Tennessee Department of Agriculture
Ellington Agricultural Center, Box 40627, Nashville, Tennessee 37204
615-837-5100 / FAX: 615-837-5333

Julius Johnson
Commissioner

Bill Haslam
Governor

Tennessee Department of Agriculture
Debbie Ball-Director of Market Development
Phone: 615-837-5384
Email: Debbie.Ball@tn.gov
Specialty Crop Block Grant Program
Grant # 12-25-B-1095
Final Performance Report
January 14, 2014

Project 1-Organic Strawberry High Tunnel Production for Early Market

Need for a grant:
This project addresses the economic incentives for enhanced strawberry production for early markets in Tennessee. The effect of using production techniques to extend the growing season needs to be demonstrated to farmers and the economics of these techniques needs to be determined. This project was developed to demonstrate Low Tunnel, Row Cover and Conventional techniques using organic production as well as hydroponic techniques for greenhouses. The results of this project can be used by Tennessee fruit and vegetable producers to help them determine the economic usefulness of the season extending technologies demonstrated.

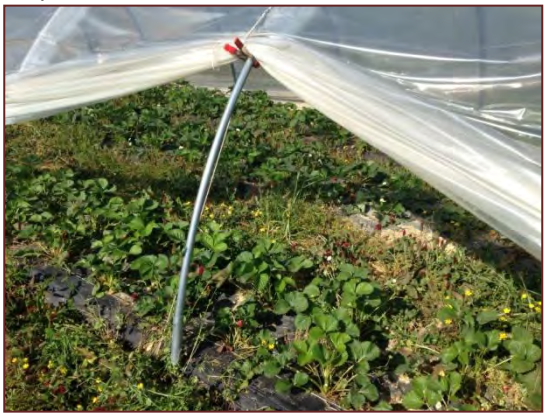
Approach taken for the project:
Research plots were established for growing organic strawberries using Low Tunnels, Row Covers and No Tunnels as well as a demonstration of hydroponic strawberry production with homemade and commercial Styrofoam hydroponic equipment. Our horticultural staff and student workers collected yield and timing data while harvesting the crops from the different organic production systems once the berries began ripening and throughout the harvest season of 2012.

In April of 2012, we held a field day and invited fruit and vegetable growers from middle and east Tennessee to attend. We were able to show the attendees all five of the production techniques and answered any questions about them that they had.

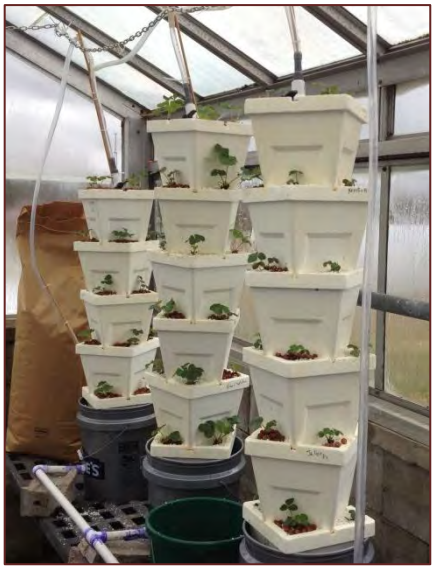
The data has been analyzed from the research plots and a research pamphlet was produced that shows the results of our research and demonstration project. The analysis shows that there is a significant difference between the plants that were covered with either Low Tunnels or Row Covers versus No Tunnel. In addition, the Low Tunnels produced their crops earlier, which is an important factor in determining the overall benefit due to earlier berries being able to be sold for a higher price.

The berries that were harvested from the project were sold through a local network by the university. The money generated from those sales was rolled back into the project budget to help pay for the harvesting of the berries.

The pictures below show the demonstration and research plots during the growing season.



TTU Strawberry
Field Day
9:00 -11:00 am
TODAY!



Achievement of goals:
We were able to plant strawberries and grow them out using five different production methods including two hydroponic systems. Of the two hydroponic systems, one was built from materials that can be purchased at a hardware store, while the other was a commercial Styrofoam system. The three outdoor plantings were grown using organic methods. They used both a Low Tunnel that was six feet tall in the center, and a Row Cover "cloche" to produce early season berries. We were able to gather data from the production of strawberries using the organic production methods for use in an analysis of costs and production for a research pamphlet that we distributed to the 65 strawberry producers listed by the TDA for the state of Tennessee.

We have analyzed the data from the research plots and produced a research pamphlet that shows the results of our research and demonstration project. The analysis showed that there is a significant difference between the plants that were covered with either Low Tunnels or Row Covers versus No Tunnel. However, the high tunnels produced their crops earlier, which is an important factor in determining the overall benefit due to earlier berries being able to be sold for a higher price. In addition an economic analysis was performed that involved costs and returns to determine the cost effectiveness of the two season extension methods compared to the conventional organic production method. The

results showed that due to the additional cost of the production techniques, there is no economic benefit to using those techniques even when accounting for a higher price that earlier berries normally receive.

We also held a field day to demonstrate all five techniques and to answer any questions about them. We invited fruit and vegetable growers from middle and east Tennessee to attend and the field day occurred on Wednesday April 25th from 9-11. We had nine people attend for the first session at 9:00 and three people attend for the second hour at 10:00. The attendees came from three counties. It wasn't the turnout we had hoped for, but we think weather played a role. It was the first dry sunny day in weeks that farmers could actually work in the fields.

Beneficiaries:
The intended beneficiaries were the farmers who would be interested in producing and selling early market strawberries, either organically or conventionally. The results were disseminated by way of a field day at the Tech Farms (Where TTU's organic plots are located) and by way of a research pamphlet that was distributed by way of email. There were a total of 77 farmers who had an opportunity to benefit from this project.

Lessons Learned:
Results of the program
The results showed that even though the techniques for producing berries were effective at increasing both yields and earliness, they were not economically beneficial. These results were only based on one year's worth of data, but they also showed that there are significant differences in the results based on the variety of the berry chosen. This means that a producer interested in these techniques should look at growing multiple varieties to test the techniques on their own farm. Although the results show that there is not an economic incentive to use the techniques, there is not a significant cost to using them either (because of the increased returns) and that experimentation on farm could prove to be beneficial. Other varieties may be able to provide a significant economic benefit when using these techniques.

Progress made to achieve the long term outcome of the program
Both the research and the demonstration field day provided Tennessee fruit and vegetable producers with information that will help them make decisions on how to produce strawberries for early market on their farms. It was very interesting that the Row Covers, which are a low cost technique for season extension, generated around the same additional revenue as what it costs to use the technique. The Low Tunnels are a more expensive technique, and again they generated enough additional revenue to almost cover their costs. At the current time these techniques may best be viewed as break even. But as the "buy local" movement continues to grow, so will the demand for local fruits and vegetables, which should lead to economic benefits from extending the local growing season.

Additional information:
See attached research results pamphlet

Contact information for the sub-recipient:
Michael J. Best, Professor
Tennessee Technological University
School of Agriculture
931-372-3154
mbest@tntech.edu

Strawberry Production Methods for Early Market Production in Tennessee

Michael J. Best, Professor of Agricultural Economics, Tennessee Tech University
G. Kim Stearman, Professor of Agriculture, Tennessee Tech University
Randy Dodson, Farm Manager, Tennessee Tech University
October 31, 2013

Current Strawberry Crop Situation:

Growers in Tennessee have the ability to grow strawberries using a fall planting – spring harvest sequence. Normal strawberry production in the state does not utilize season extending technologies like high tunnels or cloches. Strawberries normally produce during May and early June in the state. Some producers in Tennessee are using organic techniques, but most use conventional methods with plastic mulches and drip irrigation and chemical fertilizers and insect control.

According to the 2007 Agricultural Census for Tennessee, there were 219 strawberry farms in the state. That same year there were 301 acres of strawberries grown total. In 2008 there were six operations in the state producing three acres of certified organic fruit. They produced a total of 8,600 pounds of fruit. Sales totaled $20,158 for these three acres of fruit. This equates to approximately $2.34 per pound of strawberries or $6,719 per acre (NASS, 2013)

Methods of Strawberry Production for Early Harvest:

For producers that sell their crops locally, early crop production generally results in higher prices. When a producer combines row covers and low tunnels with black plastic crops can mature one to three weeks earlier than under normal cropping practices. However, increased costs, generally limit use to the high-value horticultural crops like strawberries, tomatoes and similar valued crops.

Row covers and low tunnels not only provide frost protection for strawberries, but the greenhouse effect of most row covers will not only warm air surrounding the plant but will also result in warmer soil temperatures, root growth, shoot growth and maturity. Depending on the material, the frost protection factor associated with a row cover can vary from 2° to 7° F.

Row covers and Low Tunnels also increased yields. Many cucurbits (squash, cucumbers, melons) respond well under row covers with increased yields of as much as 25 percent (Helbacka, 2002). Crop that have responded well to row covers include tomatoes, peppers, eggplant, cauliflower, strawberries, sweet corn, cole crops and peas.

Row covers that are supported with wire hoops and low tunnels will also provide protection from wind and blowing soil particles. This will result in less plant stress and reduces desiccation of delicate early season growth. Row covers and low tunnels will also protect crops from hail and heaving rainfall.

There are some disadvantages to using both low tunnels and row covers on crops. First there is the added cost associated with growing these crops under covers and high tunnels. Crops like fall planted

strawberries which normally require a wire support will incur greater costs associated with wire hoops required for support. If a producer needs additional temperature protection, the heavier materials used tend to be more expensive. Additional labor costs can also be quite significant. Costs can be reduced when using reusable material, assuming they are stored properly when not in use.

Another disadvantage is that row covers and low tunnels provide a favorable environment for insects to multiply very quickly. Weeds, like the strawberries tend to flourish, especially with organic production when the area cannot be treated with an herbicide. A row cover may have to be removed from time to time to allow for weeding. In addition it is necessary to open the tunnels and covers during flowering in order to allow bees to pollinate the plants.

Lastly the use of row covers and low tunnels requires considerably more labor input earlier in the season than traditional production techniques. The labor will obviously increases if the row cover has to be removed occasionally to weed and allow for pollination.

Objective:
To determine the impact on yield from utilizing season extension techniques for spring harvest strawberries so a value can be place on these techniques for Tennessee farmers.

Procedure:
This study analyzes three different methods of producing strawberries, two of which involve season extension techniques and the other a conventional method. Both low tunnel berries and row cover berries were planted with conventional varieties for the study. Six blocks of strawberries were produced, each with 402 plants in them for a total of 2,412. There were two blocks grown for each method. There were two blocks grown for each method that measured 16 feet by 100 feet. All plots had black plastic mulch and a trickle tube irrigation system.

For the row-covers the hoop supports were made from 9-gauge galvanized wire 60 inches long and spaced every three feet in the row. The wires were allowed to have their natural curved shape and each end was pushed into the ground about nine inches. The wires were covered with a floating row cover material.

The low tunnels were made with 1-3/8 inch greenhouse purlin pipe that was manually bent to create the hoops. These hoops were anchored into the ground be two foot long anchor pipes. Once the hoops were in place, they were covered with greenhouse plastic that should last four years. Ropes and a wiggle wire locking system were used to secure the plastic to the tunnel structure.

Within the blocks the strawberry plots consisted of three rows, middle rows were Sweet Charlie and the two outside rows were Chandlers. Plots were 40 feet in length with Strawberries planted in two rows per bed 18 inches apart. Plots were treated with compost at 20 tons per acre and bedded with black plastic mulch in August 2011. Strawberries were planted the week of Sept 1st 2011, Tunnels and row

covers were placed over hoops and wires the week of December 1st 2011 and remained over plants during the freeze period through April 2012.

Covers were removed from wire hoops on warm days and returned during cold weather throughout the growing season. Tunnels were vented daily during the growing season to control heat and provide wind and insect pollination.

All row middles were seeded with Crimson Clover cover crops in the fall and allowed to flower naturally to help attract pollinators and provide weed suppression during the growing season, at harvest time the clover was manually crimped to kill and leave as mulch in the row middles.

Production Expenses:

Table 1 shows the additional expenses that were associated with the low tunnel. Some of the materials are expected to last longer than a year so the expense was prorated over that period of time. The total on the last line of the budget represents the cost of the technique on a per plant basis. Thus a producer needs to be able to generate an additional $0.57 per plant from using a low tunnel in order to cover all of their costs associated with the technique. If a producer can't generate that, then the technique is not deemed profitable.

Table 1. Low Tunnel Budget

Low Tunnel Cost	Number	Units	Cost Per Unit	Total Cost	Initial Cost Per Plant	Expected Life	Cost Per Season Per Plant
Plastic	2	100' Rolls	$ 135.00	$ 270.00	$ 0.34	4	$ 0.08
Cross Connectors	44	Pieces	$ 2.75	$ 121.00	$ 0.15	10	$ 0.02
Pipe	54	Pieces	$ 21.50	$1,161.00	$ 1.44	10	$ 0.14
Anchors	88	Pieces	$ 1.75	$ 154.00	$ 0.19	10	$ 0.02
Wiggle Wire & Base	14	6' Pieces	$ 8.40	$ 117.60	$ 0.15	10	$ 0.01
Rope	2	150' Length	$ 17.95	$ 35.90	$ 0.04	3	$ 0.01
Setup Labor	28	Hours	$ 8.00	$ 224.00	$ 0.28	1	$ 0.28
						Total	**$ 0.57**

Table 2 shows additional expenses that are associated with the row covers. Row covers are expected to last two seasons and the wires 10 seasons. The labor associated with the setup also includes labor associated with opening the tunnels on warm days and for weeding. The total on the last line of the budget represents the cost of the technique on a per plant basis. Thus a producer needs to be able to generate an additional $0.28 per plant from using a row cover in order to cover all of their costs associated with the technique. If a producer can't generate that, then the technique is not deemed profitable.

Table 2. Row Cover Budget

Row Cover Cost	Number	Units	Cost Per Unit	Total Cost	Initial Cost Per Plant	Expected Life	Cost Per Season Per Plant
Floating Row Cover	3	250' Rolls	$ 59.50	$ 178.50	$ 0.22	2	$ 0.11
No. 9 Wire	200	Feet	$ 2.63	$ 526.00	$ 0.65	10	$ 0.07
Setup Labor	10	Hours	$ 8.00	$ 80.00	$ 0.10	1	$ 0.10
						Total	**$ 0.28**

The following five figures show what the study looked like in the field. Figure 1 shows the row cover hoops in the foreground and the low tunnel plot towards the back of the photo. Figure 2 shows another plot that has both the low tunnel and row covers in it. Figure 3 shows the strawberries that weren't covered. Figure 4 shows what the inside of the low tunnel looks like in the winter time. Figure 5 shows the inside of the low tunnel in March and how the tunnels are ventilated as it warms up in the spring.

