently resides in West Fork, AR. He is married and has four children.

Abstract

Trials were completed over successive years (2005 and 2006) for control of powdery mildew in pumpkins using new and/or biocompatible fungicidal products. In both years, heavy mildew pressure developed in test plots, especially during late August and September. Most products tested controlled powdery mildew early in the tests when disease pressure was minimal. However, as pressure became more intense, the majority of products began to break down. In control plots, some 80 to 100% of foliage was covered with powdery mildew by mid-September during both years. During the first year, all treatments consisting of the product Quintec showed excellent control of mildew, even to harvest. In addition, an experimental (NF149) had very good control of mildew through most of the trial period. In 2006, most treatments had at least minimal control of mildew through mid-August. But, during late August and through September when mildew developed rapidly because of heavy rains, control broke down in essentially all treatments except those containing Quintec. In both years, fruit number was not affected significantly though a tendency for decline in heavily diseased plots was noted. Overall, these were very definitive tests with clear results. Quintec was, by far, the most superior product tested, holding control under the most heavy disease pressure. Other products of note included the experimental NF149 and the biocompatible product Endorse, both of which appear to hold some promise for controlling mildew in pumpkins.

2005 Test

Susceptible pumpkin plants ('Lil' Ironsides) were direct-seeded within the row in a sandy loam soil at the University of Arkansas Vegetable Substation near Alma, AR on 15 Jun. Plots consisted of a single row in a 3-ft by 12-ft spacing containing nine plants per plot after thinning on 19 Jul. Plots were randomized within blocks with four replicates per treatment. Pumpkins were irrigated with an overhead system at 0.8 in/wk for 8 wk beginning on 27 Jun. Applications were made in an equivalent of 47 gal/A using a hand-held, modified CO₂ sprayer to insure adequate coverage on a 3-ft block down the center of each row. Initial application was placed on 2 Aug and continued on a 10- to 14-day schedule until 15 Sep. The amount of diseased leaf tissue in the 3-ft center of plots was estimated beginning on 31 Aug

with the third and final rating made on 20 Sep. Maximum temperatures for Aug and Sep were 100 F (12 Aug) and 97 F (2 Sep), respectively. Minimum temperatures were 65 F (31 Aug) and 51 F (30 Sep). Rainfall amounts were 1.19 in and 6.39 in. for Aug and Sep, respectively.

Powdery mildew initially developed in control plots around 20 Aug with consistent spread from these plots. By mid-Sep, untreated controls had an average of 80% of foliage diseased. Following a significant rain event in mid-September, the disease spread more rapidly. This also correlated with full canopy closure in late Aug through Sep. Most treatments gave excellent control of mildew with the treatment containing Endorse as the mid-treatment becoming slightly more diseased as the season progressed. The standard control treatment (Tanos and Nova) was relatively good early but began to breakdown during late season under heavier disease pressure. The experimental NF-149 was exceptional and appeared to control the mildew as well as the Quintec alone.

Treatment and rate/A	Application timing*	% Foliage Diseased**		
		31 Aug	8 Sep	20 Sep
Untreated control		35 a	58 a	83 a
Tanos 50DF 8 oz	1, 3, 5	4 bc	10 bc	28 b
Nova 40WP 11 oz.....	2, 4			
Quintec 2.08EC 6 fl oz.....	1, 2, 3, 4, 5	0 c	1 c	6 c
Nova 40WP 4 oz	1, 3, 5	0 c	1 c	6 c
Quintec 2.08EC 6 fl oz	2, 4			
Nova 40WP 4 oz	1, 4	0 c	1 c	6 c
Milstop 85WP 5 lb	2, 5			
Quintec 2.08EC 6 fl oz	3			
Nova 40WP 4 oz	1, 4	0 c	1 c	11 bc
Endorse 2.5WP 1.8 lb	2, 5			
Quintec 2.08EC 6 fl oz.....	3			
NF-149 10SC Exp. 1.7 fl oz	1, 2, 3, 4, 5	0 c	0 c	6 c
V-10118 6.24 fl oz	1, 2, 3, 4, 5	6 b	18 b	26 b
V-10118 9.36 fl oz	1, 2, 3, 4, 5	0 c	6 c	19 bc
Rubigan 9 oz	1, 2, 3, 4, 5	1 bc	18 b	25 b

*Fungicides were applied on 1= 2 Aug; 2=12 Aug; 3=24 Aug; 4=4 Sep; and 5=16 Sep.

**Means separated via LSD (p=0.05). Averages followed by a different letter are significantly different based on statistical analyses. Estimate (%) of amount of foliage per plot infested with PM.

2006 Test

Susceptible pumpkin plants ('Lil' Ironsides) were direct-seeded within the row in a sandy loam soil at the University of Arkansas Vegetable Substation near Alma, AR on 26 Jun. Plots consisted of a single row in a 3-ft by 12-ft spacing containing eleven plants per plot after thinning on 24 Jul. Plots were randomized within blocks with four replicates per treatment. Pumpkins were irrigated with an overhead system at 1 in/wk for 6 wk beginning on 27 Jun. Applications were made in an equivalent of 47 gal/A using a hand-held, modified CO2 sprayer to insure adequate coverage on a 6-ft block down the center of each row. Initial application was placed on 4 Aug and continued on a 10- to 14-day schedule until 13 Sep. The amount of diseased leaf tissue in the 3-ft center of plots was estimated beginning on 5 Sep with the fourth and final rating made on 4 Oct. Maximum temperatures for Aug and Sep were 104 F (10 Aug) and 94 F (16 Sep), respectively. Minimum temperatures were 59 F (30 Aug) and 42 F (29 Sep). Rainfall amounts were 3.88 in and 4.96 in. for Aug and Sep, respectively.

Powdery mildew initially developed in control plots during the third week of Aug with rapid spread from these plots. By late Sep, untreated controls had an average of 96% of foliage diseased. Rain and cooler temperatures caused the disease to spread even more rapidly during mid to late Sep. This also correlated with canopy closure throughout Sep. The Quintec treatments gave excellent control of mildew throughout the test. In particular, the Quintec alternated with Nova seemed superior in terms

of plant appearance and related. This is important to contain the potential for development of fungicide-resistant isolates of *S. fuliginea*. Endorse gave acceptable control until late in the trial. Other treatments began to break down in early Sep as disease pressure became more rapid and heavy. Only Quintec and, to some degree, the Endorse treatments gave acceptable control in this test where powdery mildew pressure was extremely heavy.

Treatment and rate/A	Application timing*	% Foliage Diseased**			
		5 Sep	14 Sep	26 Sep	4 Oct
Untreated control		36 a	70 a	96 a	100 a
Quintec 2.08 EC 6 fl oz.....	1, 2, 3, 4, 5	0 b	0 c	4 d	4 c
Quintec 2.08EC 12 fl oz.....	1, 2, 3, 4, 5	0 b	0 c	2 d	4 c
Quintec 2.08 EC 6 fl oz	1, 3, 5	0 b	0 c	0 d	1 c
Nova 40WP 5 oz.....	2, 4				
Endorse 2.5 WP 1.8 lb	1, 2, 3, 4, 5	3 b	14 bc	36 c	89 b
AgriFos 4 pt	1, 3, 5	5 b	29 b	70 b	100 a
Prev Am 4 pt.....	2, 4				
Prev Am 4 pt	1, 2, 3, 4, 5	5 b	51 a	83 ab	98 a
FosPhite 6 pt.....					

*Fungicides were applied on 1= 4 Aug; 2=11 Aug; 3=21 Aug; 4=1 Sep; and 5=13 Sep.

**Means separated via LSD (p=0.05). Averages followed by a different letter are significantly different based on statistical analyses. Estimate (%) of amount of foliage per plot infested with PM.

Niche Marketing Strategies

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Ron is an Associate Professor with the University of Arkansas Division of Agriculture, Cooperative Extension Service (CES). He has worked for CES since 1993 currently working as an Extension Economist within the Agriculture Economics and Agribusiness Department. Ron also has an adjunct appointment in the U of A Horticulture Department.

His academic background includes a Ph.D. in Economics (2001), M.S. in Agricultural Economics (1993), and a BSA in Agribusiness (1991) all from the University of Arkansas at Fayetteville. Ron specializes in business planning, cooperatives and farm management. Currently, his work primarily focuses on developing resources to serve the horticulture industry, specifically in the areas of cost analysis, business planning, and marketing.

Presentation discusses niche marketing approaches. Discussions include an examination of what is strategy and how a business can strategically create a unique and valuable position in their marketplace. It is important to note that eliminating possible marketing options is just as important as outlining specific objectives in the strategic planning process. Strategy is also about choosing what not to do. A niche marketing focus is examined and discussed during this presentation. The session defines niche marketing and investigates a framework for a business to discover its own niche.

It has been said that effective marketing is the lifeline of any business. Business philosopher Jim Rohn said that businesses should do three things. First, have something good to say. Second, say it well. Lastly, he said say it often. All three areas have a single focus, the customer. This means that to market effectively, a business must have a clear understanding of their products/services and how they fit in the marketing place. Next, a business must have a good understanding of their current and potential customers. Lastly, a business must also have clear messages that are effectively communicated to a satisfied customer.

To gain a better understanding of where you stand in the market, you should first look at your product(s) or service(s) and conduct an objective analysis. This analysis should focus on competitors, suppliers and potential new products. Some important questions that should be asked when conducting this analysis include:

- Where does my product fit in the marketplace?
- Are competitors providing the same product or service?
- Is there a demand for my product or service?
- Can I be competitive with price, quality and delivery?
- Will I need to develop new products?

Once these questions regarding your product or service are answered, start gathering information in regard to your potential customer base. Some useful questions to ask during this step include:

- Who are my customers?

- Where are my customers located?
- Will I sell directly to the customer, what marketing channel do I use?
- Will I target new customers?
- Will I be servicing existing customers?

After determining where you stand in the marketplace in terms of your product and target audience, a marketing strategy will be needed. Table 1 details specific strategies once you have evaluated your current marketing position. The table details four specific strategies to use depending on your current market situation. The marketing matrix is a tool that can be used to identify which marketing strategy is best suited for your business.

The strategies break your marketing options down across two areas: (1) markets or customers and (2) the products and/or services which your business offers. Within both of these areas, a business only has to consider whether to serve existing markets/products or to explore new markets and products. The paragraphs below detail each of the strategies and when they are advantageous to a business marketing plan.

Table 1. Strategic Market Options

		MARKETS	
		<i>Existing</i>	<i>New</i>
PRODUCTS	<i>Existing</i>	Market Penetration	Market Development
	<i>New</i>	New Product Development	Related Diversification

Source: Marketing, McDaniel and Darden, pg. 70 Strategic Opportunity Matrix, H.I Ansoff Corporate Strategy (McGraw-Hill, 1965)

Market Penetration: Market penetration occurs when a business increases its share of the market through current product markets. This strategy can be employed to dominate the existing market. Market penetration is achieved by increasing current customer product usage or obtaining new customers. Firms can achieve market penetration by reducing price, expanding distribution and increasing promotional activities. This strategy should be incorporated when the market is expanding.

Market Development: The purpose of market development is for venturing into new markets. This can be done by selling existing products into new markets, seeking new uses for existing products, modifying existing products, using different distribution methods and pursuing a different advertising/sales strategy. Market development should be looked at when the present market is saturated.

Product Development : Product development is the act of creating new products and/or improving upon existing products for the present market. This strategy is incorporated when the customer has new needs to be fulfilled or when a firm is looking to expand into new markets.

Diversification: Introducing new products into new markets is the strategy of diversification. Diversification can be a good way to create growth opportunities outside of the current business. Diversification strategies can help spread a firm's risk throughout different markets and prevent having "all of your eggs in one basket."

Proper research and analysis can help your business identify your marketing options. If you are interested in a narrowly defined segment of the marketplace, niche marketing orientation is your focus. **Niche marketing** is marketing a product or service to a narrowly, defined segment in the market. The target audience may or may not be readily served by the main stream marketplace. A niche focus requires a strategic orientation toward your customer that is focused, specialized, and builds a relationship with your customer. It may not require a highly differentiated product, but it will require a customized marketing focus that communicates clearly with your target audience.

