PROCEEDINGS OF THE

23rd ANNUAL

HORTICULTURE INDUSTRIES SHOW

TULSA COMMUNITY COLLEGE
NORtheast Campus

JANUARY 9-10, 2004
Tulsa, Oklahoma

Growing Your Horticulture Business
PROCEEDINGS of the

23rd ANNUAL

HORTICULTURE INDUSTRIES SHOW*

January 9-10, 2004

Tulsa Community College
Northeast Campus
Tulsa, OK

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*Formerly the Oklahoma Horticulture Industries Show from 1981 through 1997
The 23rd Annual Horticulture Industries Show in Tulsa had good weather, good attendance, excellent speakers, and interesting exhibits.

The keynote speakers — addressing "Growing a Horticulture Business" — provided plenty of ideas and experience to think about. Scott Landgraf, Madill, OK, provided background details on Landgraf Farms pecan business, sharing special insight on “focused marketing.” Professor Lee Manzer, Oklahoma State University, delivered an innovative lecture that drew much laughter, but also pause for thought. I’ve heard several people remark that Professor Manzer’s advice to make “small changes” in our lives, and businesses, still resonates in their minds.

We would like to thank all the speakers for sharing their expertise and experience at the horticultural meetings, as well as for the papers published in these proceedings. We would also like to thank this year’s exhibitors for showcasing their products and services that are so vital to our horticultural industry.

Also, a special thank you is extended to personnel at Tulsa Community College, Oklahoma State University, and Arkansas State Horticulture Society, as well as Horticulture Industries Show board members, who worked so hard to organize and facilitate this show.

Most importantly, isn’t it wonderful to see so many new faces attending our program, as well as meeting old friends? The comradery among horticulturists is superb. Thanks for your attendance, and we look forward to seeing you again next year!

Please note we’ll be shifting the Arkansas meetings to Ft. Smith on January 14–15, 2005. The location of the 24th Horticulture Industries Show will be the Ft. Smith Holiday Inn Civic Center.

Sincerely,

Steve Diver
President
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Scott and Janice Landgraf
Landgraf Farms
RR 1, Box 148
Madill, OK 73446
Phone: 580-795-7644
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Friday General Session Topic:
“Growing a Family Business”

Dr. Lee Manzer
Professor of Marketing, Oklahoma State University
419 Business, Stillwater, OK 74078
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FAX: 405-744-8956
e-mail: llm@okstate.edu

Saturday General Session Topic:
“Growing Your Business Through Expanded Markets and Customer Satisfaction”
Christmas Tree Session
Diverse Marketability of Leyland Cypress in Oklahoma

Rachelle Batesole, Co-owner of Cal@Home Christmas Tree Farm
Gore, Oklahoma

Rachelle Batesole holds a Bachelor of Science in Chemistry, from California State University at Long Beach, with which she utilized within the environmental waste management/remediation and wholesale nursery fields for twelve years before turning her interests to the growing of three specialty crops: fall garden mums, topiary and Christmas trees. This family owned farm consists of 8 acres with 3 acres currently involved in the production of farm products mentioned above. Production of Christmas trees began in 1998 and 2003 marked the first year in which all three farm products were sold. Because being good stewards of God’s creation is the cornerstone of the Farm’s operations, water conservation, in the form of drip irrigation, and conservative use of herbicides, insecticides and fungicides are judiciously practiced.

Leyland cypress (Cupressocyparis leylandii) is a sterile hybrid that originally came about because of a naturally occurring cross between a Monterey cypress (Cupressus macrocarpa) and an Alaskacedar (Chamaecyparis nootkatensis), not a true cedar, in 1888 and the reverse in 1911 at Leighton Hall, Great Britain. As is the case with many crosses, Leyland cypress exhibit wonderful “hybrid vigor” which includes long life, disease resistance and fast growth (Not to mention its beautiful and graceful appearance!). It is considered to grow well in hardiness zones 6 through 10. Because Leyland cypress is virtually a sterile hybrid, vegetative propagation is the most common method of reproduction.

When referring to “Leyland cypress”, the specific cultivar needs to be referenced due to the many cultivars now available. We grow four cultivars on our farm: “regular” Leyland (Leyland), Murray X, Carolina Sapphire and Blue Ice. Each has its own unique appearance and growth habit, and therefore, determines which farm product for which it will be grown. The Leyland and Murray X exhibit green and gray green coloring, respectively, and “needles” that are scale-like and grow on planar branches, while the Carolina Saphire and the Blue Ice exhibit greenish blue and silver blue coloring, respectively, and the scale-like “needles” grow in a more “juniper” fashion. The Blue Ice, unlike the other three, grows more upright, whereas the others have a rounded pyramidal form.

The trees are grown for three purposes on our farm: Christmas trees, landscape trees and/or topiary specimens. Christmas tree cultivars include Leyland, Murray X and Carolina Sapphire (limited due to color and needle type). Because the Murray X is subject to freeze damage in Oklahoma, we grow it exclusively for Christmas trees since freeze damage, if any, is shear off the following spring. Leyland, Carolina Sapphire and Blue Ice are grown for topiary (single/double poms, spirals, pom-spiars, etc.) and sheared garden specimens (uprights and “gumdrops”). We are marketing the Carolina Sapphire as an alternative for Colorado blue spruce, which are a challenge to grow in...
Oklahoma, since the Carolina Sapphire has a beautiful blue color, can be grown in full sun and is disease resistant. Consumer response has been favorable.

The Leyland is a more economical tree to grow than many pine varieties due to its fast growth and disease resistance. A saleable apartment, or tabletop tree, can be grown in 2 to 3 years and a standard six foot tree in 3 to 4 years. Furthermore, as you are aware, blights and needle casts are an ever present concern when growing evergreens in Oklahoma, however, the Leyland doesn’t seem affected by these. There is a cypress canker that can be troublesome. Benomyl and chlorothalonil have proven to be effective in control programs for this fungal disease, according to research done by Clemson University (Leyland Cypress a Tree of Beauty, Clemson University). We have not found this disease to be a problem on our farm at this time. Leylands are virtually pest damage free with the exception of bagworms (Thyridopteryx ephemereformis), which can be controlled during spring insecticide spraying events. We spray our Leylands on two to three times per season depending upon weather conditions and insect populations observed in the growing fields. Leyland’s water requirements are about equal to that of the Virginia pine, however, the Carolina Sapphire and the Blue Ice do well in dryer locations and growth doesn’t slow even during the hot months of August!

There are several marketable features of the Leylands that benefit both the grower and consumer. Leylands are considered to be non-allergenic. In a time when Christmas tree growers are competing against the sale of artificial trees for allergenic reasons, this is quite an advantage. Since Leylands do not have needles, there loss is not an issue for Christmas tree or landscape trees sales. Having green and blue cultivars, also gives the consumer a choice when purchasing specimens for their home and commercial landscapes. When selling trees for Christmas or landscape, many consumers want to know that the trees they purchase can be grown in an environmentally friendly manner. The Leyland meets this concern. Lastly, the Leyland doesn’t demand any special watering requirements and, in fact, the blue varieties are suited for dryer locations. It is the uniqueness of these qualities that make the Leyland cypress so versatile to the horticultural community.
Weather-Based Decision Support Tools from the Oklahoma Mesonet

Dr. J. D. Carlson, Agricultural Meteorologist
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Phone: (405) 744-6353

Dr. J. D. Carlson serves as agricultural meteorologist for the Oklahoma Mesonet, Oklahoma’s automated weather station network. Working in the Biosystems and Agricultural Engineering department at OSU since 1991, he provides research and extension support for weather-based applications in agriculture and natural resources.

A joint effort between Oklahoma State University and the University of Oklahoma, the Oklahoma Mesonet is Oklahoma’s automated weather station monitoring network of 116 remote sites. There is at least one station in every county, with an average station spacing of 19 miles (Figure 1). In meteorological terms, this spacing falls in the “mesoscale” range of distances; hence, Mesonet is a “meso”scale “net”work. Also, in terms of frequency of data reporting, the time scales fall in the mesoscale range, with weather and soil data being reported every 15 minutes. The Oklahoma Mesonet has been operational since 1994.

Figure 1. Locations of stations in the Oklahoma Mesonet.

What this means to you the grower is that you can access “live” weather data across the state, updated every 15 minutes, and usually from a Mesonet site located no further than 10 miles from your area of interest. The Oklahoma AgWeather web site
(http://agweather.mesonet.org) offers a large number of real-time weather and soil products which may be of interest, as well as a number of “value-added” products which we will discuss later.

With respect to weather/soil values themselves, the AgWeather web site offers real-time maps and graphs to display these values. One example, the standard weather map, is shown below (Figure 2). This map clearly depicts a strong cold front moving through Oklahoma on November 18, 2001. The solid dots represent the different Mesonet sites, which on the map are surrounded by information on temperature, relative humidity, and winds. The upper left number is the temperature in °F; the lower left, the relative humidity in %; and the upper right, the value of any wind gust above 20 mph. Winds blow along the staff from where the barbs are located to the solid dot; thus, northwest Oklahoma shows strong north winds while southeast Oklahoma shows light southeast winds. The number and size of the barbs are proportional to the speed (see the legend on the map). A circle around a Mesonet site signifies calm conditions. This type of map is updated every 15 minutes.

![Sample weather map showing strong cold front moving through Oklahoma.](image)

Other available maps concentrate on specific variables, such as temperature, inversion conditions (for fruit growers), wind speed, rainfall, soil temperature, or soil moisture. Some maps feature colorized contours and can be animated; another feature is the ability to zoom in and out of an area of interest. To activate these features, as well as many other of the products available (such as radar maps), the user needs to download and activate the “plug-in” software accessible from the home page of the Oklahoma AgWeather web site. Besides maps, the user can access “meteograms” from a specific Mesonet site; these meteograms are charts of various weather variables at that site over past time periods. Rainfall products, including tables and maps of past
totals going back months, are also available. Real-time NEXRAD radar images (having the animation and zoom features) are also accessible free of charge.

Forecasts, while not “part” of Mesonet, are available at the AgWeather site as well, to help you in planning your field activities. In particular, the NGM MOS forecasts have proven useful to a number of growers. These forecasts, available in both table and map form, provide predictions of various weather variables at 3-hour intervals over the next 60 hours.

Besides weather/soil data and forecasts, a number of weather-based, value-added products have been developed for agriculture and natural resources in Oklahoma. Insect and disease models, which are useful as pesticide scheduling tools, are available for pecans (pecan nut casebearer and pecan scab) and watermelon (watermelon anthracnose). More recently, tools for irrigation scheduling have been developed which show daily water use amounts for specific crops such as peaches, pecans, and other fruit/vegetable crops; daily amounts and totals going back over the past weeks can be used as a guide as to when and how much to irrigate. A fire danger model is also available to provide near-real-time estimates of fire danger across the state.

One model of particular interest, in terms of scheduling spraying activities, is the Oklahoma Dispersion Model. It is a tool which assesses the current and future ability of the atmosphere to disperse a material (such as a gas or aerosol) horizontally and vertically. Current conditions are calculated from the Oklahoma Mesonet, while forecast conditions utilize input from the NGM MOS forecasts. The Oklahoma Dispersion Model can be used as a tool to avoid spray drift in certain sensitive directions. The direction of drift can be determined by looking at the wind direction on the weather map (for current and forecast conditions) or NGM MOS table (for forecast conditions), while the dispersion conditions themselves (very poor - red; poor - orange; moderately poor - beige; moderately good - light green; good - green; and

Figure 3. Dispersion condition map for same date/time corresponding to Figure 2.
excellent - dark green) can be seen on the dispersion maps (current and forecast conditions) or listed in the NGM MOS table (for forecast conditions). Knowing the wind speed, direction, and dispersion condition of the atmosphere at the current time and over the next two days, a grower can use the Oklahoma Dispersion Model to decide when is the best time to spray, while minimizing drift to sensitive directions. A sample map showing dispersion conditions, corresponding to the same date/time as the Mesonet weather map in Figure 2, is shown in Figure 3. Note the poor dispersion conditions (band of orange/red color) just ahead of the cold front and also in southeast Oklahoma. In such areas, a pesticide plume would not disperse well and would travel largely undiluted downwind. Behind the cold front, however, note that dispersion conditions improve (green colors).

As mentioned earlier, these and other products are accessible free of charge at the Oklahoma AgWeather web site (http://agweather.mesonet.org). The site is organized with main menu items as follows: Weather, Soil, Livestock, Rangeland, Crops, Horticulture, Forestry, and Markets. When one clicks on a main menu item, other items appear related to the main topic. For example, if one were interested in specific products related to peaches, one would click on “Horticulture” on the main menu bar, then on “Fruit and Nut” on the left menu, then on “Peach” (see Figure 4). In this example, “Evapotranspiration” (ET) has been selected. The resulting table shows a list of daily and accumulated water usage (ET) by peaches at Porter over the past number of weeks.

![Figure 4. Organization of Oklahoma AgWeather web site showing example for peaches.](image-url)
In summary, Oklahoma is privileged to have what we believe to be the premiere weather and soil monitoring station network in the world. A wealth of information is available for growers on the Oklahoma AgWeather web site. Weather and soil information is updated every 15 minutes, while other Mesonet-based value-added products are updated at time scales ranging from every 15 minutes to daily. We hope the Oklahoma Mesonet and its associated products can become increasingly useful to those in the horticultural industry in Oklahoma. We also encourage your feedback on the web site and also any ideas you may have for future products.
INTRODUCTION

Because of Oklahoma's geographical location and somewhat harsh environment, Oklahoma Christmas tree producers often plant non-native trees for eventual sale. Exotic species such as Virginia pine, Scotch pine, white pine, and Arizona cypress constitute a significant proportion of Oklahoma's annual Christmas tree harvest. In addition, Leyland cypress, a hybrid with no established native range, is often used within the state. It should be noted that a number of other species, both native and non-native, are also grown by Oklahoma producers in their attempts to find suitable species for use as Christmas trees.

One of the difficulties of using non-native tree species is that they are generally more susceptible to insects, disease, and other stresses than when living in their native environments. Likewise, the less-than-perfect Oklahoma weather often leads to increased plant stress, even on native plants.

DEFINITIONS

A common, undesired outcome of these increased plant stresses is the increase in disease occurrence. Disease may be defined as "a harmful deviation from normal functioning of physiological processes." Such deviations are said to be either biotic (pathogenic), meaning that they are caused by living organisms or abiotic, resulting from non-living agents.

Biotic organisms causing disease include 1) viruses, 2) bacteria, 3) fungi, and 4) plants. Other agents such as insects and slime molds also are known to result in diseases. Abiotic agents include 1) high or low temperatures, 2) drought or excess water, 3) nutritional problems, 4) air pollution, 5) mechanical injury, and 6) others.
FUNGAL DISEASES

Dothistroma Needle Blight

*Dothistroma* attacks over 30 species of pines although Austria pine appears to be most susceptible. The disease results in premature needle drop, usually 2-3 weeks after initial symptoms appear. Symptoms generally develop in the fall and consist of yellow and tan spots, along with water-soaked bands on the needles. Lower branches usually show needle loss first. Fruiting bodies can be observed in the fall. The control is usually some form of copper fungicide such as Bordeaux mixture. Trees should not be sheared in the fall when they are wet, as spores may be carried on tools.

Diplodia (Sphaeropsis) Tip Blight

*Diplodia* attacks all two and three needle pines (also known as hard pines). This fungus kills newly developing shoots, and repeated infections over several years may kill the tree. Symptoms include death of shoots, browning of needles and failure of needles to elongate. Cones may also be infected. The fungus overwinters in shoots, bark, or litter, with spores released from spring through fall. The control is usually a copper fungicide, but any fungicide must be applied several times during growing season.

Phomopsis

*Phomopsis* is common to junipers and arborvitae. This disease involves browning of foliage and dying of twigs and branches. Initially, foliage will turn light green but then rapidly changes to the red-brown color of dead shoots. High humidity and high temperature are extremely conducive to the spread of *Phomopsis*. Similar symptoms are often observed from attacks by *Kabatina* fungus. To distinguish the difference, *Phomopsis* attacks new season’s growth, while *Kabatina* attacks last season’s growth. Recommended control for *Phomopsis* is to apply labeled fungicides throughout the growing season. Infected twigs should be pruned prior to applications of fungicide.

Needle Casts

Needle cast diseases, those which result in untimely shedding of needles, are caused by over 25 different species of fungi in the South. One of the more common fungi is *Lophidermium* spp. *Lophidermium* and similar diseases usually result in rapid browning of needles and then the characteristic shedding. Needles are usually killed late in their first growing season. *Lophidermium* control consists of removal of debris and fungicide applications, usually twice in the growing season.

Cedar Apple Rust

Cedar Apple Rust is caused by the one or more of *Gymnosprangium* rust species, and is common to junipers (redcedar). The disease requires alternate hosts, which are apple or crabapple species. The most striking feature on junipers is the large gall that appears in spring and produces orange, gelatinous tendrils. Other than the unsightly galls and the potential for severe damage to commercial apple trees, the disease is not considered a serious problem. Control of cedar apple rust is to remove galls and avoid
planting near apples or crabapples. Commercial fungicides may also be used if infection becomes severe.

Stem/Branch Rusts
Stem or branch rusts are caused by several fungi, with *Cronartium quercuum* f. sp. *fusiforme* the common in the South. Loblolly pine and slash pine are most susceptible. The pine-oak gall rust (also know as the eastern gall rust), a similar disease, attacks Virginia pine and Scotch pine. As with most rusts, alternate hosts are required. These hosts are primarily members of the red oak group. Symptoms on pines include large galls on stems or branches, which exhibit an orange color in spring. If the gall is within the stem, the tree generally will die, although often not immediately. Control of *Cronartium* is to remove infected parts and avoid planting near alternate hosts.

Pine Wilt from Pinewood Nematode
The pinewood nematode is a small worm that is carried from tree to tree by wood boring beetles. The nematodes are tiny and are carried by beetles in their air tubes. Transmission of the disease occurs when young beetles that are infested with nematodes emerge from diseased trees in the spring and fly to shoots of healthy trees. By feeding on specific cells, the nematodes then result in wilting and death of trees. Symptoms include a rapid death, with internal symptoms of dry wood with no pitch flow. Control of nematodes is to remove trees as soon as they are diagnosed. In addition, insecticide sprays can be used to control the beetle vector.

SUMMARY
Trees species used for Christmas trees in Oklahoma are often not native to the state and as a result, are subject to a number of biotic and abiotic stresses. These stresses subsequently result in a number of diseases that may damage or kill valuable Christmas trees.

Proper disease control is dependent upon tree species, planting location, the disease, other cultural treatments, etc. Once the causal agent is identified, appropriate steps should then be taken.

Not all diseases are caused by fungi, but a large number are. Thus, a great deal of attention should be given to the proper identification and management of harmful fungi. General control measures for fungi-causing disease include 1) planting adapted species, 2) preventing undue stress from other environmental conditions, 3) providing good air circulation, 4) removing infected parts and/or trees, and 5) applying pesticides according to label.
Tax Considerations for Christmas Trees

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Christmas tree farmers face an enormous amount of work—not only in the field but also in keeping records for tax purposes. If your Christmas tree operation is a business, then you must operate as a business, with the appropriate books and records. The IRS only allows deductions if there is a clear profit motive. Generally, the IRS will only allow business deductions when there are profits in three of five years. There are several factors that the IRS uses to determine if there is a profit motive. Any one of these factors can indicate a profit motive, even when the business may not actually make a profit in three of five years.

The Profit Motive

Some of the more relevant factors include the following: carrying on the operation in a businesslike fashion, expertise of the taxpayer; time and effort spent on the business, expectation of profitability, and amount of occasional profits earned. A good Christmas tree farmer keeps a set of business books. He or she spends a great deal of time and effort in growing and shaping the trees prior to any sales. He or she studies Christmas tree farming through books, publications, seminars, workshops, and attendance at Christmas tree farmers’ meetings. Finally, once, the first set of trees is ready for harvest, he or she should be receiving a reasonable return on the investment of money, time, and effort.

One additional factor that Christmas tree owners might wish to consider is the creation of a business plan. Developing a good business plan allows the owner to consider various options of management, anticipate costs and potential pitfalls, plan marketing and sales strategy, and estimate profitability. Especially for single proprietors or family businesses, the business plan is important in case the primary decision maker should die or become unable to direct the business. Business succession planning is an important part of any business, but especially for small family businesses.

Cost Recovery

The costs of any farm business can be sorted into capital costs, preproductive costs, or ordinary operating expenses. For Christmas trees, costs of growing the trees must be divided into establishment costs, growing costs, and sales costs. Each is recovered a different way according to IRS rules. Ordinary operating costs and growing costs are deducted as business or farm expenses annually. Sales costs are deducted from the sales proceeds. Capital costs for equipment are recovered through depreciation and special tax programs such as the Section 179 deduction and bonus depreciation. Tree establishment costs are recovered when trees are cut and sold. See “A Federal Income
Capital costs include equipment costs such as tree shakers, mowers, trucks and establishment costs for trees that will be harvested after they are six years old from seed or from establishment as individual plants (e.g. Leyland cypress cuttings). These costs are generally recovered through depreciation according to MACRS, the modified accelerated cost recovery system. MACRS establishes the length of depreciation and the percentage of cost deducted each year according to the type of asset purchased.

**Section 179 Expensing**

An important option for businesses is the use of Section 179 expensing to recover capital investments in tangible property. Section 179 allows taxpayers to deduct up to $100,000 in costs for a capital item the first year of purchase. If you elect to use the Section 179 deduction, it is applied before the MACRS depreciation, or bonus depreciation, if any, is taken. The Section 179 deduction is applicable to used property as well as new purchases. The $100,000 ceiling on the deduction is reduced by $1 for each $1 over $200,000 of property placed in service during the tax year. The amount deducted under Section 179 cannot be more than the total taxable business income, but the excess can be carried forward to future taxable years.

**Bonus Depreciation**

Another new provision to encourage investment by small business is the Bonus Depreciation. First enacted after the terrorist attack on September 11, 2001, the bonus depreciation allowed business owners to deduct outright up to 30% of the cost of new equipment purchased between September 11, 2001 and December 31, 2004. The Jobs and Growth Tax Relief Reconciliation Act of 2003 (JGTRRA) added an additional rate of 50% for qualified property purchased after May 5, 2003 and before January 1, 2005. The provision is limited to new business assets with a MACRS class life of 20 years or less.

After either or both the Section 179 or Bonus depreciation of 30% or 50% are taken, the remaining basis of the property is depreciated using the standard MACRS rules. Taxpayers may elect not to use Section 179 or the Bonus depreciation. Use of these special provisions may reduce the taxpayer’s ability to claim the earned income credit, reduce social security coverage and prevent him or her from using exemptions and deductions. The property must be used predominantly for business—that is, more than 50%. Special rules apply for automobiles and other vehicles which significantly limit these deductions. For complete information, please consult the IRS Publication 946, *How to Depreciate Property*, available for downloading from the IRS website, [www.irs.gov](http://www.irs.gov).
Capital Gains for Christmas Tree Sales

Christmas trees that are harvested when more than 6 years old (from seed or cuttings) are eligible for treatment of capital gains under IRS code section 631(a). This allows the capital appreciation of the asset to be taxed at the lower capital gains rate rather than the ordinary income rate. In addition, capital gains are not subject to self-employment taxes. While the capital appreciation of the tree is taxed as a capital gain, the value added by conversion of the asset to a product is ordinary income. In order to determine the capital gain on the trees harvested, the value of the trees must be established as of January 1 in the year of harvest. This value may be estimated by using a per linear foot value times the number of feet in the trees harvested, by using the value per standing tree, or by using the final harvest value discounted back to January 1. An example of this process can be found in Agricultural Handbook 718, Forest Landowners’ Guide to the Federal Income Tax. This publication can be ordered from the General Printing Office of the US Government or by downloading from www.timbertax.org. See also Revenue Ruling 77-229, 197-2 CB 210 at www.timbertax.org.

Preproduction Expenses

Since most Oklahoma landowners harvest trees before age six, they are subject to the Uniform Capitalization rules applicable to agricultural products such as fruit and nut trees, horticultural trees, etc. Under these rules, the cost of establishing the trees are treated as preproduction costs and recovered when the trees (crop) are sold. Preproduction costs include the costs that would be considered reforestation costs if the trees were planted for timber. This includes site preparation, planting, and seedling costs.

Farming operations, such as a Christmas tree farm, may elect out of the Uniform Capitalization rules and directly expense the cost of establishing the trees. If this election is made, however, capital expenses must use the alternative depreciation system (ADS) rather than MACRS. This will cause the taxpayer to be ineligible for Section 179 expensing and the bonus depreciation. See IRS Letter Ruling 9818006, January 6, 1998 and IRS Pub. 946, How to Depreciate Property.

Ordinary Operating Expenses

After the trees are established, ordinary operating expenses are taken as business or farm deductions. This includes such costs as mowing between the trees, maintaining fire lanes, spraying of herbicides to control weeds, etc. The costs of maintaining trees as Christmas trees, such as basal pruning, shearing, and pesticide treatment are deductible as ordinary operating expenses. See IRS Revenue Ruling 71-228, 1971-1 CB 53 at www.timbertax.org.
**Gifting of Christmas trees**

Often growers donate Christmas trees to churches, schools, or other charitable or nonprofit groups. When property that will be sold to generate ordinary income is donated, the value of the donation is the fair market value of the property less the ordinary income expected if sold on the market. This is generally the adjusted basis of the property.

For property that is a capital gain property or would result in a sec. 1231 gain (business property), the deduction is the fair market value of the property.

**References**

For tax purposes, Christmas tree farming has both farm and timber characteristics. If all trees are harvested at less than 6 years old from seed or cutting, the farming rules are more applicable. For trees harvested at greater than 6 years old, some timber rules apply. In addition to the sources cited above, Growers may be interested in IRS Publication 334 *Small Business Guide* and the IRS Publication 225, *Farmer’s Tax Guide*. All IRS publications may be ordered through the IRS hotline at or downloaded from www.irs.gov.
Farmer's Market/Sustainable Agriculture Session
Community Supported Agriculture

Doug Walton, Oklahoma Farmers’ Market Alliance
Muskogee, Oklahoma

Doug Walton serves as the President of the Oklahoma Farmers’ Market Alliance, a statewide association of farmers’ markets working together to inform growers and build successful markets. Doug is also the Board President for the Muskogee Farmers’ Market, where he farms and lives with his wife and two children. Besides having grown vegetables and herbs for sale at market and a local restaurant, he has conducted on-farm research of cover crops in cooperation with USDA and OSU researchers.

The term Community Supported Agriculture or CSA has been widely used in recent years to describe a situation where a farmer or group of farmers make a pre-season arrangement with customers, usually at the household level. CSA customers agree to buy a certain amount, or share, of products from the farmer(s) on a weekly basis throughout the growing season. The shareholders often pay for some or all of their upcoming year’s share at the beginning of the season, and therefore also share some of the risk with the farmer.

CSA farms first appeared in the U.S. in the mid 1980’s, and were patterned after other customer-driven farming models in place in Germany and Japan since the mid 1960’s. Today there at least four CSA’s in Oklahoma, and well over a thousand farms in the United States utilizing some variation of community supported agriculture. These farms range in size of customer membership from as few as 15 to 20 customers to as many as 500, or more. While many of these differ in the specifics of their organization, most all CSA’s share the common thread of a commitment between the farmer and customer; where the customer entrusts the farmer to provide a regular supply of seasonally available food. Shareholders also gain insight through this direct connection to the source of their food. In turn, the farmer enters the growing season with an established market of supportive community members, theoretically allowing the farmer to devote more time to production and less time to marketing.

One of the many distinctions between basic types of CSA’s revolves around the timing of customer payment. Often, CSA customers will be required to pay the farmer up-front for the full season of produce and other goods they hope to receive. This is the method that was predominately utilized in the CSA’s that formed early in the movement, and is still widely used today. By receiving a full season’s payment in the winter months, farmers are bestowed with much needed cash resources at an otherwise slow time of the year. These funds can help offset many of the operating expenses normally occurring at this slow time of the year, such seed buying, greenhouse operation, applying soil amendments and equipment maintenance and purchasing. It should be noted that CSA’s requiring pre-season payment will tend to attract customers who truly value their connection to the farmer, as well as attracting those who are simply more affluent but not necessarily dedicated. By receiving these monies before ever
producing a crop, farmers are assuming a fairly significant responsibility. One that has caused some farmers to consider other payment options.

The alternative to a full payment up-front is some type of periodic billing. Some farmers using this approach will require an initial deposit when customers sign up, but then bill biweekly or monthly once deliveries begin. This method obviously allows more financial flexibility in terms of customers who can participate, but it may also tend to attract more customers who are not as inspired about supporting a local farmer. Some CSA’s who utilize a “pay as you go” approach refer to themselves as “subscription farmers” and to their customers as subscribers.

Besides the differences in the relative timing of customer payments, some CSA’s offer alternative methods of payment, namely the ability of customer members to substitute their own time or labor for farm products. Some of the larger CSA’s rely heavily on this volunteer labor force to help weed, pick and distribute produce each week. However other farmers have mentioned excessive time requirements for training and supervising volunteers, as well as needing a willingness to have frequent visitors on the farm. The use of volunteers for assisting with deliveries does seem to be of interest among many CSA’s. One promising idea is that of giving food credit to customers who help sign up new members and/or help with arranging delivery/pick-up for their own geographic area such as a neighborhood, church or workplace.

While there are possibly as many different variations of CSA, as there are farms that are practicing it, most all participants in Community Supported Agriculture are involved in a process of creating their own local food systems. Besides giving consumers a direct link to the sources of their food, CSA’s provide farmers with a unique marketing and community building opportunity.

Some pointers offered by other CSA farmers to those producers who may be interested in starting a CSA include:

- Don’t start a CSA until you are a consistent grower, comfortable handling the particular soil and climate conditions at your farm.
- Talk to other CSA farmers to learn about various approaches.
- Start small, being careful not to sign up more members than you can adequately supply.
- Avoid giving too much produce at one time or too much of the same item over a period of time.
- Provide plenty of recipes for the items customers are given.
- Identify a “core group” of customers who may be willing to assist with various tasks.
- Consider working with other farmers to provide a wider diversity of products to your customers.
Doyle's Country Gardens

Burl Doyle
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My Grandfather came to Indian Territory in 1903 and lived in the territory for a period of time, but was removed back to Arkansas where he lived in the Winslow, Arkansas area until Oklahoma statehood. He returned to Oklahoma in 1908 and lived there for about 5 years returning to Arkansas.

My father and mother were married in 1913 and moved to Adair County, Oklahoma in the fall of that year. Purchasing a small tract of land my father began a blacksmith business that was supported by growing a variety of vegetable products and selling them to the merchants of both Westville and Stilwell, Oklahoma.

During the Great Depression and the dust bowl era, my father expanded his land holdings to a sizable tract of land. During World War II, dad contracted cordwood taken from the land, to Baron Charcoal Company. The newly cleared land was put to the production of green beans and tomatoes, which were all contracted to the government.

After the war, and with the development of refrigeration, a new industry moved into Adair County. The industry was the production of strawberries. Stilwell, Adair County, became known as the Strawberry Capital of the World.

In the 1950s, my brother and I became active in strawberry production, growing about 50 acres each year. Having only three varieties the harvest was over in a short time. This caused us to diversify our activities. We began growing a variety of summer vegetables, but mainly squash and tomatoes.

In 1969 I opened my first commercial greenhouse producing ornamentals, and bedding plants. This business has grown till today we have about 9000 sq. ft. of hot plastic production and about the same footage of cold frame. The key to a successful greenhouse operation is insect and disease control along with frugal temperature management. Be much more concerned about quality than about quantity. Quantity will come with quality.

We currently market about 1500 hanging baskets annually and don’t plan an increase. We produce 15 to 20 varieties of tomato plants that are sold retail and wholesale. About 2000 gallon pots are marketed retail annually. We retail and wholesale a variety of flowers, herbs, and shrubbery.

Currently we have 12 acres in strawberry production. Experimenting with different
varieties we have been able to extend the harvest from late April to mid June. For the 2004 season we will harvest 2 acres each of 6 different varieties. The key to success in the berry business is a long harvest season with quality fruit. This can only be attained by careful bed preparation, weed, and disease control. It is very important to use the available resources and expertise of your state agriculture university.

The type of bed development is of utmost importance it may vary with locality, but a raised bed is most common. Weed control is very important, but the berry itself is your most important problem. They will reproduce so much that they will destroy themselves. For maximum production of quality fruit, keep plants thinned to near four inches apart in the beds. Firmness of the fruit is necessary for its longevity on the market stands. This is obtained by the right time and analysis of fertilization.

Strawberries are extremely perishable with a shelf life of only hours. So have a ready market for them. Develop your market days or weeks in advance of harvest. A pick your own program has not worked for us, however several neighbors have successful pick your own programs.

In 2001 we planted 5 acres of blueberries that will begin production in the 2004 season. We planted 7 different varieties; the selection of these varieties will enable us to have an extended harvest of blueberries. We plan a pick your own program for the blueberries.

We are currently harvesting 5 acres of blackberries. The same procedure applies to the maintenance of the blackberries, healthy canes makes quality fruit. Stretch the harvest as much as possible through variety selection.

Our vegetable production ranges from a few plants per variety to acres of a variety depending on the market. We currently have about 10 acres devoted to vegetable production sold at the retail store north of Stilwell and the Muskogee Farmers’ Market.

For the last three years Doyle’s Country Gardens has produced about 3 acres of watermelons. We only grow three varieties, sugar babies, crimson sweet, and black diamond. We will make three plantings per year. The first plants are grown under heat and transplanted to the field the second week of April; this allows for harvest in late June providing for locally grown Fourth of July melons which brings a premium price.

Doyle’s Country Gardens opened a new 4000 foot produce outlet on Highway 59 north in Stilwell, Oklahoma in the spring of 2003 and are looking forward to a bright future in agriculture.
Growing a Cut Flower Business

By Mark Cain
Dripping Springs Garden, Huntsville, AR

For the past 19 years, my partner and I have operated an organic market garden in Carroll County, Arkansas, and have marketed into nearby Fayetteville through the Fayetteville Farmers’ Market. Established in 1974, this market is on the downtown square near the University of Arkansas, with markets every Tuesday, Thursday, and Saturday from April through November. Having access to a savvy clientele with an interest in both fresh produce and cut flowers has made it possible to carve out a niche market that continues to grow each year. Since this is a growers-only market, customers have the opportunity each market day to chat with the farmers about growing practices or special dishes prepared with their produce; farmers can continually learn from their customers what the public wants and is prepared to buy, and for how much. Each market day is an education for these town-dwellers and our rural producers, and for many it is the social highlight of the week.

We are primarily known at the Market for our cut flower bouquets, which are assembled into arrangements on-site to the delight of customers and onlookers. Selling this way requires more labor than selling pre-made bunches, but we have found that we simply do not have time on busy harvest days to assemble the hundreds of bunches necessary—and the public loves the entertainment we provide. On Saturdays during the height of the season, we need 3-4 people at our booth who can speedily arrange attractive bunches for customers who wait in line for their special bouquet. Sunflowers, tuberoses, gladiolus, crested celosia, lilies, and a few others are sold by the stem, but by and large most of our flowers are made into bouquets. Our price on bouquets for the 2003 season was $5, $8, and $12; special arrangements may be $20-$30 depending on the flowers used. It is important to be able to price by the stem also, since some customers will only want to buy a few zinnias or lisianthus. Growers should befriend a retail florist in their area and obtain the going prices for wholesale flowers in the florist trade in order to make informed pricing decisions. We always keep an eye on what other options our customers have when buying flowers—prices on bunches at the local supermarket, for example. Local growers can often supply a much superior product in terms of freshness IF flowers are properly harvested, stored, and transported.

Production Techniques

All of our cut flowers, vegetables, and herbs are produced in 4’ wide raised beds which are laid out on contour and range in length from 65’-100’. For many years these were managed with Troy-Built tillers, but two years ago we purchased a 28 HP Kubota tractor and a 51” Celli articulating spader for primary tillage of the beds. This Italian-made spader, originally purchased from Market Farm Implement (tel. 814-443-1931), works like a hand shovel on a crank shaft. Each spade shovel takes a turn entering the soil, so very little horsepower is needed to operate it. The spading action completely loosens the soil across the bed and its motion does not compact or smear the soil at the bottom.
of its travel. We have been very impressed with this tool, though in our gravelly soils one spading will not usually produce a fine seedbed, and the walk-behind tiller is used to do this. It does a great job working in our winter cover crops of wheat and Austrian winter peas. Other market growers we know own Imants spaders (Imants USA tel. 610-754-1110) with attached power harrow to form a seedbed in one pass. See the Acres, USA August 2001 issue for a complete discussion of spader models and uses.

Irrigation is accomplished via 8 ml T-tape with emitters spaced 4" on center. We use a minimum of 2 tapes per bed, often 3 per bed since our soil is so porous. Our usual suppliers for T-tape and fittings are DripWorks (tel. 800-522-3747) or Morgan County Seeds (tel. 573-378-2655). Water is pumped directly from the creek below the garden site with a 2HP electric pump, and passes through an Amiad filter with 155 mesh stainless steel screen before entering the main system. Since watering-in is necessary for new transplants, there are ¾" risers for garden hose at every other bed end. If overhead irrigation is required to establish new seedbeds that are direct-sown, or to supplement the drip tape during the driest periods, we will use oscillators or stationary rose sprinklers.

In addition to the annual winter green manures of wheat and winter pea, we normally will apply 25-30 lbs of pelleted chicken litter per 500 square feet to supplement fertility in the beds. This is available from Honeycrest Farm (tel. 479-248-2458) in Cave Springs, AR, at a cost of $150/ton.

We prefer to transplant the majority of our cut flowers (and many vegetables as well) rather than direct seeding. Transplants are produced in a 30' x 80' wood-heated greenhouse using Sunshine #2 mix (no nutrient charge) supplemented with Sustaine organic fertilizer, Atlas fish emulsion, and MaxiCrop soluble seaweed. Several years ago we began using 128-cell and 72-cell Winstrip trays (tel. 828-891-6226) in the greenhouse wherever possible, since they are long-lasting hard plastic and designed to prevent root circling (air-pruned on the bottom). Otherwise we still employ many conventional 50-cell tray insets to produce stocky transplants for the field.

Beds are prepared for planting, fitted with drip tape, then completely mulched-over with 3'-4' of clean wheat straw or weed-free (good luck!) hay. Holes are opened in the mulch and the transplants planted through the mulch and watered in. This is essentially the same technique as conventional black-plastic production using an organic mulch layer instead of plastic. It is not perfect in terms of weed prevention, but prevents further cultivation of beds during the season. Most beds will require 1-2 hand weedings during the summer, which can be enjoyable or not, depending on the weed pressure. We would not even think of not using mulch for weed suppression and water retention, given our porous soil. And the residual mulch is spaded in at the end of the season, giving the soil organic matter a boost. Of course, some few crops must be direct-seeded and cultivated more conventionally (in our case, with scuffle hoes): root crops and transplant-resenting species, for instance. Dahlias, lilies, gladiolus, garlic, potatoes, and other tuberous items can be planted and mulched over to come up through the mulch.
Successful market gardening requires plenty of practice in the field, through record-keeping, experimentation, and a good attitude. Direct-marketing to customers can be tremendously rewarding and educational. For us, the Farmers’ Market is one of the healthiest social events around. If you don’t have one, get one started!!