Figure 1. Row Cover (foreground) and Low Tunnel Strawberries (back ground)

Figure 2. Row Cover Strawberries

Figure 3. No Cover Strawberries

Figure 4. Low Tunnel Strawberries From Inside Tunnel

Figure 5. Low Tunnel Strawberries in March

Comparison of Yields and Implications for Covering the Cost of Techniques:

Table 3 shows the average yields per plant that were obtained during the study. The table also shows a breakdown of yields by variety, Chandler and Sweet Charlie. Chandler had higher yields for each technique and the low tunnel was the method with the highest yield at 0.369 pounds per plant for the season. The average yield for the Low Tunnel was 0.333 pounds per plant. A t-test was performed on the data from the trial and there was a significant difference between both the Low Tunnel method and no cover and the Row Cover method and No Cover. This means that the difference shown was not due to chance alone.

Table 3. Pounds Per Plant

	Low Tunnel	Row Cover	No Cover
Both Varieties	0.333	0.269	0.173
Chandler	0.369	0.313	0.212
Sweet Charlie	0.297	0.225	0.135

Table 4 shows how these yields convert into income on a per plant basis. The price of organic strawberries was set at $2.50 a pound. This price was set slightly higher than the price of Tennessee strawberries that was reported in the last Agricultural Census for Tennessee. The Chandler variety generated $0.92 per plant for the Low Tunnel technique and the average of both varieties for the same technique was $0.83 per plant. If one compares the additional revenue generated over the No Cover option, the profitability on a per plant basis can be determined for both the Low Tunnel and Row Cover techniques. For both varieties the Low Tunnel generated $0.40 of additional income on a per plant basis, but as can be seen from the Low Tunnel Budget in Table 1, the cost per plant is $0.57. Thus when looking at both varieties combined the Low Tunnel technique is not cost effective.

The Row Cover Technique generates an additional $0.25 per plant when looking at the combination of the two varieties and according to the budget for Row Covers in Table 2, costs $0.28 per plant. Thus based on yields differences alone, neither technique will be cost effective based on the data obtained in this study. However, yields are not the only critical factor that needs to be analyzed when trying to determine the benefits of using season extending techniques. Normally in local markets early crops will command a premium price. This impact is analyzed in the next section.

Table 4. Dollars Per Plant

	Low Tunnel	Row Cover	No Cover
Both Varieties	$ 0.83	$ 0.67	$ 0.43
Chandler	$ 0.92	$ 0.78	$ 0.53
Sweet Charlie	$ 0.74	$ 0.56	$ 0.34

Results from Assumed Premium for Early Berries:

For the last part of the study, earliness was also factored into the revenue side since earlier production normally means higher prices. There were an average of six harvests that occurred for the Low Tunnel technique before the No Cover berries started to mature and two harvests for the Row Cover technique. Table 5, below shows the revenue per plant based on a premium of 50 percent for the berries that were harvested during the first six harvest dates. These occur before the first No Cover berries start to ripen. The results show that the difference between the Low Tunnel and the No Cover berries (LT-NC) is at the highest $0.56 for the Sweet Charlie. With the cost of the Low Tunnel technique being $0.57 per plant, it is not profitable to use this technique. In comparing the Row Cover to No Cover berries (RC-NC), again the additional cost of the row cover is slightly higher than the additional revenue one would receive from utilizing the technique.

Table 5. Premium Dollars Per Plant (After First Week of April Price Drops)

	Low Tunnel	Row Cover	No Cover	LT -NC	RC-NC
Both Varieties	$ 0.92	$ 0.69	$ 0.43	$ 0.49	$ 0.25
Chandler	$ 0.95	$ 0.78	$ 0.53	$ 0.42	$ 0.25
Sweet Charlie	$ 0.89	$ 0.59	$ 0.34	$ 0.56	$ 0.26

Conclusions and Implications for Further Research:

The results of this research show that the Low Tunnel and Row Cover techniques do provide both a production and earliness benefit. However, since the cost of using the techniques was so close to the additional value they generated in this study, more work should be performed on other varieties as well, to see which combination of variety and technique could potentially provide the best benefit to the producer. There was also found to be a significant difference between the varieties in all of the methods of production. The fact that both techniques almost returned enough money to cover their costs allows the producer some ability test different varieties with these two methods to see how they might work for them.

References Cited

Dickerson, George W., 2004 (October), *Row Cover Vegetable Production Techniques*, New Mexico State University, Guide H-251.

Helbacka, Joan, 2002 (March), *Row Covers for Vegetable Gardens*, Washington State University, King County Cooperative Extension Service, Fact Sheet No. 19.

Contact information for the sub-recipient:

Michael J. Best, Professor
Tennessee Technological University
School of Agriculture
931-372-3154
mbest@tntech.edu

Project 2-The Tennessee Fruit and Vegetable Association

Project Title: Regional Food Safety Coordinators

Project Summary:

Building upon the Good Agricultural Practices (GAPs) and Good Handling Practices (GHPs) training seminars conducted by the University of Tennessee, the Tennessee Fruit and Vegetable Association (TFVA) planned to implement regional statewide GAP workshops and appoint part-time regional food safety coordinators. A coordinator would be appointed for each of the three regions of Tennessee – East, Middle, and West.

Project Approach:

Each coordinator was to offer two food safety training courses focusing on specific elements of GAPs and GHPs, including: development of Standard Operating Procedures (SOPs), proper equipment and material usage for food safety, water quality, traceback, and general food safety updates. In addition, a portion of the annual TFVA conference would be focused on similar topics.

Goals and Outcomes Achieved:

The TFVA offered sessions at the 2012 Tennessee Horticultural Expo focusing on food safety; however, several issues arose when implementing the initial project. TFVA intended to assist 100 growers in food safety compliance; however, many of the larger growers had passed their GAP audit and the practices have been incorporated into their daily routine and many smaller growers are not at the revenue level which requires them to participate in a GAP audit. Following a mid-year meeting and review by the TFVA and the TDA, the scope of the grant was amended and approved to focus on building an infrastructure to communicate with the members and educate potential members on the role of the TFVA.

Beneficiaries:

Over 50 growers were provided updates and sessions on food safety at the annual conference.

Lessons Learned:

Increased communication and a survey of growers' needs and objectives earlier in the process would have made this project more successful.

Contact Information:

James Beale, President – TFVA
615-390-2787
sunfreshfarms@msn.com

Additional Information: N/A

SCBG# 12-25-B-1095 (*amended*)

Project Title: Rebranding the Tennessee Fruit and Vegetable Association Through Technological Upgrades and Providing Outreach in the Areas of Safety and Marketing

Project Summary:

The Tennessee Fruit and Vegetable Association (TFVA) exists to educate growers to produce what they sell and sell what they produce. However, in recent years the organization has declined in relevance for specialty crop growers due to a lack of central coordination and meaningful benefits. Increasingly, membership organizations educate and communicate through websites and social media and the TFVA had not kept up with new communication tools, reflected in declining membership and lack of a unified vision for the organization.

Project Approach:

The purpose of the revised project was to 1. Hire a coordinator to perform outreach to centralize concerns of members and develop value for membership; 2. Create signage for growers that have completed and passed a food safety audit; and, 3. Gather scientific data on irrigation water quality to assist growers.

The role outlined for the coordinator was to work with designers to develop a TFVA website to feature articles on specialty crop production, legislation that affects specialty crop production, and other timely information that specialty crop growers need; and, create marketing materials. In addition, the project was to create signage for growers that have completed and passed a food safety audit, demonstrating knowledge and implementation of Good Agricultural Practices (GAP), and to brand the certification to the public and other growers. Finally, the project was to gather scientific data on irrigation water quality in Middle Tennessee, contribute to the nationwide Irrigation Water Quality Database for fresh fruit and vegetable production through the National GAPs Program, which will help shape future irrigation water standards.

This project drew on the resources and worked cooperatively with the Departments of Plant Sciences and Food Science and Technology at the University of Tennessee through the state extension specialists in vegetables, fruit, and food safety as well as the Tennessee Department of Agriculture's marketing specialist in fruit and vegetables.

Goals and Outcomes Achieved:

This project directly impacted our fruit and vegetable industry by providing a branded sign for growers that have passed a food safety audit. These signs can be displayed at on farm enterprises or at off site events such as farmers markets. In addition, the signs provide a positive reinforcement of Good Agricultural Practices (GAP) training and reinforce the new regulations that are pending as a result of the Food Safety Modernization Act of 2010. Thirty (30) signs (32" x 40") were created for growers across the state to help promote GAP audit completion to the public and other growers.

A coordinator was engaged in April 2013 to provide a contact point for the board and growers and spearhead website development, marketing materials, and outreach to Tennessee's fruit and vegetable growers. The coordinator worked with a graphic designer/illustrator, website designer, and others to create marketing collateral to brand the Tennessee Fruit and Vegetable Association. The website (www.tfva.org) was redesigned using original branding and photography from Tennessee farms and growers; a Facebook page created (https://www.facebook.com/TNFVA); and, marketing materials created to develop a cohesive industry organization across the state. Examples of materials are provided below.

While the projects received positive feedback in informal communication with members of the TFVA the surveys that were sent out to help measure the projects effectiveness were only returned by two growers. At the 2014 Tennessee Horticulture Expo, growers will be giving a survey to determine the effectiveness of the activities from the SCBG. While this information will not be in this report, the board of the TFVA considers it essential in determining a path for future activities.

Water samples were taken from 4 farms in Middle Tennessee. Most farms had multiple irrigation sources to sample (# of sources ranged from 2-5/farm). Of the fifteen sources sampled, twelve were

surface water sources, one was municipal water, and two were wells. Water was sampled three times throughout the growing season. Nine surface water samples were above the acceptable limit for generic *E. coli* for irrigation water quality. Mitigation strategies for these samples were discussed with the growers. All four growers are currently working toward GAP certification.

The grant has laid the groundwork for an effective membership organization by branding and establishing strategies with Tennessee's fruit and vegetable growers. This project increases growers' access to information and capacity to make key strategic decisions for planning and, thereby open up new and increased opportunities.

Beneficiaries:

Providing a central point of communication for Tennessee's fruit and vegetable growers will increase their access to information and capacity to make key strategic decisions for planning and, thereby open up new and increased opportunities for growers. This project has the potential to impact all fruit and vegetable growers (approximately 2,500 growers) in Tennessee and have a positive economic impact by saving time and resources for growers as well as providing key information to direct business planning.

In addition, this project impacted our fruit and vegetable industry by providing an objective assessment of the quality of water currently used for irrigation and evaluating the ability of currently-used criteria to discern contamination by key pathogens. Furthermore, the four participating producers received a considerable savings through this grant paying for their water testing costs instead of having to pay these costs themselves. Lastly, maintaining buyer and consumer confidence in and demand for fruit and vegetable production in Tennessee will potentially enhance farm viability and profits.

This project helped to fill the nationwide irrigation water quality knowledge gap by compiling and analyzing water samples for generic *Escherichia coli* (*E. coli*) densities, pH, conductivity and turbidity that were incorporated into the Irrigation Water Quality Database created by Betsy Bihn of the National GAPs Program at Cornell University.

Lessons Learned:

The importance of a paid position, rather than relying solely on volunteer efforts, was established during this year. While volunteers, board members, university partners, and state efforts are critical to the TFVA, it has shown to be helpful to have a paid employee – at least part time – to provide the administrative and communication support for the organization.

Contact information:

James Beale, President – TFVA
615-390-2787
sunfreshfarms@msn.com

Fiona McAnally, Coordinator -TFVA
865-806-1557
fmcanally@gmail.com

Tammy Algood

Marketing Development Division
Tennessee Department of Agriculture
625-837-5347
tammy.algood@tn.gov

Dr. Annette Wszelaki
University of Tennessee
UT Extension Vegetable Specialist
865-974-7324
annettew@utk.edu

Additional Information:

Logo:

Project 3-Marketing TN Grown Nursery Plants and Industry Education

Need for a grant:

The nursery industry in Tennessee has suffered many setbacks over the past few years. Late freezes, long periods of drought, and flooding have hit the industry recently. In addition to the hits nature has dealt with the nursery industry the recession and slow recovery have hit the growers pretty hard as well. Many growers have left the industry in the past few years. The past few years have seen innovations in technology and marketing that have assisted the growers in stabilizing their business. Tennessee Nursery and Landscape Association (TNLA) secured funding to prepare and print their buyers' guide, assist with their Winter Education program, promote a show that was held in partnership with the Kentucky Nursery and Landscape Association, and attend 2 trade shows to promote Tennessee specialty crops.

Approach Taken for the Project:

One of the ways that TNLA could benefit its members directly is through its Winter Education program. By getting speakers that could assist growers in both the technical/growing side of specialty crops along with speakers who could assist the grower with marketing their nursery crops we felt that there would be something for all growers at our education sessions.

The TNLA Winter Education program attendees were mostly owners and managers of garden centers, landscape companies and growers who needed pesticide points. They attended the seminars that offered pesticide points. TNLA did not mail them a questionnaire to complete since the attendees were mostly needing pesticide credits and would not reflect on the entire industry.

Another way that TNLA would be able to use funding from the SCBGP would be in updating their buyers' guide. The last update was done in 2007 for distribution in 2008, TNLA utilized the funding to update their buyers' guide in 2010 and had 3000 copies printed in 2011. By the time of this report over 2000 copies of the buyers' guide have been distributed.

To complete the object, TNLA needed to attend a couple of trade shows in 2012 to promote Tennessee specialty crops and market the buyers' guide. The Ohio Floral Association Show (OFA) and the Penn Atlantic Nursery Tradeshow (PANTS) were chosen because of their high attendance and opportunity to gain new customers. TNLA used this opportunity to distribute the buyers' guide and promote the TNLA's upcoming show in Nashville.

Achievement of Goals:

As stated earlier, TNLA distributed over 2000 of the buyers' guides. The main success of the buyers' guide is not through its physical distribution but its ability to drive users to the website. Because of the improvement of technology, TNLA is now able to constantly update its website. TN nursery association members grow over 1400 types of specialty crops and they are constantly changing their products. Technology now allows us to keep our members' specialty crops updated. All changes can be done within an hour. Also if new specialty crop growers join the association their specialty crops can be added to the buyers' guide.