If a company is interested in a niche marketing focus, time should be spent defining the niche. The firm must research its audience and evaluate the dynamics of how your target group will change over time as well as attempt to evaluate competitor responses. Communication is key in a niche marketing scheme. Firms must not only say the "right things" to their target audience but also make sure that the message is reaching the right people. Lastly, the firm's products must effectively meet the unique needs of the target group.

Focusing on a market niche requires constant and clear communication with your targeted audience. Marketing is everything that you do to communicate your product/service to your customer. To effectively use a niche marketing strategy, businesses must know their customer.

Ideas for a Summer Promotion of Oklahoma-Grown Fresh Market Vegetables

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An editorial in the April, 1982 issue of *American Vegetable Grower* magazine contained this quote: “The biggest problems of expanding local market production [of vegetables] lie in distribution and marketing.” The following paper is designed to encourage the development of one particular marketing option: The selling and promotion of “homegrown” fresh market vegetables by local supermarkets.

Why would a retailer consider this marketing option? Incentives include reduced transportation and handling costs, the potential for longer shelf life, and more flexibility in meeting the preferences of a local customer base. This option also provides an opportunity for a smaller chain to differentiate itself from larger competitors. Of course, the larger chains have noticed and have taken steps to get into the game themselves. For example, an article in the Sept. 4, 2006 issue of *The Packer* was headlined: “Wal-Mart stores focus on locally grown produce.”

“Homegrown” produce can be either regional or local. Larger wholesale packing facilities are likely to employ field buyers who scout for product in a multi-state region. Retailers may source product from these larger wholesalers or from produce auctions, from their chain’s own warehouse, and/or directly from growers. Everyone involved (grower, wholesaler, retailer, and consumer) must receive a fair price for this marketing option to succeed.

Retailers also must get the message to consumers that, for a limited time, their stores are offering produce that comes as close as possible to backyard freshness. Strong advertising support is needed to inform consumers that the homegrown items are in season. Once the consumers enter the store, the local items are displayed at the front of the produce department so shoppers see them right away. Displays may include poster-size photos of local growers holding the products they are supplying to the chain. Some retailers have created an in-store “farmers market” theme. In-store sampling also helps to move the products.

Some of the vegetables for which “homegrown” promotions have been successful in Missouri include green bell peppers, summer squash, sweet corn, tomatoes, and watermelon. Inadequate harvest labor can limit the volume of these and other potential crops like cabbage and okra. Some crops like snap bean and sweet corn can be mechanically harvested, but lose quality rapidly after harvest and may require precooling. Larger retailers may require the produce to be packed in display-ready corrugated boxes. Growers can overcome some of these obstacles by considering the development of a marketing co-op with a central packing shed. Produce buyers for larger chains in particular prefer to purchase local produce as needed with just one or two phone calls, rather than dealing with a patchwork of individual growers.

Retailers will demand consistent quantity and quality during the promotion period for a particular item. Requirements for volume and for frequent, reliable delivery must be satisfied. Produce must be wholesome and acceptable to the public, but need not necessarily meet the top USDA grade standard if the freshness and flavor are there. The consumer must perceive value for his/her dollar. Retailers may also want a group of items that overlap in availability for insurance of supply during a “homegrown” promotion. That way, if one item is short on quantity or quality, the entire promotion is not compromised. A table (see the end of this article) has been developed to provide some supply information for several key crops that could be part of a retailer’s summer promotion of “Oklahoma-grown” fresh market vegetables. Hopefully, producers and retailers will get together and take advantage of this marketing strategy.

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**KEY FRESH MARKET VEGETABLES FOR AN
"OKLAHOMA-GROWN" SUMMER PROMOTION**

All crops shown below, except asparagus, would fit somewhere in a June through September promotion of Oklahoma-grown fresh market vegetables. Asparagus is included because it is available in many areas and would make an excellent lead-in item. All of these crops should produce an acceptable quality product under Oklahoma conditions. Virus is a threat to quality with pumpkin and summer squash, and worm damage is a factor with sweet corn (clipping may be needed).

<u>CROP</u>	<u>PRIMARY MONTHS AVAILABLE</u>	<u>MAXIMUM ESTIMATED HARVESTING PERIOD</u>	<u>APPROX. NO. OF WEEKS MARKETED FROM A SINGLE VARIETY PLANTING</u>	<u>ESTIMATED % HARVESTED PER WEEK</u>
Asparagus	April-May	3/25-6/3	10	5-9-12-12-12-12-12-12-9-5
Cabbage	May-June & Oct.-Nov.	5/15-7/7 10/15-11/25	3	25-50-25
Cantaloupe	July-Sept.	7/1-10/15	5	5-20-35-30-10
Cucumber	June-Oct.	6/3-10/21	4	30-40-20-10
Eggplant	July-Oct.	7/1-10/15	6	5-20-25-25-15-10
Okra	July-Sept.	7/1-10/15	13	3-4-5-6-8-13-14-14-13-8-5-4-3
Pepper (bell or specialty)	July-Oct.	7/1-10/21	6	12-25-25-18-12-8
Pumpkin	Sept.-Oct.	7/20-10/21	3	25-50-25
Snap Bean	June & Oct.	6/10-7/1 & 10/14-10/21	1	100
Southern Pea	July-Sept.	7/15-10/7	1	100
Summer Squash	June-Sept.	5/27-10/15	4	20-30-25-25
Sweet Corn	June-July	6/3-7/22	1	100
Sweetpotato	Sept.-Oct.	9/1-10/21	1	100
Tomato	July-Oct.	6/24-10/21	6	2-5-24-30-24-15
Watermelon	July-Sept.	7/1-10/15	3	25-50-25

Onions: Transplant Production, Varieties, and Storage Trials

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and Penny Perkins-Veazie, South Central Agricultural Research and Extension Center, USDA-ARS,
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Fresh market onions are of interest to various Oklahoma growers, including those using farmers markets, on-farm sales, and shipping to regional markets and retail outlets. Most production systems use late winter transplanting and include the use of short and intermediate day cultivars. Certain problems and needs are associated with this production. These include transplant source, cultivar selection, and short term storage. Casual observation suggests that transplant quality can vary considerably from one year to the next. Low quality factors include plants that are excessively small or large and plants that are packed wet and decay during shipment. Some cultivars suitable for Oklahoma are not available as commercial transplants, while others have been tested only in observational trials in Oklahoma. Finally, while fresh market onions are generally not intended for storage, short term storage is sometimes desirable when onions can not be marketed as quickly as they need to be removed from the field. This presentation provided an update of recent work that addressed these issues.

Trials have been conducted during the past 5 years to assess the potential for producing onion transplants in hoop-houses (alias high tunnels or cold frames). An initial trial was conducted in 2002-2003 (See Shrefler, Jim, Steve Upson, and Sam McClure. 2004) which showed that quality transplants could be grown and that these could produce good bulb yields. However, there was also some incidence of bolting. This trial was repeated in 2004-2005 as follows: Onions of the cultivars Candy and 1015Y were seeded in hoop-houses at Lane, OK on Oct. 15, 25 and Nov. 2. Seed were planted on beds in rows spaced 4.5 inches apart with about 2-3 plants per inch of row. In late February plants were removed for the houses and planted in open fields at Lane and Calvin. Percent bolting and yield were determined. Essentially no bolting was observed. Yields ranged from an estimated 23,000 lbs per acre for plants sown in the hoop-house on October 15 to 20,000 lbs per acre for plants sown on November 2.

In 2004-2005 a variety trial was conducted using hoop-house grown transplants. Data was collected on weight loss during storage at 32-34° F from July 5 until December 7. Cultivars and results are shown in Table 1. Varieties differed for bulbs of size categories 3-4 inch and >4 inch but not for smaller sizes. Total yields did not differ across treatments. Weight loss during storage did not differ across treatments. Additional data that was collected includes bolting (seed stalk formation while in the field) and bulb decay during storage. Only traces of seed stalk formation were detected. Only traces of bulb decay were observed during storage.

Additional cultivars were sown in the hoop-house in November 2005 and planted in an observational (non-replicated) trial at the Oklahoma Vegetable Research Station at Bixby. Seed were sown early to mid November, depending on cultivar, and transplanted to the field on April 4. Cultivars included 1015-Y, Candy, Cimarron, Renegade, Sequoia, Aurora, Sweet Caroline, Redline, Denali, and Cowboy. Results are shown in Table 2. Sweet Caroline is a very early variety and matured before adequate plant size was achieved. Consequently, results do not fairly represent its yield potential.

These combined studies show that hoop-house production of onion transplants is a feasible means of producing productive transplants. Bolting should not be a major concern with plants produced in this manner. Advantages of the use of hoop-house transplants include an avoidance of plant injury from exposure to undesirable conditions during harvest to delivery, and the ability to grow varieties not readily available as commercial transplants. Preliminary trials suggest that weight loss over several months may not be great when suitable storage temperatures are used. Effects of relative humidity during onion storage may also be important but we have not yet assessed this.

Table 1. Harvest and storage data for the 2004-2005 transplanted hoop-house onion variety and storage trial.

Variety	Percent of onions per sample of 20 bulbs by diameter ¹				Yield / acre (100 lbs units)	Percent weight loss during storage ²
	A	B	C	D		
1015Y	0	13.4	57.7 b	28.8 ab	228	2.5
Candy	1.6	20	65.0 b	13.3 b	195	3.5
Cimarron	17.6	22.6	34.7 c	25.0 ab	190	4.2
Renegade	3.3	8.3	81.6 a	6.6 b	205	1.8
Sequoia	0	7.9	51.5 b	40.6 a	275	1.8
Statistical Significance					Not different	Not different

¹ Bulb diameter size classes: A = 2 inches or smaller, B = 2 to 3 inches, C = 3 to 4 inches and D = greater than 4 inches. Means in a column followed by a common letter are not different based on Duncan Multiple Range test.

² Weight loss of a sample stored at approximately 32-34° F from July 5 until Dec. 7.

Table 2. Harvest data for the onion cultivar trial at Bixby.

Cultivar	Bulb diameter categories ¹				Disease Incidence ²
	(Percent of total)				
	A	B	C	D	
Aurora	0	77	23	0	M
Candy	0	40	45	15	M
Sweet Caroline	60	40	0	0	Tops already gone due to maturity
1015-Y	20	45	20	15	S
Redline	15	55	30	0	M
Cimarron	0	60	40	0	S
Denali	0	25	75	0	S
Sequoia	0	50	50	0	S
Renegade	10	35	55	0	M
Cowboy	0	45	50	5	M-S

¹ Bulb diameter size classes: A = 2 inches or smaller, B = 2 to 3 inches, C = 3 to 4 inches and D = greater than 4 inches.

² Foliar disease identified as Purple Blotch was observed in late June. S indicates severely affected onion leaves and M indicates a moderate affect.

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Chemical Profiling of Herbs as Alternative or Rotation Crops with Vegetables

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Since 2000 we have been evaluating annual herbs and expanding plantings of perennial herbs to determine their potential as alternative crops. Herb crops could fit well as a rotational crop with vegetables, particularly as extraction crops, since many of the production steps are similar to those used in vegetable production. In last year's proceedings we published fresh and air dried production potential for a number of herbs. The focus of this report is to provide information as to the chemical content of many herbs under study, to provide a basis for value of the crops for extraction markets.

Herbs vary dramatically in their chemical content and thus potential value as natural producers of chemicals. In the report that follows, in concert with a multitude of previous reports by others, plants within the same genus and species may produce markedly different chemical profiles (Italian pesto basil versus Lemon basil versus Thai basil) and/or markedly different amounts of the same chemicals ('Common' versus 'Aromata' summer savory). Since herb chemical profiles and production potential may be influenced by a multitude of external factors, our results from plants grown at Bixby may not be exactly the same as plants grown at another location or under different production practices, but they do serve as a point of reference for those interested in considering herbs as an alternate or rotational crop.