**Dripping Springs Garden Cut Flowers**

Tulips (primarily late Darwin hybrids)

Zinnias Benary’s Giants, Oklahoma, Envy, Cactus Mix, Persian Carpet


Bearded Iris assorted

Rudbeckia ‘Cherokee Sunset’, ‘Prairie Sun’, and ‘Indian Summer’

Gladiolus assorted varieties

Tuberose (single only)

Snapdragon ‘Rocket’ series (field), ‘Potomac’ series (greenhouse)

Static ‘QIS’ series

Ageratum ‘Blue Horizon’

Centaurea cyanus (bachelor button): ‘Blue Boy’, ‘Pinkie’, ‘Redman’

Marigold ‘Gold Coin’ series

Larkspur ‘QIS’ series, ‘Cloud’ series

Helichrysum ‘Swiss Giants’

Aster ‘Irresistible’

Artemesia annua (Sweet Annie)

Carnation ‘Grenadin’

Yarrow ‘Colorado’

Calendula ‘Indian Prince’

Nigella ‘Miss Jekyll’

Cosmos ‘Versailles’ series

Sunflower ‘Sunrich Orange’, ‘Superior Sunset’

Helenium ‘Red/Gold Hybrids’

Dianthus barbatus (Sweet William) ‘Electron’, ‘Super Duplex’, ‘Amazon series’


Liatris purple
Asclepias tuberosa (butterfly weed)
Gomphrena ‘QIS’ series
Narcissus assorted late bloomers
Bells of Ireland
Columbine ‘Barlow’ series
Lisanthus ‘Echo’ series (hoophouse only)
Stocks ‘Cheerfulness’ series (greenhouse only)
A Strategy for Weed-Free Onions, Part I

Anne and Eric Nordell
Beechgrove Farm, Trout Run, PA

Anne and Eric Nordell have been growing vegetables, small fruits and herbs in the mountains of north-central Pennsylvania for twenty years. Their horse-powered market garden has been certified organic since 1987, when they wholesaled most of their crops through an organic growers cooperative and distributors. Now they sell their diverse mix of cool season and root crops to restaurants, supermarkets and at a farmers’ market in nearby Williamsport, PA. They are frequent contributors to The Small Farm Journal, active members in the Pennsylvania Association for Sustainable Agriculture, and speakers at conferences across the country.

Onions can be a real challenge in terms of weed control because of their slow growth and sparse canopy. Given that our original goals for the farm included remaining debt free, keeping the market garden a two-person-operation, and relying on the internal resources of the farm as much as possible, we needed a way to reduce weed pressure in onions that relied more on management than off-farm inputs. We also needed an approach that carefully distributed our labor over the course of the growing season. We decided to lean heavily on the most available resource close at hand, namely the land.

It took us five years to develop the following system, which has kept in-the-row hand weeding of onions well below 15 hours an acre, regardless of the weather. The rewards for taking time to develop this system were two-fold: we could now afford to grow staple, storage items, such as onions, carrots and potatoes; and we could devote more time during the busiest months in the market garden to high value perishables and specialty items for restaurant sales and farmers market.

We begin weed control for onions a full year in advance of planting. This "fallow year" usually includes two winter cover crops sandwiching a bare fallow midsummer. We have tailored this cover crop / fallow sequence to take advantage of the growing-conditions on our farm and the life cycle of the weeds we needed to control.

The cover crop / fallow sequence leads off with rye established after the previous cash crop in the rotation. If circumstances prevent us from planting rye in the fall, then we plant oats the following spring. We manage these small grain covers by clipping them repeatedly before they shoot to head. Mowing them at this time encourages them to tiller and re-grow, creating a mulch effect. This shot captures the second clipping of rye at the end of May 1992. Cut-and come-again cover crop management prevents spring weeds, such as the mustard family, from setting seed and makes incorporation of the cover crop easier than letting the rye grow to its full height of four to- five feet.
We plow the first cover crop down after it has put on the bulk of its bio-mass but before summer weeds have had a chance to set seed. For rye, in our climate, that means after the third clipping at the end of June; for oats, after the second clipping in mid-July. Incorporating these carbonaceous residues during the biologically active summer months gives them plenty of time to break down without robbing nitrogen from the next spring’s crop of onions. This may-seem farfetched, but we think the soil has less "need" to grow weeds when we use these high carbon cover crops and their aggressive root systems to repair the damage done to soil structure by the preceding cultivated crop.

More to the point, plowing deeply at this time of year targets perennial weeds at the weakest point in their life cycle. Likewise, harrowing the ground every two to three weeks during the following bare fallow period brings the roots and rhizomes of perennial weeds to the surface to dry in the sun. This frequent harrowing also prevents annual weeds from getting established at a time of year when they are likely to grow quickly and run to seed. As a result of religiously fallowing our fields every other year this way, quackgrass no longer exists in the market garden and broadleaf weeds like pigweed and lambsquarter are rare visitors. In fact, in recent years we have been able to reduce the bare fallow period to as little as two to three weeks without sacrificing weed control.

However, the transition from very manageable to minimal weed pressure was only realized when we began composting the horse manure before using it to fertilize the fields. The composting process kills most weed seeds in the manure and bedding, and the resulting stable soil amendment does not seem to stimulate weed growth in the fields like fresh manures or fast-acting fertilizers. Applying the compost during the fallow year gives it more time to break down before early planted cash crops, saves a step in spring, and enhances the root and top growth of the second soil improving cover crop in this fallow sequence leading up to onions.

The bare fallow ends the first or second week of August when we seed down the field to the second cover crop. This planting date takes advantage of the fact that most annual weeds which germinate now are likely to frost kill before setting seed here in the mountains of north-central Pennsylvania. Our preference of a cover crop before onions is Canadian field peas because they fix nitrogen, put on a lot of top growth in fall and tend to die back over winter.

The big advantage of winter-killed cover crops is that they are so easy to incorporate first thing in spring, making timely planting of onions more dependable. Thanks to winter-killed field peas, we got the 1993 crop in the ground in plenty of time despite receiving two inches of rain every week that spring.

In terms of weed control, an easily incorporated cover crop allows us to restrict tillage to just the top two to three inches of the soil. For example discing the winter-killed field peas lightly is not as likely to bring new weed seeds to the surface as plowing or rotovating deeply. Keeping the residues near the surface also helps with erosion and
moisture control.

By the middle of June, 1993, we had yet to do any in-the-row hand weeding at this time even though the extremely wet conditions extended through May. We usually do plan on cultivating onions three or four times. But because we have been able to reduce weed pressure during the previous fallow year, we target cultivation more for moisture control than weed control. That means getting into the fields as soon as possible after a heavy rain to break the crust and create a mulch of loose soil around the plants to slow evaporation.

Three hot, rainless weeks later, we spent a total of six hours hand weeding this half-acre field by the time harvest was complete the middle of August. By hand weeding, we mean simply walking the field and pulling those few weeds that threaten to go to seed; not a rescue effort to save the crop. Nor is this an attempt to completely clean the field of weeds. Those weeds that manifest themselves later in July or August, such as blown-in dandelions, volunteer clover and a few smartweed, will be plowed down after harvest when preparing the field for seeding the winter cover crop and starting the fallow cycle over again.

Keep in mind that a single fallow year is not likely to work miracles, and that the types and timing of cover crops to get this kind of control will depend on your climate, soil and weeds. For example, we can well imagine that the bare fallow period between two winter cover crops might be excessively long in a warmer climate than ours, causing unnecessary damage to soil structure. By the same token, the life cycle and growth habits of winter weeds might require a very different cover crop/ fallow sequence than the one we have described for controlling weeks like quackgrass, landcrest, pigweed and lambsquarter.

We learned this firsthand the past two years when we saw chickweed creeping into the field slated for onion production. Based on past experience with isolated patches of this intruder, we were afraid our usual sequence might proliferate rather than control chickweeds since it sets seed well ahead of the normal bare fallow period. Chickweed is also too low growing to control by mowing. So, we plowed down the first cover crop prematurely before the chickweed had a chance to re-seed. We planted a cover of quick-growing buckwheat the first of June to avoid an extended bare fallow period, and followed the buckwheat with the usual fall cover of winter killed field peas. Both years, this outwitted the chickweed.

To be truthful, some of our time is tied up managing the cover crops and that needs to be figured into the labor equation. As we see it, the total hours devoted to cover crop management are a small fraction of the time spent hand-hoeing an otherwise weedy crop of onions. Besides, we find the fieldwork involved is a welcome balance to all the stoop labor that goes with market gardening. Of more practical importance, this integrated approach to weed management allows us to spread the weed control effort
over the course of the growing season to suit our schedule rather than letting the weeds set the pace.

While many growers may feel they cannot afford to idle productive land for weed control alone, bear in mind that the cover crops in the fallow fields serve many purposes. We count on cover crops to help restore fertility, structure and moisture holding capacity after cultivated cash crops. And we depend on them to minimize erosion, interrupt the cycles of insects and disease and attract beneficials. The beauty of the fallow years is that it gives us the opportunity to use the cover crops to their fullest potential, in this way increasing biodiversity on the farm.
"A Strategy for Weed-Free Onions" describes the cover crop sequence of rye/bare fallow/winter-killed peas we use in the fallow year before EARLY planted cash crops like onions, spring spinach, lettuce and snap peas. In the fallow year before LATE planted cash crops like tomatoes, squash, main crop potatoes, or fall greens, we employ a cover crop sequence of clover/bare fallow/rye and vetch. Alternating the cash crops between those planted EARLY and LATE sets in motion these two distinct cover crop sequences which help to keep weeds off balance and adds more diversity to the overall farm system.

The four-field photo shows how the cover crop sequences and cash crop rotation work together. For instance, in this shot taken around the fourth of July in 1991, you see a cover crop of yellow sweet clover in the fallow field to the left. The clover is fixing nitrogen and building soil structure for the next year's heavy feeding cash crops of late-planted mixed vegetables, such as squash, celery, tomatoes, and corn. To the right, winter hardy rye, seeded after the previous year's late planted cash crop, has been plowed down to begin the bare fallow period. We count on the summer fallow, in conjunction with the cover crops, to create weed-free conditions for the next year's crop of early-planted onions to the far right. To start the rotation over again, we seed the clover directly into-or immediately after-these early cash crops so the clover is well established before winter.

By the time we plow down the sweet clover the next July, almost a full year later, the tap roots have tilled and fiberized the soil much deeper than plow depth or the root zone of most market garden crops. If we can use the cover crops to improve soil structure, then the weeds, which often come in to perform this important role, have less reason to grow.

The four-year rotation then repeats itself three times over the twelve-field market garden. We simply substitute different cash crops into the EARLY and LATE slots as shown in the chart below the black line. Even the depth of tillage can be rotated to the benefit of the crops and discouragement of the weeds.

Reducing the depth of tillage enhances the moisture conserving potential of the cover crops we grow in the market garden by creating a mulch of cover crop residues at the soil surface. This mulch slows evaporation and preserves the soil structure created by the cover crop’s root system. At the same time, surface tillage provides enough soil disturbance to use our existing equipment for seedbed preparation, planting and cultivation, and to warm up our mountaintop soils. For some crops, we have also been
able to reduce the frequency, intensity and zone of tillage by using five distinct cover crop-tillage combinations tailored to specific planting windows:

FOR OVERWINTERING COVER CROPS
1. Skim Plow rye/hairy vetch or Italian ryegrass/clover in early April for cash crops planted late May / June.
2. Ridged Rye surface tilled late April for cash crops planted late June or early July.

FOR WINTER-KILLED COVER CROPS
1. Mulch-Tilled oats/Canadian field peas or sorgham-sudan grass/forage soybeans for cash crops planted the end of April and May.
2. Ridge-Tilled/No-Till oats for the earliest direct seeded and transplanted cash crops of the season.

Of course, the details of the rotations and tillage practices have changed over the years as we adapt to the changes in the climate, marketplace and insect pressure. The principle we keep in mind as we fine-tune the system is simply to rotate the types and timing of cover crops in the fallow fields to create the best conditions and control for the cash crop to follow. In this way we have been able to maintain our original objective of substituting land for off-farm inputs and pain labor.

This land-extensive, or bio-extensive, approach to market gardening is much easier to visualize in the slide presentation we had videotaped at the 1996 Pennsylvania Association for Sustainable Agriculture Conference. The 52-minute video also includes segments on designing the market garden with workhorses in mind, deer control, marketing, and animal-powered composting. Tapes are available for $10 (which includes postage) from Anne and Eric Nordell, RD I Box 205, Trout Run, PA 17771.
Fruit Session
The University of Arkansas blackberry breeding program has released eleven varieties thru 2003, offering a range of thornless and thorny choices for growers. These varieties are important in Arkansas and Oklahoma, in addition to many other areas of the U.S and other countries. These are all floricane-fruiting types, which fruit on second-year canes. Overwintering the canes is required with this type and the fruit is normally harvested from late May to late July, depending on location and variety. The UA has been working to develop a primocane-fruiting (PF) blackberry. This type of plant bears fruit on current-season canes, known as primocanes. Plants of this type are envisioned to be similar to that of PF red raspberries, in which fruit is produced in late summer and possibly until frost.

There are no PF blackberry varieties available commercially at the time of this writing. However, an old wild-selection, known as Hillquist, has the PF trait. This variety was discovered in Virginia, and was used in crossing at the University of Arkansas in the mid-1960s. Its hybrids did not exhibit PF, however. In the early 1990s, the selection A-1836 was found in a seedling field, and expressed the PF trait (it lacked in many other characters however). Jose Lopez-Medina, a Ph.D student at UA in the 1990s, investigated the inheritance of the PF trait. In his research he found the trait to be recessive in inheritance, thus the reason that the original Hillquist hybrids did not express the trait. From the seedlings used in his study, a number of the plants expressed PF (A-1836 was a parent in his studies). This was due to the recessive gene for this trait being present in some genotypes (but still floricane-fruiting) in the Arkansas program, and when crossed with A-1836 yielded some PF seedlings. Thirteen selections were made in 1997 from his seedlings that exhibited the PF trait. Following evaluation of these selections, two have been identified to be released in 2004.

The two selections, APF-8 and APF-12, fruit on both floricanes and primocanes. The summer crop is borne in June (rather early near that of Choctaw), and the primcane crop begins ripening in late July and on into the fall. They have been observed to fruit until frost in most trials.

Floricane yields have been found to be very high for these selections, as high as those for some of the most productive floricane-fruiting types released from the program. They usually begin ripening in early June at Clarksville, and finish by the end of June. Fruit size averages 5 g for these. Fruit quality and flavor is good, although the postharvest handling performance of these is similar to the Arkansas thorny varieties, and not as firm as the thornless options. This limits the shipping capability of the PF selections.

Primocane-fruiting performance has varied greatly with these selections. In trials at Clarksville and Hope, the summer heat of July until early September contributes to poor fruit set, small fruits and poor fruit quality in most years. Fruit size is often 3-4 grams in
trials at these locations. The heat effect is worse at Hope, a warmer location compared to Clarksville. At Fayetteville, they perform better in most years, due to routinely cooler temperatures compared to the more southern locations. Fruit size can still be reduced at Fayetteville, although in 2003 a few fruits had a weight of up to 15 grams for APF-8 in August, showing the size potential that can be achieved. Testing south of Portland, Ore., at the Oregon State University North Willamette Research and Extension Center, has shown these selections to be well-adapted to this more moderate climate. Primocane fruit yields have been recorded that surpass those in Arkansas by 5 to 10 fold. Fruit size is larger in Oregon also, up to 10 g per berry in some years. This enhanced performance is attributed to the more moderate summer temperatures at that location, allowing better fruit set and development compared to Arkansas. This heat limitation is also anticipated to be a concern in all areas with high summer temperatures during bloom. It appears that several consecutive days with temperatures of 85F or above a very negative effect on the PF selection performance.

These selections will be recommended for home garden use, and limited commercial trial. These are not envisioned to be used by commercial growers in the southern U.S (or other high summer temperature areas) due to the high heat limitations. They may have more potential for commercial fall production for local fruit sales in moderate climate locations, however.

The plan for these selections is for them to be released in early 2004, and a limited number of plants available for purchase in summer of 2004. The first plants will be given a priority for licensed nurseries to purchase to establish propagation plantings. These will be patented, and likely trademarked, and nurseries licensed for propagation. Names for these selections have not been designated, but will be assigned upon official release.

Breeding for PF blackberries is progressing vigorously. The second generation hybrids show marked improvement for several traits, such as fruit firmness, primocane crop, improved fruit set, and fruit size. Third generation hybrid seeds have been produced, and it is hoped that more rapid improvement will be seen. Also, the moving of the many traits from the floricane types, including flavor, firmness, thornlessness, and other traits is being done, through hybridizing the PF types with the floricane fruiters. These intermediates will then be crossed back to PF types to recover improved PF selections. It is anticipated that the coming years will yield great improvements over these original releases.

Thanks are expressed to Dan Chapman, Kenda Woodburn, and the staff at the University of Arkansas Fruit Substation, Clarksville, and Manjula Carter and associates, located at the UA Southwest Research and Extension Center, Hope, for their assistance in the evaluation of these selections, and for maintaining the evaluation plantings.
Potential New Low-Acid Peach Releases from the University of Arkansas

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The University of Arkansas peach and nectarine breeding program emphasizes fresh-market-type fruits for use for local, and possibly shipping markets. Major objectives include bacterial spot resistance (no bacteriacides are used in the evaluation orchards), overall good plant health, good productivity, and also a focus on selection for later-blooming genotypes. For peaches, white flesh types are the major emphasis, both standard and low acidity. Firm flesh, a range of flavors, cling and freestone, all are included in the peach improvement emphasis. Nectarine improvement includes yellow and white flesh, with melting and non-melting types in the program. A minor effort is also put forth in improving flat or “saucer” peaches and nectarines, also known as peen-tao or peen-too types.

Three nectarine varieties, Arrington, Bradley, and Westbrook, were released in 2000 from the program. These offer a range of ripening dates beginning about June 10 (at Clarksville, Ark.) for Westbrook, to July 1 for Bradley. These all have yellow flesh, with Westbrook a melting flesh type, and the other two non-melting types.

White River peach was released in 2002, the first fresh-market peach from the breeding effort. It ripens about July 20, and has very good flavor with standard fruit acidity. It is resistant to bacterial spot, and has shown high yields in trials. It is a freestone, melting-flesh fruit.

Two additional selections are in final consideration for release. These are described briefly as follows.

The low-acid selection A-658 is an early ripening white peach, maturing about June 24. It has a light, white peach flavor. The fruit is non-melting, very firm at maturity, and is a clingstone. Fruit size is greatly enhanced with proper thinning. Bloom date of A-658 averages March 27, four days after Redhaven. It has shown heavy crop load potential, as well as holding well on the tree when mature. It has shown slight bacterial spot on leaves in some years, but overall is quite resistant to this disease overall. It is envisioned to be an early white peach option for growers, to complement early yellow-flesh varieties. It has not been tested for storage potential, but may perform well in storage based on its very firm flesh characteristic.

A second low-acid, freestone selection under final evaluation to release is A-678. This is also a low-acid peach with very nice white peach flavor. Fruits are large, and very firm
even at maturity although a freestone-type fruit. It ripens on average June 13, a few
days before White River. Crop load potential is good with this genotype and it has been
a reliable producer in Arkansas trials. Bloom date averages March 26, three days after
the average for Redhaven. Slight bacterial spot is seen at times on leaves, and one
year a slight infection on fruit was seen; however, resistance is quite good for this
selection.

Final decision on release is planned for winter/spring of 2004. Upon approval for
release, these will have plant patents filed, and budwood made available to licensed
nurseries for budding and subsequent tree sales. If the described plan is followed, trees
of these selections will be on the market in winter/spring of 2005.

Names for these selections have not been designated, but will be assigned upon official
release.

Thanks are expressed to Dan Chapman, Kenda Woodburn, and the staff at the
University of Arkansas Fruit Substation, Clarksville, and Manjula Carter and associates,
located at the UA Southwest Research and Extension Center, Hope, for their assistance
in the evaluation of these selections, and for maintaining the evaluation orchards.
FRUIT ENTERPRISE BUDGETS FOR 2004

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Roger Sahs has been employed with the Oklahoma Cooperative Extension Service since 1985 and currently serves as an extension assistant with the OSU Department of Agricultural Economics.

Management is the most important factor in the success of any agricultural production activity with profit maximization traditionally assumed to be the overriding goal in most management decisions. Peaches are a significant fruit crop in Oklahoma and within the past few years, wine grapes have been added to many operations in the hopes of increasing farm profit. Lacking the information needed to make perfect decisions, specialty crop producers are forced to use the best information available and take calculated risks. Like a puzzle, an enterprise budget brings to the table an important piece that will help address how available resources best fit together on the farm. Specific questions such as how and what to produce, production levels, and achieving goals can then be answered once the puzzle is completed.

Enterprise Budgets

An enterprise budget estimates the full economic costs and returns projected to accrue to an activity - raising livestock, producing grain, growing fruit - for some period, generally one year. They facilitate comparisons of profitability while documenting resources, management practices and technology used in production. Among the various uses for enterprise budgets are:

1. First step in developing business/marketing plan.
2. Evaluating options before a commitment of owned or controlled resources.
3. Estimating the size of farm needed to earn a specified return.
4. Uncovering costs that have not been previously considered.
5. Estimating potential income for a particular farm.
6. Comparing the profitability of two or more different systems of production.
7. Estimating the amount of rent that can be paid for land or machinery.
8. Identifying production and financial risks and whether they may be managed.

Providing the documentation necessary to obtain/maintain creditworthiness.
Projecting cash flows for a specific period of time
Enterprise Budget Software

Budget software tools offer valuable decision support in assisting producers with farm and financial planning. With funding support from the Samuel Roberts Noble Foundation and the USDA-Risk Management Agency, enterprise budget software for major commodities have been under development at Oklahoma State University based on Microsoft Excel spreadsheet templates. This management tool provides users access to important agricultural references during an “interactive” budget building process.

Through a series of pop-up menus and available references, a base budget may be tailored in order to fit any particular operation. References consist of OSU fact sheets and current reports, Oklahoma Agricultural Statistics data, and, in some cases, expert opinion. Where possible, web-links are built into the spreadsheets to connect users who have Internet access.

A one-page report summarizes key production items and prices, operating and fixed costs, plus breakeven prices and yields. In addition, a variety of reports may be generated and printed that provides detailed cost and return information. Price and yield sensitivity tables may also be viewed to measure the risks associated with price and yield variability.

OSU enterprise budget software may also be used to generate cash flow budget files for Integrated Farm Financial Statements (IFFS) 2000 software. This compatibility provides an integral link to whole farm and ranch financial statements and plans.

Sources of Budget Information

To enhance their use as a decision aid, fruit budgets should be based on the best information possible. And many times, that begins with the operator’s own records. Their reliability as a planning tool is only as good as the quality of the data. Keep in mind that experiences from one year is only an indicator and not a guarantee of a future occurrence. Other sources of information are:

Books on fruit production and industry.
Fruit organizations.
Other fruit producers.
University specialists, educational materials, and meetings.
Fruit production websites on the Internet – www.pearl.agcomm.okstate.edu
Internet search engines – www.agrisk.umn.edu

Oklahoma State University crop and livestock enterprise budget software is currently
available via the Internet or CD-Rom. Horticultural budgets will be available soon. The CD-Rom contains all selected enterprise budgets, instruction manual, and supporting information references in Adobe Acrobat. Media and mail fees are included in the purchase price. Online purchasers will be notified via email as to their login name and password needed to access budget files and other supporting information. Purchases include periodic material updates for one year after which annual update subscriptions will be available for a fee.

For more information, contact your local County Extension Office, Area Agricultural Economics Specialist or on campus:

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A website containing more information may be found at: www.agecon.okstate.edu/budgets.

**Summary**

Although managers lack the information needed to make perfect decisions, they are forced to make decisions on the basis of information available and must accept the risk associated with that decision. Enterprise budgets are the foundation for risk-management decisions. Through the use of historical data, specialists' recommendations, and current prices, OSU enterprise budget software provides the user an interactive method to customize budgets and generate information needed to supplement farm records. Knowledge of budgeting and the ability to use them will help them make the right decision.
Size controlling apple rootstocks for high density orchards in the Arkansas-Oklahoma region: Results of the 1994 NC140 Uniform apple Rootstock Trial

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Introduction:

In order for fruit producers to be economically sustainable in the Arkansas-Oklahoma region, they must develop orchards that come into production quickly, are easy to manage and maintain, and may be adaptable to labor or pick-your-own harvest. Thus, fruit growers should consider high density orchards. Our previous research has indicated that orchards in the range of 600 - 800 trees per acre maximize production and minimize labor using traditional, central leader training systems such as the vertical axis. However, to establish orchards of the appropriate densities and have production characteristics of early production of high quality fruit, it is essential to select the appropriate rootstocks. Thus, rootstocks must be locally tested and demonstrate good characteristics of survival, precocity and fruit size.

As part of the NC140 national uniform tree fruit rootstock evaluation project, apple rootstock trials in Arkansas have been planted in 1984, 1989, 1990, and 1994. These studies have developed site-specific information that provides information eliminating unadapted rootstocks, indicates adaptable rootstocks, and gives practical insight into the management of those rootstocks. These sort of trials are absolutely necessary to support fruit production in this region. The trials provide growers both information and observations of rootstock performance that may fit their production systems. This report is a summary of the 1994 dwarfing apple rootstock trial in Arkansas.

Methods

A trial of ‘Gala’ on 18 dwarfing rootstocks was planted at the University of Arkansas, Agriculture Research and Extension Research Farm, Fayetteville, in 1994, as part of the NC140 Uniform cooperative tree fruit research project. The trial was also planted at 24 other locations in North American (19 states, some with multiple test sites, and 3 Canadian provinces). The site used for the study had not previously been used for orchards but had been used for ornamental plants. However, during the planting process, it was determined that the orchard site was the site of a barn and tractor facility from the 1940s until the 1960s. The site was a Captina silt loam soil with natural pH at
planning of 5.5-5.8. Prior to planting, soil was deep-ripped and tree rows were cultivated. Fescue (‘K-31’) was planted in tree row middles.

Trees were planted at a spacing of 2.5 x 4.5 m (8’ x 15’). Trees were trained to a vertical axis training system using a single wire at 3m (9.5’) height with a single bamboo pool being attached to the wire and the tree trunk. A herbicide strip of 1.5m (5’) was maintained by annual applications of residual and contact herbicides. Trees received supplemental trickle irrigation, annual fertility and standard pest control management. Trees did not crop in the first two seasons (1994, 1995), but were allowed to crop thereafter.

Rootstocks used in the trial (Table 1) represented commercially available stocks which may be useful for high density plantings. In the test were a number of M9 clones including M9 EMLA, Nic29, Pajam 1, Pajam 2, T337, and FI56.

Annually trees growth was measured as tree height, spread (average of in-row and across-row), trunk cross-sectional area at 25 cm (10”) height. Beginning in the third season, fruit were harvested and total yield and average fruit size of a 25 fruit sample determined. From total yield and trunk cross-sectional area, annual and cumulative yield efficiencies were calculated. All data are reported in table 1.

Observations and Results

Weather Extraordinary weather in some years had a significant impact on this trial. A record cold temperature in March 1996 resulted in bud damage and thus lighter bloom than anticipated. A bloom-time frost in April 1997 resulted in moderate to poor fruit set and no fruit thinning was used. Bloom in 1998 was about one week earlier than normal due to warm spring conditions followed by severe heat and drought during the period of July through September. Sun burn and summer rots were prevalent in 1998. A bloom-time frost occurred in 2000 followed by record precipitation during May through June. Trees showed some flood stress during this period. However, this was followed by severe drought and heat July through September resulting in sunburn and severe summer rots limiting cropping. In 2002, bloom and post bloom conditions were cool and wet. A frost occurred during bloom followed by a severe epidemic infection of fireblight which limited tree growth and cropping. In 2003, a frost limited cropping and thus no fruit thinning was practiced.

Survival and Growth Tree survival in this trial was not good, less than 60% overall, due to a number of factors including, poor soil (result of fuel-oil tainted ground), a lightening strike (1996), and wind shear that broke trees in several rows in two different seasons. However, some notable observations can be made.
Trees on Mark and Ott.3 had only 30% survival during the 10-year trial. This low survival is consistent with low survival of these stocks in other trials we have conducted. Trees on P16 also had only 30% survival. A number factors led to this low survival. Ott3 appeared to die over the trial from fireblight, other undetermined root rots. Mark, known not to tolerate hot and dry conditions, had the greatest tree loss in seasons where those conditions occurred. As a result of poor survival, these rootstocks (Mark, P16, and Ott3) cannot be recommended for this region.

The best overall survival was on FL56 (90%) and B9, B491, and Pajam 1 (80%). Trees on M9 and its clones had average survival of approximately 70%, better than average in this trial.

The largest trees based upon trunk cross-sectional area (TCSA), height and spread were grown on the rootstocks V1, Ott3, M26, and M9. TCSA is a good index of total vegetative growth of a tree. Of the M9 clones, only Pajam 1 tended to be larger than standard M9 EMLA while other clones were similar in size or tended to be smaller than M9 EMLA. B9, although producing significantly thinner trunks (about 40% less) than M9 produced trees that were only about 10% shorter or narrower.

**Cropping: Yield and Fruit Size**  Trees exhibited a bit of a biennial bearing pattern with larger yields in 1997, 1999, 2001, and 2003 than the years prior or succeeding. Yields in 2000 were very light due to the large amount of sunburn, summer rots, and early fruit drop due to the very high temperatures experienced that year. In 2002, yields were suppressed by a very severe epidemic of fireblight, and poor codling moth control which led to significant tree and fruit damage.

Yield per tree appeared to followed tree size and was significantly correlated to TCSA and canopy volume/surface area ratio. Thus, trees on M26, V.1, Ott.3, and M9 had the greatest yield. Yields of the M9 clones were somewhat similar although trees on Nic29 and Pajam 1 had yields greater than M9 EMLA and trees on T337 and FL56 had yields a bit less than M9 EMLA. Trees on B9 had a cumulative yield 35% less than M9. In the last season of the trial, trees on Nic29 and Pajam had the largest yield per tree and represent a significant production potential of those rootstocks. Fruit size and crop load are typically inversely related. However, rootstocks that produced consistently the largest fruit size with the largest crop were trees on M26, Nic29, Pajam 1, and Pajam 2. Trees on P16 produced large fruit but had a large annual variation and relatively small yields.

Yield efficiency, yield per TCSA, is an indicator of production potential as it is a
comparison of the amount of fruit relative to the amount of vegetative growth of the tree. Trees with the highest cumulative yield efficiency were B9 and Ott.3. Trees on Mark and FL56 had the lowest yield efficiency but for different reasons. Trees on Mark were relatively nonproductive while trees on FL56 grew vigorously even though having adequate yields. There was very little difference among the clones of M9 for yield efficiency.

Trees on P16, V1, Nic29 and Pajam 1 all produced more root suckers than the other stocks, but only about 2-3 root suckers per tree per year. Suckering was not a problem in this trial.

**Summary and Conclusion**

The majority of the rootstocks tested in this trial appear useful in high density orchards in this region. Potential rootstocks and matching planting densities are suggested in Table 2. For moderate density orchards, M26 and M9 are both adaptable. Trees on M9 and trained to a vertical axis may be planted at densities up to about 800 trees per acre. At higher densities with a vertical axis system B9, B469, and P22 may be used. M9 has been shown in other regions of the country to be adaptable to super-spindle, ultra high density plantings of 1500-3000 trees per acre but these systems have not been tested in this region and are not recommended at this time.

**Additional Resources**

NC-140 Website: [http://www.nc140.org/](http://www.nc140.org/)


Table 1. Summary of 10 years growth and production of ‘Gala' on 18 dwarfing rootstocks in the 1994 NC-140 Uniform Cooperative Trial, Fayetteville, AR.

<table>
<thead>
<tr>
<th>Rootstock</th>
<th>Survival (%)</th>
<th>TCSA (cm²)</th>
<th>Ht. (m)</th>
<th>Spread (m)</th>
<th>Cumulative Yield (kg/tree)</th>
<th>Average Fruit Size (g)</th>
<th>Avg Var in Size (g)</th>
<th>Annual Yield Efficiency (kg/cm²)</th>
<th>Cumulative Yield Efficiency (kg/cm²)</th>
<th>Root Suckers</th>
<th>Annual (no)</th>
<th>Cumulative (no)</th>
</tr>
</thead>
<tbody>
<tr>
<td>M26</td>
<td>50</td>
<td>96.3</td>
<td>4.0</td>
<td>3.1</td>
<td>289</td>
<td>134.0</td>
<td>27.2</td>
<td>0.811</td>
<td>3.1</td>
<td>0.3</td>
<td>3.0</td>
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<tr>
<td>M9</td>
<td>50</td>
<td>89.1</td>
<td>4.1</td>
<td>2.9</td>
<td>268</td>
<td>122.8</td>
<td>20.8</td>
<td>0.824</td>
<td>3.1</td>
<td>1.0</td>
<td>9.6</td>
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<td>M27</td>
<td>60</td>
<td>23.4</td>
<td>2.1</td>
<td>1.4</td>
<td>59</td>
<td>117.3</td>
<td>19.2</td>
<td>0.901</td>
<td>2.6</td>
<td>0.3</td>
<td>2.8</td>
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<td>Mark</td>
<td>30</td>
<td>46.6</td>
<td>2.8</td>
<td>1.8</td>
<td>92</td>
<td>110.6</td>
<td>28.1</td>
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<td>P16</td>
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<td>117</td>
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<td>37.9</td>
<td>0.870</td>
<td>2.9</td>
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<td>P2</td>
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<td>67.0</td>
<td>3.4</td>
<td>2.5</td>
<td>182</td>
<td>129.0</td>
<td>15.0</td>
<td>0.768</td>
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<td>0.2</td>
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<td>P22</td>
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<td>44.4</td>
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<td>2.0</td>
<td>97</td>
<td>126.5</td>
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<td>B9</td>
<td>80</td>
<td>52.4</td>
<td>3.1</td>
<td>2.3</td>
<td>173</td>
<td>119.9</td>
<td>20.4</td>
<td>0.904</td>
<td>3.3</td>
<td>0.1</td>
<td>1.4</td>
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<tr>
<td>B491</td>
<td>60</td>
<td>48.1</td>
<td>2.7</td>
<td>2.4</td>
<td>120</td>
<td>128.7</td>
<td>17.9</td>
<td>0.949</td>
<td>2.9</td>
<td>0.1</td>
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<td>B469</td>
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<td>2.0</td>
<td>129</td>
<td>123.2</td>
<td>16.2</td>
<td>0.803</td>
<td>2.7</td>
<td>0.5</td>
<td>5.1</td>
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<td>OTT3</td>
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<td>4.0</td>
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<td>283</td>
<td>134.3</td>
<td>24.7</td>
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<td>3.9</td>
<td>3.0</td>
<td>321</td>
<td>129.7</td>
<td>23.7</td>
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<td>NIC29</td>
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<td>3.7</td>
<td>3.0</td>
<td>340</td>
<td>133.1</td>
<td>17.8</td>
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<td>101.4</td>
<td>3.8</td>
<td>2.9</td>
<td>307</td>
<td>133.2</td>
<td>23.5</td>
<td>0.843</td>
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<td>3.2</td>
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<td>28.8</td>
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<td>262</td>
<td>131.4</td>
<td>19.8</td>
<td>0.783</td>
<td>2.9</td>
<td>0.9</td>
<td>8.8</td>
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<tr>
<td>FL56</td>
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<td>83.0</td>
<td>3.7</td>
<td>2.6</td>
<td>204</td>
<td>134.7</td>
<td>21.5</td>
<td>0.730</td>
<td>2.5</td>
<td>1.7</td>
<td>17.2</td>
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<tr>
<td>Average</td>
<td>71.2</td>
<td>3.4</td>
<td>2.5</td>
<td>207</td>
<td>128.4</td>
<td>22.6</td>
<td>0.823</td>
<td>2.9</td>
<td>1.1</td>
<td>11.1</td>
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</table>
Table 2. Approximate Planting densities, spacings, and their appropriate apple rootstocks for use in high density vertical axis plantings in the Arkansas and Oklahoma Region.

<table>
<thead>
<tr>
<th>Trees/Acre</th>
<th>500-750</th>
<th>600-800</th>
<th>800-1000</th>
<th>1000-1200</th>
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<tr>
<td>Row Spacing (ft)</td>
<td>15-10</td>
<td>12-8</td>
<td>8-10</td>
<td>8-10</td>
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<tr>
<td>Tree Spacing (ft)</td>
<td>6</td>
<td>6-5</td>
<td>5-4</td>
<td>4-3</td>
</tr>
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<td>Rootstocks</td>
<td>M26 Ott.3, V1 M9 EMLA, Nic29 Pajam 1, 2 Fl56 B491, B9</td>
<td>Pajam 1 M9EMLA, Fl56, T337 P2, B9, P16 B469, P22</td>
<td>P2, P16, P22 B9, B469 T337</td>
<td>P22, Mark, M27</td>
</tr>
</tbody>
</table>
Weather-Based Decision Support Tools from the Oklahoma Mesonet

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Dr. J. D. Carlson serves as agricultural meteorologist for the Oklahoma Mesonet, Oklahoma’s automated weather station network. Working in the Biosystems and Agricultural Engineering department at OSU since 1991, he provides research and extension support for weather-based applications in agriculture and natural resources.

A joint effort between Oklahoma State University and the University of Oklahoma, the Oklahoma Mesonet is Oklahoma’s automated weather station monitoring network of 116 remote sites. There is at least one station in every county, with an average station spacing of 19 miles (Figure 1). In meteorological terms, this spacing falls in the “mesoscale” range of distances; hence, Mesonet is a “meso”scale “net”work. Also, in terms of frequency of data reporting, the time scales fall in the mesoscale range, with weather and soil data being reported every 15 minutes. The Oklahoma Mesonet has been operational since 1994.

Figure 1. Locations of stations in the Oklahoma Mesonet.

What this means to you the grower is that you can access “live” weather data across the state, updated every 15 minutes and usually from a Mesonet site located no further than 10 miles from your area of interest. The Oklahoma AgWeather web site
(http://agweather.mesonet.org) offers a large number of real-time weather and soil products which may be of interest, as well as a number of “value-added” products which we will discuss later.

With respect to weather/soil values themselves, the AgWeather web site offers real-time maps and graphs to display these values. One example, the standard weather map, is shown below (Figure 2). This map clearly depicts a strong cold front moving through Oklahoma on November 18, 2001. The solid dots represent the different Mesonet sites, which on the map are surrounded by information on temperature, relative humidity, and winds. The upper left number is the temperature in F; the lower left, the relative humidity in %; and the upper right, the value of any wind gust above 20 mph. Winds blow along the staff from where the barbs are located to the solid dot; thus, northwest Oklahoma shows strong north winds while southeast Oklahoma shows light southeast winds. The number and size of the barbs are proportional to the speed (see the legend on the map). A circle around a Mesonet site signifies calm conditions. This type of map is updated every 15 minutes.