One of the advantages of the buyers' guide being online is that all of the producers' information is online. Each plant listing in the online directory gives the growers information along with a link to their email address and website. TNLA utilized funding from the previous year's SCBG to offer growers ½ of their plant listing fee in the buyers' guide. Forty-nine producers utilized this and the promotion of their product online along with the cost share reimbursement really gave the grower an opportunity to promote their specialty crops for a low price. In the time period after the 2012 trade shows were attended traffic to the web site increased over 10% from the time period in the previous year.

Attendance at the trade shows also helped TN specialty crop growers by keeping their specialty crops displayed to many buyers in a down economy. For small producers who usually allocate for little of their operating expenses towards marketing, TNLA is able to reach many buyers of specialty crops this way.

Results of the program:

Growers who took advantage of the services that TNLA offered with funding from the SCBG program were rewarded with an average increase of 10% in sales. One grower who was surveyed reported an increase of 20% in sales. This was reported in the last annual report on the SCBG. In follow-up correspondence the Executive Director of TNLA had with members who turned in the survey, members reported that the increased sales were holding steady.

TNLA was able to increase attendance in its Winter Education by over 10%. In 2011, 130 attendees were at the meeting and that figure increased to 145 in 2012. The growers that attended were able to get CEU's for pesticide recertification.

TNLA also had a 9% increase in traffic to its website following its promotion of the buyers' guide. By speaking to buyers of specialty crops and giving them a physical copy of the guide, TNLA was able to stress to the buyer that the web version of the buyers' guide is constantly updated and that just because a product is not in the physical copy, that it does not mean that it is not available.

Progress made to achieve the long-term outcome of the project:

TNLA is working hard to get our growers to embrace technology in marketing their specialty crops. The average age of agricultural producers (all producers not just specialty crops) is 55 years of age. This demographic is still skeptical of technology and many do not see how the internet can work for them. By showing growers the value of advertising in the buyers' guide and how it can be constantly updated and used to work for the producer, we are teaching our growers to market their products cheaply and efficiently.

TNLA is also assisting their growers in additional internet marketing. Our marketing sessions during our Winter Education are becoming pretty popular and many of our growers are learning to use Twitter and Facebook to reach buyers quickly and efficiently. This is an industry that normally does not participate in outreach with the exception of trade publications and trade shows that are now showing their products to many different groups at once. By also showing what products Tennessee nurseries have to offer to retail buyers of specialty crops, they are able to communicate with their retail outlet about what products they would like to use either in their home, business, or environmental project.

TNLA also was able to market Tennessee specialty crop growers and themselves as an entity that was responsive to market conditions by updating their buyers' guide and being able to update the guide instantaneously. Nurseries are learning that they have to be like other agricultural entities in that

market conditions can change instantly and they have to be able to fulfill demand in an ever-changing market. By constantly keeping our guide updated TNLA is working with the producers to give them the opportunity to earn customers and form long lasting business relationships.

Additional Information:

TNLA - Buyer's Guide
TNLA - Home Page

Contact information of the sub-recipient:

Tennessee Nursery and Landscape Association
Louree Walker
PO Box 57
McMinnville, TN 37111
(931) 473-3951

Project 4-Bioactive Wood Mulches

Project Summary:

This project paired applied research with educational Extension outreach in order to assess the potential for bioactive wood species to perform as superior, weed-controlling mulches for inclusion within agricultural systems. In turn, effective bioactive wood mulches would provide innovative ornamental plant producers with a renewable resource that could limit both herbicide and labor inputs, thus leading to greater sustainability of managed ornamental crops and landscapes. Whole plant and timber industry by-product inputs that would be needed to fulfill demand for a bioactive wood product market are already available in TN. "Green Solutions" like the one proposed are also currently in demand by ornamental plant consumers and landscape clients. If effective, this approach would be easily adapted into proactive marketing messages by ornamental and vegetable crop producers.

The broad objectives were to determine whether the bioactive wood species chosen are capable of:

1. providing enhanced mulch performance (e.g., via suppression of weed seed germination and extended durability), and
2. yielding water-soluble compounds that may inhibit crop growth or cause ornamental crop plant injury when applied as mulches

Project approaches taken to achieve objectives:

We obtained eastern red cedar, black walnut, and white oak waste wood chips from regional commercial millworks. Pine bark nuggets were purchased at a local garden center, commercial pine bark substrate was purchased from a regional distributor and commercial landscape hardwood mulch was obtained at a local firm. To assess water soluble constituents in wood mulches, we collected fractions across 3 temperatures (25, 35 & 45C) and exposure durations (2, 24 and 72 hr) from cedar,

oak, and walnut wood chips. These samples were compared to samples from commercial pine bark nursery substrate and pine bark nuggets. Fractions were examined chemically and also used to assess redroot pigweed and 'Green Ice' lettuce seed germination, and consequent seedling root and shoot growth.

We screened mulch-induced crop sensitivity 'Noble Upright' holly, 'Red Heart' Hibiscus and 'Red Trailing Queen' Coleus using plants grown for 8 wk in trade 3-gallon nursery containers. Crops were planted into an aged pine bark substrate, over-seeded with about 100 each of redroot pigweed and common purslane seeds, then pots were given a 3 inch top-dressing of either eastern red cedar, white oak, black walnut wood chips, large pine nuggets, commercial pine bark substrate or quartered, black plastic, pond filter units. Data included weed counts, weed biomass, ornamental plant growth indices, leaf areas, and stem dry mass measures.

We also established field demonstration plots, including into which 3-gal 'Little Lime' hydrangea were planted. Plots were over seeded with 0.25g each of purslane and redroot pigweed seed (about 657and 551 seeds, respectively), 0.75g of (~1035) lambsquarters seeds and 2.0g (~835) teaweed seeds, then mulched 2 inches deep with either eastern red cedar, white oak, black walnut wood chips, large (>1 inch [2.5 cm]) pine nuggets, commercial hardwood mulch or commercial hardwood mulch over three layered sheets of newspaper. We assessed pigweed and teaweed percent cover across time. Performance, subsidence and decomposition of these wood mulch products are also currently being assessed in additional field demonstration plots.

Results and measured outcomes of the project:

When exposed to water (e.g., by irrigation or rainfall), both hardwood tree species readily and rapidly released phenolic compounds contained within their woody tissues. Release rates increased as temperatures were raised. In sum, high temperatures that are commonly recorded at ground level and in nursery containers (often exceeding 45°C) during summer would be likely to trigger quick release these substances from wood substrates. As expected, pine bark and pine bark nuggets contained less total phenolic compounds with low levels released following exposure to water. For all tested mulch types, lower temperature exposures slowed release rates of water-soluble compounds, thus these mulches may offer a limited extension of benefits if used in early spring.

More lettuce and redroot pigweed seeds germinated by 5 DAT after exposure to 45F extracts and only pigweed germination were reduced across all treatments compared to distilled water alone. Regardless, pigweed seed germination was not reduced when seeds were exposed to total phenolic compounds made soluble in extractions at 35F. Germination of chemically-sensitive lettuce seeds was reduced by exposure to oak and commercial pine bark extracts versus exposure to distilled water-only, red cedar, or walnut extracts. Although lettuce root growth was reduced by exposure to 35F white oak and walnut extract samples, we saw no reduction in lettuce root growth after exposure to 45F mulch extracts, nor in pigweed root or shoot growth for either temperature. These results, which are not explained by levels of total phenolic compounds recovered from woods, will be re-examined in a repeated trial this winter.

More common purslane and redroot pigweed weeds were recovered from containers having only commercial pine bark when compared with shadehouse containers top-dressed with wood substrates or bioball filters. The fewest redroot pigweed and common purslane plants were recovered after 33 days of growing in pine bark nugget and eastern red cedar top-dressing. However, these redroot pigweed and common purslane plants yielded the most weed growth observed among mulch treatments. This result suggests that regardless of biomulch treatment, once weeds successfully germinate, they can

grow aggressively and become established. Taken together with seed germination demonstrations, reduced weed growth observed in containers top-dressed with inert, black, plastic bioball filter pieces (during shadehouse demonstrations), suggests that either reduction in light exposure to seeds or alteration of the container environment may be more relevant to seed germination than exposure to phenolic compounds that are released from tree substrates.

Indeed, phenolic or other compounds released from mulch top-dressings did not yield injury or growth reductions in 'Red Heart' hibiscus or 'Red Trailing Queen' coleus plants. 'Noble Upright' holly exposed to Eastern red cedar, white oak and pine bark nugget treatments did have less shoot growth and plant weights less than hollies in other treatments, yet plants exposed to all mulch types had similar average leaf areas. Shoot growth and plant weigh reduction in holly is most likely explained by greater crop competition with redroot pigweed and common purslane plants that were growing in these treatments, rather than exposure to phenolic compounds.

In replicated demonstration landscape beds, teaweed and redroot pigweed were the only seeds that germinated and persisted during the trial. Overall, all wood substrates also out-performed the commercial hardwood mulch alone that was applied 2-inches deep on bare soil. Yet plots having three sheets of newspaper overlapped beneath commercial hardwood mulch had the least weed growth, compared with plots containing other wood mulches. Although eastern red cedar extracts did not yield lasting inhibition of weed seed germination, cedar wood chip mulch did provide a thorough and stable plot covering, which would limit light transmission to seeds. Cedar mulch produced an aesthetically pleasing aroma that lasted about 56 DAT.

Beneficiaries and Impact:

In 2007, statistics on ornamental plant producers in Tennessee (alone) listed 75 operations growing cutting, seedling, liner, and plug crops valued at $3.5 million; 481 growers producing almost $56 million in bedding and garden plants and 790 growers producing almost $177 million in nursery stock. If 85 percent of farm gate sales are attributed to production cost, and bioactive wood mulches cut costs by just 1%, this proposal could help growers realize $201,025 in annual savings. Individual TN landowners, municipal, urban and private foresters, and sawmill operators would also benefit from added value by bioactive wood mulches. A value-added commodity could next be developed from yard wastes, "waste" tree species, and by-products from sawmill operation.

Bioactive phenolic compounds in woods that are soluble in water can become active in the weed seedling root zone. However, applying excessive irrigation to nursery containers, particularly later in the growing season, would be expected to wash bioactive compounds out of the container substrate thus limiting the duration of their effectiveness. This conclusion is supported by lab and field-based demonstrations using solution extracts and mulch top-dressing from eastern red cedar, black walnut, and white oak wood chips that did not support consistent or lasting inhibition of weed seed germination. However, mulch applications did not reduce crop plant aesthetics and did not limit plant growth. A shadehouse assessment will be repeated this spring. Durability and decomposition demonstrations are also ongoing with these mulch options, and may represent the greatest value-added benefits for use of these renewable resources in sustainable landscape settings.

Lessons learned and deviations from the plan of work:

A significant portion of the proposed budget was designated at the project outset for expenses (e.g., travel costs, meals, speaker honoraria) related to a planned independent workshop and meetings to be

held in conjunction with a field day. Because results of biomulch assays were mixed and outcomes were of limited direct utility as a stand-alone attraction to TN stakeholders, demonstration plots were showcased via other venues. Thus, these portions of the budget were not expended as proposed.

Summary assessment of outputs:

A summary tally of presentations/outputs/contacts made by Klingeman, Wszelaki, or Taylor, including the number of contacts achieved during outreach and educational training events and/or workshops, number and titles of presentations, modules, webinars, and publications educational materials developed, are detailed below:

Demonstration Plots [4]:

Topic/Project	Location	Duration of Demonstration
Shadehouse Container Plant Growth & Mulch Demo	UT-Knoxville Nursery Facility	5/2012-8/2012
Biomulch Durability & Subsidence Plots	UT Forestry REC, Oak Ridge	5/2012-9/2013
Biomulch Field Performance Demo	ETREC, Plant Sciences Unit	5/2013-9/2013
Shadehouse Container Plant Growth (repeat project)*	UT-Knoxville Nursery Facility	9/2013-5/2014

Presentations [6](<1095 attendees & potential contacts):

Opportunity	Title*	Times presented	Total contacts
ETN-NGA Smoky Mountain Tour (2012)	What's New in UT Landscape & Nursery Work*	1	30
ETN-NGA Monthly Meeting (2012)	*IPM and Sustainability Projects at UT**	1	15
TNLA Green Industry Field Day (2012)	Update on UT Landscape & Nursery Research*	3	80
ETREC Turf & Orn. Field Day (2012)	*UT Landscape & Nursery Research Update**	1	90
TNLA Green Industry Field Day (2013)	*Update on UT Landscape & Nursery Research**	2	60
SNA Research Conf. in Atlanta (2013)	*"Soluble phenol extraction and weed suppressive activity of selected bioactive wood mulches"*	1 (poster)	<800
ETREC Turf & Orn. Field Day (2013)	Interactive Session & Field Demo*	1	20

*Biomulch studies and observations discussed as a topic within a overall program/project showcase

Publications/Educational Materials Distributed [3]:

Taylor, A., W. Klingeman, A. Wszelaki, D. Saywell, and S. Amundson. 2013. Treated wood on organic farms. UT Extension Pub. W235-H. https://utextension.tennessee.edu/publications/Documents/W235-H.pdf

Oetting, C., W.E. Klingeman, A. Taylor, K. Hoyt, A. Wzselaki, and P.C. Flanagan. 2013. Soluble phenol extraction and weed suppressive activity of selected bioactive wood mulches. 58th Proc. S. Nursery Res. Conf. [*2013 Conference Proceedings will become available online at http://www.sna.org/Default.aspx?pageId=1052564, about Jan. 2014*]

Oetting. C., B. Klingeman, A. Taylor, K. Hoyt, A. Wszelaki and P. Flanagan. 2013. Do selected wood mulches add value in weed suppression?, *In:* 2013 UT Turf and Ornamental Field Day Proceedings. UT AgResearch and UT Extension. 2013 Program:

http://www.tennesseeturfgrassweeds.org/Lists/Home%20Page%20News/Attachments/41/2013%20Turf%20and%20Ornamental%20Field%20Day.pdf

Presentation Venues and Visibility of Outreach Programs

2012 UT Turf & Ornamental Field Day (on Facebook)
https://www.facebook.com/media/set/?set=a.405029696218726.104352.107965492591816&type=3
2013 UT Turf & Ornamental Field Day (on Facebook)
https://www.facebook.com/media/set/?set=a.553568888031472.1073741830.107965492591816&type=1

Contact information for the sub-recipient:

Dr. W.E. Klingeman
University of Tennessee
Department of Plant Sciences
2431 Joe Johnson Drive
Knoxville, TN 37996
865-974-7324

Project 5-Honey Bee Queen Producer Training

Need for the Grant

Honeybees are in integral part of our way of life. One out of every three bites of food that we eat is the result of honeybee's pollination a crop. Honeybee populations in the US have been declining since the introduction of the *Varroa* mite in the mid 1980s. CCD has become the plague of the honeybee in the past decade and still has no definitive causative agent. Feral honeybee populations have all but disappeared in the State of Tennessee. There are approximately 1600 registered beekeepers with a total of approximately 15,000 registered colonies of honeybees in the State of Tennessee. These are the bees that our State's farmers rely on to pollinate their crops.