Crop culture, harvest and pre-extraction processing: Seed sources and varieties will be presented in the crop summaries. Crop results are presented for the 2005 and/or 2006 cropping seasons. In both years soil tests indicated adequate phosphorus, potassium and micronutrients, but very low nitrogen, and crops were fertilized preplant with 40 pounds of nitrogen per acre using urea. A top dress application of an additional 40 pounds of nitrogen per acre using urea was applied about one month after planting. All annual crops were planted in 2005 in late April and in 2006 in early May (following a failed planting in mid-April) using a Monosem vacuum planter. Summer savory was planted in 4 row beds (12 inch between row spacing) and a targeted plant density of 4 to 6 plants per linear foot of row. Basils were planted in 2 row plots with row spacing of 36 inches and a targeted plant spacing of 2 to 3 plants per linear foot of row. Oregano (established in 2002), winter savory and thyme (established in 2005) were established from transplants in two row plots with 36 inch between row spacing and 18 inch within row plant spacing. Plots were watered as needed from overhead sprinklers with approximately ½ inch water per application. Harvest was conducted with a Kincaid self propelled greens/forage harvester and harvested material was conveyed into plastic lugs. Harvester cutting height was set at 10 inches for all basils except 'Sweet Thai', which was cut at 6 inches; summer savories were harvested at 6 inches; winter savory and thyme was harvested at 10 inches and oregano was harvested at 12 inches. Total harvested weight was obtained and a sub-sample of 7 to 10 pounds (2 plastic lugs) from each plot was placed into a cooler at 50 F. The contents of each lug was placed into a plastic bag, overlaid with ice inside a cooler and transported to Stillwater. Samples were held at 50 F overnight, and were then weighed, washed to remove soil and other debris, spin-dried in a greens washer and placed onto cheesecloth. The cheesecloth was then tied to contain the samples and dried for five days at 74 to 80 F in a Proctor-Shwartz forced air drier. Moisture content was determined for all samples and results are presented on a dry weight basis.

Extraction and chemical profile analysis: Dried samples were ground to a fine powder using a Udy cyclone mill and duplicate samples were accurately weighed (500 mg for basil, 200 mg for ‘Common’ summer savory and thyme, and 50 mg for ‘Aromata’ summer savory, oregano and winter savory) and extracted with stirring for 20 min with 4 ml of hexane. Just prior to extraction, thujone (a chemical not present in the crops studied) was added to allow for extraction recovery determination. Samples were centrifuged and decanted into a clean pre-weighed vial and the extraction process was repeated two more times for a total of three extractions. Hexane extracts were weighed to determine volume and a predetermined amount was added to 2-heptanol (another chemical not naturally present in the crops studied) just prior to analysis, then injected onto a gas chromatograph. Individual chemical components were identified according to coelution with authentic standards and their quantities were determined in comparison to the authentic standards, relative to 2-heptanol. Although many chemicals were found in samples, only the major chemicals are reported in the tables that follow.

Basil chemical profiles and chemical production potential: Chemical profiles for six basil varieties (‘Genovese’, ‘Italian Large Leaf’ and ‘Sweet Thai’, *Ocimum basilicum*; ‘Mrs Burns’ Lemon’, *Ocimum basilicum citriodora*; ‘Lime’, *Ocimum americanum* – all from Johnny’s Seed Co. and ‘Ethiopian’, *Ocimum basilicum* – a privately acquired line) are shown in terms of concentration (mg per lb dry weight) in table 1. Classified according to typical use/aroma characteristics these basil varieties fall into 3 broad groupings: a) typical pesto-type basil – ‘Genovese’ and ‘Italian Large Leaf’, b) citrus flavored – ‘Mrs. Burns’ Lemon’ and ‘Lime’, and c) regional specialty basil – ‘Sweet Thai’ and ‘Ethiopian’ (very similar to ‘Egyptian’). Chemical concentrations in bold type face denote chemicals of notably highest concentration for the variety, and can be used to compare the varieties. The pesto type basil contained higher concentrations of the two impact chemicals eugenol and linalool, with ‘Italian Large Leaf’ containing slightly less of these chemicals but substantial quantities of methyl chavicol not found in ‘Genovese’. The only other basil containing substantial amounts of eugenol was ‘Ethiopian’, with about 10 times or more eugenol than the pesto type basil. Eugenol imparts a clove-like smell and flavor to basil, has important health-promoting properties and is an effective antimicrobial, and perhaps nematocidal, agent. Methyl chavicol imparts an “anise-clove” flavor, differentiating the two pesto basil, imparting a very unique flavor in combination with the extremely large eugenol content of ‘Ethiopian’ basil and resulting in the distinctive anise flavor of ‘Sweet Thai’ basil. The citrus flavored basil both contained substantial quantities of geraniol and neral (collectively referred to as citral), and differed most substantially in terms of linalool concentration – ‘Mrs Burns’ Lemon’ basil contained a substantial quantity of linalool whereas ‘Lime’ basil did not.

We have summarized annual production potential (gm per acre) using data from five basil varieties (all noted above except ‘Lime’ basil) grown during the 2005 season in table 2. Our 2006 planting was very irregular in terms of stand establishment and herb yield data was considered non-usable. Our 2005 data represents cumulative yield from 6 individual harvests. Although space in this report does not allow presentation of chemical production within all basil at each harvest, we did notice a striking difference. In terms of in-season production potential, the impact chemicals fell into two categories: those that tended to peak in production about mid-season (mid August) and then decline (cineole, linalool, α -terpineol, β -caryophyllene and humulene) and those that continued to increase throughout the season (October harvest numbers were higher than early July and mid August; methyl chavicol, geraniol, neral and eugenol). Looking at total impact chemical production potential alone, the basil varieties fall into two broad categories: those preferentially accumulating one chemical (‘Ethiopian’ – eugenol, and ‘Sweet Thai’ – methyl chavicol) and those accumulating multiple chemicals (‘Mrs. Burns’ Lemon’ – geraniol, neral and linalool, ‘Genovese’ – eugenol and linalool, and ‘Italian Large Leaf’ – linalool, methyl chavicol and eugenol).

Summer savory, winter savory, oregano and thyme chemical profiles and chemical production potential: Chemical profiles for two summer savories ('Common' and 'Aromata', *Satureja hortensis*, Johnny's Seed Co.), one winter savory ('Winter', *Satureja montana*, Johnny's Seed Co.), one oregano ('Turkish', *Origanum vulgare*, Prairie Wind Nursery) and one thyme ('German Winter', *Thymus vulgaris*, Johnny's Seed Co.) is shown in terms of both concentration (mg per pound) and production potential (gm per acre) in table 3. The summer savories are annual crops and data is provided for the 2005 harvest season – our 2006 plots were abandoned due to poor field emergence. Winter savory and thyme were established from transplants as perennial crops in 2005 and first harvested in 2006. The oregano plots were established in 2002. The oregano, winter savory and thyme yields were extremely low because of the hot and dry weather conditions prevailing in 2006 and a severe insect infestation which prevented a third harvest that should have occurred in early September.

The most notable difference between these crops and basil was comparatively fewer impact chemicals, with predominance of carvacrol and, in one case thymol, in these crops. Turkish oregano produced the highest concentration and overall yield of carvacrol. Carvacrol has value as a natural antimicrobial agent, with activity against both fungi and bacteria. Extracts from Turkish oregano have shown good activity against pathogenic *E. coli* bacteria. The savories produced substantial quantities of carvacrol. Winter savory had the highest savory carvacrol concentration, but due to very low yield in 2006 it produced the least on a per acre basis. 'Aromata' summer savory contained over twice the concentration of carvacrol than 'Common', and even though it yielded only half that of 'Common' it produced more carvacrol on a per acre basis. Thyme was the only crop producing substantial quantities of thymol – the extremely low yield in 2006 resulted in very low production potential. We are hopeful that yields for the perennial crops will increase in seasons to come.

Prospects for the future: All of the basil appear to have good production potential in Oklahoma, with fresh yield potential in excess of 60,000 lbs per acre. If eugenol is desired, 'Ethiopian' basil appears to have promise; if methyl chavicol is desired, "Sweet Thai" basil may be of interest. A basil (or other herb) extract may also have value as a natural flavoring, in which case each basil (or herb) would be judged on its own merits. Turkish oregano produced almost four times more carvacrol than the savories and could have potential as a carvacrol source. Turkish oregano has potential as a carvacrol-rich crop – we plan to expand our planting in 2007 to continue its evaluation as a new crop with potential for production in Oklahoma.

Table 1. Average concentration (mg per pound) for impact chemicals extracted from six air dried basils.

Impact chemical	Genovese	Italian Large Leaf	Mrs. Burns' Lemon	Lime	Ethiopian	Sweet Thai
Cineole	15	9	1	1	58	12
Linalool	108	75	154	14	1	1
α -Terpineol	5	2	1	3	10	7
Methyl Chavicol		74		1	107	365
Geranial			204	293		
Neral			192	270		
Eugenol	102	41			984	1
β -Caryophyllene	1	1	48	35	26	3
Humulene	3	2	8	5	26	10

Table 2. Annual production potential (g per acre) for impact chemicals from five basil cultivars.

Impact chemical	Genovese	Italian Large Leaf	Mrs. Burns' Lemon	Ethiopian	Sweet Thai
Cineole	102	60	8	392	106
Linalool	728	507	1040	6	6
α -Terpineol	31	10	8	66	58
Methyl Chavicol	2	501		718	3126
Geranial			1382		
Neral			1301		
Eugenol	1229	275		6601	2
β -Caryophyllene	7	5	325	174	22
Humulene	18	16	55	177	85
2005 dry seasonal production (lb/ac)	6745	6760	6768	6707	6556

Table 3. Average concentration (mg per pound) and production potential (gm per acre) for impact chemicals extracted from various air dried herbs.

	Summer Savory		Winter Savory	Oregano	Thyme
Impact chemical	Common	Aromata	Winter Savory	Turkish	German Winter
Concentration in mg/lb dry wt					
Carvacrol	307	793	1386	3234	57
Thymol			11		519
β -Caryophyllene	8	20	36	46	20
Production potential in gm/ac					
Carvacrol	1246	1466	1091	4414	7
Thymol			9		62
β -Caryophyllene	32	38	29	63	2
Cummulative seasonal production (lb/ac)	4057 (2005 season)	1848 (2005 season)	787 (2006 season)	1365 (2006 season)	120 (2006 season)

Vegetable Posters

A Production Handbook for New Growers of Horticulture Food Crops

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Background and basis: The title of this new publication will be “Oklahoman’s guide to growing fruits, nuts & vegetables”. The guide will include essential information on 33 vegetables, 10 fruit crops and pecans. The approach used for the publication will be similar to a cookbook with most information presented as bulleted lists of standard items for each crop and a minimal amount of narrative. Topics will include: Critical production points; Varieties; Soil preferences; Ideal growing conditions; Establishment; Fertilization; Irrigation; Pest management; Harvest; Shipping & storage. The targeted users include small-scale & new growers, county extension educators, and established growers trying new crops. Plans are to publish in spring 2007. Planned delivery methods include a printed document, web-based PDF, and a PDF on CD.

A survey taken at the 2007 Horticulture Industry Show asked people to take a look at a sample book and then fill out a simple survey and make additional comments. The ratings and comments follow in the table below.

Ratings on Guide to Growing Fruits, Nuts, & Vegetables	
Topics	Rating scale (0 to 5 with 0 = stinks, 5 = best)
Title headings	4.0
Tab markers	3.9
Note space	3.9
Font size	3.1
Binding	2.6
Physical size	4.4
Usefulness of crop information	4.4
Note placement	4.0
Adequate references	4.0
Conversion table usefulness	4.1
Ease of use	4.7
Additional comments included: Need to add a common problems topic, need a better binding for the printed version, good approach to the document and good to have web-based additional references, needs more specifics regarding weed control, easy to use, but needs crops listed alphabetically in each section, good introductory publication that includes other references for more in-depth information, where can it be purchased.	

