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SPECIALTY CROP BLOCK GRANT PROGRAM

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Karen Reichel, Grants Coordinator

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PROJECT 1: USING CONSUMER AND FLORAL WORKFORCE TO GROW THE FLORAL INDUSTRY

Partner Organization: Texas State Florists' Association (TSFA)

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Type of Report: Final

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Project Summary

The Texas State Florists' Association increased awareness of the Texas local florist through a high school design competition and increased media activities to promote local flower shops and increase sales.

Marketing is critical for the traditional retail florist to succeed. In 2011, the Texas Legislature passed a law making deceptive floral advertising illegal on the Internet. False advertising continues to be a concern to the traditional retail florist. Recognizing this concern several years ago, the Texas State Florists' Association created TexasLocalFlorist.com, a website that lists all Texas florists that have a brick and mortar shop location. TSFA completed social media marketing through Facebook and Twitter to increase visibility of this campaign.

In addition, the local floral industry continues to need skilled floral designers. TSFA has been training high school agriculture teachers with the goal of their students testing and becoming High School Floral Design Certified. Floral design competitions are an important challenge to advance skills in floral design. TSFA established a high school floral design competition that starts at the high school level with advancement to a state competition, annually in the Food & Fiber Pavilion at the State Fair of Texas®. TSFA anticipated that by creating this challenge and marketing it to the public, local florist will become familiar with the new skilled floral designers that are available and the media promotions increased awareness of Texas florists by consumers and new students.

Finally, TSFA and national floral industry leaders have also seen a decline in plants and flowers at funerals and memorial services, primarily with the phrase of "in lieu of flowers" printed by the funeral directors in obituaries. Plants and flowers are a thoughtful and a traditional way to honor a beautiful life. TSFA built on the promotion of the importance those plants and flowers make to a grieving family. With these promotions also being viewed on the Texas Local Florist website, TSFA anticipated that consumers will not only visit a local florist but will take the time to honor their loved one through flowers thereby increasing the sales of flowers.

Activities Performed

High School Floral Design Competition

-Three preliminary competitions were held on March 9, 16 and April 3, 2013, with a total of 13 contestants. TSFA held brief seminars in Pittsburg and El Paso, Texas to discuss the competition

and ways of encouraging participation in 2014. Five design competition finalists were selected based on scoring and represented their schools in the Final Competition. The Final Competition was held on October 19, 2013 in the Food & Fiber Pavilion during the State Fair of Texas®.

TSFA selected a media advertising company to help develop a campaign for TSFA's Final Junior Floral Cup Design Competition. The campaign included the following:

- 56 Radio ads ran on KDMX (Dallas/Fort Worth - Music variety) with a total of 569,900 impressions
- 79 radio ads ran on KPLEX (Dallas) with a total of 605,300 impressions
- Online Ad Results October 7-19 with a click through rate of 20 percent.
- Ran a network of online ads October 9-19, 2013 with a click through rate of 38 percent.
- Texas Local Florist.com "post" summary

Part of the online advertisements included a flower arrangement giveaway during the Jr. Cup Competition. As a result there were 125 online entries into the contest with approximately 30,000 page views of the contestants. The idea was this would increase awareness of the program. SCBGP dollars were not used in the floral arrangement giveaway.

Marketing on Social Media Sites

Zilker Social was contracted to market and promote local flower shops on social media sites through TexasLocalFlorist.com. The social media campaign was developed as the common resource for the consumer explaining and visually showing the importance of purchasing from a local florist.

Facebook: TSFA's Facebook page (<https://www.facebook.com/txflorist>) was completely redesigned to include custom tabs that functions as a mini-site within TSFA's Facebook page. There are 773 likes on this page, an increase of 130 from the previous reporting period. The local florist website has reached 329,524 visits since the project began in February 2013. TexasLocalFlorist.com Facebook page (<https://www.facebook.com/TexasLocalFlorist>) was created and has reached 223 likes on this page. Staff have had a tremendous amount of success creating customized tabs to merge different social media accounts together.

Twitter: A new account for TexasLocalFlorist.com (<https://twitter.com/#!/txlocalflorist>) was created in February 2013 and Twitter followers have grown to 130. The strategy on Twitter is to reach out to new prospective purchasers for the brick and mortar flower shop driven by visiting.

Several times per week there are "tweet ats" the followers and others around the Twitter-sphere that are talking about, or hash-tagging about relevant subject, (flowers, plants, weddings, local florist, etc.) This really creates a personal bond with the potential followers and customers.

TexasLocalFlorist.com: This works by targeting certain keywords and phrases, using those keywords to talk to specific people who may have posted an upcoming wedding or birthday.

Texas State Florist Association (<http://www.tsfa.org>): The success of this page is measured by the engagement posts have with the fans of the page and also with friends of fans. The more people that see and engage with posts, the more viral they become. The average viral rate is around 6.60 percent (Texas Local) and 4.72 percent (tsfa.org) as estimated by Facebook. This shows the power of influence within Facebook. Project staff is reaching a tremendous amount of people through Facebook. Not only those that like the page, but those people's friends also.

LinkedIn: A Texas State Florists Association Group has been established on LinkedIn with the goal of engaging people to talk about flowers and plants by showing the potential consumer ideas they can use with flowers and plants in the home, for events, birthdays, wedding, and sympathy.

Blogs: Are being written and published on TexasLocalFlorist.com, linked to Twitter and Facebook.

Pinterest: Staff has created a similar branding experience for the Texas Local Florist's Pinterest page (<http://pinterest.com/txlocalflorist>) and regularly "pin" floral related interests, insights, ideas, and inspirations. Boards were created for the consumer to view and directly link to the local flower shops.

In Lieu of Flowers Project

The Celebrating Life: The Families, Funeral Director and Florist program was presented at the Texas Funeral Directors Association (TFDA) on June 10, 2013 during the 127th Annual Texas Funeral Directors Convention where over 900 attendees earned Continuing Education Credits. The program content was developed with the outline of the importance of flowers and plants, eliminating the "In lieu of flowers" phrase and providing alternate phrases to "in lieu of" and showing that the local florist is here to support the funeral director.

During the convention TSFA members secured booth space and visited with the funeral directors about the importance of flowers and plants on the grieving process and requested they discontinue using "in lieu of flowers" in obituaries. TSFA members provided alternate phrases to "in lieu of flowers" on signage and brochures that were distributed during both the design program and the exhibits. TSFA was also able to distribute the Sympathy brochure.

Goals and Outcomes Achieved

The goal of the project was to develop marketing strategies that would increase traffic to the TexasLocalFlorist.com and TSFA Facebook pages along with the Twitter accounts encouraging the consumer to engage in the sites. Google Analytics reporting shows that 86 percent of those that visited the TexasLocalFlorist.com website from October 9-19 came from the Jr. Cup media campaigns referring sites where consumers were able to see the local flower shops.

TSFA surveyed member florists in the following areas of the state to determine a sales increase based on the "in lieu of flowers" campaign. The majority of florists did not separate sympathy sales out of overall sales so specific tracking was not possible. The percentage of sales provided below is based on total sales.

Austin: 21%

Houston: 11%

Dallas: 11%

San Antonio: 12%

Valley Area: 5%

Each florist surveyed did indicate there was an increase in sales over the period of the “in lieu of flowers” project.

Expected Measurable outcome of project was an increase in website traffic by 10%. The actual increase in website traffic was 15% based on google analytics.

Beneficiaries

- High School floral design students. Thirty-five floral design high school students from across Texas participated in the design competition. Each student increased their design skills throughout the project. Fifteen students received scholarships from the Texas Floral Endowment ranging from \$100 - \$500. each.
- The high school floral design teachers (ten) benefitted by additional publicity from the competition within their school districts and the public. However, TSFA expects the 2014 enrollment for the competition to double.
- Texas growers who benefited from the exposure of Texas grown products included in the campaign and on stage during the design competition. Texas has 6 plant growers/producers that were involved with the promotion.
- Texas local retail flower shops. There are over 900 retail, brick and mortar flowers shops listed on texaslocalflorist.com that benefited from the marketing/media exposure.

Lessons Learned

Creating a new program that will benefit Texas florist, growers and students, implementing the media and seeing it to conclusion was very rewarding for the industry.

TSFA will make certain that in the future, social media companies will assign one account representative to TSFA for the overall contracted time. Not every social media source is relevant to either the local florist or the consumer. The LinkedIn account has been the least popular and more focus will be given to Twitter, Pinterest and Facebook as these social media sources are the most used for the target demographic.

The funeral directors were not aware that by suggesting to their clients “in lieu of flowers” be listed that they were affecting their clients grieving process. By giving the funeral directors the alternative of suggesting the “in lieu of flowers” the funeral director was able to meet the family’s request of donations to the favorite charity and support the beauty of flowers and plants in the deceased memorial or funeral services.

Additional Information

During the 2013 Preliminary Competition, TSFA surveyed 125 high school floral design students asking if they were interested in pursuing a career in the floral design industry. Of the 125, 115 answered yes to some type of floral career interest.

PROJECT 2: IMPROVING MANAGEMENT PRACTICES FOR OLIVE (*OLEA EUROPAEA* L.) OIL PRODUCTION IN TEXAS (FOURTH PHASE)

Partner Organization: Texas Tech University

Project Manager: Dr. Thayne Montague

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Type of Report: Final

Date Submitted: December 2013

Project Summary

With commercial production of olives in Texas rapidly moving forward, production practices need continuous refinement. Given increased consumer demand for domestically produced olive oil, this growing industry provides new opportunities for olive oil production within the state of Texas. Starting in 2009 researchers at Texas Tech University, in conjunction with the Texas Olive Oil Council (TOOC) and the Specialty Crop Block Grant (SCBG), began research investigating environmental impacts and best management practices on growth of olive trees (*Olea europaea*) for oil production in Texas. This proposal continued research from previously funded SCBG initiatives by quantifying environmental impacts (salt tolerance, fruit production, and mycorrhizal inoculations) and best management practices (irrigation) on sustainable olive production in Texas. Secondly, due to increased pressure (drought and oil exploration) for valuable irrigation water, research was conducted on trees located in two orchards to study the effects of various irrigation regimes on olive production and oil quality. In addition, the potential for new orchards in Texas is increasing, and potential growers need basic information regarding startup costs. Therefore, a final component of the project was to assist new growers by developing a cost production budget for economic analysis of olive production decisions.

Project Approach

Throughout the project, a Masters graduate student (Staci Parks) performed much of the “hands on” work (orchard data collection, experiment upkeep, etc.) set forth in the grant proposal. Ms. Parks (assisted by Dr. Montague and Dr. McKenney) collected physiology and growth data (cultivar ‘Arbequina’) at orchards in Carrizo Springs and Artesia Wells, Texas (Figures 1 – 16). In addition, several olive producers contributed time and in kind donations (orchard trees, labor, etc.) which helped with completion of this project. Ms. Parks also completed research investigating the influence of salinity on gas exchange of containerized olive trees (cultivars ‘Arbequina’, ‘Koroneiki’, and ‘Picual’). In addition, Dr. Montague conducted research investigating water loss of containerized olive trees (cultivars ‘Mission’ and ‘Sevillano’) grown on lysimeters (Figure 17). Dr. Sharma contributed research investigating how mycorrhizae influence drought tolerance of olive cultivars ‘Mission’ and ‘Picual’ (Figure 18). Dr. Sharma also tested effects of inorganic and organic fertilizers on growth and development of the cultivar ‘Lecino’. Dr. Johnson conducted a survey of current practices, input, and decision making models to build a budget scaffold that will be used to make economic analysis of olive production decisions.

- Field research revealed olive tree gas exchange data generally did not differ between irrigation treatments. Shoot growth did differ between irrigation treatments. Greatest shoot growth was found on trees receiving the greatest amount of irrigation water.
- Data from harvested fruit indicate differences in fruit volume. Fruit with the greatest volume was found on harvested fruit from the low irrigation treatment. Low irrigation fruit was 5 and 16 percent greater when compared to high and medium irrigated fruit, respectively.
- Density of fruit did not differ between irrigation treatments.
- Oil results indicate total phenolic content was 24 and 31 percent greater from trees receiving the low irrigation treatment when compared to trees receiving the medium and high irrigation treatments, respectively.
- Results from this year's experiment indicate irrigation volume had little influence on 'Arbequina' olive tree gas exchange. Despite receiving two thirds less water, trees in the low irrigation treatment had similar gas exchange when compared to high and medium irrigated trees.
- Total phenols are the aggregate measure of polyphenol content in olive oil, and are a key antioxidant component in olive oil. In addition, total phenol is an indicator of the oil's health benefits. Low irrigation is often reflected in increased polyphenol levels and this is true for the study.
- Reduced irrigation appears to have been beneficial to fruit production in this orchard. In addition, reduced irrigation helped to conserve precious natural resources. However, reduced irrigation can have limitations. Late in the growing season when temperature levels increased, researchers and the orchard manager noticed fruit had a raisin (shriveled) texture. This influence was true for all irrigation levels. This raisin effect likely reduced fruit density and lowered fruit quality.
- Salinity results indicate increased soil salinity did influence olive tree gas exchange and growth. However, results varied according to cultivar. Of cultivars examined, across all salinity treatments it appears 'Arbequina' had the greatest root, shoot, and leaf growth. However, 'Picual' tended to have the greatest gas exchange (transpiration, photosynthetic rate, etc.).
- Lysimeter data indicate water loss for cultivars 'Mission' and 'Sevillano' is closely related to reference evapotranspiration. However, lysimeter data continues to be evaluated.
- Mycorrhizae data indicate organic fertilizers may produce greater growth when compared to inorganic fertilizers. Biomass of mycorrhizae inoculated plants in response to irrigation regimes are yet to be determined. However, preliminary data indicates plants inoculated with mycorrhizae may have greater biomass under water stress conditions.

After consulting with TOOC leaders, and numerous growers, Dr. Johnson developed budget spreadsheets to help determine grower economic decisions. An example budget case was developed and tested following interviews with olive producers. Researcher's data indicate reduced irrigation may be beneficial to olive growers. Not only would growers conserve water, but oil with greater quality may be produced. In addition, selection of more salinity tolerant cultivars, inoculating trees with mycorrhizae, and using organic fertilizers have potential benefits which could save productions costs and increase profitability.

Several significant accomplishments were achieved during the term of the grant. First, as field research was conducted, the researchers were able to visit with numerous growers to discuss concerns and future research possibilities. Second, Dr. McKenney, Dr. Johnson and Dr. Montague were able to participate in the Second Annual TOOC Research Conference. Instead of giving talks to a live audience (as was done in 2012), presentations were recorded on video and uploaded to the TOOC website (<http://www.texasoliveoilcouncil.org>)

Goals and Outcomes Achieved

One of the chief goals of this project was to investigate response of olive tree flowering to weather and climate. Although progress was made in this area, to date researchers have not accomplished all that was set out to do. Staci Parks collaborated with a number of producers. However, producers did not follow through on monitoring phenological events in their orchards, greatly hindering data collection. Weather stations have not been set up in three orchard locations (Carrizo Springs, Artesia Wells, and Walburg, TX).

A second goal of the research project was to investigate the physiological response of established olive trees to various irrigation regimes. Goals were achieved in this area. Field grown trees in two orchards were subjected to three irrigation regimes. The data indicate trees exposed to low irrigation rates often compared favorably with trees exposed to medium and high irrigation rates. Fruit and oil quality data confirmed reduced irrigation may favorably influence production practices.

During the growing season, lysimeter data was collected for several months. As previously mentioned, data is currently being analyzed.

Mycorrhizal data appears promising. Research investigating if the presence mycorrhizae influence enables olive trees to withstand drought shows positive results, and data will be collected and analyzed shortly.

The data continues to give insight into physiology, irrigation, and mycorrhizae options for olive oil production. Staff believes irrigation in most orchards should be more closely monitored, and may likely be reduced without adversely affecting tree response (physiology and crop production).

The goal of increasing producer access and knowledge of best management practices (irrigation, mycorrhizae, salinity, increasing profits, etc.) through access to the TOOC website (<http://www.texasoliveoilcouncil.org/conferences/2013/09/index.html>) was obtained. Personal contact with growers indicates many visited the website and viewed the presentations. Officially, as of December 2013, conferences presentations had been viewed 151 times (talks were downloaded 651). Because most TOOC members are couples or farm groups, it is estimated each single use represented 2.3 individuals. Therefore, approximately 341 conference views were made. This is a dramatic increase when compared to the 270 people who attended the 2012 TOOC Conference in San Antonio, TX. Online pre and post-conference surveys were conducted. Overall, for each presentation post-conference survey results indicate significant increases in knowledge based as compared to pre-conference knowledge base.

Beneficiaries

Beneficiaries from this olive research are the 150 olive growers in Texas, and those who are planning to produce Texas olives in the future. Current producers are in need of greater management information. As previously mentioned, irrigation management in olive orchards is critical for healthy trees and oil quality. Data from this research gives current producers updated, regional information which will help them make decisions to increase productivity. In addition, growers can reduce energy costs and save water. Future growers have greater knowledge of olive varieties which may be best suited for Texas climates and weather. In addition, future growers will have greater knowledge of irrigation requirements, and soil management techniques to improve production. This will assist in planning and installing irrigation systems in new orchards. Over the past year, staff has presented research at several meetings sponsored by the TOOC including the olive grower conference. In addition, Staci Parks presented her olive research at the Annual Southern Region of the American Society for Horticultural Science meetings in Orlando, Florida to more than 25 people each session.

Lessons Learned

Managing projects from a distance of several hundred miles continues to be a trial. Cultural management practices (irrigation, pruning, etc.) needs to be better coordinated with producers. Data collection at a distance is difficult and time consuming. It is better to collect data more frequently (weekly or bi-weekly). However, because of distance and finances this was not possible. Therefore, staff took the best approach and collected data on a monthly basis. They continue to have great participation from select olive growers, which seem interested in the work. In addition, whenever a need has come up, the TOOC is anxious to assist in finding solutions. Encouraging growers to collect data is a challenge that currently does not have a solution. Producers have little free time, and relying on them to gather phenological data (flower, fruit set, etc.) has been difficult. Although important, this aspect of future research may need to be eliminated.

Additional Information

Graduate student Staci Parks will receive her Masters of Science degree in August 2014. The working title of her thesis is “Effects of Salinity and Irrigation on Gas Exchange and Productivity of Texas Olive Trees”. Dr. Montague is scheduled to present a portion of this year’s research at the upcoming Southern Region American Society for Horticultural Science annual meeting to be held in Dallas, Texas (February, 2014). In addition, a portion of the research conducted in 2011 and 2012 will be published in the journal HortScience, titled “Evaluation of Mulch and Pre-emergence Herbicide Combinations for Weed Control in High Density Olive (*Olea europaea* L.) Production”, and will be published in 2014.



Figure 1



Figure 2



Figure 3



Figure 4



Figure 5



Figure 6



Figure 7

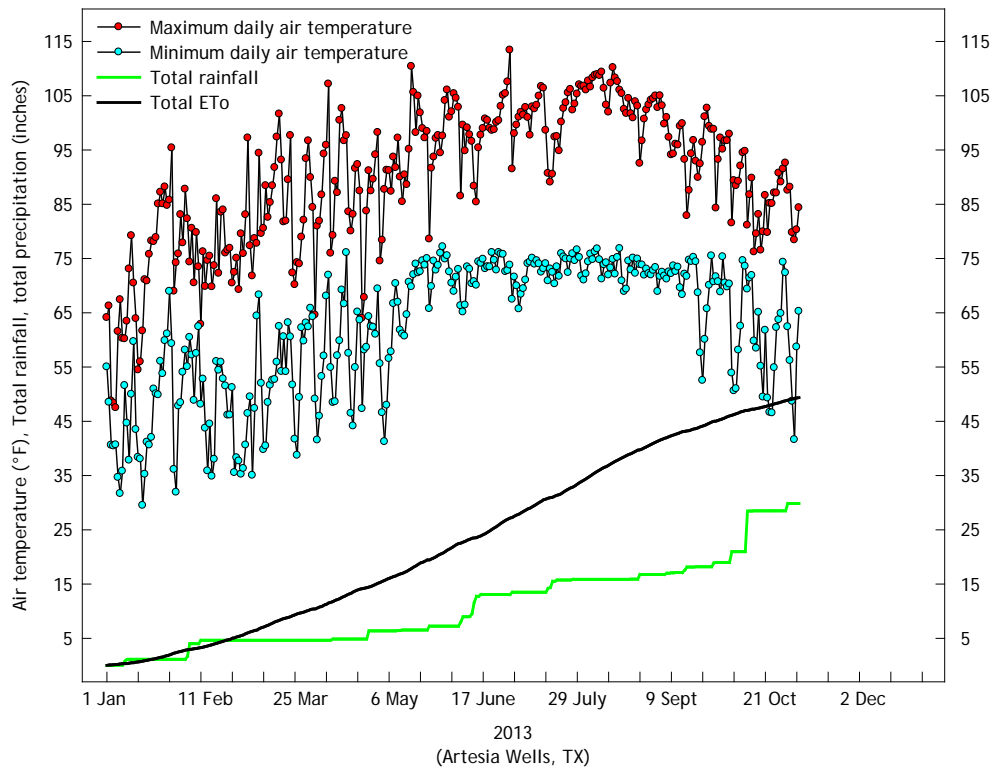


Figure 8

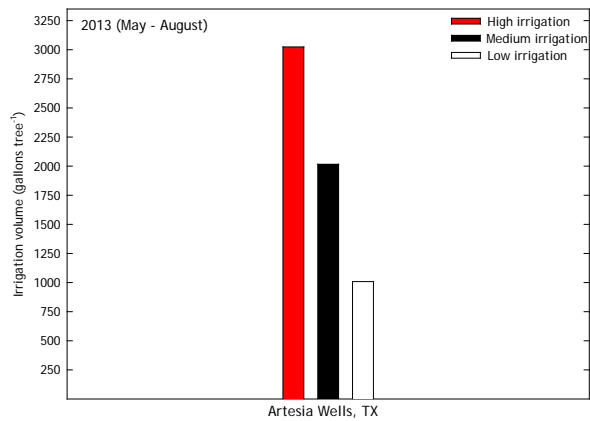


Figure 9

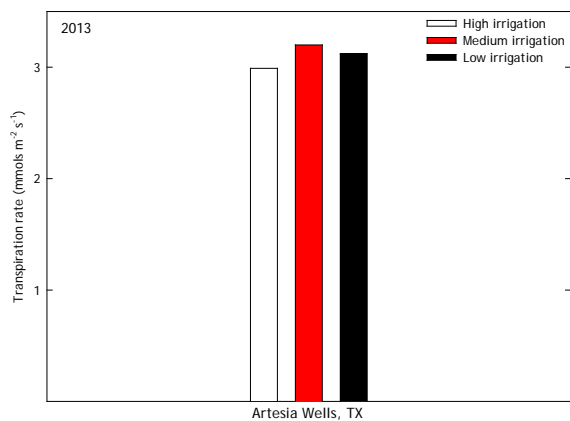


Figure 10. Each bar is the mean of 150 measurements.

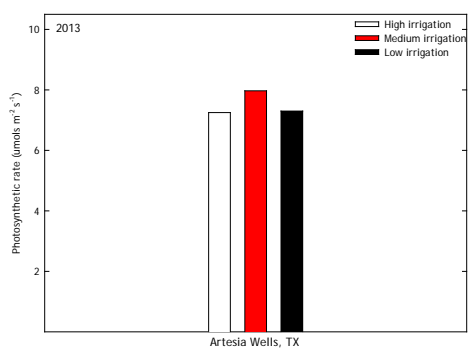


Figure 11. Each bar is the mean of 150 measurements.

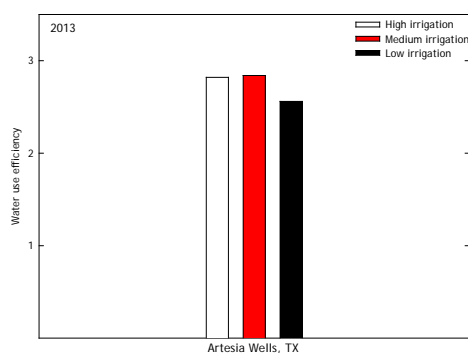


Figure 12. Each bar is the mean of 150 measurements.

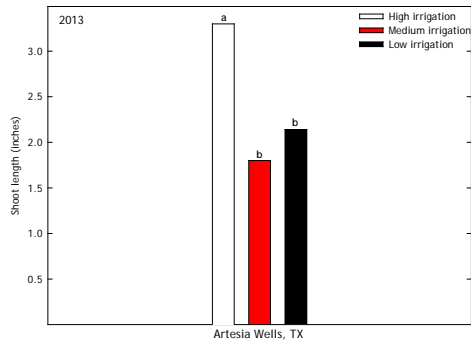


Figure 13. Each bar is the mean of 50 measurements. Letters above each bar indicate differences between irrigation treatments.

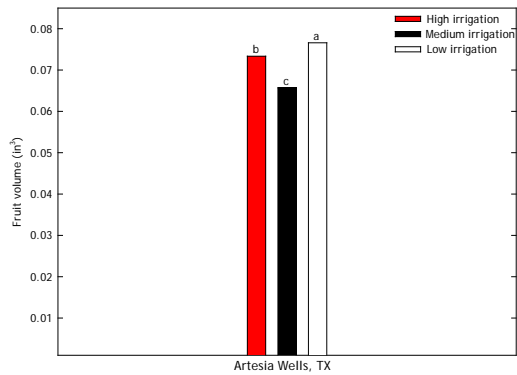


Figure 14. Each bar is the mean of 250 fruit. Letters above each bar indicate differences between irrigation treatments.

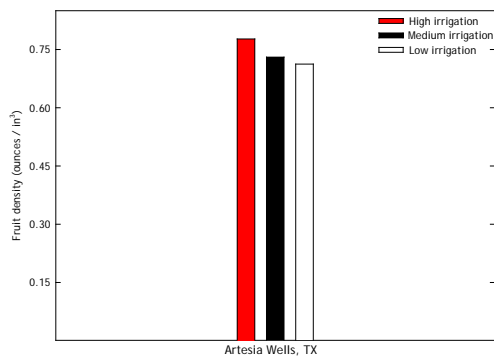


Figure 15. Each bar is the mean of 250 fruit.

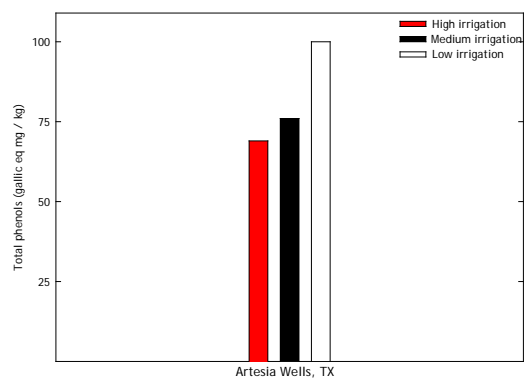


Figure 16.



Figure 17.



Figure 18.

PROJECT 3: DEVELOPMENT OF A RAPID, GROWER-FRIENDLY, HIGHLY-SPECIFIC FIELD METHOD FOR DIAGNOSIS OF CITRUS GREENING DISEASE USING TISSUE-BLOT IMMUNOASSAY

Partner Organization: Texas A&M AgriLife Research

Partner Organization: Texas Citrus Mutual; Rio Grande Valley Sustainable Agriculture Task Force, South Tex Organics

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Type of Report: Final

Date Submitted: Aug. 31, 2014

Project Summary

Citrus greening (also known as Huanglongbing or HLB), is a deadly bacterial disease recently confirmed in the Lower Rio Grande Valley (LRGV) and poses a serious threat to citrus production in Texas. Early/accurate pathogen detection is a critical component of an efficient HLB containment/management strategy. However, the current visual and PCR-based methods for detection of the HLB pathogen (*'Candidatus Liberibacter asiaticus'*) are non-specific, labor-intensive, time-consuming, and not practical for large-scale field screening. Project staff proposed to (1) develop high-specificity antibodies against *'Ca. Liberibacter spp.'*, (2) use the newly-developed antibodies to develop HLB-specific TBIA detection protocols, (3) cross-validate the new technique with PCR and visual diagnostic methods, and finally, (4) develop prototype grower-friendly kits for field screening trees for HLB infection.

Project Approach

Project staff partnered with the local containment areas (door-yard) and the area-wide psyllid management programs in south Texas and worked closely with the scouting crews of Texas A&M University Kingsville Citrus Center to obtain samples for DNA extraction and polyclonal antibody development. Leaf tissues from suspicious infected trees were collected for mineral content and PCR analysis. Tissue samples that were confirmed as positive were further used for DNA sequence analysis.

Researchers analyzed the sequence data of the HLB-causing bacterium, *'Candidatus Liberibacter asiaticus'*. Two proteins, nod T (GenBank accession YP_003065343.1) and Outer Pr (GenBank accession YP_003064727), were identified as outer membrane proteins. Two peptides, CG_nodT_5343 "LIRNRPDIRYQEKKLAD" and CG_Outer_Pr_4727 "KGARLGYYSWSDEVN" were selected from the 2 identified outer membrane proteins and used for developing polyclonal antibodies. The specificity was tested of the 2 polyclonal

antibodies using Western hybridization. The result showed that the sizes of the target proteins of the antibodies are correct. However, the specificity of the antibodies needs to be improved.