The lack of available quality honeybee queens and packages over the past five years from traditional out of state sources has significantly impacted Tennessee beekeeper's ability to pollinate crops, produce honey and over-winter their colonies.

The purpose of this project is to increase the ability of Tennessee beekeepers to have a quality source of honeybee queens and package bees, increase honey production, obtain additional income through the production and marketing of value added products and to provide an absolute source of honeybee pollinators to pollinate the crops of the State's fruit and vegetable industry.

Approach Taken for the grant

The approach taken to fulfill this grant can be summarized as follows:

1. Provide training to beekeepers across the State in queen breeding and package production.
2. Provide guidance and assistance in forming a Tennessee queen and package producer association to ensure a quality product through quality control and Best Management Practices (BMPs).
3. Provide value added product production and marketing training to beekeepers across the State.

Achievement of Goals

Qualified beekeepers were trained in queen rearing and package production in all four areas of Tennessee. Workshops were held in Jackson, Murfreesboro, Knoxville, and Johnson City and were attended by over 80 beekeepers.

The Tennessee Queen Breeders Association (TQBA) was formed, and currently has several members across Tennessee.

Tennessee Beekeepers have been trained in value added products of beehives in the following product areas: beeswax preparation, candles and candle making, lotions and creams with honey and wax, and creamed honey. The training sessions were taught by beekeepers that have technical training and marketing experience in honeybee products and were held in the four areas mentioned heretofore.

Results of the Program

As mentioned previously there were over 80 beekeepers that were taught queen rearing and many of them are now raising their own queens throughout the State. There were over 100 additional Tennessee Beekeepers who were taught the value added products and marketing skills in the use of beeswax and propolis from the beehive. These value added products are: beeswax candles, lotions and creams made from honey and wax. The collection and marketing of pollen was also included and marketing of all of these products was a part of the training.

Lessons Learned

The lessons learned as a result of this project are varied and numerous. Among those learned include: time frame to raise queens, mating of the queen and the need for drones for mating, equipment needed for queen production, the many value added products available across the market place, marketing skills needed to sell beehive products such as candles, lotions, and lip balms. In addition, the need for a state-wide network of queen producers was recognized and the organization began putting together participants of beekeepers who had a true desire to raise queens.

Progress Made to Achieve the Long-Term outcome of the Project

This project and the further use of this training are discussed at the Tennessee Beekeepers Association's (TBA) annual conference and at the spring board meeting as well. There are four (4) Regional Vice President's for TBA and each person is encouraged to discuss and promote the Queen Breeding program and value added products at various meetings throughout the State. The Regional VPs typically visit all

the local clubs inside their regions and this topic is discussed at those meetings as well. The year 2013 has been a very difficult year for honeybees in Tennessee as a result of inclement weather and disease problems that were very prevalent through the State. Therefore, queen rearing in Tennessee also was very difficult and many beekeepers had difficulty raising queens. However, all members of TBA and the TQBA are encouraged to continue the projects and develop long term positive results of our efforts and put the training into practice.

Additional Information

This project was very much needed and very well participated in by many beekeepers in Tennessee. The future value of raising our own queens and providing honeybees for beekeepers in Tennessee is immeasurable. We continue to be encouraged by the progress many are making in these endeavors.

Contact Information for the Sub-Recipient

Tennessee Beekeeper's Association, 3900 Rock Springs Road, Watertown, TN 37184, Jim Garrison, Project Coordinator and Current Middle Tennessee Regional Vice President, phone, 615-377-7696. Email jimg@boardroominc.net

Project 6-Olives and Truffles: Two Potential Specialty Crops in Tennessee

Need for a grant:

The purpose of this grant was to investigate the potential for two new crops for Tennessee farmers – olives and truffles.

Olives

Domestic production of olives in the United States falls short of meeting the demand for fruit and oil. Recent development of several cold hardy olive cultivars has allowed the expansion of this crop into areas previously considered as unsuitable from a climate standpoint. The purpose of this study was to evaluate several olive cultivars in regards to survival and growth in East Tennessee and to identify potential pests for this crop.

Truffles

Truffles are ectomycorrhizal fungi prized for their culinary uses. Truffles are in demand by gourmet restaurants and gourmet food suppliers throughout the world. At a time when demand for truffles is expanding, world production of this commodity is stable or declining slightly. Truffles are produced in numerous countries throughout the world, including the United States. Within the U.S., Oregon is perhaps the area of greatest production. However, there appears to be an opportunity to produce this crop in Tennessee. The quality of fresh truffles declines rapidly following harvest, therefore the ability to bring them in from distant production areas is very limited and the opportunities for a good local market, if the crop can be produced, are expanding.

Impact:
The initial focus for both crops was to determine whether they could be produced in East Tennessee and to discover some of the challenges that growers would face if they elected to grow them. The 3-year window of the grant was not sufficient to fully evaluate the long-term potential for olives and truffles. In fact, neither of the crops would have been harvested prior to expiration of the grant. However, this fact was known and understood prior to the awarding of the grant. With both of these crops, several years will elapse between the time of planting and first harvest, but the potential for yields with time are dependent on success in establishing the plantings and growing out trees capable of supporting production.

Approach taken for the project:

The general planting scheme for the olives and truffles project is shown below (Fig. 1). The planting location has good visibility from Alcoa Highway and those visiting the East Tennessee Research and Education Center (ETREC), Plant Sciences Unit. The silvery appearance of the olive trees from a distance has generated interest from visitors to the ETREC Unit.

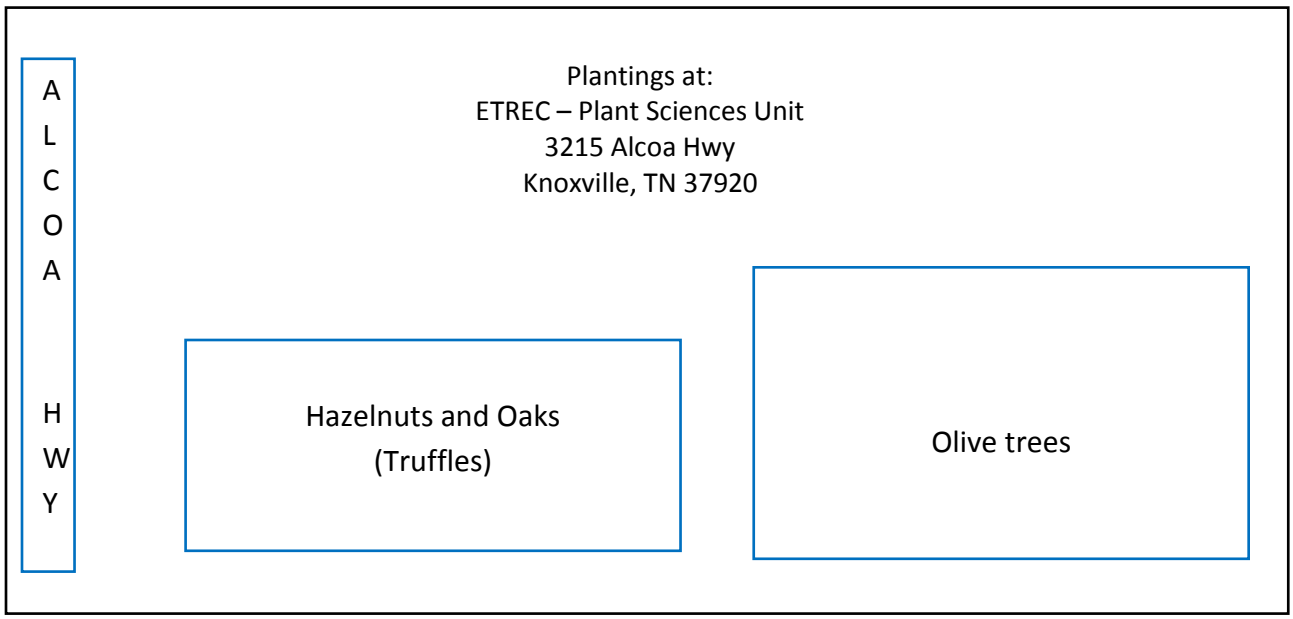


Fig. 1. General planting scheme for hazelnuts, oaks and olive trees.

Olives
There were two plantings of olive trees during the project period (Fig. 2). Ten replicate trees of ten cultivars (Aglandau, Arbequina, Ascolana, Coratina, Frantoio, Leccino, Maurino, Mission, Pendolino, and Picual) were planted in the spring of 2011 (March 18, 2011). Trees were set 5 feet apart within row and rows were spaced 24 feet apart. Trickle irrigation was installed to supplement natural rainfall. There were two replicate blocks in each row. In 2012, to offset losses of 24 trees (of 100 planted in 2011), 32 additional olive trees (four each of eight cultivars – Aglandau, Arbequina, Ascolana, Coratina, Frantoio,

Leccino, Mission, and Sevillano) were planted in four new single tree replicates on April 27, 2012. 'Sevillano' was only planted in 2012. Only eight cultivars were planted in 2012 due to cost and availability. We attributed death of trees from the first planting mainly to irrigation problems during the hot summer months and, to a lesser extent, cold temperatures during the winter, rather than pest issues. Growth measurements (height and stem diameter) and tree survival were recorded during the project period. Trees were scouted periodically for pest and pathogen issues. Diseased plant material was brought back to the lab for identification as needed.

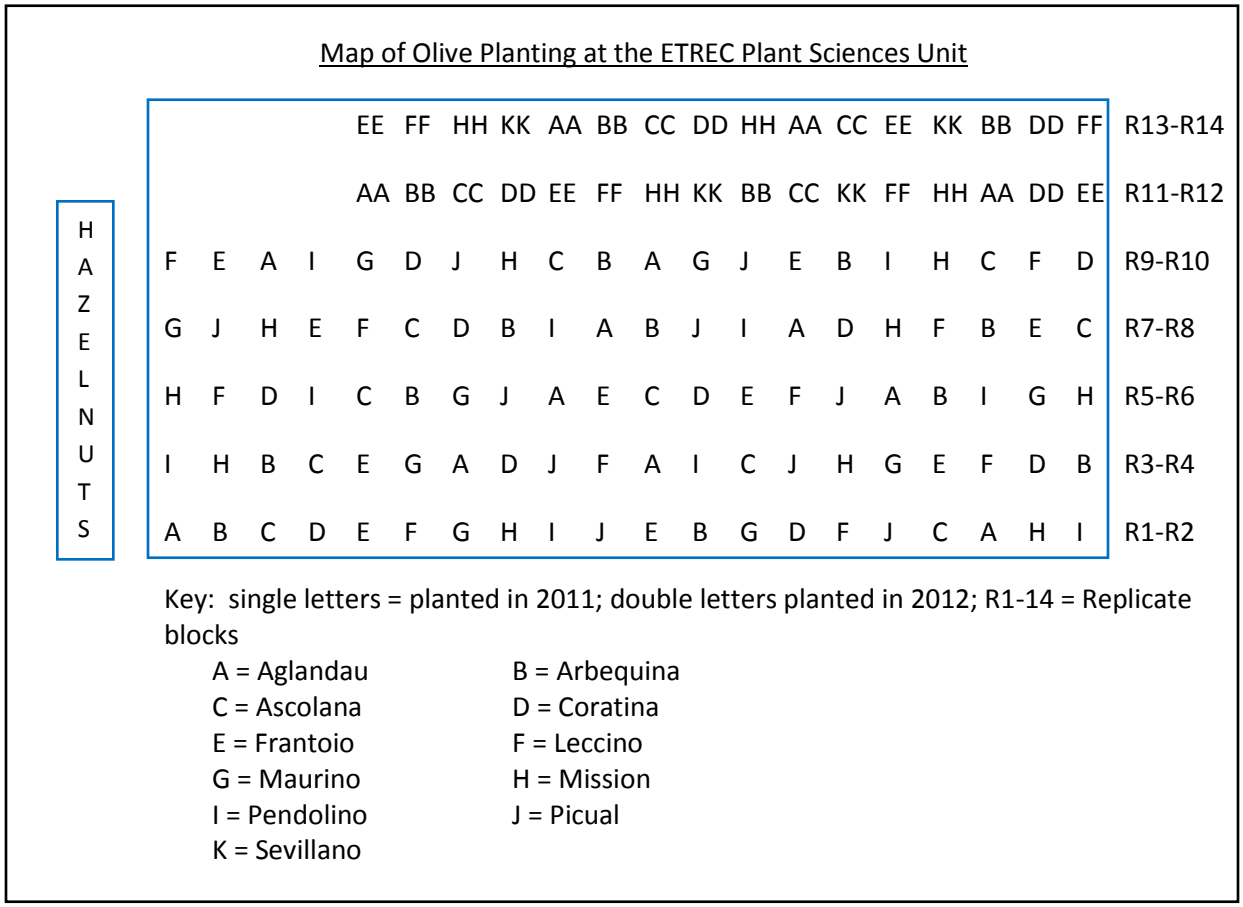


Fig. 2. Diagram for planting scheme for olive trees.

Fig. 3. Olive trees at the ETREC Plant Sciences Unit, at planting in 2011.

Truffles

Hazelnut and Oak Trees:

A site for the Truffles portion of the project was identified at the ETREC – Plant Sciences Unit, 3215 Alcoa Hwy., Knoxville, TN 37920 (Fig. 4). This site is immediately adjacent to the one being used for the olive tree portion of this project and separated from the olive planting by a 30-feet corridor to allow adequate room for equipment travel. Soils on the planting site are Sequoia silty clay loam. Prior to planting, the site was soil sampled extensively on July 28, 2011 to determine soil pH, phosphorus, potassium, calcium, and magnesium levels and percent organic matter. Soil samples were collected at 4-inch intervals from the soil surface to 16 inches in depth (0 to 4, 4 to 8, 8 to 12 and 12 to 16 inches). Soil sampling was repeated on October 4, 2013 using the same procedures, depths and analyses to monitor changes that may have occurred over time.