![Sample weather map showing strong cold front moving through Oklahoma.](image)

Other available maps concentrate on specific variables, such as temperature, inversion conditions (for fruit growers), wind speed, rainfall, soil temperature, or soil moisture. Some maps feature colorized contours and can be animated; another feature is the ability to zoom in and out of an area of interest. To activate these features, as well as many other of the products available (such as radar maps), the user needs to download and activate the “plug-in” software accessible from the home page of the Oklahoma AgWeather web site. Besides maps, the user can access “meteograms” from a specific Mesonet site; these meteograms are charts of various weather variables at that site over past time periods. Rainfall products, including tables and maps of past totals going back months, are also available. Real-time NEXRAD radar images (having the animation and zoom features) are also accessible free of charge.
Forecasts, while not “part” of Mesonet, are available at the AgWeather site as well to help you in planning your field activities. In particular, the NGM MOS forecasts have proven useful to a number of growers. These forecasts, available in both table and map form, provide predictions of various weather variables at 3-hour intervals over the next 60 hours.

Besides weather/soil data and forecasts, a number of weather-based, value-added products have been developed for agriculture and natural resources in Oklahoma. Insect and disease models, which are useful as pesticide scheduling tools, are available for pecans (pecan nut casebearer and pecan scab) and watermelon (watermelon anthracnose). More recently, tools for irrigation scheduling have been developed which show daily water use amounts for specific crops such as peaches, pecans, and other fruit/vegetable crops; daily amounts and totals going back over the past weeks can be used as a guide as to when and how much to irrigate. A fire danger model is also available to provide near-real-time estimates of fire danger across the state.

One model of particular interest, in terms of scheduling spraying activities, is the Oklahoma Dispersion Model. It is a tool which assesses the current and future ability of the atmosphere to disperse a material (such as a gas or aerosol) horizontally and vertically. Current conditions are calculated from the Oklahoma Mesonet, while forecast conditions utilize input from the NGM MOS forecasts. The Oklahoma Dispersion Model can be used as a tool to avoid spray drift in certain sensitive directions. The direction of drift can be determined by looking at the wind direction on the weather map (for current and forecast conditions) or NGM MOS table (for forecast conditions), while the dispersion conditions themselves (very poor - red; poor - orange; moderately poor - beige; moderately good - light green; good - green; and

Figure 3. Dispersion condition map for same date/time corresponding to Figure 2.
excellent - dark green) can be seen on the dispersion maps (current and forecast conditions) or listed in the NGM MOS table (for forecast conditions). Knowing the wind speed, direction, and dispersion condition of the atmosphere at the current time and over the next two days, a grower can use the Oklahoma Dispersion Model to decide when is the best time to spray, while minimizing drift to sensitive directions. A sample map showing dispersion conditions, corresponding to the same date/time as the Mesonet weather map in Figure 2, is shown in Figure 3. Note the poor dispersion conditions (band of orange/red color) just ahead of the cold front and also in southeast Oklahoma. In such areas, a pesticide plume would not disperse well and would travel largely undiluted downwind. Behind the cold front, however, note that dispersion conditions improve (green colors).

As mentioned earlier, these and other products are accessible free of charge at the Oklahoma AgWeather web site (http://agweather.mesonet.org). The site is organized with main menu items as follows: Weather, Soil, Livestock, Rangeland, Crops, Horticulture, Forestry, and Markets. When one clicks on a main menu item, other items appear related to the main topic. For example, if one were interested in specific products related to peaches, one would click on “Horticulture” on the main menu bar, then on “Fruit and Nut” on the left menu, then on “Peach” (see Figure 4). In this example, “Evapotranspiration” (ET) has been selected. The resulting table shows a list of daily and accumulated water usage (ET) by peaches at Porter over the past number of weeks.

Figure 4. Organization of Oklahoma AgWeather web site showing example for peaches.

In summary, Oklahoma is privileged to have what we believe to be the premiere weather and soil monitoring station network in the world. A wealth of information is
available for growers on the Oklahoma AgWeather web site. Weather and soil information is updated every 15 minutes, while other Mesonet-based value-added products are updated at time scales ranging from every 15 minutes to daily. We hope the Oklahoma Mesonet and its associated products can become increasingly useful to those in the horticultural industry in Oklahoma. We also encourage your feedback on the web site and also any ideas you may have for future products.
Peach Cultivar Testing in Arkansas: Finding Cultivars adaptable to the Arkansas-Oklahoma Region - early results of a new trial.

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Department of Horticulture, University of Arkansas, Fayetteville, AR 72701
http://www.uark.edu/ArkHort/

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. He attained the MS and PHD degrees from The Ohio State University. He was a horticulturist at the Washington State University prior to becoming a professor at AR.

Introduction
Selecting the appropriate cultivars is one of the most important decisions that an orchardist can make because of its long term nature effecting production for 15-25 years, impact on production costs, risk of production, and the crop value due to fruit quality and customer demand. In order to provide fruit growers in the Arkansas-Oklahoma region with cultivar choices, the Department of Horticulture of the University of Arkansas has had an extensive peach cultivar evaluation program. Prior to the mid 1980’s, peach cultivars were tested at field stations in Nashville, Hope, Clarksville, and Fayetteville, AR. Currently, peach cultivars are tested primarily at the Fruit Research Substation (FRSS) at Clarksville and at the Southwestern Research and Extension Center (SWREC) at Hope, AR. These tests, with multiple sample trees being observed for multiple years give a good indication of adaptability and commercial potential for cultivars for orchardists of this region.

Peach Cultivar Testing
In 1999 and 2000 trials were planted at both the FRSS and SWREC to evaluate current recommended cultivars and newly released cultivars which were commercially available. Some breeding lines from the USDA-ARS breeding program in Byron, GA, (BY numbers) were included (Tables 1 and 2). Two to three trees of each cultivar were planted adjacent to each other, at a spacing of 6’ between trees and 15’ between rows and trained to a 2-scaffold perpendicular-V system. Trees received supplemental irrigation and standard fertilizer and pest management regimes. Trees were not allowed to crop the first two years but did crop in 2002 and 2003.

Trees are observed and data for more than 40 growth and production characteristics are gathered annually. Additionally, the project leaders observe the trees and take field notes of observations of tree growth, performance, and fruit quality. To assess the data, annual data from individual trees was pooled and was analyzed with years as replications. The results presented here are early observations of the cultivar performance.
Several factors are evaluated and considered in subsequent recommendation of peach cultivars. Primary considerations in recommendations will be 1) time of bloom to avoid the last average frost date, 2) time of harvest season, 3) fruit appearance, flavor, and overall quality, 4) fruit size, 5) and pest susceptibility. The disease bacterial spot (BS) which manifests disease on both foliage and fruit is a primary concern. Although there is no good chemical control, there is very good genetic resistance. Thus, all of the suggested cultivars have good to excellent resistance to BS. Cropping reliability is critical to maintain a viable fruit enterprise. For the most part, the cultivars suggested herein have demonstrated to be reliable croppers and in fact in some cases are selected because demonstrated good winter hardiness and late bloom. Fruit quality, both appearance and edibility are critical to sustainable sales. Therefore, these characteristics have weighed prominently in evaluations and recommendations. For a cultivar to be considered for recommendation, it must have performed well for a minimum of 5 cropping years. Some cultivars with less than five years of data may be suggested for grower test. The data presented here are preliminary and do not constitute any recommendations.

Because cultivar evaluation is largely subjective, the authors suggest these cultivars and encourage growers to plant the cultivars to see if they perform well at their specific site and with their individual orchard management systems.
Table 1. Early performance of peach cultivars, in order of maturation, at the Fruit Research Substation, Clarksville, AR, 2002 and 2003 seasons.

<table>
<thead>
<tr>
<th>Cultivar Name</th>
<th>Full Bloom Date</th>
<th>Peak Harvest Date</th>
<th>Average Fruit Wt. (G)</th>
<th>Fruit Firmness (kg)</th>
<th>Soluble Solids (%)</th>
<th>Attractiveness Rating (1-5)</th>
<th>Flavor Rating (1-5)</th>
<th>Overall Rating (1-5)</th>
<th>Bacterial Fruit Spot Rating (1-5)</th>
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<tbody>
<tr>
<td>Spring Prince</td>
<td>26-Mar</td>
<td>17-Jun</td>
<td>135</td>
<td>5.81</td>
<td>8.0</td>
<td>3.5</td>
<td>2.5</td>
<td>2.5</td>
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</tr>
<tr>
<td>Gold Prince</td>
<td>28-Mar</td>
<td>20-Jun</td>
<td>137</td>
<td>4.09</td>
<td>7.9</td>
<td>3</td>
<td>4</td>
<td>4</td>
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<tr>
<td>Flaming Fury 5B</td>
<td>28-Mar</td>
<td>23-Jun</td>
<td>154</td>
<td>3.59</td>
<td>8.5</td>
<td>3.5</td>
<td>4</td>
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<td>St. Early White Giant</td>
<td>29-Mar</td>
<td>28-Jun</td>
<td>236</td>
<td>6.53</td>
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<td>2</td>
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<td>03-Jul</td>
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<td>03-Jul</td>
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<td>9.3</td>
<td>4</td>
<td>5</td>
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<td>Flaming Fury 12B</td>
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<td>12-Jul</td>
<td>201</td>
<td>4.88</td>
<td>10.2</td>
<td>4.5</td>
<td>4.5</td>
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<td>Redstar</td>
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<td>12-Jul</td>
<td>128</td>
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<td>9.3</td>
<td>3</td>
<td>4</td>
<td>4</td>
<td></td>
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<tr>
<td>Starfire</td>
<td>28-Mar</td>
<td>12-Jul</td>
<td>179</td>
<td>2.78</td>
<td>10.1</td>
<td>4.5</td>
<td>4</td>
<td>3.5</td>
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<td>Peak Harvest Date</td>
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<td>Fruit Firmness (kg)</td>
<td>Soluble Solids (%)</td>
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<td>Flavor Rating (1-5)</td>
<td>Overall Rating (1-5)</td>
<td>Bacterial Fruit Spot Rating (1-5)</td>
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</table>

All ratings are subjective by same evaluator on a scale of 1-5; 1 being least, lowest, poorest, and 5 being most or best. Cells with no number received no rating during the study period.
Table 2. Early performance of peach cultivars, in order of maturation, at the Southwest Research and Extension Center, Hope, AR, 2002 and 2003 seasons.

<table>
<thead>
<tr>
<th>Cultivar</th>
<th>Full Bloom Date</th>
<th>Peak Harvest Date</th>
<th>Average Fruit Wt. (G)</th>
<th>Fruit with Spots (%)</th>
<th>Fruit with Brown Rot (%)</th>
<th>Fruit with Split Pits (%)</th>
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<td>Bounty</td>
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<td>30-Jun</td>
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<td>02-Aug</td>
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Weed Science Principals

Blair Griffin CEA-SC University of Arkansas
John Boyd, Extension Weed Scientist, University of Arkansas

In fruit production a weed can be described as being “a plant out of place”. Bermudagrass in a row of blackberries is a weed. A blackberry vine in a bermudagrass pasture is a weed.

Weeds affect fruit production in a variety of ways. They lower yields due to competition for sunlight, nutrients, and moisture. Weeds provide a host for insects and diseases, which can decrease the visual quality of the fruit. Weeds can interfere with fruit harvest, this is very important in the pick your own business.

Weeds are can be classified by lifespan, growing season or botanical family. These classifications are very important when it comes to planning a weed control program.

Although most producers associate the term weed control with herbicide applications, weed control actually involves a combination of cultural, mechanical, and chemical applications that most producers already utilize. Mowing, mulching, disking and plowing are some of the practices that fruit producers use in combination with or without herbicide applications for weed control. Each of these activities has distinct advantages and disadvantages for a weed control program.

Like most areas of commercial agriculture, some producers rely on herbicide applications for weed control. At the present time there are an adequate number of herbicides on the market for fruit producers to conduct successful weed management. However, the long term outlook is for a reduction in labeled products.
Peach Weed Control

Blair Griffin, CEA – SC, UACES
John Boyd, Extension Weed Scientist, UACES

Weed control in a mature peach orchard is important for a number of reasons. Nuisance weeds such as poison ivy, horsenettle, and blackberries can interfere with fruit harvest and are very annoying to pick your own customers. Blooming weeds in the spring are hosts to tarnished plant bugs and stinkbugs. This can result in increased insect damage to fruit, and a visually unappealing product.

The standard peach weed control program in the Arkansas River Valley is a spring application of burndown herbicide plus a preemergence herbicide tankmix. The burndown herbicides control emerged winter weeds and the preemergence products reduce the amount of emerging late spring and summer weeds.

Burndown products include 2,4-D, Roundup (glyphosate) and Gramoxone. Each product has its strengths and weaknesses, but all of the products have weeds that they do not control. The preemergence herbicides are applied before the weed seeds germinate. Karmex, Princep, Slicam, and Surflan control most of the small seeded annuals for a period of time. These products differ in their activity on perennials and crop restrictions.

A test was conducted in 2003 to determine the effects of herbicide applications for horsenettle - *Solanum carolinense* in a peach orchard. Treatments were applied on April 25, 2003 with a CO2 backpack sprayer at 15 gallons per acre (GPA) with a hand held boom. Plots size was 5’ x 50’ and each treatment was replicated three times.

The following treatments (product/acre) were tested:

1. Roundup 1 qt
2. 2,4-D amine 1 qt
3. Roundup + 2,4-D 1 qt + 1 qt
4. Slicam 3.5 lbs.
5. Karmex 2 lbs.
6. Roundup + Slicam 1 qt + 3.5 lbs
7. Roundup + Karmex 1 qt + 2 lbs

The treatments were evaluated for horsenettle control 30, and 90 days after treatment (D.A.T.). Thirty D.A.T. the Roundup and Roundup tank mixes had 90% or better horsenettle control. Karmex control was 80%, 2,4-D control was 70% and Slicam was 60%.
Ninety D.A.T. the Roundup and Roundup tankmixes had 90-95% horsenettle control. The 2,4-D, Karmex and Solicam treatments resulted in 90% control.

In conclusion all of the treatments resulted in excellent control of horsenettle. For best results Roundup should be included in any application for Horsenettle control.

A peach weed control test was conducted to determine the effects of herbicide applications for control of winter weeds. Treatments were applied on February 22, 2001 with a CO2 backpack sprayer at 15 gallons per acre (GPA) with a hand held boom. Plots size was 5’ x 50’ and each treatment was replicated three times.

The following treatments (product/acre) were tested:

1. Roundup 1.5 pt
2. 2,4-D amine 1.5 pt
3. Gramoxone 1 qt
4. Gramoxone + Karmex 1 qt + 2 lbs
5. Gramoxone + Princep 1 qt + 2 lbs
6. Roundup + 2,4-D 1.5 pt + 1.5 pt
8. Goal 1 qt

The plots were evaluated 60 D.A.T. for percent control of cheat-\textit{Bromus secalinus}, hairy vetch-\textit{Vicia villosa}, curly dock-\textit{Rumex crispus}, white clover-\textit{Trifolium repens}, and wild carrot-\textit{Daucus carota}.

The tank mixes of Roundup + 2,4-D, Gramoxone + Karmex, Gramoxone + Princep, Gramoxone + Princep + Karmex provided 90-100% control of all weeds. Roundup controlled 90% of cheat, hairy vetch, and wild carrot, 80% of curly dock, and 60% of white clover. 2,4-D provided 90% control of hairy vetch and curly dock, 80% control of wild carrot, 70% control of white clover and 0% control of cheat. Gramoxone controlled 60 – 70% of all weeds. Goal controlled 90-100% of all weeds species except wild carrot which was 60%.

In conclusion, the tank mixes of a Gramoxone + preemergence herbicide resulted in the best broad spectrum control.
History and Management of the Japanese Beetle (*Popillia japonica* Newman) in Arkansas and Oklahoma

Dr. Donn T. Johnson, AGRI 320, Department of Entomology, University of Arkansas, Fayetteville, AR 72701; Email: dtjohnso@uark.edu

The Japanese beetle was imported from Japan to New Jersey and first reported causing damage in 1916. In the past, it has taken 15 to 27 years for this beetle to spread across states east of the Mississippi River. By 1932, the Japanese beetle had been reported as far west as St. Louis, Missouri (Fleming 1972, USDA Technical Bulletin No. 1449). Recently, it was reported to be spreading to additional states in soil associated with burlap balled nursery stock or in turf from infested areas. In 1997, it was first detected in Arkansas and Oklahoma. The National Agricultural Pest Identification System has a 2003 infestation distribution map on the Internet titled, "Reported Status of Japanese Beetle in US and Puerto Rico.

Surveys to determine the extent of the spread of the Japanese beetle in both AR and OK were initiated in 1997. Trece Japanese beetle pheromone / floral lure traps were placed at nurseries, turf or tree farms at a density of 1 trap / 10 A and 2 traps / sq mi buffer around these sites. The sex pheromone (fluranone) only attracts males. The floral lure contains: 2 eugenol: 1 geraniol: 1 2-phenyl ethyl propionate that attracts both adult males and females. In 1997, Japanese beetles were trapped in only Benton, Pulaski and Washington counties in AR and Cherokee, Oklahoma and Tulsa counties in OK. By 1999, ten AR counties trapped Japanese beetles (Fig. 1). By 2003, adults (number in parentheses) were also captured in Cross (55), Franklin (2), Lawrence (48), Madison (440), Pope (3) and Sebastian (4) counties. By 2003, two (Muskogee county) to as many as 4155 (Tulsa county) Japanese beetles were trapped in 11 of 24 counties surveyed in OK (Fig. 2). Data were provided by Tom Hill, USDA: APHIS: Plant Protection and Quarantine; Paul Shell, Arkansas State Plant Board; and Jeanetta Cooper, Horticulture Program Administrator, OK Department Of Agriculture Food & Forestry.

Since 2001, significant crop damage by Japanese beetle was reported in nurseries, vineyards and home landscapes in northwest AR. In August 2003, a number of personnel from the University of Arkansas research, Cooperative Extension Service, AR State Plant Board, USDA: APHIS: Plant Protection and Quarantine, and AR County agents met in Clarksville, AR. This group reviewed the pest status of the Japanese beetle in various counties in AR. Three fact sheets are available for distribution to the public to answer questions about biology and how to minimize damage caused by Japanese beetle: 1) “A New Pest in Arkansas: *Popillia japonica* Newman” (Lorenz et al. 1999, University of Arkansas Cooperative Extension Leaflet MP399); 2) “Managing the Japanese Beetle: A Homeowner’s Handbook” (1998, USDA APHIS Program Aid 1599; or on the Internet); and 3) “Common Questions About Japanese Beetles in Arkansas”
The present goal is to find ways to increase public awareness of the Japanese beetle and its management. First, fact sheets noted above should be promoted and distributed using an educational poster to be displayed at fruit, landscape and turf industry shows both in AR and OK. Monthly in May, June and July 2004 and thereafter, extension specialists in each state should compose and print articles in local newspapers in Japanese beetle-infested counties that describe Japanese beetle adult and grub identification, seasonal biology, list susceptible and resistant plants and outline management programs that will minimize plant and turf damage by this pest.

**Japanese beetle identification.** Adults are less than ½ inch long (length of smallest adult finger nail) with brown-coppery outer wings, shiny, metallic-green head and body and characteristic six pair of white tufts of hair along the abdomen under the wing edges. The adults feed mostly on leaves but will feed on ripening fruit. The egg is laid in the soil by host roots such as grass, is oblong and measures 1/8 inch. Eggs hatch into an immature called a white grub. The grub varies from ½ to ¾ inch in length and is c-shaped with 6 legs. The area near the anus on the underside of the abdomen has a v-shaped formation of hairs visible with a hand lens. Grubs will feed on grass roots and decaying mater in the thatch layer.

**Plant Resistant Plants.** The easiest pest management control tactic is to plant resistant plants in your landscape. The adults attack leaves and some fruit of 300 or more plants. Some susceptible plants include: American elm, American mountain ash, apple, apricot, beech, birch, black walnut, cherry, cigar flower, crabapple, crape-myrtle, dahlia, English elm, evening primrose, grapes, gray birch, hawthorn, hibiscus, hollyhock, Japanese maple, linden, Lombardy poplar, Norway maple, peach, pin oak, plum, poplar, raspberry, rose, rose mallow, rose of Sharon, sassafras, soybean, sweet corn, Virginia creeper, willow, and zinnia. Grubs attack roots of Kentucky bluegrass, perennial ryegrass, and fine fescues. Some resistant plants include: American sweetgum, arborvitae, begonia, columbine, common pear, coreopsis, flowering dogwood, fir, forsythia, green and white ash, hemlock, holly, hosta, impatiens, juniper, lilac, lily-of-the-valley, nasturtium, pine, redbud, red and silver maple, rhododendron, red and scarlet and white oak, spruce, tulip tree, yew, Bermudagrass, tall fescue and zoysiagrass (from lists in University of Arkansas FSA7062 and USDA Program Aid No. 1599).

**Other Control Tactics.** Several control tactics are available given that you have susceptible plants or grass in the landscape. The fastest and most effective control of Japanese beetle adults and grubs is achieved by timely applications of insecticide (see recommended insecticide formulations and rates in FSA6072 or other insecticide recommendations by Cooperative Extension Service in AR and OK). The adults first emerge from the soil in late May in OK to mid June in AR with adults feeding and laying...
eggs into early August. The turf manager must check and map several damaged sites of turf to see which sites exceed the action threshold that will justify an application of a control tactic. That is there must be greater than 18 grubs per square foot in irrigated turf (2 grubs per 4” grass/soil core) or greater than 5 grubs per square foot in non-irrigated turf (1 grub per 4” core) to make a decision to control the grubs (see UA Cooperative Extension Leaflet FSA7062). Spray only these HIGH-RISK sites and READ AND FOLLOW THE PESTICIDE LABEL INSTRUCTIONS. Be sure that the Japanese beetle is listed on the label. A preventative spray program requires insecticide be applied from late-June to mid-July prior to or during egg laying. A curative spray program applies sprays in August or September to control established populations of older Japanese beetle grubs. It is noted that Trichlorfon (Dylox®, Professional and homeowner use) is most effective at penetrating thatch whereas Bendiocarb (Turcam®, Professional use only) and Carbaryl (Sevin®, homeowner use) are very toxic to earthworms.

There are several alternative control tactics that require one or more years to significantly reduce the local beetle population. Mass trapping adults can be effective in lowering the local population only if the whole community works together by setting out 25 to 50 traps / square mile each placed at least 50 feet from any susceptible plants. Then people have to agree to check and empty/destroy beetles captured in trap bags of daily. Daily trapping occurs from the first appearance of adults (late-May to mid-June) until no more adults are captured in the traps (late August). The Japanese beetle attractant trap kits range from $5 to $30. Yearly, you must place a new lure in each trap ($3.94 per replacement lure); and replace the bag ($3.84 per 3 bags).

Natural diseases or nematodes can kill Japanese beetle grubs if released into grub-infested turf areas. These biological control organisms include: Milky Spore® powder (Bacillus popilliae bacteria); Naturalis-T (Beauveria bassiana fungus); and nematodes. Once bacteria are established in the soil, milky spore may provide control of Japanese beetle grubs for decades. The powder is applied to grub-infested turf via a Milky Spore® Powder Dispenser tube can be used to inoculate turf with 1 teaspoon of spores every 3 feet in rows three feet apart followed by 30 minutes of watering to move bacteria into the thatch and root area where grubs are located.

Nematodes infest and kill grubs by either lying in wait for grubs or actively searching for grubs and entering the grub body. Cruising nematodes that are most effective in killing Japanese and May/June beetle grubs, field crickets and Mormon crickets are: Steinerema glaseri, S. carpocapsae; and Heterorhabditis bacteriophora. Irrigation of ¼ inch applied before and after nematode application increases efficacy and survival of the nematodes. It is best to apply nematodes when most of the white grubs are in the second instars that probably occur in August or September. The suggested rate is 1million nematodes applied to 3,000 sq. ft. This tactic will cost from $16 per 3000 square foot to $235 per acre.
Future With Japanese Beetle. The Japanese beetle will become a pest in more locations across AR and OK. Some irrigated landscape areas may experience extremely high populations and plant damage. Eventually, the Japanese beetle population level is expected to drop to less damaging levels due to increases in natural enemies (nematodes) and diseases (milky spore bacteria and *Beauveria* fungi) and the stress of occasional years of drought.

Figure 1. County distribution and number of Japanese beetles caught in pheromone traps in Arkansas (1999)
Figure 2. County distribution and number of Japanese beetles caught in pheromone traps in Oklahoma (2003)
Hoop House Strawberry Production

Steve Upson
The Noble Foundation

Steve Upson, a native of Tulsa, Okla., received a bachelor’s degree in horticulture from Oklahoma State University and a master’s degree in horticulture from Kansas State University. His past employment includes serving as a county and district horticulture agent with the Oklahoma Cooperative Extension Service and as the manager of a commercial market garden operation east of Kansas City, Missouri. For the past 15 years, Steve has lived in Ardmore, Okla., where he is employed as a horticulture specialist with the Noble Foundation. Steve’s current area of specialization involves researching and demonstrating the benefits of modified environment “hoop house” high-value crop production.

Strawberry plasticulture is a relatively new production system for growing strawberries. Plasticulture offers many advantages over traditional, matted-row culture, including weed control without the use of herbicide, earlier harvests and heavier yields of extra large fruit.

While these advantages are significant, there are some drawbacks plasticulture has in common with other types of field culture. Weather related phenomenon, namely excess rainfall, freezing temperatures, strong winds and hail often threaten to destroy the crop or reduce yield and crop quality.

Disease is a major problem experienced by strawberry growers. During excessively wet periods, berry rot can be severe even when berries are resting on plastic mulch instead of soil.

Cultural tasks including spraying and harvesting are hampered during rainfall events and when soil is saturated.

Since 1996, the Noble Foundation has researched and demonstrated the benefits of producing high-value crops in hoop houses. Hoop houses, also referred to as high tunnels or cold frames, are generally Quonset-shaped, constructed of metal or plastic hoops (bows) and covered with a single layer of 6-mil greenhouse-grade polyethylene film. The houses are vented by rolling up the sides, and there is no permanent heating system and no electrical connections. Compared with greenhouses, hoop houses are relatively inexpensive, ranging in price from $1.50 to $3.00 per square foot.
The primary advantages hoop houses offer over standard field plasticulture include additional earliness, increased protection against storms, a dry environment for cultural activities including harvest (especially important if crop is U-Picked) and a decreased incidence of disease.

There are two basic methods of hoop house strawberry production. For growers producing strawberries using the annual hill plasticulture system, movable hoop house structures or structures with removable end walls are recommended. For the smaller grower who doesn’t own a tractor, bedder, and mulch layer, a permanent structure is recommended.

Currently, all of the Noble Foundation hoop house strawberry research and demonstration work is being conducted in permanent structures that are not accessible by tractor. To minimize hand labor required for bed construction, we’ve equipped every house with permanent beds. Good results have been experienced growing in 40-inch wide beds constructed on 5-foot centers. The growing medium consists of fine sandy loam soil amended with peat moss.

In order for the hoop house production system to be effective, strawberry plants need to be planted early enough in the fall to become established before cold weather but not to early as to produce excessive plant size that results in crowding.

We’ve experienced good results planting the first week of October. As a general rule, the farther north your operation is located, the earlier you need to plant. Growers in northern Oklahoma should consider planting the second or third week of September; in central Oklahoma the third or fourth week and in southern Oklahoma the fourth week of September or the first week of October. These dates should be considered as guidelines only. Additional research needs to be conducted to determine the best planting dates for various regions of the state. First time growers would be wise to try two or three planting dates spaced one week apart.

Strawberry plants suitable for transplanting can be purchased as fresh dug or plug plants. Plug plants are more expensive but require less post-plant care. Plug plants tend to establish quicker than fresh dug plants.

Plug plants are produced from runner tips harvested from nurseries in the northern United States and Canada. Some growers choose to propagate their own plug plants by ordering tips directly from a tip nursery. A hoop house equipped with a mist system is required to propagate plug plants. A good-quality plug plant can be produced in four weeks.
The quality and yield of your hoop house strawberry crop will only be as good as the health and vigor of your planting stock. Purchase your plants from a reputable nursery. Plants should be true-to-variety and free of insects and diseases.

Several varieties have performed well in Noble Foundation yield trials. “Treasure” and “Chandler” produced the highest yields in our 2003 trial, producing 1.55 and 1.40 lbs. of marketable fruit/plant respectively. Both varieties produce berries averaging over 0.5 oz. For extra early production, “Sweet Charlie” is a good choice. This variety is a week earlier than Treasure but not as prolific producing 1.2 lbs. of marketable fruit/plant. All of the varieties tested in our yield trials are classified as Short Day or “June Bearing” types.

To avoid heat buildup in the beds, wait as long as possible before applying plastic mulch. Delaying mulch application also enables extended harvest of a preceding crop or extended “cooking” time if beds are summer solarized to control soil borne disease organisms.

At the Noble Foundation, we typically apply plastic mulch the last week of September. Prior to application, fertilizer is incorporated into beds according to soil test results, drip irrigation is installed (two drip lines per bed), the soil surface crowned and smoothed and the beds hand watered. Never apply plastic mulch to a dry bed. We always surface water using a hand wand just prior to mulch application.

We currently recommend planting three rows of plants on a 40-inch bed. Space plants 16 inches apart in each row and space the rows 12 inches apart. Locate the middle row in the center of the bed. To create an alternating plant pattern, which provides for a more even distribution of plants, shift the middle row 8 inches towards one of the bed ends. Use a bulb planter to punch planting holes in the plastic.

Use a fertilizer injector and water wand to top apply a starter solution containing a soluble complete fertilizer at planting. Do not rely solely on the drip system for plant establishment. In addition to drip irrigation, plan on top watering the first week. After the first week, or when the plants have initiated new growth, switch over to the drip system.

Because the plastic mulch obstructs the view of the soil surface, irrigation scheduling can be difficult. Consider using a tensiometer, a device that measures soil moisture content, to schedule irrigation. A 6-inch tensiometer will cost about $60.00.
All required plant nutrients may be applied preplant with the exception of nitrogen. To avoid excessive vegetative growth, which can result in delayed flowering and poor fruit quality, nitrogen should be applied in small doses over the life of the planting. A typical nitrogen fertigation schedule (the term fertigation refers to the application of fertilizer through the irrigation system) consists of weekly applications of nitrogen at the rate of 5 lbs. N/acre beginning one to two weeks after transplanting or when new growth occurs and continuing through November. No fertilizer is applied December through February. Weekly nitrogen applications resume March 1 and continue through April. If soil is amended with compost, the nitrogen application rate should be reduced or eliminated depending on the amount of compost used. Each grower will need to fine tune his nitrogen fertigation schedule based on his particular situation.

Short Day varieties initiate flower buds during the fall. Under mild growing conditions during late November and December, some varieties will flower. While some of the berries are capable of maturing, quality is usually poor and yield is not sufficient to justify harvest. Therefore, in order to maximize spring production, all fall formed flowers and runners should be pinched off.

With a few exceptions the house can remain fully vented October through February. Exposing plants to cold weather helps delay flowering.

Strawberry plants can tolerate freezing temperatures; however, injury to the crown can occur at 25 degrees F with the extent of damage increasing as the temperature drops. Death can occur at 10 degrees F. If plants are not acclimated to cold weather prior to a freeze or if temperatures below 25 degrees F are forecast, close the house and cover beds with heavy weight floating row covers. We currently use fabric weighing 1.5 oz per square yard for freeze protection. When the danger of low temperature injury is past be sure and vent the house and remove row covers.

Beginning in late February or early March, vents should be adjusted as needed to maintain a target daytime temperature range of 70 to 80 degrees F. This is the ideal air temperature range for flowering and fruit set. When the forecast calls for a possible freeze, cover the beds with row covers. The use of heavy weight covers inside a closed hoop house during the spring can provide an additional 10 degrees F of freeze protection. When the danger of freeze subsides, the row covers must be removed and vents opened to provide bee access for pollination.

Aphids and spider mites are the two biggest pest problems you’re likely to encounter. Aphid populations can explode during the winter as a result of the protection environment afforded by the structure. Spider mites often go undetected until damage has resulted due to their small size. Excellent spray coverage of the leaf underside is critical for control of both these pests.
Primary disease problems encountered include powdery mildew and Botrytis fruit rot (gray mold). Development and spread of powdery mildew is favored by humidity and temperatures between 60 and 80 degrees F, conditions prevalent in hoop houses much of the time. Vent the house as soon as possible following a rain event to reduce the humidity. The gray mold fungus infects the flower, ultimately destroying the fruit. The disease is spread by air, water, or by harvesting. The removal of all diseased and unmarketable fruit will reduce the spread of the disease. Fungicide applications for the control of both of these diseases should be made according to label directions.

In southern Oklahoma, harvest of hoop house strawberries typically commences the first week of April. It is not unusual for a few Sweet Charlie berries to be ripe the last of March. Harvest will increase weekly before topping out and leveling off the third week of April. Production remains fairly constant for two weeks before starting to decline. Harvest during the 2003 season was wrapped up by May 23.

The profit potential for growing hoop house strawberries is dependant on cost of production, marketable yield and price obtained for the crop. During 2003, we were able to produce the equivalent of 837 lbs. of marketable Treasure berries from one of our 20-ft. by 68-ft. hoop houses. If the fruit were direct marketed for $3.00/lb., an income of $2,511 would be realized. Given that it cost us $1,910.26 to grow the crop, our profit is $600.74. For a detailed hoop house strawberry budget, contact the Noble Foundation.

For additional information on hoop house high-value crop production, contact the Noble Foundation at (580) 223-5810 or e-mail me at sdupson@noble.
Growing Raspberries for the Local Market

Rick Dye, M.A. Marketing, Fruit Grower, Harrah, OK.,
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I. Introduction
Welcome to growing raspberries for the local market. Thank you for your interest in our raspberry story. I will begin by telling you a bit of how we became cane berry growers. Then, we will take a look at how we establish a block of berries. We will discuss our experience with trellis construction, annual renovation, and our spray schedule. Time permitting, I’d like to share some thoughts on marketing raspberries and customer management. And finally, I’ll try to answer any questions and then draw some conclusions.

II. Biography
This is an article about my Grandfather Spencer and his peach orchard located 20 miles east of Oklahoma City in Harrah, Oklahoma. The article dates back to 1965 when I was 12 years old. I spent a good part of many childhood summers there, hoeing weeds and picking peaches. Little did I know that years later, I would make a career move back to those early beginnings. Today “Spencer's Orchard” and “Wind Drift Orchard” are owned and operated by my uncles, James Spencer and Bill Spencer, respectively. They’re operations are both situated within a mile of our farm.

While working on my Masters in Marketing in Holland, I served as European Promotion Director for The Washington Apple Commission for three years. My duties included promotional program oversight of (10) ten countries from our office in the World Trade Center in Rotterdam. I returned yearly for industry tours of Washington orchards, packing and storage facilities, and brokerage firms. With so much exposure to the beautiful life style possible as growers my wife, DeAnn, and I took the chance when some suitable land in Oklahoma came available.

After purchasing our eighty acres in Harrah near family, we concluded brambles would make a good choice for an interim crop while waiting on our crop of tree fruit to mature. With diversified plantings we chose the name “Sun Berry Orchard” hoping to wrap our name around both a berry farm and fruit orchard. Today we have plantings of strawberries, raspberries, blackberries, peaches, nectarines, apples, sweet cherries, and apricots, totaling around 15 acres and counting.
III. Establishing a Block of Raspberries

(Picture # 5 Planting) Site selection should include well drained soil with a PH around 6.0. We’re on a hill & have not suffered frost damage in the past four seasons. Soil should be fumigated or treated with a pre-emerge like Surflan at planting. We apply 13-13-13 fertilizer down the row at 300 LBS. (6 X 50 LB. bags) per acre. Six (6”) inch raised beds should be made on twelve (12’) feet row centers to allow for mowing and spraying equipment.

Bare root plants in bundles are received in February for planting. If you can’t plant within a day or two, then heel them in to keep the roots moist and free of air. To quickly establish a self-shaded row of Reveille raspberries plants should be set on 24 inch centers. Shading is the best tool against most weeds and grasses.

We have an irrigation well with a two (2”) inch main that supplies water to all our plantings. An inch and one half (1 ½”) header center feeds individual blocks. Our choice for bramble drip tubing has one half (½) gallon per hour emitters at 20 PSI. embedded and spaced every 24”.

An Example translating well capacity into linear feet of planted row follows:

A 30 Gallon Per Minute Well X 60 Minutes = 1,800 Gallons Per Hour
25 Gallons Per Hour will then feed 50 emitters or 100’ linear feet at 20 PSI.
So, 1,800 Gallons Per Hour / 25 Gallons Per Hour = 7,200 linear feet.
30 Gallons Per Minute Well can support 1.36 miles of raspberries at one time!

IV. Trellis Construction, Annual Renovation, and Spray Schedule

(Picture # 6 Row Ends) Our rows are planted twelve feet apart to provide ample room for our tractor and sprayer. We are using tee posts set every twenty (20’ feet down the row. I now believe every fifteen (15’) feet would be better for crop load support. (Picture # 7 Cross-Arms) Attach twenty-four (24”) inch cross-arms about twenty (20”) inches above the ground to support the low growing canes which will fruit the second year. I made the mistake of welding my own cross-arms before I discovered Jim’s Supply in Bakersfield, California. You can buy them for sixty-five cents $0.65 cents each. Run 12 gauge wire down both sides or use nylon baling twine which is inexpensive and can be quickly tied in Spring. If, middles between tee posts sag too much just tie short pieces of twine between the runs.

(Picture # 8 Dormant Canes) We wait to renovate our blocks and remove dead canes
only when dormancy is reached. When all the leaves have blown off last season’s floral canes they will appear light gray to white in color. We remove all twine from the block and let the canes lie down making it easier to reach inside the planting. We have tried using our pneumatic pruners but have found it about as easy to break the canes by hand and pull them aside. We use the tines on our box blade to rake the dead canes to the ends of the rows where they’re loaded onto a trailer and hauled away for burning. In Spring, we raise the cross-arms up about a foot above the last year’s elevation to allow for a narrowing pass of our rototiller and ban sprayer. The supported canes can then put on fruit.

(Picture # 9 Tractor Sprayer) A dormant oil along with lime sulfur are applied at green tip stage for Anthracnose. We have not seen any cane blight in our Reveille blocks but during heavy flooding one year we observed yellowing in the lower leaves and successfully treated the Phytophthora Root Rot with one application of Ridomil Gold through the drippers. We did a better job on drainage for our second block and have not seen the problem again. Both Stink Bugs and Sun Burn cause tough white spots on berries making them unmarketable. Spray on a regular schedule with Malathion and hope for mild weather. We lose 5% each year. We spray Diazinon in early Spring for Cane Bore larva and don’t see a problem. (Picture # 10 Mite Damage) Mites have given us a good deal of trouble. We used Vendex for a time but re-entry time was too long. Last season we successfully controlled mites using M-Pede, an insecticide soap. It carries a u-pick friendly 12 hour re-entry period. We avoid Nitrogen until after harvest to reduce blight activity and primal cane vigor. However, Calcium Nitrate 15.5-0-0 at 10LBS per acre is applied weekly through the drippers starting one month before harvest, April 20th. Calcium chelate will also firm up raspberries as a foliar feed. Potassium Nitrate will safely bring up sugars in berries if used moderately.

V. Marketing Raspberries

We do not sell any product wholesale for distribution to retail outlets like supermarkets. We’ve tried selling direct to high-end select customers such as restaurants and grocery stores. Reasons it hasn’t worked are: too many decision makers, wholesale pricing, delivery requirements, perishable nature of raspberries, sales force cost. (Picture # 11 Farmers Market) The local market for us means in the first instance, that fruit which is sold at our farm, pre-picked or pick-your-own. And secondly, the local market means the farmers markets we attend.