To develop high-specificity antibodies against '*Ca. Liberibacter asiaticus*', we compared genome sequence of '*Ca. Liberibacter asiaticus*' with all the available pathogen sequences in GenBank. Based on the comparison analysis, we excluded the sequences that share high similarity with other pathogens. 3 proteins were selected that are predicted to be surface proteins and didn't show high similarity with other pathogens. Staff screened the 3 proteins to identify hydrophilic regions for ideal antigenic epitopes. Six peptides were designed from the hydrophilic regions of the selected proteins and submitted for developing monoclonal antibodies against '*Ca. Liberibacter asiaticus*'. The 6 peptides are listed in **Table 1**.

Table 1. Selected peptides for developing monoclonal antibodies against '*Ca. Liberibacter asiaticus*'

Start position	End position	Epitope sequences
30	41	LHKSNDTIDVKNK
60	71	DTGIVVSRIGDM
67	78	SFGEEAHHNAGG
147	158	ETGKAGEITPIA
293	304	TKNSITSDPGYT
328	339	RKDLPKEIDSGY

The western-blot assay was optimized to obtain complete transfer of proteins to the PVDF membrane and used secondary blotting technique to eliminate non-specific background. We used a synthetic peptide-BSA conjugate as positive control that was detectable up to a concentration of 0.01 ug using dot-blot (**Figure 1**), indicating the monoclonal antibodies we have developed are specific to the targeted proteins. However, we were not able to detect a positive signal in the four pooled symptomatic midrib samples using the monoclonal antibodies on a western blot (**Figure 1**). Previous studies showed large numbers of '*Ca. Liberibacter asiaticus*' bacterial cells were observed in phloem sieve tubes from presymptomatic young flushes (Folimonova and Achor 2010). In contrast, no bacterial cell was observed in highly symptomatic leaf samples (Folimonova and Achor 2010). The leaf samples we tested were collected based on symptomology alone, and thus it is likely unsuccessful western blot results were simply due to low numbers of bacterial cells in the tested samples.

Researchers further analyzed the genome sequence of '*Ca. Liberibacter asiaticus*' and designed 4 pairs of PCR primers targeting '*Ca. Liberibacter asiaticus*' as a cross-validation method for detecting HLB. These new primer sequences are listed in **Table 2**. Among the 4 pairs of primers, primers 1, 2, and 4 worked consistently and were, therefore, used for testing samples from field scouting.

Table 2. PCR primers targeting '*Ca. Liberibacter asiaticus*'

Primer Name	Primer Sequences	Tm
HLB-1F	CCCGCTTAAACGAGAGTTGA	60.38
HLB-1R	AATGCACCACAGGCATACAA	60.00
HLB-2F	GGCTAAAGATGTCGCTACGG	59.87
HLB-2R	TAGCCACCTGAGACCTTGCT	60.01
HLB-3F	CTCTTCGCCACCAAGTCATG	58.92
HLB-3R	GATGCGCCATGATACTCTGC	59.20

HLB-4F	GCGGCTCTTCTTGATACACC	58.34
HLB-4R	GCTGTTCTCTGGCAGTAAGG	56.17

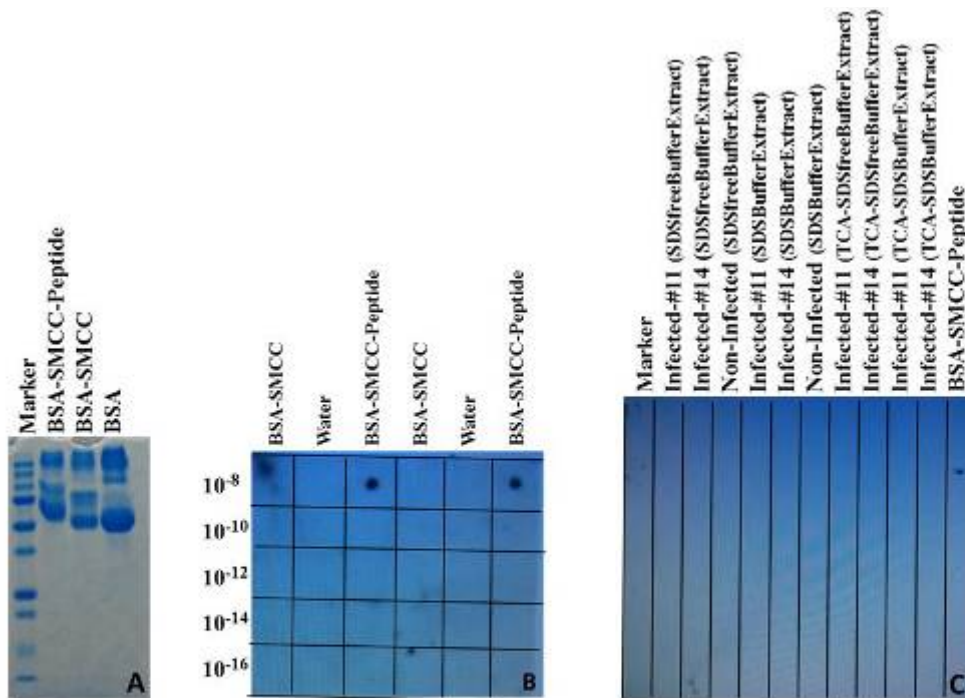


Figure 1. A. Gel shift indicated successful conjugation of synthetic peptide to BSA to use as positive control. B. Chemiluminescent signal corresponding to peptide conjugated to BSA could be detected in dot blot using Primary antibody (1:5000 dilution) and HRP conjugated secondary antibody (1:500,000 dilution). C. Chemiluminescent signal corresponding to the peptide-conjugated BSA was detectable but no signal was detected in lanes corresponding to various protein preparations of symptomatic and non-symptomatic leaf midrib samples using double blotting procedure.

Goals and Outcomes Achieved

Project staff developed 2 polyclonal and 6 monoclonal antibodies against surface proteins of '*Candidatus Liberibacter asiaticus*', and tested specificity of all the antibodies were developed. The antibodies developed from the project can be used for immune-based assay to detect HLB, and can be used to trace the pathogen movement within the host plants or insects as well.

Project staff also designed 4 pairs of PCR primers targeting '*Ca. Liberibacter asiaticus*'. Three of them showed consistent and robust results. These primers can be used as a PCR-based cross-validation method for detecting HLB.

Project personnel made frequent field visits and consulted with interested/participating growers to advice on HLB diagnosis. A workshop was conducted in conjunction with "Education Program for Asian Citrus Psyllid Scouting and Citrus Greening Survey" on June 13, 2014 at the TAMUK-Citrus Center. Attendees included more than 25 citrus growers in the Lower Rio Grande Valley.

Beneficiaries

The antibodies developed in the project can be used for early detection and screening for HLB in citrus orchards, nurseries and breeding programs. Currently, the only recourse after a tree is positively identified as infected with HLB is removal. The cost of tree removal and replanting has been estimate at approximately \$600 per acre. Early detection and tree removal will reduce inoculum size, slow HLB spread, and minimize the cost of removing/replacing infected trees. There are over 1200 active citrus growers in Texas who collectively manage about 28,000 acres of citrus groves. Farm receipts from citrus operations are estimated to be approximately \$85-88 million; the citrus industry as a whole contributes approximately \$250million to the state economy. Using the antibodies developed in the project, early diagnostic tool can be developed and integrated into HLB management.

Lessons Learned

Low numbers of '*Ca. Liberibacter asiaticus*' bacterial cells in infected trees made early detection of the HLB challenging. '*Candidatus Liberibacter asiaticus*' are currently uncultured α -proteobacteria. Therefore, no reliable positive control is available for us to develop a standard detection protocol. A more sensitive assay, such as immunocapture-PCR and immune-PCR, needs to be developed for early detection of the HLB.

Additional Information

N/A

PROJECT 4: SUSTAINABLE FOOD CENTER SPECIALTY CROP PROMOTION PILOT

Partner Organization: Sustainable Food Center

Project Manager: Suzanne Santos

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Type of Report: Final

Date Submitted: 02/27/14

Project Summary

The Sustainable Food Center (SFC) Specialty Crop Promotion Pilot was developed to increase the sale of specialty crops (fruits and vegetables) to low-income families in east and southeast Austin. The specific strategy used was doubling the dollar value of Supplemental Nutrition Assistance Program (SNAP) and Women, Infant and Children (WIC) benefits using electronic benefits transfer (EBT) technology and Farmers' Market Nutrition Program (FMNP) vouchers utilized to purchase specialty crops at participating farmers' markets. SFC also sought to create a replicable model of the Double Dollar Incentive Program (DDIP) to increase the sale of specialty crops to low-income families at Farmers' Markets community-wide. SFC did increase the DDIP from one site to two sites within this grant period. At the end of this grant period (September, 2013) SFC was rolling out the DDIP to two more sites in the SFC Farmers' Market system.

Since SFC is very focused on hunger/food insecurity and obesity prevention, our programming primarily targets families, neighborhoods and schools within the most economically disadvantaged zip codes of Austin. SFC also serves the more than 50 farmers that make up the majority of the vendors in the SFC Farmers' Market system. The DDIP proved to address both needs: 1) Raise consumption of more fruits and vegetables to begin the trend to address diet related disease; and 2) Keep small local family farms viable by increasing the competitive sales in fruits and vegetables.

The Center for Disease Control confirms there is a high correlation of diet-related illnesses and poverty (<http://www.cdc.gov/chronicdisease/states/pdf/texas.pdf>), and recommends that communities, "improve availability of mechanisms for purchasing foods from farms." Studies also strongly demonstrate that the consumption of nutritious food, such as fresh fruits and vegetables, can improve academic performance in children and reduce the incidence of diet-related diseases by half.

Project Approach

The Double Dollar Incentive Program (DDIP) pilot extended into a second year (October 2012 through September 2013) utilizing grant funds from the 2012 Specialty Crop Block Grant (SCBG). The 2012 SCBG allowed staff to continue operations of the program at two sites to increase the competitiveness of the fruits and vegetables from local farmers, and, to begin the planning and refining of operations to replicate them at two additional sites in FY 2013-2014. The 2012 SCBG allowed staff in this second year to train more than 24 farmers (proposed 20) at two sites (SFC Farmers' Market East and SFC Farmers' Market at Sunset Valley) and to conduct

the Double Dollar Incentive Program (DDIP) in efforts to make specialty crops more competitive. Specialty crop farmers selling fruits and vegetables at the market sold \$86,757 in this second year at two markets (87% of the \$100,000 goal). During October 2012 through September, 2013, the project reached 1,726 unduplicated clients, 226 over the proposed goal of 1,500. Including family members in client households, this represents a total of 6,041 individuals who benefited from the program. 100% of the participating specialty crop farmers reported an increase in sales, while the objectives were that 80% would. More than 175 consumers in the DDIP program were surveyed this summer and 92% of them reported increased consumption of fresh fruits and vegetables, demonstrating that in the second year of the program consumption is well over the proposed 80% of those surveyed. Staff in this second year continued to refine the processes for the on-site operations team that were executing the program, and also instituted training sessions for the volunteers who assist the DDIP coordinator.

Three training sessions were held for more than 30 Information Booth volunteers, and seven market coordinators or assistant coordinators on site at market days were trained extensively in the operations for the DDIP. During the expansion into the second Sunset Valley site for program replication, the SFC Farm Direct Program Director and SFC Food Access Manager refined the training materials for the farmers and conducted on-site trainings with 24 farmers. The operations steps for implementing the program at farmers' markets were designed with such detail and precision that Wholesome Wave Foundation and USDA requested SFC's operational description for use nationwide.

Training includes details on the types of scrip (WIC, SNAP, DDIP), the significance of each of these scrip types, customer interaction standards, redemption processes, and tracking requirements. In order to support the training, the SFC Farm Direct Program Director, the SFC Food Access Manager, each of the DDIP coordinators, the SFC Farmers' Market Coordinators, and Information Booth Volunteers conduct role playing with the farmers to prepare them for participating in the program and understanding how to sell their specialty crops competitively. Additional training and monitoring continues constantly as new representative from farms come into the markets.

A strong operational and programming team designed a quick and efficient process to access DDIP benefits, and maintained a consistently high quality market with ample volume and variety of specialty crops for the clients, many of whom had not experienced a farmers' market before, and who certainly had never used DDIP before. The operations of the market implementation on market day consists of two hours of set up, four hours of running the market, then two hours of break down. The market manager was on site at all times for market operations, trouble shooting on machines used by farmers, collecting scrip for reimbursement, setting up layout each week, generally making clients and shoppers feel welcome to be in the market. There was also a bilingual DDIP coordinator, who provided the explanations to clients and who ran the SNAP, Texas WIC EBT and FMNP doubling process, which included data entry and also using a central SNAP machine.

This is how it specifically worked, in order to track the SNAP, Texas WIC, and FMNP benefits spent to measure that the process worked to increase the competitiveness of specialty crops. Specialty crop purchases and the corresponding Double Dollar Incentive dollars were tracked via

a token and scrip system. Project staff has used a token system for SNAP purchases at SFC markets for over five years and the farmers and other vendors were already trained on how to accept the tokens for other SNAP eligible products like milk, eggs, etc. We separated the SNAP benefits for fruits and vegetable buys from the other SNAP-eligible, non fruit and vegetable purchases in the following manner:

Step 1: A customer approaches the central information booth to use a SNAP card.

Step 2: The market coordinator asks the customer the following questions: “How much would you like to purchase today from your SNAP card for fruits and vegetables, knowing that you will get a ‘match’ for those fruit and vegetable purchases with double dollars in a one for one match up to \$10? Would you like to get tokens for any eligible, non-fruit/vegetable SNAP purchases such as eggs, bread or honey, which are not matched with double dollars?”

Step 3: The customer tells the coordinator they want to take \$10 from their SNAP account for fruits and vegetables and \$10 for non-matched eligible items. (This is just a sample, it has been a number of different variables each time).

Step 4: The market coordinator swipes the card and processes a \$20 transaction.

Step 5: The market coordinator indicates the following on the \$20 SFC receipt of the transaction: \$10 in TOKEN amount for non-matched, eligible items (non fruit and vegetable), and \$10 in Double Dollar matched eligible items. The customer will receive \$10 in scrip to signify the withdrawal from their SNAP account, which indicates that it can only be used for fruits and vegetables. The customer will also receive \$10 in scrip for the ‘doubling’ of their \$10 SNAP purchase in fruits and vegetables. The total in scrip the customer receives is 20 \$1 SNAP Double Dollars that can only be used to buy fruits and vegetables. The customer will also receive \$10 in market tokens for the non-matched portion of the transaction.

Step 6: The coordinator asks the client for their first name and if this is their first visit to the market. They also ask them for the last group of four digits on their SNAP card. The coordinator then records this information immediately on the laptop computer at the market.

Step 7: The coordinator then records on the laptop the amount of non-matching SNAP tokens that the client receives, the amount of scrip that the client receives, and the matching amount of scrip double dollars that the client receives – exactly one to one – for the fruit and vegetable portion of the SNAP purchase.

Step 8: The coordinator then gives the client their tokens and scrip, and ensures that the customer understands the difference between the two forms of payment before they leave the central information booth. All farmers and vendors at the market understand what these forms of payment can be used for, which is how the spending is controlled once the customer leaves the booth to shop.

In addition, the Sustainable Food Center (SFC) was one of the 501 (c) (3) entities that was contracted with the state of Texas Department of Agriculture to issue and administer the Farmers Market Nutrition Program in the Austin area. All entities in other cities in Texas in the limited FMNP program were food bank organizations working with area farmers’ markets. In Austin, SFC was the entity contracted for distributing the FMNP in voucher booklets, one booklet per eligible client in which the booklet held 5 \$4 vouchers that had to be signed by the mother (or a proxy) at the time of the purchase at the farmers’ stand. SFC was contracted by TDA to

distribute and regulate the use of these booklets, as well as being the organization that also ran the farmers' markets willing to accept the FMNP in the Austin area. This put SFC in a unique situation to distribute the vouchers designated for Women, Infant and Children (WIC) eligible clients right at the farmers' markets, where the clients would then be able to immediately be able to purchase the fruits and vegetables from the farmers. The FMNP program specifically limits purchases to only fruits and vegetables at participating farmers' market associations. At the time of the implementation of the TDA supported FMNP program, SFC Farmers' Market convinced other farmers' markets in the area to commit to taking FMNP (though other markets did not have the capacity to issue the vouchers). The issuance of the voucher booklets at SFC Farmers' Markets (all four sites) was conducted by an entirely different staff person hired for the season. The location of the farmers' markets as the distribution point was an added incentive for WIC moms to come to the markets in the first place, and because we already had the staffing for the DDIP program, and the funding (from private foundations) for the matching dollars, we instituted doubling of purchases on the FMNP purchases as well, tying in the traceability of the fruit and vegetable purchase with a receipt that was written by the farmer, that was then brought back to the information booth for the DDIP coordinator to record the receipt of the FMNP purchase total. Data was then entered for the amount of the purchase, and the amount of the matching scrip (marked as FMNP scrip double dollars only) that was issued. The farmer kept the vouchers that they had received from the FMNP client, and then turned them in according to prescribed processes for the voucher system.

Goals and Outcomes Achieved

The goals of the project were to increase the sale of specialty crops in east and southeast Austin in the amount of \$100,000. SFC did track, from October, 2012 through September, 2013, specialty crop farmers selling \$86,757 in fruits and vegetables in this second year at two markets (87% of the \$100,000 goal). During October 2012 through September, 2013, the project reached 1,726 unduplicated clients, 226 over the proposed goal of 1,500. Including family members in client households, this represents a total of 6,041 individuals who benefited from the program. 100% of the participating specialty crop farmers reported an increase in sales, while the objectives were that 80% would. More than 175 consumers in the DDIP program were surveyed this summer and 92% of them reported increased consumption of fresh fruits and vegetables, demonstrating that in the second year of the program consumption of fruits and vegetables is well over the proposed 80% of those surveyed. Other data, such as collecting anonymous information about a survey respondent's ethnicity, income range, and zip code, were also collected in this snapshot survey. The 2012 DDIP program data of how many farmers participated, how many transactions were conducted, how many benefits were used (e.g. SNAP amount), and how much was doubled—was all entered weekly into a data collection report that was submitted to Wholesome Wave. The annual report is compiled here, using data collected from dozens of projects nationally http://www.wholesomewave.org/wp-content/uploads/2014/07/2013_double_value_coupon_program_factsheet.pdf

A more extensive research report that used the 'cluster' method of four cities (Austin was not included because it was still a new program)

http://www.wholesomewave.org/wp-content/uploads/2014/07/2013_healthy_food_incentives_cluster_evaluation.pdf

This program of DDIP was specifically implemented to increase the competitiveness of the farmers' fruits and vegetable sales (specialty crops) so that they could sell more fruits and vegetables specifically tied in with an incentive program that attracted new customers that could become steady buyers. These are estimates given by the farmers on their fruit and vegetable sales.

Beneficiaries

24 local farmers (up from 20 the previous year) were involved in the Double Dollar program. There were also 1,726 unduplicated clients (up from 1,075 the previous year) who benefitted. The shoppers, who also shared their purchases of fruits and vegetables with approximately 3.5 other members of the family, were preparing healthy foods for 6,041 individuals. The Double Dollar program, upholding the competitiveness of fruits and vegetable farmers in central Texas, could not have been possible without the funding of the incentive dollars (\$43,379) by foundations (St. David's Foundation, Anderson Foundation, Farm Aid, Wholesome Wave) to match the purchases made by SNAP and WIC shoppers.

Lessons Learned

The outreach for the DDIP needs to continue each year, as new clients from SNAP and WIC enter into the system. Even new staff at SNAP and WIC offices need to stay informed. While SFC continues to conduct targeted outreach to low-income clients, there also needs to be a more general appeal to people of all spectrums to come to farmers' markets. The messaging is being revised so that cash customers as well as SNAP and WIC customers are attracted to markets.

In this second year of DDIP operations, SFC converted to scrip (paper) only for the currency in the program and is slowly phasing out the tokens. There was a period where scrip and tokens were in use and the consistency of the currency needed to be achieved so that no one type of customer would be discriminated against.

Additional Information

n/a

PROJECT 5: PRODUCTION AND MARKETING STRATEGIES FOR SPECIALTY MELONS AND ARTICHOKE

Partner Organization: Texas A&M AgriLife Research at Uvalde

Project Manager: Daniel I. Leskovar

Contact Information: Daniel.Leskovar@agnet.tamu.edu 830.278.9151 x.249

Type of Report: Final

Date Submitted: February 24, 2014

Project Summary

The main purpose of this project is to expand the commercial production of specialty melons and globe artichokes in Texas. Tuscan type melons and other cantaloupes with green and orange flesh color are very popular in the U.S. These melons have gained substantial market share in the past 10 years across the U.S., primarily due to consistently high sugars, excellent quality, unique flavor and high nutrient levels. Globe artichoke is a high-value commodity in the U.S. where consumption has more than doubled in the last three decades, from 0.6 to 1.5 lbs per capita in 1980 and 2009, respectively. Commercial production of artichoke is almost exclusively in California, with 7,900 acres, and an average yield of 9,490 lbs/acre. This project is expected to benefit small and large producers from diverse growing regions in Texas, as well as consumers who will be able to distinguish fresh, locally grown, and high quality melons and artichoke produced in Texas. This project had initial target duration of three years. The project was designed to evaluate and refine planting and crop management systems (irrigation, mulching, planting configuration and cultivars) for artichokes and melon genotypes and commercial cultivars in both growers' fields and research settings. The production components were complemented with consumer preference studies for both crops.

Project Approach

Activities and tasks

1. Artichoke cultivar performance

Field tests were established in commercial sites in the LRGV (Brownsville), Wintergarden (Uvalde), Hill Country (San Antonio and Stonewall), and in small plots in central Texas (College Station). Among the traditional cultivars, the OP types Imperial Star (early) and Green Globe Improved (late) were the best performers. Four new germplasm recently developed by Big Heart Seed Company (Brawley, CA) was tested for the first time in Texas: Lulu; Big Red, #176, Deserto and Imperial Jade. In Brownsville, Imperial Star and Imperial Jade cultivars had highest marketable yield (7.6 and 8.5 t/ha, respectively) due to high head number. Big Red and Deserto had very low yields due to late maturity, response that is related to more chilling requirements. In Uvalde under a plasticulture system, Imperial Star and LuLu had the best marketable yields (11.5 and 10.4 t/ha, respectively) and Purple Romagna the lowest (5.2 t/ha). Similarly trends were observed in San Antonio. At the Uvalde location individual plant selections were made from Green Globe and Imperial Star based on earliness, vigor, freeze tolerance, yield, and head quality.

2. Artichoke planting configuration and plasticulture

Black plastic mulch with 1 central line per bed (80 inch-wide) and subsurface drip irrigation (4 inch-depth) was the best system for growth and yield of artichoke in the Wintergarden area. Compared to bare-soil, this system promoted yield earliness, high marketable yields and saved significant irrigation water. A second study comparing this system on three cvs. Imperial Star, Green Globe and Purple Romagna grown under plastic mulch and bare soil, confirmed the previous results, with marketable yields being 11.5, 8.7 and 5.2 t/ha with mulch, and 9.0, 7.8 and 4.1 t/ha with bare soil, for cvs. Imperial Star, Green Globe and Purple Romagna, respectively. A follow up study on these cultivars aimed at evaluating spring and summer plantings under plastic. The first year results indicate that transplanting during late spring or midsummer may not be suitable for artichokes due to increased heat stress that caused high transplant mortality. This indicates the importance of future evaluations of transplant systems aiming at improving root growth while reducing leaf transpiration to reduce summer transplant ‘shock’.

3. Artichoke consumer preferences

This study conducted with 196 individuals evaluated seven products (fresh and processed) which were rated based on the overall appearance, color, smell, taste, freshness and final overall acceptance. The artichokes that were canned, large size and purple color received the highest ratings for appearance, color, smell, taste, and overall acceptance. However, the fresh varieties selected by Texas A&M received the highest ratings in terms of freshness. Among the fresh varieties, the large, green received the highest ratings for all the attributes. Regardless of size and color, when comparing can vs. glass containers, those (large-green) received equal or higher ratings based on appearance, color, smell, and freshness.

4. Melon trials for vine growth, fruit quality and yield

From all established melon trials those at Edinburg, La Feria and Uvalde Center produced harvestable melons. The latter also was successful to screen for powdery mildew, fruit quality and maturity data. About 8 from 70 breeding lines tested showed best fruit quality and yield. Among the breeding lines, 6 were orange-fleshed western shipper types, one was a white-fleshed Asian type muskmelon, and one was a white-fleshed honeydew melon. All of the hybrids but one were orange-fleshed western shipper types. One line (# 6) was a Tuscan type melon with orange flesh and sutures. Six hybrids (# 4, 7, 8, 14, 20 and 21) showed excellent vine vigor and resistance to decline caused by *Monosporascus* root rot. At Uvalde powdery mildew was severe, while vine decline was limited to a few cases of charcoal rot. Hybrids 4,7,17,20,24,27 and 31 exhibited intermediate resistance to powdery mildew, while hybrid 14 had high level resistance. All were more resistant than the commercial hybrids Mission and Olympic Express. The crossing block at College Station generated several hundred seeds each of 15 hybrid combinations, and about 1000 seeds of hybrid 4 for 2014 field trials.

5. Melon irrigation management

The irrigation melon experiment that compared deficit irrigation (50% vs. 100% ETc) on three melon types showed significant differences in root and shoot growth and yield. Specific details of this study are going to be published in the peer reviewed journal *Agricultural Water Management*. Overall, deficit irrigation saved 37% to 45% of irrigation water in Mission and Da Vinci cultivars (*reticulatus*) with a moderate reduction in marketable yield. This practice may not be applicable for cv. Super Nectar (*inodorus*), as it reduced yield, without improving water use efficiency. Additional work showed that root distribution patterns changed with cultivars with a

significant increase (2.3x) in root growth with deficit irrigation in cv. Mission. In terms of root methods, the soil core root growth estimates were more consistent than when measured with a minirhizotron; however the latter was useful for screening cultivars under water deficit due to its ability to capture more root growth in deeper soil layers.

Goals and Outcomes Achieved

The main goal of this project is to expand the area and offer of these commodities grown in Texas, while adopting improved production strategies leading to high quality products for consumers. Our initial target of growers was achieved (6 minimum) while the numbers of consumers participating in the panel was exceeded by 4x, since we reached a population of 196 consumers. We are on target to reach an initial goal of 40-50 acres of artichoke and specialty melons. We have achieved about 32 acres of artichokes growing in Texas so far and new efforts for 2014-2015 indicate the possibility to add another 10-20 acres. Melons with elevated sugars and desirable organoleptic qualities, as grown in south Texas, were identified within the TAMU breeding program. Seed of new, TAMU melon cultivars was produced and licenses with commercial seed companies were pursued.

The data obtained from the second year for objectives 1 and 2 will assist long-term in the application and validation of best production strategies and treatments in growers' fields. Similarly, experiences shared with the growers will continue to be used in educational activities related to production and marketing.

Events:

A consumer preference study with seven products was conducted in College Station to elicit preferences and willingness to pay of artichoke products, including green and red heads, fresh and readily available processed products.

A total of 172 nonstudents participated in a consumer experiment of specialty melon during 8 sessions. The six products analyzed were cantaloupes, honeydews, galia, Tuscan and canary yellow. The average willingness to pay (WTP) for all products was \$1.92 without tasting. After tasting the products willingness to pay decreased for all products except for Tuscan melons with WTP increased from \$1.83 to \$2.05 after tasting.

Training and on-farm discussion on artichoke harvesting, product quality, size, packing, and marketing outlets were conducted in Rancho Viejo at M. Ortiz farm during March 2013.

Presentations:

Outcomes from the melon and artichoke portion of the project were highlighted at the American Society for Horticultural Science (ASHS) Conference in Palm Springs, California; the Desert Technology Conference in San Antonio, Texas, and water regional meetings in Texas.

Leskovar, D., Xu, C. Agehara, S., Sharma, S.P. and K. Crosby. 2013. Irrigation strategies for vegetable crops in water-limited environments. DT11: 11th Annual Desert Technologies Conference, San Antonio, TX, November 19-22, 2013.

Sharma, S.P., Leskovar, D., Crosby, K. and A. Volder. 2013. Root growth adaptation to deficit irrigation of melons in semi-arid conditions - A minirhizotron study. DT11: 11th Annual Desert Technologies Conference, San Antonio, TX, November 19-22, 2013.

Sharma, S.P., Leskovar, D.I., Crosby, K.M., Ibrahim, A.M.H and A. Volder. 2013. Soil type and cultivar effect on root growth and stomatal conductance of muskmelon (*Cucumis melo* L.). 73rd Annual meeting SR-ASHS, p 5. (Abstr.)

Sharma, S. P., Leskovar, D.I., Crosby, K.M., Volder, A. and A.M.H. Ibrahim. 2013. Comparing minirhizotron and soil core methods for measuring root growth of melons under deficit irrigation. ASHS Annual Conference, p 75. (Abstr.)