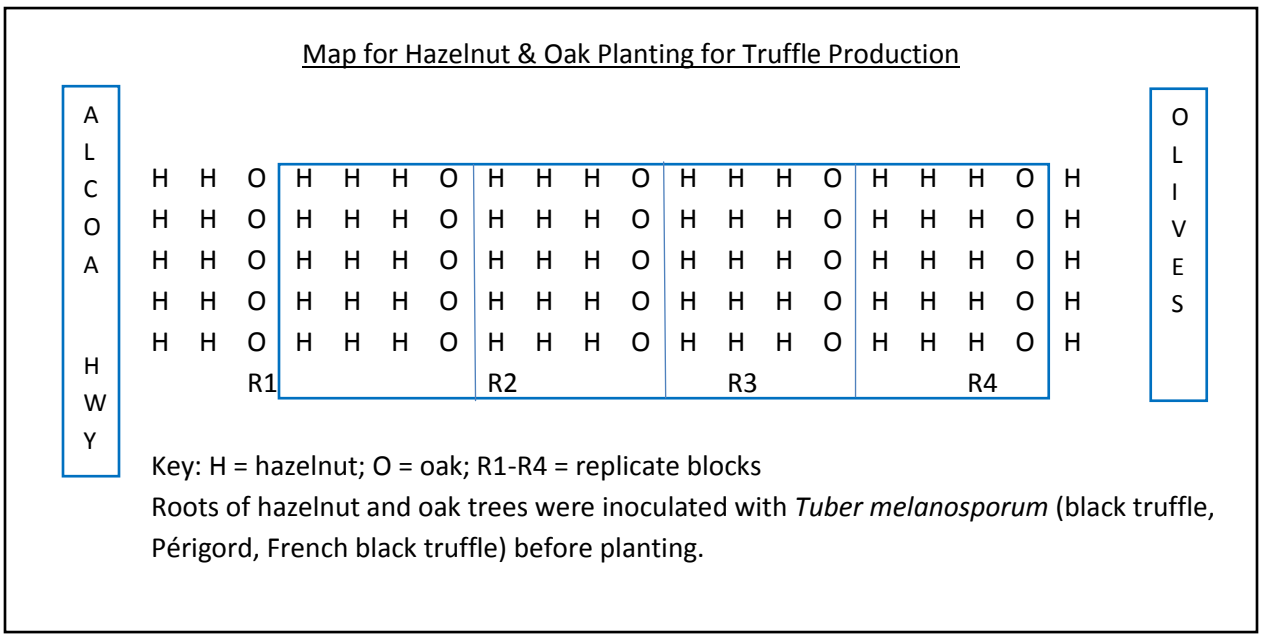


Fig. 4. Diagram for planting scheme for hazelnut and oak trees to support truffle production.

On May 11, 2012, 75 hazelnut trees and 25 oak trees, all of which had roots inoculated with *Tuber melanosporum*, the black Périgord truffle, were planted. A high density planting was used; trees were set 5 feet apart in the row and 24 feet between rows (Figs. 5-7). In each row, the pattern of planting consisted of one oak tree followed by three hazelnut trees. This pattern was repeated three times to give a total of twelve hazelnut trees and four oak trees per row plus one hazelnut tree on the end of the row closest to the olives and one oak plus two hazelnut trees on the end of the row closest to Alcoa Highway. A total of five rows were planted using this sequence. The planting could then be divided into four replications going across the five rows, with three hazelnut trees and one oak tree in each row included in each replication. This planting pattern was used to facilitate future research. Trickle irrigation was installed to supplement natural rainfall. This was critical to survival and growth of trees in 2012 when high temperatures and very little rainfall characterized much of the growing season. In 2013, natural rainfall was plentiful and irrigation was not needed throughout the growing season.

Fig. 5. Hazelnut and Oak planting (for truffle production). Left: planting on 5/11/12, Right: 10/29/13.

Fig. 6. Hazelnut at planting on 5/11/12 (left); Hazelnut tree on 10/29/13 (right).

Fig. 7. Oak tree at planting on 5/11/12 (left); Oak tree on 10/29/13 (right).

The rationale behind a high density planting was to fill in the row quickly so that when truffle production began, yields would be higher than in plantings utilizing wider in-row spacings. When tree crowding becomes a negative factor for truffle production, progressive tree thinning will be employed to sustain good light relationships in the row and, hopefully, maintain good yields of truffles. The first tree thinning would involve removal of 2/3 of the hazelnut trees (the first and third trees between the oak trees), leaving 10 feet between trees in a row. The final thinning would entail removal of the remaining hazelnut trees to leave an in-row spacing of 20 feet between trees and a solid oak planting.

A mixed planting of hazelnut trees and oak trees was used because truffle production is reported to occur more quickly with hazelnut trees than with oaks (approximately 5 to 6 years versus 7 to 9 years for the oaks. Oaks were included in the planting because it has been reported that they will produce truffles for more years than hazelnuts (approximately 45 to 50 years as compared to 30 to 35 years).

Achievement of goals:

While the duration of this proposal falls far short of addressing the entire time period from planting of trees to harvest of truffles or olives, it did cover the critical year of site preparation and first 1-2 years of establishment. For olive production, hot and dry conditions impacted survival more than cold winter temperatures. Potential pest problems were identified, but pest pressure was found to be minimal. Olive cultivars were identified with good growth and high survival rates after three summers and two winters. The olive orchard will continue to be maintained. Growth measurements and scouting for pests will be done periodically. When the plants are old enough, yield differences among the cultivars will be determined so that information can be provided to Tennessee growers with an interest in this crop.

For truffle production, proper pre-plant site preparation will impact the performance of the planting in its formative years and set a baseline for maintaining favorable soil conditions throughout the life of the planting. Utilizing successfully inoculated trees of the proper cultivar and instituting recommended cultural practices such as irrigation and orchard floor management will be essential to good tree survival and growth and will increase the potential for good truffle production within a reasonable time period.

The expenses involved in site development and planting establishment will constitute the bulk of the costs involved in bringing in the first crop of truffles. The truffle site will be maintained with an aim to harvest truffles in a few years.

Results of the program

Olives

What have we learned?

1. Irrigation is critical for establishment of olive trees during the first year. Tree losses resulted mainly from lack of water due to problems with the irrigation system, rather than cold temperatures. Temperatures in the Knoxville area from 2011-2013 were within the range suitable for olives.
2. Olive cultivars with the greatest growth were 'Aglandau', 'Maurino', and 'Mission', while tree survival was greatest (90-100%) for 'Mission', 'Picual', 'Sevillano', and 'Aglandau'.
3. Soil pH values above 7.0 can result in iron chlorosis, but trees responded quickly to soil amendment of ammonium sulfate and chlorosis was no longer evident after three weeks.
4. Pressure from insect pests and pathogens was minimal; however, trees were more susceptible to foliar pathogens with less than optimal soil pH.

At the final measurement date (August 06, 2013), there were significant differences in growth (Figs. 8-9) and percent survival (Fig. 10) among olive cultivars. At the end of the project, for trees planted in 2011, those that had increased most in height were 'Aglandau', 'Maurino', and 'Mission', followed by 'Arbequina and 'Ascolana'. Similar to the results with height, the stem diameter (at 50 cm from the ground) of 'Aglandau' was greatest. 'Frantoio' and 'Pendolino' had the smallest gains. The summer of 2012 was hotter and drier than 2011, and trees planted in 2012 have not grown significantly; however, all trees planted in 2012 have survived.

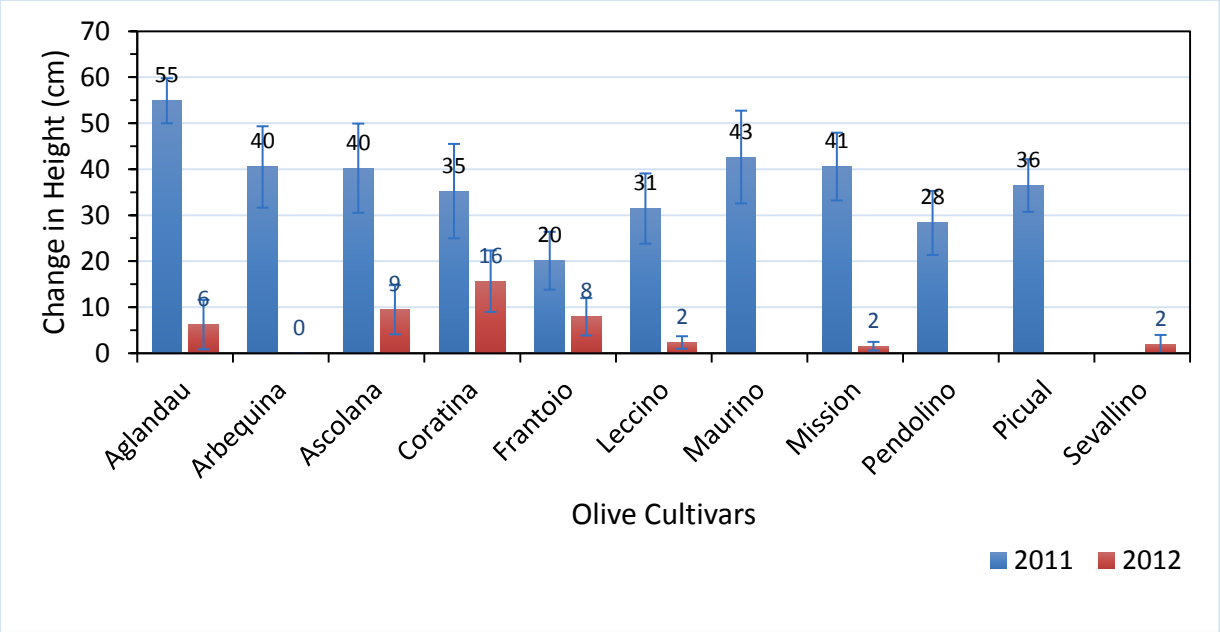


Fig. 8. Change in tree height (cm) since planting. Trees were planted in 2011 and in 2012. The bars represent means ± standard errors.

Fig. 9. Selected olive cultivars. From left to right: 'Aglandau', 'Arbequina', 'Ascolana', and 'Mission'.

Tree size was not directly correlated with survival. As of the end of the project period, for all trees planted in either 2011 or 2012, survival rates were 100% for 'Mission', 'Picual', and 'Sevillano', 93% for 'Aglandau', 86% for 'Arbequina' and 'Leccino', 71% for 'Ascolana', 70% for 'Maurino', 64% for 'Coratina' and 'Frantoio', and only 40% for 'Pendolino' (Fig. 10).

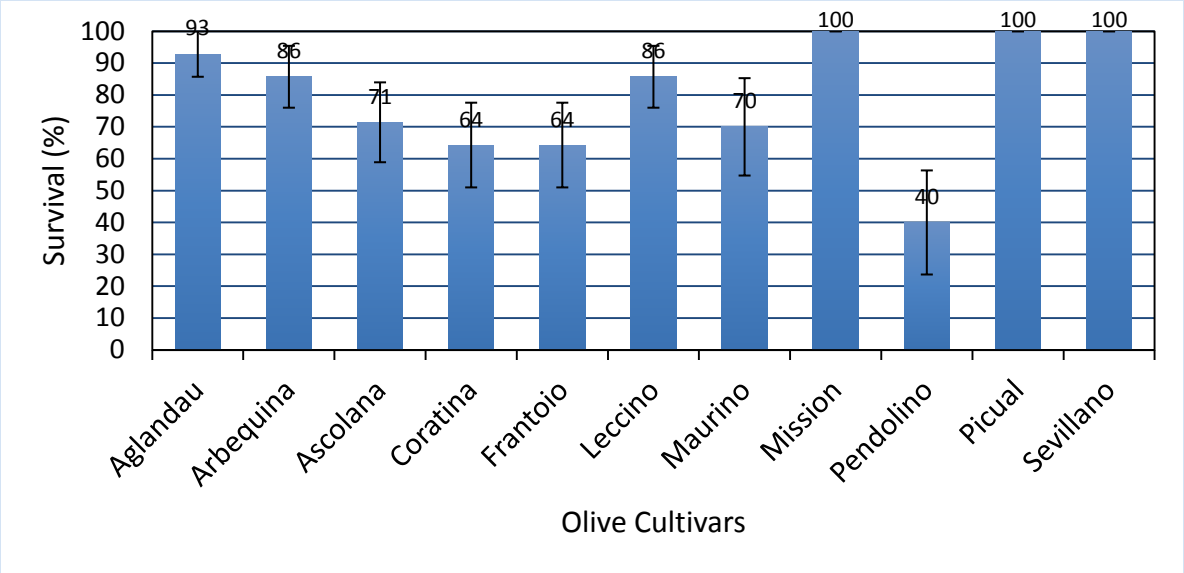


Fig. 10. Percent survival of olive cultivars.

Olive trees were less affected by cold temperatures than anticipated. Over the project period, the lowest temperature recorded was 15°F. During dormancy, olive trees are purported to tolerate temperatures as low as 21°F for brief periods, and they actually need colder temperatures (36-59°F) to initiate flower formation. Temperatures of 10°F can cause damage to aerial portions of the trees. The cultivars selected for this project are considered cold-hardy, but some branch dieback was observed in spring. There were also several hail storms recorded in Knoxville, TN during 2011-2013, and some caused extensive damage to landscape. Damage to developing olive stems and branches became obvious about two months after such events, as evidenced by sections of dead branches.

Pathogen problems encountered were relatively minor and included mainly *Alternaria* spp. with some *Colletotrichum*. Problems with *Alternaria*, which is likely a secondary pathogen of stressed trees, subsided greatly when soil pH was reduced with ammonium sulfate (Fig. 11). Defoliation of affected leaves occurred, followed by healthy new growth. Peacock spot (*Spilocaea oleaginea*) was observed primarily in the first year of planting on trees shipped from California, where the disease is endemic. Once temperatures rose well above 85°F, peacock spot subsided. 'Ghost spot', which is likely a physiological problem since no pathogens were isolated from affected leaves, was also observed in 2013 (Fig. 12). Grasshoppers were observed on olive trees during the first year, but proper weed management around trees resolved the problem.