Exclusion of Deer and Yield of Dry Bean

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Dry navy beans (*Phaseolus vulgaris* L.) are a source of protein for the human diet. Yields worldwide range from 0.25 to more than 1 t/a (0.56 to 2.4 Mg-ha⁻¹), but good yields in the United States are closer to 1 t/a. Research on navy bean has been conducted for several years at SCARL. However, yields have been inconsistent, and are more likely to be on the lower end of the yield potential. Plants appear to be healthy during the growing season, and do not present symptoms of nutrient deficiency, disease, or insect infestation. The reasons for this inconsistency are likely due to environmental factors. A problem that confounds determination of yields is grazing by deer. An experiment was established to determine how the deer population in the region of the laboratory affects yield.

Seed of the navy bean cv. Aspen were sown in a sandy-loam soil in a 1-acre field. The soil was pre-plant fertilized with sufficient amounts of a NPK material to support dry bean production. Rows were on 3 ft centers and in-row plant spacing was 2 in. The herbicide Dual was applied preemerge. After plants emerged, exclusion cages were placed around six areas in the field that were chosen at random. The cages were constructed from chicken wire supported on rebar driven in to the soil and protected 6 linear feet of row. An equal length of row, immediately adjacent to the caged length of row, was designated for comparison to the protected row. Irrigation was applied as needed through seed filling, and stopped after that point so pods could dry. The field was scouted during the growing season for evidence of deer grazing.

When about 80% of leaves had dropped, cages were removed, and pods were harvested from plants in protected and un-protected areas. Seed moisture at that time was between 13 and 15%. Seed were separated from pods and weighed. During the growing season deer tracks were found between rows of plants in all areas of the field. It appeared that the deer traveled the length of the rows as they fed. Unprotected plants exhibited evidence of grazing beginning shortly after flower formation. The youngest leaves and the flowers appeared to be the preferred graze. It was determined that yields from protected plants were about 20% greater than those from plants that were in unprotected portions of the rows (Fig. 1).

Although yields were higher from plants that were protected, they were still below desired levels of 1 T/Ac. It was obvious that deer presence affected dry bean yield, but grazing does not account for all of the reduction in yield. Previous work with bean at Lane that examined fertilizer levels, irrigation timing and plant density in bean cultivars have not produced an acceptable level of yield. Protecting beans from grazing by deer increased yield but did not bring them to acceptable levels.

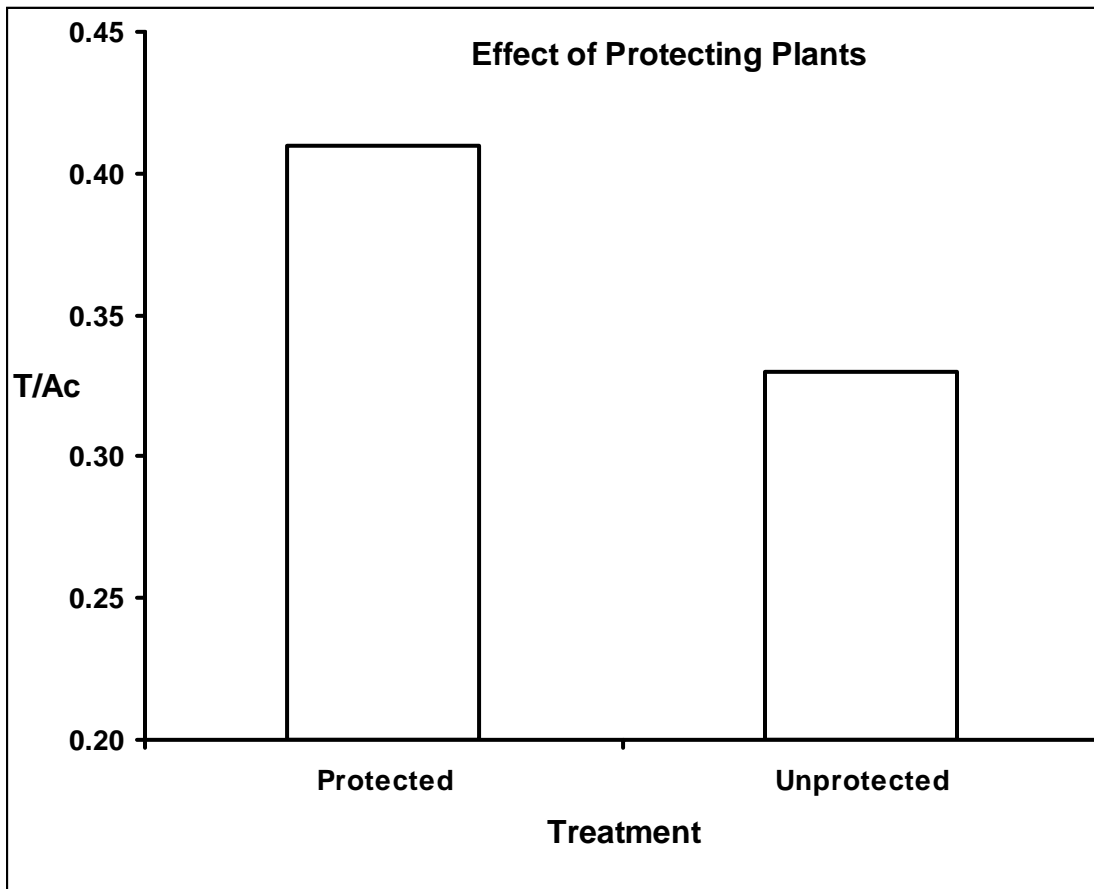


Figure 1. Seed yield of navy bean harvested from plants protected by chicken wire mesh cages and unprotected plants from adjacent portions of the row.

A Not so Funny Thing Happened on the Way to the Salad Bar (Safety of Fresh Greens for Consumers)

L. Brandenberger, W. McGlynn, L. Wells: Dept. Horticulture & L.A

The safety of fresh produce is extremely important for the U.S. food system. In the past, food-borne disease outbreaks made the news much less often. Recently, however, both the frequency of food-borne disease outbreaks and the publicity surrounding them have increased dramatically. In the time period between 1970 and 1997 the consumption of fresh fruits and vegetables increased 24% from 577 to 718 lbs per person. Unfortunately food-borne illness linked to fresh produce has also increased. In the twenty five year period between 1973 and 1998 food-borne illness associated with fresh produce increased 4 times.

A good example of what can occur is the recent food-borne outbreak caused by eating contaminated fresh spinach. Between August 23rd and October 6th 199 cases of illness were reported, with 3 to 4 deaths attributed to the outbreak. The pathogen involved was E. coli O157:H7, which was carried on washed-bagged fresh spinach. This was verified when a bag of spinach was found in a victim's refrigerator that contained the pathogen.

The outbreak not only resulted in many people becoming ill and a few tragic deaths it also severely affected the fresh spinach industry. Sales of bagged spinach fell by 80% and estimated losses to growers and packers of this product alone are expected to be up to 100 million dollars. No sign of E. coli O157:H7 was ever found in the packing plant, but Centers for Disease Control investigators did trace the genotype of the pathogen to a nearby cattle ranch. Investigators surmise that the pathogen may have been moved into the spinach field by feral pigs or deer.

So what are some of the lessons that we can learn from this latest food-borne illness tied to fresh produce? First, a relative handful of packing companies are washing and packing bagged spinach that is being sold under many different labels. This causes confusion and makes it more difficult for investigators to determine what is happening when an outbreak like this occurs. It also suggests that there is an opportunity for more diversification of products and production in the industry. Such diversification would likely reduce the number of people affected by food-borne illness outbreaks and may provide enhanced opportunities for more local production and processing. The second point is that although the outbreak was tied to a single operation, the entire fresh spinach industry suffered badly. The black-eye that the industry received from this incident will take some time to recover from. It also points out the the truth of the old adage that if something can go wrong it will. Therefore it behooves the fresh produce industry to make certain that it has a good plan in place to deal with similar disasters in the future. Following Good Agricultural Practices (GAP's) including good site selection and understanding how a system-based approach works will help reduce the number of future outbreaks. We've all been told that it is impossible to clean-up contaminated fresh produce, and this latest disease outbreak has once again driven the point home.

Information used to develop this presentation includes the following sources:

Food Safety Begins on the Farm a Grower's Guide
Cornell University, CSREES, USDA, FDA

Food Safety Begins on the Farm: a grower self assessment of food safety risks
Cornell University, CSREES, USDA, FDA

Guide to Minimize Microbial Food Safety Hazards for Fresh Fruits and Vegetables
USDA, FDA

The Packer Newspaper for the Produce industry

Centers for Disease Control & Prevention “CDC”
<http://www.cdc.gov/ecoli/2006/september/updates/100606.htm>

Organic Markets: Growing Consumer Demand Creates Producer Marketing Opportunities.

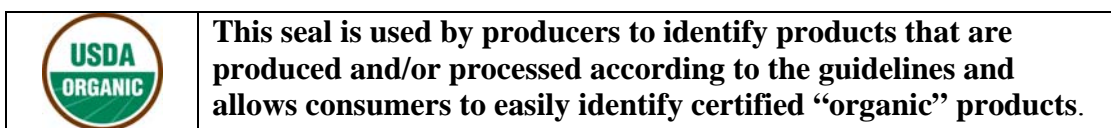
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A recent report estimates that the organic food market is the fastest growing sector in the United States' food industry. This poster examines this market segment by discussing the organic market's rapid growth and listing educational resources to increase producer and consumer knowledge of this rapidly emerging market. These objectives are accomplished by discussing USDA's National Organic Program, statistics describing the size of the industry, and results of an on-line survey of Extension professional perceptions about the organic market.

USDA regulates the organic market through its National Organic Program. The National Organic Program (NOP) regulations were developed to ensure that organically labeled products meet consistent national standards. For additional information on organic guidelines visit the program's website at <http://www.ams.usda.gov/nop>. The website contains many resources which include production guidelines, labeling restrictions, and a listing of certifying agents. Certifying agent ensures that a farm's production practices meet NOP standards. The agents' approval process includes developing and reviewing the producer's farm plan and a site visit to the operation.