Leskovar, D.I., Palma, M.A. and R.I. Cabrera, R.I. 2013. Deficit irrigation strategies for high-value crops in South Texas. NGWA Summit- The National and International Conference on Groundwater. San Antonio, TX. April 28-May 2, 2013.

Leskovar, D.I., Xu, C., Solis-Perez, A. Agehara, S., Sharma, S.P., Cabrera, R.I. and K. Crosby. 2013. Irrigation strategies for high-value vegetable crops: Making the most with less water. RGBI Annual Meeting, San Antonio, TX, April 2013

Publications:

Leskovar, D.I., Xu, C. and S. Agehara. 2013. Planting configuration and plasticulture effects on growth, physiology and yield of globe artichoke. HortScience 48(12):1496-1501.

Leskovar, D.I. and Chenpig Xu. 2013. Irrigation strategies and water use efficiency of globe artichoke. Acta Horticulturae 983:261-267.

Beneficiaries

This project is directly benefiting current and potential growers (and also Texas consumers) of specialty melon and artichoke in south, southwest and central Texas. Growers involved in the project were instrumental in providing data, comments, inputs and suggestions in areas of interests such as production management, harvesting as well as promotion of both heads and flowers. The project assisted not only in the production issues, but in the commercialization and promotion of Texas grown artichokes from Brownsville and Stonewall which were successfully marketed in Austin and San Antonio retailers and farmers markets. About 30 acres of artichokes are currently growing in Texas, with expected sales of about \$375,000 and a minimum economic impact in excess of \$1 million. By changing varieties and adoption of improved management practices for the same 30 acres we expect sales to increase over \$630,000 and an economic impact in excess of \$1.7 million. The potential opportunity for artichoke consumption in Texas is much higher since, conservatively Texas may consume a volume produced in 1,250 acres.

The Texas AgriLife communications Dept. develop a comprehensive Research-Grower Texas artichoke YouTube video clip which was posted in at least 18 websites and several newspapers. For a preview of this video, visit our Texas A&M AgriLife Uvalde Center site at uvalde.tamu.edu. Seed of new TAMU melon cultivars will benefit commercial seed companies, growers and home gardeners.

Field tours to interested growers are conducted at the Texas A&M AgriLife Research Center at Uvalde. In addition, lessons learned from the evaluations and research is shared among the

leading growers in the LRGV, Wintergarden, Hill Country and central Texas, including growers' organizations such as TOFGA and TVA.

Lessons Learned

The lack of available new cultivars of specialty melons and artichokes (e.g. red color head) is in part due to limited seed production from the main seed-producing areas (e.g. California, Arizona) as well as the lack of cultivar adaptability to Texas environments, which are characterized by dry and hot climates, and high nighttime temperatures. Project staff are screening selections from Imperial Star and Green Globe cultivars that have shown better adaptation to our conditions, and expect seed availability to increase for testing in 2014/2015 season. Commercial seed companies have less interest in Texas as a market for melon seeds, therefore making production of new hybrids difficult. Another uncontrollable situation is the decline of melon production in Texas due to safety issues in open fields, and the more stringent regulations in growing this crop, including in the packing and storage operations.

In artichoke, local farmers' markets continue to be ideal marketing channels. Other direct marketing outlets, including retailers such as Whole Foods and HEB and community supported agriculture (CSA), offer good possibilities to expand production, assuming they can develop a product line with specifications more realistic to Texas grown product (e.g. mid-large size artichokes grown in Texas vs. the jumbo size typically coming from California).

Additional Information

Links to artichoke stories

<http://today.agrilife.org/2013/04/04/artichokes-in-heart-of-texas/>

http://www.freshplaza.com/news_detail.asp?id=107755

<http://eatsblog.dallasnews.com/2013/04/texas-artichokes-challenge-california-staple.html/>

<http://livingbetteronline.blogspot.com/2013/04/artichokes-in-heart-of-texas.html>

<http://www.perishablenews.com/index.php?article=0028524>

http://www.yourglenrosetx.com/news/lifestyles/article_c6746d3a-b884-5607-83b1-36949efe6628.html

<http://agfax.com/2013/04/04/texas-low-maintenance-high-profit-artichoke-looks-good/>

<http://www.thegrower.com/news/regions/southwest/Artichokes-are-a-rising-star-in-Texas-201532281.html>

http://news.silobreaker.com/artichokes-finding-a-place-in-the-heart-of-texas-5_2266728303962357807

http://m.brownsvilleherald.com/news/local/article_9963b41c-a490-11e2-b234-0019bb30f31a.html?mode=jqm&login=

<http://www.hobbyfarms.com/farm-industry-news/2013/04/30/artichokes-take-spotlight-in-texas.aspx>

<http://www.myplainview.com/content/tncms/assets/v3/eedition/e/98/e985c7ac-76a3-5d09-aedd-f7f9dee38968/5165e8ef0b171.pdf.pdf>

<http://www.growingproduce.com/article/33761/artichokes-find-a-place-in-texas>

<http://www.texasgardener.com/Newsletters/130515/>

<http://www.great-taste.net/tidbits/artichokes-prosper-under-mo-produce-llc-in-the-heart-of-texas/>

<http://jhvonline.com/artichokes-find-a-place-in-the-heart-of-texas-p14990-148.htm>

PROJECT 6: ENGAGING CONSUMER AND GROWER AWARENESS FOR OLIVES AS A TEXAS SPECIALTY CROP – CONTINUATION OF 2012 PROJECT

Partner Organization: Texas Olive Oil Council,
Manager: Karen Lee PhD
Contact Information: 512-466-3816, klee@texasoliveoilcouncil.org
Type of Report: Final
Date Submitted: 2/28/2014

Project Summary

Since commercial olive cultivation began in Texas in the 1990s, the scale of Texas olive agriculture has grown from a small group of six pioneering visionaries with small test orchards to approximately 200 growers actively cultivating orchards for commercial olive production. Extra virgin olive oil production has grown from 1,200 gallons in 2006 to 18,800 gallons in 2013, with approximately 3,000 additional acres expected to begin producing in the 2014 growing season. This new production could add up to 50,000 additional gallons to Texas olive oil production in 2014. In addition, current olive orchard developments in Texas are expected to add between 600,000 and 800,000 new olive trees this year. The Texas Olive Oil Council sees an increasing interest and investment among growers and entrepreneurs in Texas olive agriculture, and works toward supporting the growth of both Texas olive growers and the Texas olive oil consumer market.

Freshly milled, Texas-grown extra virgin olive oil is a new specialty food produced in Texas, Texas consumers are relatively unaware of its existence, what fresh olive oil tastes like, why it is good for you, or where to get it. In addition, many Texas farmers are interested in developing or repurposing family farms or ranch lands to grow a specialty crop with higher revenue potential. While Texas growers have begun the process of developing olive orchards and making olive oil, it is necessary to educate and inform Texas consumers about this new specialty crop and product so there will be a strong, growing consumer market for Texas grown extra virgin olive oil as it comes to market. It is critical to the success of Texas growers that the demand for quality Texas extra virgin olive oil be developed in a manner commensurate with production.

The Texas Olive Oil Council seeks to increase consumer awareness, interest, and trial of Texas olive oil, provide information about quality and availability, and provide information and practical tools for Texas olive growers to improve the viability and yield of Texas olive crops. This project undertook to further these goals by upgrading, maintaining and expanding our current website, promoting Texas olive oil via the Internet, organizing and presenting a conference that consolidated the main body of research on Texas olive horticulture, and providing ongoing Texas olive oil demos at Texas farmers markets, community events, festivals, and media opportunities.

Project Approach

The Texas Olive Oil Council approached this project by building on the foundation we created when this project began in 2011. At that time, our website was old and outdated, difficult to navigate, and was not easily updated or user friendly. Under our 2012 SCBG project, we

overhauled the website so that it is now easy to use across multiple platforms—smart phones, readers, and computers. We enhanced this project in 2013 by adding a Texas Olive Growers Conference ONLINE new media archive summarizing and condensing the most relevant and contemporary body of research on Texas olive horticulture. The online conference was able to reach our membership more efficiently and cost-effectively than a physical venue conference, and enables access to information at the user's convenience, thus establishing a valuable and enduring resource for Texas olive growers. Our continuing work on this project since 2011 has increased our website users by more than 35% per year since this project launched, and our 2013 online conference has resulted in 651 downloads by the end of 2013, compared to attendance at our 2012 physical growers conference which was attended by 270 people representing 159 business and private interests. In summary, the 2013 project greatly increased reach and accessibility of important olive horticulture information to growers and potential growers, and remains available as an established resource, summarizing the entire body of work to date of publication on olives in Texas. It is and remains a valuable resource.

It is generally agreed among olive oil professionals that an actual taste experience of fresh olive oil is the most convincing way to educate consumers about the importance of freshness for olive oil health benefits. We created practical, educational and informative materials for Texas olive consumers and horticulturists, including bookmarks detailing the benefits and uses of Texas extra virgin olive oil and where to purchase it, and performed olive oil demonstrations at more than 800 different venues, providing almost a quarter of a million samples to Texas consumers, along with telling the story of Texas olive oil and building demand for this specialty crop production.

The Texas Olive Oil Council also used the internet to reach a diverse and geographically diffuse group of interested consumers, potential growers and active growers in Texas via social media, accumulating over 5,000 Facebook 'likes' and generating a Facebook forum where fans post recipes and experiences. We also provided quarterly updates for important news impacting the olive industry.

Texas olive growers donated much of the product that was sampled at demo events. Cowgirl Brands provided special sample bottling and secured product from Texas producers not contributing donations to this project. Texas Olive Ranch, Central Texas Olive Ranch, Anderson Ranch, Farrell's Olive Orchard, First Texas Olive Oil, Sandy Oaks Olive Oil, and Texas Hill Country Olive Oils were routinely sampled. Website design, maintenance, upgrades, electronic media and online events were provided by BAH Design of Austin Texas, and Iniosante Productions provided video production services for the online conference. Product Demonstrations were conducted in central Texas through Next Door Pantry of New Braunfels and in the Dallas-Fort Worth metro area through Cowgirl Brands LLC. The scope and commitment of this project has been extensive throughout the state, and has resulted in thousands of olive oil samples being distributed every weekend of the year.

The overall change to an online conference did not change the budget more than 20%.

Goals And Outcomes Achieved

• Increasing Awareness And Acceptance

Goal: 50% increase in olive oil retail sales over previous 12 months

Product demonstrations at Farmers Markets and Community Events – Since the beginning of the grant period, olive oil tasting demos have been conducted at 884 events and farmers markets, with an average of 280 sample demos per day, for a total of **247,520** 0.5-oz samples given (964 gallons over the grant period). The majority of this extra virgin olive oil was donated by Texas olive oil producers including Texas Olive Ranch, Central Texas Olive Ranch, Jewett Farms,

Farrell's Olive Orchard, and Anderson Ranch. In addition, the TOOC purchased oil from noncontributing Texas olive producers Texas Hill Country Olive Company, Sandy Oaks Olive Orchard, and First Texas Olive Oil to include in demonstrations so that customers could learn the breadth of Texas olive oil production and availability.

Of the people sampling Texas-grown olive oil for the first time, approximately two-thirds reported not being aware of the taste and properties of freshly grown extra virgin olive oil, expressed surprise at the flavor and complexity of the oil, and made purchases. Approximately 8% of tasters had previously tasted fresh olive oil from Texas or while traveling in Europe or California and were pleased to know freshly pressed Texas-grown olive oil is more readily available. Approximately 4% of people sampling fresh Texas olive oil did not like it, saying it was "too hot," or "too peppery," and this is consistent with research conducted by UC Davis in 2009 showing that 33% of American olive oil consumers prefer flat, tasteless, or rancid olive oil. Overall, sampling at events has shown consistently to be the most effective method of converting consumers to purchasing fresh Texas grown olive oil. Olive oil demos were performed during local news broadcast in these metro areas:

- Harlingen Texas PBS Station KMBH, December 4, 2012
- San Antonio Texas KLRN, Fine Wine & Cuisine Tasting, February 17, 2013
- San Antonio Texas Crazy Caprese Event at RIPE Market with Paula Disbrowe demonstrations July 20, 2013

Expected Measurable Outcomes: Our goal was to increase total Texas olive oil sales by 50% over estimated 2012 retail sales of \$782,550. With an average unit price of \$11.54, this represents approximately 67,800 bottles sold. For the last 12 months, November 2012-October 2013, total retail sales of Texas grown olive oil is estimated at \$2.14 million, based on sales venue reports from participating resellers and Texas olive oil brands distributed through retail channels including Texas Olive Ranch, Central Texas Olive Ranch, Farrell's Olive Orchard, Anderson Ranch Olive Oil, Texas Hill Country Olive Company, Sandy Oaks Olive Orchard, First Texas Olive Oil, Lone Star Olive Farm, and Charta Olive Farm. Converting sales dollars to bottles sold at the 2013 weighted average unit price of \$11.81, this represents approximately 185,400 bottles sold. This increase represents approximately **273% increase** over the previous 12 months, exceeding our goal of a 50% increase in sales.

Goal Outcome: Far Surpassed Goal, and Extended Performance to Achieve 273% Growth in Sales Over Previous 12 Months.

• Website Marketing & Upgrades

Goal: Increase website viewership by 10% over previous 12 months

This year, our website audience continued to grow at a robust pace. Feedback comments from users and members on the new website has been very positive. Overall, users like the new look and feel and find the website very user-friendly.

Building Awareness: Chef Rebecca Rather Cooking With Olive Oil Demos in Cooking Classes -- Chef Rebecca Rather has performed 16 cooking classes using Texas-grown olive oil at Central Markets in Dallas, Houston, Austin, and San Antonio over the past 12 months. In her capacity as a celebrity chef (winner of the James Beard Cookbook Award) she has served as a celebrity judge and demonstrated recipes as a celebrity chef at 23 additional special events and always makes a point of telling the story of Texas olive oil. Chef Rather has created 24 recipes across six seasonal themes, a 60% increase in output over our goal. Recipes are featured on Chef Rather's Blog which is embedded on the Texas Olive Oil Council website. In addition, in 2013 we added embedded blogs for other food writers focusing on olive oil including Tom Mueller's Truth in Olive Oil Blog, Love & Olive Oil Blog, Olive Oil & Lemons Blog, Simple Craves & Olive Oil, and the Olive Press Blog.

Social Media Promotion: In 2013 we launched a Facebook campaign promoting "Texas Olive Oil" to generate word of mouth advertising in the social media realm. As of this writing, Texas Olive Oil has 5,218 new "likes" and a constantly growing Texas Olive Oil fan base. Facebook stats show 409% increased traffic and click-throughs to the Texas Olive Oil Council website during periods of paid promotion, so we are utilizing Facebook 'boosting' when we post new information to the Texas Olive Oil Council website, which is driving a lot of our increased website viewership.

Google AdWords Promotion: Also in 2013 we launched a Google AdWords program to capture consumers searching for information in the popular search engine. Using this tactic, we create an average of 889 impressions per day for Texas olive oil searches including "texas olive oil," "texas olive trees," "texas olive," "olive oil," and "olive orchard." This tactic has to-date yielded an average click-through rate of 0.42% and an estimated reach of 106,608 Facebook members. We are also seeing a lot of user posts and discussion regarding olive oil quality, uses, and recipesharing.

Expected Measureable Outcomes: Across all activities and tactics, results have been strong. Website activity increased over all and remained higher throughout the year for a total result of 836,279 hits in this grant period, a 38% increase on a month to month basis over 2012. Unique visitors were up sharply in the last quarter of the grant period, with total unique visits in the past twelve months up 39% over the previous twelve months. This increase is significantly greater than the 10% goal set for this grant period. Daily average hits for the past twelve months are 1808, up from 1432 the previous 12 months. Website statistics are from AWSTATS, a statistical analytics package provided by our domain hosting service, Bluehost; Facebook Ads Manager, and from Google Analytics.

Quarterly Ezine & Newsletter: Our ezine mailing list includes 543 Texas Olive Oil Council members comprised of growers, potential growers, suppliers, industry resources and sponsors. We published four quarterly issues in the past 12 months covering timely events in the olive industry and two issues in promotion of the online Texas Olive Growers Conference, for a total of six ezine issues in the last twelve months, and two special editions in the last quarter of 2013.

Goal Outcome: Surpassed Goal and Continued to Improve on Metrics, Achieving 38% Increase in Viewership Over Previous 12 Months. These data provide new baselines for measuring future growth in media utilization.

• **Provide Grower Training and Education**

Goal: Provide industry resources and information for 60 olive growers in Texas.

Texas Olive Growers Conference -- In 2013 we coordinated a comprehensive review of all relevant research in the Texas olive industry and filmed the primary researchers presenting their work. This landmark body of material was reviewed, edited and posted on our website for the ongoing reference of our membership, creating an industry archive of easily accessed scientific research presented in an easily understood manner. It is a body of work we are especially proud to have preserved for our industry. Since launching, these presentations have been viewed 151 times and remain available for members to access at their convenience. Interest in these presentations is drawing inquiries from all over the US, particularly with regard to expansion of the US olive industry outside of California, where escalating costs of land, regulation, and limited water resources are increasingly precluding possibilities for expansion of the US olive industry in that state. Texas continues to be the focus of interest for development for US olive agriculture. In addition, the demand for Dr. Johnson's crop calculator has been strong, and that tool continues to be beta tested as more data become available. The online conference officially launched September 30, with the following video presentations permanently capturing the current state of Texas olive horticulture research:

1. *Feasibility, Management, and Bio-Active Compounds: What We Have Learned So Far: A Review of USDA Olive Research*, **Nasir Malik PhD**, Research Plant Physiologist, USDA — Agricultural Research Station
 2. *Olive Research at Texas Tech University: Impact of Salinity on Olive Management*, **Cynthia McKenney PhD**, Department of Plant and Soil Science at Texas Tech University. Authors: Cynthia McKenney, Thayne Montague, Jyotsna Sharma, Staci Parks
 3. *Update on Olive Tree Research at Texas Tech University*, **Thayne Montague Ph**, Department of Plant and Soil Science at Texas Tech University; Texas AgriLife Research and Extension Center
 4. *Enterprise Budgets for Texas Olive Growers*, **Jeff Johnson PhD**, Agricultural and Applied Economics, Texas Tech University
 5. *Report on Recent Developments in the Olive Oil Industry*, **Karen Lee Henry PhD**, Managing Director, Texas Olive Oil Council
 6. *Critical Considerations for Olive Farming*, **Noel Garcia**, President, Texas Plant & Soil Lab
- Javascript Olive Orchard Management Calculators:* Dr. Jeff Johnson, Professor of Agricultural Economics at Texas Tech University introduced a newly developed agricultural cost-calculator designed for Texas olive growers. The calculator enables growers to accurately predict costs of planting olive trees and bringing them to maturity in specified locations in Texas. Dr. Johnson began developing this project in February of 2013 and presented the beta version of this calculator online in the 2013 Texas Olive Growers Online Seminar launched September 25, 2013. The functions of the calculator are reviewed and all variables are discussed in detail. Dr. Johnson plans to release the final version by the end of the calendar year.

Significant Contributions: BAH Design of Austin has handled all of the website design and interactive user interfaces, Dr Jeff Johnson of Texas Tech University has developed the Crop Calculator Tool along with his students; Jim Henry and Karen Lee Henry of the Texas Olive Oil Council continue to provide economic data, content, direction and product samples as needed; Dr

Nasir Malik of USDA Research, Dr Cynthia McKenney of Texas Tech University, Dr Thayne Montague of Texas Tech University, Texas Plant and Soil Lab of Edinburg Texas all provided scientific research and presentation materials; Ashley Scott Davison of Iniosante Inc. provided video production, writing, art direction, and editorial services for all the video presentations; Texas Department of Agriculture GoTexan Program made this program possible through the Specialty Crop Block Grant Program and ongoing consultation.

Expected Measureable Outcomes-- Conference Attendance: Since the conference materials are published online and there is no deadline for availability, we are seeing a slow and steady pattern of usage rather than the intense spike associated with a physical, live conference at a normal conference venue. Since launching this project, conference presentations have been viewed 151 times, averaging 35 views per week and downloaded 651 times. There are 34 unique member users to date. Since most attendees at last years conference were part of a couple or farm group we estimate each single use to represent 2.3 individuals, boosting our estimate of number of exposures to **347 views** to date. As the year progresses we expect this material to continue to be relevant and maintain viewership.

Expected Measureable Outcomes--Knowledge Base: Pre-and post-conference surveys were posted using Survey Monkey.

The pre-conference survey is here:

<https://www.surveymonkey.com/MySurvey/Responses.aspx?sm=Y2xtMEI8H6YJ1E45gsYgld%2fjfy4vwHMRpYR3%2bLSbpBY%3d>.

The post-conference survey is here

<https://www.surveymonkey.com/MySurvey/EditorFull.aspx?sm=eDVb5sq5rm%2bQ7g1qHmrXWebbruArSTMqs427AA8aYm%2fg%3d>.

Survey results are shown in Appendix 1. Overall, postconference survey results show significant increases in knowledge base as compared to preconference knowledge, for all presentation topics.

Expected Measureable Outcomes--Revenue: Due to the character of the online presentations, we decided to increase the membership fee from \$50 per year to \$75 per year, and make presentations available to all current members at no extra conference charge. Membership can be renewed online using PayPal, or members can renew by sending a check via US Mail. At the end of December 2013, paid membership is 188 members, with 184 memberships overdue for renewal. Most 2012 memberships were concurrent with registration for the 2012 conference and ran out in August 2013. Current memberships have the option of automatic renewal. Revenue from membership renewals during this grant period has been \$14,100.00. This figure is below our expected program income of \$20,000. Feedback from our membership suggests they are more willing to pay an annual membership fee when they attend physical meetings.

Goal outcome: Surpassed audience goal and continue to increase viewership, created a benchmark presentation archive available to members on demand, established new, virtual presence for conferencing online for trade association.

Beneficiaries

Texas Olive Growers: The current and future olive growers of Texas are the beneficiaries of the newly created new media archive that summarizes and reviews significant peer-reviewed research on Texas olive horticulture and makes this material available to members and nonmembers on demand via the Texas Olive Oil Council website. The growth of Texas olive oil production is detailed below, showing a very strong increase in the rate or growth since this program began.

Year	Number of Growers	Number of Acres	Number of Trees	Gallons of Olive Oil Produced
2000	6	<100	10,950	0
2002	8	150	13,590	0
2004	12	175	14,850	5
2006	21	300	69,800	1,200
2008	24	320	80,800	4,500
2010	40	780	183,100	16,893
2012	50	920	248,090	14,380
2013	85	1,500	950,000	18,800

Texas Olive Oil Consumers: Texans who are interested in local food production, quality of foods consumed, authentic flavors and uses of real foods benefitted enormously through the ongoing interaction and educational materials shared at the 884 farmers markets, community events, and festivals where Texas Olive Oil Council representatives presented demonstrations. Demos at weekend artisanal food events such as farmers markets drive consumers to retail locations where olive oil can be purchased during the week. Texas olive oil sales in 2013 are estimated at \$2.14 million, representing a 273% increase over sales in 2012.

Lessons Learned

Overall, we have learned that providing people with a human connection to Texas olive oil is our most effective strategy, whether we are sampling olive oil at a farmers market or providing information to growers. The most enduring lesson we learned is that people interested in growing olives in Texas are keen to mingle and share experiences in person more than they say they want to engage in information available online, even though the personal experience is ephemeral and the archived media resource is enduring and available on demand. We believe that a balanced approach to publishing useful resources vs presenting meetings in a cost-effective venue can be maintained and thereby meet the greater needs of community and educational sources.

Our goal to provide a growers map to our membership was met with resistance from the growers themselves. We are developing a database with orchard data for our trade association with is available to researchers, but will not be made available to the public, as our growers have experienced an increasing demand from consumers who wish to drop in to see an orchard as a tourist event, take a tour, and purchase product from the farm store, even when the farm is only a farm. Our growers have expressed concern that this is disruptive and upsetting for both parties and that the privacy of their operations is more important to them than offering a consumer experience of their farming operation.

It is also important to note that the Texas olive industry is experiencing significant growth and has a lot of potential for grower groups to form cooperatives to enhance, enable, and improve resource availability on a local scale. This development will potentially impact the organization's approach to information dissemination on a personal level. It should be noted that virtually everyone in Texas is a potential olive oil customer, and that the widely recognized Mediterranean Diet recommends two tablespoons of fresh extra virgin olive oil per person, per day. If Texas' entire population were to consume this much olive oil, Texans would consume over a million gallons of olive oil PER WEEK. We believe that the future of the Texas olive industry is robust, and are grateful to the Texas Department of Agriculture and the Specialty Crop Block Grant Program for their support in promoting this specialty crop.

Additional Information

For the latest information on the Texas olive industry, please visit texasoliveoilcouncil.org. or email klee@texasoliveoilcouncil.org.

PROJECT 7: DEVELOPMENT OF SIMPLIFIED METHODS FOR RAPID AND EFFECTIVE SCREENING OF PSYLLIDS AND PLANT TISSUES FOR THE CITRUS GREENING AND POTATO ZEBRA CHIP PATHOGENS

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Project Summary

Texas citrus production is threatened by the recent discovery (January, 2012) of huanglongbing (HLB) disease in Texas, a disease that results in the ultimate death of infected grapefruit and orange trees. Zebra chip (ZC) disease of potatoes was first reported in Texas in 2000 and continues to be a major economic threat to potato production in Texas. Both of these diseases are caused by species of ‘*Ca. Liberibacter*’, a nonculturable bacterium transmitted by psyllid insects. The goal of the project was to improve detection of the HLB and ZC pathogens in insect vectors and host plants. The research streamlined the FAST DNA extraction method followed by the LAMP-PCR (Loop-mediated isothermal amplification) protocol for on-site testing of psyllid vectors and plant samples, and validated its reproducibility and sensitivity in detecting the ‘*Ca. Liberibacter*’ pathogens. PCR detection methods on samples were tested from commercial citrus trees and potato fields. Results show that the FAST DNA extraction from psyllid vectors was sensitive and more efficient in comparison to previous methods used for pathogen detection.

Project Approach

Plant diseases caused by psyllid transmission of the bacterial pathogen ‘*Ca. Liberibacter*’ did not occur in Texas prior to 2000, but are now threatening both citrus and potato production, multimillion dollar industries in Texas. HLB management in Texas is currently focused on aggressive identification and eradication of infected trees and timely management of insect vector populations. The identification and use of HLB-free budwood for plant propagation is also extremely important. Similarly, management of ZC requires accurate and timely detection of psyllids vectoring the pathogen as well as diseased plants in potato fields to maximize the effectiveness of chemical control of psyllids and limit spread of infection among field plants. In short, *effective detection is at the heart of the current management practices* available for plant diseases caused by ‘*Ca. Liberibacter*’ in Texas.

Accurate pathogen detection in insects and plant tissues is essential for management of HLB and ZC and for understanding how ‘*Ca. Liberibacter*’ diversity affects disease epidemiology. Current methods for pathogen detection consist of four steps: sampling, DNA extraction, PCR amplification, and analysis of PCR results. Especially for plant samples, these methods have been somewhat inconsistent due largely to the low titer and unequal distribution of bacteria in plant tissues and the presence of polyphenolics and polysaccharides in leaf and fruit or tuber tissues. Both of these problems limit the efficacy of PCR reactions and necessitate extraction of pure DNA before amplification. Efforts to improve this methodology (by this group and others) include studies on the movement and titer of bacteria in plant tissues to facilitate better sampling,

the development of better conventional PCR primers, and the development of other PCR methods such as quantitative real-time PCR (qPCR). Despite progress in optimizing these methods for increased reliability, they remain expensive (e.g., requiring thermal cycling equipment) and time consuming (requiring DNA extraction and post-PCR analysis via gel electrophoresis or qPCR software) and must be conducted in a laboratory environment.

Project staff has been working with several new technologies that have the potential to dramatically *decrease the expense and time needed as well as increase the reliability* of pathogen screening from insect *and plant samples for both diseases*. The objective was to test methods for *direct* PCR amplification from insect and plant tissues (e.g., do away with the DNA extraction step). PCR amplification directly from insects and especially plant tissues is limited by PCR inhibitors; however each DNA extraction requires reagents, access to laboratory equipment, and 2 hours to complete. In addition, project staff has been working with a new technology known as Loop-mediated isothermal amplification (LAMP), successfully used in medical laboratories for rapid detection of bacteria in specimens. Project staff believes that these next generation improvements in PCR detection methods will be adapted and tested for general use in HLB and ZC screening in citrus and potatoes, because of the unique problems associated with the detection of this deleterious but elusive, low titer pathogen in these important commodities.

Goals and Outcomes Achieved

The research aimed to streamline diagnostics via the development of methods for direct PCR and LAMP-PCR from insect and plant samples for on-site testing detection of the Las ('*Ca. L. asiaticus*') and Lso ('*Ca. L. solanacearum*') pathogens in psyllid vectors and plant samples. Hence the project goal was to *improve detection of the HLB and ZC pathogens in insect vectors and host plants*.