Fig. 11. Healthy appearance of leaves in 2013 after soil pH was reduced.

Fig. 12. Symptoms of "Ghost Spot" on olive leaves in 2013.

Truffles

What have we learned?

1. Hazelnut trees will grow at a faster rate than oaks in the first years of their life. Not only should they produce truffles earlier in their life than the oaks, they should be a larger tree at the time of first production. A high density plan similar to the one used in this project appears to be the way to get good yields early and sustain production for a longer time.

2. Hazelnut trees grow multiple trunks as opposed to a single trunk for oaks. Each of the trunks on the hazelnut trees outgrew the single trunk on the oaks by at least 2 to 3 times. Pictures of the trees earlier in this report show that differences in tree size between the hazelnuts and oaks were minor at the time of planting. However, two years later, the hazelnut trees have developed a much larger canopy. It is anticipated, based on hazelnut tree growth to date, that a solid hedgerow of trees may exist by the time the tree roots begin to bear truffles.
3. Prior to planting, soil conditions (pH and fertility) should be adjusted to encourage good tree growth. A soil pH of 6.5 to 7.0 is suggested as ideal for hazelnut trees. Once the trees reach the age and size where truffle production should be expected to start, soil pH should be increased, as a pH of 7.9 to 8.0 is considered optimal for truffle production. At higher soil pH, tree growth is apt to slow down dramatically, to the point that a tree that has not attained good size by the time it starts producing truffles may need much longer to do so, resulting in a potential lower truffle yield.
4. Grass and weed competition needs to be eliminated in the vicinity of trees as they outcompete the trees for moisture and nutrients. Trees should have trunk guards for protection. Weeds and grasses should be controlled via the use of approved herbicides or by hand weeding. The use of string trimmers and/or mowers operated close to the trees invariably results in damage or destruction of some (many) of the trees. We have had to replant on two occasions to maintain a solid stand of trees in the study.

In the fall of 2011, 75 hazelnut trees and 25 oak trees inoculated with *Tuber melanosporum* were ordered from Garland Truffles, 3020 Ode Turner Rd., Hillsborough, NC. The trees were not available for delivery until May 10, 2012. They were planted the following day.

Trees were hand watered until trickle irrigation could be set up to supplement natural rainfall. The late planting date coupled with very high temperatures and little rainfall for much of the summer necessitated reliance on the irrigation system to keep the trees alive.

As of Nov. 16, 2012, eight hazelnut trees out of 75 were dead, representing a 10.7 percent loss. Four oak trees out of 25 (16%) died over the summer. Replacement trees were ordered in late winter when the impact of the winter on survival of the remaining trees could be assessed. If trees had been available in the preferred planting period of late winter through early spring, we strongly suspect that tree mortality would have been much lower. This is based on some earlier experiences with establishing a new hazelnut planting.

Soil pH was above 7.0 for all rows and for all sample depths (Table 1). Therefore, no pre-plant liming was needed as the ideal soil pH for tree growth is from 6.5 to 7.0. Once the trees approach their fifth year, when truffle production should begin, soil testing will be repeated and the soil pH will be amended to about 7.9 as this is desired for truffle production. Levels of phosphorus and potassium were well within the desired range so no fertilizer was applied prior to planting.

Table 1. Hazelnut & Oak for Truffles Production - Soil test results

		pH		P		K		Ca		Mg		O. M.*	
Row#	**Depth**	**2011**	**2013**	**2011**	**2013**	**2011**	**2013**	**2011**	**2013**	**2011**	**2013**	**2011**	**2013**
1	**0-4**	7.2	6.77	58H	30M	388V	199H	3252	2576	618	789	3.8	1.72
1	**4-8**	7.2	7.01	20M	27M	219H	76L	2171	1742	461	317	2.3	1.98
1	**8-12**	7.3	7.0	13L	18L	190H	116M	1850	1267	432	279	2.0	1.19
1	**12-16**	7.5	7.14	7L	3L	148M	130M	1183	903	362	273	0.9	0.59
2	**0-4**	7.3	7.12	34H	29M	235H	123M	2744	2356	567	399	3.6	3.11
2	**4-8**	7.4	7.2	6L	4L	145M	69L	1800	1271	420	285	1.8	1.42
2	**8-12**	7.5	7.24	6L	4L	113M	76L	1369	1056	401	292	0.9	0.97
2	**12-16**	7.4	7.33	4L	3L	75L	62L	1184	956	423	319	0.6	0.48
3	**0-4**	7.5	7.08	20M	25M	319H	84L	1422	2453	378	394	3.7	3.29
3	**4-8**	7.3	7.12	8L	4L	175H	41L	1790	1281	402	281	1.8	1.43
3	**8-12**	7.5	7.19	9L	4L	147M	36L	1319	985	362	281	0.9	0.78
3	**12-16**	7.5	7.29	6L	4L	125M	30L	1155	922	360	284	0.5	0.45
4	**0-4**	7.5	7.17	52H	36H	280H	168H	2800	2264	637	391	2.6	3.19
4	**4-8**	7.5	7.19	25M	5L	198H	93M	1577	1108	375	259	1.5	1.18
4	**8-12**	7.4	7.27	11L	3L	174H	89L	1337	875	374	268	0.9	0.57
4	**12-16**	7.4	7.32	6L	3L	119M	88L	973	863	347	300	0.4	0.42
5	**0-4**	7.6	7.3	48H	54H	300H	140M	2314	2251	533	436	2.3	2.74
5	**4-8**	7.3	7.29	16L	18L	332V	100M	1071	1109	328	284	0.8	1.06
5	**8-12**	7.4	7.22	8L	4L	302H	162H	1006	962	310	307	0.9	0.76
5	**12-16**	6.9	7.13	6L	2L	277H	152M	855	944	282	375	0.7	0.41

*= Organic Matter content

In 2013, Japanese beetles caused up to 60% defoliation on hazelnuts. Foliar application of carbaryl at the recommended rate resolved the problem. Olive trees and oaks were not affected.

Beneficiaries:

Olives

The main beneficiaries of this project will be growers interested in high value crops who have experience with fruit and tree crops, such as blueberries, but want to diversify their farming operations. We have shown that olives trees can be established (3-yr-period) in the climate of East Tennessee. Selection of cold hardy cultivars for our tests was key to find those that would flourish. According to a recent report in 2012 from the University of California Agricultural Issues Center (Xiong, Matthews, and Sumner. 2012. New Demand for an Old Food: The U.S. Market for Olive Oil *ARE Update* 16:9-11), consumption of olive oil in the U.S. has tripled in the past 10 years. The marked increase is attributed mainly to health benefits of the oil. U.S. consumption is now 10% of world production, while the U.S. only produces 1.3% of our olive oil consumption. Clearly there is room for growth of this commodity in the U.S. Development of cold hardy varieties has made production possible in the southeastern U.S., as evidenced by the newly developing olive industry in Georgia.

Truffles

Changes in the Mediterranean region, where black truffles are typically grown, including climate change (hotter summers and less precipitation), changes in land use, and shrinking forests, have caused prices of truffles to climb to $1000-1200 per pound. Increasing demand and decreasing supply present potential markets for East Tennessee. One grower (commercially producing as Tennessee Truffles) has already established a market for black perigord truffles in East Tennessee.

Lessons Learned:

Olives

5. Irrigation is critical for establishment of olive trees during the first year in East Tennessee. Tree losses resulted mainly from lack of water due to problems with the irrigation system, rather than cold temperatures. Temperatures in the Knoxville area from 2011-2013 were within the range suitable for olives.
6. Weed management around newly established saplings is important to reduce competition for soil nutrients and water; however, care must be taken not to damage stems.
7. Olive cultivars with the greatest growth were ‘Aglandau’, ‘Maurino’, and ‘Mission’, while tree survival was greatest (90-100%) for ‘Mission’, ‘Picual’, ‘Sevillano’, and ‘Aglandau’.
8. Soil pH values above 7.0 can result in iron chlorosis, but trees responded quickly to soil amendment of ammonium sulfate and chlorosis was no longer evident after three weeks.
9. Pressure from insect pests and pathogens was minimal; however, trees were more susceptible to foliar pathogens when soil pH was less than optimal.

Truffles

5. Hazelnut trees will grow at a faster rate than oaks in the first years of their life. Not only should they produce truffles earlier in their life than the oaks, they should be a larger tree at the time of first production. A high density plan similar to the one used in this project appears to be the way to get good yields early and sustain production for a longer time.
6. Hazelnut trees grow multiple trunks as opposed to a single trunk for oaks. Each of the trunks on the hazelnut trees outgrew the single trunk on the oaks by at least 2 to 3 times. Pictures of the trees earlier in this report show that differences in tree size between the hazelnuts and oaks were minor at the time of planting. However, two years later, the hazelnut trees have developed a much larger canopy. It is anticipated, based on hazelnut tree growth to date, that a solid hedgerow of trees may exist by the time the tree roots begin to bear truffles.
7. Prior to planting, soil conditions (pH and fertility) should be adjusted to encourage good tree growth. A soil pH of 6.5 to 7.0 is suggested as ideal for hazelnut trees. Once the trees reach the age and size where truffle production should be expected to start, soil pH should be increased, as a pH of 7.9 to 8.0 is considered optimal for truffle production. At higher soil pH, tree growth is apt to slow down dramatically, to the point that a tree that has not attained good size by the time it starts producing truffles may need much longer to do so, resulting in a potential lower truffle yield.
8. Grass and weed competition needs to be eliminated in the vicinity of trees as they outcompete the trees for moisture and nutrients. Trees should have trunk guards for protection. Weeds and grasses should be controlled via the use of approved herbicides or by hand weeding. The use of string trimmers and/or mowers operated close to the trees invariably results in damage or destruction of some (many) of the trees. We have had to replant on two occasions to maintain a solid stand of trees in the study.
9. In 2013, Japanese beetles caused up to 60% defoliation on hazelnuts. Foliar application of carbaryl at the recommended rate resolved the problem. Olive trees and oaks were not affected.

Deviation from the plan of work:

The original plans called for spacing trees 6 feet apart within the rows and 24 feet between rows. The in-row spacing was closed in to 5 feet between trees, but the 24 feet between row spacing was maintained. Rationale for this decision was based on previous experience in growing hazelnuts by the investigator.

In the planning stages for the project, two different truffle fungi were to be evaluated, *Tuber melanosporum* and *Tuber uncinatum*. Due to the difficulty in securing trees inoculated with *Tuber uncinatum*, and the fact that *Tuber melanosporum* is considered to be the best black truffle, led us to focus entirely on *Tuber melanosporum*.

Originally we had planned to present information on this project at one of the East Tennessee Research and Education Center field days, in particular, the Organic Crops Unit Field Day during the time period of

this project. However, it took time to properly establish the trees successfully and have something to "show" audiences. We have arranged to present our results at the 2014 Organic Crops Field Day, which will be held in April. We are preparing materials for departmental websites and Extension fact sheets, based on the information contained in this report. A journal article on establishment and growth of olives in East Tennessee will be submitted to HortScience or HortTechnology. The established orchards for olives and truffles will continue to be maintained to gather information for potential growers on yield and management.

Contact information for the sub-recipient:

David W. Lockwood
Dept. of Plant Sciences
University of Tennessee
252 EPS, 2431 Joe Johnson Drive
Knoxville, TN 37996-4561
telephone: 865-974-7421
FAX: 865-974-1947
Email: dlockwood@utk.edu

Project 7-Marketing of Middle Tennessee Nurseries in unexplored market sectors

The Middle Tennessee Nursery Association is a non-profit organization whose purpose is to promote the nursery industry in Middle Tennessee, an industry that has an economic impact of over $150 million dollars in Warren County alone. MTNA has a charter that requires all 245 members to be active in the nursery industry with the principal place of business being in middle Tennessee. The recession of 2008-09 has ended but the recovery has been slow and construction has lagged way behind other sectors of the economy. When construction was booming, promotion of the nursery industry was relatively easy but with new construction still down we utilized the funds to help promote TN nursery products to all areas of the country. We also utilized funding to attempt to stop a declining attendance in the MTNA annual trade show started when the recession started. The trade show has proven in the past to be a great marketing opportunity connecting specialty crop growers and buyers. This grant project enabled MTNA to implement new aspects to increase the effectiveness of the current trade shows.

Approach taken for the project:

MTNA realized that while housing construction is down, there is still a demand for nursery products in upgrading existing homes, a consumer's desire to grow some of their own fruits, utilizing nursery products to enhance security for businesses, and the use of nursery products to stabilize environmental situations, ex. the planting of trees after a forest fire. MTNA developed and actively promoted a show schedule that would be the most beneficial to our growers and also give us the best opportunity to find people who will set up a booth or attend our annual trade show.

MTNA attended three shows in 2013, in addition to the 11 we previously attended. These were the MANTS (Mid-Atlantic Nursery Trade Show) show in Baltimore, the GSHE (Gulf States Horticulture Expo) in Mobile, and the TNLA Nursery Show in Nashville. The number of buyers of specialty crops totaled over 7000 for the three shows. We included buyers' guides, contact cards, samples, brochures, and other literature at our booth. Mark Halcomb, a UT extension agent with over 38^{+} years in the nursery industry was on hand to answer any inquires made and the MTNA representative, Ann Halcomb was on hand to connect the potential buyer to the grower. We have given MTNA members over 7,500 new sales leads based on our participation at these shows. We have given out over 3,000 maps at these shows and through other media outlets.

We offered a workshop on Social Media and the business. We offered reference materials and demonstrations on setting up a company Facebook page and suggested things appropriate for company social media pages, explaining security and working in conjunction with the web pages. We had 32 participants with many of those going ahead and starting their own pages marketing their products.

We also have participated in the TNLA Short Course (Sevierville) and the Griffin Expo (Knoxville) promoting the Trade Show and nursery products to the Landscapers in the upper East Tennessee Area.

MTNA also did a complete overhaul of its annual trade show. They moved the trade show from McMinnville, TN, the heart of the TN nursery industry to a more urban setting in Murfreesboro, TN. This gave the attendees more opportunities in the way of dining options, lodging, and other entertainment while they were not attending the show. The show was also moved to August from October. Funding was utilized to help market the show and accentuate the benefits of the show's changes.
MTNA also designed a gridded buyer's map to highlight each member and also the wide variety of TN specialty crops and their corresponding support products, i.e. liners and containers. This map is too large to include a PDF in this report but it can be obtained by contact MTNA.
The SCBG project awarded 66 Tennessee Growers marketing assistance with their booths either a ½ price refund or a credit toward their 2013 booth with 30 being credited for their 2013 booths.