According to USDA regulations, foods that are sold, labeled, or represented as organic must be produced and processed in accordance with NOP standards. Farm and processing operations that grow and process organic foods must be certified by USDA-accredited certifying agents, except for operations whose gross agricultural income from organic sales totals \$5,000 or less. A certified operation may label its products or ingredients as organic and may use the "USDA Organic" seal:

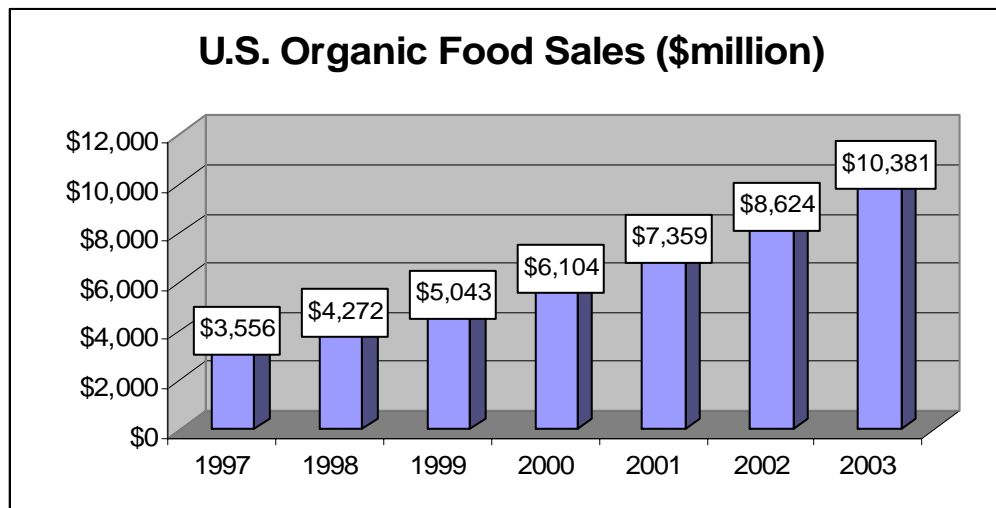


With an increased focus on healthy eating combined with the rise in the popularity of farmers' markets and other direct marketing outlets (fresh produce consumption), organic markets presents an opportunity for today's producers interested in niche marketing opportunities. According to a 2004 on-line survey of Extension faculty with statewide responsibilities, 18.6 percent of those responding indicated an increase in client requests for sustainable agriculture educational material. Additionally, 42.6 percent of the responding faculty indicated "very interested" in terms of their personal interest in organic agriculture. Some additional highlights from the survey:

- **83.3%** of the respondents indicated a professional interest in organic agriculture
- **71.1%** of the respondents expressed a professional interest in developing new markets for farmers

- **81.3%** of those surveyed agree that there is a need to increase research for organic agriculture at the University of Arkansas
- **79.6%** of those surveyed agree that there is a need to increase Extension efforts for organic agriculture at the University of Arkansas

In 1997 organic products accounted for just under \$3.6 billion in sales. In 2003, that number increased to over \$10 billion. Figure 1 details the growth in organic food sales over the last decade. These estimates represent an increase of over 286% for the seven-year period. The growth rate of organic food sales as a percent of total food sales is similar. In 1997 organic foods represented 0.8 percent of total food sales, but by 2003 the percentage had grown to 1.9 percent. In 2003 U.S. total food sales totaled \$554 billion, so the organic sector is still only a small segment of total sales. Today, over 20,000 natural food stores and 73 percent of conventional grocery stores carry organic food products (Amber Waves, USDA).



Source: Economic Research Service, USDA.

The rapid growth in the organic food sector provides an emerging marketing opportunity for agricultural producers. Additionally, these markets offer price premiums over conventional products, providing opportunities for producers to generate relatively higher incomes. Because it is a specialty, niche market involving more direct sales, organic producers are able to capture relatively higher prices.

Potential Herbicides for Use in Cilantro

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Background and objective: Cilantro is being investigated as an alternative crop in Oklahoma. Weed control in this crop is limited to pre-plant applications of postemergence herbicides because no preemergence herbicides are labeled for use within the state on the crop. Due to the lack of labeled herbicides, the objective of this study was to identify and begin development of pre & post herbicides for use in this crop.

Methods: The study was completed in spring 2006 at the Oklahoma Vegetable Research station in Bixby, Oklahoma. Study design was a randomized block design with four replications that included 19 herbicides in 26 treatments and untreated and weeded checks (Table 1). On 4/17/06 two pre-plant incorporated treatments were applied (hand-boom CO₂ sprayer) and incorporated (tractor drawn rototiller) then cilantro (Johnny's cultivar 'Santo') was direct seeded with a pneumatic planter (Monosem Inc.) in four rows on 12 inch row centers. Preemergence treatments were applied on 4/18/06 to previously planted plots and irrigated immediately following with 0.5 inches of overhead irrigation to incorporate all treatments. Postemergence treatments were applied on 5/17/06 to previously planted plots with crop plants in the 4 true-leaf stage of growth. Plots received a total of 70 lbs/acre of nitrogen in three split applications on 5/02/06, 5/15/06, and 5/25/06. Supplemental water for the study was provided through overhead irrigation with the study area receiving 1 to 2 inches of water per week. Preemergence crop injury ratings were recorded on 5/05/06 and 5/18/06, efficacy ratings and plant counts on 5/30/06, and yield on 6/15/06. Postemergence crop injury ratings were recorded on 5/24/06, efficacy ratings and plant counts on 5/30/06, and yield on 6/15/06

Discussion: The goal in any screening study is to identify compounds that will control weeds while not damaging the crop enough to reduce yields drastically compared to the weeded check. In this study, four preemergence compounds appear to have potential to do that. Barricade, Define, KIH 485, and Prowl H₂O injured the crop very little (0 to 16%), but it appears that Palmer amaranth control could be improved (61 to 86%). The authors would conclude that future studies should be undertaken to determine if higher rates of these compounds would result in higher levels of weed control and thereby higher yields, or if higher rates would injure the crop more, thereby reducing yields further. For postemergence weed control, Lorox appears to be very effective and safe for use in cilantro. The authors would recommend further study of Lorox to determine the optimal rate and timing of applications for this herbicide on this crop.

A more detailed report is in the 2006 Vegetable Trial Report MP-164 available on line at:
<http://www.okstate.edu/ag/asnr/hortla/vegtrial/index.htm>.

Table 1. Spring 2006 Cilantro pre emergence weed control, Bixby, OK.

Treatment lbs ai/acre	Number plants ^z	Injury % ^y		Palmer amaranth control % ^x	Yield lbs./acre ^w
		5/5/06	5/18/06		
Untreated check	11 a-f ^v	0 g	0 e	0 i	1144 c-f
Weeded check	15 a-d	0 g	0 e	100 a	3032 a
Aim 2 EC 0.03 + Dual Magnum 0.65	9 a-f	13 e-g	8 e	94 ab	1342 c-f
Aim 2 EC 0.015 + Roundup 1.0 + Dual Magnum 0.65	11 a-f	14 d-g	18 c-e	79 a-d	877 c-f
Barricade 4FL 0.66	15 a-c	0 g	4 e	86 ab	2724 ab
Define DF 0.3	6 c-f	11 e-g	18 c-e	61 b-f	685 c-f
Define DF 0.6	15 a-d	6 e-g	10 e	86 ab	1696 b-d
Dual Magnum 0.65	15 a-d	19 c-g	14 de	91 ab	1255 c-f
Dual Magnum 0.65 + Nortron 0.164 post + NIS .25% post	12 a-e	20 c-g	19 c-e	85 ab	1063 c-f
Kerb 1.0	5 d-f	36 a-c	35 b-d	28 f-i	325 d-f
Eptam 7E (PPI) 1.3	10 a-f	10 e-g	11 e	9 hi	256 ef
Eptam 7E (PPI) 3.5	5 c-ef	23 c-f	10 e	40 e-h	122 f
Far-Go 1.25	15 a-d	3 fg	3 e	19 g-i	743 c-f
Far-Go 1.5	8 a-f	5 e-g	3 e	24 g-i	529 c-f
KIH 485 60 WDG 0.05	9 a-f	9 e-g	16 c-e	85 ab	1824 bc
KIH 485 60 WDG 0.15	3 ef	25 b-f	39 bc	100 a	430 c-f
Lorox 0.1	16 ab	4 e-g	3 e	44 d-h	1196 c-f
Lorox 0.2	12 a-e	15 c-g	5 e	20 g-i	627 c-f
Nortron 0.5	9 a-f	0 g	6 e	23 g-i	749 c-f
Nortron 1.0	9 a-f	20 c-g	6 e	14 g-i	383 d-f
Outlook 0.125	11 a-f	3 fg	10 e	38 e-h	1063 c-f
Outlook 0.5	3 ef	48 a	65 a	89 ab	93 f
Prowl H ₂ O 0.5	17 a	10 e-g	9 e	61 b-f	1597 b-e
Command 3ME 0.375	12 a-f	26 b-e	9 e	41 e-h	970 c-f
Command 3ME 0.75	10 a-f	35 a-d	20 c-e	11 g-i	70 f
Everest 0.01	11 a-f	13 e-g	13 de	48 c-g	500 c-f
Goal 1.6 EC 0.25	2 f	45 ab	44 b	71 a-e	93 f
Spartan 0.05	6 b-f	21 c-g	23 b-e	81 a-c	1260 c-f

^zNumber plants=actual number of cilantro plants in 0.5 meter².^yInjury=visual ratings of injury based on percentage scale.^xPalmer amaranth (*Amaranthus palmeri* S. Wats.) control ratings on 5/30/06.^wYield in lb fresh weight/acre 6/15/06.^vNumbers in a column followed by the same letter exhibited no significant differences based on Duncan's Multiple Range Test where P=0.05.

Table 2. Spring 2006 Cilantro post emergence weed control, Bixby, OK.

Treatment lbs ai/acre	Number plants^z	Injury (%)^y	Palmer amaranth (% control)^x	Yield (lb/acre)^w
Untreated check	11 c ^y	0 c	0 d	738 cd
Weeded check	15 bc	. .	100 a	3032 a
Kerb 1.0	16 bc	0 c	6 cd	1069 cd
Lorox 0.1	16 bc	0 c	61 b	3177 a
Lorox 0.2	27 a	1 c	89 a	2974 ab
Outlook 0.125	29 a	0 c	34 c	2021 a-c
Outlook 0.25	21 a-c	0 c	31 c	1650 a-c
Outlook 0.5	19 a-c	0 c	33 c	1615 a-c
Prowl H ₂ O 0.5	22 ab	0 c	29 c	1388 b-d
Stinger 0.09	0 d	66 b	14 cd	0 d
Stinger 0.188	0 d	71 a	16 cd	0 d

^zNumber plants=number of cilantro plants counted in 0.5 meter² on 5/30/06.

^yInjury= visual ratings of injury based on percentage scale on 5/24/06.

^xPalmer amaranth (*Amaranthus palmeri* S. Wats.) control ratings on 5/30/06.

^wYield in lb fresh weight/acre 6/15/06.

^vNumbers in a column followed by the same letter exhibited no significant differences based on Duncan's Multiple Range Test where P=0.05.

Specialty Melons in Oklahoma

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Background and objectives: Cucurbits in all shapes and sizes are grown for market and consumption in Oklahoma. Fresh market producers, particularly those that sell through local farmers markets have indicated that they are interested in being able to see specialty melons in the field and possibly to have replicated trials carried out in the future. The objective of this demonstration was to provide an opportunity for growers to observe several types of less common cucurbits that may hold promise for direct marketing and to observe these for potential for replicated trials in the future.

Methods: The trial was completed in summer 2006 at the Oklahoma Vegetable Research station in Bixby, Oklahoma. It was direct seeded on 6/16/06 with no randomization or replication. Plot length was 20 feet long with between-row spacing of 12 feet. The trial was thinned to an in-row spacing of 2.5 feet between plants. The study area received 45 lb/acre of nitrogen from urea (46-0-0) on 6/23/06 and was drip irrigated throughout the season. Weed control included a tank-mix of Curbit at 0.75 lb ai/acre plus Sandea at 0.016 lb ai/acre applied on 6/19/06, followed by cultivation and a layby application between rows of Sandea at 0.024 lb ai/acre on 8/01/06. Plots were harvested multiple times during August.

Discussion: Melon qualities were rated on 8/22/06 with results in table 1. The taste of the melons was rated on a 0 to 10 scale with 0 representing poor taste and 10 representing desirable taste. Visa, Vicar, and Galileo all had ratings of 6.5 or above with Visa having the highest rating with a 7.7. Exterior color was rated on a 0 to 10 scale with 0 representing poor color and 10 representing best color. Sensation had the highest exterior color rating at 7.4 followed by Vicar and HiBrix having 7.3 and 7.1, respectively. No differences were recorded for interior color. Overall ratings were also on a 0 to 10 scale and represent a combined rating that gives some indication of a melon's consumer appeal. Visa had the highest overall rating with a 7.4 and was followed by Galileo and Sensation, both with 6.8, indicating that these melons had good consumer appeal. Average fruit weight ranged from 2.8 to 7.3 lb/fruit (Table 2). Three cultivars had fruit weights above 5 lbs., these were HiBrix, Lilly, and Sancho which had fruit weights of 6.3, 7.3, and 6.6 lb, respectively. Smaller fruited types with average fruit weights of less than 4 lbs included Duke, Galia Max, HSR 4028, HSR 4296, Passport, and Vicar. Sweetness was measured at one harvest with a hand-held refractometer. Percent soluble solids ranged from 4.3 to 13.8% for cultivars in the trial.