The research target was to determine that detection methods result in reliable pathogen detection. Because direct PCR would eliminate the DNA extraction step, project staff aimed to reduce the amount of time by ~60 percent, costs of reagents by ~30 percent, and equipment while increasing the sensitivity of PCR based detection by developing standardized methods 1) for direct PCR from insects and plant tissues (eliminates DNA extraction) by developing a FAST DNA extraction procedure, and 2) for direct LAMP-PCR from insects and plant tissues ((reduces time for PCR and post-analysis). LAMP-PCR reduces PCR amplification time and eliminates post-PCR analysis. Project staff also aimed to show that the modification of the LAMP-PCR previously developed for detection of Lso from potato psyllids (PP) can be used for Las detection from citrus and the Asian citrus psyllid (ACP) vectors.

Project staff developed a method for the rapid isolation of DNA from *insect vectors* that can be used with cPCR or LAMP *for reliable detection of Lso*. The FAST DNA extraction protocol requires little time (*5 minutes for 10 samples*), labor (*three steps*) and no specific equipment. Samples prepared from single or multiple insect samples using the FAST DNA extraction protocol should be diluted 1/100 in sterile water for reliable cPCR or LAMP amplification. LAMP amplification requires no thermocycler or gel electrophoresis step for analysis, therefore coupling the FAST DNA protocol with LAMP greatly streamlined the current detection process by reducing the time and materials needed for DNA extraction, DNA amplification, and PCR analysis, making this process efficient, reliable and portable. Nevertheless LAMP is still a more

expensive method than conventional PCR. This protocol also worked for rapid isolation of DNA from ACP vector, however none of the ACP collected in Texas were positive for Las so staff could not verify that staff could have paired this method with LAMP detection of Las.

Staff also evaluated how well the method did relative to the previously reported method for FAST DNA extraction from citrus leaves using the BioMasher products. Staff found their method and the BioMasher I system worked equally well for isolation of DNA from *both PP and ACP*. The quality of the DNA extraction procedure was monitored using PCR amplification of the insect ferritin gene. Excellent quality DNA was isolated using the BioMasher I system and staff was able to detect the Lso pathogen from PP, but the ACP collected in South Texas did not carry the Las pathogen despite good amplification of the ferritin gene control for insect DNA. In all tests, the quality of DNA extraction for PCR was assessed on electrophoresis gels, and results compared to those obtained from the CTAB and FAST DNA extraction methods. Three different sites were tested ACP collected in the Rio Grande Valley of South Texas. Primers were used to detect the possibility of '*Ca. Liberibacter americanus*' (Lam) in these samples in response to reports of its occurrence in South Texas. All results were negative for either Las or Lam in the psyllid samples from Texas. These results were compared with ACP, which were up to 70% infected with Las, collected from HLB-diseased citrus groves in Florida and frozen for shipment from our collaborators in Florida. The regular CTAB extraction procedure gave positive results for Las samples from Florida.

Staff harvested potato material from a zebra chip diseased field in Weslaco, Texas, and evaluated the BioMasher I system for rapid DNA extraction from *potato tubers*. Based on our tests, the starchy potato tuber tissues are not suitable for extraction using the BioMasher I system. Staff also tested the BioMasher I on *tomato leaf* samples and detected plant DNA (both undiluted and diluted 1 µl in 100 µl) by amplification of the β -tubulin gene. Staff completed tests to evaluate the detection efficiency of the BioMasher I system for detection of Lso from other plant tissues. This includes testing infected solanaceous material processed in Mexico.

Because the *Liberibacter* bacterium is exclusively found in the phloem tissue, staff evaluated methods for extracting phloem sap from Lso-infected tomato plants. In these studies a commonly used method for phloem sap collection using EDTA was tested. Infected tomato plant sap was collected by cutting the plant petiole (top and middle tier) in an Eppendorf tube containing EDTA (10 mM). Phloem sap was collected in the Eppendorf tubes for time periods of either 3 hours or 24 hours. PCR using Lso primers was performed directly on 1 µl of the phloem sap extract and on 1 µl of the phloem plant sap diluted (100-fold) in water. Independent of the position on the plant or the time the microfuge tubes were maintained on the petiole, the DNA quality was inconsistent based on only about half of the samples showed positive for plant DNA. However, they were unable to detect the Lso pathogen in those samples that yielded quality DNA even though it was confirmed that the plants were diseased.

Staff evaluated another recently described detection method for the *Ralstonia* pathogen infecting potato tubers (Grover et al. 2012, *Advances in Microbiology*, 2:441-446). The tuber cell homogenate was boiled for 5 min, vortexed for 2 min, and then the DNA was extracted with phenol:chloroform:isoamyl alcohol (25:24:1). The DNA was then precipitated by adding 0.1 volume of ammonium acetate and two volumes of chilled ethanol. DNA extraction from tuber

tissue is always difficult and necessitates several steps, but staff observed that this streamlined protocol did not work with tubers in detecting Lso.

Our recommendation for samples from potato tubers is that the conventional CTAB method is still the most reliable. However, staff was able to develop improved methods for DNA extraction from psyllids. Our recommendations for the detection of Lso and Las (although staff did not have Las positive samples from Texas to evaluate) from PP and ACP are that both the FAST DNA extraction method developed by us and the BioMasher 1 can be used for obtaining good quality DNA for downstream pathogen detection. Staff found both methods of DNA extraction can be coupled with conventional PCR and LAMP detection. When the FAST DNA extraction method was coupled with LAMP detection they were able to realize our goals of reducing project staff time by ~60 percent, costs of reagents by ~30 percent, and equipment requirements while increasing the sensitivity of PCR.

The results have been published on the Texas A&M AgriLife website devoted to the zebra chip disease <http://zebrachipscri.tamu.edu/>. Presentations and the published summaries within the Conference Proceedings are also available on this website. Information regarding this website is communicated directly to interested growers through the Texas AgriLife Extension specialist's network and is the second hit (behind Wikipedia) for the key words Zebra Chip on Google and other search engines. In the proceedings for 2012 the following article was published: New Methods for Streamlining the DNA Extraction Process for Detection of "*Candidatus Liberibacter solanacearum*" from Insect Vectors. Levy, J.G., Hancock, J., Ravindran, A., Gross, D.C., Tamborindeguy, C., and Pierson, E.A. This 2012 report summarized the work conducted under this ZC grant.

Beneficiaries

The future of the citrus industry of Texas is dependent on rapid and sensitive detection of the Las pathogen in psyllids and citrus trees and effective management of the psyllid vector through cultural and chemical control methods. Similarly, management of ZC of potato requires close monitoring of plants and psyllid vectors for the Lso pathogen. These methods will facilitate studies of the distribution of Las and Lso populations in Texas that also are a critical component of effective disease management. The information has been shared with the diagnostic lab (TPPDL) in Texas. Results of our studies were presented at the annual meeting of the American Phytopathological Society held in Austin, TX in August, 2013 (approximately 1400 people attending the meetings with about 200 or more people viewing ZC poster reports). Information from these studies also was shared with scientists and industry representatives at the 2012 Zebra Chip Disease Conference in San Antonio, TX where approximately 100 scientists and potato industry leaders were in attendance.

The specialty crop stakeholders include industry representatives on the ZC Advisory Board that represent Frito-Lay, Barrett Potato Farms, R. D. Offutt, Syngenta Crop Protection, Washington State Potato Commission, Walther Farms, J.W. Farms, CSS Farms, and Bayer CropScience. The impact of the project has promoted early and reliable disease diagnosis of the ZC disease in potatoes and psyllid vectors. The research has benefits all growers in Texas as there has been good control of this disease because of these and related methods for pathogen detection using DNA-based diagnostic technology.

Lessons Learned

Staff demonstrated that the FAST DNA isolation method from PP and ACP could be used with LAMP-PCR, and they validated the reproducibility and sensitivity of this protocol for pathogen detection. The BioMasher I system also gave excellent results for DNA extraction from potato psyllids. Both of these methods, when coupled with LAMP result in significant increases in the efficiency of detection (in terms of man hours and reagents saved).

Although the BioMasher I was previously reported to be useful for extraction of DNA from citrus leaves, the system was not useful for isolation of DNA from infected potatoes, especially tubers. Because of the large amounts of phenolics in solanaceous leaves and the large amounts of starch in tubers, staff was unable to devise as rapid method for DNA extraction from potatoes. In the final analysis, they succeeded in streamlining methods for rapid detection of *Liberibacter* in psyllids that will be of benefit to the citrus and potato industries of Texas.

Additional Information

Project staff will continue to refine and promote the use of the detection methods to help the industries manage these diseases. In particular, they will continue to survey citrus psyllids and citrus specimens collected in South Texas for Las in support of the industry.

A scientific paper describing development of detection methods was published in 2013 as follows: Lévy, J, J Hancock, A Ravindran, D Gross, C Tamborindéguy, and E Pierson. 2013. Methods for rapid and effective PCR-based detection of '*Candidatus Liberibacter solanacearum*' from insect vectors *Bactericera cockerelli*: streamlining the DNA extraction/purification process. *Journal of Economic Entomology*, 106(3):1440-1445.

Additionally researchers will soon contribute a chapter describing LAMP methodology to "Methods in Molecular Biology – Plant Pathology: Techniques and Protocols" to help provide a step-by-step protocol of our method for detection of 'Ca. *Liberibacter*'. This is scheduled for publication in 2014.

PROJECT 8: PREVENT THE SPREAD OF HLB THROUGH CONTAINMENT MEASURES IN THE QUARANTINE AREA

Partner Organizations: Texas Citrus Mutual, USDA-APHIS-CPHST

Project Manager: Dr. Mamoudou Sétamou

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Type of Report: Final

Date Submitted: March 2014

Project Summary

Citrus greening or Huanglongbing (HLB) is considered to be the most destructive citrus disease in the world. It is caused by bacterial pathogens transmitted by psyllids. The Asian citrus psyllid which transmits HLB has invaded Texas in the last decade and is currently widespread. To mitigate the risk of HLB, a proactive area-wide management of psyllid was initiated in 2009 by growers with great success. Despite this ongoing effort, HLB has been detected in South Texas in January 2012, and currently a total of 4 infected commercial groves are known. The disease has also been found in 8 residential settings. TDA and APHIS have put in place quarantine areas around the finds to prevent further spread of the disease. In this project, project staff developed a psyllid control program for both commercial groves and residential trees to mitigate the spread of the disease from the currently known quarantine area. In commercial groves a judicious and targeted psyllid control at the beginning of flush cycles and during the dormant season has led to an effective psyllid control. In residential areas, chemical control every three months within 0.5-radius from the HLB find sites was also effective at controlling psyllid populations. Although inundative releases of the nymphal parasitoid *Tamarixia radiata* resulted in parasitism levels >70%, residual psyllid population was high enough to warrant complementary control strategies. Project staff therefore recommends to couple the use of the entomopathogen fungus *Isaria fumosorosae*-specifically during the dormant season- with *Tamarixia* releases to ensure satisfactory psyllid control in residential settings

Project Approach

- Staff partnered with Texas Citrus Mutual; the grower with HLB infected groves and a private pest control operator to develop mitigation efforts to prevent the spread of HLB in Texas.
- Since HLB detection in January 2012 in commercial groves, staff continued their monthly surveys in that grove and surrounding ones for early detection of the disease and implemented an aggressive psyllid control program in residential citrus within a 0.5 mile radius from the epicenter of the initial detection to prevent psyllid spread.
- Staff collected suspicious leaf samples both in commercial groves and residential areas for testing.

Goals and Outcomes Achieved

- Using psyllid data obtained from our weekly monitoring of psyllid population in targeted commercial groves, and made specific recommendations to growers on spray program. This recommendation has resulted in seven well-timed sprays during the entire year that has resulted in an effective control of major pests in the grove. Based on this information, one can assume that a well-timed spray program based on effective pest monitoring program will lead to significant reduction of psyllid and other pest populations in commercial groves in South Texas and thus significantly reduce the risk of HLB spread.
- Project staff collected over 548 suspicious leaf samples in 23 commercial citrus groves and 48 residential areas in the San Juan quarantine from November 2012 to October 2013. During the course of the study 36 new trees were detected, 22 in the initial sweet orange grove, 10 in an adjacent grapefruit grove and 4 in three residential sites within the core of the quarantine area. All infected trees have been removed.
- Given the aggregative pattern of HLB distribution observed in the two known infected groves, and recommended to the grower to remove a patch in the area of high disease concentration. Thus, patches of 19 rows in the sweet orange and 4 rows in the grapefruit groves, respectively, were destroyed. Despite these efforts, a third grove was found to be infected with 3 HLB-positive trees. All known HLB positive trees in the 3 residential sites have also been destroyed.
- Through a private pest control applicator, all psyllid host plants within the 26 residential sites located in the high risk 0.5-mile radius were treated every three months. This treatment has led to dramatic reductions of psyllid populations in those sites.
- In collaboration with APHIS-PPQ, staff initiated intensive releases of *Tamarixia radiata*, a parasitoid of psyllid nymphs. This parasitoid was released in 52 trees to initiate *Tamarixia* colonies. An evaluation of psyllid parasitism conducted in August 2013 indicated an average parasitism exceeding 65% in the HLB quarantine area.
- During the sampling period, psyllid densities were also always lower in managed residential trees with insecticides as compared to sentinel trees used as untreated controls. The rate of decrease in psyllid populations varied from 60 to 100% depending on the time of the year and the days post treatment. In those trees where only the nymphal parasitoid *Tamarixia radiata* was released, it was difficult to assess reduction in psyllid populations due to time delay impact of the biological control agent, however, parasitism levels of psyllid nymphs ranged from 50 to 70% in trees with inoculative releases of *Tamarixia radiata*.

Beneficiaries

- The immediate beneficiaries of this project include the 53 citrus growers in the quarantine area and specifically, the grower with known infected groves. Through the activities of this project staff was able to develop to demonstrate that combining psyllid monitoring data and citrus tree phenology, and are able to develop a cost-effective multi-pest control approach to mitigate the spread of HLB in known infected areas. Such mitigation program must be combined with a HLB detection and tree destruction program, especially at the beginning of infection.
- Homeowners within the epicenter of the quarantine area (0.5 mile radius from the infected groves) also benefited directly from the project activities. Effective psyllid

control was achieved in their yards and such control program has motivated them to better take care of their trees.

- Through frequent releases of *Tamarixia radiata*, all homeowners within the San Juan quarantine area have directly benefited from the psyllid reduction brought by the impact of the parasitoid.
- One other important achievement of the project is the awareness created at the public level on the threat of HLB in Texas at the public level.
- The project created awareness in different ways: 1) all participating homeowners (37 in total) were educated on the threat of the ACP/HLB complex. In addition, a public meeting was organized in January 2013 at the San Juan city Hall to educate the public on different HLB mitigation strategies. All citrus nursery trees in the quarantine area have been voluntarily destroyed and nurserymen have been educated on the new regulations of growing trees under insect resistance structures. The Texas Pest and Disease Management Corporation built on the success of this demonstration project to develop a statewide outreach and education effort on ACP and HLB.

Lessons Learned

- All growers are willing to participate in the HLB mitigation efforts.
- Psyllid control program must be organized at the neighborhood with all growers within a certain area working together. Although important on an area-wide basis, effective psyllid control can only be achieved only if neighboring groves are managed within the same time frame to prevent having refuge of psyllids.
- Residential sites within the proximity of commercial groves must also be target of psyllid control to prevent them from being constant sources of psyllid for commercial groves. However, given the high cost of chemical control in residential areas, only effective biocontrol and microbial programs can be combined for a sustainable psyllid control in these areas.
- Given that new flush shoots on which psyllid nymph develop are not present from late October to mid-March, incollulative releases of *Tamarixia* must start with the first flush of the year from late February to March.
- During the overwintering period, a microbial control of psyllid can be conducted in residential sites immediately adjacent to commercial groves.
- Most of the homeowners are willing to participate into the program. There were only two homeowners who refused to participate.
- During the implementation of the project, it was difficult to reach homeowners to obtain their permission to go in their properties. To improve access to residential site in light of ongoing psyllid area-wide management, it will be important to initiate an outreach program to create awareness of the risk of HLB at the public level. Such outreach program is necessary to ensure that homeowners contribute into psyllid management and HLB mitigation.

Additional Information

- Through his program, staff learned that homeowners are willing to be involved in psyllid biological control by providing their trees for *Tamarixia* field rearing (Fig. 1). In collaboration with APHIS-PPQ, staff established 10 field insectary cages within the

quarantine area. In these field cages the population of the parasitoid *Tamarixia* was multiplied by 16-fold within 6 weeks.

- Consequently, higher psyllid nymphal parasitoid was observed with the release of *Tamarixia* which will contribute to further reduction of psyllid populations (Fig. 2).



Figure 1: *Tamarixia radiata* rearing field insectary cage in residential area

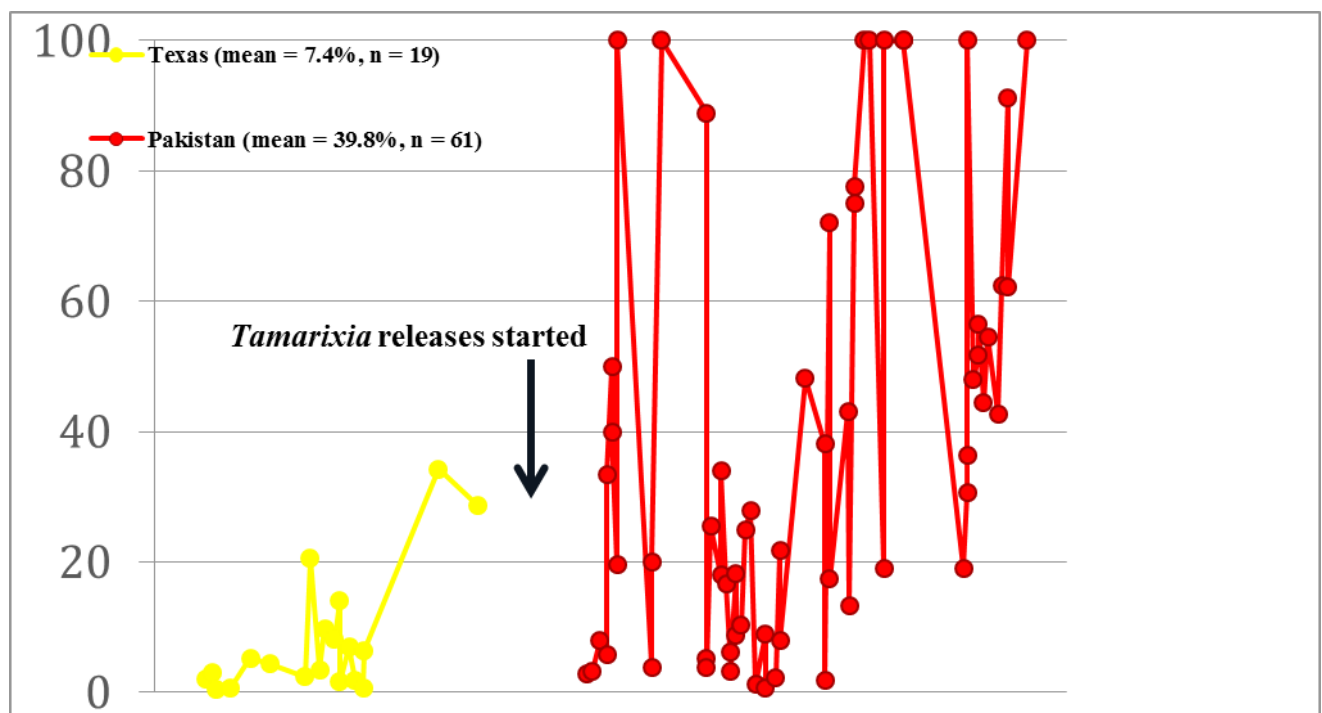


Figure 2: Psyllid parasitism level achieved by Pakistani strain of *Tamarixia radiata* in South Texas

PROJECT 9: INTERCROPPING TO MITIGATE SALINITY STRESS ON WATERMELONS

Partner Organization: Texas A&M University

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Type of Report: Final

Date Submitted: 02/28/2014

Project Summary

Increasing water demand and decreasing irrigation water quality are promoting salt buildup in Texas agricultural soils. Our project selected several salt-accumulating, marketable, companion species with the goal of improving soil conditions and developing a field inter-cropping system that will increase watermelon production in salt affected soils. Project staff also investigated the productivity of these crops for potential use as alternative food and forage crops.

In many areas of Texas, low rainfall amounts and low water holding capacity of soils used for watermelon production usually require supplemental irrigation of crops. With increased irrigation of low quality water, soils become more saline which can negatively affect crop growth and yield. Watermelon is a moderately salt sensitive crop and thus susceptible to low quality irrigation water. In south Texas, for example, the use of local irrigation water with an EC of 1.55 dS/m adds approximately 2,700 lbs. of salt per acre foot (Electrical conductivity (EC) is a common way of measuring how much salt is in a solution of soil or water). Salinity destroys soil structure, reduces water holding capacity and plant available water, and limits the availability of plant nutrients. Salinity can also cause direct toxicity problems via the accumulation of sodium (Na) and chlorine (Cl) in plant tissues which interferes with ion uptake and cell membrane functioning.

Few studies have investigated the use of salt tolerant plants (halophytes) in intercropping systems as a technique to reduce salt stress on a target crop. Halophytic plants can accumulate Na and Cl, which removes Na and Cl from the soil environment. Albaho and Green (2000) found that the halophyte *Suaeda salsa* (saltwort) reduced Na concentrations in tomato foliage as well as in the growth medium. The incidence of blossom end rot was reduced but yield was not affected. In another greenhouse study on tomatoes, Zuccarini (2008) found a decrease in tomato plant Na and Cl content when intercropped with the halophytes *Portulaca oleracea* (purslane) and *Atriplex hortensis* (garden orache). In the same study, purslane enhanced potassium (K) uptake while nitrogen (N) absorption was enhanced with garden orache. Tomato fruit yields were increased due to an increase in fruit size and mass when mixed with either of these species. The investigators concluded that purslane performed best overall as a companion plant as tomato plants grown with purslane achieved yields that were comparable to those of tomato plants grown in non-saline conditions, a yield increase of 44 percent when compared to tomatoes grown alone in saline conditions. Graifenberg et al. (2003) also found an increase in tomato fruit size and an increase of 22 and 33 percent in tomato yield when intercropped with purslane and another halophyte *Salsola soda* (saltwort), respectively. Na uptake was decreased and phosphorus (P) and calcium (Ca) uptake was increased in intercropped tomato plants. In this study, purslane was found to be more effective than saltwort. When intercropped with *Atriplex*

halimus (saltbush), *Medicago arborea* (shrub medick), a nitrogen-fixing fodder shrub, increased N₂ fixation and there was an increase in combined dry matter yield by 21 percent when compared with monocropped shrub medick (Kurdali 2010). The above effects were all observed in greenhouse studies. In one of the few field-based studies involving halophytes as companion plants, Kurdali et al. (2003) saw a 12 percent increase in total combined yield when sorghum was intercropped with *Sesbania aculeata* (dhaincha), a nitrogen-fixing halophytic plant, as compared to the sorghum monocrop. Additionally, sorghum enhanced N₂ fixation in dhaincha. In summary, greenhouse based studies have demonstrated a 20 to 40 percent increase in crop yields when intercropped with halophytes in pot studies yet field based experiments are rare and none of these studies have been performed with watermelon. In areas where good water supply is generally unreliable and most irrigation sources are of low quality there is a strong potential for mixed cropping systems with halophytes to improve crop yield while reducing irrigation inputs. In addition, a successful intercropping system would allow more marginal land to remain in production.

Project Approach

Phase I evaluation criteria included the height relative growth rate, change in soil electrical conductivity (EC), and amounts of sodium (Na) and chloride (Cl) in leaves, stems and roots of halophytes subjected to salt treatments. Height measurements were taken on a weekly basis for the duration of the study as reduced height can be related to plant stress response to salinity. Project staff calculated height relative growth rate (RGR) for each individual plant as $(\ln H_{t_2} - \ln H_{t_1}) / t_2 - t_1$, where t refers to the date of initial measurement (t_1) and the final date of measurement (t_2). To compare species response to salinity amongst unrelated species with different growth rates, staff also calculated relative growth rate response ratio (RGR RR = RGR (salinity) / RGR (no salinity)). Staff found that Garden Orache had the highest RGR and RGR RR of the six halophytes studied (Figs. 1&2). Although purslane had high RGR's, its RGR RR was comparable to saltwort and barley at 6 dS m⁻¹ and barley at 3 dS m⁻¹ (Figs. 1&2). Saltwort had high RGR RR at 3 dS m⁻¹, suggesting a high salinity tolerance; however its prostrate growth habit and limited vigor made it less likely to survive competition from a vigorous watermelon variety.

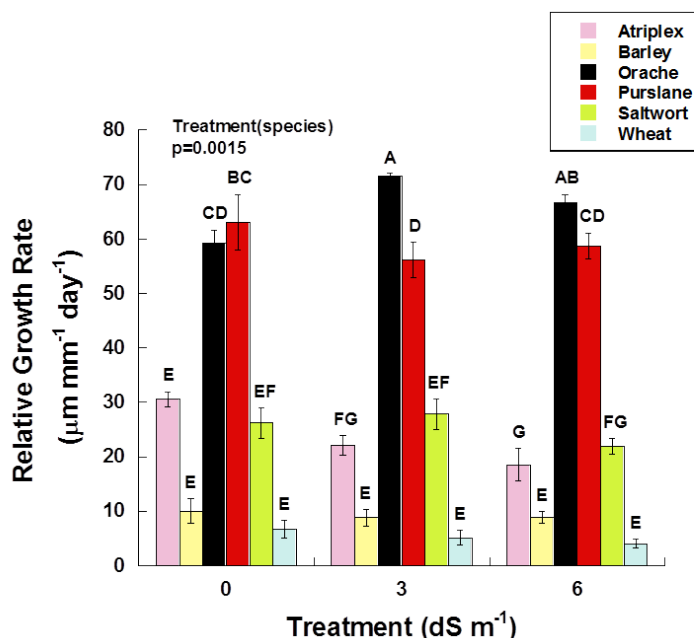


Figure 1. Height relative growth rate (RGR) of halophytes irrigated with 0, 3 and 6 dS m⁻¹ salt treatments in the greenhouse evaluation. Different letters indicate statistically significant differences ($P < 0.05$) in RGR between species and salinity combinations.

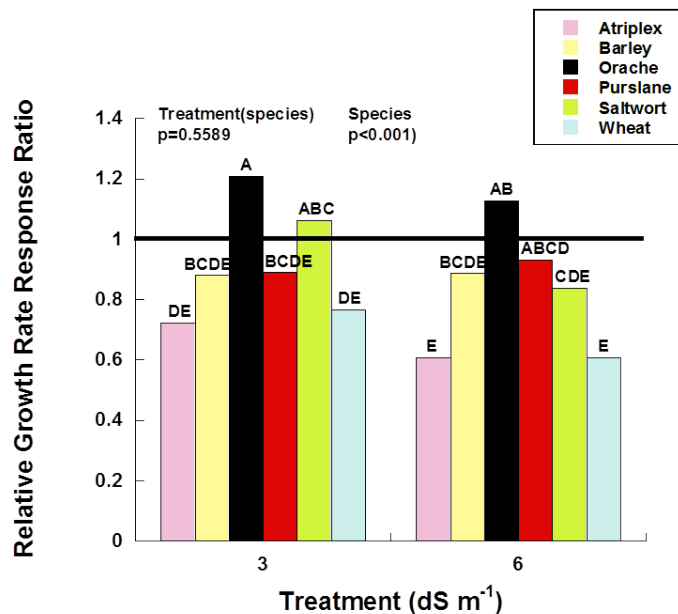


Figure 2. Height relative growth rate response ratio of halophytes irrigated with 3 and 6 dS m⁻¹ salt treatments grown in the greenhouse evaluation. Plants with response ratios above 1 indicate positive height when compared to the 0 dS m⁻¹ control. Plants with response ratios below 1 had lower growth rates than their 0 dS m⁻¹ control. Different letters indicate statistically significant differences ($P < 0.05$) in RGR between species and salinity combinations.

The greenhouse (Phase I) evaluation of halophytes involved measuring soil parameters such as soil EC to determine if halophytes had the potential to remove salts from the soil system which would reduce salt stress on watermelons adjacent to them. Our greenhouse data indicate that when compared to day 1 soil EC data, soil EC for soils subjected to salt treatment was lower when saltwort and orache were planted at 3 dS m⁻¹ (Fig. 3). The lowest increase in soil EC at the 6 dS m⁻¹ treatment level was for purslane, followed by wheat, saltwort, barley, orache and atriplex.