Achievement of goals:

The SCBG project helped MTNA and its members achieve our goal of marketing nursery products effectively in a recession/slow recovery environment. We utilized the funding to find new markets and our members are seeing benefits from that. By allowing two MTNA agents to attend shows and market all different types of nursery products and support products, we were able to connect a new type of buyer with our members. Whole Foods is now purchasing fruit trees from our members for their retail outlets. During the grant period, new markets opened up for our members in Canada, Germany, and the Netherlands. The boom period in construction led to some areas being over built and erosion is now a concern, MTNA members were able to provide nursery products to those areas that are now helping to minimize the effect. While this has not replaced new construction, it has taught the growers to diversify their products offered and has given them new avenues to update their business model.
The funding did not prevent the MTNA trade show in declining attendance, but all nursery trade shows have seen declining attendance in the past five years. Since 2008, the show's attendance has steadily declined and even though we gave the annual tradeshow a complete overhaul our attendance still declined from 2011 and we did not achieve our desired attendance level.
One marketing effort did pay off in our show's attendance and that was in the area of education. Attendance in 2012 and 2013 increased over 100% from 2011, with a few attendees traveling over 8 hours to take part in the education including the states of Alabama and Kentucky. By attending the MTNA's education session a specialty crop grower in the nursery industry received the 7 pesticide points necessary to fulfill the Commercial Applicator Requirements that are necessary every year.
Marketing with horticultural publications has been increased in both printed and electronic links through their websites. Emphasis was made through Facebook and major email distribution to multiple lists. Because of the additional marketing, we had attendees that had never been to the Trade Show before and some of the larger nursery management personnel and some attendees that had not attended the show in years attended and toured various nurseries and have since placed orders.

Results of the program:

Our attendance of industry trade shows nationwide has had a positive effect on the nursery industry in many ways:
a) By attending a wide variety of shows nationwide we are able to connect specialty crop growers to buyers of these products in all of the continental U.S., the EU, and Canada. Tennessee

specialty crops have a large presence in the Netherlands and Germany and sales are increasing annually in Italy and France.

b) Attending the shows has helped our growers become more responsive to the industry's needs. By attending these shows and giving our members many sales leads this has opened up communication in the association and allowed MTNA to tailor its products to the market demands.

c) By using the funding to open up our attendance at shows, MTNA board of directors and lone executive have been able to draft a show schedule that allows it to maximize its presence to the most number of buyers. Attendance at new shows was extremely risky because attendance at one show meant we would not be able to attend another and we were constantly chasing the market instead of being responsive to market conditions. By attending other shows, MTNA is now able to maximize its travel budget every year to determine the schedule that best suits its members and if market conditions change we are now able to respond because we are aware of what each show offers and the buyers we will contact at each show.

While the MTNA annual trade show suffered declining attendance over the period of the grant we did see an area where we can be beneficial to the industry and find our place in a crowded trade show arena. That is in the area of education and nursery tours, which we will be emphasizing as we market our 2013 show. We felt the changes we made in 2012 allowed us to move forward and that in 2013 while we do not have the initial attraction that Baltimore or Mobile has, a local trade show that stresses the technical expertise our growers possess along with our knowledge of worldwide regulations that have allowed TN specialty crops to be shipped to six continents and all of the 48 continental states has a place in a crowded industry. We will highlight the benefits of a locale change and what a show in the shadow of the "cradle of the plant kingdom" has to offer.

Beneficiaries

Our 250 members benefited from our efforts of promoting the Tennessee Nursery Industry by social media, maps, membership directories and Trade Shows. Our sales have increased in many cases 10-25% over recent prior years. We had new customers to attend our trade shows that were interested in purchasing plant materials. Our Show attendance promoted our industry and answered the technical questions and plant sources. Efforts are made to help the customer as well as the producer without being bias. New Customers are contacting the MTNA office seeking sources of plant materials.

Lessons Learned Sections

While we tried to increase our exposure to other market areas, it was found that we needed to stay more within our industry. (i.e. Homebuilders are cutting back on the amount of landscape work, sowing grass and letting the homeowner decide and control of their landscape. Homebuilders are doing less landscape in an effort to cut costs. The MTNA Show being moved to Murfreesboro attracted 3 times more landscaper and professionals needing pesticide points.

Progress made to achieve the long-term outcome of the program:

The MTNA is in the process of optimizing its show schedule that provides the most benefit to all of its producers. This not only provides members with the confidence that MTNA will utilize funds in the best

possible manner but that all members will have the opportunity to increase revenue because of MTNA's participation.
We are also focusing our 2014 trade show efforts on what we excelled at in 2012-2013, education for the producers and fostering a relationship between the grower and buyer by holding the show in proximity to McMinnville, TN.

Additional Information:

Middle Tennessee Nursery Association homepage

Contact information for the sub-recipient:
Ann Halcomb
Executive Secretary, Middle Tennessee Nursery Association
201 Locust Street, Suite 14
McMinnville, TN 37110
931-507-7322

Project 8-GAP Compliance and Traceability with Small-Scale Producers

Need for a grant:

The purpose of this project was to create a food safety system for the producers growing for Rural Resources' Mobile Farmers' Market and for the Mobile Farmers' Market itself. The Rural Resources Mobile Farmers' Market is a means of transporting locally produced specialty crops to families with limited transportation and to institutional purchasers such as schools, colleges, and hospitals.

The intention behind creating the food safety system was to bring producers into compliance with Good Agricultural Practices (GAP).

Approach taken for the project:

The first approach taken was to provide general education to the producers we work with by working with the University of Tennessee. This included on-farm workshops, additional workshops with experts on becoming GAP compliant, and training on writing a Standard Operating Procedure. Materials were also created and distributed to growers on becoming GAP Compliant.

As a second part of our strategy, we hired a contractor whose job was to learn and understand what was necessary to become GAP compliant and then to work with individual producers to create Standard Operating Procedures for their specific farm(s). That contractor spent many hours working individually with growers, visiting their farms, etc.

Our third strategy was to create a model for GAP Compliance on a small scale using the Rural Resources Farm.

Achievement of goals:

	Nov 2010 through Oct 2013
Objectives	Realized
• 40 producers will learn about GAP through written information and personal consultations on their farms.	430
• 40 producers will participate in 5 workshops focused on harvesting and post harvesting. Handling, manure handling, hygiene and first aid, sanitation of equipment, record keeping and demonstrating a GAP audit.	28
• 35 producers will utilize new GAP compliant harvest containers to improve produce handling and food safety.	6
• 10 producers will upgrade hand washing facilities to be GAP compliant, including but not limited to portable hand washing stations.	3
• 8 producers will pass the on-line GAP course.	1
• 8 producers will utilize portable fencing for their crop production area to exclude wildlife and make their production area GAP compliant.	1
• 5 producers will upgrade their enterprises with GAP compliant refrigeration units to cool appropriate crops.	1
• 2 producers will utilize GAP-compliant washable sinks and worktables.	1
• Produce aggregation and traceability will be improved at Rural Resources with a stainless 3-bay sink, tables and labeling equipment.	✓
• 5-10 producers will receive full or partial assistance in paying for an independent GAP auditor to inspect and certify their farm.	0
• A system of training producers about GAP will have been created for producers who work with Rural Resources in the future.	✓

Over the course of the project, several things became clear. First, growers—especially small scale—vegetable and fruit growers—were very reluctant to become GAP certified even knowing that their first inspection would be partially paid by this grant. They were glad to learn more about GAP and growers from two farms in addition to the Rural Resources farm wrote Standard Operating Procedures for their farms. These same growers presented their SOPs at a workshop.

With lack of interest in becoming GAP compliant among growers, Rural Resources turned to the potential markets demanding GAP certified produce to help convince growers to engage in the process.

Ultimately, many of the growers did not feel that the scale on which they grow could justify any extra expense towards compliance.

Next, Rural Resources redoubled its effort to make the Rural Resources farm a model of GAP Compliance on a small scale. At the end of the project period, with Standard Operating Procedures in hand, the Rural Resources farm underwent a mock GAP inspection with the recommendation to wait until spring for an actual inspection. The mock inspectors felt that the model farm would be in compliance at that that time.

Additionally, one expense identified by growers that they needed particular help with was water testing. In addition, the nationwide Irrigation Water Quality Database for fresh fruit and vegetable production needed additional data. Rural Resources contracted with the University of Tennessee to gather water samples that would help both growers and the National GAPs Program database.

> **Mini Report from the University of Tennessee:** Measuring irrigation water quality on vegetable farms in East Tennessee: Assessing food borne illness risks
>
> **Purpose:** The purpose of this project was to gather scientific data on irrigation water quality in East Tennessee, contribute to the nationwide Irrigation Water Quality Database for fresh fruit and vegetable production through the National GAPs Program, which will help shape future irrigation water standards.
>
> This project helped to fill the nationwide irrigation water quality knowledge gap by compiling and analyzing water samples for generic *Escherichia coli* (*E. coli*) densities, pH, conductivity and turbidity that were incorporated into the Irrigation Water Quality Database created by Betsy Bihn of the National GAPs Program at Cornell University.
>
> **Impact:** This project impacted our fruit and vegetable industry by providing an objective assessment of the quality of water currently used for irrigation and evaluating the ability of currently-used criteria to discern contamination by key pathogens. Furthermore, the four participating producers received a considerable savings through this grant paying for their water testing costs instead of having to pay these costs themselves. Lastly, maintaining buyer and consumer confidence in and demand for fruit and vegetable production in Tennessee will potentially enhance farm viability and profits.
>
> **Measureable outcome:** Water samples were taken from 4 farms in East Tennessee. Most farms had multiple irrigation sources to sample (# of sources ranged from 1-7/farm). Of the fourteen sources sampled, four were surface water sources and ten were wells. All samples, except one well sample, were within the acceptable range for irrigation water quality. A mitigation strategy for the sample outside of the allowable limits was discussed with the grower. One grower used the results in his food safety plan and successfully passed a third-party food safety audit. The other three growers are currently working toward GAP certification.

Progress made to achieve the long term outcome of the program:

This Project has raised the visibility of Good Agricultural Practices with over 430 growers in East Tennessee. It has worked with a smaller number of growers to take specific steps towards GAP compliance (if not GAP certification) and it has resulted in a model for small scale GAP compliance that

will remain in the community as a place for growers to visit and understand methods that they can employ to become certified should they decide to in the future. Because one farm is now ready to be audited, the possibility now exists for this farm to begin selling into new wholesale markets next season. With the possibility that these markets will take an interest in local produce, there will be increased incentives for other growers to reconsider GAP certification.

Additional Information:

This link has resources that we've collected on food safety:
http://ruralresources.net/index.php/community/food-safety

This link is the food safety guide that we put together for the project:
http://ruralresources.net/images/gapinfosheet.pdf

Pictures of mock audit at the RR model farm:

Beneficiaries:

-Producers who: Attended workshops, received written information, or wrote SOP's.
-Customers of producers for now and into the future (for consuming safer food).
-Rural Resources. Our organization now has a viable GAP demonstration farm for producers and the general public to visit and learn from.
-Producers who received water testing and the input of the University of Tennessee on those water tests.

Lessons Learned:

-Producers are strongly resistant to change, even with food safety involved. Producers have strong mistrust of entities requiring them to spend money or change the way they farm.

-An unintended consequence of GAP standards is the disproportionately large expense it is for small scale growers.
-Once GAP standards are adopted, producers did find the system was easier to implement than it seemed at first.

Contact Info:

Sarah T. (Sally) Causey,
Executive Director
Rural Resources, Inc.
2870 Holley Creek Road
Greeneville, TN 37745
(423) 636-8171
sally@ruralresources.net

Project 8A: Increasing Specialty Crop Consumption in the Youth of Greene County

Need for a grant:

Upon completion of the GAP training aspect of this project we worked closely with the Tennessee Department of Agriculture to diversify our strategies to create more awareness of production of and consumption of specialty crops beginning in April 2013.The felt need in our community included teaching food insecure teens about growing and preparing specialty crops, and distributing container gardens with specialty crops to families who need an opportunity to grow and consume higher quality food. Additionally, we presented tastings of specialty crops in food insecure neighborhoods in conjunction with our Mobile Market as a way to promote specialty crops.

Approach taken for the project:

Our first strategy included involving 46 food insecure teens in training around specialty crops. Four groups with 10 teens each were to receive 18 hours of training each around different aspects of growing, preparing, and marketing specialty crops. Six teens were lined up to participate in a 70 hour intensive summer internship learning and participating in growing specialty crops. These training opportunities were all hands-on. Teens grew and prepared specialty crops, they planned and implemented businesses around specialty crops, and they promoted specialty crops to the public by putting on presentations at the local farmers market and county fair.

During the summer, six teens were transported by our contracted bus driver to the Rural Resources farm and to two other farms in Greene County where the teens worked as farm interns. During the school year, all 50 of the teens were involved with specialty crop activity: working in the Rural Resources garden, cooking/preparing fresh produce and making a specialty crop value-added items for sale: frozen casseroles.

The Rural Resources garden was managed by our farmer, Paul Peterson, who designed the garden for a variety of program-related activities, including, but not exclusive to the teen training program. The plan was to recruit 4 CSA/Donors who would pay $1000, or three times the value of their food in order to pay

for extra baskets for teen interns and for Rural Resources program events. Other produce was sold via our online market (Localorbit).

Our second strategy was to distribute container gardens and involve low income families in other means of gardening/growing specialty crops.

Our third strategy was to improve the appearance of our Mobile Market—a roving billboard for specialty crops and provide tastings of specialty crops to families in low income neighborhoods.

Achievement of goals:

Three groups of 10 teens surpassed the projected training hours with each participating in 24 hours of training between April and September. One group fell below the projected hours of training with 12 hours. Six teens participated in the 70 hour summer internship.

In an end- of- the- year survey of teens, 100% of respondents indicated that their knowledge of specialty crop production/preparation increased. Additionally, we know from surveys that 100 % of respondents reported an increase in specialty crop consumption among their families.

Twenty families living in public housing neighborhoods received a container garden with peppers, tomatoes, squash, and cucumbers planted in them. Another 30 families participated in beginning and maintaining a shared raised bed garden in their neighborhood which provided vegetables to them all summer long. Our goal of involving 50 families in growing and eating specialty crops was achieved.

Hundreds children and their parents participated in 10 tastings between April and September alongside the Mobile Market which had a paint job to improve its appearance to better promote specialty crops.