The objective of this trial was to provide an opportunity to observe several specialty melon cultivars and to determine if further trials would be justified. Based upon the interest of producers at and following the 2006 field day, further testing of Galia type melons will be carried out in the future in replicated trials.

Table 1. 2006 Speciality melon quality measurements including: taste, exterior and interior color, and overall quality ratings Bixby, OK.

Variety	Category	Company	Taste ^z	Exterior color ^z	Interior color ^z	Overall rating ^z
Courier	Galia	Hollar	4.1 ef ^y	5.5 cd	5.4 a	5.0 bc
Duke	Ananas	Hollar	4.1 ef	6.4 abcd	6.3 a	4.9 bc
Galia Max	Galia	Hollar	1.5 g	4.9 d	4.9 a	3.0 d
Galileo	Galia	Syngenta	6.5 ab	6.7 abc	6.6 a	6.8 ab
HiBrix	Canary	Rupp	4.7 cdef	7.1 ab	5.6 a	5.0 bc
HSR 4028	Galia	Hollar	5.9 bcd	6.6 abc	6.4 a	6.3 abc
HSR 4296	Speciality	Hollar	5.2 bcde	6.2 abcd	5.9 a	5.9 abc
Lilly	Crenshaw	Rupp	4.4 def	5.8 bcd	6.1 a	4.6 cd
Passport	Galia	Hollar	3.4 f	6.0 abcd	5.9 a	5.3 bc
Sancho	Piel de Sapo	Syngenta	4.5 def	6.6 abc	5.9 a	5.1 bc
Sensation	Speciality	Hollar & Twilley	6.3 abc	7.4 a	6.5 a	6.8 ab
Vicar	Galia	Syngenta	6.5 ab	7.3 ab	6.6 a	6.5 abc
Visa	Galia	Hollar	7.7 a	6.9 abc	6.5 a	7.4 a

^z All ratings based on a 0-10 scale, 10 being best.

^y Numbers in a column followed by the same letter exhibited no significant differences based on Duncan's Multiple Range Test where P=0.05.

Table 2. 2006 Speciality melon average fruit size, largest harvest date, Soluble solids, Bixby, OK

Variety	Category	Company	Avg. Fruit size (lbs.)	Largest harvest	Soluble solids ^z
Courier	Galia	Hollar	4.2	8/18	4.3
Duke	Ananas	Hollar	3.4	8/18	7.3
Galia Max	Galia	Hollar	3.7	8/18	9.0
Galileo	Galia	Syngenta	4.2	8/14	8.9
HiBrix	Canary	Rupp	6.3	8/23	13.0
HSR 4028	Galia	Hollar	2.8	8/18	10.2
HSR 4296	Speciality	Hollar	3.1	8/14	11.0
Lilly	Crenshaw	Rupp	7.3	8/29	NA
Passport	Galia	Hollar	3.7	8/18, 8/23	8.0
Sancho	Piel de Sapo	Syngenta	6.6	8/23	5.0
Sensation	Speciality	Hollar & Twilley	4.3	8/18	13.8
Vicar	Galia	Syngenta	3.5	8/23	8.2
Visa	Galia	Hollar	4.1	8/23	8.0

^z Soluble solids=percent soluble solids using a refractometer. One melon sampled on each variety on 8/23/06.

Hydrogen Peroxide as a Soil Amendment for Greenhouse Nasturtium Production (Tropaeolum majus L.)

Charles L. Webber III¹, Steven Sandtner², and Charles L. Webber Jr.³

Introduction

Hydrogen peroxide, H₂O₂, is a highly reactive oxidizing agent naturally occurring in plants and animals. Research has shown that hydrogen peroxide reacts to abiotic and biotic stressors to protect plants (Hung et al., 2003). Plants produce hydrogen peroxide to destroy either infected plant cells or pathogens within a plant. This compound acts as a stress signal to plants and a regulator for gene expression to deal with abiotic and biotic stressors (Prasad et al., 1994; Desikan et al., 2003; Hung, et al., 2005). In addition to its use as a topical disinfectant for humans and in water purification, hydrogen peroxide is approved for the control of microbial pests, fungi and bacterial that cause plant diseases (EPA, 2007). It is labeled for greenhouse and nursery crops as an algaecide and fungicide (Altland, 2006). In greenhouse and nursery crop production, hydrogen peroxide can prevent infestations of moss, algae, and liverwort by controlling the spores of these pests (Altland, 2006). It is applied as a foliar spray, as a dip for cuttings and roots, and as a pre-planting soil treatment to prevent or control plant pathogens (EPA, 2007). There is ample evidence documenting the effectiveness of this compound as a pesticide and a signaling agent to increase a plant's biotic and abiotic stress tolerance (i.e. chilling tolerance) (Prasad et al., 1994). There are also anecdotal reports that hydrogen peroxide provides additional growth benefits beyond its actions related to plant infection or plant stress. Anecdotal reports by hydrogen peroxide promoters, gardening groups, and newspaper articles suggest that hydrogen peroxide watering solutions (1 to 20 tsp hydrogen peroxide/gallon) will produce greater foliage, root, and flower production for greenhouse and house plants. The objective of this research was to determine the effect of soil applications of hydrogen peroxide solutions on plant growth and flowering.

Nasturtiums (*Tropaeolum majus* L.) were selected to evaluate the impact of hydrogen peroxide on plant growth and flower production. These plants are native to South America and were introduced to the United States by the English during Colonial times after Spanish conquistadors brought the plants to Europe from South America. They are hardy, fast-growing, ornamental plant with brightly colored flowers that have been long-treasured for their medicinal and culinary characteristics. Nasturtiums were a favorite of Thomas Jefferson (Hatch, 2000) and Claude Monet (Gilbert, 2007). Jefferson grew large areas of nasturtiums in his vegetable garden each year, the leaves were harvested for greens, the flowers for salads, and the seeds as a pepper substitute (Hatch, 2000).

Material and Methods

Greenhouse Set-Up

Nasturtium cv. Scarlet Glean Improved⁴ seed were sown into speedling⁵ trays containing LC1⁶ organic soil mix on January 11, 2006. On February 7, 2006, 27 days after planting, individual nasturtium

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⁵ Speedling Mfg. Inc., P.O. Box 7238, Sun City, FL 33586-7238

seedlings were transplanted into 120 4-in diameter pots containing LC1 soil mix. After transplanting and during a 1-week establishment period, the transplants were uniformly watered and fertilized (2-3-1, %N-%P₂O₅-%K₂O, Fish & Seaweed Fertilizer⁷ at 2.2 oz/1 gallon).

On February 14, 2006, 80 plants of uniform height and development were randomly divided among 8 replications with 10 plants per replication. Two plants within each replication were randomly assigned to the 5 experimental treatments. The 5 experimental treatments included 3 hydrogen peroxide treatments (1X, 10X, and 20X) and 2 controls (tap and distilled water). The 1X (0.005% H₂O₂), 10X (0.05% H₂O₂), and 20X (0.1% H₂O₂) solutions are equivalent to 1.3, 13, and 26 tsp/gallon of 3% hydrogen peroxide⁸. The hydrogen peroxide treatments were prepared by adding 3% hydrogen peroxide to distilled water. The treatment solution was applied as a soil drench to the growing nasturtiums for either 22 days (Feb 14 to March 8) or 33 days (Feb 14 to April 3) until plant harvest. The same volume of solution was applied to each treatment and allowed to drain.

Data Collection

One plant from each treatment per replication was harvested at 22 days and 33 days after initiating treatment (DAIT). Each harvested plant was cut at the soil surface and separated into either foliage or roots. The soil was washed from the roots. Any flowering material was included with the foliage weights; but the number of buds, flowers, and senesced flowers were also counted. The fresh and dry weights of the foliage and roots were determined.

Analyzed data included fresh and dry weights of the foliage, roots, and total plant (foliage and roots). Flowering data included flower buds, flowers, and senesced flowers at each harvest. All data were subjected to ANOVA⁹ and mean separation using LSD with P=0.05.

Results and Discussion

Foliage and Root Weights

Twenty-Two Days After Initiating Treatment (22-DAIT) - The foliage and root fresh and dry weights harvested at 22 DAIT were not significantly different as a result of the hydrogen peroxide concentrations (data not shown). No discernable trends attributable to the treatment effects were observed across the different data sets. Only two flowers were present at 22-DAIT. The first flower was a 1X treatment, and the second flower was a 10X treatment.

Thirty-Three Days After Initiating Treatment (33-DAIT) – Although no significant differences were observed among treatments for foliage, root, and total *fresh* weights harvested at 33 DAIT, hydrogen peroxide concentrations did significantly impact the foliage, root, and total *dry* weights at 33 DAIT (Figures 1, 2, and 3). The 1X concentration of hydrogen peroxide produced significantly greater amounts of nasturtium foliage and total plant dry weights at 33 DAIT compared to the 10X concentration, but it was not significantly different from the distilled and tap water applications. The 20X root dry weights were significantly greater than all other treatments except the 1X hydrogen concentration.

Flowering

⁶ LC1 Potting Mix, Sun Gro Horticulture Distributing Inc., 15831 N.E. 8th Street, Suite 100, Bellevue, WA 98008

⁷ Fish & Seaweed Fertilizer, Neptune's Harvest, Ocean Crest Seafoods, 88 Commercial St., Gloucester, MA 01930.

⁸ 3% Hydrogen Peroxide, U.S.P., Aaron Industries Inc., Clinton, SC, 29325

⁹ SAS Institute Inc., 100 SAS Campus Drive, Cary, NC 27513.

Total Flowering (33 DAIT) - Total flowering was significantly affected as a result of hydrogen peroxide concentration (Figure 4). The 1X concentration produced significantly greater total number of flowers than either the 10X or 20X concentrations and 64 and 57% greater number of flowers than the distilled and tap water treatments. No significant differences were observed individually for the number of buds, flowers, or senesced flowers at harvest.

Conclusions

The results indicate that watering nasturtiums at the tested hydrogen peroxide application rates did provide slight growth and flowering benefits to nasturtiums grown in containers. The 1X rate (0.005% H₂O₂, 1.3 tsp/gallon of 3% hydrogen peroxide in distilled water) provide the best trend for improving plant growth. The absence of the dramatic benefits proclaimed by anecdotal reports may be a result of two factors. The most likely explanation for the anecdotal reports of dramatic growth stimulus of hydrogen peroxide watering solutions may be a result of hydrogen peroxide decreasing or eliminating diseases in the soil containers rather than it serving as a direct stimulus to the plant. A second possibility for the absence of the dramatic benefits of hydrogen peroxide in this research may have been the selection of the plant species, nasturtium, which might not be as responsive to hydrogen peroxide applications as other plant species. Additional research should focus on additional plant species grown as container plants.

Acknowledgements

The authors would like to thank Buddy Faulkenberry, USDA, ARS, Research Technician, for his greenhouse work, data processing, and poster preparations.

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Figure 1. Total dry weight (foliage and roots) of nasturtium at harvest 33 days after initiating treatment, weight/plant in grams.