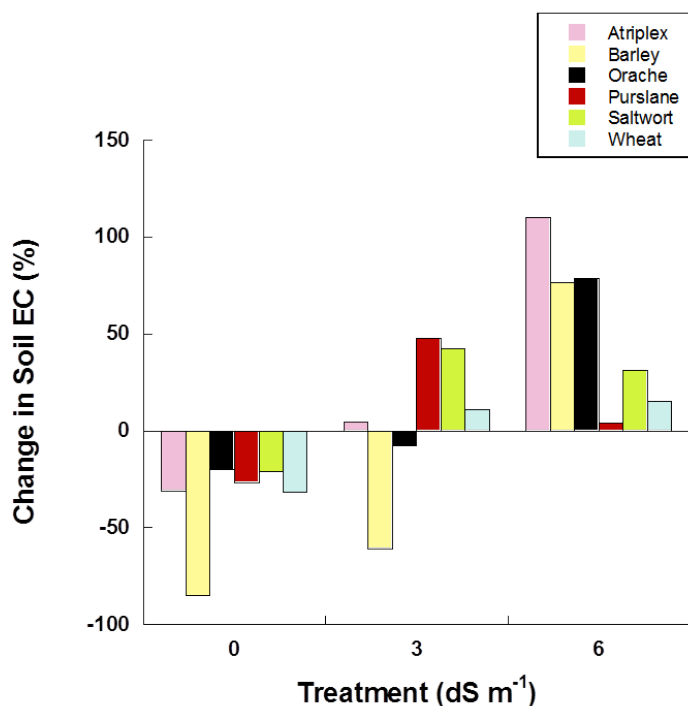


Figure 3. Percent change between the start of the experiment and the end (40 days) in electrical conductivity of soils with different halophytes grown in the greenhouse evaluation.

Preliminary tissue analysis (Fig. 4) results suggest orache and purslane accumulated the most salts, particularly in leaf and stems indicating salts are being translocated from roots to leaves/stems. Saltwort and atriplex were excluded from the preliminary analysis because their growth habits determined that they would be less likely to perform well in a field study.

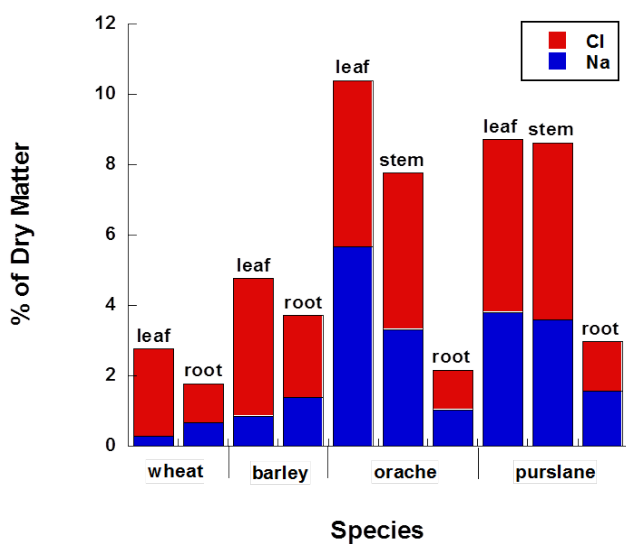


Figure 4. Percent sodium and chloride in dry matter of four halophytes grown in the greenhouse experiment.

Orache and purslane were the top performers in the greenhouse evaluation of halophytes and were, consequently, selected for phase II. Due to the poor vigor, slow growth, and growth habits of saltwort and atriplex staff determined that they would not perform well in a field trial with watermelons. Therefore, phase II was conducted with watermelons, purslane and orache.

Phase II, Field Trial Outcomes:

In the field trial with purslane and orache as the halophyte intercrop species, watermelon stress status was measured by photosynthesis and stem water potential. Fruit quality was evaluated by assessing brix, mass, flesh firmness, and rind thickness. Photosynthesis measurements were taken once a month throughout the duration of the study; midday stem water potential and predawn leaf water potential measurements were taken within 2 days of photosynthesis measurements. Fruit was harvested 3 times; fruit mass and production were recorded at each harvest. Fruit quality measurements were taken within 2 days of harvest.

Monocropped watermelons yielded as high as 41,000 kg/ha in the 0 salinity level and intercropped watermelons yielded as high as 49,000 kg/ha in the watermelon/orache combination at 3dS/m. The watermelon/orache (W/O) treatment combination had the highest yields averaged over salinity level at 40,000 kg/ha followed by watermelon in monocrop (W) at 35,000 kg/ha, watermelon/orache/purslane (W/O/P) at 28,000 kg/ha, and watermelon/purslane (W/P) at 26,000 kg/ha (Figure 5). Salinity treatment did not have a significant effect on fruit yield.

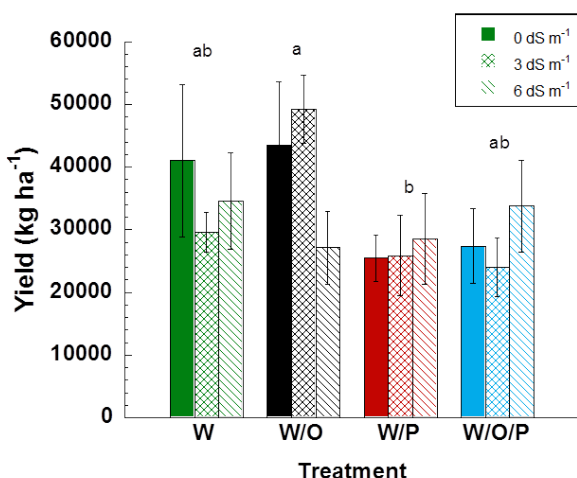


Figure 5. Watermelon intercropped with orache had the highest yields, while there was no effect of salinity. ($P_{\text{treatment}} = 0.092$). W = watermelon monoculture, W/O watermelon intercropped with orache, W/P = watermelon intercropped with purslane, W/O/P = watermelon intercropped with orache and purslane.

Salinity and intercropping treatment had a significant effect on individual fruit mass (Figure 6). At 6 dS m⁻¹ the watermelon/orache/purslane treatment yielded fruit with the highest mass and watermelon/orache had fruit with the lowest mass. The watermelon monocrop, watermelon/orache, watermelon/purslane treatments irrigated with 3 dS m⁻¹ water had intermediate masses.

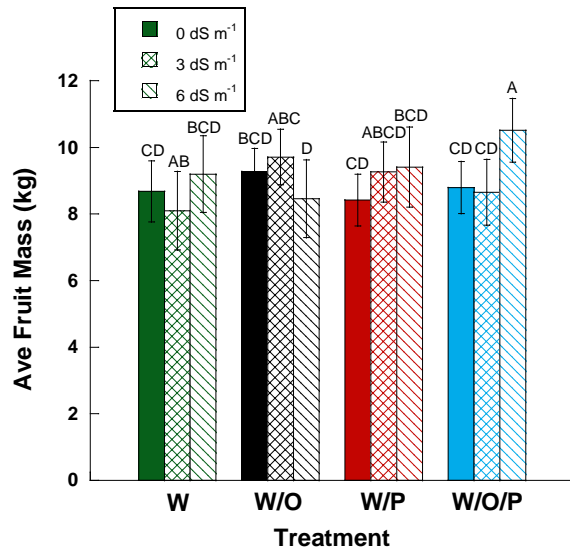


Figure 6. Salinity and treatment affected fruit mass ($P_{\text{salinity} \times \text{treatment}} = 0.014$). W = watermelon monoculture, W/O watermelon intercropped with orache, W/P = watermelon intercropped with purslane, W/O/P = watermelon intercropped with orache and purslane.

Neither salinity nor intercropping had a significant effect on fruit brix values (Figure 7). Most brix values were between 10 and 12, acceptable values for marketable watermelons.

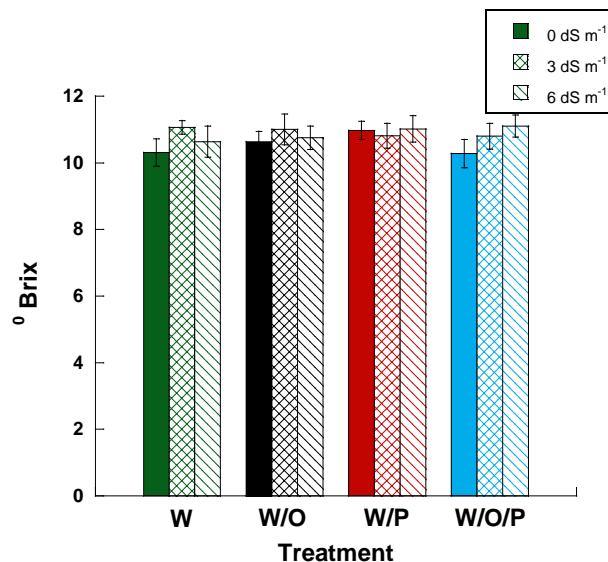


Figure 7. Salinity and treatment had no effect on fruit brix values ($P = 0.827$). W = watermelon monoculture, W/O watermelon intercropped with orache, W/P = watermelon intercropped with purslane, W/O/P = watermelon intercropped with orache and purslane.

Fruit flesh firmness was not affected by salinity or intercropping treatments (Figure 8, $P_{\text{salinity} \times \text{treatment}} = 0.616$).

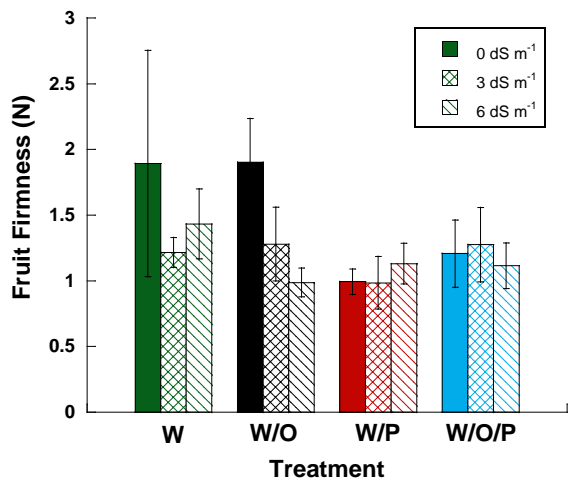


Figure 8. Salinity and treatment had no statistically significant effect on fruit firmness ($P_{\text{salinity} \times \text{treatment}} = 0.616$). W = watermelon monoculture, W/O watermelon intercropped with orache, W/P = watermelon intercropped with purslane, W/O/P = watermelon intercropped with orache and purslane.

Rind thickness of watermelon fruit was not affected by salinity or intercropping treatment (Figure 9, $P_{\text{salinity} \times \text{treatment}} = 0.467$).

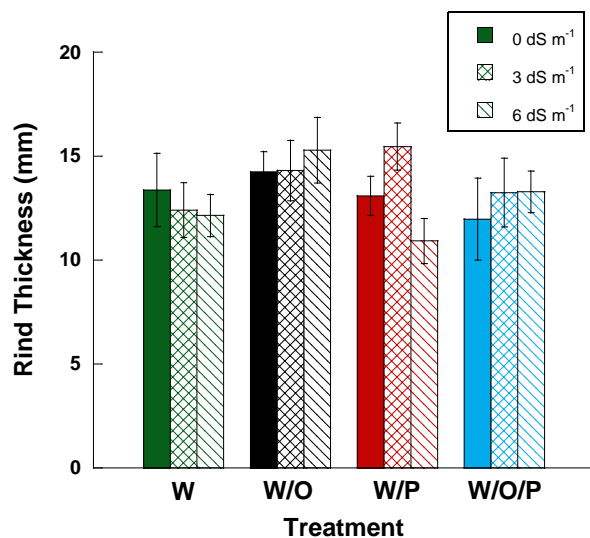


Figure 9. Salinity and treatment had no effect on rind thickness ($P_{\text{salinity} \times \text{treatment}} = 0.467$). W = watermelon monoculture, W/O watermelon intercropped with orache, W/P = watermelon intercropped with purslane, W/O/P = watermelon intercropped with orache and purslane.

Plant water status was not affected by salinity or intercropping treatment within each measurement date, but plants were significantly more water stressed overall by the mid-August

measurement date as compared to June and July (Figure 10). However, it is unclear whether this increased stress was due to elevated soil salinity levels or higher temperatures or a combination of both.

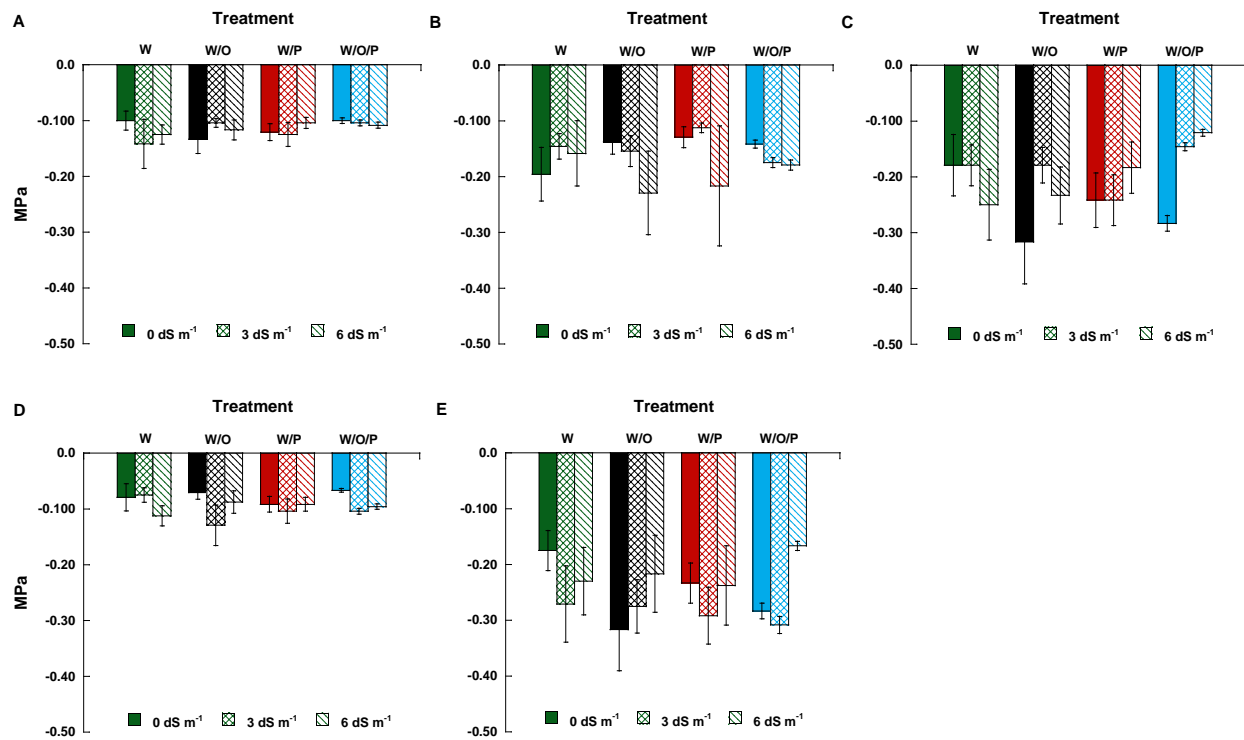


Figure 10. Watermelon midday stem water potentials taken in (A) mid-June, (B) mid-July, and (C) mid-August and predawn leaf water potentials taken in (D) mid-June and (E) mid-August 2013. No statistically significant differences were detected between treatments, salinity levels, or treatment x salinity level interactions within measurement date. W = watermelon monoculture, W/O = watermelon intercropped with orache, W/P = watermelon intercropped with purslane, W/O/P = watermelon intercropped with orache and purslane.

Soils were analyzed for nutrient concentrations, electrical conductivity (EC), sodium and chloride before planting and post-harvest to determine the degree of salinization due to salinity treatments and if halophytes removed salts from the soil. While there was no halophyte effect on EC, the salinity treatments did have a significant effect on soil EC ($P = 0.001$). The 0 dS m⁻¹ treatment had the lowest soil EC values while the 3 and 6 dS m⁻¹ treatments were higher.

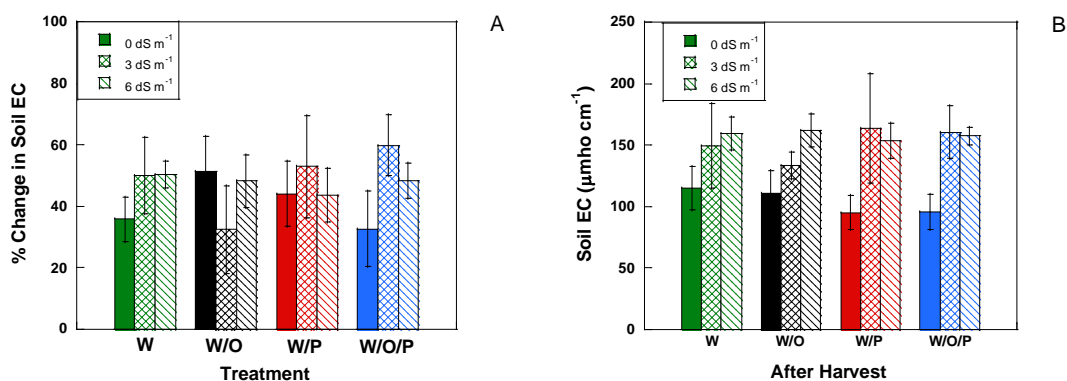


Figure 11. A. Percent change between the start of the experiment and the end (108 days) in soil electrical conductivity (EC) in field grown crops, B. Soil EC ($\mu\text{mho cm}^{-1}$) before planting and after harvest. W = watermelon monoculture, W/O watermelon intercropped with orache, W/P = watermelon intercropped with purslane, W/O/P = watermelon intercropped with orache and purslane.

Percent change in extractable soil sodium in the field was significantly affected by salinity treatment but there was no effect of halophyte treatment on soil Na^+ ($P_{\text{salinity}} = 0.001$, $P_{\text{halophyte}} = 0.245$, Figure 12). Extractable sodium was equally enhanced in the 3 and 6 dS m^{-1} treatments.

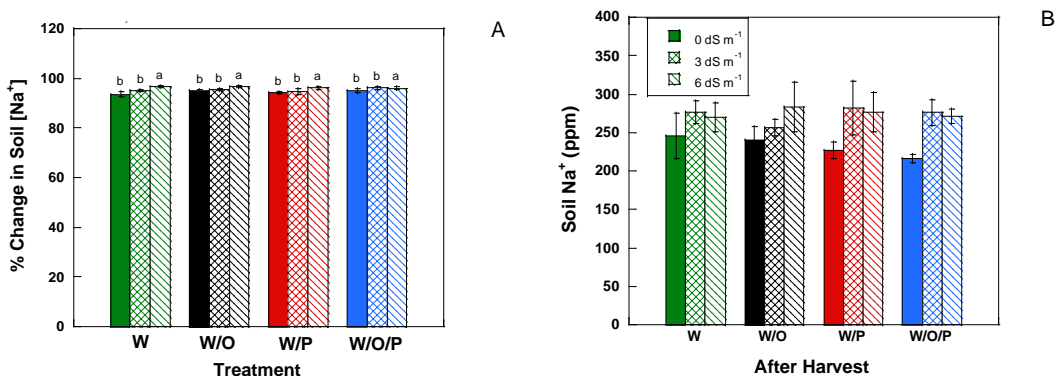


Figure 12. A. Percent change between the start of the experiment and the end (108 days) in sodium concentration in field soils, B. Soil Na^+ (ppm) of soil samples collected before planting and after harvest. W/O watermelon intercropped with orache, W/P = watermelon intercropped with purslane, W/O/P = watermelon intercropped with orache and purslane.

Percent change in chloride concentration was not significantly affected by the halophyte treatments, however there was an effect of salinity treatment ($P_{\text{salinity}} = 0.011$) on soil Cl^- concentrations (Figure 13).

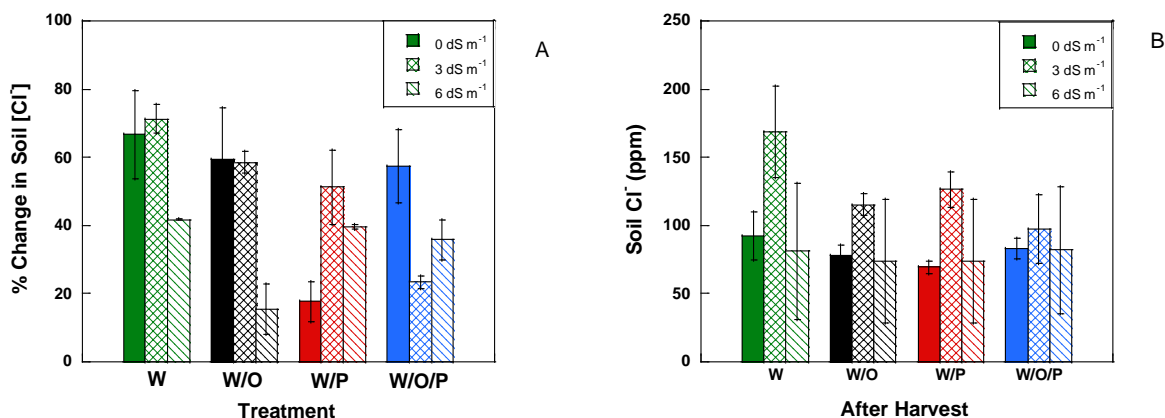


Figure 13. A. Percent change between the start of the experiment and the end (108 days) in chloride concentration in field soils, B. Soil Cl⁻ concentration (ppm) of soil samples taken before planting and after harvest ($P_{\text{date}} = 0.001$, $P_{\text{salinity}} = 0.011$).

The results suggest purslane and orache had little effect on salt removal from soils under these conditions. Orache and purslane performed well in greenhouse trials, with the highest height growth rates and removing the most salts from the soil. Field trial results suggest that salinity and intercropping will not affect watermelon yield or fruit quality. The saline irrigation treatments indicate that the plants may be removing more chloride than sodium from the soil, however there was no difference between intercropping treatments. These results also indicate that the watermelon plants were not significantly stressed even in response to chronic salinity stress. The supplementary irrigation and above average rainfall may have contributed to these results by alleviating some of the drought stress that might have exacerbated salinity stress. To fully explore these results staff would need to evaluate the stress situations more thoroughly. Staff have shown that halophytes have some potential to remove added salts from the environment, however, the salinity treatments had no effect on watermelon fruit yield or plant performance and thus adding halophytes did not have any positive effects on yields.

Goals and Outcomes Achieved

Goal: To minimize salinity stress on watermelon utilizing halophytic companion species for improved yields.

Outcomes Achieved: The project was completed in two phases. In phase I, 6 halophytic species were successfully tested for their ability to reduce salt accumulation and potentially remove existing salts from soil. Orache and purslane performed the best overall. However, tissue analysis is still being conducted to determine how much sodium and chloride were accumulated within plants. These findings were presented at the 2013 American Society for Horticultural Sciences annual meeting. For phase II, the two best performing halophytes (orache and purslane) were then used in an intercropping field study. To develop a field-based intercropping system that optimizes salt removal and enhances watermelon yield, several factors were monitored. Performance data (soil EC and salt levels, leaf gas exchange, plant water potential, fruit yield and fruit quality) for the field intercropping study were collected from April 2013 until August 2013 when the project was harvested and production data was collected. Preliminary findings, showing that yield was not affected, were presented at the 2013 Soil Science Society of

America/Crop Science Society of America/American Society of Agronomy annual meeting. Preliminary data was presented at regional and national meetings during the study period and a peer-reviewed paper will be submitted by August 2014.

Project presentations:

Simpson, C.R., Franco, J., Nelson, S.D., King, S., and Volder, A. Using Halophytes to Mitigate Salinity in Watermelons. Oral Presentation. 29th International Horticultural Congress, Brisbane, Australia. August 17-22, 2014.

3200 meeting attendees, 120 in the session

Simpson, C., J.G. Franco, S. King, S. Nelson and A. Volder. 2013. Using Halophytes to Mitigate Salinity Stress on Watermelons (poster). Tri-Societies (ASA-CSSA-SSSA) Annual Meeting. Tampa, FL.

4000 meeting attendees, 250 in the session (poster attendance is a wild guess)

Simpson, C., J.G. Franco, S. King, S. Nelson and A. Volder. 2013. Intercropping to Mitigate Salinity Stress on Watermelon: Halophyte Performance in a Greenhouse Pot Study (oral). American Society for Horticultural Science Annual Meeting. Palm Springs, CA.

800 meeting attendees, 30 in the session

The project was also featured on the local radio show "Rethinking Green" (April 16, 2014) - estimate listeners 1,000

Beneficiaries

Nationally, Texas is the third largest producer of watermelons (*Citrullus vulgaris*) on 24,900 acres (Texas Agricultural Statistics, 2010) with a statewide economic impact of approximately \$52.3 million. The vast majority of watermelon production in the State occurs in arid, semi-arid and coastal areas that are prone to drought and salinity issues. The severe drought of 2011 caused \$5.2 billion of agricultural losses in Texas and a portion of that can be directly attributed to increased salinity. Salinity levels above 2 dS m⁻¹ can lead to yield losses of 10 percent or more. An integrated cropping system utilizing salt-accumulating species has the potential of reducing these losses. With at least 60 percent of watermelon production located in areas prone to salinity issues, this project will impact 14,940 acres and have a direct economic impact of approximately \$3.14 million in annual watermelon production value. This project also has the potential to expand watermelon growing areas into previously unusable lands where high salinity and poor irrigation water quality are problematic. This study will contribute significantly toward funding priority area 3, plant health, within the environmental concerns and conservation sub-area.

Lessons Learned

Phase I was delayed by one month due to a delay in funding availability. Therefore, salt treatments started February 1st, and the experiment was shortened by one month in order to maintain projected Phase II start dates. Complete soil and plant tissue analysis was delayed by the laboratory testing facilities and staff expect these data to be available soon. Tissue analysis required for the assessment of halophytes used in Phase II was conducted on a preliminary basis with more replicates tested when the facilities clear their backlog. Overall, tissue analyses are important in explaining our results; however, the delay in getting these analyses finished does not prevent us from deriving conclusions from our yield data.

Project staff have illustrated that halophytes have the potential to be intercropped with watermelons without diminishing yield or quality of the fruit. Furthermore, the watermelon/orache treatment had the highest yields compared to the other intercropping and

control treatments. While there was no significant effect of halophyte treatment on soil parameters, salinity did affect soil EC and chloride concentration. This shows that the salinity treatments were effective, yet not strong enough to cause significant yield decreases, suggesting that watermelon may be more salt tolerant than initially expected. Additional experimentation is recommended to further explore how watermelon tolerates salt stress and what intercropping combinations may be best to optimize yield.

PROJECT 10: TRUFFLE PRODUCTION IN TEXAS: ADDING VALUE TO THE PECAN INDUSTRY

Partner Organization: Texas Tech University, Texas Pecan Growers Association (TPGA)

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Type of Report: Final

Date Submitted: 1 March 2014

Project Summary

Despite increasing stakeholder interest, basic information and protocols for production, harvest, and post-harvest processing of the native pecan truffle (*Tuber lyonii*) are lacking. The long-term goal is to establish production and management methods for dual cropping of pecans and pecan truffle in Texas, complete with sustainability and profitability analyses of the co-cropping system. The current project primarily targeted pecan truffles, however, project results can be directly applicable to production of other truffle species (e.g. the highly prized European Black Truffle, *Tuber melanosporum*) with pecans. The entire truffle industry is in its infancy in the U.S., and Texas almost completely lacks production methods for growing truffles, including the pecan truffle which can naturally grow with pecan trees. Coupled with the facts that Texas is the second largest pecan producing state with ca. 175,000 acres in pecan production and that pecan truffle remains underutilized in the U.S., co-cropping of pecan and truffles in Texas has an even larger economic potential. While natural fruiting can occur in existing orchards, inoculated seedlings can take up to 7 years to produce truffle fruiting bodies. Inoculated plants were planted at pecan orchards in Texas to allow data on growth and development over time. In summary, across these initial years of this novel research and outreach effort, project team discovered and disseminated information to growers and educators on the distribution of pecan truffles, production of truffle-inoculated seedlings, food safety level of pecan truffle, and the general growth requirements of inoculated pecan seedlings. The economic analyses remained a challenge in light of the continuing drought in Texas and the lesson that irrigation management could be key, among other factors, in promoting fruiting. Project staff expanded the number of directly involved growers by 25% over the past year. Positive indication of interest in pecan truffle was observed in 100% of the participants.

Projects funded under the 2011 Specialty Crop Block Grant Program, included an assessment of the sites from where herbarium samples of pecan truffles had been collected, and surveys of pecan orchards for the presence of pecan truffles. Inoculation of two different pecan seed-stocks with pecan truffle has been carried out to produce seedlings with colonized roots for transplanting into orchards. Each conversation with stakeholders results in requests for more information and new production questions, some of which will be addressed under this application. This project continued to develop feasible methods for dual production of truffles and pecans.