Oklahoma Farmers Markets are artificial markets. They were established to benefit, protect, and nurture local growers as well as to provide a fresh alternative for consumers. Take advantage of them. They are one of the corner stones, not only for marketing, but ultimately for expansion planning and capital expenditure. We started selling on Saturdays at the OSU market in Oklahoma City and now we also sell on Wednesdays as well. Additionally, we send fruit twice a week to the Norman, Oklahoma, Farmers Market. In most categories growers do not sell into a vacuum. Usually, there exists or soon will exist competition. However, we alone have sold raspberries for the past three years at the OSU market.
An important caveat to this opportunity is the challenge of consumer acceptance of raspberries in general. Both high prices and small quantities work against consumer trial both at the Farmers Markets and in supermarkets. Raspberries are offered in stores at $3.00 a half pint (only 6 Ounces) most of the year. However, a good many of these berries go bad I believe because of too high pricing and too small quantity. Therefore, we sell raspberries by the pint for $4.50. Pint sizing addresses the quantity issue giving customers enough fruit for multiple servings with a $2.00 dollar savings over stores. We try to reduce shrinkage at this price point.

**VI. Customer Management**

While competition will require us to expand into additional Farmers Markets, the majority of fruit sales continue to be made on site at Sun Berry Orchard. We think in terms of three kinds of customers. At our farm, there are “New” and “Repeat” customers. It is easiest and least expensive to promote “Repeat” customers. “Potential” customers, those we do not yet know and who do not yet know us, are the most expensive to reach. Visitors are asked to sign our guest book to receive a ripening notification the following season. (Picture # 12 Post Card) We sent out over two thousand (2,000) pieces of direct mail to “Repeat” customers last year.

(Picture #s 13 & 14 Barn) We are remodeling our barn this year to create an indoor retail experience. We are looking at Point of Sale Software by Intuit to not only manage inventory, taxes, and credit card sales, but to better manage our customers. By instantly pulling up customer sales history the cashier knows with whom they are dealing. With more complete information, strategies to reward loyalty may be executed on the spot. Longer term, using information technology (IT) to score customer loyalty and identify “heavy users,” will help us to demonstrate our appreciation more equitably. In addition, if a new employee at the register is not familiar with your customers, the POS software is!

Reaching unknown Potential Customers is expensive. First, we chose a message. (Picture # 15 SBO Kids) We believed a message of “Fun Simple Country Life and Healthy Eating” would make Sun Berry Orchard an appealing activity for our target markets: Tourists, Retirees, Students, and their Moms. Then, we divided advertising and promotional activities into two categories: Paid and Unpaid. Thinking in terms of “activities” helps when if comes time to assign a budget to the wish list. Examples of unpaid activities include publicity from newspapers, radio talk shows, and hopefully a TV station with a local interest news editor. (Video Tape # 1 Channel 4 “Is This A great State Or What?”) Another, unpaid activity is the press release which can be sent to over one hundred (100) Oklahoma Newspapers, large and small. Small town papers are read by thousands of people who will be interested in freezing, canning, and eating fresh produce. The best unpaid activity is “word of mouth” endorsements from satisfied customers.
Paid activities for us include road signs, feature ads in newspapers, radio spots, a website, sunberryorchard.com, and any special events put on at the farm. We will experiment this season with a for-profit Raspberry Pancake Tent to demonstrate the product to customers. Adding an exercise event such as a “Raspberry Run or Ride” could make for a memorable annual event tying into a healthy living theme. We do not recommend newspaper classified advertising.

VII. Conclusions:

(Picture # 16 Hand) Raspberries can be profitably grown. They require promotion, are currently little used in Oklahoma diets, and are best developed as an addition to an existing product line.
“Introduction to Blueberry Production for Fresh Markets”

by Sue Gray, MS, Tulsa County OSU Extension Horticulturist

Sue Gray has worked the past 19 years serving the commercial and home garden sectors of Tulsa County. She has also worked as a technician in fruit, vegetable and pecan research and as a horticulturist for the Maryland Cooperative Extension Service. Sue has a BS in horticulture from OSU and a MS in horticulture from the University of Maryland.

Blueberries are an excellent choice for fresh market fruit production in Northeast Oklahoma and Arkansas. They are in high demand by consumers, are not as perishable as other berries and have few insect or disease problems. They are the only fruit that can be grown organically with a reasonable profit.

Arkansas currently has 450 acres in blueberry production, 80% is sold as fresh market fruit and 85% of the crop is hand harvested. It represents less than 1% of US production. The leading blueberry growing areas are Michigan, New Jersey, North Carolina/Georgia and the Pacific Northwest.

Success in growing blueberries relies on understanding the nature of the plant. It is a member of the Ericaceae or Heath family. Other members of this plant family are azaleas, rhododendrons, and cranberries. These plants all share the following cultural requirements with no room for “bending the rules”: They must have an acid soil that is well-drained, but contains high levels of organic matter. They must be heavily mulched to insulate the fine, fibrous roots from temperature fluctuations and to conserve moisture. Drip irrigation is essential.

There are many species of blueberries in the U.S., as they are native to North America. The three most commonly grown species for this area are: Northern Highbush blueberry (Vaccinium corymbosum), Southern Highbush blueberry (Vaccinium corymbosum x V. spp.) and Rabbiteye blueberry (Vaccinium ashei).

While all three types will grow in both Arkansas and Oklahoma, the Northern Highbush is best adapted north of Interstate 40, the Southern Highbush will grow in all parts of both states and the Rabbiteye will grow best in the southern areas of these states. All three types grow well at the University of Arkansas Fruit Research Station in Clarksville.

Commercial blueberry plantings need not be large. A one acre planting contains up to 1,000 plants and can support hundreds of customers. A five acre planting would be
considered very large for fresh market sales. One person, with a bit of help at harvest time, can manage a one acre planting as a part time endeavor. Larger plantings will require more labor, time and the hiring of extra help or family members.

Marketing of fresh blueberries can be done by way of roadside stands, pick-your-own sales or at farmers markets. Expect to begin selling blueberries the third summer after planting.

Yields will be between 400 and 800 pounds per acre the third year, increasing to several thousand pounds per acre as production increases each year.

A site for blueberries should be selected based on soil type and drainage. It should also be in full sun. An ideal soil should be a sandy loam that is well-drained. Heavier soils will require raised beds or rows and the addition of much more organic matter.

Planting blueberries should never be done without careful soil preparation and planning. Good growers know that they must spend a season getting their land ready before planting. This means controlling perennial weeds, such as Bermuda grass, Johnsongrass and other competitors. Soil must be tested and adjusted to a pH of between 4.4 and 5.0. Soil testing will also indicate the needed Nitrogen, Phosphorus and Potassium levels required for blueberries. Organic matter levels must also be high. Blueberries grow best in soils that are a minimum of 3% organic matter. This extra test can be requested from University soil testing laboratories. Many farmers plant green manure crops leading up to planting blueberries to control weeds and add increase soil organic matter levels.

Very finely ground sulfur is used to acidify soil for blueberries. This should be added according to soil test recommendations at least six months before planting. It takes time for the soil matrix to chemically react with the sulfur and effectively change the pH to acid conditions.

Blueberries growing in soils with a less acid pH (above 5.5) will show signs of iron chlorosis….foliage will be yellow with green veins. The iron is chemically bound to soil particles when pH is too high, making it unavailable to the plant.

Blueberries are normally fertilized with ammonium sulfate \{(21-0-0) + 18% sulfur\}. It is added to soil each growing season in split applications to maintain growth. Organic growers use fish waste, compost and other organic materials to stimulate growth. Foliar sprays of fish emulsion plus liquid seaweed have been effective fertilizers on organic plantings.
Quality irrigation water is essential for blueberries. Have water tested for “irrigation use" by your state university soil and water testing lab. Blueberries are highly sensitive to elevated levels of chlorides, sodium and boron. Well water that contains high levels of any of these elements is not suitable for watering blueberries. Some growers use pond water, but it must have a dual filter system to keep particulate matter out of drip irrigation emitters.

Water pH is also important. Water with a pH above 7.0 may need a small acid injection pump to acidify the water being applied to blueberries.

Planting blueberries can be done in fall or later winter. Most growers order two year old container-grown plants. The advantage is a large root mass that can get better established on new sites. Rooted cuttings, though cheaper, should not be planted directly. They should instead be grown in a small nursery area for a year, then transplanted to the field.

Plant at least two cultivars of each type of blueberry. For example, if growing northern highbush blueberries, select two cultivars, such as 'Bluecrop' or 'Toro' to insure cross pollination, larger fruit set and a dependable crop. Honeybees, bumblebees and wild pollinators all serve to pollinate blueberry flowers.

Set plants five feet apart in rows that are ten to twelve feet apart. Plant a low-maintenance, non-creeping grass, such a tall fescue, between rows.

Set plants at the same level in which they grew in the nursery, working into the soil one gallon of pre-moistened peat moss per plant. Mulch with at least five to six inches of pine or hardwood mulch. Sawdust may be used, but should be mixed with the chips to prevent crusting. Repeat mulch applications yearly.

Remove blueberry flowers the first two years they are growing. This puts all the plant’s energy into getting established in the field. Failure to remove flowers will result in a premature fruit crop, greatly shortening the life of the fruit planting.

In the third year, plants will flower in early spring with a crop following in two to three months. Harvest is generally in early to mid-June in our area. Birds can remove up to one third of a blueberry crop. Growers and researchers have found that one-inch wide holographic bird-scare tape is very effective. Place tape in the planting BEFORE fruit is ripe. It’s much harder to eliminate a bird problem once it begins.
Pick berries into one pint containers when they are dark blue with a light grey, waxy bloom on fruit. Get them to a shady place as soon as possible. Blueberries will stay fresh up to two weeks at 34 degrees F. and high humidity. Most small growers either sell their crop in the field to customers or hold a small amount for market sales. They have found that moving the pint containers to an air conditioned area with a fan nearby to move the field heat out of fruit will help keep them fresh for a few days.

County Extension educators can assist growers with any disease insect problems that might arise. Such problems are not common in this area. Weeds are another matter. Make sure weeds are controlled correctly right from the beginning. Both Oklahoma and Arkansas have resource materials available on herbicides labeled for use in blueberries.

For additional information consult these resources:
University of Arkansas Cooperative Extension; http://www.aragriculture.org/horticulture

ATTR A (Appropriate Technology Transfer for Rural America)

Also: Northwest Berry and Grape Info. Network: http://berrygrape.oregonstate.edu
North Carolina State University: http://www.ces.ncsu.edu/depts/hort
Weed Control Strategies in Vineyards

RE. Talbert, E.F. Scherder, & M.L. Lovelace
Department of Crop, Soil, and Environmental Science, University of Arkansas

Dr. Ron Talbert is University Professor of Weed Science at the University of Arkansas where he has spent his career, of now 40 years, teaching and conducting research in the field of Weed Science. Dr. Talbert earned his B.S. in Soils from the University of Missouri and M.S. and Ph.D. in Crops (Weed Science) from the University of Missouri. He teaches courses at both the Undergraduate and Graduate level and is especially active in working with graduate students as a part of the University of Arkansas' internationally recognized weed science program in graduate training. Through the years he and his students have done research on a wide variety of problems associated with the use of herbicides in crops, especially horticultural crops, herbicide behavior in soil, factors affecting herbicide selective activity, persistence and carryover, and now herbicide resistance in weeds. Dr. Talbert is a Weed Science Society of America Fellow, Southern Weed Science Society Weed Scientist of the Year in 1991, Past President of SWSS, received the Distinguished Service Award from Arkansas Agricultural Pesticide Association, a Recognition Award from the Arkansas State Horticultural Society, Distinguished Service Award from SWSS, Research Award of Merit from the U of A Gamma Sigma Delta Chapter, the IR-4 Meritorious Service Award, the Spitzel Land Grant Award from the Dale Bumpers College of Agricultural Food and Life Sciences, and the John W. White Outstanding Team Award for his contribution to the grape production team from the U of A Division of Agriculture.

Weed control in grapes requires proper planning to maintain effective season-long weed control. Some of the more common weeds present in Arkansas vineyards include crabgrass, johnsongrass, bermudagrass, primrose spp., ragweed, brambles, nutsedge spp., and red sorrel. If weeds are not controlled, competition for nutrients, water, and light can occur. Competition early with grapes can lead to a delay in growth and ultimately a decline in production in the bearing years. To achieve proper vegetation control, management strategies must be implemented for under the grape row and row middle.

Weed control in row middles can be achieved utilizing four approaches. The first approach employs multiple cultivations with a cultivator or spring tooth harrow. This can be an effective approach; however, multiple tillages are needed throughout the growing season. Erosion of row middles is also a potential problem on hillsides and sites prone to frequent rainfall, therefore making this an option for non-erodible areas only. A second approach utilizes the competitive nature of grass species to compete with weeds. With grasses established in row middles, erosion is minimized. Established row middles allow for travel of equipment in the field throughout the season, whereas
cultivation can restrict the use of equipment during wet periods. Care should be taken in selection of grass species when establishing row middles. Grass species, such as bermudagrass, and legumes species may provide good ground cover but can be a problem, when they spread beneath the grape vines. The third approach implements herbicides and the establishment of a grass species in the row middle. Grass is allowed to grow to a target height, then mowed or treated with a reduced rate of a non-selective herbicide, such as Roundup, Rely, or Gramoxone to suppress further growth (Table 1). By allowing the establishment of the grass, then suppressing the vegetation, row middle erosion is minimized, travel throughout the season can occur, and weed control has been maintained with the non-selective herbicide. The last method of weed control involves simply repeated mowing with a flail mower or brush hog to maintain low vegetation cover. This method requires multiple trips across the row middles to achieve proper control. Weeds growing in the middles can be a problem in subsequent years. Also travel late in the growing season can damage branches on established vineyards, so care needs to be taken in late season mowing.

Under-the-row weed control can be achieved using cultivation and/or herbicides. Herbicide applications under the row are specific to the age of the vineyard. Some herbicides cannot be applied to newly established grapes, and others cannot be applied to bearing grapes. Always read and follow the detailed instructions and restrictions on the product label of each specific herbicide. The non-selective postemergence herbicides can be used anytime with care not to spray young vineyard bark or leaves. If spray or spray drift contacts the green bark of the vine, stunting and delayed growth can occur. To minimize bark contact, growth tubes can be used. These aid in training the vines and also to help shield the trunk from spray drift.

There are many selective herbicides that can be used safely and legally on grapes. These include preemergence compounds, applied prior to weed emergence, and postemergence compounds, applied to the vegetation foliage. When the vineyard is in the non-bearing stages of year 1 and 2, the preemergence herbicides Surflan, Devrinol, Gallery, or Casoron can be used. The main control with Surflan and Devrinol is suppression of seedling grasses (Table 1). Gallery is effective on seedling broadleaved weeds. Casoron G can be used, especially in a nursery, but probably is not cost effective in a vineyard (Table 2). Postemergence herbicides that selectively control a wide range of grass species are called graminicides. Labeled graminicides in grapes include Poast, Fusilade DX, and Select. These graminicide-type herbicides control a wide range of grass species, but there is no effect on broadleaf species, either weeds or crops. Therefore, a non-selective herbicide such as Roundup, Rely, or Gramoxone will need to be used for broadleaf weed control. These non-selective herbicides have to be very cautiously used to avoid any contact with the grape foliage.

Karmex and Solicam are two other preemergence herbicides that can be used for weed
control in the third year after grape establishment. Once the vineyard is into the third season of growth the only postemergence graminicide that can be used is Poast. Neither Fusilade DX nor Select are registered for use where fruit is produced and marketed. In the forth and fifth year Princep can be used as a preemergence herbicide. Princep is excellent for annual broadleaf weed control but gives only short residual annual grass control.

When focusing on weed control under the row, an understanding of the weed species present is needed. A good management practice does not rely on one class of herbicides, but rather a program approach of preemergence herbicides, postemergence herbicides, and cultivation. By implementing different methods of control, the overuse of one product does not occur, and this minimizes the possibilities of weed shifts and herbicide resistance issues that lead to worse weed control problems.

Under-the-row weed management requires care in proper identification of the weeds present, proper calibration, and care in application. If one of these factors is not achieved, poor weed control or injury to the vineyard can occur. Considerations at the time of application include actively growing weeds, low wind, and optimum weather conditions. If weeds are not actively growing, herbicide uptake can be minimal. If high wind is prevalent, extreme care must be taken to minimize off-target movement. When rain is expected, postemergence spraying should be delayed. By understanding the management strategies available, weed control can be attained in either row middles or under the row. By utilizing a variety of herbicides and cultural practices, cost-effective weed control (Table 2) can be attained throughout the life of the vineyard.
Table 1. Weed control ratings by species from various herbicides labeled in Grapes$^1$.

<table>
<thead>
<tr>
<th></th>
<th>Preemergence</th>
<th>Postemergence</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Devrinol</td>
<td>Gallery</td>
</tr>
<tr>
<td>Annual Grass</td>
<td>E</td>
<td>P</td>
</tr>
<tr>
<td>Bermudagrass</td>
<td>P</td>
<td>N</td>
</tr>
<tr>
<td>Seedling johnsongrass</td>
<td>P</td>
<td>N</td>
</tr>
<tr>
<td>Rhizome johnsongrass</td>
<td>P</td>
<td>N</td>
</tr>
<tr>
<td>Annual broadleaves</td>
<td>P</td>
<td>E</td>
</tr>
<tr>
<td>Brambles</td>
<td>P</td>
<td>N</td>
</tr>
<tr>
<td>Nutsedges spp.</td>
<td>P</td>
<td>N</td>
</tr>
<tr>
<td>Red sorrel</td>
<td>N</td>
<td>G</td>
</tr>
</tbody>
</table>

E = 90% or better control  
G = 75% - 90% control  
F = 50% - 75% control  
P = 5% - 50% control  
N = less than 5% control  
C = Contact burn of foliage but repeated applications are necessary for long-term control.

Table 2. Herbicides available, approximate retail price, rates used, and relative cost of herbicide application (assuming a 4-ft band applied and 10-ft row spacing) for vineyards.

<table>
<thead>
<tr>
<th>Herbicide</th>
<th>Approximate retail price</th>
<th>Product/treated A</th>
<th>Cost/A (4 ft band)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Karmex 80DF</td>
<td>$ 4.25/lb</td>
<td>1.25 - 2.5 lb</td>
<td>$2.12 - 4.25</td>
</tr>
<tr>
<td>Princep 4L</td>
<td>$ 13.70/gal</td>
<td>1.25 - 2.5 qt</td>
<td>$1.70 - 3.40</td>
</tr>
<tr>
<td>Surflan 4AS</td>
<td>$ 83.46/gal</td>
<td>2 - 4 qt</td>
<td>$16.00 - 32.00</td>
</tr>
<tr>
<td>Devrinol 50DF</td>
<td>$ 10.50/lb</td>
<td>4 - 8 lb</td>
<td>$17.00 - 34.00</td>
</tr>
<tr>
<td>Solicam 80DF</td>
<td>$ 17.60/lb</td>
<td>2.5 - 5 lb</td>
<td>$17.00 - 34.00</td>
</tr>
<tr>
<td>Gallery 75DF</td>
<td>$ 99.13/lb</td>
<td>0.7 - 1.3 lb</td>
<td>$28.00 - 51.00</td>
</tr>
<tr>
<td>Casoron 4G</td>
<td>$ 1.70/lb</td>
<td>100-150 lb</td>
<td>$68.00 - 102.00</td>
</tr>
<tr>
<td>Roundup Ultra Max 5L</td>
<td>$ 38.76/gal</td>
<td>0.5 - 5 qt</td>
<td>$2.00 - 20.00</td>
</tr>
<tr>
<td>Gramoxone Max 3SL</td>
<td>$ 38.00/gal</td>
<td>13 - 26 oz</td>
<td>$1.50 - 3.00</td>
</tr>
<tr>
<td>Rely 1L</td>
<td>$ 61.20/gal</td>
<td>3 - 5 qt</td>
<td>$18.00 - 30.00</td>
</tr>
<tr>
<td>Poast 1.5 EC</td>
<td>$ 115.00/gal</td>
<td>1.5 - 2.5 pt</td>
<td>$9.00 - 14.00</td>
</tr>
<tr>
<td>Fusilade DX 2EC</td>
<td>$ 118.00/gal</td>
<td>1.5 pt</td>
<td>$9.00</td>
</tr>
<tr>
<td>Select 2EC</td>
<td>$ 169.00/gal</td>
<td>0.5 - 1 pt</td>
<td>$4.00 - 8.00</td>
</tr>
</tbody>
</table>

1. These are only ballpark price estimates from various sources, provided during 2002 and should be used only to compare different broad approaches of herbicide usage.
Herb Session
Promising Plant Presentation

Originally presented by:
Jim Adams, Deni Brown, Madalene Hill, Scott Kresge, Alann Mezo
Summarized and presented by Rae McKimm

Ocimum tenuiflorum ‘Red and Green’ – Red and Green Holy Basil

Red and Green Holy Basil is a cultivar of Holy Basil that has been grown in the National Herb Garden for several years. It has the typical growth habit of Holy Basil reaching a height of 18 inches by the end of the summer. This cultivar starts out growing green leaves flecked with purple, but at full maturity, the leaves become heavily mottled with the rich purple making a beautiful combination of the two colors. The flower stalks, also purple, support the delicate light-pink flowers. The scent of Red and green Basil is the same as the straight species of O. tenuiflorum and can be used the same way. It is used in many of the ornamental plantings throughout the Herb Garden. It brightens up borders, edges and makes a wonderful accent in containers as it combines nicely with a lot of different plants.

Phormium tenax, Phormium colensoi (cultivars and hybrids) – New Zealand Flax

These two species, having the same common name, are native to New Zealand. Discovered by Sir Joseph Banks on Captain Cook's first voyage, these plants were used by the New Zealand Maori peoples as a source of fiber for weaving into cord, rope, baskets, and clothing. These plants have interesting histories and I encourage people to explore them in greater depth. Phormium tenax can grow to nine or ten feet with ideal conditions, but in most of our gardens it won't grow more than four. It is possible for it to reach its growth potential in mild climates of North America. Phormium colensoi is the smaller of the two species only growing to seven or so feet. There are many cultivars of both species and hybrids are also available. In the National Herb Garden they grow Phormium tenax var. purpurea, Phormium ‘Hilo Princess’, Phormium ‘Yellow Wave’. The older plants grow to about four feet in a container and the smaller plants to about two feet. It makes a wonderful focal point or accent in the garden. Grow in any well-drained good garden soil with full sun to very light shade. Their long strap leaves make a dramatic statement. They make wonderful container plants and easily overwinter in a cool room with a lot of light.

Zingiber officinale – Ginger

This common herb readily available fresh in almost every grocery store is sadly not often grown in gardens. This herb is one of the few that will thrive in a shady place and rewards the gardener with lots of product at the end of the season if they have a good rich soil. In late winter or
early spring, purchase or select from your own storage a large “hand” of ginger that is plump and has many eyes. Plant them in a pot and get them started early if you live in a northern climate. If in zone 7 and south, they can be planted directly outdoors. Many suppliers sell hands of ginger but you can buy them from the grocery store. During the growing season ginger makes a striking foliage plant and a wonderful contrast to other plants. In southern zones that have a long growing season, ginger may be perennial and may send up a short, inconspicuous flower stalk. The reward of growing ginger comes in the autumn when large, fresh hands of ginger can be dug to be used all winter long. If stored in a cool, slightly humid space, the hands can last almost all winter. Ginger is great for making teas, settling an upset stomach, or for flavorful ginger snaps.

**Angelica gigas – Korean Angelica**  One of the most beautiful Angelicas for the garden, this biennial has bold, tropical-looking foliage its first year with dark purple veins. In mid-summer of the second year, the plant sends up a robust, dramatic flower spike in a rich purple color reaching four to six feet. The umbel flowers are dark purple as well and make a statement on their own or combined with other plants. The flower is irresistible to bees, butterflies, and wasps and makes a great stage for watching them work. Grow Korean angelica in part shade in zone 7 and further south. It performs well in any average to rich garden soil and will tolerate moist soils. It is used medicinally where it grows natively in China, Korea, and Japan.

**Calamintha nepeta – Lesser Calamint**  A workhorse perennial for any garden with full sun, it flowers from June thru October with a cloud of white or light purple flowers. Lesser Calamint thrives in any average garden soil and grows to about 18 inches tall. Another wonderful attribute of this plant is that the entire plant smells strongly of peppermint. Lesser Calamint makes a wonderful edging plant to pass by along a walk or garden border. So you not only enjoy its flowery mass but its minty smell as well. It is hardy from zone 5 to 8.

**Asimina triloba – Pawpaw**  This small tree is native to North America with its range from southern Ontario to New York, south to Florida and Texas, west to Oklahoma. It is a wonderful addition to any herb garden. Growing to be a small tree up to 30 feet tall, it can be wither a single trunk specimen or a multi-stemmed tree. Pawpaws have large ovate-oblong leaves that can grow up to twelve inches long and give the tree a semi-tropical appearance. In the National Herb Garden a pawpaw grows in the corner of the culinary garden and provides shade for other culinary herbs like ginger, violets and turmeric. In autumn, the leaves turn a bright, clear yellow. Pawpaw flowers appear in early spring and are inconspicuous to the passing eye. They are thick, brown and fascinating to look at but odiferous on olfactory inspection (an attractant to the flies that pollinate
them). Late in summer the ripe fruit grows two to five inches long and is bluish green in color. Fruits are ripe and ready to eat after they fall off the tree and become soft. The skin should be peeled from the fruit or insides scraped with a spoon bearing a yellow pulp with a tropical, banana-like taste. There are large one-inch seeds inside the pulp, which should not be eaten. Their fruit can be used to make a fruity spread or to flavor desserts, including ice cream and puddings. For more information about Pawpaw, contact the Pawpaw Foundation at Kentucky State University at www.pawpaw.kysu.edu

**Ilex vomitoria – Yaupon holly**  This native evergreen holly gets a bad rap because of its botanical name and stories of its history, but this plant should be in almost every herb garden zone 6 and warmer. It is an incredibly tough plant and grows in very wet, heavy, soils or once established in very dry soils. There are many cultivars of Ilex vomitoria out there to fill any function in a garden design - straight species, weeping forms, tall dense columnar forms, dwarf forms, red berries, orange berries, yellow berries, variegated forms, etc.

**Zizaphus jujube – Common jujube, Chinese Date**  This is another small herbal tree not grown very often in gardens. There are several specimens at the U.S. National Arboretum that are about twenty feet tall. One on the grounds of the United States Capitol is about 30-40 feet tall with interesting blocky bark. Easily grown, its small, two inch long glossy dark green leaves are beautiful in summer and turn a bright yellow in the fall. In early spring inconspicuous, small green flowers appear shortly after the leaves. In early fall the small one-inch long plump brown fruit is noticeable on the tree and ready for harvest. The fruit has the flavor of a Granny Smith apple and has one large seed in its center. The fruit is delicious fresh or dried and has been used in China for thousands of years. ‘Lang’ is a cultivar that produces larger fruit – up to two and a half inches long. Reportedly hardy outside of its Zone 6 to 9 range with a twenty foot specimen growing in London, Ontario Canada.

**Calotropis procera – Giant Milkweed**  Originally from warm parts of Africa and Asia, this species is now pantropical and in ecological terms is regarded as an indicator plant for overgrazed lands. It is not eaten by camels, goats and cattle. It is a shrub, reaching up to 10 feet tall with large silver-green leaves, clusters of waxy purple-tipped flowers, and inflated pale green seed pods that split open when ripe to release silk-tufted seed to the wind. The latex is poisonous, containing digitalis-like compounds and is used to make arrow poison. The acrid sap latex is used to treat boils, infected wounds and other skin problems and parasitic skin infestations in animals. It also yields ash for making gunpowder and also has extremely strong fibers.
Croton flavens – Yellow Balsam or Rock Sage or Seaside Sage  Native to the Greater and Lesser Antilles and Venezuela, it grows in dry rocky coastal areas. It is a shrub, 3 to 5 feet tall with golden brown stems, attractive leaves and a pleasant aroma. The sap is a clear golden color and is used directly on sores and minor injuries. It is also used on a spoonful of sugar for coughs and colds.

Comptonia peregrina – Sweet fern  A shrub that looks like a fern, native to eastern USA, with beautifully scalloped, deciduous leaves and small, wind-pollinated catkins in spring. It is an aromatic astringent herb used mainly to control bleeding and diarrhea and as a wash for poison ivy rash. It is reputedly very difficult to find in nurseries. Also difficult to establish, transplant and propagate according to author Deni Brown.

Eleuthercoccus senticosus – Siberian Ginseng  Siberian ginseng is much easier to grow than Korean and American ginsengs, but oddly uncommon in cultivation. It spreads by underground runners and is tough.

Portulaca oleracea var. aurea – Golden Purslane  The golden form comes true from seed and tastes the same as the green purslane but is much more ornamental. Purslane is one of the richest known plant sources of omega-3 fatty acids, which help the circulatory system. It is excellent in salads or tossed briefly in stir fries.

Gentian lutea – Yellow Gentian  Yellow Gentian is another magnificent medicinal plant that is difficult to grow. It grows wild in the Alps, preferring well-drained but moist, alkaline soil and a cool climate. It is an intensely bitter tonic herb that stimulates the digestive system. Used in gentian brandy, angostura bitters, etc.

Chionanthus virginicus – Fringe Tree  A slow growing, striking, large shrub/small tree that is native to eastern North America. It is a bitter tonic herb, acting mainly on the liver and gall bladder.

Litsea glaucescens – Mexican laurel, Litsea prengleii, Litsea aestivalis – pond spice  Litsea glaucescens grows naturally in the dry arid hills of Mexico. It gets 15 to 18 feet with dark blue green evergreen foliage with an aroma very much like Laurel nobilis, Bay. In areas of Mexico it is used as a clipped 6-8 foot hedge, tightly pruned in containers and as specimen trees. Litsea prengleii also
has the bay-like aroma but grows in more moist areas of Mexico. It looks much like L. glaucescens but seems to bloom more frequently with flowers resembling small hard balls of creamy yellow. Litsea aestivalis is commonly called pond spice and is an airy and delicate small tree found naturally in ponds in South Carolina. Probably zone 8b at best.

**Origanum vulgare ‘Yunnan’ – Wild marjoram/oregano** This oregano was raised from seed that came from Deni Brown in England who received the seed from an Australian friend who received it from the collector who acquired it in Yunnan, China. It has a mounding growth habit. Stems are very blue in winter, the leaves are hairy and warm to the tongue with typical origanum vulgare’s strong aroma. The inflorescence was bluish lavender on the stalk similar in form to O. laevigatum ‘Purple’ but the color was not as deep purple.

**Origanum x majoricum ‘Hilltop’ – Majoricum** In the 1960’s Rex Talbert brought Madeline Hill a 3” pot of badly damaged, almost dead plant that he found while wandering around the back of a California nursery. It was tossed on the compost heap. He recovered it even though it had only a few scraggly leaves that smelled like chicken and dumplings. It was identified by Art Tucker as O. x Majoricum. It was grown for many years at Hilltop and both sold and shared. The tornado of 1983 destroyed every vestige of their favorite oregano. An O. majoricum ‘Italian’ began appearing on the market which looked like the lost oregano but lacked something in the aroma and seemed hotter to the tongue. In the spring of 2000, a long time friend drove up in her pickup with a load of gallon containers. She said, “Madeline, you gave this to me twenty-seven (1973) years ago and I needed to thin it out. Do you want them? It was Madeline’s long lost oregano. A valid reason for sharing plants… They were all planted and labeled as ‘Hilltop’ as a working moniker while Art Tucker finishes testing on both oreganos to determine if they are truly different.

**Artemisia ‘Afra’ – African wormwood** This semi-shrub has finely divided, silvery green foliage with tall spikes of small flowers. Its potential growth is 4 to 6 feet. The original plant in Madeline’s garden resides in the raised African bed in the Pharmacy garden. It is kept pruned to about 2 1/2 to 3 feet. It is a lovely mound and does not invade other areas of the bed like typical artemesias. It is used medicinally in its native habitat, South Africa. This is a great landscape plant. It can be used by either letting it grow to its potential as a specimen woody shrub or kept clipped. The hardiness of this plant is not known yet. It shows no burning in our low winter temperatures for short periods, usually low 20’s and occasionally dipping into the teens. While easy to propagate, the best news about this artemesias is that it does not spread by stolons. It grows larger at the base each year with new growth that can be kept pruned.
**Pycnostachys urticifolia**  This plants’ provenance is from South Africa and the Tropics. It blooms in the summer with spectacular sky blue flowers in a unique formation called thryse-like, very unusual. It grows to about 3 feet. Hardiness is not known but it is believed to be Zone 8B. There are about 20 members of this genus that are related to Plectranthus. This is a Richard Dufresne selection from Silverhill Seeds, Capetown, South Africa.

**Scutellaria longifolia – Hummingbird Plant**  This is one of the showiest skullcaps in the collection at Hilltop. It grows to about 4 feet with branches of magenta tubular flowers that attract butterflies and it is known as the hummingbird plant in its native habitat. The undersides of the leaves are hairy. It is grown in South Texas in both sun and high shade. While its provenance is from Mexico to El Salvador, Madeline’s plant came from the mountains of Costa Rica. While this is considered a tropical skullcap, Madeline finds that when the provenance of a plant is mountainous, it indicates that there is possibly a special hardiness in that plant. Many plants falling in this category will be hardy in Zone 8 or lower. Richard Dufresne said that this skullcap is hardy in Charleston, S. C.

**Hemizygia Zimbabwe – No common name**  This is a small ornamental shrub with a maximum height of about 18 inches. It blooms continually with dense flower heads like lilacs that are pale blue in color. The soft green leaves are ruffled along the edges. This is a beautiful perennial houseplant or a show stopping annual in the garden. Silverhill Seeds says there is some discussion that this might be a plectranthus.

**Gaultheria procumbens – Wintergreen, Teaberry**  This is a Eastern North American native dense, creeping ground cover with beautiful shiny, ovate leaves. It is hardy to zone 3 and likes moist rich soil with afternoon shade. In late spring to early summer, white pendant flowers are followed by red fruits about ½ inch wide. Both the leaves and fruit have culinary uses. The leaves are used for tea and the fruits can be eaten raw or cooked in pies or preserves.

**Geranium macrorhizum ‘Variegata’ – Musk Geranium**  This member of the Geraniaceae family is hardy to zone 6 and likes rich soil and in hotter areas likes after noon shade. The variegated form has intense yellow edged leaves that are set off by stunning lavender-purple flowers in July. This is not a culinary herb, but is used in potpourris and perfumes. It is rhizomatic and will eventually spread to form a ground cover over time. The leaves are a little sticky to the touch and have a peculiar smell like that of musk. Just as an ornamental this is a stunning specimen in the herb garden or perennial border.
Sanguisorba officinalis ‘Variegata’ – Variegated Greater Burnet

Native to an area from Europe through Asia & Japan, this striking plant gives incredible structure to the garden. The foliage clumps to 18-24 inches in height and width with flower spikes of the most intense deep burgundy reaching 3 foot or a little higher. The pinnate leaves are irregular edged with white. This combined with the toothed edges of the leaves makes for a stunning contrast in the garden. It is a hardy perennial to zone 4 and has culinary uses. The young leaves and unopened flower heads are used in salads, stir fry, soups and teas. The roots are used in Chinese medicine.

Myrtus communis – Grecian Myrtle

This tender shrub hardy to zone 9 makes a nice container plant addition to any garden. It likes full sun and well-drained soil. Traditionally used for wreaths, potpourri and beautiful standards, this plant also makes a great addition to your culinary herb garden. This is not a new plant and most of you probably grow it but many have not realized its culinary potential. There are many varieties of myrtle; Variegated, Broadleaf, Narrowleaf, Double-flowering. Grow at least one of them and start experimenting in the kitchen.

Lippia micromeria – Dominican Oregano

This zone 10 tender shrub is wispy and delicate looking. It is native to the West Indies, Central and South America. It grows to about 3 feet high in a container and is covered with tiny white flowers in early summer. Culinary is used as a substitute for Oregano in the tropics. It has a very distinct and complex flavor.

Chamaemelum nobile ‘Teneague’ – Lawn chamomile

This perennial herb is hardy to zone 5. Roman chamomile has been around and used by people for a while. This non-flowering form is a great addition to the garden. It is a dwarf lawn type that is ideal for walkways and hypertufa containers. The fragrance when walked on is that of apples with overtones of citrus. Give it full to partial sun, rich soil and a little room to grow. It will spread, but is not an invasive groundcover. It will form an impressive mat of foliage rosettes.

Salvia clevelandii – Cleveland Sage

Most often found in the trade as a cross between S. clevelandii x S. leucophylla. This highly aromatic herb is very distinct in the garden. The one variety believed to be the actual S. clevelandii is a named variety ‘E. Winifred Gilman’ that has greener foliage and a scent of eucalyptus. The hybrid more circulated has more of a sweet rose tone to the sage. Cleveland sage wants very well drained soil and full sun. It is publication hardy to zone 9 (although there is a plant over wintering in Little Rock) and produces beautiful
blue flowers.
Herb Plant Propagation
By Tom Bergey

Tom Bergey is the owner of the Golden Trowel Herb Farm in Newalla, Oklahoma. Tom is the current Vice President of the Oklahoma Herb Growers & Marketers Association.

Although these propagation techniques can be applied to large scale, automated growers, the information here is geared for the small scale grower with limited resources.

Herb plants are easily produced and propagated by the basic three methods of propagation; seeds, cuttings and divisions.

Propagation From Seed:
Nearly all annual herbs and many of the common perennial herbs can be easily propagated from seeds. Required equipment includes solid (no drain holes) plant flats, seed or plug flats, humidity domes, quality growing medium (Ready Earth plug mix) rack or shelf system with suspended artificial light source, small fan and a collection of selected seeds.

Perennial seeds should be started 12 to 16 weeks prior to targeted sales date. Annual herbs should be started 6 to 8 weeks prior to sales date.

Begin by filling plug or seed trays with moistened plug or seed mix. Growing medium should not be too loose nor packed to tightly. Chive seeds and all large seed such as borage, cilantro and nasturtiums should be started in plug flats and covered with ¾ inch of medium. All other herbs seeds should be sown directly on top of soil medium. This will allow direct exposure to the artificial light which will speed up germination and increase germination percentage. Be sure to tag or log what varieties of seeds are sown in which flats.

Once flats are sown, lightly mist with water, cover with clear dome and place under artificial light source. Your light or “germination stand” can be constructed from wood. A light stand 6 ft. tall and slightly over 4 ft. long and 2 ft. wide with 4 shelves will accommodate 16 flats. Above each shelf, suspend in a way that their height can be adjusted, two - double bulb 48” shop light fixtures. Use alternating
cool and warm light fluorescent bulbs in each fixture to provide a good light spectrum for the seedlings. Light fixtures should be plugged into a timer that will automatically turn on and off allowing about 15 hours of artificial light per day.

As soon as the first seeds in a flat germinate, remove the clear dome and adjust the lights so that they are no more than 3 inches from the tops of the seedlings. The closer the light source is to your seedlings, the stockier and healthier they will be. Adjust lights periodically as the seedlings grow. A small fan aimed at the flats will provide needed air circulation around the seedlings.