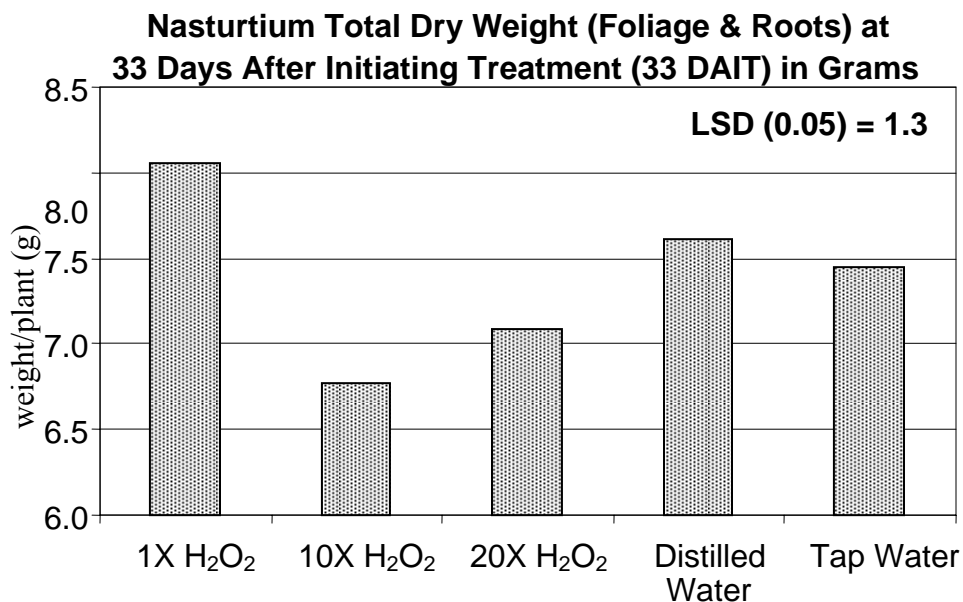


Figure 2. Foliage dry weight (grams) of nasturtium at 33 days after initiating treatment.

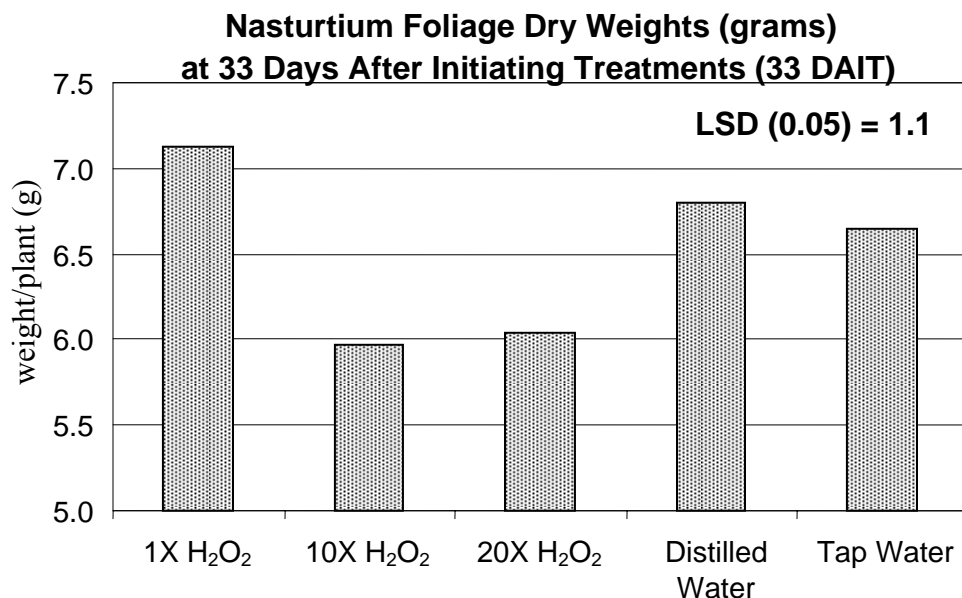


Figure 3. Root dry weight (grams) nasturtium at 33 days after initiating treatment.

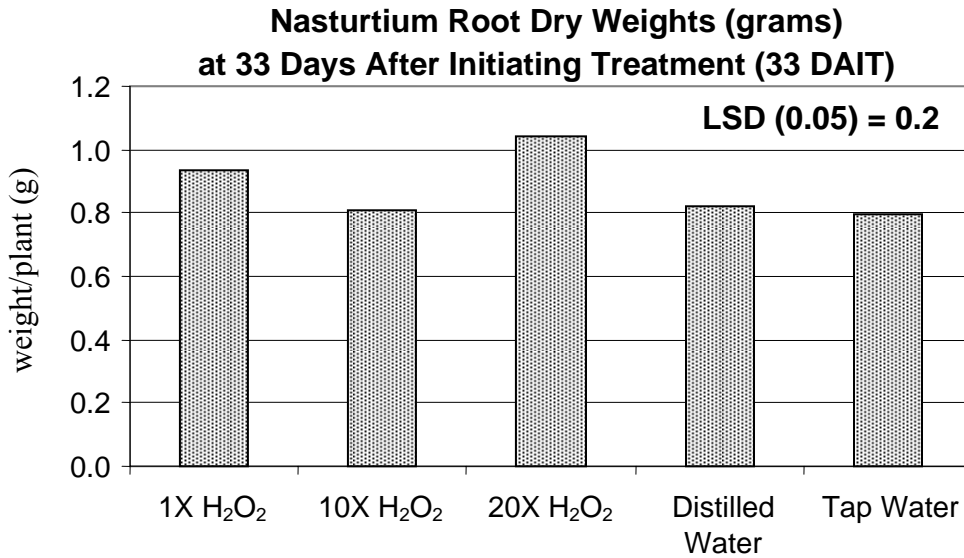
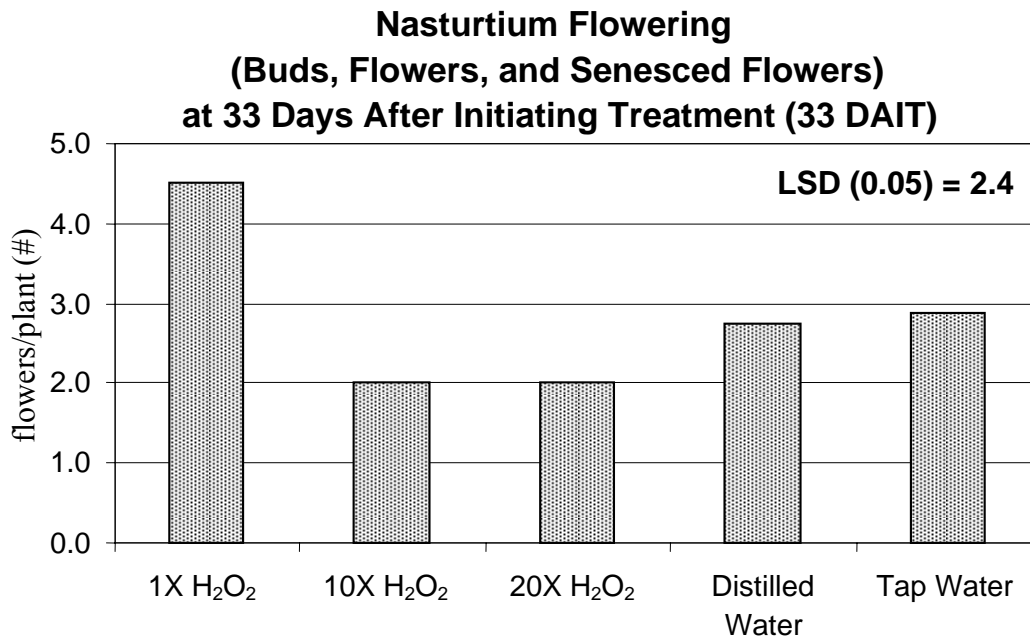


Figure 4. Flowering number (buds, flowers, and senesced flowers) at 33 days after initiating treatment.



Pelargonic Acid Weed Control: Concentrations, Adjuvants, and Application Timing

Charles L. Webber¹ III and James W. Shrefler²

Introduction

Pelargonic acid is a fatty acid naturally occurring in many plants, animals, and foods (EPA, 2004). Pelargonic acid has potential as a broad-spectrum post-emergence or burn-down herbicide. It inflicts damage at the point of contact and is not translocated throughout the plant; therefore, it is considered a contact herbicide rather than a systemic herbicide such as glyphosate. Pelargonic acid injures and kills plants by first destroying the cell membranes, which then causes rapid desiccation of plant tissues. As a contact herbicide, pelargonic acid should be more effective in controlling seedlings and annuals than more mature plants or perennials. Field research was conducted in southeast Oklahoma (Lane, OK, Atoka County) to determine the effect of pelargonic acid (nonanoic acid) concentrations, adjuvants, and application timing on weed control efficacy as a burn-down herbicide.

Materials and Methods

The field experiment was conducted on a Bernow fine sandy loam, 0-3% slope (fine-loamy, siliceous, thermic Glossic Paleudalf) at Lane, OK (southeast Oklahoma). One month prior to spraying the weed control treatments, the land was cultivated to kill the existing weeds and provide a uniform seedbed for new weed growth. Scythe^{3,4} (57.0% pelargonic acid) is a commercial weed control product containing 4.2 lb of pelargonic acid per gallon.

The factorial experiment included three application concentrations of Scythe (3, 6.5, and 10% v/v), three adjuvant treatments (none, orange oil, and non-ionic surfactant), and two application dates (July 21 and July 28, 2005). All herbicide treatments were applied with a sprayer volume of 100 gallons per acre⁵ (gpa) using a tractor mounted CO₂ sprayer equipped with XR8002VS nozzles, 40 psi, on 20-inch spacing. The 100 gpa sprayer application volume was achieved by driving the tractor at 0.6 mph. The orange oil and non-ionic surfactant were mixed at 0.25% volume/volume (v/v).

Weed plots were sprayed on either July 21 or July 28, 2005 allowing a 1-week growth period between the two respective applications. The experiment also included a weedy-check treatment, which served as an untreated control. Weed cover and weed control ratings were collected 10 days after each application date.

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³ Scythe, Active Ingredient (Pelargonic Acid), Dow AgriSciences, The Dow Chemical Company, Dow Center, Midland, MI 48674

⁴ The mention of trade names or commercial products in this publication is solely for the purpose of providing specific information and does not imply recommendation or endorsement by the U.S. Department of Agriculture.

⁵ Scythe label states "For the best control or burndown of annual, biennial or perennial weeds using conventional boom equipment, use the recommended rate of this product in 75 to 200 gallons of spray solution per acre as a broadcast spray."

Results and Discussion

Weed Species

The weeds present at spraying included large crabgrass (*Digitaria sanguinalis* L.), carpetweed (*Mollugo verticillata* L.), cutleaf evening primrose (*Oenothera laciniata* Hill), spiny amaranth (*Amaranthus spinosus* L.), eclipta (*Eclipta prostrata* L.), and yellow nutsedge (*Cyperus esculentus* L.). The size of the predominate weeds at the two spraying dates (July 21, July 28) were large crabgrass (2-4 leaves, 2-7 leaves), carpetweed (1 rosette, 2 rosettes), spiny amaranth (2-3 leaves, 1-4 inches tall), and cutleaf evening primrose (2 – 3 leaves, 3-8 leaves).

Treatment Analysis (10 DAT)

The first application date (July 21) provided good to excellent weed control across all weed control treatments for total weed, grass, and broadleaf control (Table 1). The second application date (July 28) produced significant differences between weed control treatments and between broadleaf and grass control. The delay of only 1 week between the two applications dates resulted in a significant decrease in weed control across most weed control treatments. Only the highest Scythe application concentration (10%) maintained excellent control at the later spray date, but only for the broadleaves.

Factorial Analysis (10 DAT)

Weed control increased for both application dates for total, grass, and broadleaf weed control as the Scythe concentration increased from 3 to 10% (Table 2 and 3). The differences in weed control resulting from increasing Scythe concentrations were greater during the second application date, as weed control decreased at the lower concentrations.

When averaged across Scythe concentrations, there was only one indication during the first application date that the use of an adjuvant affected weed control. For the first application date, broadleaf weed control was significantly reduced when the non-ionic surfactant was used, but in spite of this difference, broadleaf weed control still remained high (94%) (Table 4 and 5). For the second application date, adjuvants again appeared to have little impact on weed control when averaged across Scythe concentrations. There was a small difference among adjuvants for broadleaf control, where the non-ionic surfactant produced significantly greater control than orange oil.

Summary

Application timing and Scythe concentrations were the most important factors in determining degree of weed control. An early application of Scythe, even at the lowest concentration, provided excellent weed control. Delaying Scythe applications by just 1 week resulted in a significant decrease in weed control at the 3 and 6.5% concentrations. These results demonstrate the importance of applying Scythe when the target weeds are small enough to achieve adequate weed control. Additional research should investigate a larger range of weed species at different maturity levels. This research also demonstrated the potential usefulness of pelargonic acid as an organic herbicide, if the appropriate formulations changes can be made to permit its use in certified organic production systems, while maintaining its weed control efficacy.