Project Approach

In collaboration with the Texas pecan industry, growers, researchers and educators, project staff accomplished the objectives listed below:

1. Culture and production method development for pecan truffle inoculated pecan plants.

Several experiments were continued or initiated in the 2nd year of this project. All experiments are in progress to allow testing of questions that require data to be collected over a longer period. To optimize the colonization of pecan seedlings with *Tuber lyonii* mycorrhizal fungus, research activities were conducted with assistance from a graduate student. Currently, 5 different experiments are underway. Each experiment is at a different stage of maturity with regard to pecan plants and their mycorrhizal condition. For each experiment, the seed germination methods and the initial culturing methods were similar. Seeds of the 'Elliott' variety were cold-stratified for 35 days and then planted in autoclaved vermiculite for germination. Seeds of the variety MX-87 were not stratified because of their tropical-subtropical origin. Once the emerging shoots reached a height of 5 cm, they were transplanted into larger containers containing autoclaved a mix of peat: sand: vermiculite: perlite in a ratio of 2:1:1:1 by volume. Plants that were assigned to the inoculation treatments received 2 g of thick inoculum slurry directly on their roots (Figures 1a and 1b). Plants in the un-inoculated treatments were planted without being exposed to the inoculum. All plants are fertilized with foliar fertilizer unless they were a part of the experiments that were set up to test the efficacy of other methods of applying fertilizers.

Of the five experiments, three experiments are set up to test the efficacy of inoculation practices on the growth of two varieties (Elliott and MX-87). One of these sets of plants (III) was designed to test the effect of vernalization on inoculated and uninoculated plants. Plants to be vernalized were placed outdoors during the winter months by placing them within a poly-covered greenhouse-like structure. A fourth experiment is designed to test the effect of fungicide application to plants and the consequences of the fungicide for the mycorrhizal colonization of the plants by pecan truffle and on growth of plants. Finally, a fifth experiment is designed to test various sources of nutrients and their application methods on the growth of plants and on the colonization of roots by pecan truffle.

A staining method for staining *T. lyonii* colonized roots with Trypan Blue (Figures 2a and 2b, Table 1) was developed. This method has not been reported before for this truffle and is a significant advance in assessing the colonization in the roots. It was then used to assess colonization in plants. The results show that colonization increases over time and was highest in the plants that were inoculated approximately 15 months ago. Plants inoculated approximately 4-6 months ago had lower colonization percentage. Regardless, ectomycorrhizal formation was not detected in plants that were not inoculated with *Tuber lyonii*. It is to be noted that each plant must be carefully and gently removed for examining the root systems without letting it dehydrate. Small root samples then are collected randomly for EcM inspection. The method requires careful handling of each plant so as to not disturb its growth. It also necessitates that plants not be examined too frequently because of the possibility of damaging the root systems.

Further, the culture methods were refined significantly over time and it is clear that the data are new for the truffle industry (Figure 1). Previous reports by others do not discuss the details of the culture method and leave stakeholders in the dark. Instead, results from SCBG studies will be shared clearly with the stakeholders. Results so far indicate that inoculated plants are taller and have more compound leaves than the un-inoculated plants (Figure 3). Also, inoculated plants supplied with inorganic fertilizer resulted in taller plants compared to other treatments (Figure 3). It appears that a combination of mycorrhizal symbiosis and nutrients applied to soil is beneficial for plant growth. Analyses of colonization percentages will be conducted for each

nutrient treatment separately to assess the direct effect of each nutrient application treatment on the symbiosis of pecan truffle and pecan varieties.

Figure 1. (a) *Tuber lyonii* inoculum being prepared before inoculation. **(b)** Pecan seedlings before they are transplanted into larger containers in the greenhouse.

1a.



1b.



Figure 2. Roots of pecan seedlings showing presence of ectomycorrhizal root tips (**a**). A staining method was developed and used (**b**) to confirm the presence and colonization of the roots by pecan truffle.

2a



2b

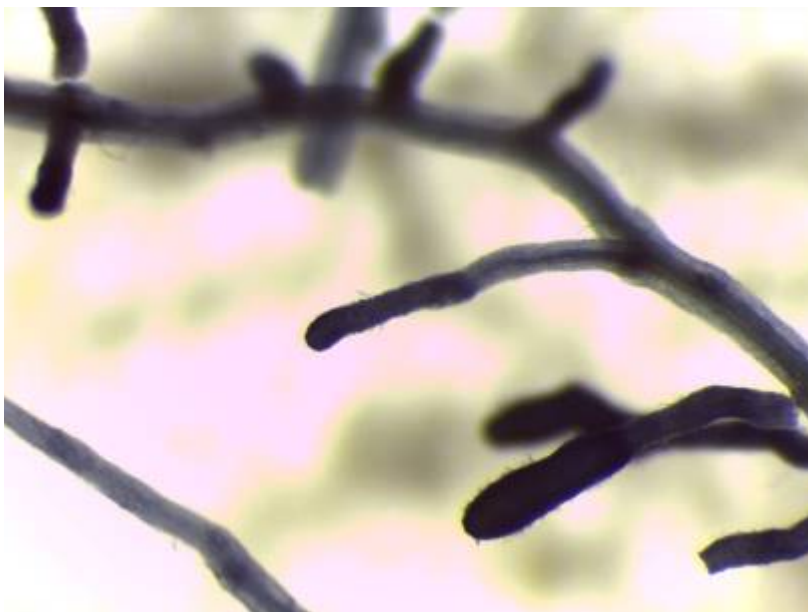
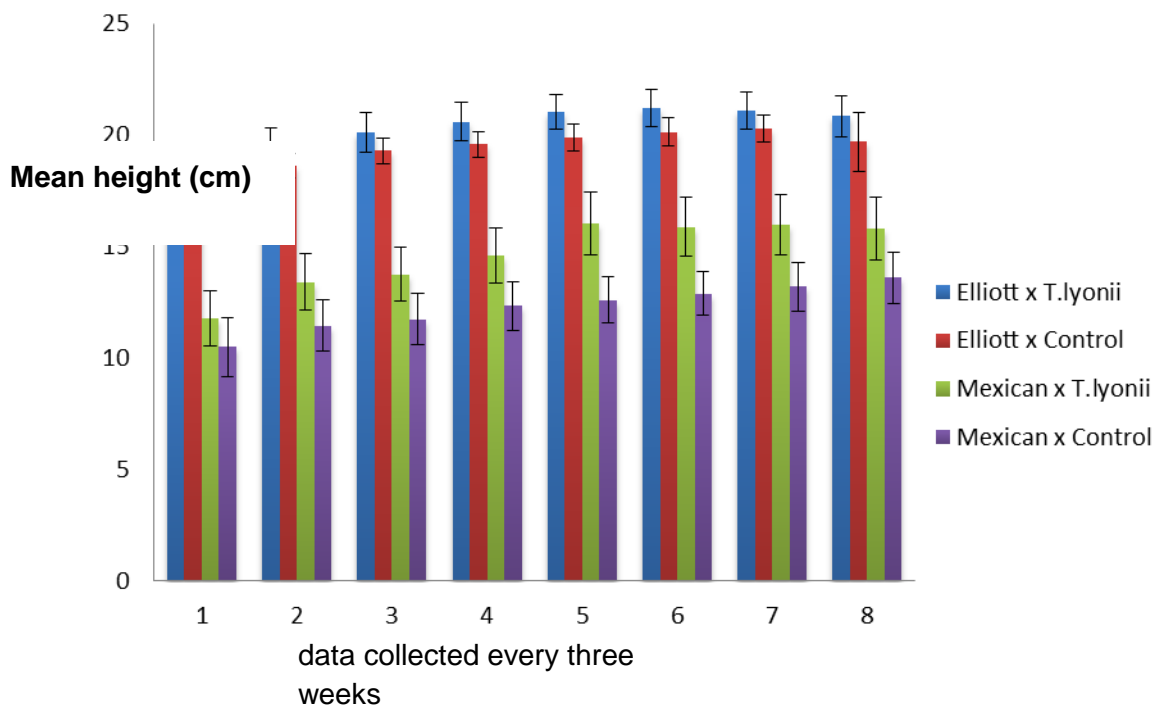


Table 1. Percent colonization in roots of two varieties of *Carya illinoensis* after inoculation with *Tuber lyonii* spores. Data are presented for various intervals after seedlings were inoculated.

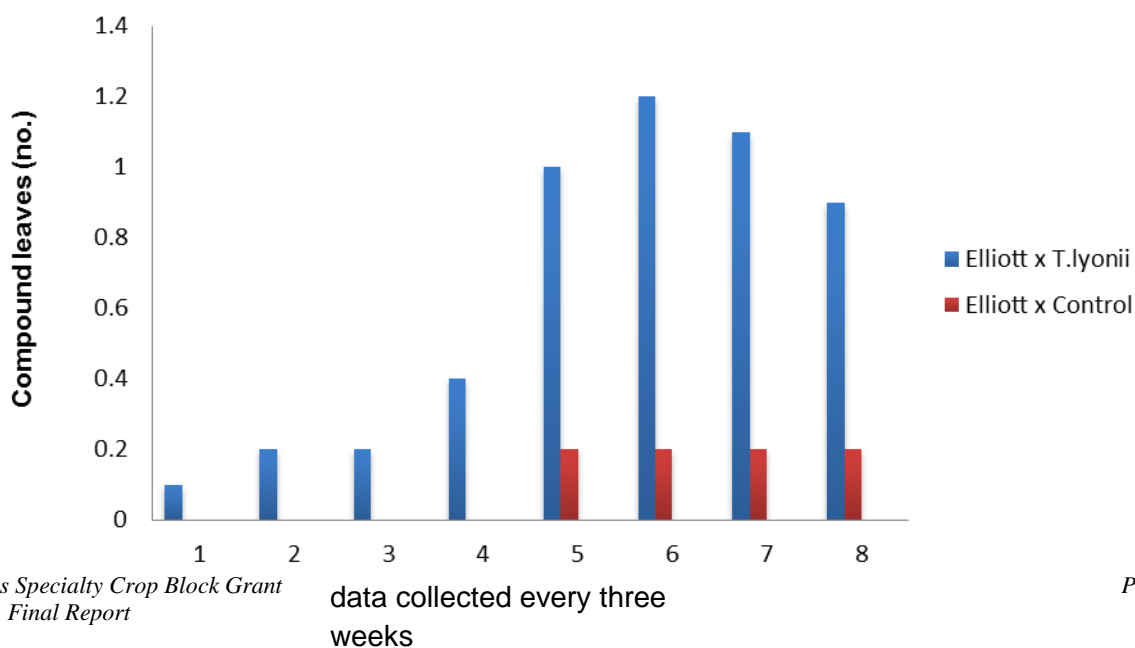
	% colonization (after 4 months)	% colonization (after 6 months)	% colonization (after 15 months)
<i>T. lyonii</i>	4.13 (both varieties)	16.98 (both varieties)	49.12 (Elliott) 38.42 (MX-87)
Control	0.00	0.00	n/a

Figure 3. *Tuber lyonii* inoculated plants of each pecan variety are taller (a) than non-inoculated plants. Number of compound leaves also is higher in inoculated plants of each variety in comparison to the non-inoculated plants (b). Finally, inoculated plants supplied with inorganic fertilizer resulted in taller plants compared to other treatments (c).

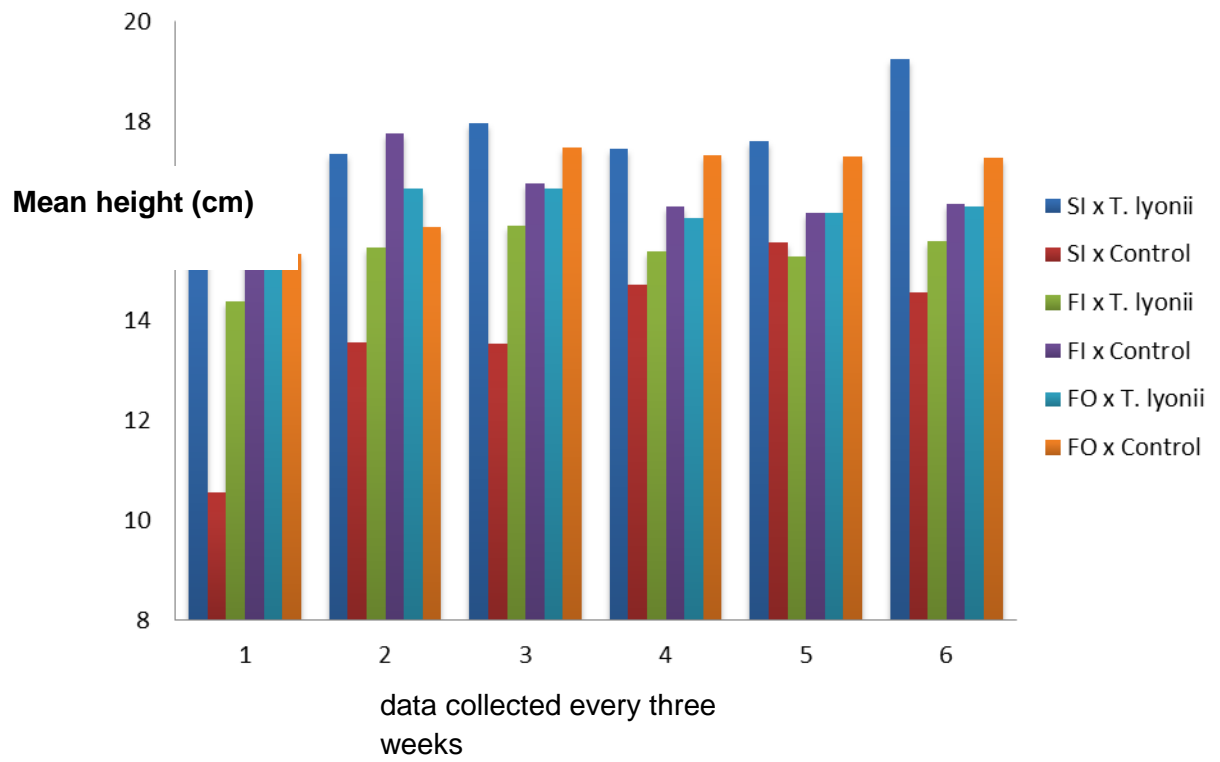
3a



3b



3c



2. Assess the presence of pecan truffle in pecan orchards and evaluate the longevity of truffle inoculum in inoculated root-stocks.

Toward this end, staff sampled for the presence of pecan truffle in pecan orchards in year 2013 and pecan trees in home yards. Truffle fruiting bodies in orchards were almost non-existent in 2013 despite our efforts to conduct dog-assisted surveys throughout the state. The largest proportion of truffles were located in home yards in NW Texas in Lamb County. Collaborators from New Mexico, Tennessee, North Carolina, and Georgia reported truffles but only a few grams were located in each of the States.

Surveys of truffles in Clay, Brown, Williamson, Bastrop, Burleson, and Lamb Counties were conducted with Lamb Co. being the most informative because there is a resident dog that can find truffles as they occur over the various growing seasons. It was also observed that *T. lyonii* generally fruits in October, November and December. Although the yields decline in December in colder/drier weather, it indeed produces fruiting bodies even in December in northwest TX. Results from the SCBGP studies also indicate that moisture availability is likely very important for the fruiting of pecan truffle.

During this field work, 10 inoculated plants were planted at 2 orchards (5 plants at each) to assay the survival of young (1 year old) transplanted plants. These plants will be irrigated as pecan trees are when they are first planted. Plants will be inspected for colonization after 12 months.

Active partners for the project are listed below:

Texas Pecan Growers Association members

USDA ARS Pecan Breeding Station (Somerville, TX and Brownwood, TX)

Montz Pecan Orchard (Charlie, TX)

Yegua Creek (Elgin, TX)

Kleins' (Bastrop, TX)

Pecan Grove Plantation (Bastrop, TX)

Cinco B Farms (Brenham, TX)

University of Georgia

University of Florida

Homeowners in Texas

Homeowners in New Mexico

Truffiere in Oregon

Truffle dog trainers in Oregon, Tennessee, New Mexico.

3. Determine the concentration of heavy metals and pesticide residues in pecan truffles and indicate safe levels of consumption:

In addition to conducting the heavy metal and pesticide residue analyses, project staff also conducted sensory analyses that were not originally a part of this project. This information is applicable and the project could accommodate this test because of adjustments that had to be made to the other parts of the project due to drought effects.

Sensory Analyses

Stir-bar-headspace-extraction (SBHE) and gas-chromatograph-mass-spectrum (GC-MS) analysis was conducted on pecan truffle samples to determine the important aroma compound presented in fresh pecan truffles from Texas and investigate the aroma intensity change with the extended storage period (Tables 2 and 3). The aroma extraction and analysis was operated every other day.

Table 2. Sample information and OSA test date.

Sample I.D.	PT #16	PT #17
Variety	<i>T. Lyonii</i>	
Common name	"pecan truffle"	
Source Country	US	
Source State/Province	Texas	
Source Nearest City/Town	Littlefield	
weight (g)	5.82	0.71
Whole/cut	whole	whole
Date Harvested	Dec. 11, 2012	
Date Received	Dec. 12, 2012	
Status upon receiving	fresh	
Aroma analysis 1	Dec. 13, 2012	
Aroma analysis 2	Dec. 15, 2012	
Aroma analysis 3	Dec. 17, 2012	
Aroma analysis 4	Dec. 19, 2012	

Table 3. The aroma compounds detected in fresh pecan truffle

Compound name	CAS No.	Retention time (min)
dimethyl sulfide	000075-18-3	1.995
2-butanone	000078-93-3	~2.1
ethyl acetate	000141-78-6	~2.6
1-octen-3-ol	003391-86-4	13.339
3-octanone	000106-68-3	13.591
3-octanol	000589-98-0	14.019
trans-2-octenal	002548-87-0	17.095
2-ethylfenchol	018368-91-7	25.313

n-tetradecane	000629-59-4	28.701
4-ethylphenol	000123-07-9	20.795
creosol	000093-51-6	21.606
4-ethylguaiacol	002785-89-9	24.676

The aroma intensity change with the storage days were plotted (Figures 4-7). The abundance of 1-octen-3-ol, 3-octanol and n-tetradecane were determined to decrease with the increased storage time in both samples. 3-octanone was determined in both samples, but only PT #16 was shown that the abundance decreased with the increased storage time. 4-ethylphenol, creosol and 4-ethylguaiacol were detected in PT #17. To summarize, the intensity of pecan truffle aroma intends to decline with the increased storage time up to 10 days after harvest in common refrigerator. This aroma loss can affect the quality of fresh truffle significantly. In further, it can potentially reduce the fresh truffle market value. The further study will focus on the optimal ways to preserve truffle.

Figure 4. The aroma compounds detected in pecan truffle by GC-MS (retention time=12.5-14.5min)

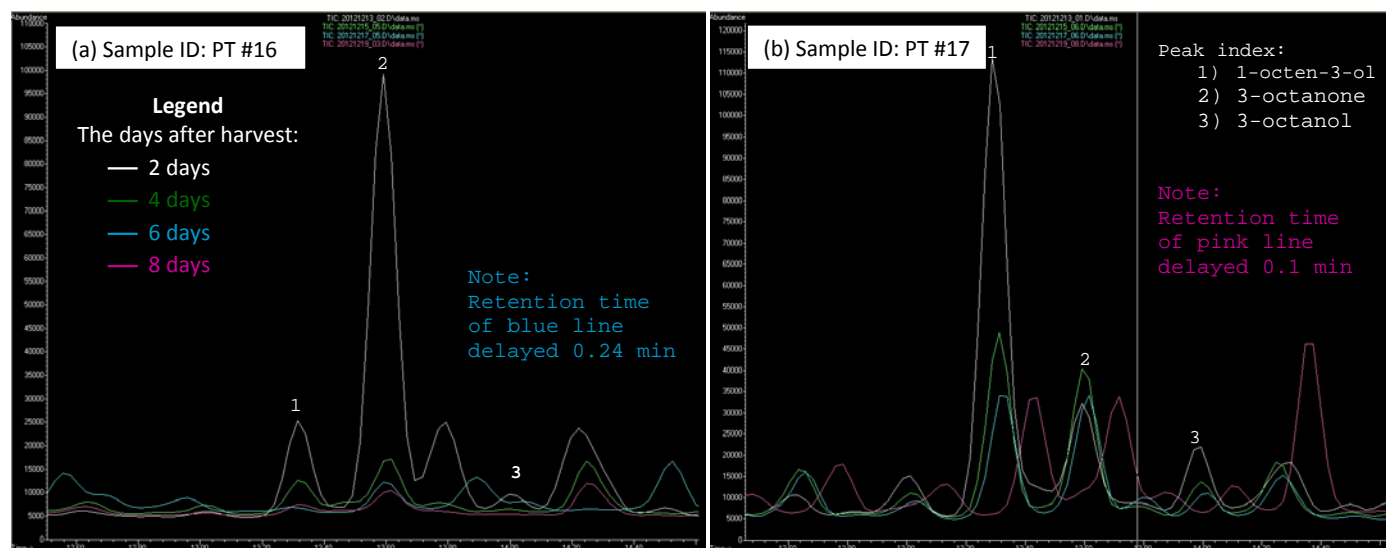


Figure 5. The aroma compounds detected in pecan truffle by GC-MS (retention time=20.5-22.5 min)

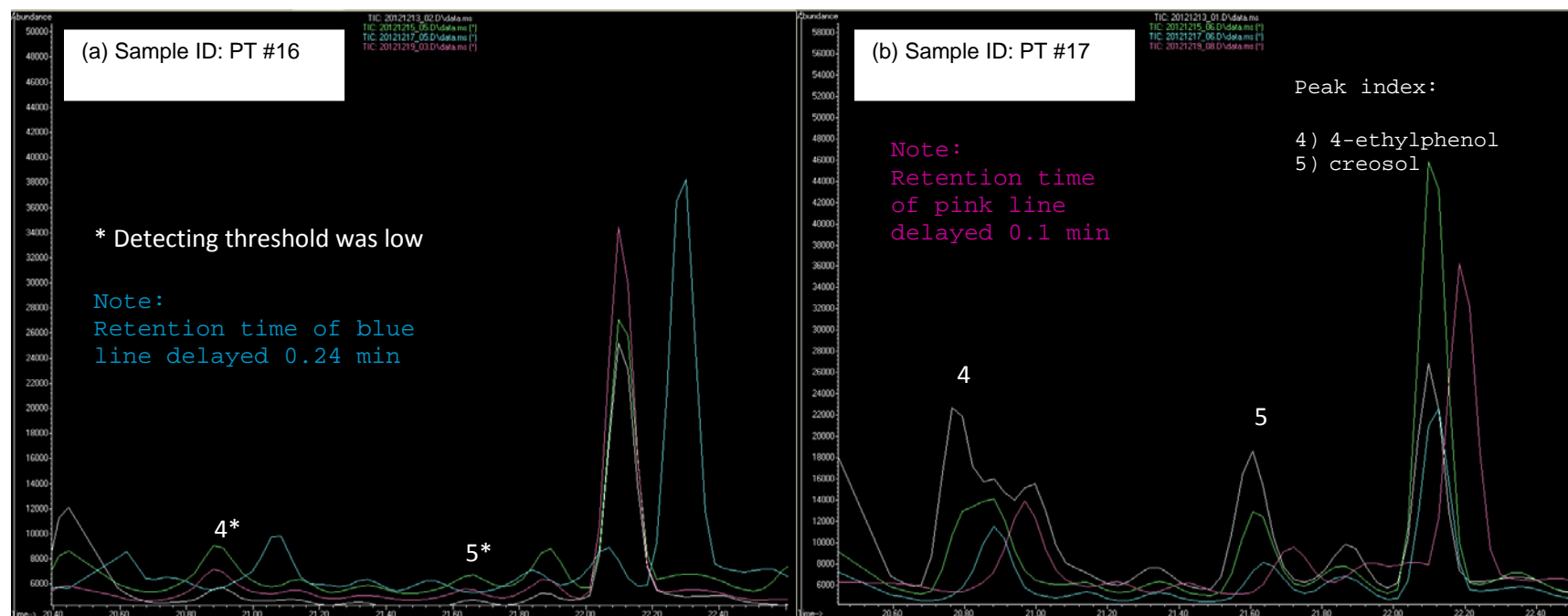


Figure 6. The aroma compounds detected in pecan truffle by GC-MS (retention time=23-26 min)

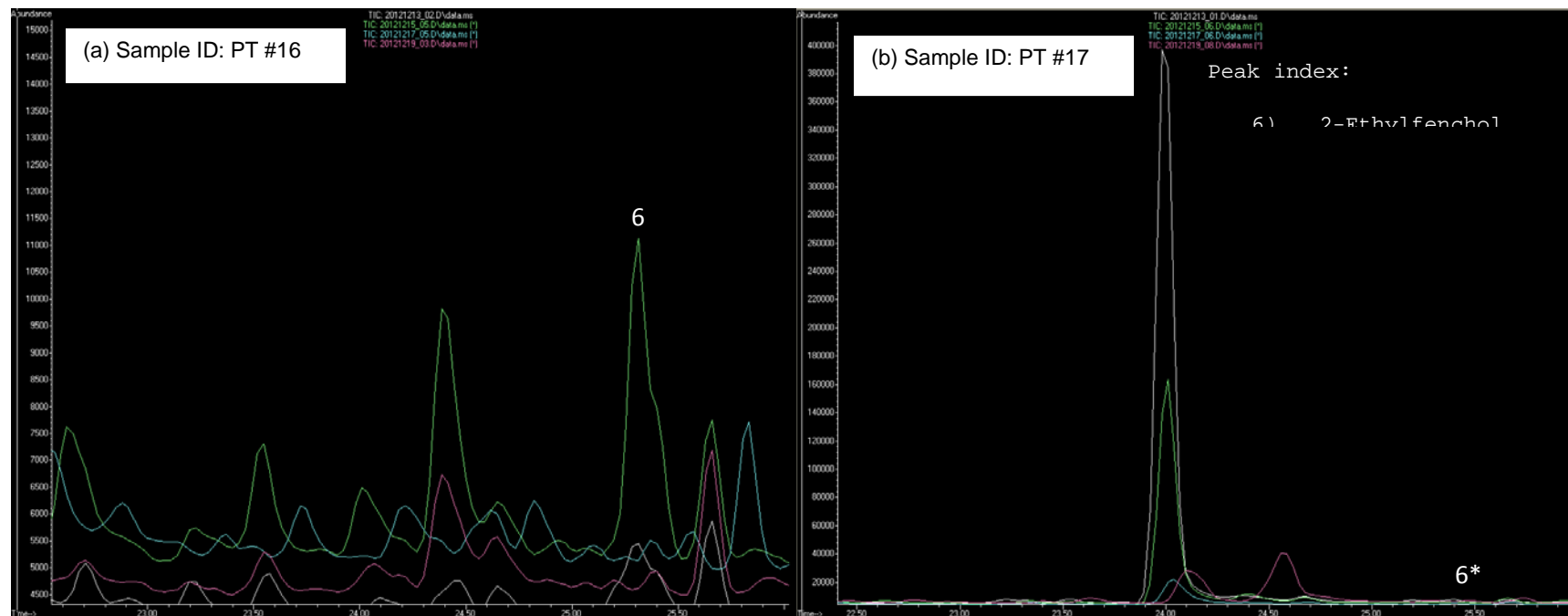
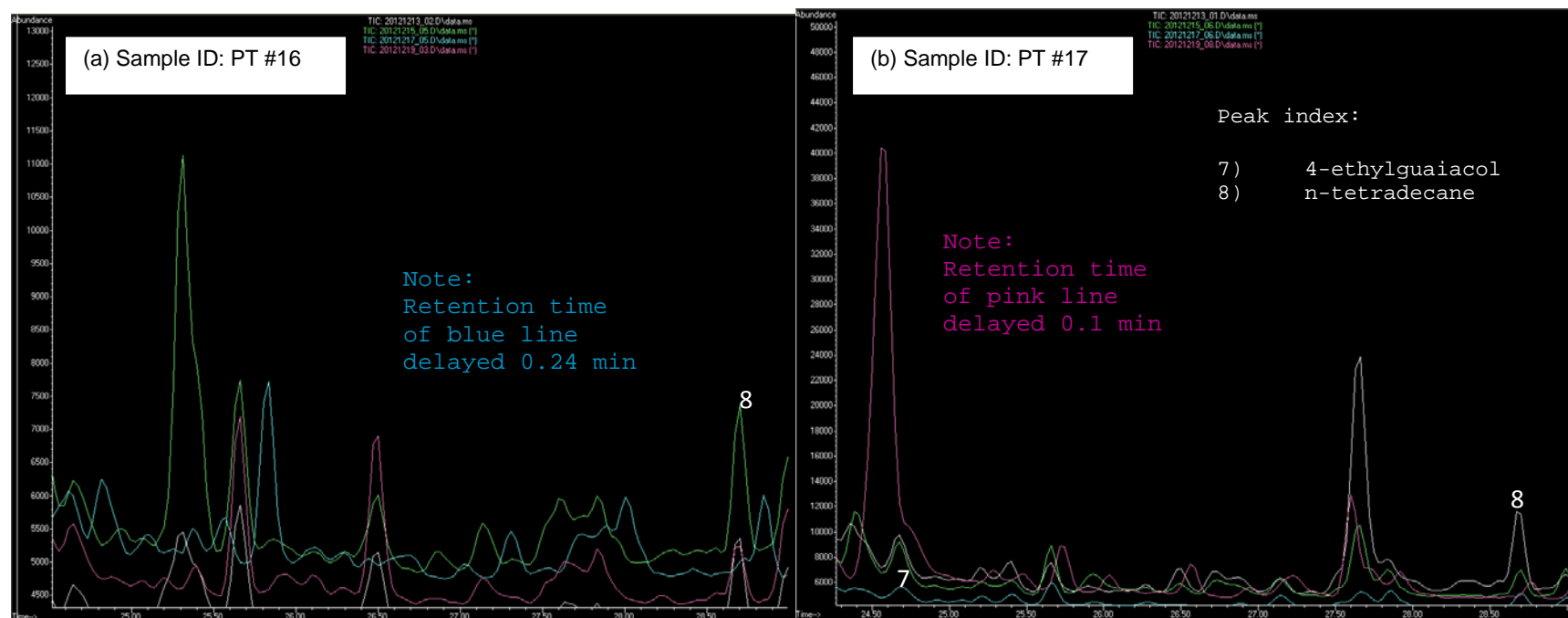


Figure 7. The aroma compounds detected in pecan truffle by GC-MS (retention time=24.5-29 min)



Pesticide analyses of truffles harvested from pecan orchards

Pesticide analyses were performed on 3 groups of truffle samples. Because of the high cost of

<u>Analyte</u>	<u>Amount</u>	<u>RL ppm</u>	<u>Tolerance ppm</u>
a, b, d-BHC	ND	0.010	
Alachlor	ND	0.020	
Aldrin	ND	0.010	
Benfluralin	ND	0.020	
BifenoX	ND	0.050	
Boscalid	ND	0.020	
Bromacil	ND	0.040	
Captafol	ND	0.040	
Captan	ND	0.020	
Chlordane	ND	0.250	
Chlorfenapyr	ND	0.040	
Chlorobenzilate	ND	0.400	
Chlorothalonil	ND	0.010	
Cyanazine	ND	0.100	
Dacthal	ND	0.020	
DDD	ND	0.020	
DDE	ND	0.020	
DDT	ND	0.020	
Dichlobenil	ND	0.030	
Dichloro	ND	0.050	
Dicloran	ND	0.020	
Dicofol	ND	0.050	
Dieldrin	ND	0.010	
Endosulfan alpha	ND	0.010	
Endosulfan beta	ND	0.010	
Endosulfan sulfate	ND	0.010	
Endosulfans (Total)	ND	0.010	
Endrin	ND	0.010	
Ethafuralin	ND	0.030	
Fenhexamid	ND	0.030	
Folpet	ND	0.050	
Heptachlor	ND	0.010	
Heptachlor epoxide	ND	0.020	
Hexachlorobenzene	ND	0.010	
Indoxacarb	ND	0.030	
Iprodione	ND	0.050	
Lindane (gamma-BHC)	ND	0.010	
Linuron	ND	0.150	
Methoxychlor	ND	0.050	
Metribuzin	ND	0.020	
Mirex	ND	0.020	
Myclobutanil	ND	0.050	
Oxadiazon	ND	0.050	
Oxyfluorfen	ND	0.040	
Pendimethalin	ND	0.050	
Pentachloronitrobenzene (PCNB)	ND	0.020	
Pentachloroaniline (PCA)	ND	0.010	
Perthane	ND	0.100	
Polychlorinated Biphenyls	ND	0.250	
Procymidone	ND	0.020	
Profluralin	ND	0.020	
Pronamide	ND	0.050	
Propanil	ND	0.050	
Tetradifon	ND	0.020	
Toxaphene	ND	0.250	
Triadimefon	ND	0.020	
Trifloxystrobin	ND	0.030	
Triflumazole	ND	0.050	
Trifluralin	ND	0.020	
Vegadex (Diethyldithiocarbamic Acid)	ND	0.050	
Vinclozolin	ND	0.020	

these analyses, truffles were combined into categories instead of analyzing each source separately. One sample included a combination of truffles harvested from various Texas orchards. The second sample was composed of truffles harvested from a home lawn, and the third contained a sample of European truffles (*T. melanosporum* and *T. magnatum*) originating from France and Italy. All truffles were stored by freezing from collection or purchase until the samples were prepared for the analyses.