When seedlings have developed their second pair of leaves, they can then be transplanted to the pots they will be sold in and moved to the greenhouse. Two weeks prior to sale plants may be fertilized with a light mist of a strongly diluted solution of liquid seaweed and fish emulsion.

**Propagation From Cuttings.**

Many of the unusual variegated and scented perennial herbs will not produce viable seed.

These herbs are easily propagated from cuttings taken from stock plants. Two simple methods are used to root herb cuttings that require no rooting hormone or heat tables.

“Cinnamon Roll Cuttings” This method was shown to me by Richard Franks of Noble, Oklahoma over 10 years ago and is one of the easiest and most successful way to root cuttings of any kind. Begin by cutting strips 3 inches wide and 24 inches long from discarded plastic potting soil or growing medium bags. Lay plastic strips on table and cover with a very thin layer (about 1/8 inch) of moistened seed or plug mix. Take desired 3 inch cuttings and strip of lower 2/3 leafs. Arrange cuttings on the soil covered plastic strip in a row spaced 1 inch apart with the leafless stem on soil and the top of the cutting above the plastic. Starting at one end, roll the plastic up like a cinnamon roll. Secure the roll of cuttings with a small rubber band and the wedge the roll in to a standard pot. Place the pots of cuttings in a flat and locate in a sunny spot.

Cutting rolls should not be soggy but never allowed to dry out. Depending on variety of herb, cuttings may wilt after first day but will perk up and be ridged within a week. After 3 to 4 weeks, a mass of root hairs will be visible at the bottom of the roll. Remove rubber band and gently unroll cuttings. Pot rooted
cuttings and grow on as you would for potted seedlings.

“Stuffed Pot” method: This works best for stiff stem cuttings such as rosemary, lavender and sage. Fill a 6 inch azalea pot with moist growing medium. Gather 3 inch cuttings of selected variety and remove bottom 2/3 leafs. Stick as many cuttings as possible in filed pot. Place pot in flat and move to sunny location in greenhouse. Again, keep cuttings moist and never allow them to dry out. When root hairs appear after 3 to 4 weeks, gently tap cuttings out of pot, re-pot in to selling container and continue to grow as you would with seedling transplants.

Propagation From Plant Divisions: This is best done in early spring or early fall. For production purposes, it is best suited for plants that have spread into a dense mat such as oregano, mint and several varieties of thyme.

Plants may be dug up and separated by pulling or cutting apart individual sections. Basically, any section of the plant that has a small, healthy root can be potted and allowed to grow into a nice plant for sales. Divisions can also be taken by simply cutting out small plugs from the parent plant and potted into containers for sales.

When dividing French Tarragon, dig up the entire plant and gently untangle the root mass. As you do, you will end up with many individual divisions that can be potted into 4 or 6 inch pots, grown on and sold at a premium price.

Sources: For plant material, you can do no better than to purchase herb plants from the growers in your association. They are knowledgeable about various varieties and their plant material will already be acclimated to your growing area.

There are hundreds of good seed companies that offer a great selection of herb seeds. I strongly recommend Johnny’s Selected Seeds. They offer a free commercial growers catalog and have an extensive selection of both culinary and medicinal herb seeds as well as an excellent selection of vegetable and flower seeds. Their prices are very reasonable, service is exceptional and seeds are of the highest quality.

Johnny’s Selected Seeds
955 Benton Avenue
Winslow, Maine 04901-2601
1-800-854-2580
FAX 1-800-738-6314
A unique herb farm of sorts

April Harrington
Earth Elements Farm, Lexington, OK, 405-872-3722

Six years ago, with visions of yellow blossom filled beds, ladybugs and the scent of basil in the wind, I dreamed of a place to call home, a place to learn, grow, explore and share. The idea was to find a place to grow healthy food and the ingredients for the line of natural body care products I had been developing from old-time recipes. Seeking to simplify my life and to experience the environment first hand, I began the journey toward sustainability.

We started with not much more than an acre and half, a well house, a roof over our head and some fruit trees. But we had good soil and good water. These were at the top of the list in our search for the right piece of property. Since I had never farmed before, I needed all the help I could get. We arrived in early spring and were greeted by beautiful blossoms that later produced bounties of cherries, plums and peaches.

Our first garden was 4,000 square feet. We planted everything we could get our hands on, and had a wonderful assortment of herbs and vegetables. That first garden taught us a lot of things. We learned about Bermuda grass, Johnson grass and how black walnut trees affected the soil. We learned about squash bugs and working at night to survive the heat. After living in the Pacific Northwest for awhile, I had almost forgotten about the Oklahoma wind, the hot, dry summers and the sweet smell in the air before a thunderstorm. Adjusting to the regional, environmental differences was challenging, but I was looking for change. It was definitely a change moving to the country, and being a farmer was a whole new experience for me.

A few weeks after settling in and breaking ground, we loaded up the truck and set out to our first herb show. I was excited about meeting new herb-loving friends and getting to see what was growing in Oklahoma. I knew that the herb market in Seattle was stronger and more established than here, but I had no idea that the organic movement in Oklahoma was pretty much yet to come. That first show made me wonder if everyone back in Seattle who thought I was crazy for leaving my comfortable office job were right. But I’m a Taurus, so I’m inspired by challenge. I booked every show I could. I spent a lot of time educating people about what I did and why I did it. Education was the key. Some people just didn’t get it but some people did; that is why we are still here. We have explored every festival, faire and show across the state. We have decorated and
participated in theme shows, watched the land run re-enactment several years in a row, ate cheese curds like there was no tomorrow, tried sorghum and learned all about honey bees. But the most rewarding thing we learned was that there were others out there - others interested in alternative agriculture and healthier, simple living. Connecting with these people gave us the motivation to keep doing what we do.

Our second year in production, we applied for Organic Certification and that opened up avenues we could have never imagined. We had farmed organically from the start and we had talked about certification, but we were leery of the cost and paperwork. We soon learned that it really wasn’t cost prohibitive, and the paperwork wasn’t much more than the records we kept for ourselves. Receiving an organic status helped us develop relationships with consumers and find the market niche we needed to strengthen our foundation. Becoming Earth Elements Certified Organic Farm was a good thing for us. It showed our community our commitment to farm earth-friendly and to produce products in a healthy manner.

The more we learned about diversifying, the more focused we became on the physical building of the farm. About 80% of the farm is built from recycled materials. These materials were salvaged before going to the landfill. Some of this material was new and had never been used. The first building on the farm was a storage bldg / workshop. It was a comfortable and sanitary place to make products that also provided extra storage upstairs. As we learned more about the needs of our customers and the opportunities for diversification, we decided that a facility approved by the Health Department was the best way to go. This opened the door for food processing and value-added food products. So with the help of many hands, we recycled and salvaged as many materials as we could and turned our storage shed into a fully functional, certified kitchen.

We built our first barn out of metal recycled from a dumpster. In its previous life, it was a storage shed for a restaurant. On our way to a family gathering and dressed in nice clothes, we stopped to salvage enough nice metal sheets to cover three and half sides of a 28’ x 28’ barn. The roof was salvaged from a Sonic canopy remodel, the wood floor came from left-over lumber from an apartment complex and the shelves came from dumpsters behind a church and an law office in town. The front is designed from old fence panels that we recycle from the throw-away pile at the local fence company. We spent $12 on this barn for nails for the floor and doorknobs for the doors. The barn has three areas: The drying room, the drying /loading dock and the tool room. The tool room was built as a temporary tool room until materials and time allowed for the building of
a carpentry workshop. We are now moving into the new carpentry shop and the temporary tool room will be our new classroom next summer. Our drying room and dock is filled with shelves for storing seeds and dried herbs. It has areas for hanging herbs and airflow shelves for drying pods, gourds and flowers.

I have experimented with drying herbs for seasoning blends, medicinal herbs to use in my products and herbs for crafts. Drying herbs for culinary use is an opportunity we focus very little on. We market most of our culinary herbs fresh and prefer to use dried for value-added products and ornamentals. One year, we extended our fresh culinary production of basil through the winter. We covered our existing field crop with cattle panels covered in plastic, creating a hoop house, which we heated with a wood stove on the coldest nights. We continued to deliver fresh Genovese basil into late January. Delivering fresh herbs to restaurants is part of our diversification, and we also value-add basil into gourmet pesto for a local Italian restaurant. The herbs that we dry are mostly used in my body care products. We also utilize our drying room to dry seedpods from herbs and vegetables. We grow only heirloom, open-pollinated varieties, which allows us to save our seeds. Seed saving is probably one of my favorite garden tasks. We started out with heirloom vegetables, most vegetables seeds are pretty easy to obtain. Cross-pollination can be an issue, but we are selective with what we grow and save. Most of the herbs we are working with are propagated by using cuttings or root division. Some herb seeds are so small it seems an impossible task without the right equipment. Each year our herb seed selection grows as we learn more and improve our techniques for handling such small seeds.

As our business grew we learned about many different resources that were available to help us. It amazed me to learn about all these places that were set up to help sustainable agriculture, we are so grateful to all of them for their help. OSU FAPC, ODAFF, Kerr Center, Attra, and SARE. Having these resources helped us educate ourselves about diversification, which has helped us become the unique farm we are today.

Just thinking about springtime, starter plants and Saturday markets makes me want to get my hands dirty. In the early spring, just a few short weeks away, we start seeding flats in our mini greenhouse and cold frames. We usually get a jumpstart on about 25-30 varieties of herbs and vegetables. We use herbs to intercrop and companion plant with our vegetables. Our production herbs have permanent beds that reseed themselves or are perennial plants. Established beds contain crops such as dill, sage, oregano, salad burnett, parsley, peppermint, calendula, comfrey, thyme, poke and fennel. Some production herbs like basil are rotated in our crop plan like the vegetables.
After the first couple of years working the garden, we realized the significance, raised beds made on our yields and our backs. At first, we row planted using drip irrigation and black plastic, and was farming in an intense method similar to the Noble Foundation permanent raised bed research project. Our intentions are to raise the production fields into long-growing beds and utilize them for row planting while reaping the benefits of being raised. Our existing raised beds are made mostly from recycled materials as well. We have used above-ground swimming pools, galvanized metal from old storage sheds and recycled bricks from new house construction. Old bathtubs painted are bed center pieces, old hospital screens and metal bed frames are great trellis material. Our garden is a delightful place filled with a wonderful selection of produce and old treasures.

For the past three years, we have traveled to Edmond’s Farmers Market on Saturday mornings to set up shop and fill our table with bounties from the beds to sell. In the spring, we offer heirloom vegetable and herb seeds. Also offered is a fair selection of starter plants as well. We don’t focus a lot of our business on plants to sell, but we always have an assortment leftover from the hoop house after we plant the beds and fields. Lettuces are also a spring time delight; we grow about nine different varieties of lettuce and spinach to make our salad blend to sell. I like to throw in a little bit of salad burnett and borage to enhance the flavor. Next year, I am going to add edible flowers to the mix and see what happens. Value-added products are an important part of our business. The natural body care product line has been the foundation for several years, and with the new addition of our organic cookie mixes, our value-added business continues to grow. Our booth is like an old farm store. We offer a selection of everything possible. It keeps things interesting and customers curious. I like to fill my tables with colorful cut flowers, fragrant culinary herbs and mounds of veggies, and any farm crafts I can come up with. I try and share with my customers about life on the farm. I bring pictures and invite them to come and enjoy the variety of workshops and festivals we host each season.

Every month, we offer a variety of workshops for adults. We teach soap making, salve making, bath and body workshops and more. All classes are designed to be hands-on, and each student gets to take home what they make. We also have a wonderful assortment of kids programs; everything from making gourd birdhouses, jelly making, worm composting and my personal favorite Farmer for a Day. This program came to life from parents who called and asked if their kids could come and work for a day. The kids had so much fun that we developed a program for kids to come and work. We harvest and hoe and plant and weed. Last spring, we had several groups come and help build raised beds. It teaches kids about the environment and where their food comes from. My favorite part of the program is the smell tour, where the kids get to smell different herbs and try and guess what food they are used in. Identifying herbs and associating them
with the foods we eat is fun and the kids get a kick out of it. Having kids come to the farm also brings parents, and we do our best to educate them about our mission, our products and services. The biggest problem with the kids is getting them to go home.

Having workshops and kids programs is, I guess, a form of agri-tourism. The workshops have lead to garden tours, and we now host two annual festivals; Springfest and Fallfest. Once in June and again in October, we open the gates, cook up a bunch of wholesome food and have an old-fashioned picnic. We make homemade ice cream, people gather and play music, sing and dance, play games and camp out. It is a wonderful family event that creates enjoyable memories for everyone. Each year, our festivals have grown and the benefits are amazing. People come and enjoy the day and then want to keep coming back for workshops and classes and they want to bring their friends and family. We have struggled with the tourism part a little, setting hours of operation means, I can not come and go as I please. Touring takes a lot of time and I haven’t found a way to make it keep the lights on. So for now we try and work by appointment but handle the drop-ins as they happen and try to get them through the farm store before they are ready to go.

Being diversified can sometime be crazy. Some days, we may have too many irons in the fire, but with careful planning, not too much overlap happens, except for certain times of the year and that is just business. I like being diverse because everyday is new and challenging. It keeps life exciting and creates a lot of interest in the community. Our diversity has helped promote community and build a family of supporters and volunteers that keep this farm growing strong. Without the help of these wonderful people, our farm would be very different. Earth Elements Farm is about a lot more than herbs and veggies; it is about community, friendship, knowing your neighbors and sharing weekly meals with friends. It is opening my home to students who want to learn and offering a place for people to feel comfort and kindness. Our farm is a unique herb farm of sorts; diverse in what we do and how we do it. It is the hardest I have ever worked and the most rewarding work I ever done.
Water Gardening
Richard Franks, Owner of Franks Landscaping, Noble, OK

I have been landscaping since I graduated from college in 1967. We do all types of landscape construction including sprinkler systems, retaining walls, flagstone, and water gardens. My five-acre nursery is located south of Noble, which is south of Norman. I grow over four hundred varieties of perennials, ground cover water garden plants as well as over four thousand trees up to thirty-five feet tall.

My first water garden was built in 1983 for one of my landscape maintenance customers. In the last eight years water gardening has become a bigger part of my business. We now work on about thirty ponds a year.

I have one greenhouse for propagation and three for overwintering plants. Most water garden plants are little more than aquatic weeds and are very easy to propagate either by seed, cuttings or divisions. Because I am a big recycler I use almost any thing that will hold water and have twelve old bathtubs. Because I am out landscaping most of the day I need a way for whatever I am growing to survive until I get back. I have an old galvanized shelf that has plastic sheeting draped over it to make a mini greenhouse in side my big green house.

One way to handle cuttings is to cut a strip of plastic two or three inches wide and lay it on the potting table. Then add a thin layer of potting soil. Next prepare cuttings as usual using a rooting hormone and lay three quarter to one inch apart with tops sticking off plastic in one direction. Add another layer of potting soil. Roll the plastic up like a cinnamon roll and place the roll inside a pot that will accommodate that size roll. The pot is then labeled with date and variety and placed in side the propagation tent. Water pot and spray foliage as well as inside the tent to make higher humidity. Soft woodcuttings will normally root with good success in two to four weeks on most varieties. When new growth occurs the plants are ready to pot. This system is successful for several reasons. You can get a lot of plants in a small area. Because the plastic divides the cuttings from the next row it concentrates the roots in a very small space. If you just stick the cutting in a pot of soil, they would grow in all directions into all the other plants. Because the tops are so close to each other it helps keep the humidity level up inside the tent.

You can start and easily maintain many plants by simply lining a flat with a layer of plastic and inserting a plug tray of the right size. By filling the flat with water this keeps the plants evenly moist for a much longer time.
Do not use soil less potting mixes for water garden plants because it will float to the top when placed in the pond. Good old Oklahoma red clay is very good to grow aquatic plants. There are several containers made especially for the water garden or you can recycle old nursery containers. If you use nursery containers you need to line the bottom with plastic to keep the clay in. I then add a small amount of soil. Put fertilizer in next covered by more clay, so that the roots do not directly touch the fertilizer.

Next add the plant and enough clay to bring soil level to within one to two inches of top. If the plants are going to be sold soon I will top it off with either pea gravel or a larger river rock. This makes it look nicer as well as to help keep the soil in the pot. Koi are little more than aquatic hogs and like to root in the pots. Pea gravel is ok for gold fish, but koi will simply put it in their mouth and spit it out into the pond so they can get to the soil. For big koi you need to use rock egg size or larger. I usually do not rock the pots until they sell so that I can get the size the customer prefers. If they do not sell before needing dividing I do not have to cut through the rock.

The location of the water garden is very important. I prefer to put the water garden close to the house in an area that can be easily seen from inside especially when weather conditions are less than ideal. It is critical that the edge of the pond is higher than surrounding area so that rain water does not wash fertilizer and weed killer into pond. I usually use the soil from the hole to hide my filter and at the same time making a waterfall and a planting beam. This saves hauling off so much soil.

We normally make a shelf around the entire pond about four to ten inches under the surface. This is to hide the liner in the area where the water transitions up and down.

I prefer to not rock the whole pond even though it looks pretty when first installed it soon fills with fish waste and debris. When you build a pond that will have fish you need to take the water out of one end and return it in the other. Do not have any necks that do not get recirculation. I prefer ponds at least two feet deep. If they are shallow they heat up and cool down very quickly. This makes the fish more likely to get sick. The bottom should slope to one end thus making cleaning easier.

In the past many books said not to put the pond in the shade. We now have many varieties of plants that will grow in the shade. There are now even water lilies that will bloom in a minimum of sun. In the shade you have fewer problems with green water. If you use a good skimmer it will catch the leaves and other debris from the surface.
Koi and gold fish are compatible in the same pond. Gold fish can multiply like rabbits while koi usually do not overpopulate the pond. It is not unusual for many ponds to have green water for two to three weeks in the spring. The single cell algae grow much faster in the cool water in spring than the beneficial bacteria that eliminate their food can grow. An ultra violet clarifier may be used to kill single cell algae. Because the bio filter that I build performs so well I rarely need a UV light on my ponds.

For the typical pond I use either fifty-five or sixty gallon plastic barrels. The water is pumped to the bottom of the barrel; it then comes up through river rock, pea gravel and two sizes of sand blast sand. This filter usually needs to be cleaned about every six weeks. This is accomplished by using a one horsepower spa blower. This typically takes about fifteen minutes. I installed two barrels on my new 15 by 30 pond. In two weeks it cleared pea soup green water enough to tell if a fifty-cent piece on the bottom of the pond was head or tails.

I used four different skimmers before I found one I liked well enough to put it on my ponds. It is the POND SWEEP SKIMMER also sold under the LITTLE GIANT name. They have a baffle on the weir so that all the water comes in at the surface and not around the sides. Next is a catch net for the big debris. There is a one and a half filter pad that can be lifted out and washed as necessary. The pump sits in the back, in filtered water so you do not need the foam filter that comes with many pumps. By having your pump in the back of the skimmer there are no electric cords or hoses to clutter your main pond. This skimmer can be plumbed for a bottom drain and or an out of pond pump. The pumps I normally use are very energy efficient. The Danner 1800 will pump eighteen hundred gallons of water while using less electricity than a 150-watt light bulb.

I now include fish and aquatic plants and even landscaping in most of my proposals. Because I now grow over four hundred varieties of plants I have been making a display garden that keeps getting bigger every year. I now have three ponds, which are stocked with different varieties of gold fish so they will breed true. In my newest pond, which is fifteen by thirty feet, I also put in small koi that I let grow larger. I do not attempt to breed koi because that is such a specialty.

Most towns now use chloramines in their water system. This will be toxic to fish for many days so you must use a chloramines buster whenever you add water to the pond.
Public Gardens & Master Gardeners Session
Color in the Garden

Louis Scott, Assistant Naturalist
Will Rogers Park, OKC Parks and Recreation

Louis Scott has been actively involved in horticulture since the late ‘80’s. His experience includes working in both the retail and public garden aspects of horticulture: five years with Mid-America Iris Garden, two years with OSU/OKC, five years with the OKC Zoo and three years with OKC Parks and Recreation. A self-avowed ‘plant nut’ he enjoys collecting and trying new plants, especially perennials, shrubs and small trees. Born and raised in Stillwater, Oklahoma, he proudly considers himself a true ‘Okie’ and enjoys the area’s challenging aspects of horticulture. His original background in the fine arts field gives him a particular interest in color aspects of gardening.

COLOR THEORIES

A. The Color Wheel.

B. Complimentary Contrast is the most vivid – any opposite colors on the wheel.

C. Contrast of Extension – contrasting colors must be used in the correct proportion or one will overpower the other.

D. Cold-Warm Contrast – colors can appear warm or cool depending on adjacent colors.

ANNUALS – TRUE WORKHORSES IN THE GARDEN

A. All-American Selection Trials at OSU/OKC.

B. Trial plants are cultured with consistency.

C. Varietal differences are the keys to performance – side-by-side performance evaluation.

D. Varietal differences are key in design aspects as well – shorter petunias behind a taller selection.

E. Annuals are most effective when single varieties are massed.

F. Even small quantities of annuals can be effective if ‘staged’ within the site.

FLORAL COLOR VERSUS FOLIAGE COLOR
A. Floral color can be spectacular.
B. Foliage color can be just as spectacular.
C. Foliage color will outperform floral color during mid to late summer.
D. Interesting color contrast in foliage can be created by using common plants. It’s all in how they are combined.

COLOR IN CONTAINERS
A. Do not over-plant annuals. Individual plants need space to develop supportive root systems that are free from competition.
B. One plant in an appropriate sized container will be healthier and require less maintenance.
C. Permanent container plants that flower such as small shrubs make excellent choices if given the right site and right sized container.
D. Evergreen plants in containers can provide ‘round the year color.

SEASONAL ASPECTS OF COLOR
A. Avoid using too many deciduous plants. November through March, the landscape will appear ‘brown’.
B. Incorporate a ratio of about 65% evergreen plants to provide ‘backbone’ interest all year long.
C. Do not focus color on one given season. Select ‘star’ plants that support the backbone during each of the four seasons.
D. Late Fall and winter are the best times to evaluate the lack of yearlong color interest.

CASUAL, FORMAL AND EFFECTIVE PLACEMENT
A. Wildscapes can be made to appear more ‘tidy’ if given defined edges to areas.
B. Hardscape materials can be colored to add impact to sites.
C. Sculptural and natural hard materials add visual interest.
D. If time and maintenance are limited, site plants where they can be viewed from both inside and outside. Here plants in a small side yard are planted only in the area opposite a window.
GREAT PLANTS FOR EASY COLOR IN THE GARDEN

- Any annual with highly colored foliage such as Persian Shield.
- Any annual that does not require regular deadheading to continue flower production such as Gold Lantana.
- Perennials with long bloom cycles such as ‘Pink Mist’ Scabiosa
- Evergreen perennials such as Dianthus ‘Firewitch’ add interest all year.
- Hardy spring bulbs such as species tulip *T. clusiana*. It multiplies freely.
- Some native wildflowers such as *Callirhoe involucrate* have extremely long bloom periods, some for months.
- Red Yucca blooms for months; is attractive to hummingbirds, has evergreen foliage, is drought resistant, is relatively pest and disease free.
- Purple Smoketree, great color and ease of maintenance.
- Washington Hawthorn – Spring flowers and fall fruit.
- Rose-of-Sharon ‘Aphrodite’ – long bloom period, triploid genetics so produces little to no unwanted seedlings.
- Crapemyrtles – select superior varieties such as ‘Pink Velour’ or ‘Dynamite’.
- Hollies with unusual fruit colors such as *Ilex opaca* ‘Canary’, which has yellow fruit.
- Amur maple, small size but big fall color. Select seedling produced varieties such as ‘Flame in fall when color can be observed.
- Western Snowberry, *Symphoricarpos occidentalis*.
- Spiraea ‘GoldFlame’ – colorful foliage and flowers.
- Engelman’s Daisy, a native perennial that blooms for months.
- Variegated Parson’s juniper. Branching is at 90 degree angles.
- Burning Bush.
- Thornless climbing rose ‘Zephrine Droughtin’. A repeat bloomer
- Miniature climbing rose ‘Red Cascade’. A continual bloomer.
- Vitex.
- ‘Moonshadow’ euonymus.
- Tall bearded reblooming Iris ‘Feedback.dollins@okstate.edu’
- Variegated Rose-of-Sharon.
• Juniper 'Lime Glow'.
Zoo Horticulture - The Rest of the Story

Jay Ross, Horticulture Curator
Tulsa Zoo and Living Museum
Oklahoma State University, Class of ‘79
City of Tulsa Parks Dept., 1982-Present

Historically, zoos have been known as sites where animals are on exhibit for the public to view and learn about their lives. For years this presentation was geared towards just showing you an animal, a captive animal. Over the past quarter-century, zoos have started seeing the bigger picture in showing and housing animals for display. There has been this realization that both for the well-being of the animal and for better edification of the zoo visitor, presenting habitats that relate to the animals was the direction to go. The animal may be the focus for many, okay most, zoo visitors. But attempting to tell the whole story of the many natural living systems that exist together to create our world is a much more intriguing story. As a result of this grander perspective, horticulture is playing a bigger role in today’s zoos than it ever has in the past.

At the Tulsa Zoo, we are attempting to tell our visitor the whole story as it relates to the living collections we house there. This is a challenge from a number of angles. When I went to work at the Tulsa Zoo after spending my entire career in a traditional public ornamental horticulture setting, I was excited at the possibilities. Here was a place that their intent was to show people living things, plant or animal, from all over the world. The opportunities to work with many different plants was quite mouth watering. But the challenges that came with this opportunity were interesting and in many ways different from what I had experienced previously in my career. Telling the rest of the story is an exciting endeavor, but it doesn’t come without its share of obstacles and challenges.

In creating a successful zoo exhibit, I have two primary objectives. One, I want to be as realistic as possible and secondly, I want to have as much of the exhibit present year round as possible. Both of these objectives are directed by a plant’s ability to grow and survive in an environment known for having summer temperatures reach into the 100s, winter temperatures that have the potential of dropping as low as zero, an average rainfall between 35” and 40” per year that comes in great quantities at some times and not at all for periods of time.

With these parameters in mind, I first do my research to determine what plants are indigenous to the area of the world we are trying to interpret. Armed with this information, I try to fit the information into the climatic parameters mentioned as
well as if they are available in some manner for obtaining. The next objective, if
for some reason these criteria cannot be met is to find a relative of the specific
plant that exhibits like characteristics of its native relative and meets the
requirements. Lastly, plant selection is made to emulate the native material.
This is just the first step.

Now that plants have been selected for their ability to work at creating or
interpreting the environment from somewhere (usually other than Oklahoma) on
earth that we are telling the story about, they must be deemed safe to use with
the animals in the exhibit. Phytotoxicity, physical injury, and creation of a
possible escape route are primary considerations that must be addressed about
any plants used in the creation of a zoo exhibit. The zoo’s veterinary staff,
animal care staff, and horticulture staff look at these aspects. Any points of
concern are addressed or if deemed too large a liability, a plant is excluded from
the design and a possible replacement or alternative is researched out.

As well as protection of the animal from the plant must be considered, an even
greater concern is the survival of the plant from the pressures of the animal or
animals. With this in mind, protecting the plant is something that must be
considered. And in doing this, of vital knowledge are the behaviors of the
specific animal you are dealing with. An animal’s inability or ability to do
something can be used creatively to prevent the animal from getting to a plant or
group of plants. This may need to be during an establishment period or forever.
Whatever is utilized must not be created such that it will possibly be injurious to
the animal. Barriers are one measure and can be accomplish with actual
fencing, structures that distract or prevent an animal from getting to the plants
such as boulders, or with electrical fencing. Besides barricading the planting
from the animal, sometimes over-planting or planning to make repeated plantings
is the answer. Often the damage that an animal imparts on plantings is due to
their newness and the curiosity that is invoked. Once they become accustomed
to this new element in their exhibit, they will cause very little disturbance to it.

The use of horticulture in zoo exhibits to create realistic habitats and help
interpret for people the interaction between plants and animals from around the
world is a very challenging and rewarding endeavor. It is part of the story that
has been neglected for years in zoos but is more an integral part today.

I’m proud to say is something we work hard to tell at the Tulsa Zoo.
Perennials—Oklahoma’s Tried and True; and Some New Ones Too!

Susan Brammeier
10907 E. 76th St., Tulsa, OK 74133

Susan grew up in St. Louis, Missouri, where her love for gardening was cultivated in her father’s 2-acre vegetable garden. She received a B.S. in Biology from Florida International University and served as a research assistant for Fairchild Tropical Garden in Miami, Florida. She is currently employed by Southwood Landscape and Nursery in Tulsa, Oklahoma, where she heads the perennial and container garden departments. Susan is also an adjunct instructor in the horticulture department at Tulsa Community College.

Perennials- Oklahoma's Tried And True, And Some New Ones Too!

I am perennial department head for Southwood Landscape and Nursery. In the 6 years that I have been at Southwood I have seen their perennial sales skyrocket as the popularity of perennial gardening increases all across the country. They say that perennials, container gardens and annuals are the biggest growth categories right now in the garden center industry. This has certainly been the trend for us at Southwood.

There are literally thousands of choices gardeners have in perennials. And plant breeders are constantly coming up with new and improved varieties; making sorting out the good from the bad a challenge for even seasoned horticulturists. My home garden is a test ground for perennials, ground covers and some annuals. Since I have not gardened in Oklahoma for very many years I had to do this to figure out exactly which plants actually can withstand our extremes in temperature and humidity. Certainly not all perennials will do well, or even live at all for that matter, in our climate.

I have compiled a very short list of some of the perennials that I have found to be "bullet-proof". That is, they are tolerant of our weather, don't require absolutely perfect soil and aren't fussy about whether or not they are pruned or deadheaded on a strict schedule. In other words, these are some plants I recommend for the average gardener who wants to add some perennials to their landscape because they are tired of the time-consuming and expensive process of planting annual bedding plants every year.
1. Phlox subulata
2. Iberis sempervirens
3. Dianthus deltoids
4. Coreopsis grandiflora 'Zamphir
5. Coreopsis verticillata 'Moonbeam', 'Limerock ruby', American dreams
6. Hemerocallis
7. Heuchera micrantha 'Plum pudding'
8. Achillea millefolium
9. Artemesia schmidtiana 'Nana'
10. Astilbe ardensii 'Fanal'
11. Hosta
12. Hardy ferns *Athyrium nipponicum pictum*
13. Autumn fern
14. Echinacea purpurea 'Magnus', White swan'
15. Salvia superba 'May night'
16. Scabiosa columbaria 'Butterfly blue'
17. Gaillardia grandiflora
18. Rudbeckia fulgida 'Goldsturm'
19. Sedum spectabile 'Brilliant
20. Phlox paniculata 'David'

NEW
Verbasum 'Jackie'
Verbasum 'Summer sorbet'
Fallopia japonica
Heuchera 'Amber Waves'
Heucherella 'Sun spot'
Polmonium 'Bris Anjou'
Pulminaria 'Raspberry splash'
Coreopsis 'Limerock ruby'
Coreopsis 'Limerock passion'
Echinacea purpurea 'Razzmatazz'
Tiarella 'Crow Feather'
Gaillardia 'Fanfare'
Helleborus 'Pine knot strain'
An overview of gourds, their use in art and utility, in cultures all over the planet.

Gourds are ancient, perhaps one of the first plants to make its way around the world from life’s cradle in Africa. Hypothesis of dispersal: Ocean currents deposited the buoyant fruit on all continents of the planet. In the temperate and tropical zones, the fruit took hold. There are gourd-using cultures the world over.

Gourds are mentioned in early histories: from Hannibal using gourds to augment the buoyancy of log rafts in ferrying his elephants across the Strait of Gibraltar to Pliny exposing the medicinal properties of gourds.

Gourds figure in myth and folklore in Asian, European, African, Polynesian and Native American cultures, among others.

Gourds are edible, particularly in Asian cultures, but they are primarily used for mundane purposes, often culinary, from gathering bowls, to food storage, to serving dishes for prepared food. Humans drink from gourd vessels and collect water, blood and milk in gourds. Early crockery was often crafted in gourd shapes.

Gourds have been used in warfare as hornet-filled bombs. Gourd vessels were used in blood sacrifice ceremonies. Gourds make music as resonanting bodies for stringed instruments, and through a variety of percussion and wind instruments.

Gourd-using cultures consider gourds heirlooms and favorite gourds are passed down through generations. Some gourds are finely crafted art objects. They can be painted, pyrographed, inlaid, grown in molds, carved and stained.

Gourds are a gift from the natural world and to this day are used and treasured.
Gourds plain and fancy, old and new were brought as visual aids. A newsletter and gourd fact sheet were available and complementary gourd seed gifted.
Vegetable Session
Opportunities in Fresh-Cut Vegetables

Mark E. Vaughan, President CEO Vaughan Foods, Inc.
Moore, Oklahoma

Bio: Mark E. Vaughan, President CEO Vaughan Foods, Inc.
Vaughan Foods is a Moore, Oklahoma – based fresh vegetable and deli salad processor. The firm is a supplier to Quick-Serve Restaurant Chains, Grocery Retailers, Foodservice Operators and other Food Processing Firms. Vaughan Foods employs 260 people and has sales support and customers in a 10 state area.

Growth and Development of the Industry
1. 1975 - Fresh-Cut emerging in foodservice
2. 1985 - Fresh-Cut emerging in retail
3. 2004 - One of the most successful and profitable lines at retail and increasing demand at foodservice.

Current Fresh-Cut and Produce Industry Drivers

Point of Differentiation
Produce items can provide a point of differentiation for most operators. Fresh produce options available to today’s operator and consumer are expanding at a good rate. Year around availability and imports are expanding choices for consumers and operators.

Fresh Vegetables = Cheapest Change –
Operators and consumers want cost-effective changes to their menu and are increasingly looking at vegetables to effect these changes. Vegetables bring probably the cheapest and easiest change to the menu.

Risk Reduction or Mitigation –
Processors can produce these products with greater attention to food safety than can a restaurant operator or consumer. This means less risk for the consumer.
Control of Costs-
Fresh-Cut vegetables reduce costs from most systems

Waste reduction and Wise Use of Labor - Direct labor needed to prep fresh vegetables at the operator level rise at about 3-4% per year. Indirect costs are also on the rise.

Food Safety - Food suppliers, must take ever-increasing steps to ensure food safety for the consumer. The market demands food be safe, produce represents a special problem because so much is consumed with no kill step. Increased accuracy and sophistication of testing methodology means traceability right back to the processor, packing facility or farm.

Future of Fresh-Cut/Convenience Vegetables
Health Concerns –
Obesity increases: ADULT ONSET DIABETES, HEART DISEASE, SOME TYPES OF CANCER, HYPERTENSION, RISK OF PREGNANCY COMPLICATIONS,

Need to develop healthy eating habits at an early age, undoubtedly fresh fruits and vegetables will play an important role in the world’s getting back to better health.

Rapid Growth of Organic and Natural -
Study by the FMI, 61% of US shoppers feel that organics are better for their health, 57% of consumers had tried organics in the second six months of 2002. Consumers want broader selection and prices that are more comparable to non-organics. Several organic only restaurant chains are springing-up – mainly on the coasts. They offer organic meats, cheeses, vegetables and condiments and they are achieving some success. In my estimate, this category is

Reasonably Priced Exotics and/or Heirloom Varieties –
Consumers will continue to search for “NEAT” vegetables. Exotic and heirloom vegetables bring excitement to the plate.
Consumers/Buyers will be looking for increased ways to use fresh vegetables -

FRESH TRENDS 2004 (PACKER) 2003 Results

Biggest increase in produce buying is among those aged 18 to 37 = net gain of 34%. Similar number reported that they are preparing and serving more meals made with fresh produce than they did five years ago and again the biggest gain was from those 18 to 37 of age. This is good news for the vegetable community because it means increasing demand in the future.

Vegetables will migrate to center-of-the-plate.

Hardee’s is testing low-carb burgers wrapped in lettuce and Taco Bell is introducing a line of “FRESCO” entrees substituting fresh salsa and increased vegetables for high-fat sauces. Retail consumers will increasingly want large salads adorned with fresh-cut fruit and vegetables. Most vegetables fit with LOW-CARB regimens.

Increasing competition from imported fruits and vegetables

Increased fruit and vegetable marketability via packaging innovations -

What matters is what the customer sees. This is a two-edged sword – allows imports to arrive in better shape.

Increased emphasis on safety in our food supply. Suppliers, at all levels from the farm, to the packing shed, the processing facility, grocery distributor must ALL answer to the consumer. The consumer demands a safe AND delicious product. Increasing sophistication in tracing food-borne illness sources –
Management of the risk of investing in production of vegetables is highly related to the producer’s tolerance or aversion to exposing that investment to a possible loss or a reduction in the expected returns on the investment. Some of the factors that affect a producer’s tolerance to risk are age, family status, debt level and psychological makeup. As a people age they generally become more conservative and are less willing to risk an investment. Changes in family status also change a producer’s willingness to risk the potential for a housing upgrade for the growing family or the college fund. An increase in debt level usually will reduce the producer’s or his banker’s willingness to risk the investment. Lastly, there are certain people who are psychologically more tolerant to the probability that an investment in vegetable production may be lost. A person should evaluate their individual circumstances regarding these five risk tolerance conditions before any investment but certainly before investing in vegetable production.

In risk management the focus is on reducing the variability of income, not increasing net income. Income stability assures that the producer can meet personal and business obligations. This paper looks at five sources of risk for vegetable production and provides a few strategies to reduce those risks. The five sources of risk that will be evaluated are 1. Production Risk, 2. Marketing Risk, 3. Financial Risk, 4. Legal and Environmental Risk and 5. Human Resources risk. Each of the five sources of risk can increase the variability of expected net returns.

Production Risk: Some of the sources of production risk include, weather related conditions such as drought, excessive rain, wind and freezes; pest problems such as insects, diseases, weeds and wildlife; problems with inputs to production such as timely availability and quality; and problems with fire, theft, and other casualties. There are several tools and strategies for dealing with these production risks. Enterprise Diversification embodies the old axiom of not having all the eggs in one basket. The many different characteristics of different crops usually reduce the impact of a single weather or pest event because the plants are impacted differently. Growing different varieties of a crop will often reduce the impact of external events. For a small producer, obtaining an off-farm job by the producer or the spouse (particularly in a non-farm sector) will also reduce variability of income. Technology to protect against weather events, include plasticulture, irrigation, frost protection, and tile drainage where heavy rainfall occurs. Crop Insurance (if available for the crop) can stabilize income when
used with a sound marketing program. Broadening the Site Selection for production such as renting a farm at a distance from the main farm can frequently reduce variability of production, particularly if the sites are at different elevations. These distant sites would be less susceptible to similar weather events such as excessive rain, wind, hail, and freezes. Timeliness of application of the inputs to vegetable production is critical to maximum yields and quality. A producer of vegetables must commit more time to overseeing the daily needs of fast growing, short growing time, and highly perishable, vegetable crops than virtually any other crop production business. A single day missed of needed irrigation, insect or disease control can impact the quality and quantity of vegetable crops.