Progress made to achieve the long term outcome of the program:

This part of the project was instrumental in connecting children, teens, and families with specialty crops and convincing them over the course of several months that specialty crops were foods that they desired. The true results will continue to grow overtime as teens and families continue to use the skills they gained by growing/preparing specialty crops as well as demanding the foods that they now have an experiential connection with.

Beneficiaries:

-Food insecure teens and their families.
-Families receiving container gardens.
-The community who benefited from trainings and promotions conducted by the teens at the Greeneville, TN Farmers Market and at the Greene County Fair.
-Those in the community receiving “tastings” of specialty crops delivered by Rural Resources Mobile Farmers Market.

Lessons Learned:

-How enthusiastic food-insecure teens and their families are to learn about growing and preparing specialty crops.
-How difficult it is for many families to access specialty crops due to lack of transportation and competing needs for the small amount of resources they receive.
-How open the community is to validating the teens as they share their knowledge as well as specialty crop culinary creations.

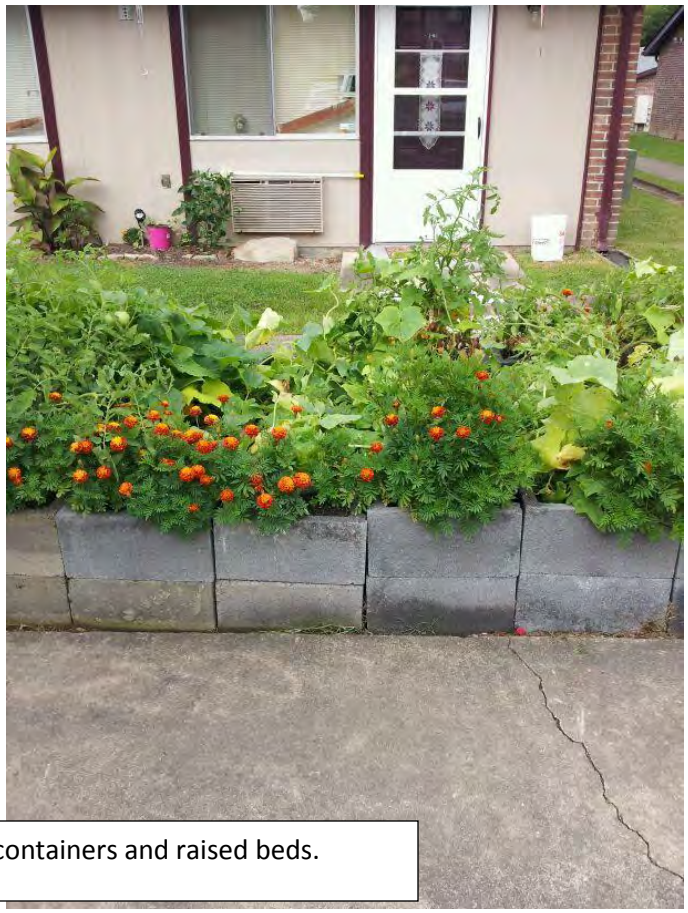
Additional Information:

Teen Interns: They spent 70 hours participating in an on-farm internship. Each week they received a basket of veggies to take home to their families and prepare and eat!

Teens cooking with specialty crops (sweet potatoes!)

Teens promoting specialty crops at the fair—who is a carrot and who is a pumpkin?

Teens promoted specialty crops by designing this interactive fair booth. In addition to veggie games and activities, samples of cherry tomatoes they had helped grow were given out!



Gardening happened in public housing via containers and raised beds.

The Mobile Market got a paint job to serve as a roving billboard for specialty crops!

Kids and grandmas too living in public housing got treated to locally grown apples.

Contact Info:

Sarah T. (Sally) Causey,
Executive Director
Rural Resources, Inc.
2870 Holley Creek Road
Greeneville, TN 37745
(423) 636-8171
sally@ruralresources.net

Project 9-Tennessee Farm Fresh Brand

Need for a grant:

The Tennessee Farm Fresh (TFF) program was started by the Tennessee Farm Bureau federation in 2007 from the Specialty Crop Block Grant Program (SCBGP). The development of the "Buy Local" movement has been strong and has aided the grower in profitability. TFF is bridging the gap between the consumer who wishes to purchase local agricultural products and the growers who are attempting to get their produce to a local customer base. This grant was needed to enhance and complement the work done with the previous SCBGPs, which were used to establish TFF. TFF was able to use this grant to start heavily promoting specialty crops in Tennessee by working to increase and improve TFF offerings to consumers, soliciting new specialty crop growers into TFF, visiting farms to verify specialty crop offerings and production, and conducting outreach to maintain service.

Approach taken for the project:

TFF holds a quarterly workshop in an agriculture area of Tennessee four times a year to help the producers market their specialty crops. These workshops cover many different topics that help the producer reach the consumer who wishes to buy locally. TFF covers many topics during these meetings that are included but not limited to; how to communicate the benefits of GAPs (Good Agricultural Practices) to consumers, the benefits of adding value to specialty crops, how to utilize Point-of-Sale materials to add recognition to your operation, and the importance of using customer service in a retail environment. In addition to the operations all new members are given a publication prepared by the University of Tennessee extension program on direct marketing of specialty crops and an educational book by Sarah Beth Aubrey, "Starting and Running Your Own Small Farm Business."

In addition to working with the producers to help them transition to a retail business TFF recognizes the need to promote specialty crops. TFF's marketing plan reaches over 25% of Tennessee's 6.4 million residents every six months. This is done through a series of print, radio, television, and online advertising as well as live promotional events throughout the state. TFF also placed brochures detailing the availability of Tennessee specialty crops in many areas throughout the state including farmers' markets, fairs, state parks, local attractions, welcome centers, street festivals, and other events throughout the state.
Tennessee specialty crops were promoted through the following series of advertising:

A) The purchase of promotional items that reach a targeted audience at events with a heavy presence of local food enthusiasts, ex. A new farmers' market grand opening.
B) Advertising on the WCTE "Live Green" series that reaches over 500,000 Tennesseans.

C) A series of advertising on WTVF, “News Channel 5” that advertises the availability of specialty crops when they were in season and a series of live promotional events on the daily news/human events series “Talk of the Town.” These live advertisements spoke about the specialty crops that were in season, the many uses of these specialty crops, and most importantly direction to the website where the consumer could locate these specialty crops.
D) A series of advertisements and a live remote with WATE-TV in Knoxville, TN. These advertisements were geared towards the availability of in-season specialty crops and the website where the grower could be located.
E) A series of advertisements on WBBJ in Jackson, TN that detailed the availability of specialty crops. These advertisements ran during news and human events programming.

We tailored our promotional plan to reach the maximum number of consumers with programming that was watched by the demographic we were attempting to reach.
TFF saw an increase of over 10% in the number of people who were following them on Facebook. This free resource has been invaluable in reaching the consumer who is searching for fresh, locally grown produce. Not only are we able to instantly connect to our consumer base, we are able to give fresh new ideas for uses of specialty crops in recipes. The consumer who seeks out and purchases fresh produce is usually the consumer who wishes to try new recipes and to also share recipes with the online community that follows these two promotional entities on Facebook.

TFF also started a newsletter during the peak growing season that was made available to consumers who wished to learn more about TFF members and their products. Initially, over 1,100 consumers signed up to receive the email newsletter.

Achievement of goals:

We have reached over 50% of Tennessee residents about the availability of specialty crops through the efforts of TN Farm Fresh. Since Tennessee always has the availability of locally produced specialty crops we were able to give all growers advertising time. The summer is when the majority of our fruits and vegetables are available, spring is when we are able to assist nursery and floriculture specialists, fall is when pumpkins and fall squash are available, and winter we are able to market Christmas trees and honey.

While we were not able to gain a percentage of the increase of on-farm cash receipts of sales to consumers, a survey sent to members that allowed them to answer anonymously indicated an average increase of $30,000 of on-farm cash receipts to our members. Many growers also stated that customer attendance was up and that the amount each consumer spent also increased, though we could not gage an accurate reading in either percentage or dollars spent.

One of the main goals of TFF has been to get the grower heavily invested in marketing their specialty crops. By reaching out to the consumer and inviting them on location to see how their produce is grown, handled, and packaged many growers have made GAPs the standard operating procedure and are employing many other safety and sanitary practices that is making the local producer an inviting place to come and visit and even more importantly spend money. Since the advertising budget for specialty crops mainly consist of the availability and directing consumers to the websites, many of the benefits and uses of the specialty crops as well as the practices of the grower have to be explained by the grower. TFF is extremely proud of the customer service skills that many of our growers have developed

and we are enlisting them to assist other specialty crop growers who are attempting to market their produce in a retail setting.

Results of the program:

Tennessee Farm Fresh (TFF) maintained the symbol of fresh and quality produce from a local Tennessee grower. After six years the TFF logo is now a recognizable standard on farms participating in the program. When TFF started it had 76 members, there are now 101 members.

The TFF webpage continues to operate as a main source for information and contact with the consumer and potential producers. This webpage received 9,497 views in 2013 with 27,210 page views. This includes 7,853 "unique" visits indicating multiple returns to the website. We believe these numbers indicate the TFF site is a widespread tool used by consumers to find local produce in their community. We believe a large majority of the 9,497 view represent family units. This belief is based on the following demographics visiting the webpage:

Percentage	Age Range
27%	18-24
18%	25-34
15%	35-44
12.5%	45-54
5.5%	55-64
5.5%	65-Over

This program has experienced some changes in 2013. The coordinator who launched TFF in 2007 took advantage of another job opportunity. This position has not been filled but remains open. A search for a qualified replacement with experience in this type of employment remains underway. Because of this open position, TFF changed policies regarding membership. Membership in the program is now without cost and members have free placement on the TFF website. The TFF program continued to provide promotional material, banners, and other support publicity featuring the TFF logo.

The success of the TFF program along with the open coordinator position provides an opportunity to transition TFF to an organization or institution with a greater capacity to expand the program. We believe TFF's success exceeded expectations and enables the program to evolve to higher level. We want to TFF to grow along with the local food market. Since this market is increasing exponentially, the TFF program must be in a position to do the same. The future expansion of TFF is currently being explored to maintain and enhance this coordinated marketing structure for a growing local food movement.

One of the goals that we stated in the proposal was that we wanted to increase on-farm cash receipts from sales to consumers purchasing locally by 10% over three years. We receive feedback from growers regarding how our advertising and events benefit their operation. However, they are extremely reluctant to give specific numbers pertaining to sales that would allow us to determine how advertising affects on-farm cash receipts. The most recent TFF survey of growers had 38 participants. Of these 38, 6 growers stated they gained 100 or more customers through participation in the program and 6 growers stated that sales increased $5,000 or more due to their participation in TFF. The majority of survey

respondents said that they were not able to measure how TFF increased their customer base or their sales.

Beneficiaries

The direct beneficiaries of the TFF program are the producers participating in the program and thousands of consumers pursuing locally grown produce. Other producers of locally grown products also indirectly benefited from the global awareness of locally grown products. Over 100 participants in the program were provided educational tools necessary to enhance their marketing efforts, improve the salability of their products, and reach out to potential consumers. Their operations are better prepared to find, market to, and keep customers through workshops, idea sharing, and one-on-one site visits.

The locally produced market is growing. One of TFF's primary goals is to connect producers with consumers because producers were not organized under a collective symbol for fresh and local produce. All indicators showed an established market and established producers but no prominent link between the two. The Farm Fresh program provided this link for consumers. As a result, consumers are able to find the products they want, the assortment they want, and the convenience in finding those producers.

TFF's promotion of locally grown products extends beyond participants of the program. While participants in the program receive many other services beyond commercialization, the entire market for locally produced products is expanded through TFF. This is an indirect benefit for producers across the state. TFF is an advantage for all of agriculture.

Lessons Learned

TFF is a new and innovative program. This type of program generally encounters many challenges. TFF learned branding is a critical component, relationships build success, demographics of consumers must be a consideration, and producers need to be prepared for this market.

1. The symbol of a marketing organization is the first introduction to consumers. The Farm Fresh logo was a major first step and ultimately was successful. The logo had to appeal to consumers and make a statement upon first glance. Many concepts for a logo were considered and casually placed in front of several individuals before settling on a final concept. This logo appeared on TV, web advertisements, print media, displays, and on farms. The importance of getting the logo right was one of the first lessons learned in this program.
2. Having a relationship with the producer of your food is core to the locally produced market. TFF had to build relationships with consumers through tradeshows, commercials, web messaging, and one-on-one encounters. One of the best examples of building relationships indirectly was local TV cooking shows. These shows typically highlight local businesses or organizations. Viewers are mostly food buyers for their home and depend on these shows for guidance. Also, producers are trained to develop relationships with their customers. Consumers of local products want to feel like they are a part of the operation. This is a major component to the success of a local products farm operation.
3. If a consumer of locally produced products has made the conscious decision to purchase these products as opposed to the convenience of most retail food stores, then they have a preconceived notion of their producer. Whether the market is on the farm, farmer's market, or

roadside market facility, the producer must make sure their facility and presentation is clean, pleasing, the products show quality, and the farm atmosphere is evident. Producers must take into consideration their potential consumer is willing to pay more for quality both in the product and the facility.

4. Some producers are not prepared for this niche market. Some potential members were not allowed to be part of the program because an on-site visit revealed quality issues, food safety concerns, and general lack of concern for the consumer. In some cases these issues were resolved but in others it could not. Saying no to a potential TFF member is not easy but ultimately the producer needs to realize they are entering a type of retail environment. Being part of the TFF program means the producer has prepared to meet a certain standard. This means the facility must be pleasing, the products must meet market demand, time must be allocated for continuing education through workshops, and customer relations should be a priority.

Progress made to achieve the long term outcome of the program:

TFF has made tremendous progress to help market the wonderful and varying specialty crops that the state of Tennessee produces. TFF recently upgraded its website to include Google Maps that will help the consumer find the farm that is sometimes off the beaten path. The "Buy Local" movement this initiative has been promoting is now taking off and buyers of agricultural products that do not have a historical record of buying locally, schools, restaurants, and cafes, are now advertising locally grown agricultural products.

Additional information:

Information about the Tennessee Farm Fresh program can be found at the website:

Tennessee Farm Fresh Home Page

Contact information for the sub-recipient:

Stefan Maupin
Tennessee Farm Bureau Federation
931-388-7872 ext. 2231
smaupin@tfbf.com