Analyses included CB Screen (12 different analytes), OP Screen (44 analytes), ON Screen (32 analytes), Pyrethroid Screen (11 analytes), and OC Screen (61 analytes) for all three truffle samples.

Results indicate that none of these pesticides were detected (ND values for each analyte was recorded) in any of the samples (Table 4). This result is significant in estimating the food safety of truffles as a specialty crop.

Table 4. Pesticide residues for truffle samples collected from Pecan Truffle from pecan orchards and home lawns, and for European truffles.

<u>Analyte</u>	<u>Amount</u>	<u>RL</u> <u>ppm</u>	<u>Tolerance</u> <u>ppm</u>
Bifenthrin	ND	0.020	
Cyfluthrin	ND	0.040	
Cypermethrin	ND	0.040	
Deltamethrin	ND	0.020	
Esfenvalerate	ND	0.030	
Fenpropathrin	ND	0.010	
Fluvalinate	ND	0.040	
lambda Cyhalothrin	ND	0.010	
Permethrin	ND	0.100	
Tralomethrin	ND	0.020	
Pyrethrins (Total)	ND	0.050	

<u>Analyte</u>	<u>Amount</u>	<u>RL</u> <u>ppm</u>	<u>Tolerance</u> <u>ppm</u>
Acetamipride	ND	0.050	
Atrazine	ND	0.030	
Azoxystrobin	ND	0.030	
Benthiocarb	ND	0.050	
Cyanazine	ND	0.050	
Cyromazine	ND	0.050	
Cyprodinil	ND	0.050	
Dimethomorph	ND	0.050	
Diphenyl Amine	ND	0.050	
Fenamidone	ND	0.050	
Fenbuconazole	ND	0.050	
Fipronil	ND	0.050	
Fludioxinil	ND	0.050	
Hexazinone	ND	0.050	
Imazalil	ND	0.050	
Kresoxim Methyl	ND	0.050	
Metaxyl	ND	0.050	
Metolachlor	ND	0.050	
Metribuzin	ND	0.050	
Molinate	ND	0.050	
Myclobutanil	ND	0.050	
Prometon	ND	0.050	
Prometryne	ND	0.050	
Propamocarb	ND	0.050	
Pymetrozine	ND	0.050	
Pyraclostrobin	ND	0.050	
Pyriproxifen	ND	0.050	
Sethoxydim	ND	0.050	
Simazine	ND	0.050	
Tebuconazole	ND	0.050	
Terbacil	ND	0.050	
Thiabendazole	ND	0.050	

<u>Analyte</u>	<u>Amount</u>	<u>RL</u> <u>ppm</u>	<u>Tolerance</u> <u>ppm</u>
Acephate	ND	0.020	
Azinphos-methyl	ND	0.050	
Bolstar	ND	0.030	
Bensulide	ND	0.050	
Carbofenthion	ND	0.020	
Chlorfenvinphos	ND	0.030	
Chlorpyrifos	ND	0.020	
Chlorpyrifos-methyl	ND	0.030	
Clodrin	ND	0.050	
Coumaphos	ND	0.050	
DEF	ND	0.050	
Demeton (Systox) O/S Analogues	ND	0.040	
Diazinon	ND	0.030	
Dibrom	ND	0.050	
Dichlorvos	ND	0.030	
Dicrotophos	ND	0.020	
Dimethoate	ND	0.020	
Disulfoton	ND	0.020	
EPN	ND	0.020	
Ethion	ND	0.030	
Ethoprop	ND	0.050	
Fenamiphos	ND	0.020	
Fenitrothion	ND	0.030	
Fenthion	ND	0.020	
Fonofos	ND	0.040	
Isofenphos	ND	0.030	
Malathion	ND	0.020	
Metasysthionazin tox-R	ND	0.050	
Methamidophos	ND	0.030	
Methidathion	ND	0.030	
Methyl Parathion	ND	0.030	
Mevinphos	ND	0.050	
O-methoate	ND	0.050	
Parathion	ND	0.040	
Phorate	ND	0.050	
Phosalone	ND	0.050	
Phosmet	ND	0.030	
Phosphamidon	ND	0.020	
Pyrimiphos-methyl	ND	0.050	
Profenofos	ND	0.020	
Propetamphos	ND	0.020	
Ronnel	ND	0.030	
Tetrachlorvinphos	ND	0.020	
Thionazin	ND	0.020	

<u>Analyte</u>	<u>Amount</u>	<u>RL</u> <u>ppm</u>	<u>Tolerance</u> <u>ppm</u>
Aldicarb Sulfone	ND	0.030	
Aldicarb Sulfoxide	ND	0.030	
Aldicarb	ND	0.030	
Carbaryl	ND	0.030	
Carbofuran	ND	0.030	
3-OH Carbofuran	ND	0.030	
Methiocarb	ND	0.030	
Methomyl	ND	0.030	
o-Phenyl Phenol	ND	0.030	
Oxamyl	ND	0.030	
Propoxur	ND	0.030	
Thiodicarb	ND	0.030	

4. Conduct cost and return analyses of harvesting pecan truffles in established pecan orchards:

This project objective remains challenging because of the effects of drought on pecan orchards. It would be a better strategy to first establish yield data over a longer period and subsequently propose analyses. It is anticipated that over the next several years, yield data would become available from several locations that could be combined to obtain estimates. Once sufficient data are accumulated, such analyses will be feasible. Resources requested for this objective were directed toward the additional experiments to determine the cultural requirements for truffle inoculated seedlings. Please see Objectives 1 and 3.

Goals and Outcomes Achieved

GOAL: Provide best production practices for co-cropping of truffles and pecans in Texas and increase truffle production knowledge of Texas pecan growers to ultimately increase truffle production in Texas.

This is an ongoing, long-term goal. Toward this end, project staff shared results with growers, consumers, industry and general public during state-wide surveys of truffles, and via presentations at industry and academic conferences.

Target: Any increase in the number of growers aware of truffle production and interested in harvesting truffles at their orchards will be considered significant in this start-up phase of the project. Truffle production methods and yields, food safety analyses of truffles, and characterization of the conditions for profitable truffle production will all be new information for Texas growers.

Project team increased the number of growers and industry personnel who were exposed to relevant information by 25%.

Performance Measure: Project staff will produce occurrence, yield, colonization, and growth data, data on heavy metal and pesticide levels, and will conduct a cost and return analysis of producing truffles in pecan orchards. Pre- and post-surveys of specialty crop stakeholders' will be conducted at the TPGA annual conference to document any increase in knowledge and interest in truffle harvesting.

These measures were met except cost and return analyses because yields were not sufficient to allow this work. Drought is affecting pecan orchards and presumably the truffle crops. Additionally, Year 2013 was an 'off' year for pecan harvest at the majority of the partner orchards. In Texas, pecan harvest was approximately 50% of the yield in 2012.

While not at the TPGA conference due to scheduling conflicts, surveys of stakeholders were conducted by targeted e-mails and in person. Data show that 100% of the inquiries resulted in 'increased interest' and 'interest in more information.' Lack of information on pecan truffle culture and management is the largest gap in knowledge.

Smith, ME, GM Bonito, ZW Ge, J Sharma, and TB Brenneman. 2013. Exploring the potential of co-cropping the Pecan Truffle (*Tuber lyonii*) with Pecan (*Carya illinoensis*) in the Southeastern US. 1st International Congress of Trufficulture. Teruel, Spain.

Number of Conference Attendees - 475

Smith, ME, GM Bonito, J Sharma, TB Brenneman, R Healy. 2013. An update on the biology of the pecan truffle (*Tuber lyonii*) in the southeastern USA. APS/MSA joint meetings. Austin, Texas.

Number of Conference Attendees - 1000

Beneficiaries

1. Texas Pecan Growers Association (TPGA) members - this is an organization whose members include pecan growers, pecan value-added industry members (i.e. pecan oil, pecan bread, etc.), farm-equipment industry personnel, academic members from various universities including those in Georgia, Oklahoma, New Mexico, and from across Texas. Approximately 500 members were exposed to the educational and research information
2. Non-TPGA members in Texas - pecan growers that are not paying members of TPGA. Approximately 20 non-TPGA members were exposed to educational and research information via direct inquiry (individuals e-mailing or calling with questions).
3. USDA ARS Pecan Breeding Station (Somerville, TX and Brownwood, TX) - staff at the USDA Pecan Breeding Station. At least 4 members of the station directly participated in the truffle searches and providing research materials.
4. Montz Pecan Orchard (Charlie, TX) - pecan orchard owner and staff. At least 5 members of the operation directly participated in educational discussions and truffle searching at the orchard.
5. Yegua Creek (Elgin, TX) - pecan orchard owner and value-added vendor - At least 4 staff members assisted with truffle searching, planting the inoculated seedlings, and / or educational discussions.
6. Kleins' (Bastrop, TX) - homeowner who has a pecan orchard at his property. At least 3 members of the family assisted with truffle searching and educational discussions.
7. Pecan Grove Plantation (Bastrop, TX) - commercial pecan orchard -
8. Cinco B Farms (Brenham, TX) - homeowner and pecan orchard owner
9. University of Georgia - One research collaborator from UGA
10. University of Florida - Three research collaborators from UF
11. Homeowners in Texas - At least 4 homeowners with pecans on their property were directly involved in the truffle searching activities and/or

12. Homeowners in New Mexico - Two homeowners who have dog breeding operations and pecan orchards on their property provided data on truffle fruiting.
13. Truffiere in Oregon - truffiere owner's staff accompanied in truffle searches in Texas and disseminated educational information via the web. Publicity of pecan truffles from Texas is good marketing and advertisement for the state's pecan industry as well as the potential for truffle cropping in Texas.
14. Truffle dog trainers in Oregon, Tennessee, New Mexico. - Two trainers assisted with truffle searches and helped to disseminate information on pecan truffles from Texas.

Lessons Learned

1. As expected, inoculation of pecan seedlings with *Tuber lyonii* inoculum is a technical skill that requires special training and conditions. Project staff is gaining expertise in this method and yet many questions remain unanswered. This skill itself can be a value-added industry for pecan nurseries. It is an opportunity currently unexplored in Texas. Maximizing the colonization while minimizing the inoculum needed is a broad question that needs to be investigated further.
2. Production of pecan seedlings in containers has additional challenges of disease management and fertilization management. Project team has discovered some environmental conditions and management conditions necessary for culturing truffle-inoculated seedlings of pecan. However, the conditions still need to be optimized.
3. Economic analyses must wait until after yields are significant. This could mean that alleviation of drought conditions could or irrigation rates must be adjusted in orchards.

Additional Information

Publications and Presentations

- Smith, ME, GM Bonito, ZW Ge, **J Sharma**, and TB Brennenman. 2013. Exploring the potential of co-cropping the Pecan Truffle (*Tuber lyonii*) with Pecan (*Carya illinoensis*) in the Southeastern US. 1st International Congress of Trufficulture. Teruel, Spain.
- Smith, ME, GM Bonito, **J Sharma**, TB Brennenman, R Healy. 2013. An update on the biology of the pecan truffle (*Tuber lyonii*) in the southeastern USA. APS/MSA joint meetings. Austin, Texas.

PROJECT 11: A STRATEGY TO EXPEDITE TRIALING AND INTRODUCTION OF HEAT-RESISTANT TOMATO CULTIVARS FROM TEXAS A&M THROUGHOUT THE STATE

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Project Summary

Tomato is the number one home-garden and small acreage specialty crop in Texas. However, the roughly 2000 acres of this crop for fresh and processed markets throughout the state does not come close to supplying the entire demand from Texas consumers. This results in large imports of tomatoes and missed opportunities for Texas growers. Texas tomato production is hampered by quality issues, labor costs and lack of adapted, heat and disease resistant cultivars. This project addressed two of these issues: quality and disease/stress resistance. The uniquely heat and virus resistant germplasm developed by Texas A&M AgriLife Research during the last 12 years made it possible to address these impediments to expanded Texas tomato production. Integration of physical, chemical and sensory analyses improved the capacity to create flavorful cultivars for marketing as Texas-grown tomatoes in the vine-ripe marketplace. The potential for higher returns to growers exists in this high quality segment of the fresh market. The increased damage caused by the recent spread of Tomato Yellow Leaf Curl and Tomato spotted Wilt viruses throughout Texas adds urgency to the need for new cultivars with resistance genes. The rising temperatures and frequent drought periods associated with climate change have also added urgency to the need for heat tolerant tomato germplasm for Texas growers to be competitive.

Project Approach

1) Plant and evaluate grower trials around Texas

During the Fall 2012, a field trial with J&D Produce at Edinburg was planted, and included 30 experimental hybrids and 20 breeding lines. These included lines with round, plum, beefsteak and heirloom type fruits and multiple virus resistance genes. Both experimental hybrids and lines with high levels of resistance to tomato yellow leaf curl virus were selected, due to our pyramiding of resistance genes. Maturity, yield and fruit size were recorded, as well as any negative attributes such as deformed or soft fruit. In addition, plant size and foliage coverage were assessed, as they relate to fruit quality and yield. Fruit samples from this trial were provided to Dr. Marco Palma for his taste panel. Five round red, 2 plum/Roma types and one heirloom (beefsteak) type were selected as superior performers for further testing in the Spring 2013 trials. Seed of the TYLCV resistant processor line TAMU 5 were provided to Rio Valley Canning Company for their production fields around Donna, TX. This 30 acres of production would not have not been possible without the virus resistance in this tomato. One expected outcome was to increase consumption of Texas grown tomatoes in the state. This was achieved

because these canned tomatoes were distributed by HEB as Hill Country Fare brand diced tomatoes.

Seven field trials were planted during March. Five were established with commercial growers in La Feria, Jacksonville, Austin, Fredricksburg, and Pleasanton. Field trials of new TAMU lines and hybrids were also planted at Uvalde and College Station. The Uvalde trial included more than 80 new F1 hybrids and was intended to serve as the site for a field day in June. One trial of processor types was planted with Rio Valley Canning of Donna. All trials were established with transplants produced by the project at the greenhouse in College Station or at Peterson Brother's nursery in San Antonio. At all field trials, commercial practices such as drip irrigation and pest control were applied.

From the seven field trials planted during March, meaningful performance data was collected from only three. Fortunately, the trials at La Feria, Austin and College Station grew well and suffered only minor virus or insect damage. The trial of processor types with Rio Valley Canning of Donna grew well enough to select for virus resistance, compact plant size and yield. Additionally, several thousand plants of the new virus resistant T5 tomato were produced by Peterson's nursery and distributed around San Antonio to home gardener outlets. This was publicized by David Rodriguez of the Texas AgriLife Extension service and served to promote growing TAMU tomatoes for virus and heat resistance.

The trial at La Feria in the Lower Rio Grande Valley was an excellent test of heat tolerance, virus resistance, maturity and yield potential. Plants were vigorous and fruit quality was excellent on some lines. Ten commercial cultivars were included as checks, though most had severe Tomato Yellow Leaf Curl virus infection. This trial allowed us to identify 13 TAMU hybrids with strong TYLCV resistance, heat tolerance, high yield and nice fruit qualities for further testing. Fruit were all large to extra large (200-300g). Additional resistance genes in some of these hybrids are Fusarium 1,2, Verticillium, Stemphyllium, TSWV, TMV, late blight, and Fusarium crown and root rot. By comparison, the commercial cultivar Crista was 250 g and Tasti Lee was 150 g. Neither of these cultivars has TY resistance. The commercial cultivar Charger has TY resistance and 200g fruit, but was so late compared to everything else it was not favored by the grower. It was expected that one outcome would be improved earliness, yield and virus resistance with our experimental hybrids. This is exactly what was found at Edinburg, La Feria and College Station.

In addition to hybrids, more than 100 new breeding lines were selected for TY resistance, heat tolerance and high yield at this trial. These will be advanced for use as parents in the breeding program. Some of these new lines demonstrated capacity for very early maturity and extra large fruit in excess of 350 g. Some selections of processor and cherry tomatoes with virus resistance were also made.

The trials at College Station and Austin were smaller than the one at La Feria and had much more thrips and mite pressure as opposed to the whiteflies in south Texas. However, in both these trials, the two top performing hybrids were the same. These two experimental hybrids were also among the top 10 at La Feria and one was the best performer during the Fall 2012 for both yield and flavor. At College Station, three new hybrids with both virus and nematode

resistance were also included for the first time and one produced high yields of medium sized fruit (170 g) on a very healthy plant. At Austin, the grower was happy with the earliness and yield of the two best hybrids but severe TSWV infection from thrips damaged these as both are susceptible to the virus. Most other entries, except Crista were also severely damaged by this virus, while spider mites were also a problem in this organic trial. One heirloom type TAMU hybrid with extra large (400 g) yellow fruit was also appealing to the grower as a specialty item. The grower of the Jacksonville trial reported no disease problems but did not like the large size of the TAMU hybrids' plants. He is only interested in compact determinate types.

Data Collection on Fruit Quality

During June-July fruit quality data was collected from the La Feria, and College Station trials. Though chemical analysis of fruits has not been completed, some positive fruit quality data are included in this report. Size, shape, color, blossom scar, firmness and flavor were assessed for each hybrid that had acceptable field performance. Samples for lycopene and acid concentrations were placed in a -80 C freezer and are currently being analyzed. Table 1 lists some attributes of hybrids with the best quality. Hybrid 1 from College Station had the firmest fruit of any entry and was also the 2nd earliest to mature (Figure 1).

Table 1. Comparison of Experimental TAMU tomato hybrids and Commercial Checks at two locations

Line	La Feria			College Station			Resistances Known
	Maturity	Size (g)	Yield (g)/ plt	Maturity	Size (g)	Yield (g)/plt	
Crista	Late	250	750	Mid	230	690	TSWV, F1-3, V, N
Tasti-Lee	Mid	150	450	Mid	140	560	F1-3, V
Charger	V Late	200	1000	-	-	-	TY, F1-2
TY-coon	Late	190	570	Late	129	645	TY, F1-2
TY-gress	Late	200	800	Late	142	284	TY, F1-2
H34	Early	194	1164	-	-	-	F1, TY
H38	V Early	180	1260	-	-	-	F1, TY, St
H40	Early	220	1320	Early	157	942	F1, TY
H49	Early	180	1080	-	-	-	F1-3, TY
H50	Mid	205	1435	-	-	-	F1, TY
H56	Mid	377	1885	-	-	-	TY, F1-3
H68	Late	85	1700	-	-	-	TY, F1-3, TSWV, TMV, FOR
H1	-	-	-	Early	160	1120	F1, TY
H3	-	-	-	Early	118	944	F1, N, TY, TMV, TSWV

2) Produce and prepare seed of TAMU tomatoes for planting

There were 28 disease and heat resistant inbred lines planted in the greenhouse in College Station during October 2012, allowing for controlled pollinations to generate F1 hybrid seed for grower trials during the Spring 2013. These included the best hybrids from the 2012 spring trials. A project to create joint hybrids with Dr. Randy Gardner of NCSU was also continued. Resistance to Fusarium crown rot and fusarium wilt races 1 and 2 in some lines was verified through our collaboration with Dr. John Scott and Dr. Sam Hutton at the University of Florida.

The Fall greenhouse crossing block generated about 100 new experimental hybrids to combine heat tolerance, large fruit and multiple disease resistance genes. During February the Spring crossing block was planted in the greenhouse and crosses were made to produce additional seeds of 12 promising hybrids from 2012 trials. New hybrids to introgress nematode and tomato spotted wilt resistance genes into some elite TAMU lines were also created.

In the Spring greenhouse, hybrid seeds of the five best hybrids from the 2012 Fall trial and also 24 new hybrids with novel resistance gene combinations, including nematode, tomato spotted wilt, fusarium crown and root rot and fusarium wilt race 3 were generated. These seeds were planted in the Fall 2013 trial in Edinburg and will also be planted in the Spring 2014 trials. Self-pollinated seeds of elite breeding lines were produced at both La Feria and College Station.

Collaborations were initiated with four seed companies- Lark, Emerald, Harris Moran and BHN, to test TAMU inbred lines for virus resistance and determine if they will commercially produce the seed. Lark and Emerald expressed interest in producing hybrid seed for commercialization of two, large fruited, TYLCV resistant hybrids.

3) Record feedback from growers and consumers

The first feedback was achieved by meeting the research manager of J&D Produce in Edinburg (Dr. Carlos Lazcano) and walking through the field trial during November. His input regarding plant and fruit quality, especially flavor and disease resistance, was recorded. He delivered some fruit from the best yielding and most virus-resistant hybrids to the owner, Jimmy Basetti, who provided his feedback regarding flavor and appearance. Samples of the 8 best experimental hybrids were provided for a taste panel at College Station. Dr. Marco Palma assisted in conducting a blind taste panel with 200 consumers from the College Station area during December. The results are being compiled and analyzed for publication by a graduate student.

Four growers provided feedback regarding the growth and health of the tomato plants in their trials at La Feria, Donna, Jacksonville and Austin. The growers at La Feria and Donna were pleased with the plant health, heat tolerance and fruit set. Both of these growers expressed interest in very firm fruit with good color. The organic grower near Austin was able to harvest and sell most of the tomatoes from the trial and also liked the heat tolerance and large size of the fruit. The hybrids with larger plants were preferred to extend the harvest season. The grower in Jacksonville was not happy with any of the hybrids because they had large, vigorous plants and he is looking for extremely compact, determinate types. Trials were visually inspected at Austin, Donna, and La Feria to assess disease resistance and fruit quality.

Dr. Marco Palma provided some data from his blind taste panel with two TAMU hybrids from the Fall field trial. One of the TAMU hybrids was chosen second overall and first for appearance and color by a panel of more than 100 participants. The conventionally grown, vine ripe, store bought tomato was ranked first and just edged out the TAMU entry for taste and freshness. Post harvest factors may have contributed to this result as the TAMU tomatoes were first stored in a cooler by J&D Produce and then at room temperature at College Station for 4 days prior to the taste panel being conducted. It will be preferable to repeat the panel with TAMU tomatoes which are fresher and have not been chilled. This taste panel was the first to evaluate TAMU tomato germplasm, so data generated will serve as a baseline for future quality assessments.

Another one of the expected outcomes was achieved by recording the feedback of both growers and consumers to guide selection and development of the best new TAMU hybrids from the field trials. The quality and production concerns expressed by the growers helped direct the focus on a few specific hybrids for seed increase and commercial production. Dr. Crosby also attended the TOFGA Meetings in Austin and passed out a survey to roughly 35 growers and industry professionals. He presented a talk about tomato and melon breeding and solicited feedback directly from organic growers about their priorities. This resulted in multiple new collaborators for field trials of the TAMU tomatoes, including a large grower near Pleasanton.

A tomato mini-conference and field day was successfully carried out at the Texas A&M University Research and Extension Center at Uvalde during June of 2014. The program began with five slide presentations by TAMU scientists who work on issues related to tomato culture. This was followed by an opportunity to taste elite TAMU tomato hybrids and commercial cultivars by the attendees and interact with AgriLife personnel. A flyer for the new TAMU cultivar- 'Hot-Ty' was also distributed. The group of 30 attendees then went to observe the field plots. These included 6 elite TAMU hybrids and four commercial check cultivars in replicated plots and 31 additional experimental TAMU hybrids. All plants were grown with commercial practices- drip irrigation, plastic mulch. Several small commercial growers and representatives of the NCAT were able to interact with AgriLife scientists and discuss tomato cultural practices, quality and disease resistance.

Goals and Outcomes Achieved

The team of Crosby, Rodriguez and Stein completed several activities related to achieving the following measurable outcomes:

1) Increase production of Texas grown tomatoes-

This is a long term goal which can be achieved through making seed of improved TAMU tomato cultivars available as they are commercialized. Seed of the processor tomato T5 was produced and made available during this project and three growers and the cannery (Rio Valley Canning) directly benefited from the virus, heat tolerance, and yield of this cultivar. Seed of new experimental hybrids was also made available for commercial trials and several growers were able to sell their vine ripe fruit from these.

2) Improve sales of home-garden tomato plants through introduction of new, heat and virus resistant cultivars-

This was tested in the San Antonio market and 2000 seedlings were produced and sold by Peterson Nursery, but larger seed supplies will be needed to have a significant economic impact. Promotion of the TAMU tomatoes by Rodriguez was accomplished and will need to be expanded to other markets through additional Extension agent participation. Millions of tomato transplants are produced and sold in Texas each year, so demand for seed is great. Production of additional seed is underway to enhance availability for nurserymen.

3) Record feedback from participating growers and calculate economic impact-

This was conducted on a one by one basis from each grower that participated in La Feria, Edinburg, Jacksonville, Donna, Austin and Overton. Contact was maintained with these growers every 3-4 weeks to determine progress of the plantings and yield potential. Two growers did not have feedback near San Antonio due to hail destroying their trials. The two growers that experienced significant economic impact were in Austin (Johnson's Backyard Garden) and Donna (Rio Valley Canning). Due to the small number of growers, a questionnaire was not needed and production figures were obtained directly from the collaborators in person. The acreage was roughly 0.25 at JBG and 20 at RVC. They were able to sell their tomatoes and based on the size of the production, experienced returns of \$2000 and \$25,000, respectively. The performance data from all growers was utilized to extrapolate potential economic impact if acreage was increased beyond the experimental level. The estimate was 120 additional acres of all tomato types in the near term. Returns per acre vary from \$2000 for canning tomatoes to more than \$5000 for organic or specialty fresh market types. The main impetus to plant the TAMU lines would be improved prices for early maturing tomatoes and potential for much greater yields where TYLCV pressure was high, such as in south Texas.