Marketing Risks include Price Risk due to increases in supply or changes in demand; Loss of Market Access due to closing or relocation of a processing plant or a turnover in the buyer position; Loss of Market Power due to small size of producer (or seller) relative to buyer. Primary to any business success is a written Business Plan and Marketing Plan but in the fast moving vegetable world it is critical to success. The vegetable producer must be highly aware of all of the internal resources and capabilities that are present within the business as well as the external operating environment. Since the production season is so short and so intense the grower will reduce variability of income by planning all phases of marketing the product before the seed is ever planted. Forming a marketing club or Marketing Cooperative with neighbors and other growers may enhance prices, or guarantee a market and even-out cash flow through deferred payments. There is a interest cost associated with deferred payments but most risk management strategies have an associated cost. Direct Marketing of products will potentially reduce the variability of revenues associated with selling to processors or wholesalers and has the added benefit of allowing for “differentiation” of the product, but requires retailing skills. Contract Production will generally reduce the downside price risk but usually includes inputs specified by the buyer, some specific legal issues, less flexibility of the grower and some potential extra transaction costs.

Financial Risks include those imposed by production risks, price risks, inflation (especially cost increases of inputs to production), and increases in interest rates. To deal with financial risks the producer needs to monitor and try to control key financial ratios and expenses. Maintaining complete records of all expenses, yields, and net worth can provide information for developing trend analyses. The producer can determine if specific areas of the business are tending away for the original business plan and be able to correct the problem. In a good year, the producer can pay down debt to increase solvency (debt-to-asset ratio). To increase liquidity the current asset to current liability ratio should be at 2.0 or above. During good years is also a good time to increase the credit
reserves. Of course the producer should constantly invest time in making the business more efficient in an attempt to lower cost/unit of production. There is an interaction between family expenses and business obligations in most farm businesses. Deferment of some household expenditures are obvious when income is low, but not always attainable. Off-farm employment of the farmer or spouse, preferably in a non-farm sector, provides extra income, and the possibility for health insurance, group life, and a retirement plan. A producer should also consider non-farm investments such as IRA’s and mutual funds to diversify the asset portfolio. In the case of a natural disaster, there may be some emergency disaster assistance, loans, or loan guarantees from USDA/FSA

Legal and Environmental Risks should be considered along with the other risks. Tort liability is a major concern for direct marketers. Exposure to environmental risks can drastically affect the business. The structure of the business itself can increase or decrease legal risks of the business. It is recommended that the farm carry sufficient farm or business insurance to prevent a legal action from ruining the business. Adequate coverage can best be obtained by being totally honest and forthright with your insurance agent, including any direct marketing activities being anticipated. The best protection from environmental risks is to practice “good agricultural practices”. Being a “good neighbor” enhances good will with neighbors and reduces the potential of problems. Don’t automatically assume that the “sole proprietor” structure of the business is the best business organization. Consider Limited Liability Company (LLC’s) structure or the corporate structure. A good attorney can assist in determining the business structure that will reduce the legal risk or exposure of the business.

Human Resource Management Risks include losing an essential (or key) owner, manager or employee and the three D’s (Divorce, Death, and Disability). It is critical that the owners of the vegetable business have a plan to protect the business and the family from the human resource risks. There are several types of insurance policies that cover the impact of losing a key owner, a key manager or a key employee. An evaluation of the impact to the business of the loss of such a person can be assisted by working closely with your accountant, attorney and insurance agent. A good safety program and human resource management program can reduce the potential for some of the human resource risks. Sufficient insurance to cover the loss of key owners, management, or employees can not only alleviate the short-term impact of the loss of these people but can assure continuity of the business. A formalized written management and planning document can improve business performance, improve safety performance, and reduce risk arising from employee relationships. Another risk management consideration is the need to control the legal liability of the business due to employee actions.
Points to Remember:
The business and family finances are intertwined in most farm businesses

The focus of risk management is to reduce variability of net income so the business and family obligations can be met.

Tolerance to risk is different from farm to farm depending on factors such as age, family status, debt levels, and psychological makeup.


Merritt J. Taylor: Center Director/Professor, Oklahoma State University, the Wes Watkins Agricultural Research and Extension Center, Lane, Oklahoma.

John R.C. Robinson: Area Farm Management and Marketing Specialist and Professor, Texas Agricultural Extension Service, Weslaco, Texas.
Biology and Management of Leafhoppers
Jonathan Edelson, Professor of Entomology, Oklahoma State University

Dr. Edelson has responsibilities for conducting research and developing education programs for managing insect pests on vegetable crops in Oklahoma. He has worked in this capacity for OSU since 1989. Previously he was an Associate Professor of Entomology with Texas A&M University and was charged with developing insect pest management strategies for commercial vegetable production throughout Texas. Dr. Edelson has served as a consultant with numerous agricultural products companies and for processors including Gerber Products, Campbell’s Soup, Green Giant and Bird’s Eye vegetables. He has traveled and consulted with producers and researchers throughout the world including Mexico, United Kingdom, Israel and Trinidad/Tobago.

Biology. The beet leafhopper, Circulifer tenellus, is a small insect (the adult is 3 mm long) that varies in color from pale green to tan with dark markings on its wings. It belongs to the leafhopper group of insects known as the Cicadellidae. Leafhoppers are characterized by their small size, movement characterized as a very active hopping from plants when disturbed and that they fold their wings over their backs in the form of an inverted ‘V’ or as a roof. The adults and immature forms or nymphs have piercing/sucking mouthparts and feed on the phloem tissue of leaves of plants. Leafhopper feeding on leaves results in discoloration of the tissue and a drying of the leaves referred to as ‘hopper burn’. However, the more critical damage from the beet leafhopper is that the adults and nymphs serve as the vector of the curly top virus that causes significant damage to many important crops including peppers, tomatoes, beans, melons, spinach and beets.

The beet leafhopper is primarily considered a pest throughout the arid western region of the U.S. but does occur throughout North America. In the southwestern region of the U.S. the adults spend the winter primarily in noncultivated or rangeland and feed on wild mustard and other weeds. Overwintering adults lay eggs in the tissue of host plants and the eggs hatch in late winter/early spring and the nymphs emerge and feed on the host plants. Adults developed from this first or spring generation disperse from the overwintered wild hosts as the host plants begin to mature or senesce during warmer and dry weather in the spring. The dispersing adults fly and/or are moved by spring weather fronts to areas where spring emerging plants and crops are growing. The adults orient towards green plants and settle to begin feeding and to find suitable hosts on which to lay eggs for the 2nd or summer generation development. The spring dispersing generation picks up the virus from infected host plants fed upon prior to
dispersing and carries the virus with it to inoculate plants and crops with the virus. Second and subsequent generation nymphs may then pick up the virus from host plants infected by dispersing adults of the first generation and then once again move the virus among plants locally and as they disperse. As summer host plants and crops mature and senesce, adults may disperse back to overwintering sites and carry the virus with them to inoculate wild hosts during the overwintering stage.

**Management.** Successful management programs will focus on preventing adult migrating forms from feeding on crops in the spring. Adult and nymphal stage leafhoppers are susceptible to many insecticides, however, to prevent inoculation of host plants with the virus any successful management strategy must focus on preventing the infected adult leafhopper from initiating feeding on plants. Generally, IPM programs are based on monitoring crops for the presence of insect pests and then controlling the pests after they are found to occur and exceed an economic threshold number in abundance. However, for this pest and to stop the transfer of the virus, the management program focuses on preventing the leafhopper from initiating any feeding on the crop host.

Management Strategies: Regional Control - In California, groups of growers have funded a program in which government employees monitor beet leafhopper populations in their overwinter sites and then treat areas in which large populations exist so as to reduce populations prior to dispersal to crops in the spring. We do not currently know from where the populations in Oklahoma are moving and therefore at this time this strategy cannot be initiated.

**Cultural Control** – Germinating seedlings and transplants can be covered with floating or tunnel row covers and maintained under the covers until flowering stage to protect the plants from leafhoppers thus delaying feeding by the spring migrating leafhoppers and possible escape from the disease. Planting dates for crops can be delayed as long as possible in an effort to escape the first, initial movement of leafhoppers that generally occurs in early spring. Observations indicate that late-planted summer crops may have less infection of virus. Research conducted in more western states indicates that the leafhoppers are preferentially attracted to sparse planting configurations of crops and therefore one strategy in use is to increase planting densities to make the crop less attractive to the migrating leafhoppers. Dense plantings can also be thinned to remove any diseased plants and remaining plants may compensate in growth to maintain crop production.

**Insecticide Control** – In California, overwintering populations of leafhoppers are
controlled by spraying weed host plants with insecticides in locations where high densities of the insects are found on weeds. Migrating adults may be controlled by treating perimeters of crop fields with insecticides to prevent movement of leafhoppers from adjacent weedy areas into the crop. Research indicates that the at-planting application of Admire or Platinum to peppers controls leafhoppers and reduces the incidence of curly top disease.

**Recommendations for Oklahoma.** Home gardens – Plant extra plants and in a dense configuration and/or use row covers to protect plants. Also, make sequential planting to provide season-long production of which some plants may ‘escape’ migrating leafhoppers.

**Commercial plantings of peppers and tomatoes** – Apply Admire or Platinum at planting or transplanting. Increase the density of plantings by not thinning seedlings if direct seeded for as long as possible, and use double plants in seedling flats if using transplants. Thin diseased plants when possible, leaving only healthy plants that may then be able to compensate in growth and production to replace the removed, diseased plants. Monitor crops for leafhopper activity and treat with foliar applied insecticides to control leafhopper populations in the crops so that they are not able to vector the virus from diseased to healthy plants within a field.
Biology and Management of Beet Curly Top Virus

John Damicone, Extension Plant Pathologist, Oklahoma State University

Dr. Damicone has been an extension plant pathologist at Oklahoma State University since 1990. He conducts research and develops educational programs centered on management of economically important diseases of vegetable crops and peanuts.

Introduction

Curly top disease, caused by *Beet curly top virus* (BCTV), was a severe and widespread problem for Oklahoma tomato producers in 2003. Tomatoes in both commercial operations and gardens were similarly affected. Levels of plant infection ranged from 10 to 50% in central and eastern Oklahoma, to over 80% in western Oklahoma. Peppers were also affected, but to a lesser degree. In commercial production of chilies in western Oklahoma, about 10-15% of the plants were affected, but isolated areas of at least one field had a much higher level of symptomatic plants.

During most of the 1990's, the disease was observed periodically, but was mostly confined to only a few isolated plants. The problem was attributed to feeding by the potato (or tomato) psyllid which causes "psyllid yellows". In psyllid yellows, damage is caused by a toxin that the immature psyllids (nymphs) produce as they feed. Reported symptoms of psyllid yellows are very similar to those of curly top. In recent years, higher levels of disease were observed in tomatoes where no psyllids were found. Representative plants were periodically sent to a commercial diagnostic lab for serological testing of most of the common viruses that affect tomato. Such tests were negative and supported the "psyllid yellows" theory.

During the 2003 outbreak, careful examination of affected plants also revealed no signs of psyllids or their prior presence. It was determined that the observed symptoms closely resembled curly top, caused by a virus (BCTV). BCTV has long been a problem on sugar beets and various vegetable crops in arid and semi-arid regions of the Western U.S. BCTV is a gemini virus for which available serological tests are not effective. This explains why previous virus testing had not detected BCTV. Using a commercial DNA hybridization test, and a PCR test conducted at U.C. Davis by Dr. Bob Gilbertson, it was confirmed that the disease
was curly top, caused by BCTV. The OSU Plant Disease Diagnostic Laboratory can now test plants for curly top using the PCR (DNA) test.

Symptoms
On tomato, plants stop growing, become pale green in color, and develop a severe and uniform inward curling of the leaves. Plants become severely stunted compared to healthy plants and often develop distinct, purple-colored leaf veins. Branches and leaves become thickened and brittle. Any fruit set prior to infection ripens prematurely. Young plant are soon killed while older plants that become infected later in their development remain stunted and fail to produce quality fruit. On pepper, curly top symptoms are less obvious than on tomato. Plants become pale green and are stunted, but do not show the dramatic leaf curl or vein purpling that is so distinctive on tomato. Leaves are thickened and the youngest leaves develop a limited degree of upward curl. Infected plants remain stunted and are eventually killed if infected early in the season. On other crops such as cucurbits, bean, and spinach, the virus causes varying degrees of leaf yellowing, stunting, and plant death. BCTV is one of the few plant viruses that actually cause plant death.

Biology
Curly top is caused by beet curly top virus (BCTV). The virus is in the gemini virus group, that consists of DNA rather than RNA-encoded viruses. Most gemini viruses are spread by whiteflies, but BCTV is transmitted to from plant to plant by the beet leaf hopper, *Circulifer tenellus*. Both the virus and the beet leafhopper have very wide host ranges. The virus infects over 300 species of broadleaf plants in 44 plant families. BCTV survives in infected crop plants and weeds such as wild mustards, tumble pigweed, lambsquarters, field bindweed, and redstem filaree. The virus is acquired by the beet leaf hopper as it probes or feeds on infected plants as it searches for food. The virus can be during brief (1 minute) periods of probing and/or feeding, but more leaf hoppers become infective during longer feeding periods (30 minutes to 4 hours). After a 4-hour incubation period, leaf hoppers become infective and can remain so for the rest of their lives. As leaf hoppers migrate in search of suitable plants for feeding, they can infect healthy plants following brief (1 minute) probing and/or feeding periods. Symptoms of curly top begin to appear about one week after infection.

Because of the persistence of the virus in the vector, and the leaf hopper's ability to fly long distances (up to 400 miles), long distance spread of the virus is possible. Severe epidemics of curly top depend largely on population levels of beet leaf hopper, the percentage of infective leaf hoppers in the population, and their migration patterns. Thus, outbreaks of curly top vary greatly from year to
year. These events have been studied mostly in western states where curly top has been a problem for many years. Leaf hoppers are thought to overwinter in sparsely vegetated, dessert areas on plants such as wild mustards and Russian thistle. As dessert vegetation dries up in the spring, the leaf hoppers migrate into crop areas in search of food. Tomatoes and peppers are not thought to be desired food sources for the beet leaf hopper, and infections in these crops probably result from brief visits during which these crops are sampled. Because the leaf hoppers are attracted to sparse vegetation, transplanted fields of tomato and pepper are highly attractive early in the season compared to direct-seeded fields.

Management

Management of curly top disease is difficult. In sugar beet and snap beans, resistant varieties have been developed which are effective. However, efforts to breed resistance to curly top in tomatoes and peppers has been largely unsuccessful. There are a few tomato varieties that have been bred for curly top resistance, but they are adapted to production areas in the inter-mountain Northwest. Apparently these varieties have not been effective because curly top remains a major limiting factor for tomato production in many western states such as California, Washington, Oregon, and Utah. All currently available tomato and pepper varieties adapted to Oklahoma are susceptible. Insecticide use to manage the beet leaf hopper has met with limited success. In sugar beets, pre-plant, systemic insecticides have been effective. However, spraying tomatoes with insecticides does not control the disease because leafhoppers migrate from distant places and do not reproduce or remain long in tomato or pepper fields. By the time migrating leaf hoppers succumb to an insecticide, they have already transmitted the virus. When symptoms of curly top become evident in tomatoes and peppers, the leaf hoppers have long since moved away to other crops or weeds which they prefer. Removing symptomatic plants is probably a good idea, but since the vector does not remain in tomatoes or peppers, there probably is little secondary, or plant to plant spread. Other management strategies have focused on using cultural practices that reduce the attractiveness of tomato to the leaf hoppers. The beet leaf hopper (and most other insect vectors) is attracted to widely spaced, vigorous plants grown in open areas where the plants sharply contrast with the surrounding soil. In areas where curly top is chronic, dense plant spacings, direct seeding, shading, row covers, and intercropping have been reported to reduce levels of curly top.

Outlook

It is uncertain what the future hold for this disease in Oklahoma. In states where curly top has been a problem for many years, levels of the disease vary greatly from year to year. In New Mexico where curly top has become a serious, but
sporadic problem in chili production, outbreaks of the disease appear to have become more frequent. The disease was first reported in Oklahoma by D. A. Preston in 1945 and it is my suspicion that we have had curly top for some time, but it has been mis-diagnosed as psyllid yellows. The sporadic nature of this disease is thought to be the result of yearly variation in overwintering leaf hopper populations and their migration pattern. Currently, the overwintering sources of the virus and beet leaf hoppers that affect crops in Oklahoma has not been determined.
Hoop House Specialty (Colored) Pepper Production

Steve Upson
The Noble Foundation

Steve Upson, a native of Tulsa, Okla., received a bachelor’s degree in horticulture from Oklahoma State University and a master’s degree in horticulture from Kansas State University. His past employment includes serving as a county and district horticulture agent with the Oklahoma Cooperative Extension Service and as the manager of a commercial market garden operation east of Kansas City, Missouri. For the past 15 years, Steve has lived in Ardmore, Okla., where he is employed as a horticulture specialist with the Noble Foundation. Steve’s current area of specialization involves researching and demonstrating the benefits of modified environment “hoop house” high-value crop production.

The next time you are grocery shopping, check the prices for specialty (colored) bell peppers. They are anywhere from two to three times as much as green bell peppers. Retail prices as high as $3 per pound are not uncommon and are associated primarily with the additional cost (risk) involved in growing specialty peppers.

Most bell pepper fruit are green when immature and red when mature. Red bell pepper fruit have higher concentrations of vitamins A and C, as well as higher sugar content. Because of increased consumer demand for a more nutritious, flavorful and attractive fruit, pepper breeders are releasing an increasing number of hybrid varieties that develop a yellow, orange, purple, or chocolate color after maturing.

It takes about 45 to 60 days from the time a pepper flower is pollinated until the fruit reaches its maximum green size. It takes an additional three weeks for the color to develop. A lot of things can go wrong during that time. There are additional operating expenses, and fruit quality often suffers as a result of harsh growing conditions. Fruit maturing during the heat of summer are less dense and have thinner walls. Also, sunscald risk to the fruit increases as light intensity increases.

In an effort to beat the heat, we’ve conducted several hoop house colored bell pepper trials at the Noble Foundation Horticulture Center in Ardmore, Okla.

Hoop houses, also referred to as high tunnels or cold frames, are generally Quonset-shaped, constructed of metal or plastic hoops (bows) and covered with a single layer of 6-mil greenhouse-grade polyethylene film. The houses are vented by rolling up the sides, and there is no permanent heating system and no
electrical connections. Compared with greenhouses, hoop houses are relatively inexpensive, ranging in price from $1.50 to $3 per square foot.

While there are many benefits associated with hoop house production, the most beneficial in terms of producing quality colored bell peppers is earliness. Earliness is a combination of being able to plant several weeks earlier than field planting and faster maturation of the crop due to the favorable growing environment within the house during late winter and early spring. Based on our research and the experiences of other growers, up to one month of earliness is possible growing hoop house peppers.

Currently, we recommend growing peppers on raised beds because they offer several advantages over planting on grade. Some of these include rapid early-season soil warming, better utilization of plastic mulch and easier harvest.

To date, all of the Noble Foundation hoop house pepper research and demonstration work has been conducted in structures not accessible by tractor and bedding equipment. To minimize hand labor required for bed construction, houses are equipped with 40-inch wide permanent beds constructed on 5-foot centers.

For spring pepper production, we typically apply plastic mulch during February. Prior to application, fertilizer is incorporated into beds according to soil test results, drip irrigation is installed (two drip lines per bed), the soil surface crowned and smoothed and the beds hand watered. Never apply plastic mulch to a dry bed. We always surface water using as hand wand just prior to mulch application.

Once mulch is applied, be sure the house is kept closed to facilitate bed warming. Given “normal” weather, it is possible to achieve soil temperatures at planting depth in the 70 degree F range by March 15.

We currently recommend planting two rows of plants on a 40-inch bed. Space plants 18 inches apart in each row and space the rows 18 inches apart. Use a bulb planter to punch planting holes in the plastic.

Several varieties have performed well in Noble Foundation yield trials. “Aristotle” (red) and “Early Sunsation” (yellow) produced the highest yields in our 2003 trial, producing 4.3 and 3.6 pounds of marketable fruit/plant respectively. Both
varieties produced fruit averaging over 9 oz.

Pepper plants are very cold sensitive, so avoid planting too early. In Ardmore, we typically plant on March 15 or as close to this date as possible, depending on the weather. As a rule of thumb, target planting about three weeks before the average frost-free date for your location.

Use a fertilizer injector and water wand to top apply a starter solution containing a soluble complete fertilizer at planting. Do not rely solely on the drip system for plant establishment. In addition to drip irrigation, plan on top watering the first week. After the first week or when the plants have initiated new growth, switch over to the drip system.

Because the plastic mulch obstructs the view of the soil surface, irrigation scheduling can be difficult. Consider using a tensiometer, a device that measures soil moisture content, to schedule irrigation. A 6-inch tensiometer will cost about $60.00.

All required plant nutrients may be applied preplant with the exception of nitrogen. To avoid excessive vegetative growth, which can result in delayed flowering, nitrogen should be applied in small doses over the life of the planting. A typical nitrogen fertigation schedule (the term fertigation refers to the application of fertilizer through the irrigation system) consists of weekly applications of nitrogen beginning one to two weeks after transplanting and continuing for 15 weeks. If soil is amended with compost, the nitrogen application rate should be reduced or eliminated depending on the amount of compost used. Each grower will need to fine tune his nitrogen fertigation schedule based on his particular situation. For a detailed pepper fertigation schedule refer to the Noble Foundation budget entitled “Hoop House Specialty (Colored) Bell Pepper Enterprise.”

To provide the best growing environment for peppers, adjust the roll-up side vents to maintain an air temperature of between 80 to 85 degrees F. Venting is necessary not only for temperature management but to lower the humidity within the house. Humid conditions favor disease development.

If temperatures are forecast to drop below 40 degrees F, cover the crop with floating row covers. We currently use fabric weighing 1.5 oz/sq yard for freeze protection. The use of heavy-weight covers within a closed hoop house can
provide an additional 10 degrees F of freeze protection. During the day when conditions permit, remove the covers to maximize plant exposure to sunlight.

Use the stake-and-weave trellis system to support the crop. Install 3/8-inch rebar stakes in each row between every other plant. Locate the first weave of twine 8 inches above the bed when plants are 12 inches high and in 6-inch increments thereafter as the plants grow.

To date, we've experienced no major disease problems growing hoop house peppers. For the most part, this can be attributed to the fact the foliage remains dry.

Aphid is the biggest pest problem you'll likely encounter growing hoop house peppers. Damaging populations can explode early in the growing season as a result of the protection afforded by the structure. Excellent spray coverage of the leaf underside is critical for control of this pest.

The pepper fruit wall is very susceptible to sunburn. This can be a real problem in late June and July as solar radiation becomes more intense. The highest incidence of sunburned fruit occurs on plants growing along the west side of the house. High air temperatures combined with intense evening solar radiation cook any exposed fruit. A thick plant canopy and the use of shade fabric will help control this problem.

In southern Oklahoma, harvest of colored bell peppers typically commences the second week of June. Harvest increases weekly before topping out and leveling off the fourth week of June or the first week of July, depending on variety. Production begins to wane the second week of July and is usually wrapped up by the fourth week of July, at which time fruit quality and size have dropped to an unacceptable level.

Profit potential growing hoop house specialty peppers is dependent on cost of production, marketable yield and price obtained for the crop. During 2003, we were able to produce the equivalent of 1,335 lbs. of marketable Aristotle peppers from one of our 20-ft. by 68-ft. hoop houses. If the fruit were direct marketed for $3.00/lb., an income of $4,005 would be realized. Given that it cost us $1,707.51 to grow the crop, our profit is $2,297.49. For a detailed hoop house pepper budget contact the Noble Foundation.
For additional information on hoop house high-value crop production, contact the Noble Foundation at 580-223-5810 or e-mail me at sdupson@noble.org.
Antioxidants in Spinach: Implications for Health and Profit

T.E. Morelock, J.B. Murphy, University of Arkansas, Department of Horticulture and L.R. Howard, Department of Food Science, University of Arkansas

Spinach (Spinacia oleracea L.) is a highly nutritious leafy green vegetable that contains high levels of vitamins A, C, E and folate as well as minerals such as iron and calcium. Spinach is also has high levels of carotenoids, specifically lutein and beta-carotene. Spinach is also rich in flavonoids. Many of these compounds that occurs in spinach are strong antioxidants which are thought to protect against oxidative damage to the cells that is associated with many chronic diseases. These beneficial aspects of antioxidants are highly correlated with ORAC (Oxygen Radical Absorbance Capacity) readings which is a common method to measure antioxidant capacity.

Recently we have begun to look at breeding lines to determine if differences in antioxidant levels existed in our breeding program. The early results are very encouraging and significant variation has been found between varieties and breeding lines for lutein and flavonoids with Arkansas material being the highest that we tested for these traits. We are presently looking at the effect of age and plant variation for these traits. When these studies are completed we plan to incorporate screening for these characteristics into our overall breeding program. At present the most limiting factor of screening and breeding for these traits is the time lag between sampling and preforming the chemical analyses which has a major impact on selecting and breeding for higher antioxidant levels.
Onion variety selection, sources and quality

Jim Shrefler, Extension Horticulturist
Oklahoma Cooperative Extension Service

Whether intended for home use, farmer’s market sale or wholesale there are several questions that should be asked when planning to plant onions. The variety you select will be determined by what the onion will be used for and how and when it will be planted. For successful marketing, factors such as color, shape and pungency can determine whether or not there will be a market for the crop once it is harvested. Finally, intended planting and harvesting dates will dictate which varieties will be most suitable for your needs.

Successful onion production requires choosing a variety that is suited to the time of year when planting will take place. Onions can be planted by sowing seed directly in the field in mid September. For best results, varieties used with this method need to be both cold tolerant and bolt resistant. It is more common for onions to be planted to the field in February or March using transplants. Transplants may be grown locally in a protected environment, such as a greenhouse, or may be obtained as commercially-grown plants which come are produced in warmer climates where the plants are field grown. Varieties classified as short or intermediate in day-length response requirement for bulb formation have given good results in southeast Oklahoma. Trials with spring transplanting of varieties having a long-day requirement for bulb formation has resulted in bulbs that do not fill out completely.

Onion variety suggestions and trial results for Oklahoma may be found in OSU Extension Fact sheets F-6032 and F-6035 and in annual vegetable trial reports. Several varieties to consider for fall seeding include Walla-Walla, Bison and Buffalo. For spring seeding, Vega and yellow and white Sweet Spanish types are suggested. For February transplanting, granex types, 1015Y and Spanish types have given good results. For winter and spring transplant (as late as early April) Walla-Walla, Candy, Madero and Cimarron are choices that have performed well in trials.

Bulb onions in Oklahoma are most often planted using February or March transplanting. Choices of variety characteristics that may be available for planting at this time of year include color, pungency and bulb size. Red, white and yellow types can be transplanted during this period. Choices of red varieties are limited but include Red Bermuda, Stockton Sweet Red, and Rumba. White
varieties to consider include White Granex, Walla Walla (color is often intermediate to white and yellow) and Super Star. Growers in central Oklahoma have also reported good results with Super Star. Some yellow varieties to consider include Yellow Granex, 1015Y, Vidalia and Candy.

Planting date will determine whether short or intermediate day-length varieties should be used. Both types may be planted in February for successful production of large (greater than 3 inches in diameter) bulbs. When planted after February, bulb size of short day types will decrease with delay in plating. Intermediate varieties can still produce large bulbs when planted in March. If smaller onions are preferred, short day varieties may also be planted in March. By using a combination of short and intermediate varieties the planting and harvesting periods can be extended. Begin by planting short day varieties and finish with the intermediate day varieties. Short day varieties will mature first and will be followed by the intermediates.

Although transplants can be grown locally in protected environments the most common practice is to purchase commercially grown transplants. These plants generally come from warmer climates south of Oklahoma. Plants are commonly sold in farm and garden supply stores, department stores, groceries and by mail order. For larger quantities, one may be able to negotiate a more favorable price by dealing directly with the plant grower or brokers involved in distribution of transplants. When purchasing plants, there are several quality factors that should be considered in order to obtain good results. Plants should be handled and stored properly from the time they are removed from the plant beds until planted in the field or garden. Avoid plants that are excessively wet or extremely dry. Wet plants are prone to decay during storage and transit. These plants may have decayed leaves within the bundle and the basal region may be spongy. Excessively dry plants may be slow in getting established once planted. Plants that show very little green color may also be slow to establish. Plants that are found on display in direct sunlight should also be avoided. Storage at 50 to 60 °F without wetting should keep plants in good condition until planted in the field.

Another transplant quality factor to consider when purchasing plants is size. Bundles of plants will usually include a range of sizes. Ideal plant size is about pencil diameter or slightly larger so choose bundles that have a high proportion of plants in that size range. If plants are much larger than pencil size there may be fewer plants to a bundle. However, the greatest problem with large plants is that these may have a greater tendency to bolt and produce a seed stalk rather than a bulb. On the other hand, plants smaller than pencil-size may not establish as well or, if they do become established, may produce bulbs of reduced size.
First year experience with hoop-house grown onion transplants

Jim Shrefler, Oklahoma Cooperative Extension Service
Steve Upson, Noble Foundation
Sam McClure, McClure Farms, Calvin, OK

Transplant source is a limiting factor to spring transplanted onion production in Oklahoma. Commercially available transplants are generally grown at latitudes south of Oklahoma where winter temperatures are warmer. Oklahoma producers are therefore dependent on the success of other growers at producing an adequate quantity of a quality product that is free of diseases. In addition, commercial transplant growers produce varieties that have an established market demand. Because onion varieties are adapted to specific production regions the varieties available as transplants tend to be those that have demand over wide regions. Recent variety trials with onions in Oklahoma have indicated that there are varieties that will perform well in Oklahoma that are not currently available as commercial transplants. If a large quantity of such plants are needed it would be possible to contract with a plant grower to produce these on a custom basis. However, this would probably not be practical for a small quantity of plants.

One alternative to purchasing commercially grown plants is to grow transplants in a greenhouse. However, many growers do not have greenhouses and, for those that do, the production of enough plants for commercial-scale onion production would require substantial greenhouse space and associated heating costs. Such greenhouse production would probably be cost prohibitive. Hoop-houses are a type of greenhouse that have been used successfully in Oklahoma to extend the growing season for a variety of fruits, vegetables and floral crops. These houses are often idle during the winter period. The idea arose that the use of hoop-houses may be a way to grow onion transplants locally. A trial was conducted during the winter of 2002-2003 to assess the potential for growing onion transplants in hoop-houses. Several planting dates and two onion varieties were used in order to assess the importance of these factors on transplant production.

Onions were seeded in rows on beds 40 inches wide and 8 inches in height on each of October 15, 21 and 29. Seeds were planted in rows spaced 4.5 inches and later thinned to a final stand of about 1 plant per inch of row. Additional plantings were made by solid seeding at about 100 plants per square foot. Two varieties were used; Candy, an intermediate variety and 1015Y, a short day type.
Plants were removed from the hoop-house on February 26 for planting to the field at Calvin, Oklahoma in early March. Plants were transplanted to the field on rows spaced 3 feet apart and a spacing of 6 inches between plants. Plants from the different planting dates, varieties and planting configuration in the hoop-house (rows versus solid seeded) were kept separate and labeled in the field. About two field acres were planted with the hoop-house grown plants. As onions neared maturity, plants of all variety and planting date combinations were checked for bolting (seed stalk formation). On June 6, once onions of the variety 1015Y matured (tops falling over), samples of 10 bulbs of each variety, planting date and planting configuration were collected. Bulbs were then weighed. Candy onions were sampled at this initial harvest but tops on these were not beginning to fall yet. When the tops on Candy began to fall, additional samples of this variety were collected on June 23 and weighed.

Very little bolting occurred for the 1015Y variety. For the Candy onion about 11% bolting occurred in the onions planted on Oct. 15. About 4% bolting was found in onions planted on Oct. 22 and 1% in onions planted Oct. 29.

Yields of 1015Y onions averaged 9,000 lbs per acre. Average weight for an individual bulb was 0.6 lb. For the first harvest of Candy, yield was about 11,000 lbs per acre. For the second harvest of Candy the average yield was about 16,000 lbs per acre. Individual bulb weight for the second Candy harvest was about 1 lb. Planting date in the hoop-house did not have an obvious impact on yield of either variety.

For the onions harvested at the first harvest there was no obvious difference in yield for the onions seed in the hoop-house in rows compared to the ones that were solid seeded. For the second harvest of the Candy variety that was planted in rows in the hoop-house, final onion yields were about 20% greater than when planted with solid seeding.

This first trial suggests that hoop-house production of onion transplants is a potentially useful method. It also shows that the planting period of mid to late October is a suitable time for planting. The fact that bolting was minimal is further indication of the potential usefulness of this method as bolting results in onions being of little value for consumption.
SUMMER SQUASH CULTIVAR UPDATE

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This information in this paper is based on cultivar trials conducted at the OSU Vegetable Research Station in Bixby during the last decade. Data tables and more information may be found in the yearly Vegetable Trial Reports (see references at the end of this paper). Companies listed are, to the best of our knowledge, those that bred a given cultivar.

I. Yellow Straightneck Types

Cultivars discussed here are based on the 1999 trial at Bixby. All but one are hybrids, and several carry the *precocious yellow* gene, shown here as “PY”.

There were no significant differences in total marketable yield or in any other measured variable in the 1999 trial.

**Enterprise** - Syngenta. Green stem. No obvious negatives.

**Fortune** - Syngenta. PY. No obvious negatives.

**General Patton** - Seminis. PY. No obvious negatives.

**Goldbar** - Seminis. Green stem. Acceptable, but being replaced by newer cultivars with better yield potential and more disease tolerance.


**Midas** - Seminis. Green stem. Lowest yield in 1999 (though not significant), only fair color, and some fruit tended to be bulbous.

**Multipik** - Harris. PY. An industry standard and still recommended.

Saffron Prolific - Hollar. Open-pollinated. Green stem. Limited plant vigor compared to the hybrids, and showed variation in fruit shape.

Seneca Prolific - Seminis. Green stem. Some variation in fruit shape, but top yielder in 1999 (though not significant).

Seneca Supreme - Seminis. PY. Fruit may not be as long or as attractive as some other cultivars.

Sunray - Seminis. PY. No obvious negatives.

Superpik - Harris. PY. Longer-necked fruit than ‘Multipik’.

Zephyr - Johnny’s. Yellow fruit with faint white stripes and light green blossom ends. Fruit varied in appearance and color sometimes became streaky with age; looked best when relatively small.

II. Green Zucchini Types
Cultivars discussed here are based on the 2001 trial at Bixby. All are hybrids. Zucchini comes in various skin colors; the 2001 trial focused on green to dark green (“black”) types.

Ambassador - Seminis. Solid green color but with a distinct contrast between the top and the lighter green belly of the fruit. Being replaced by newer cultivars with better yield potential and more disease tolerance.

Bobcat - Harris. Good color, but definite tendency to bulbous fruit at the blossom end. May not be available any more.

CashFlow - Syngenta. Attractive fruit.
**Declaration II** - Seminis. May have an edge in yield and appearance over ‘Independence II’.

**Dividend** - Syngenta. Fruit may be relatively long and attractive.

**Independence II** - Seminis. More distinct yellow speckles on fruit compared to ‘Declaration II’; still a good squash.

**Jaguar** - Harris. “Black” type. Young fruit sometimes angular. Tolerance to ZYMV and WMV2 may give it an advantage over ‘Raven’.

**Raven** - Syngenta. “Black” type. Relatively compact plants. May have even darker fruit than ‘Jaguar’.

**Revenue** - Syngenta. Distinct yellow speckles on fruit, and a few fruit varied in shape. Should be compared to ‘Dividend’.

**Spineless Beauty** - Syngenta. Smooth, glossy fruit, but some were bulbous with narrow middles.

**Tigress** - Harris. Fruit light green and distinctly speckled, thus not as attractive as some others. Yielded well in 2001 despite wind damage to some plants and relatively high cull production.

## III. Yellow Crookneck Types

Cultivars discussed here are based on the 2003 trial at Bixby. All are hybrids, and several carry the *precocious yellow* gene, shown here as “PY”.

**Destiny III** - Seminis. Green stem. Transgenic. Yielded well in 2003, but varied in shape from semi-crookneck to crookneck, and had some wartiness.

Fancycrook - Seminis. PY. Full crookneck that varied in shape and sometimes looked odd due to its long, thin neck. Might have potential as a “baby” vegetable.

Gentry - Syngenta. Green stem. Varied both in shape and color, with some fruit that had a ‘Butternut’ squash shape.


Horn of Plenty - Hollar. Green stem. Varied in shape from semi-crookneck to crookneck, and had some wartiness.

Medallion - A&C/Twilley. Green stem. A semi-crookneck that yielded well in 2003 but was downgraded for appearance due to wartiness.


Sunbrite - Syngenta. Green stem. Had the poorest appearance of any cultivar in the 2003 trial. Fruit shape was highly variable, and sometimes resembled a malformed straightneck squash more than a crookneck.


Sunglo - Syngenta. Green stem. Best overall cultivar in the 2003 trial. Yielded well, and fruit had distinct crooks and a uniformly yellow, smooth skin.

Supersett - Harris. PY. Semi-crookneck that was more consistent in shape and less prone to breakage than ‘Fancycrook’.
IV. References


Marketing Fresh Produce Locally

Connie Whitmore
Coyle, Oklahoma

Connie has been involved in producing vegetables to sell for over 20 years. She and her family have participated in the farmers market in Stillwater for over 15 years where Connie has served as an officer for the market for many years. Connie is an OALP alumni and currently serving as a board member for the Oklahoma Farmers Market Alliance.

When my husband, Wayne, started growing vegetables to sell over 20 years ago, I really didn’t know just what my part in the process was going to be. I didn’t mind working in the field and I thought it sounded fun to count the money, but I hadn’t planned on being the one to try to sell the produce. But somehow, the job of selling produce seemed to fall on me. Down through the years, I’ve managed to sell a little produce.

I would like to describe to you our farming operation and some of the ways produce can be marketed locally, as well as what I think are some of the advantages and disadvantages of these markets.

Our farm is best described as a small, part-time, family-operated truck farm. Wayne is employed by Oklahoma State University in the wheat-breeding program, and I teach Kindergarten in the Coyle Public School. Our son, Justin, is a sophomore at OSU and works part time for a local farmer and our daughter, Carra, is a junior at Coyle High School and is active in FFA. Wayne’s parents also assist with watermelon production and farmer’s market. We work together to produce, harvest and market about 10 acres of produce.

We start the season in April, producing 1 1/2 acres of Purple Passion asparagus. Using a mechanical harvest aid, three people harvest the asparagus in about an hour, almost daily, through May. This year, we will be adding another ½ acre of green asparagus to our production.

Our son, Justin, owns and manages the berry production. In May, we will harvest four, 600-foot rows of strawberries and in June we will harvest two 600 foot rows of blackberries.

By June, we are harvesting the squash Carra has started in her green house as well as onions and the potatoes produced from planting 400 to 500 pounds of seed potatoes.
Also in June we begin to harvest the tomatoes planted in the hoop house in March. Producing tomatoes in the hoop house allows us to extend our market season two to four weeks earlier than field production.

Approximately 5 acres of staggered plantings of sweet corn are harvested during the season.

In July, we are harvesting the 1/4th acre of summer tomatoes as well as cucumbers and three varieties of eggplant.

We target the 4th of July to be harvesting watermelons and cantaloupe. Cantaloupes, seedless watermelon and their pollinators are transplanted into black plastic mulch and drip irrigated.

August brings okra harvest. The acre of okra will be harvested until frost.