Acknowledgements

We are thankful to Buddy Faulkenberry, USDA, ARS, Research Technician, for his field work, data processing, and assistance with the poster preparations.

References

EPA. Pesticides: Regulating Pesticides. Pelargonic Acid (217500). U.S. Environmental Protection Agency. Retrieved February 19, 2004.
www.epa.gov/pesticides/biopesticides/ingredients/factsheets/factsheet_217500.htm.

Table 1. Total percentage weed control, grass control, and broadleaf weed control collected 10 DAT for two application dates (July 21 and July 28) in response to different pelargonic acid concentrations and adjuvants.

Scythe Concentration	Adjuvant	Total ¹ Weed Control		Grass ¹ Weed Control		Broadleaf ¹ Weed Control	
		July 21	July 28	July 21	July 28	July 21	July 28
%		%					
3	None	93 a	9 d	93 a	6 d	100 a	51 c
3	Orange Oil	91 a	9 d	91 a	7 d	100 a	57 c
3	Non-Ionic	94 a	12 d	96 a	9 d	81 b	66 c
6.5	None	98 a	66 abc	98 a	66 abc	100 a	91 ab
6.5	Orange Oil	98 a	65 bc	98 a	65 bc	100 a	83 b
6.5	Non-Ionic	98 a	55 c	98 a	54 c	100 a	86 ab
10	None	98 a	76 ab	98 a	74 ab	100 a	100 a
10	Orange Oil	98 a	77 ab	98 a	76 ab	100 a	97 ab
10	Non-Ionic	98 a	81 a	98 a	80 a	100 a	100 a
-	Weedy Check	0 b	0 d	0 b	0 d	0 c	0 d

¹Values between dates (July 21 and July 28) within weed control ratings with different letters are significantly different at $P \leq 0.05$.

Table 2. Weed control ratings at 10 DAT in response to Scythe concentrations average across adjuvants for the first application date (July 21, 2005).

Scythe Concentration	Total ¹ Weed Control	Grass ¹ Control	Broadleaf ¹ Control	Nutsedge ¹ Control
% (v/v)	%			
3	93 b	93 b	94 b	36 c
6.5	98 a	98 a	100 a	75 b
10	98 a	98 a	100 a	88 a

¹Values within columns with different letters are significantly different at $P \leq 0.05$.

Table 3. Weed control ratings at 10 DAT in response to Scythe concentrations average across adjuvants for the second application date (July 28, 2005).

Scythe Concentration	Total ¹ Weed Control	Grass ¹ Control	Broadleaf ¹ Control	Nutsedge ¹ Control
% (v/v)	%			
3	10 c	7 c	58 c	0 b
6.5	62 b	61 b	87 b	8 ab
10	78 a	77 a	99 a	17 a

¹Values within columns with different letters are significantly different at $P \leq 0.05$.

Table 4. Weed control ratings at 10 DAT in response to adjuvants averaged across Scythe concentrations for the first application date (July 21, 2005).

Adjuvants	Total ¹ Weed Control	Grass ¹ Control	Broadleaf ¹ Control	Nutsedge ¹ Control
	%			
None	96 a	96 a	100 a	61 b
Orange Oil	96 a	96 a	100 a	75 a
Non-Ionic	97 a	97 a	94 b	63 b

¹Values within columns with different letters are significantly different at $P \leq 0.05$.

Table 5. Weed control ratings at 10 DAT in response to adjuvants averaged across Scythe concentrations for the second application date (July 28, 2005).

Adjuvants	Total ¹ Weed Control	Grass ¹ Control	Broadleaf ¹ Control	Nutsedge ¹ Control
	%			
None	50 a	49 a	81 ab	8 ab
Orange Oil	50 a	49 a	79 b	0 b
Non-Ionic	49 a	48 a	84 a	17 a

¹Values within columns with different letters are significantly different at $P \leq 0.05$.

Organic Weed Control with Vinegar: Application Volumes and Adjuvants

Charles L. Webber¹ III and James W. Shrefler²

Introduction

Initial results and anecdotal testimonies have reported that vinegar (water and acetic acid) has potential as an organic herbicide, but further research is needed in order to increase our understanding of the relationship between acetic acid concentrations, application volumes, weed species, and weed maturity on effectiveness of vinegar to control weeds. There is also a need to determine the effect of adjuvants (spray additives) on vinegar efficacy. The objective of this research was to determine the effect of application volumes and adjuvants on weed control efficacy using vinegar with a 20% acetic acid concentration.

Material and Methods

The field experiment was conducted on 0.5 acres of land [Bernow fine sandy loam, 0-3% slope (fine-loamy, siliceous, thermic Glossic Paleudalf)] at Lane, OK. One month prior to spraying the weed control treatments, the land was cultivated in order to kill existing weeds and to provide a uniform seed bed for new weed growth. The research involved 14 randomized weed control treatments with 4 replications; plots were 6.5 ft wide and 10 ft long.

The factorial experimental design included applications of vinegar (20% acetic acid³) applied at three sprayer application volumes [20, 80 and 160 gallons per acre (gpa)] in combination with four adjuvant treatments [none, orange oil, non-ionic surfactant, and crop oil concentrate (COC)]. The experiment also included two weedy-checks and four replications. The 20% acetic acid and the orange oil were sold through a commercial nursery for horticultural use. The orange oil, non-ionic surfactant, and COC were mixed at a 1.0% volume/volume (v/v), based on each application volume (20, 80, and 160 gpa).

All herbicide treatments were applied with a tractor mounted CO₂ sprayer equipped with four extended range, stainless steel, 0.20 gallons/min nozzles on 20-inch spacing at a height of 19 inches. The 20, 80, and 160 gpa sprayer application volumes were achieved by holding all other variables (nozzle size, pressure, and mixture volumes) constant while adjusting the travel speed to 3.0 mph, 0.75 mph, or 0.375 mph, respectively.

Weed control ratings were made at 7 days after treatment (DAT) for total, broadleaf, and grass weeds. The weed control ratings represent the percent weed control for an experimental treatment compared to the weedy-check with 0 for no weed control and 100 for complete control.

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³ Vinegars with acetic acid concentrations of 11% or greater are available commercially, these products can burn the skin and cause serious to severe eye injury, including blindness. Protective clothing that includes eye protection and gloves should be used.

Results and Discussion

Weed Species

The weeds present at spraying included large crabgrass (*Digitaria sanguinalis* (L.)), goosegrass (*Eleusine indica* L., Gaertn.), carpetweed (*Mollugo verticillata* L.), cutleaf evening primrose (*Oenothera laciniata* Hill), spiny amaranth (*Amaranthus spinosus* L.), eclipta (*Eclipta prostrata* L.), and yellow nutsedge (*Cyperus esculentus* L.). The size and percentage cover of the predominate weeds at spraying were large crabgrass (1-2 leaves, 30%), carpetweed (1 inch wide, 4-5 leaves, 25%), cutleaf evening primrose (2-3 leaves, 15%), and yellow nutsedge (2-3 leaves, 7.5%). No other weed species contributed more than 5% to the weed cover.

Treatment Analysis (7 DAT)

Total weed control ranged from 25% for the 20 gpa application volume with no adjuvant to 96% control for the application volumes of either 80 or 160 gpa used with orange oil (Table 1). Vinegar was less effective in controlling grasses than broadleaf weeds. Ninety percent or greater grass control, primarily crabgrass, was obtained when the vinegar was applied at 80 or 160 gpa, irrespective of the adjuvant used. Broadleaf weed control was 99 or 100% for plots receiving either 80 or 160 gpa. Yellow nutsedge control ranged from 8%, when vinegar was applied at 20 gpa with either the non-ionic surfactant, COC, or no adjuvant, and 23% control when orange oil was used, with a maximum control of 75% for 80 gpa with orange oil (data not shown). Yellow nutsedge represented an average of only 7.5% of the weeds present in the weedy-check, and ranged from 5 to 10% across the research plots. The low yellow nutsedge populations and the variability across treatments and replications makes the data difficult to interpret and therefore additional research should investigate yellow nutsedge control at higher population levels. In this research, cutleaf evening primrose and carpetweed were the most susceptible to vinegar applications; however, this response may reflect differences in weed size rather than weed species.

Factorial Analysis (7 DAT)

When averaged across adjuvants (none, orange oil, non-ionic surfactant, and COC), weed control increased as application volume increased to either 80 or 160 gpa (Table 2). Total weed control when averaged across application volumes was significantly greater when using an adjuvant compared to using no adjuvant (Table 3). The selection of the adjuvant or the lack of an adjuvant did not significantly affect broadleaf weed control. The use of adjuvants did increase grass control, adding orange oil provided significantly greater control than using COC. Although yellow nutsedge control, averaged across application volumes, was greater when using orange oil compared to either the non-ionic surfactant or the COC.

Conclusions

Vinegar was more effective controlling broadleaf weeds than grass weeds. The addition of adjuvants (orange oil, non-ionic surfactant, and COC) increased the effectiveness of vinegar only at the lowest application volume (20 gpa). There were no weed control differences between the 80 and 160 gpa application volumes; therefore there was no advantage of increasing the application rate from 80 to 160 gpa. Additional research should focus on the impact of multiple applications of vinegar at lower application volumes on weed control.

Acknowledgements

The authors would like to thank Buddy Faulkenberry, USDA, ARS, Research Technician, for his field work, data processing, and poster preparations.

Table 1. Weed cover and control percentages four days after treatment in response to different acetic acid concentrations, application volumes, and adjuvants.

Application Volume (gpa)	Adjuvant	Weed Control %		
		Total Weed Control %	Grass Control %	Broadleaf Control %
20	None	25 e ¹	0 d	77 b
20	Orange Oil	81 bc	83 ab	92 a
20	Non-Ionic	68 cd	70 bc	86 ab
20	COC	67 d	63 c	77 b
80	None	94 ab	92 a	100 a
80	Orange Oil	96 a	93 a	100 a
80	Non-Ionic	93 ab	92 a	99 a
80	COC	93 ab	94 a	99 a
160	None	95 ab	92 a	100 a
160	Orange Oil	96 a	97 a	100 a
160	Non-Ionic	95 ab	94 a	100 a
160	COC	95 ab	90 a	100 a
Weedy-Check ²		0 f	0 d	0 c
Weedy-Check		0 f	0 d	0 c

¹Values in columns followed by the same letter are not significantly different at P=0.05.

²Two weedy-checks were used for comparisons because of the experiment's large size.

Table 2. Weed control ratings in response to application volumes average across adjuvants (7 DAT).

Application Volume gpa	Total Weed Control %	Grass Control %	Broadleaf Control %	Nutsedge Control %
20	60 b ¹	51 b	83 b	12 b
80	94 a	93 a	100 a	60 a
160	95 a	93 a	100 a	63 a

¹Values in columns followed by the same letter are not significantly different at P=0.05.

Table 3. Weed control ratings in response to adjuvants averaged across application volumes (7 DAT).

Adjuvant	Total Weed Control %	Grass Control %	Broadleaf Control %	Nutsedge Control %
None	72 b ¹	58 c	92 a	51 a
Orange Oil	91 a	91 a	97 a	53 a
Non-Ionic	85 a	85 ab	95 a	40 b
COC	85 a	82 b	92 a	36 b

¹Values in columns followed by the same letter are not significantly different at P=0.05.

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Wine & Juice Tasting Contributors

We extend our appreciation to the following companies for providing the wine and juices for the Horticulture Industries Show wine tasting held on Friday, January 5.

Chateau Aux Arc Winery—Audrey House Post

Mount Bethel Winery—Michael Post

Post Familie Vineyard & Winery—Paul Post

Wiederkehr Wine Cellars—Al Wiederkehr