Anaheim type peppers are the last crop to mature for harvest. We transplant the ½ acre of peppers with a mechanical transplanter.
Marketing Fresh Produce Locally II
By Connie Whitmore
Whitmore Farms, Coyle, OK

Now you know what we can market, the next question to answer is where, when and to whom to market the produce? Some places to market produce include: farmer’s markets, supermarkets, restaurants, the farm, u-pick, wholesale produce companies, and retailers. In my opinion, here are some of the advantages and disadvantages to these markets.

Farmer’s markets have the best return of dollar per pound of product sold. But sales tax and market fees should not be forgotten in calculating profit as well as the fact that there is no guarantee as to how much produce will be sold. The investment of time in packaging the product to be sold is fairly high. Produce is bulk packaged for easy transport, repackaged or weighed then packaged again for the customer to take home. There is also some waste of product involved. In order to effectively market at a farmer’s market, your display must appear fully stocked; therefore, at the end of the selling day, produce that has been exposed to extreme heat for an extended amount of time is no longer marketable.

Supermarket produce managers expect to pay wholesale prices, so the dollar per pound return is not as high as the farmers market. The investment comes in establishing a good relationship with the produce manager and managing the availability of the product. The producer must not wait until the tomatoes are fully mature before the manager is contacted. The manager must be allowed time to correct his order and the product must have an adequate shelf life. If the producer is able to provide a steady, high quality supply of produce, the store is more likely to be a steady market. Another possible investment is liability insurance. Independent stores will probably not require insurance, but larger chain stores may not buy from you without it.

Restaurants that are not chain franchises can be a steady high return market, but they generally do not require a large supply of produce. Again the investment is establishing a good relationship with the chef or kitchen manager and reliably supplying a high quality product.

Selling directly from the farm or managing a u-pick operation can provide a good return if you can afford to invest your time in the customers and cultivating the market. People coming to the farm are not just coming to buy food. The producer must be willing to provide an experience for the consumer and get enough people there to buy what he can produce.

Wholesale produce companies provide the lowest return in terms of dollars per pound,
but buy large quantities of commercial quality produce in standard commercial packaging.

Retail venders also provide a low return, but they provide a market for lower quality produce with little investment in containers. The amount to be sold to these venders can be varied as well as unreliable.

The biggest key to selling in any of these markets is consistency. The producer must provide consistency in product, packaging and relations. Because most of our produce is marketed to farmer’s markets, supermarkets, and restaurants, I will discuss the importance of consistency as it relates to these markets.

Consistency in size and quality of the product is a must to effectively market produce. The produce should be consistent in size with commercial standards. Because farmer’s market customers purchase produce by sight, it should appear similar to produce they have purchased in the past. Farmer’s market consumers also have preconceived ideas as to maturity in relation to size, so they do not always realize how tasty and small the seeds are in a cucumber that has grown very fast and large! The novice farmer’s market customer also tends to overbuy for their needs, therefore produce of good quality will have a long shelf life and allow the consumer time to prepare the product before it spoils. Produce managers can integrate small quantities of home grown produce if it looks like produce coming from the warehouse. But because local grown produce is higher in quality, it pleases the produce manager because it has a longer shelf life, and it pleases his customers because it taste good! The chef will be pleased with the excellent quality of taste and may not be quite as concerned about size if he is going to chop it up into a recipe, but if he is using each tomato to make an appetizer or entrée each tomato in the box must be very similar. These standards are very important when selling to wholesale produce companies because they must resell the product to their customers’ sight unseen. Consistency in produce size and quality is not quite as important when dealing with retailers or selling direct from the farm.

Consistency in packaging is also a must in effectively marketing produce. If selling by volume at farmer’s markets, consumers expect to get the same quantity for the same price every time. In dealing with supermarkets or restaurants by phone, you must each have a standard by which to communicate. It will be beneficial to the chef or produce manager if produce is packaged in standard commercial containers. Whether using a 1 1/9th bushel box for peppers or a 25-pound tomato lug, both the producer and the buyer will know the quantity the producer has to sell. It will also aid in the communication of establishing a price for the product. The producer may be able to avoid the expense of commercial containers if the buyer handles the containers very little and the less expensive container is consistent in volume.

Consistency in relations to the buyer is very important. The farmer’s market customer
expects the producer to be at the market every time they come to the market, whether it is once a week or once a month. They expect you to have the same products each time. Of course this is not always possible, but it is important to communicate the changing seasons and weather conditions that affect the variety of produce available at the farmers market. In working with produce managers and chefs, it is important to know when and who to contact. Contact the business to establish who is in charge of ordering produce and a good time to contact the person. Avoid busy times of the day, be aware of days the business is closed and when produce orders are placed. If possible contact the buyer in person, presenting yourself in a professional manner. If the product to be sold is already being harvested, have samples of the product to show to the buyer. The producer should be prepared to inform the buyer of the quantity of produce and the length of time the produce will be available. The producer should also be informed as to the value of the product when communicating with the buyer. Producers should remember products superior in quality deserve a superior value. When the producer establishes a contact and delivery time with the buyer, it should be one that the producer can maintain consistently.

Regardless of what you produce, where it is sold, when is marketed and to whom it is marketed being able to market the product all comes down to being consistent in product, packaging and relations.
For centuries, organic farming was the only way to farm, as all methods of food production consisted of techniques that are today considered to be organic. In the middle of the twentieth century, synthetic materials became available, and provided relatively inexpensive tools for plant nutrition and pest control. Over the last half a century, the vast majority of food production has depended in some way upon non-organic methods of production and protection.

In the last quarter century, there has been a small but consistent portion of the population that has supported a return to organic methods of food production. At first, the organic industry was un-organized, but over the years organization gradually developed in various parts of the country. Problems arose in trying to develop a definition of ‘organic’, and what was accepted as organic in one region of the country might not be accepted in other regions. During the 1990’s several states implemented a statewide certification process, whereby producers within the state could claim certification if they met certain rules and followed certain guidelines. Still, there was variation from state to state concerning the definition of ‘organic’, and the tools and techniques that could be utilized in ‘organic’ production.

Today there is a National Organic Program (NOP) which defines and establishes standards for organic production and sales throughout the United States. This program, which became effective October 21, 2002, stipulates the circumstances under which food products raised or sold in the United States can be classified as organic. This national organic standard will supersede any previous state or local definitions and classifications of organic produce.

The NOP is administered through USDA, but USDA makes no claims that organically produced food is safer or more nutritious than conventionally produced food. In fact, USDA makes no claims that organic farming is better in any respect than conventional farming. Rather than making claims about the quality of the product, USDA instead has initiated a definition of organic, and has set in place a compendium of rules and regulations under which food may be classified and sold as organic. Information concerning the NOP is available through the Agricultural Marketing Service of USDA, and is available online at http://www.ams.usda.gov/nop/NOP/NOPhome.html.

The organic market is one of the fastest growing segments of the food industry. Sales of organic produce are currently increasing at about 20% per year. While total organic sales are still minimal in relation to the total food industry in the U.S., the rapid increase in organic sales suggests that in the near future a substantial amount of food sold in the U.S. may be classified as organic.
Producers who are considering growing products for sale in the organic market should be dedicated to intensive farm planning. The planning process must extend far into the future, and must be based on what occurred several years in the past. Records should be available from previous years, to show that materials and practices used during the previous three years were compliant with the current organic certification requirements.

Certified organic farming is both intensive and comprehensive. It involves a management system that includes fertility, nutrition, soil management, soil conservation, and pest prevention and control. It includes a complete, balanced management system, and is not simply the omission of pesticides. Farmers who are interested in becoming certified organic producers must develop a management plan that includes all aspects of production. This plan should outline all of the steps that are going to be taken in the entire food production process, and should show the procedures, methods, and techniques that will be used to grow the organic food while maintaining and improving soil and environmental parameters on the farm.

There are three categories of organic certification. Products may be sold as “100 % organic” if all of the ingredients and processes involved in production are approved by the NOP. Products may also be sold as “organic” if 95% or more of the ingredients and processes are approved, and finally, products may be sold as “made with organic ingredients” if 70% or more of the ingredients are in compliance with the NOP guidelines.

With one exception, all farms that are selling produce that is labeled or represented as organic must be certified. Certification standards apply to all products, including animals, fruits, and vegetables. They include raw and processed products, whether grown by individuals or organizations. The certification applies to all produce grown in all 50 states, and also to produce that is imported from other countries. Individual states may impose regulations that are more stringent than the NOP, as long as the guidelines of the NOP are met.

The one exception to the certification requirement involves small farmers and producers who have less than $5,000 per year in sales of organic products. Such producers are not required to be certified in order to sell “organic” products. However, they are required to still follow all of the rules and guidelines of the NOP. The one distinction between small and larger producers is that the small producers are not required to submit an application for certification. The small producers may call their products “organic”, as long as they follow the NOP organic guidelines, but they may not display the USDA Organic Seal.

There are penalties for people who violate the details of the NOP certification act. People who sell or label a product "organic" when they know it does not meet USDA standards can be fined up to $10,000. The fine can be repeated for each violation.
In Oklahoma, certification can be obtained through the Oklahoma Department of Agriculture, Food, and Forestry. Details of certification can be obtained by contacting ODAFF, or information is available online at [http://www.state.ok.us/~okag/food-organichome.htm](http://www.state.ok.us/~okag/food-organichome.htm). Growers who are interested in becoming certified should develop a plan, which includes a description of the practices and substances that have been used in the past three years, the practices and substances that will be used, the product to be sold, and the record keeping procedures that will be used to document each of the above. The plan should show how co-mingling of organic and non-organic products will be prevented. On-site inspections may be necessary to confirm the details of the production plan.

Certification details are available through ODAFF as well as through USDA. The specifics are quite detailed, and include over 500 pages of documentation. Some of the basic guidelines for organic production are as follows:

Soil fertility and crop nutrition should be managed through tillage and cultivation practices, crop rotations, cover crops, and animal and crop waste materials. Certain synthetic materials may be used. For a complete list of the allowed materials, as well as the un-allowed materials, the reader should consult the NOP guidelines. All of the materials used should be selected and used in such a way that they will maintain or improve the physical, chemical and biological condition of the soil. The procedures should minimize or prevent soil erosion, and should not contaminate crops, soil, or water by plant nutrients, pathogenic organisms, heavy metals, or residues of prohibited substances.

Animal and plant waste materials may be either composted or incorporated. If they are to be composted, the composting materials should be maintained at a temperature of 131-170 F for 3 days, using and in-vessel or static aerated pile system. Alternatively, the materials may be maintained at 131-170 F for 15 days using a windrow composting system, during which period the materials must be turned a minimum of five times.

If composting is not used, animal and plant waste materials used as a fertilizer should be incorporated 120 or more days prior to harvest if soil contact is likely with the edible portion of the crop. If the edible portion of the crop will not come in contact with the soil or soil particles, the waste materials used as fertilizer should be incorporated 90 or more days prior to harvest.

Organic producers should implement a crop rotation that includes but is not limited to sod, cover crops, green manure crops, and catch crops that will maintain or improve soil organic matter content. The choice of crops in the rotation should also provide for pest management in annual and perennial crops, should manage deficient or excess plant nutrients, and should provide for erosion control.
Pest prevention and control should be carried out primarily through management practices, including physical, mechanical, and biological. Crop rotation as well as soil and crop nutrient management practices are encouraged as mechanisms of pest control. Sanitation measures that remove disease vectors, weed seeds, and habitat for pest organisms should be utilized. Plant species and varieties with resistance to pests, weeds, and diseases should be selected and utilized. When these practices are not sufficient for pest control, a biological, botanical, or synthetic substance that is already on the approved list of organic materials may be used.

Weed control procedures that are recommended include mulching with fully biodegradable materials, mowing, livestock grazing, hand weeding and mechanical cultivation, flame, heat, or electrical means, and plastic or other synthetic mulches. If synthetic mulches are to be used, they should be removed from the field at the end of the growing season or harvest season. Also, there are certain restrictions on the type of compounds from which the synthetic mulches can be made.

Once a producer is approved as a certified organic producer, the certification will remain in effect until terminated, either voluntarily or through some type of enforcement process. Annual certification updates will be required, but when approved, will be seen as an extension of the original certification, rather than as a new certification. Thus, a grower with continued annual updates will be able to show that he has been certified continuously since the first date of certification.

Scientists at the Lane Agricultural Center have initiated a research and extension program in organic agriculture. Scientists from Oklahoma State University and USDA/ARS are cooperating on this new project. A field was selected in 2003 that had been in timber for about 18 years. The timber was removed, and the field was prepared for crop production. The initial steps included plowing, diskng, and land-planing to produce a uniformly shaped and sloped field. Soil samples were collected on a 30 x 30 ft grid. The field was limed and was treated with poultry litter. A cover crop of turnips was then planted into the field in the fall of 2003. The field will be used for subsequent research and extension efforts in organic vegetable production. Techniques that are approved by the NOP will be used throughout the study.
Spring Spinach Variety Trial

L. Brandenberger, L. Wells, M. Schantz
March, 2003, Blaine County, Oklahoma, Schantz Farm Cooperating with Oklahoma State University

Materials and Methods:
Spinach grown for the fresh-cut market is in the field for much shorter periods than processing spinach. The objective of this study was to evaluate spring planted spinach varieties for quality and yield in successive plantings with abbreviated production cycles. Four spinach varieties from Alf Christianson including Baker, Fall Green, Olympia, Ozarka II, four advanced lines from the University of Arkansas including 88-130, 88-212, 88-310, and 97-154, two Asgrow varieties including Cypress and Padre, and two varieties from Seminis including Bolero and Catalina were included in the trials. All varieties except for Fall Green Ozarka II, 88-130 and 88-212 were planted on each of the four planting dates (3/04/03, 3/12/03, 3/27/03, and 4/03/03). Fall Green Ozarka II, 88-130 and 88-212 were included on the last two planting dates only. Each plot was 2 feet wide by 15 feet long and consisted of 2 rows 12 inches apart. Plots were planted with a Planet Jr. push-planter. Seeding rates were approximately, 522,720 seeds per acre based on a 1 inch in-the-row seed spacing. The experimental area received 100 lbs of 34-0-0 and 100 lbs of 21-0-0 (total of 55 lbs actual N/acre) as a pre-plant fertilizer application. Supplemental water was supplied through an overhead pivot sprinkler system. Plots were arranged in a randomized block design with 4 replications. Spinach was harvested on 4 different dates ranging from 35 to 45 days after planting. Data recorded at each harvest included leaf color, growth habit, bolting and fresh weight.

Results and Discussion:
Leaf color ratings at harvest for 88-310, Ozarka II, Padre and Catalina were consistently higher indicating darker green color than other varieties in the trial (Tables 1-4). Growth habit ratings were highest for Padre and Bolero for three out of four harvests indicating a more upright form. No bolting was observed on any of the harvest dates. Yields recorded on the four harvest dates ranged from 552 to 9,111 lbs of fresh spinach per acre. Bolero recorded the highest yield on each of the four harvests while Catalina, 88-130 and 88-212 were some of the lower yielding varieties.

Based on yield only, the logical choice for a spring spinach variety would be Bolero because it consistently out yielded all other varieties, but when you consider leaf color and the potential disease pressure from white rust, some other varieties should also be considered. University of Arkansas 97-154 has been developed in a breeding program that selects for high levels of tolerance to white rust and Padre is also reported to have tolerance to white rust. These varieties performed well in the trial and should be considered as part of an overall program to manage this disease.
Acknowledgements:
The authors gratefully thank the Schantz family including Merlin, Lillian, Dean and Ben for their support and assistance in completing this study. The authors also want to thank Margaret Savage with Alf Christianson Seed for providing seed of several varieties and Teddy Morelock with the University of Arkansas for providing seed for several varieties for the trial.

Table 1. Spring 2003 Spinach Variety Trial Blaine County, OK, Planting date 3/4/03 harvested at 45 days.

<table>
<thead>
<tr>
<th>Variety</th>
<th>Leaf type</th>
<th>Color</th>
<th>Growth habit</th>
<th>Bolting</th>
<th>Yield lbs./acre</th>
</tr>
</thead>
<tbody>
<tr>
<td>Baker</td>
<td>Semi Flat</td>
<td>3.1 cd</td>
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<td>0</td>
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<tr>
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<td>574 c</td>
</tr>
<tr>
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<td>1398 b</td>
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<tr>
<td>Olympia</td>
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<td>3.5 bc</td>
<td>2.8 b</td>
<td>0</td>
<td>1263 b</td>
</tr>
<tr>
<td>Padre</td>
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<td>0</td>
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<td>1314 b</td>
</tr>
<tr>
<td>97-154</td>
<td>Semi Flat</td>
<td>3.0 cd</td>
<td>2.4 b</td>
<td>0</td>
<td>1681 b</td>
</tr>
</tbody>
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\[\text{Color}=\text{Rating scale of 1-5, 5=darkest green, 1=lightest green.}\]
\[\text{Growth habit}=\text{Rating scale of 1-5, 5=most upright.}\]
\[\text{Bolting}=\text{Percent of plants with flower stalks.}\]
\[\text{Yield}=\text{Fresh weight yield in lbs/acre.}\]

\[\text{Numbers in a column followed by the same letter exhibited no significant differences based on Duncan's Multiple Range Test where } P=0.05.\]

Table 2. Spring 2003 Variety Trial, Blaine County, OK. Planting date 3/12/03 harvested at 44 days.

<table>
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<tr>
<th>Variety</th>
<th>Leaf type</th>
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<th>Growth habit</th>
<th>Bolting</th>
<th>Yield lbs./acre</th>
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<td>0</td>
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<td>4400 c</td>
</tr>
<tr>
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<td>97-154</td>
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\[\text{Color}=\text{Rating scale of 1-5, 5=darkest green, 1=lightest green.}\]
\[\text{Growth habit}=\text{Rating scale of 1-5, 5=most upright.}\]
\[\text{Bolting}=\text{Percent of plants with flower stalks.}\]
\[\text{Yield}=\text{Fresh weight yield in lbs/acre.}\]

\[\text{Numbers in a column followed by the same letter exhibited no significant differences based on Duncan's Multiple Range Test where } P=0.05.\]
Table 3. Spring 2003 Variety Trial, Blaine County, OK. Planting date 3/27/03 harvested at 39 days.

<table>
<thead>
<tr>
<th>Variety</th>
<th>Leaf type</th>
<th>Color(^z)</th>
<th>Growth habit(^y)</th>
<th>Bolting(^x)</th>
<th>Yield lbs./acre(^w)</th>
</tr>
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<tr>
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</tr>
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<td>3.8 a</td>
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</tr>
<tr>
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</tr>
<tr>
<td>97-154</td>
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<td>3.6 a</td>
<td>3.5 a</td>
<td>0</td>
<td>2189 bc</td>
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\(^z\) Color=Rating scale of 1-5, 5=darkest green, 1=lightest green.  
\(^y\) Growth habit=Rating scale of 1-5, 5=most upright.  
\(^x\) Bolting=Percent of plants with flower stalks.  
\(^w\) Yield=Fresh weight yield in lbs/acre.  
\(^v\) 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 4. Spring 2003 Variety Trial, Blaine County, OK. Planting date 4/3/03 harvested at 35 days.

<table>
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<tr>
<th>Variety</th>
<th>Leaf type</th>
<th>Color(^z)</th>
<th>Growth habit(^y)</th>
<th>Bolting(^x)</th>
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<tr>
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<td>3.3 c</td>
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</tr>
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<td>Fall Green</td>
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<td>911 ef</td>
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<tr>
<td>97-154</td>
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</tbody>
</table>

\(^z\) Color=Rating scale of 1-5, 5=darkest green, 1=lightest green.  
\(^y\) Growth habit=Rating scale of 1-5, 5=most upright.  
\(^x\) Bolting=Percent of plants with flower stalks.  
\(^w\) Yield=Fresh weight yield in lbs/acre.  
\(^v\) Numbers in a column followed by the same letter exhibited no significant differences based on Duncan's Multiple Range Test where P=0.05.
High Density Spinach

L. Brandenberger, L. Wells, M. Schantz
Preliminary Study March, 2003, Blaine County, Oklahoma
Schantz Farm Cooperating with Oklahoma State University

Materials and Methods:

Fresh spinach in Oklahoma has potential for the fresh-cut market. The objectives of this study were to evaluate spring planted spinach varieties for use in successive high density plantings. Four spinach varieties from Alf Christianson Seed including F-380, Samish, Avon and Tyee and one advanced line from the University of Arkansas F-415 were planted on 3/04/03, 3/12/03, 3/27/03, and 4/03/03. Each plot was 2 feet wide by 20 feet long and consisted of 8 rows planted on 3 inch row centers. The planter incorporated a bed-shaper followed by eight Planet Jr. planting-shoes made up of two staggered tiers of four shoes each. Seeding rates were approximately, 2,091,000 seeds per acre based on the 3 inch row center and 1 inch in–the-row seed spacing. The experimental area received 100 lbs of 34-0-0 and 100 lbs of 21-0-0 (total of 55 lbs actual N/acre) as a pre-plant fertilizer application. Supplemental water was supplied through an overhead pivot sprinkler system. Plots were arranged in a randomized block design with 4 replications. Spinach was harvested on 4 different dates ranging from 35 to 45 days after planting. Data recorded at each harvest included leaf color ratings, growth habit ratings, bolting and fresh cut yield.

Results and Discussion:

Avon and Samish consistently had higher color ratings than either F-380 or F-415 on each of the four harvest dates, while Tyee had higher ratings than either of the two for a majority of days (Table 1). Growth habit ratings were highest for F-380 and F-415 on the first two harvest dates, indicating a more upright growth habit that would likely be easier to harvest, but were lower than the other cultivars for the last two harvest dates. No bolting was observed in any of the varieties in the study on any of the harvest dates. Differences in yield were significant for the last two harvest dates (Table 1). On the third and fourth harvest dates Avon, Samish and Tyee had yields ranging between 12,284 to 15,861 lbs/acre while F-380 and F-415 had yields ranging from 5,478 to 7,356 lbs/acre.

Based on this initial study there are several aspects of growing high density spinach that need work prior to commercial production starting in Oklahoma. First, from the initial planting it was evident that a precision method of planting was needed to obtain a more uniform stand. Due to budgetary constraints a planter was generously loaned by Texas A&M for this first year, but the authors would recommend a planting system based on what has been developed in California i.e. bedder-shaper with an air type planter to obtain precise placement of spinach seed. Bolting was not a problem with any of the varieties that were included in the study although some of them are known for bolting and this is probably due to the short time from planting to harvest. We would deduce that more planting dates (both earlier and later) should be explored and that the
possibility of a longer planting-harvesting window would be quite beneficial to the area’s potential for marketing fresh spinach. All harvesting was accomplished using a hand-held scythe that worked adequately for research, but due to the labor availability and cost in the area, we would assume that machine harvesting would be the better choice. Overall, the authors would suggest that both a bedding-planting system and harvesting system be developed simultaneously to provide for the mechanization of this potential crop. The authors would suggest that more than one year of data is needed to make a definitive decision about spinach cultivars for high density spring spinach and that once a more suitable planter is obtained work should be undertaken to determine the optimal plant population for this crop in Oklahoma.

Acknowledgements:
The authors gratefully thank the Schantz family including Merlin, Lillian, Dean and Ben for their support and assistance in completing this study. The authors also want to thank Margaret Savage with Alf Christianson Seed for supplying spinach seed for the study, Bob Wiedenfeld with Texas A&M for the loan of the planter used in the study and Teddy Moreloch with the University of Arkansas for loaning the harvesting scythe.

Table 1. Spring 2003 High Density Variety Trial, Blaine County, OK, Planting date 3/4/03 harvested at 45 days.

<table>
<thead>
<tr>
<th>Variety</th>
<th>Leaf type</th>
<th>Color</th>
<th>Growth habit</th>
<th>Bolting</th>
<th>Yield lbs./acre</th>
</tr>
</thead>
<tbody>
<tr>
<td>Avon</td>
<td>Semi-savoy</td>
<td>4.3 a’</td>
<td>3.0 b</td>
<td>0</td>
<td>7002 a</td>
</tr>
<tr>
<td>F-380</td>
<td>Semi-flat</td>
<td>3.1 c</td>
<td>3.9 a</td>
<td>0</td>
<td>4966 a</td>
</tr>
<tr>
<td>F-415</td>
<td>Semi-flat</td>
<td>3.4 bc</td>
<td>3.6 a</td>
<td>0</td>
<td>6093 a</td>
</tr>
<tr>
<td>Samish</td>
<td>Semi-savoy</td>
<td>3.8 b</td>
<td>3.0 b</td>
<td>0</td>
<td>5080 a</td>
</tr>
<tr>
<td>Tyee</td>
<td>Savoy</td>
<td>4.4 a</td>
<td>2.8 b</td>
<td>0</td>
<td>5625 a</td>
</tr>
</tbody>
</table>

Table 1. Spring 2003 High Density Variety Trial, Blaine County, OK, Planting date 3/12/03 harvested at 44 days.

<table>
<thead>
<tr>
<th>Variety</th>
<th>Leaf type</th>
<th>Color</th>
<th>Growth habit</th>
<th>Bolting</th>
<th>Yield lbs./acre</th>
</tr>
</thead>
<tbody>
<tr>
<td>Avon</td>
<td>Semi-savoy</td>
<td>4.4 a’</td>
<td>3.9 a</td>
<td>0</td>
<td>20745 a</td>
</tr>
<tr>
<td>F-380</td>
<td>Semi-flat</td>
<td>3.5 c</td>
<td>4.3 a</td>
<td>0</td>
<td>16705 a</td>
</tr>
<tr>
<td>F-415</td>
<td>Semi-flat</td>
<td>3.6 c</td>
<td>4.3 a</td>
<td>0</td>
<td>19123 a</td>
</tr>
<tr>
<td>Samish</td>
<td>Semi-savoy</td>
<td>3.8 bc</td>
<td>4.1 a</td>
<td>0</td>
<td>18502 a</td>
</tr>
<tr>
<td>Tyee</td>
<td>Savoy</td>
<td>4.1 ab</td>
<td>3.8 a</td>
<td>0</td>
<td>17685 a</td>
</tr>
</tbody>
</table>
Spring 2003 High Density Variety Trial, Blaine County, OK, Planting date 3/27/03 harvested at 39 days.

<table>
<thead>
<tr>
<th>Variety</th>
<th>Leaf type</th>
<th>Color (^2)</th>
<th>Growth habit (^y)</th>
<th>Bolting (^x)</th>
<th>Yield lbs./acre (^w)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Avon</td>
<td>Semi-savoy</td>
<td>3.8 a(^z)</td>
<td>3.9 a</td>
<td>0</td>
<td>15861 a</td>
</tr>
<tr>
<td>F-380</td>
<td>Semi-flat</td>
<td>3.1 bc</td>
<td>3.4 a</td>
<td>0</td>
<td>7356 b</td>
</tr>
<tr>
<td>F-415</td>
<td>Semi-flat</td>
<td>2.9 c</td>
<td>3.5 a</td>
<td>0</td>
<td>7106 b</td>
</tr>
<tr>
<td>Samish</td>
<td>Semi-savoy</td>
<td>3.8 a</td>
<td>3.6 a</td>
<td>0</td>
<td>14669 a</td>
</tr>
<tr>
<td>Tyee</td>
<td>Savoy</td>
<td>3.6 ab</td>
<td>3.6 a</td>
<td>0</td>
<td>14380 a</td>
</tr>
</tbody>
</table>

Spring 2003 High Density Variety Trial, Blaine County, OK, Planting date 4/3/03 harvested at 35 days.

<table>
<thead>
<tr>
<th>Variety</th>
<th>Leaf type</th>
<th>Color (^2)</th>
<th>Growth habit (^y)</th>
<th>Bolting (^x)</th>
<th>Yield lbs./acre (^w)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Avon</td>
<td>Semi-savoy</td>
<td>4.3 a(^z)</td>
<td>4.4 a</td>
<td>0</td>
<td>14533 a</td>
</tr>
<tr>
<td>F-380</td>
<td>Semi-flat</td>
<td>3.1 b</td>
<td>3.3 b</td>
<td>0</td>
<td>5788 b</td>
</tr>
<tr>
<td>F-415</td>
<td>Semi-flat</td>
<td>3.3 b</td>
<td>3.1 b</td>
<td>0</td>
<td>5478 b</td>
</tr>
<tr>
<td>Samish</td>
<td>Semi-savoy</td>
<td>3.9 a</td>
<td>4.3 a</td>
<td>0</td>
<td>12284 a</td>
</tr>
<tr>
<td>Tyee</td>
<td>Savoy</td>
<td>4.3 a</td>
<td>4.3 a</td>
<td>0</td>
<td>12671 a</td>
</tr>
</tbody>
</table>

\(^z\) Color=Rating scale of 1-5, 5=darkest green, 1=lightest green.

\(^y\) Growth habit=Rating scale of 1-5, 5=most upright.

\(^x\) Bolting=Percent of plants with flower stalks.

\(^w\) Yield=Fresh weight yield in lbs/acre.

\(^v\) Numbers in a column followed by the same letter exhibited no significant differences based on Duncan’s Multiple Range Test where \(P=0.05\).
Watermelon Weed Control

L. Brandenberger, L.K. Wells, B. Bostian, B. Kahn, F. Steiner
Sandea and Strategy Weed Control Study on Direct Seeded and Transplanted Watermelon, June, 2002
Oklahoma State University Vegetable Station at Bixby, Oklahoma

Introduction and Objectives

During the past year two new compounds have become available for weed control in watermelon, Sandea (Halosulfuron-methyl) and Strategy (Ethalfuralin + Clomazone). These compounds have been tested in a wide number of locations and environments, but as with any new materials there are still questions to be answered regarding use patterns and how they may affect both crop and weeds.

A study utilizing Sandea and Strategy as separate pre-plant and preemergence treatments on direct seeded and transplanted watermelon will provide an opportunity for the vegetable industry, Agri-Chemical companies and university extension and research scientists to determine the effectiveness and crop safety attributes of these new materials.

Materials and Methods

The study site was located at the Oklahoma State University Vegetable Research Station in Bixby, Oklahoma. Plots were either direct seeded to “XIT 101” a pollinator cultivar or transplanted to “Sugar Time” a triploid seedless cultivar together with “XIT 101” on June 27, 2002. Transplanted plots included both cultivars alternating in every other planting space on a two feet in-row spacing. Direct seeded plots were sown with a Planet Jr. planter with a seed spacing of approximately six inches within the row and thinned to a two feet in-row spacing following emergence. Direct seeded plots were sown with a Planet Jr. planter with a seed spacing of approximately six inches within the row and thinned to a two feet in-row spacing following emergence. Transplants were started on 6/11/02 in “Speedling” 8x16 trays utilizing “Scott’s Redi Earth plug and seedling mix”. Supplemental water in the field was applied with overhead irrigation through a linear system. All plots within the study utilized the same pest management practices including one application of insecticide for control of squash bug and four applications of fungicide for control of anthracnose.

Twenty treatments were included in the study along with four checks (Table 1,2). The four checks included an untreated seeded, seeded and weeded, untreated transplanted, and transplanted and weeded checks. Treatments consisted of two rates of Sandea or two rates of Strategy in combination with applications being made prior to or after direct seeding or transplanting, the last four treatments consisted of both rates of each material being applied after transplanting as a shielded application (Table 2). Except for the shielded applications, all other treatments were applied as a broadcast spray over the top of the plot. Herbicide treatments were applied on 6/27/02 utilizing a hand-held boom CO2 sprayer at an overall rate of 20 gallons of spray solution per acre. All plots received a light (<0.5 inch) irrigation immediately following application of herbicide treatments. Plots were 10 feet wide by 26.4 feet long, arranged in a randomized block design utilizing four replications.
Recorded data included phytotoxicity and efficacy for palmer amaranth (Amaranthus palmeri S. Wats.) on 7/17/02, 7/31/02, and 8/22/02 and efficacy for carpetweed (Mollugo verticillata L.) on 7/17/02. Harvest data included individual fruit weights for melons harvested from each plot and was collected on 8/30/02 for transplanted treatments and on 9/10/02 for direct seeded treatments. Harvest data were analyzed separately for seedless and seeded watermelons established by transplanting and separately for seeded watermelons that were established by direct seeding to separate treatment effects resulting from different methods of establishment. All data were analyzed utilizing Duncan’s multiple range test with P = 0.05.

Results

Phytotoxicity ratings recorded on 7/17/02 differed significantly for three treatments, Sandea 0.024 apply then seed, Strategy 0.79 apply then seed, and Strategy 1.05 apply then seed (Table 2). On 7/31/02 the same treatments plus Sandea 0.032 apply then seed had significantly higher levels of damage than the 0 to 4 percent damage recorded for the untreated and weeded checks. Only one treatment had a significantly higher level of damage on 8/22/02 compared to the untreated and weeded checks, this was Strategy 1.05 apply then seed, it had 11 percent damage.

Efficacy ratings for all treatments were significantly higher than the untreated checks that recorded 0 percent control on each day that ratings were recorded for both palmer amaranth and carpetweed (Table 3). Palmer amaranth control on 7/17/02 was between 99 and 100 percent for seven treatments. On 7/31/02, four treatments and the seeded and weeded check recorded between 99 to 100 percent control of palmer amaranth. All five treatments that utilized Sandea at 0.032 had between 93 to 95 percent control of palmer amaranth on 8/22/02. All treatments provided high levels of carpetweed control in the study, ranging from 95 to 100 percent control on 7/17/02, compared to 0 percent control for the untreated checks.

Direct seeded melon yield was significantly higher for two treatments compared to the untreated check (Table 4). Number of fruit per acre was higher for Sandea 0.024 seed then apply, and Sandea 0.032 seed then apply compared the untreated check. Average fruit size ranged from 4.4 to 9.7 pounds per fruit.

Transplanted seeded melon yield did not vary significantly between the treatments or the untreated or weeded checks (Table 5). Fruit number per acre did not vary significantly, but was highest for Sandea 0.024 apply then transplant and Sandea 0.032 apply then transplant, both recorded 1000 fruit per acre. Average fruit weight did vary significantly with a majority of treatments having higher fruit weights than the untreated check. Sandea 0.024 transplant then apply and Sandea 0.032 apply then transplant had the highest fruit weights and averaged 9.6 and 11.3 pounds per fruit, respectively.

Transplanted seedless melon yield was significantly higher for a majority of the treatments compared to the untreated check (Table 5). A majority of treatments had significantly higher numbers of fruit per acre compared to the untreated check. Number of fruit per acre ranged from a low of 208 for the untreated check to 1708 fruit per acre. Average fruit weight did not vary significantly, but ranged from 2.4 to 7.1 pounds per fruit. Combined seedless and seeded transplanted melon yield was significantly higher for a majority of the herbicide treatments when compared to the untreated check (Table 5).
Conclusions

Weed pressure in the study was extremely high, particularly for palmer amaranth which reached a height of approximately 8 to 10 feet in untreated plots. Herbicide treatments that provided consistent high levels of palmer amaranth control included Sandea at both rates with the higher rate providing higher levels of control and Strategy applied after seeding. Yields corresponded with weed control, in that higher levels of weed control generally resulted in higher yields. Based upon the results of this study, the authors would conclude that Sandea and Strategy applied after direct seeding at the lower rates used in the study provided adequate weed control and resulted in the highest yields for direct seeded watermelons. The authors would further conclude that for transplanted watermelons, Sandea applied before or after transplanting without the use of shielding to protect the crop provided the highest levels of weed control and yields in the study.

Acknowledgements

Much thanks to Dr. Glen Price of Sugar Creek Seed Company for supplying all the watermelon seed for this study. The authors would also like to thank Gowan and UAP/Platte for supplying herbicide and for additional support toward the completion of this work.

Table 1. Sandea & Strategy herbicide study on watermelons, Bixby, Oklahoma, Spring 2002. Study treatment materials.

<table>
<thead>
<tr>
<th>Material</th>
<th>Common name</th>
<th>Rates</th>
<th>Supplier</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sandea</td>
<td>Halosulfuron-methyl</td>
<td>0.024 lbs. ai/acre</td>
<td>Gowan</td>
</tr>
<tr>
<td>Sandea</td>
<td>Halosulfuron-methyl</td>
<td>0.032 lbs. ai/acre</td>
<td>Gowan</td>
</tr>
<tr>
<td>Strategy</td>
<td>Ethalfluralin + Clomazone</td>
<td>0.79 lbs. ai/acre</td>
<td>Platte Chemical</td>
</tr>
<tr>
<td>Strategy</td>
<td>Ethalfluralin + Clomazone</td>
<td>1.05 lbs. ai/acre</td>
<td>Platte Chemical</td>
</tr>
</tbody>
</table>
Table 2. Sandea & Strategy herbicide study on watermelons, Bixby, Oklahoma, Spring 2002. Phytotoxicity ratings as percent damage to the crop.

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Phytotoxicity²</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>7/17/02</td>
</tr>
<tr>
<td>Seeded Check</td>
<td>0 d ⁷</td>
</tr>
<tr>
<td>Seeded &amp; weeded check</td>
<td>0 d ⁷</td>
</tr>
<tr>
<td>Transplanted check</td>
<td>0 d ⁷</td>
</tr>
<tr>
<td>Transplanted &amp; weeded check</td>
<td>0 d ⁷</td>
</tr>
<tr>
<td>Sandea 0.024 apply then seed</td>
<td>41 abc</td>
</tr>
<tr>
<td>Sandea 0.024 apply then transplant</td>
<td>26 cd</td>
</tr>
<tr>
<td>Sandea 0.024 seed then apply</td>
<td>0 d ⁷</td>
</tr>
<tr>
<td>Sandea 0.024 transplant then apply</td>
<td>13 cd</td>
</tr>
<tr>
<td>Sandea 0.024 transplant then shield apply</td>
<td>19 cd</td>
</tr>
<tr>
<td>Sandea 0.032 apply then seed</td>
<td>24 cd ⁷</td>
</tr>
<tr>
<td>Sandea 0.032 apply then transplant</td>
<td>28 bcd</td>
</tr>
<tr>
<td>Sandea 0.032 seed then apply</td>
<td>11 d ⁷</td>
</tr>
<tr>
<td>Sandea 0.032 transplant then apply</td>
<td>25 cd</td>
</tr>
<tr>
<td>Sandea 0.032 transplant then shield apply</td>
<td>14 cd</td>
</tr>
<tr>
<td>Strategy 0.79 apply then seed</td>
<td>54 ab</td>
</tr>
<tr>
<td>Strategy 0.79 apply then transplant</td>
<td>4 d ⁷</td>
</tr>
<tr>
<td>Strategy 0.79 seed then apply</td>
<td>0 d ⁷</td>
</tr>
<tr>
<td>Strategy 0.79 transplant then apply</td>
<td>18 cd</td>
</tr>
<tr>
<td>Strategy 0.79 transplant then shield apply</td>
<td>13 cd</td>
</tr>
<tr>
<td>Strategy 1.05 apply then seed</td>
<td>55 a ⁷</td>
</tr>
<tr>
<td>Strategy 1.05 apply then transplant</td>
<td>13 cd</td>
</tr>
<tr>
<td>Strategy 1.05 seed then apply</td>
<td>30 abcd</td>
</tr>
<tr>
<td>Strategy 1.05 transplant then apply</td>
<td>24 cd</td>
</tr>
<tr>
<td>Strategy 1.05 transplant then shield apply</td>
<td>19 cd</td>
</tr>
</tbody>
</table>

²Phytotoxicity=percent damage to the crop.
³Numbers in a column followed by the same letter exhibited no significant differences based on Duncan’s Multiple Range Test where P=0.05.
Table 3. Sandea & Strategy herbicide study on watermelons, Bixby, Oklahoma, Spring 2002. Efficacy ratings on Pig weed (*Amaranthus sp.*) and Carpet weed (*Mollugo sp.*).

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Palmer amaranth control</th>
<th>Carpet weed</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>7/17/02</td>
<td>7/31/02</td>
</tr>
<tr>
<td>Seeded Check</td>
<td>0 c(^z)</td>
<td>0 d</td>
</tr>
<tr>
<td>Seeded &amp; weeded check</td>
<td>95 ab</td>
<td>100 a</td>
</tr>
<tr>
<td>Transplanted check</td>
<td>0 c</td>
<td>0 d</td>
</tr>
<tr>
<td>Transplanted &amp; weeded check</td>
<td>95 ab</td>
<td>93 a</td>
</tr>
<tr>
<td>Sandea 0.024 apply then seed</td>
<td>96 ab</td>
<td>95 a</td>
</tr>
<tr>
<td>Sandea 0.024 apply then transplant</td>
<td>99 a</td>
<td>98 a</td>
</tr>
<tr>
<td>Sandea 0.024 seed then apply</td>
<td>98 ab</td>
<td>93 a</td>
</tr>
<tr>
<td>Sandea 0.024 transplant then apply</td>
<td>98 ab</td>
<td>93 a</td>
</tr>
<tr>
<td>Sandea 0.024 transplant then shield apply</td>
<td>96 ab</td>
<td>90 ab</td>
</tr>
<tr>
<td>Sandea 0.032 apply then seed</td>
<td>100 a</td>
<td>99 a</td>
</tr>
<tr>
<td>Sandea 0.032 apply then transplant</td>
<td>100 a</td>
<td>100 a</td>
</tr>
<tr>
<td>Sandea 0.032 seed then apply</td>
<td>100 a</td>
<td>99 a</td>
</tr>
<tr>
<td>Sandea 0.032 transplant then apply</td>
<td>96 ab</td>
<td>95 a</td>
</tr>
<tr>
<td>Sandea 0.032 transplant then shield apply</td>
<td>100 a</td>
<td>99 a</td>
</tr>
<tr>
<td>Strategy 0.79 apply then seed</td>
<td>94 ab</td>
<td>85 abc</td>
</tr>
<tr>
<td>Strategy 0.79 apply then transplant</td>
<td>93 ab</td>
<td>94 a</td>
</tr>
<tr>
<td>Strategy 0.79 seed then apply</td>
<td>99 a</td>
<td>95 a</td>
</tr>
<tr>
<td>Strategy 0.79 transplant then apply</td>
<td>89 b</td>
<td>74 bc</td>
</tr>
<tr>
<td>Strategy 0.79 transplant then shield apply</td>
<td>96 ab</td>
<td>70 c</td>
</tr>
<tr>
<td>Strategy 1.05 apply then seed</td>
<td>99 a</td>
<td>91 a</td>
</tr>
<tr>
<td>Strategy 1.05 apply then transplant</td>
<td>93 ab</td>
<td>94 a</td>
</tr>
<tr>
<td>Strategy 1.05 seed then apply</td>
<td>95 ab</td>
<td>90 ab</td>
</tr>
<tr>
<td>Strategy 1.05 transplant then apply</td>
<td>93 ab</td>
<td>95 a</td>
</tr>
<tr>
<td>Strategy 1.05 transplant then shield apply</td>
<td>94 ab</td>
<td>86 ab</td>
</tr>
</tbody>
</table>

\(^z\)Efficacy=percent control of palmer amaranth and carpet weed.

\(^y\)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 4. Sandea & Strategy herbicide study on watermelons, Bixby, Oklahoma, Spring 2002. Harvest data on direct seeded plots.

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Yield lbs./acre(^z)</th>
<th>Number fruit/acre(^y)</th>
<th>Average fruit weight(^x)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Seeded check</td>
<td>3029 bc</td>
<td>417 bcd</td>
<td>4.9 bc</td>
</tr>
<tr>
<td>Seeded &amp; weeded check</td>
<td>5689 abc</td>
<td>778 abcd</td>
<td>8.1 ab</td>
</tr>
<tr>
<td>Sandea 0.024 apply then seed</td>
<td>9077 ab</td>
<td>1111 ab</td>
<td>7.5 ab</td>
</tr>
<tr>
<td>Sandea 0.024 seed then apply</td>
<td>12804 a</td>
<td>1458 a</td>
<td>8.5 ab</td>
</tr>
<tr>
<td>Sandea 0.032 apply then seed</td>
<td>2992 bc</td>
<td>542 bcd</td>
<td>6.2 ab</td>
</tr>
<tr>
<td>Sandea 0.032 seed then apply</td>
<td>9139 ab</td>
<td>1444 a</td>
<td>6.3 ab</td>
</tr>
<tr>
<td>Strategy 0.79 apply then seed</td>
<td>1242 c</td>
<td>208 cd</td>
<td>4.4 bc</td>
</tr>
<tr>
<td>Strategy 0.79 seed then apply</td>
<td>10708 a</td>
<td>1125 ab</td>
<td>9.7 a</td>
</tr>
<tr>
<td>Strategy 1.05 apply then seed</td>
<td>387 c</td>
<td>83 d</td>
<td>1.2 c</td>
</tr>
<tr>
<td>Strategy 1.05 seed then apply</td>
<td>9594 ab</td>
<td>944 abc</td>
<td>9.6 a</td>
</tr>
</tbody>
</table>

\(^z\)Yield lbs./acre=average yield in lbs. per acre.

\(^y\)Number fruit/acre=average number of fruit per acre.

\(^x\)Average fruit weight=average weight per fruit.

\(^w\)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 5. Sandea & Strategy herbicide study on watermelons, Bixby, Oklahoma, Spring 2002. Harvest data on transplanted plots.

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Seeded</th>
<th>Seedless</th>
<th>Combined yield lbs./acre&lt;sup&gt;z&lt;/sup&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Yield lbs./acre&lt;sup&gt;y&lt;/sup&gt;</td>
<td>Number fruit/acre&lt;sup&gt;y&lt;/sup&gt;</td>
<td>Average fruit weight&lt;sup&gt;x&lt;/sup&gt;</td>
</tr>
<tr>
<td>Transplanted check</td>
<td>792 a&lt;sup&gt;w&lt;/sup&gt;</td>
<td>83 a</td>
<td>2.4 b</td>
</tr>
<tr>
<td>Transplanted &amp; weeded check</td>
<td>5754 a</td>
<td>708 a</td>
<td>8.3 a</td>
</tr>
<tr>
<td>Sandea .024 apply then transplant</td>
<td>7221 a</td>
<td>1000 a</td>
<td>7.3 a</td>
</tr>
<tr>
<td>Sandea .024 transplant then apply</td>
<td>7900 a</td>
<td>833 a</td>
<td>9.6 a</td>
</tr>
<tr>
<td>Sandea .024 transplant then shield apply</td>
<td>4062 a</td>
<td>417 a</td>
<td>9.1 a</td>
</tr>
<tr>
<td>Sandea .032 apply then transplant</td>
<td>10608 a</td>
<td>1000 a</td>
<td>11.3 a</td>
</tr>
<tr>
<td>Sandea .032 transplant then apply</td>
<td>7016 a</td>
<td>917 a</td>
<td>7.9 a</td>
</tr>
<tr>
<td>Sandea .032 transplant then shield apply</td>
<td>7408 a</td>
<td>875 a</td>
<td>8.4 a</td>
</tr>
<tr>
<td>Strategy 0.79 apply then transplant</td>
<td>8000 a</td>
<td>917 a</td>
<td>9.2 a</td>
</tr>
<tr>
<td>Strategy 0.79 transplant then apply</td>
<td>5891 a</td>
<td>708 a</td>
<td>6.6 ab</td>
</tr>
<tr>
<td>Strategy 0.79 transplant then shield apply</td>
<td>3600 a</td>
<td>542 a</td>
<td>6.4 ab</td>
</tr>
<tr>
<td>Strategy 1.05 apply then transplant</td>
<td>7521 a</td>
<td>833 a</td>
<td>9.2 a</td>
</tr>
<tr>
<td>Strategy 1.05 transplant then apply</td>
<td>5612 a</td>
<td>667 a</td>
<td>7.8 a</td>
</tr>
<tr>
<td>Strategy 1.05 transplant then shield apply</td>
<td>5712 a</td>
<td>792 a</td>
<td>7.0 a</td>
</tr>
</tbody>
</table>

<sup>z</sup>Yield lbs./acre=average yield in lbs. per acre.

<sup>y</sup>Number fruit/acre=average number of fruit per acre.

<sup>x</sup>Average fruit weight=average weight per fruit.

<sup>z</sup>Combined yield=seeded + seedless yield for transplanted treatments in lbs. per acre

<sup>y</sup>Numbers in a column followed by the same letter exhibited no significant differences based on Duncan’s Multiple Range Test where P=0.05.
Introduction

The selection and use of a winter cover crop may have both long-term benefits, such as reduced soil erosion, and short-term consequences such as decreased weed competition and improved nutrient availability. In addition, the selection of a spring tillage/planting system following the winter cover crop may either be beneficial or injurious to dry bean production by affecting weed growth and soil moisture availability. The objective of this research was to determine the effect of winter cover crops, tillage/planting systems, and weed control on black bean yield components.

Materials and Methods

A two-year field study was conducted at Lane, OK (southeast Oklahoma), on a Bernow fine sandy loam, 0 - 3% slope, (fine-loamy, siliceous, thermic Glossic Paleudalf). The research was designed as a split-split-plot design with five winter cover crop treatments as main plots, two tillage/planting systems as sub-plots, four weed control treatments as sub-sub-plots, and four replications. The five winter cover crop treatments included “barley” (Hordeum vulgare L.) cv. ‘Tambar’, “oats” (Avena sativa) cv. ‘Nora’, “rye” (Secale cereale) cv. ‘Maton’, “wheat” (Triticum aestivum L.) cv. ‘Coker’, and “None” (no winter cover crop). Each of the winter cover crops were planted at a rate of 70 lb/a on September 28 of 1999 and 2001 with a 12-ft grain drill with 7-in row spacings on plots 12 ft wide and 350 ft long, oriented in a north to south direction. Planting produced excellent crop stands for all cover crops, and the cover crop treatment without any crop (none) resulted in a full stand of weeds.

Two weeks prior to spring planting (May 10, 2000 and 2002), the no-tillage sub-plots within each cover crop were sprayed with a tank mix of Roundup Ultra3 (glyphosate), N- (phosphonomethyl) glycine, 2 qt/a, 1% by weight of ammonium sulfate, and 1% by volume of Latron CS-7 spreader/binder (60% active ingredients). The herbicide was applied with a tractor-mounted sprayer using compressed CO₂, a 12-ft boom, and 8002VS nozzles on 20-in spacings. Two days prior to planting the no-tillage sub-plots were mowed and the conventional tillage sub-plots were disked, and fertilizer

3 The mention or use of a herbicide or additive for a herbicide is not intended as a recommendation. Always read and follow the manufacturer’s label before using any herbicide.
was applied at a rate of 75-75-75 lb/a N-P-K to all plots. Black bean (Phaseolus vulgaris L.) cv. 'Black Knight' was planted at Lane, OK on May 24 (2000 and 2002) at a 36-in row spacings at 90,000 seeds/a (6.2 seeds/ft). Following seedling emergence all plots were thinned to uniform stands for the purpose of determining the effects of cover crops, tillage/planting system, and weed control on plant survival during the growing season. The four weed control treatments (sub-sub-plots) included a "weedy check", an "early season", a "late season", and a "full season" treatment.

In the weedy check treatment weeds were allowed to grow throughout the 90-day growing season (May 24 to August 22, 2000 and 2002). Weeds were removed by handweeding during the first 45 days (May 24 to July 8, 2000 and 2002), for the early season weed control treatment, during the last 45 days (July 9 to August 22, 2000 and 2002), for the late season weed control treatment, and during the entire growing season (May 24 to August 22, 2000 and 2002), for the full season weed control treatment. At harvest an 8 ft length of plant row was harvested and used to determine seed yield (lb/a), pod number (pods/plant), seed number (seeds/pod), seed weight (g/100 seeds), and plant populations (plants/a).

Results and Discussions

Rainfall during the 2000 growing season was 8.88 inches, a total of 9.85 inches was supplied when a 0.97 inch irrigation just after planting was included, compared to a more equally distributed 12.17 inches (24% greater) during the 2002 growing season (Table 1). The 30-yr average seasonal rainfall (May 1 to August 31) for the location is 15.7 inches.

All yield components (seed yield, pod number, seed number, seed weight, and plant populations) for each factorial treatment or average across all factors were greater in 2002 than in 2000 (data not shown).

Cover Crops

When averaged across years, tillage/planting systems, and weed control levels, the black beans following barley (485 lb/ac), oats (401 lb/a), and rye (448 lb/ac) produced greater yields than either wheat (270 lb/a) or no cover crop (322 lb/a) (Table 2). The greatest yield advantage (lb/a) for these cover crops (barley, oats, and rye) compared to wheat and no cover crop is seen for pod number (pods/plant) and seed number (seeds/pod).

Tillage/Planting Systems

In 2000 black bean plant population was the only yield component significantly affected by the tillage/planting systems when averaged across cover crops and weed control treatments (data not shown). The conventional tilled/planted black beans had 17% lower final plant populations (44,536 plants/a) than the no-tillage (53,521 plants/a) beans, although the initial plant populations were equal. The below normal rainfall, 43%
below the 30-yr average, and the resulting less than optimum soil moisture most likely contributed to the decrease in black bean plant population for the conventionally tilled black beans. In 2002, the additional and more evenly distributed rainfall resulted in a much smaller difference (3%) in black bean plant populations between tillage/planting systems (conventional, 68,312 plants/a and the no-tillage, 70,087 plants/a; data not shown). When averaged across years (2000 and 2002), there was very little difference between the seed yield of the conventional and no-tillage planting systems, although plant stands continued to be greater for no-tillage system (Table 3).

**Weed Control**

All yield components were affected by weed control treatments when averaged across cover crops and tillage/planting systems (Table 4). Early and full season weed control produced greater seed yields, pods per plant, seeds per pod, seed weight, and plant populations than the weedy check. Any weed removal (early, late, or full season) was better than no weed control. Weeds in the weedy check resulted in smaller black bean seeds and reduced plant populations compared to all other weed control treatments. Weed removal during the first 45 days was more beneficial than weed removal during the second 45 days. Weeds in the late season weed control reduced the pod number (3.5 pods/plant), seed weight (12.6 g/100 seeds), and plant populations (57,672 plants/a) compared to the early season weed control, 4.27 pods/plant, 13.7 g/100 seeds, and 66,637 plants/a, respectively. Late season weed control also produced decreased seed yield (318 lb/a), pod number (3.53 pods/plant), seed weight (12.6 g/100 seeds) and plant populations (57,672 plants/a) compared to the full season weed control, 509 lb/a, 5.2 pods/plant, 14.4 g/100 seeds, and 64,433 plants/a, respectively. The results indicate that early season weed control is nearly as important as full season weed control, and far more beneficial than a crop receiving only late season weed control.

**Table 1.** Inches of rainfall and irrigation received during the 2000 and 2002 growing season (May –August) and the 30-year average rainfall for Lane, OK.

<table>
<thead>
<tr>
<th>Month</th>
<th>2000</th>
<th>2002</th>
<th>30-Year Average</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>inches</td>
<td>inches</td>
<td>inches</td>
</tr>
<tr>
<td>May</td>
<td>2.52*</td>
<td>2.38</td>
<td>5.9</td>
</tr>
<tr>
<td>June</td>
<td>5.84</td>
<td>4.56</td>
<td>4.2</td>
</tr>
<tr>
<td>July</td>
<td>1.46</td>
<td>2.66</td>
<td>2.9</td>
</tr>
<tr>
<td>August</td>
<td>0.03</td>
<td>2.57</td>
<td>2.7</td>
</tr>
<tr>
<td>Total</td>
<td>9.85</td>
<td>12.17</td>
<td>15.7</td>
</tr>
</tbody>
</table>

* Includes 0.97 inches of irrigation in 2000.
Table 2. Effect of winter cover crop on black bean yield components averaged across years (2000 and 2002).

<table>
<thead>
<tr>
<th>Winter Cover Crop</th>
<th>Yield Weight</th>
<th>Seed Number</th>
<th>Pod Number</th>
<th>Seed g/100 seeds</th>
<th>Plant plants/a</th>
</tr>
</thead>
<tbody>
<tr>
<td>Barley</td>
<td>485</td>
<td>4.50</td>
<td>3.56</td>
<td>13.4</td>
<td>66,446</td>
</tr>
<tr>
<td>Oats</td>
<td>401</td>
<td>4.47</td>
<td>3.28</td>
<td>12.9</td>
<td>59,187</td>
</tr>
<tr>
<td>Rye</td>
<td>448</td>
<td>4.85</td>
<td>3.20</td>
<td>13.1</td>
<td>56,981</td>
</tr>
<tr>
<td>Wheat</td>
<td>270</td>
<td>3.40</td>
<td>3.08</td>
<td>12.4</td>
<td>55,556</td>
</tr>
<tr>
<td>None</td>
<td>322</td>
<td>3.46</td>
<td>3.06</td>
<td>12.6</td>
<td>57,400</td>
</tr>
</tbody>
</table>

Table 3. Effect of tillage/planting system on black bean yield components averaged across years (2000 and 2002).

<table>
<thead>
<tr>
<th>Tillage/Planting System</th>
<th>Yield Weight</th>
<th>Seed Number</th>
<th>Pod Number</th>
<th>Seed g/100 seeds</th>
<th>Plant plants/a</th>
</tr>
</thead>
<tbody>
<tr>
<td>Conventional</td>
<td>390</td>
<td>4.09</td>
<td>3.29</td>
<td>12.6</td>
<td>56,424</td>
</tr>
<tr>
<td>No-Tillage</td>
<td>380</td>
<td>4.19</td>
<td>3.18</td>
<td>13.1</td>
<td>61,804</td>
</tr>
</tbody>
</table>

Table 4. Effect of weed control on black bean yield components averaged across years (2000 and 2002).

<table>
<thead>
<tr>
<th>Weed Control</th>
<th>Yield Weight</th>
<th>Seed Number</th>
<th>Pod Number</th>
<th>Seed g/100 seeds</th>
<th>Plant plants/a</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weedy Check</td>
<td>288</td>
<td>3.54</td>
<td>2.84</td>
<td>11.3</td>
<td>47,713</td>
</tr>
<tr>
<td>Early Season</td>
<td>426</td>
<td>4.27</td>
<td>3.34</td>
<td>13.7</td>
<td>66,637</td>
</tr>
<tr>
<td>Late Season</td>
<td>318</td>
<td>3.53</td>
<td>3.19</td>
<td>12.6</td>
<td>57,672</td>
</tr>
<tr>
<td>Full Season</td>
<td>509</td>
<td>5.20</td>
<td>3.59</td>
<td>14.4</td>
<td>64,433</td>
</tr>
</tbody>
</table>

Summary

When averaged across years, tillage/planting systems, and weed control levels, the black beans following barley (485 lb/ac), oats (401 lb/a), and rye (448 lb/ac) produced greater yields than either wheat (270 lb/a) or no cover crop (322 lb/a). The reduced black bean seed yields for the winter cover crop treatments of wheat and no
cover crop were the result of a reduction in pods per plant and seeds per pod. Rainfall and the resulting soil moisture during the 2-yr field study significantly affected the response of the black bean yield components to the tillage/planting systems and the different levels of weed control. As a result of the limited soil moisture during 2000, the yield advantage was in favor of soil moisture conservation methods such as the no-tillage planting system and reduced weed competition. The results indicate that early season weed control is nearly as important as full season weed control, and far more beneficial than a crop receiving only late season weed control. Any weed removal (early, late, or full season) was better than no weed control. Although the effect of winter cover crops differed somewhat between years, which may again be related to the differences in available soil moisture, the lack of a winter cover crop consistently produced the lowest black bean yields.

Acknowledgments

The authors appreciate the excellent work of Buddy Faulkenberry on field research, data collection, statistical analysis, and table preparation for this manuscript.
Cover Crop Thickness & Distance for Wind Control

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P.O. Box 128, Lane, Oklahoma 74555

Wind is a major problem for vegetable producers in Oklahoma. Wind can damage leaves, scar fruit, and even break leaves, vines, and entire trunks of various vegetables. Watermelon growers are not immune from having problems with wind. Wind can rearrange and pile all of the foliage to one side of the row, and even twist vines apart.

Wind is particularly detrimental to young plants, just after they emerge from the ground or just after they have been transplanted. These young plants are tender, and contain very little fiber in the stems and vines. It is not unusual to have many plants broken off at the ground within hours or days after planting. Many plants that do not die immediately are wounded and scarred so badly that they die eventually, often from disease organisms that entered the plant at the site of the wind-induced wound.

Wind can be a problem at any time of the year in Oklahoma, but it is most critical in the spring, when watermelons are being planted. Not only is the wind more severe at this time of year, but young plants are more susceptible to the effects of even a mild wind. Also, watermelon plants are usually planted from 3 to 9 feet apart in both directions, and there is no overlap of the vines until they are more than a month old. Until vine overlap and intermingling occurs, the plants are particularly vulnerable to wind damage. Thus, spring and early summer winds can be particularly detrimental to watermelon establishment, growth, and productivity.

Site selection can alleviate some of the effects of wind, but will not prevent damage from occurring. In many parts of the state, site selection is not an option, as all of the available land is relatively flat and treeless. In such areas, the only way to lower the wind velocity is to plant some type of windbreak.

Wheat is a major crop in Oklahoma, and many farmers produce both watermelon and wheat. It is common to have wheat on a field in the winter and spring, and then have watermelons or other vegetables planted in the field after the wheat is harvested. Some growers leave strips of un-harvested wheat in the field as windbreaks. These windbreaks are planted in the fall or winter, and grow during the spring. They remain in place when the watermelons are planted, and may not be removed until the watermelons are harvested.

The width of wheat strips that are left in the field varies, and the distance between these strips also varies. There appears to be no clear consensus about the width or spacing of wheat windbreaks that will effectively reduce wind velocity and resultant wind...
damage. A study was initiated at Lane, Ok in 2003 to determine the ideal thickness of wheat wind strips, and to determine the maximum distance of these strips from watermelons to effectively protect the crop from wind.

In the study, wheat was planted in a field in the fall of 2002. The wheat was allowed to grow during the winter and early spring. In March of 2003, most of the wheat was mowed. Eight rings of wheat were left standing at specific areas of the field. The rings were either 3, 6, 9, or 12 ft in radius, when measured at the inner border of the ring. The thickness of the ring was either 2 or 4 ft. Each border thickness was represented at each size circle.

Wind sensors were mounted at the center of each circle on April 1, 2003, and remained there until July 21, 2003. During that time, wind speed was monitored continuously, and data was downloaded to a datalogger from which it was periodically uploaded to a computer for analysis.

Results indicate that all treatments effectively reduced the wind speed. April was the windiest month recorded, which is the month when watermelon planting is likely to begin. During April, wind speed in the control area which was not protected by windbreaks averaged 3.7 mph, while the wind speed in areas inside the various wheat circles ranged from about 0.1 to 1.0 mph. Maximum wind speed in the non-protected area throughout the April-July period was about 21 mph, while in the protected wheat circles the maximum wind speed ranged from 2 to 12 mph.

The best protection from wind occurred in the 3 ft radius circles that were surrounded by a 4 ft wide strip of wheat. However, all treatments provided substantial reduction of wind speed relative to the control area. Both the 2 ft and 4 ft thickness treatments were beneficial, but the 4 ft thickness reduced wind speed more than did the 2 ft thickness. The data collected from this study indicates that watermelon or other vegetables planted as much as 12 ft from windbreaks would have been protected to some extent. Since the largest size circle used in the study had a 12 ft radius, we can only speculate about the possible advantages of windbreaks placed farther apart. Follow up studies will be conducted in the future to examine larger sized circles.
Evaluating Various Marketing Options for Oklahoma Candy Onions

Bradley L. Wathen, Rodney Holcomb, Merritt Taylor, Jim Shrefler, John R.C. Robinson

The Oklahoma producer traditionally produces forages, small grains, and cattle. The attrition of key federal programs has raised concern about the viability and profitability of certain production practices that occur in Oklahoma. If Oklahoma State University scientists and economists can uncover needed information about alternative markets, Oklahoma producers can better choose what production and marketing practices will return a long run net income that is beneficial for them and their business pursuit.

With proper planning and market analysis, it may be possible for Oklahoma producers to enter vegetable markets such as onion farming. Onion production is one of many opportunities for Oklahoma producers to explore alternative enterprises. This article will address key points of marketing issues so that Oklahoma producers can use the information to make better production decisions should they decide to enter onion production. Market risk analysis can help to educate producers of the risk involved with different variables in onion production. Increasing knowledge of this key issue will help producers more properly position themselves, should they decide to enter the market.

Research conducted by scientists at the Wes Watkins Research Center has provided Oklahoma State University economists with the information to build budgets and risk analysis models for onion production. A budget was built with the data gathered from the Oklahoma farmer. To measure the risk involved with onion production, a risk analysis tool called Simetar was used. This study measures risk involved with yield and output price. Three contract rates and four contract prices were used to represent possible marketing situations. Mean net incomes and risk involved with achieving those net incomes on a year to year basis were discovered through the Simetar analysis.

When performing the mean incomes analysis, it was determined that an owner/operator would be indifferent at the price $10.35 per 50 lbs. Under the cost conditions in the budget, it was determined that a contract price of $10.35 and a 100 percent contract rate allows the owner/operator to avoid 100 percent of risk. Contracting at a price of $10.35 per 50 lb., the owner/operator has decreased price risk and has no chance of making a return less than zero but also no chance of making more than $311 per acre per year. Less risk may be present at a contract price of $10.35, but if contracting cannot be arranged at a price at or above $10.35 the producer will, according to historical data, receive more net income in the open market in the long run. The analysis indicates that a producer could make an average annual return of about $192.00 per acre per year when selling 100 percent on the open market.

Contracting provides an obvious avoidance of risk, but at what level of price and contracting rate provides a harmonious situation for the producer? It may be intuitive that, with this analysis, this question cannot be answered for every producer since every
producer has their own situations, willingness to accept risk, and ways of doing business. A producer has many variables to oversee, but hopefully this article will help him/her make the business decision that is best for the operation. With research into different horticultural markets, this budget and Simetar analyses can continue to help enhance the future for Oklahoma producers.
Summer and Winter Cover Crops for Spring Planted Vegetables

Charles L. Webber III\textsuperscript{1}, Doug Walton\textsuperscript{2}, Vincent M. Russo\textsuperscript{1}, B. Warren Roberts\textsuperscript{3}, Brian A. Kahn\textsuperscript{4}, and Sue Gray\textsuperscript{5}
\textsuperscript{1}USDA, ARS, SCARL, Lane, OK, \textsuperscript{2}Walton’s Family Farm, Muskogee, OK, \textsuperscript{3}Oklahoma State University, WWAREC, Lane, OK, \textsuperscript{4}Oklahoma State University, Stillwater, OK, and \textsuperscript{5}Tulsa County OSU Extension Center, Tulsa, OK

Introduction

World history is replete with demonstrative examples illustrating the beneficial aspects of crop rotations and the dangers of neglecting those lessons. Even on the eve of the birth of our nation, a Virginia farmer was justly called “America’s first scientific farmer” for his experimentation and large-scale use of agricultural practices such as crop rotations and cover crops, crop diversity and improvement, innovative seed treatments and planting equipment, and attempts to enhance the soil environment. Although it’s been over 200 years since George Washington’s work with crop rotations and cover crops, we often face the same challenges and dilemmas in adopting crop rotations and cover crops, but we also have the potential to reap tremendous benefits.

Legume/cereal cover crop combinations have been evaluated for their potential symbiotic relationship and combined benefit to the soil environment. Nitrogen (N) fixation by legumes can increase the N availability for the subsequent vegetable crop by 50 to 200 lb/a. The additional plant material from the cover crop improves the soil environment by increasing the soil’s organic matter. The increase in soil organic matter, especially with ample N, promotes microbial activity and decomposition, and improves soil structure, cation exchange capacity, and soil moisture holding capacity. Improving the soil structure (soil tilth) further increases water infiltration, therefore increasing moisture retention and reducing soil erosion. A cereal crop can also serve as a nurse crop, protecting the soil and the legume until the latter is more fully established, and providing a trellis structure for the legume’s growth. The diverse cover crop community can also attract beneficial insects and reduce weed establishment and growth.

Experiment

Oklahoma State University scientists and extension specialists, and USDA, ARS scientists cooperated with Doug Walton, Walton’s Family Farm (Muskogee, OK), on his three-year (2000-2003) Kerr Center for Sustainable Agricultural grant entitled “Evaluation of Summer and Winter Annual Crops for No-Till, No-Herbicide Vegetable Production Systems”. The research was conducted at Walton’s Family Farm (Muskogee, OK) on a Parsons silt loam soil (fine, mixed, thermic, Mollic Albaqualf), and at the Kerr Center for Sustainable Agriculture (Poteau, OK). The research within each location was divided into cover crops using either summer or winter cereals and legumes. The objective of the research was to evaluate the performance of twenty-four cover crop combinations for potential use prior to spring planted, no-tillage, organic, vegetable production systems.
Each cover crop combination (legume and cereal) was planted on raised beds that were 30 inches wide and about 7 inches high. Plots were 12 ft long and replicated three times. The cereal crops were planted in three equally spaced rows running lengthwise, and the two rows of legumes were planted one each between the cereal rows.

**Summer Cover Crops**

The summer annual cover crops compared two planting dates (late July or mid August) for eight cover crop combinations (4 x 2), four legumes each combined with one of two cereal crops (Table 1).

<table>
<thead>
<tr>
<th>Summer Legumes</th>
<th>Scientific Name</th>
<th>Variety</th>
<th>Seeding Rate (lb/ac)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cowpea</td>
<td><em>Vigna unguiculata</em> L. Walp</td>
<td>Red Ripper</td>
<td>57</td>
</tr>
<tr>
<td>Soybean</td>
<td><em>Glycine max</em> L. Merr.</td>
<td>Quail Haven</td>
<td>64</td>
</tr>
<tr>
<td>Crotolaria/sunnhemp</td>
<td><em>Crotalaria juncea</em></td>
<td>Tropic Sun</td>
<td>57</td>
</tr>
<tr>
<td>Lablab</td>
<td><em>Dolichos lablab</em></td>
<td>Lablab</td>
<td>60</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Summer Cereals</th>
<th>Scientific Name</th>
<th>Variety</th>
<th>Seeding Rate (lb/ac)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Foxtail Millet</td>
<td><em>Setaria italica</em> L. Beauv.</td>
<td>German</td>
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<td><em>Sorghum bicolor</em> L.</td>
<td>Honey Graze IV</td>
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**Winter Cover Crops**

The winter annual cover crops planted in mid September compared sixteen winter cover crop combinations (8 x 2), eight legumes each combined with one of two cereal crops (Table 2).

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<th>Seeding Rate (lb/ac)</th>
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<td><em>Trifolium incarnatum</em> L.</td>
<td>Tibbee</td>
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<td><em>Pisum arvense</em></td>
<td>Austrian Winter</td>
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<td><em>Trifolium alexandrinum</em> L.</td>
<td>Bigbee</td>
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<td>Common Vetch</td>
<td><em>Vicia sativa</em> L.</td>
<td>Cahaba White</td>
<td>57</td>
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<td>Subterranean Clover</td>
<td><em>Trifolium subterraneum</em> L.</td>
<td>Mt. Barker</td>
<td>30</td>
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<tr>
<td>Woolypod Vetch</td>
<td><em>Vicia villosa</em> ssp. dasycarpa</td>
<td>Lana</td>
<td>39</td>
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<tr>
<td>Woolypod Vetch</td>
<td><em>Vicia villosa</em> ssp. dasycarpa</td>
<td>Namoi</td>
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<td><em>Hordeum vulgare</em> L.</td>
<td>Hitchcock</td>
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The selection and plant maturity of the winter cover crop will influence the quantity and the quality of the plant material being added to the cropping environment. Within legumes, plant biomass tends to reach a maximum at or near the peak flowering stage. Furthermore, as the legumes mature and initiate flowering the nitrogen and nutrient
levels within the plant material decreases as the plant starts to transfer metabolites from the leaves and stalks into seed production. As a result, cover crops, especially legumes, are cut as green manure crops or harvested as feed crops prior to complete flowering. Cover crop combinations were cut just above the soil surface when the legume winter cover crop mix reached 50 – 70% flowering. The intent was to maximize both the dry matter quantity and its quality in terms of nitrogen content at harvest.

Observations
A range of summer and winter cover crops were selected to determine the optimum cereal and legume combinations to precede spring planted, no-tillage, organic, vegetable production. Initial observations indicated that low soil moisture levels often adversely affected the summer cover crops during summer. Soil moisture at planting is a critical issue for the establishment and quick growth of summer cover crops prior to a killing frost in November or December. Historically, soil moisture is usually at its lowest during July and August. The lower mid to late summer soil moisture is normally the result of reduced levels of precipitation, increased evaporation, and the growth of a proceeding crop. In general, the earliest summer cover crop planting produced greater growth and dry matter than the late summer cover crop planting. It was also observed that although the cereal portion of the summer cover crop usually remained intact, often resisting lodging, the legume portion was greatly diminished by spring planting. The summer cover crops did provide an advantage compared to winter cover crops by establishing protective crop canopies and root systems sooner. It is not yet clear how this earlier canopy affected over wintering weed populations.

Winter cover crop dry matter production varied across the legume and cereal combinations. In general, the earlier a legume reached 50-70% bloom, and therefore harvest, the lower its respective dry matter production. For example, the woolypod vetches (Lana and Namoi) usually initiated flowering 2-3 weeks prior to the standard winter legume, hairy vetch, but they also tended to produce less dry matter. Therefore, the producer’s selection of winter cover crops, especially the legume portion, may require a compromise between maximizing dry matter production and dry matter quality. Although it may be more ideal to cut hairy vetch at mid to late bloom to maximize dry matter, it may be more advantageous to cut hairy vetch sooner to provide for an earlier, more timely planting date for spring vegetables. The question remains whether harvesting hairy vetch so much earlier would result in hairy vetch regrowth, with hairy vetch becoming a weed in the spring planted vegetable crop.

A legume’s plant architecture may also dictate which winter cover crop may be more suitable. For example, although subterranean clover flowered about the same time as the woolypod vetches and tended to produce less dry matter than hairy vetch, it produced its dry matter content in a much narrower range. Rather than growing in a more upright manner like the vetches, which often used the cereal crops as trellises, subterranean clover produced a very dense rug-like mat on the soil surface. Subterranean clover's dense, tight-knit growth created a very competitive environment for reducing weed establishment and growth. Crimson and berseem clover provided an intermediate plant architecture, producing ample dry matter, but with a lower dry matter
density at the soil surface compared to subterranean clover, and more dry matter in the mid range than the taller and more spindly hairy vetch. Crimson and berseem clover’s intermediate growth also seemed to produce a more balanced cereal and legume mix with either cereal crop (rye and barley) than the other winter legumes.

The experimental data, including dry matter yields and nutrient content of the cover crops, the weed ratings and yields, and soil analysis are in the process of analysis and will continue to be reported at future Horticultural Industries Shows, through the Kerr Center for Sustainable Agricultural, and other appropriate media.
Transplant Type as they Affect Onion Production

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Growth and yield of plants developed from transplants of 2 cultivars produced in seedling production trays with different cell sizes were compared to plants developed from bare-root transplants. The experiment was on a Bernow fine-loamy, siliceous, thermic Glossic Paleudalf soil at Lane, OK. Fertilizer was incorporated during final seedbed preparation to bring soil levels to 90N-100P-190K lb · acre⁻¹ in response to soil test results. Beds were on 36 in.

Eight-week-old transplants of ‘Texas Grano 1015 Y’ and ‘Walla Walla’ onions were produced in a greenhouse in trays with 128 cells with volumes of 1.8 or 3.4 in³. Bare-root transplants of the same cultivars were used. Fresh and dry weights of 10 plants of each cultivar and transplant type were determined (Fig. 1). ‘Texas 1015 Y’ transplants were heavier (fresh weight) than ‘Walla Walla’. Bare-root transplants were heavier than greenhouse grown transplants. Transplants from the larger volume cells were heavier than those from the smaller volume cells. Dry weights of bare-root transplants were heavier than for those produced in the greenhouse which was similar regardless of cell volume.

![Transplant Weights](image)

Fig. 1. Weights of types of transplants for both cultivars. Tx = ‘Texas Grano 1015 Y’; WW = ‘Walla Walla’; Bare = bare-root transplants, and 1.8 and 3.4 refer to cell volumes in transplant trays (in³).
Bulb diameters were measured at the bulb equator for a period of time prior to 50% top breakover. Onion bulb diameter increased 7.7% and 2.0% for ‘Texas Grano1015 Y’ and ‘Walla Walla’, respectively for the 5-12 d prior to harvest (Fig. 2 A,B). There was no increase in class size due to increases in bulb diameter.

Fig. 2. Percentage of top breakover and change in bulb diameter of ‘Texas Grano 1015 Y’ (A) and ‘Walla Walla’ (B) for up to 31 days prior to harvest. Abbreviations in the legend are:

BR-Break = % top breakover for plants developed from bare-root transplants; 1.8-Break = % top breakover for plants developed from transplants grown in cells with a volume of 1.8 in³; 3.4-Break = % top breakover for plants developed from cells with a volume of 3.4 in³; BR-Dia = bulb diameter for plants developed from bare-root transplants; 1.8-Dia
= bulb diameter for plants developed from transplants grown in cells with a volume of 1.8 in³; 3.4-Dia = bulb diameter for plants developed from transplants grown in cells with a volume of 3.4 in³.

Bulbs were classified as medium (2 to ≤ 3 in), large (>3 to ≤ 4 in), and extra large size (> 4 in). Yields from plants produced from bare-root transplants were similar to, or better than, those produced from plants developed from greenhouse grown transplants (Fig. 3). Plants developed from bare-root transplants appeared to have a greater yield of extra large bulbs.

![Graph showing yields and distribution of bulbs in classes for plants developed from different types of transplants for both cultivars.](image)

Fig. 3. Yields and distribution of bulbs in classes for plants developed from different types of transplants for both cultivars. Tx = ‘Texas Grano 1015 Y’; WW = ‘Walla Walla’; Bare = bare-root transplants, and 1.8 and 3.4 refer to cell volumes in transplant trays (in³).

It may be possible to produce plants in transplant trays in a greenhouse that are similar in size to bare-root transplants. However, it may not be feasible to maintain greenhouse grown transplants for that length of time. Under the conditions tested it was determined that the performance of onion transplants produced in cells with volumes of 1.8 and 3.4 in³ was, in general, not consistent enough to recommend that they be used in place of bare-root transplants.

It was found that harvest could be as early as 20% breakover of tops. Between 20 and 50% breakover there was little increase in bulb size and class size was not increased. Producers should consider earlier harvest since bulbs will likely have less exposure to disease organisms that could gain entry through senescing tissues if harvest is put off until the majority of tops break over.
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**Horticulture Industries Show Proceedings**

prepared by Donna Dollins

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