The planned field day at Texas AgriLife Research and Extension Center at Uvalde was cancelled due to damage from herbicides on the tomato field trial. This was rescheduled for June 2014 and successfully completed (see above). There were 30 attendees.

4) Increase consumption of Texas grown tomatoes

This was achieved with the same two successful producers mentioned above. JBG was able to market TAMU and other tomato cultivars through their organic produce operation in the Austin area. Rio Valley Canning was able to produce and deliver thousands of pounds of the TAMU 5 tomato as canned, diced product to HEB and other retailers. All production was in the Lower Rio Grande Valley. Most of the distribution was to HEB and other Texas retailers, thus increasing the percent of Texas-grown, canned tomatoes consumed by Texans.

5) Decrease use of pesticides due to genetic resistance of TAMU tomatoes to disease-

This was mostly achieved in trials with organic producers, where the application of pesticides was limited to natural compounds such as Neem. Under these conditions, the TAMU tomatoes performed well due to their heat tolerance and early maturity, before pest populations could build

up. The early maturity also allowed the grower in La Feria to reduce late season pesticide use because all the fruit had matured and could be harvested before commercial cultivars.

Beneficiaries

The main beneficiaries of this project were tomato producers who harvested earlier, high quality fruit due to the inherent heat and virus resistance in TAMU lines. These included Rio Valley Canning and their growers, J&D Produce and their growers, and Johnson's Backyard Garden. HEB and Kroger also benefited from having canned tomatoes at reasonable process under their store brand labels. One transplant nursery (Petersons) had a modest benefit from tomato plant sales, but could easily sell many more in the future. Two seed companies (Emerald and BHN) should benefit from producing the TAMU tomato cultivars and selling the seed in Texas. Numerous small growers and home gardeners benefitted from learning about the TAMU heat and virus resistant tomato germplasm, which is better adapted than some commercial cultivars. The scientific community such as participants of the southern region of the American Society of Horticultural Sciences benefitted from the information presented by Crosby at the annual meeting in Dallas.

Thus, an estimated 200 individuals in production and research benefitted from the knowledge and plant materials developed in this project. Additionally, an unknown number, but likely in the many thousands, of consumers benefitted from the availability of Texas grown tomatoes at HEB and other retail outlets in Texas. Despite the limited availability of seed, an estimated economic impact of about \$30,000 was realized by the tomato growers and a greater amount by the retailers. The retail economic impact was not quantified because of mixing of TAMU and other tomato cultivars in stores. This could be resolved in the future by specific labeling if the retail outlets will agree.

Lessons Learned

Positive lessons learned were that the virus resistance and heat tolerance of TAMU tomato lines was very evident in trials and appealed to all the collaborating growers. In addition, the diversity of types, including round salad, plum and beefsteak/heirloom tomatoes met the requirements of the diverse stakeholders for their unique markets. Another positive lesson learned was that Texas consumers are willing to pay more for locally grown tomatoes, and this could help offset the rising costs of production for vine ripe tomatoes.

Several negative experiences provided lessons for future project implementation. The first was that short seed supplies discourage transplant nurseries and growers when they observe otherwise desirable cultivars. Therefore, increasing seed supply of the new TAMU lines needs to be a high priority. This is somewhat difficult due to the lack of interest from the major seed companies in the relatively small Texas market. By working directly with several small seed companies, this problem can be solved.

A related issue was problems with unanticipated diseases in the greenhouse at College Station. Both charcoal rot and late blight severely damaged some key parent plants during hybrid seed production. A more stringent fungicide spray program will need to be implemented in future

seed production efforts. Having more seed produced by commercial collaborators will also reduce risk of this problem recurring in the future.

The other negative lesson learned was that herbicide and nutrition issues can dramatically impact plants at any given location, so field days are at the mercy of human and natural disasters. The failure of the main field day planting at Uvalde and the hail damage to the backup location made it abundantly clear that drastic measures may be needed to protect the transplants in the future, when a field day is a key component of the outreach program.

Additional Information

During the extension of the project granted by TDA, a mini-conference and field day at Uvalde was successfully carried out and more seed of the new TAMU cultivar- 'Hot-Ty' was generated in the greenhouse at Texas A&M. Additionally, approximately 100 lbs of seed of two elite processor lines with Rio Valley Canning were also increased during the spring of 2014.



TAMU tomato hybrid 13-04: early, heat tolerant, 200g, TY, F1, F2, St



TAMU T5: heat tolerant, processor, TY, F, FCRR, TMV, St



TAMU 13-6033: early, heat tolerant, heirloom type, TY, TSWV

PROJECT 12: FOOD SAFETY BEST PRACTICES VIDEOS AND WORKBOOK FOR SMALL FARMERS IN TEXAS

Partner Organization: Texas AgriLife Extension

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Project Summary

There have been an increasing number of consumers who support the local food movement and farmers' markets. According to the Food Safety Modernization Act (FSMA) small farmers who make less than \$500,000 annually are exempt from FDA regulations. However, it is crucial that the farmers follow appropriate GAPs/GMPs/GHPs to ensure that the produce is safe for consumption. The first objective of this proposed project was to study the survival of foodborne pathogens on storage containers to obtain scientifically validated recommendations to farmers. The second objective was an observational study in the farms, during transportation and at farmers markets. The investigators made note of effective behaviors that farmers employ to reduce foodborne disease hazards as well as possible high-risk issues. These observations were used in the final objective, which was to develop scripts for videos and a Best Practices workbook to communicate these behaviors to small farmers. Our goal is to provide farmers with scientifically validated information on how to incorporate food safety behavior on the farm, during transport and at farmers' markets.

Timeliness of Project:

The overall goal of this proposal was to increase the use of Good Agricultural Practices (GAP) / Good Handling Practices (GHP)/ Good Manufacturing Practices (GMP) by growers of specialty crops in Texas and develop a set of videos and a workbook to demonstrate behaviors that reduce the risk of pathogenic contamination on fresh produce. As local food markets increase and smaller farms become the preferable source for many consumers to procure fresh produce, this may make the control of foodborne pathogens associated with fresh produce such as human Norovirus, *Salmonella* and enterohemorrhagic *Escherichia coli* more difficult. Many of these small farms may be new to agricultural production and have varying field preparation, production, harvest, and post-harvest handling practices, and these new farmers may be unaware of some of the GAPs/GHPs/GMPs targeting both bacterial and viral pathogen contamination issues.

On December 21, 2010, the House of Representatives voted 215-144 to pass the Senate version of the Food Safety Modernization Act (FSMA). Small farms that market directly to consumers and certain retailers and restaurants with annual sales less than \$500,000 are technically exempt from produce safety standards. However, these small farms are still responsible for either identifying potential hazards associated with the food being produced and implementing and monitoring preventive controls or demonstrating that they will comply with state, county, or other applicable non-Federal food safety laws. This has been a source of great confusion and frustration for many small farmers.

This shows that there is an increasing need to provide farmers market vendors and managers with scientifically validated methods to improve farmers' market food safety. As part of this study, we chose to develop educational and informative videos for market vendors and managers. For market vendors who prefer a hard copy of the material, we designed information sheets and workbooks for the community outreach component of this study.

Project Approach

Activity 1. The survival and growth of foodborne pathogens Listeria, Salmonella, and Escherichia coli on cardboard and plastic storage containers was studied.

Task: For this activity, 10 x 10 cm cardboard and plastic coupons were designed to simulate cardboard and plastic produce storage cartons. The coupons were wrapped in aluminum foil and sterilized by autoclaving at 121°C. The following pathogenic bacteria were used for this experiment: *Salmonella* Muenchen (BAA-1594), *Salmonella* Thompson (BAA-1604), *Salmonella* Typhimurium (ATCC 14028), two *Listeria monocytogenes* strains (ATCC 51414 and ATCC 43256), and *E. coli* O157:H7 (ATCC 43895). All strains were obtained from American Type Culture Collection (ATCC) and stored at -80°C in glycerol. The bacteria were grown individually for 18 h in sterile Brain Heart Infusion (BHI) liquid media (Becton, Dickinson and Company, Sparks, MD). Following this, the bacterium cocktail was created in peptone water to yield a 10⁸ dilution. The cocktail was spread on the coupons using a sterile spreader. The coupons were placed on a sterile petri dish and samples were processed at the following time points: Day 0 (0 h), Day 0 (6 h), Day 1, 2, 5, 8, 11, 14, 17, 20, 23, 26, 29, 32, 3, 38, 41, and 44. To process the sample, the coupon was placed in a sterile stomacher bag and stomached for 120 seconds with 90 ml 0.1% peptone water. Appropriate dilutions were performed and the samples were spread plated on Eosin methylene blue (EMB) agar (EMB HiVeg™ Agar, Levine, HiMedia Laboratories Pvt. Ltd. India) to identify *E. coli* and *Salmonella* colonies and PALCAM *Listeria* Agar Base with PALCAM *Listeria* Selective Supplement (EMD Chemicals Inc., Germany) to identify *Listeria* colonies. The plates were incubated at 37°C for 48 h and then colonies were quantified.

Targets: The target was to identify how long the pathogenic bacteria could survive on the produce cartons. These results would be used in the following outreach objectives and market vendors and managers would be provided with alternative suggestions to improve produce safety at markets.

Performance Goals: The goal was to perform these experiments to provide scientifically validated recommendations to market vendors and managers.

Significant Results: The results showed that *E. coli* O157:H7 can survive on the coupons until Day 2. However, *Listeria monocytogenes* and *Salmonella* spp. can survive on the coupons up to Day 32 and 44, respectively. This shows that pathogenic bacteria can survive on produce box storage boxes and could be a potential source of cross contamination onto fresh produce.

Accomplishments: This objective/task was completed successfully without any issues. The results were used in following outreach objectives to proposed alternative produce storage options to farmers.

Conclusions: Pathogenic bacteria can survive on produce storage containers for up to 44 days. Hence, constant reuse of these containers is not recommended.

Favorable and Unusual Developments: The investigators did not expect to observe that pathogenic bacteria could survive on produce cartons for over one month. Hence, during the initial experiment design, the investigators did not prepare the ideal number of samples. However, the investigators included additional sample days while performing the biological replications of the experiment. No other unusual developments were observed and the experiment was completed successfully.

Actual accomplishments versus what was promised in the proposal: The task was carried out as promised in the proposal.

Recommendations: The investigators recommend that farmers' market vendors use produce storage containers that can be easily washed and sanitized. Another option may be to use disposable liners for cardboard containers.

Significant contributions of project partners: Co-PI Sirsat performed these experiments with the help of undergraduate students.

Activity 2. An observational study was performed to identify best practices and possible high-risk food safety related behaviors in farms, during transportation of produce, and at the farmers market.

Task: PI Neal and co-PI Sirsat have received approval from the Institutional Review Board for this component of the project. The undergraduate students visited farmers markets around the Houston, TX area to identify good and high risk practices. A survey was created that listed items to observe. For examples: are pets allowed?; are the produce cartons placed on the ground?; are the samples provided held at appropriate conditions?; etc. All the observations were made anonymously.

Targets: The target was to observe and record not just high-risk, but also good practices that are conducted by vendors and consumers at farmers markets.

Performance Goals: The goal was to use the information obtained from this study in the next objective to develop YouTube videos and workbooks.

Significant Results: The results showed that several farmers market had no hand washing stations and allowed pets. In addition, some vendors were observed smoking and eating close to their booths. Other markets did have facilities for hand washing and rest rooms. Most vendors had placed the samples in appropriate conditions (e.g. leafy greens, fruits and dairy products were placed on ice). The farmers market often have several crops and other foods that are not specialty crops; however, to ensure that funds were spent solely on specialty crops only, the investigators main objective was to observe food safety related best and high-risk practices related to specialty crops (e.g. lettuce, spinach, cabbage, and kale).

Accomplishments: The observational study was carried out in over 10 farmers markets in the Houston TX areas to ensure that several different characteristics were observed. These observations helped the investigators and students toward designing the educational material.

Favorable and Unusual Developments: Students in groups of three or four carried out the study. This enabled diverse observations at each market. No unusual developments occurred.

Actual accomplishments versus what was promised in the proposal: This objective was completed as proposed in the original grant.

Recommendations: Based on the results, the investigators recommend hand washing stations and clear signage in all farmers markets.

Significant contributions of project partners: PI Neal, co-PI Sirsat, graduate and undergraduate students completed this component of the project.

Activity 3. Videos and best practices workbooks were designed.

Activities: Based on the observations in objective 2, the investigators designed 10 scripts for the videos and workbooks. The videos were designed to be educational and interesting. The videos were designed using Toon boom studio 6 software.

Targets: The target was to create at 10 educational videos and design workbooks based on these videos.

Performance Goals: The goal was to create educational and interesting videos to motivate the farmers and vendors to watch them.

Significant Results: The videos have been extremely well received by small farmers and other market vendors.

Accomplishments: We have translated these videos to Chinese and Vietnamese. Our students at the University of Houston have presented these videos at multiple University of Houston seminars where they have been well received. In addition, co-PI Sirsat presented these studies at the following conferences:

- Southwest Regional FDA Annual Conference, San Antonio, TX, September 2013;
- Texas Certified Farmers Market Association, Seguin, TX, February 2014; and
- San Antonio Food Bank Conference, San Antonio, TX, February 2014.

Favorable and Unusual Developments: No unusual developments were observed during completion of this objective.

Actual accomplishments versus what was promised in the proposal: In the actual proposal we proposed that farmers would be shown in the videos demonstrating the good and high-risk practices. However, after consideration the investigators and students involved in this project decided to develop animation videos demonstrating “Good Ideas” and “Bad Ideas”.

Recommendations: The recommendations for “good” food safety related ideas and “bad” food safety related ideas are demonstrated in these videos.

Significant contributions of project partners: PI Neal, co-PI Sirsat and undergraduate student workers were involved in this component of the project.

Goals and Outcomes Achieved

1. The produce box study showed that pathogenic bacteria could survive on produce storage cartons for over 30 days. Based on these results, recommendations were made to market vendors and managers and a video was designed communication the risks of reusing the storage containers without sanitizing.
2. The observation study showed several good and high-risk practices and was used to design the video scripts.
3. The investigators designed the videos and have pilot tested it with several market vendors. The videos were well received and response obtained was extremely positive. Following this, the investigators conducted outreach at multiple farmers market and sanitarian conferences.
4. Workbook containing educational material available in the videos were also created and distributed at multiple farmers market and public health conferences across Texas. These included the Texas Certified Farmers Market Meeting, San Antonio's Food Bank Farmers Market Conference, and the Texas Environmental Health Association Meeting. The investigators estimate that the educational material disseminated benefited at least 130 specialty crop growers. After dissemination of educational material, informal discussion with farmers and market managers revealed that the educational material was useful and that they are incorporating several recommendations at their markets.
5. The investigators disseminated the workbooks and videos in several counties across Texas during farmers markets meetings and annual conferences. The response to the educational material was extremely positive and dissemination was greater than expected. Due to the distance of some markets and budget limitations, we were not able to travel to these markets as much as we would've liked.
6. The surveys conducted demonstrated an improved knowledge and perception of food safety at farms and farmers markets. For instance, majority of farmers (66%) believed that it would be beneficial to have food safety training after dissemination of the educational videos. This demonstrated a 10% improvement from the pre-survey. Overall, an improvement in knowledge was observed in the following sections: Wash produce before selling to improve food safety, presence of hand washing sinks at farmers markets and farms, and the importance of food safety education.

Beneficiaries

The results of this study aims to improve farmers market food safety. The outreach and education videos developed are specifically for market vendors and managers. The goal is to reduce the incidence of foodborne illness among consumers. Hence, this study benefits Texas growers, market managers and customers. The study benefitted at least 130 specialty crop growers across the state of Texas.

Lessons Learned

As per the original proposal, the investigators wanted the farmers to demonstrate good and high-risk practices. However, after further discussion, the videos would be better edited and more informative if designed using animations. Moreover, voiceovers in various languages could be done on animation videos. Even though this was not in the original proposal, the investigators believe that the translations would make the educational videos available to refugee farmers and hence increase the number of beneficiaries of the project.

Additional Information

The results of this study were presented at the International Association of Food Protection (IAFP) in August 2014. The conference consisted of a national and international audience of 2800 attended, which included academics, scientists, growers, farmers market managers and vendors and industry personnel. Investigators Sirsat and Neal are currently working on a manuscript to document the results of this study. The manuscript will be submitted for publication in a peer-reviewed scientific journal.

PROJECT 13: DETERMINING BEST MANAGEMENT PRACTICES FOR PRODUCTION OF NATIVE SOD GRASS MIXTURES

Partner Organization: Turfgrass Producers of Texas, San Antonio Water System (SAWS)

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Project Summary

Environmental concerns and the growing need for water conservation emphasize the need to develop improved production systems for landscape plant materials possessing greater resource efficiency. Although there would conceivably be great interest among the public for sod composed of native grass mixtures, to this point, sod producers have been reluctant to move into this area, primarily due to a lack of information on best management practices for its production.

Professional sod production of native grass mixtures could offer an attractive, value-added specialty crop market for sod producers, whose sales have been depressed by the recent downturn in the housing market. Furthermore, it could enhance opportunities within the Texas native seed industry. In practical terms, it would transfer the burden of native seed establishment to the professional producer, who could then provide ‘instant native lawn’ to the consumer market.

While the vast majority of Texas lawns have traditionally been established from sod, native grass mixtures are currently available to consumers only through seed. Given the late spring seeding window for these species, which coincides with heavy rains and competing summer-germinating weeds, successful establishment of native lawns has been perceived to be a challenge, with loss of sediment and nutrients often occurring due to unsuccessful establishment. If best management guidelines could be developed for sod production of Texas-adapted native grass mixtures, the Texas sod production industry would have the needed information to move forward into this area. Native sod could provide a new, value-added market for sod producers, whose sales have been depressed in recent years. Also, it could open the door to more widespread adoption and use of natives in the landscape, of which the lawn is generally the largest component. The potential savings in water and fertilizer use with natives compared to traditional monoculture turfgrass lawns (both in production and landscape management) could lead to fewer demands on water supplies with less environmental impact.

This project evaluated best management practices for sod production of native sod mixtures. Native sod production was evaluated alongside traditional bermudagrass turfgrass production, with particular emphasis on irrigation and mowing practices and their effects on establishment success within both systems. Sod development was quantified through progressive digital image analysis of canopy development and final evaluations of sod harvestability and tensile strength.

Project Approach

Activity 1- Construct plots and Install automatic irrigation

The field site required substantial rough grading to accommodate proper leveling and minimize slope of research plot areas. This was accomplished during March and April 2013. Plots were graded, with 8" of topsoil added to all plots before completion. Soil was tested and found to contain high levels of all macro and micronutrients. Three experimental areas were established at the Texas A&M Turfgrass Ecology Field Lab on F&B Road in College Station, TX. Each area was 50' by 100' in size and was subdivided into 4 plot areas, each 20' by 40' in size and equipped with individual irrigation. Each plot had 6 heads: 1 at each corner plus one midway on each long side. All experimental areas were treated with Basamid soil sterilant at the recommended rate of 10 pounds per 1,000 square feet (5 kg/100 square meters) about 4 weeks before planting to control any bermudagrass or germinating weeds. Irrigation was supplied to plots during the study period (May through October) at levels of either 75% or 50% x Historical reference ET (ET_o) for the site.

Activity 2- Evaluation of tolerance of native grasses to herbicides

Herbicide tolerance evaluations were conducted August/September 2013 in the greenhouse by Wherley and support staff. Mature plugs (7 month old) and newly seeded (2-month old) pots of native grass were used for the herbicide trial to test sensitivity to herbicides based on maturity level. Eight post-emergence herbicides were tested at both 1X and 2X label rates. 9 pre-emergence herbicides were tested at 1X label rates, both in liquid and granular form. Visual evaluations of grass phytotoxicity were made on herbicide-treated and untreated control grasses at 5, 14, 21, and 28 days after treatment.

The native grass mixture (Habiturf) was sensitive to several common post-emergent herbicides used on turfgrass landscapes. Analysis of the data showed differences due to product, application rate, planting method and most interactions of these factors (Table 3). For ease in presentation and discussion, only the data taken 21 days after treatment (DAT) will be considered. Mean turf injury at 21 DAT for each of the two planting methods showed that grass established from plugs had significantly less herbicide injury (Table 4). This is likely due to plants established from plugs were more mature and had more well developed root and shoot tissues allowing them to better withstand the effects of the herbicides.

Mean injury to Habiturf from 8 post-emergent herbicides applied at two rates are presented in Table 5. The data show that when applied at the recommended rate (1X) Dicamba, Sulfosulfuron and Triclopyr all caused significant injury (Table 5). When applied at the 2X rate, injury from Dicamba and Triclopyr increased. Injury from Sulfosulfuron still occurred at the 2X rate but was less than at the 1X rate. In addition, Fluazifop which did not cause any injury at the 1X rate did cause a significant amount of injury when applied at the 2X rate. The data indicate that Dicamba, Sulfosulfuron and Triclopyr on Habiturf should not be applied to Habiturf, however, it should be safe to use Fluazifop, Halosulfuron, Imazaquin and Metsulfuron at or below their respective recommended rates.

Tests were also conducted on the Habiturf using the following 9 pre-emergent herbicides: Oxadiazon L, Dithiopyr L, Metolachlor L, Proflumicarb L, Simazine L, Oxadiazon G, Metolachlor

G, Prodiamine G, and Pendimethilin G. These products were only applied at their respective recommended application rates (1X). The only injury observed from any of these products was

from the Oxadiazon G at 5 DAT (data not shown). Injury occurred to both seeded and plugged turf but appeared to be transient in nature. At both 14 DAT and 21 DAT no injury was evident in any turf treated with any of the pre-emergent herbicides. Thus, sod producers should use Oxadiazon G with care but may safely apply any of the other 8 tested pre-emergent herbicides at the recommended rate with little danger of turf injury.

Activity 3- Establish 2" plugs of native grasses and bermudagrass in greenhouse for field planting

Prior to the field study (February- April 2013), nearly 6000 2" plugs of bermudagrass and native grass mixture were established in the greenhouse from Jan-April 2013, in preparation for spring field planting and herbicide tolerance trials. Approximately 800 4-inch square pots were filled with commercially available potting mix and placed on greenhouse benches. Each of 400 pots received a mixture of curly mesquite, blue gramma and buffalo grass (the three components of Habiturf) at a planting ratio of 60% buffalograss, 32% blue grama, and 8% curly mesquite and a seeding rate of 25 g/m². The remaining 400 pots were seeded with hulled common bermudagrass seed at a rate of 7.3 g seed/ m². Plants were fertilized weekly using Peters 20-10-20 water soluble fertilizer at a rate of 0.25 lb N/1,000 square feet per week. Grass was clipped weekly at a height of 1.5 inch. Plants were grown for approximately 12 weeks in the greenhouse before being transplanted into the field plots.

Activity 4- Cultural maintenance of field plots according to 'industry standard' and 'conservation' practices

Irrigation treatments were set to irrigation levels of either 75% x ETo (industry standard) or 50% x ETo (conservation- deficit irrigation), according to monthly historical reference ET levels for College Station, TX. Mowing was performed 1 to 2 times weekly at either 2"(shorter height more common and conducive to sod production), or 3.5" (taller height thought to be more favorable to native grass adaptation). Due to the complex nature of the study design (irrigation x species x planting method x mowing height), fertility treatments were not imposed. All plots received 3 fertilizer applications during the year using ammonium sulfate (21-0-0) supplied at a rate of 1 lb. N/ 1000.

Activity 5- Initial Establishment of field plots by various methods

Field plots were established in late April 2013, and methods of establishment were compared including plug-planting on 1 ft. centers, broadcast seeding, and row seeding. A large number of technical and support staff assisted in completing this large effort in one day. Field plots were planted on April 31, 2013. Each 20 by 40 plot was randomly assigned an irrigation rate of either 50% or 75% of ETo. Three plots within each irrigation treatment were planted with Habiturf and 3 were planted with bermudagrass. Each 20 by 40 plot was subdivided into three planting methods: broadcast seeding, hill seeding and plugs. Broadcast seeding was accomplished by hand distributing seed to the soil surface at the recommended seeding rates of 25 g/m² (native mix) or 7.3 g/m² (bermudagrass). Hill seeding was performed using a roller seeder that seeded rows of each species on 1 ft. centers. Seeding rates for hill seeding method was significantly

lower than that used in broadcast seeding (2.5 g/m² for native grass mix and 0.7 g/m² for bermudagrass). Plug planting was performed by making holes 12" on center using a bulb planter and then planting one pot of grass in each hole. After planting, plugged plots and alleys received application of Ronstar 2G pre-emergence herbicide (oxadiazon) at a rate of 2.3 lbs. product/1000 sq. ft. Seeded plots did not receive pre-emergence herbicides due to potential implications on seedling germination. All plots were uniformly watered to prevent stress for 4 weeks after which the pre-determined irrigation rates of 50% or 75% of historical ETo were imposed.

Activity 6- Monthly Evaluation of canopy cover development in plots

Digital images of the developing treatment plots were taken every 2 weeks beginning on 25-June and ending on 1-Oct. Images were analyzed using SigmaScan and the associated macro developed by Karcher. It was noticed that some Habiturf plots experienced contamination by bermudagrass. Therefore, visual estimates of the % contamination were made on 29-Sept and 5-Oct. Images were analyzed using Karcher's Sigma Scan macro, and analyzed for percent green cover in order to quantitatively determine differences in canopy density and grow-in time as affected by species x planting methods x irrigation levels x mowing height. Data analysis has been completed and statistically analyzed using SPSS.

Data estimating the percent green cover showed highly significant effects due to irrigation levels and mowing height (Table 1). However, there were no significant interactions between any of the factors. Percent green cover steadily increased from the time of planting through day 205 at which time the green cover was in the range of 95 to 100% (Fig.D). Between days 205 and 218, green cover decreased rapidly and then increased back to the 80-100% range by day 260. The low measured green cover on day 218 was due to a large amount of leaf firing from drought stress, resulting in a straw brown color rather than a green turf color. While the turf was brown, it did rapidly regain its full green coloration after rainfall events. In general, both grasses irrigated at 75% ETo had greater cover than those irrigated at 50% ETo. These differences were statistically significant at 4 of the 7 dates, excluding the starting measurement.

When the data are split out according to mowing height, a very similar trend is seen (Fig. E). In this case as well the 3 inch height had significantly greater cover on the same 4 of 7 dates, excluding the starting measurement. It is likely that the taller grass lodged over to some extent and did a better job of covering spots of bare soil as compared to the shorter mowed grass.

Finally, the fact that there was no significant effect of establishment method (Table 1) on canopy cover indicates that all plots, regardless of initial planting method, established to the same levels of green cover. This is very important from the standpoint that 'hill' seeding in rows utilized only 10% of the amount of seed compared to broadcast establishment. This would therefore allow producers to realize a substantial cost savings by utilizing this seeding method.

Activity 7- Evaluation of harvestability and sod tensile strength of plots

Near the end of the growing season (October 28, 2013) a sod cutter was used to cut a single strip of sod from all plots. A 24" length of sod was taken from each plot and tested for tensile strength using a sod-tensile strength testing device.

Analysis of the sod tensile strength data showed that sod strength was significantly affected by both grass species and planting method (Table 1). However, there were no significant

interactions between any of the factors. The mean strength for Habiturf sod was 14.7 kg as compared to only 11.5 kg for the common bermudagrass sod (Fig A). Since the Habiturf sod was slightly stronger than the common bermudagrass sod and given that common Bermuda sod is commercially produced and sold as sod, the production of Habiturf sod should be feasible. It should be noted however, that common bermudagrass sod is much weaker than hybrid

bermudagrass sod so the overall strength of Habiturf sod will be on the low end of the acceptable range, and may likely not be superior to that of hybrid bermudagrass.

Evaluation of the data by planting method showed that the strongest sod was from areas established from plugs and weakest from areas established by broadcast seeding (Fig B). Areas using the hill seeding method exhibited intermediate sod strength. Thus, sod producers wanting to establish production fields should do so using plugs to insure the strong sod capable of being mechanically harvested, sold and installed with minimal loss.

Because harvestable sod was obtained from each plot, we found that sod netting was not necessary in the context of our study, however, it may still aid in supporting sod strength in transfer to and from pallet.

Bermudagrass Contamination Issues

One problem that is frequently encountered when establishing native grasses in the southern states is the occurrence of contamination from common bermudagrass. Common bermudagrass is native to central TX and produces large amounts of very fine, light weight seeds which are easily spread by wind and animals. Analysis of our observations of contamination in the Habiturf plots showed that areas established from plugs had significantly less contamination than those from hill seeding (Table 2 and Fig C). The areas established by broadcast seeding had intermediate amounts of contamination. Judging by the random patterns of contamination, the time required for it to become established, it is believed that the contamination is a result of wind blown seed from nearby areas. The lower amount of contamination in the plugged areas is likely due to the fact that the plugged areas were given an application of Ronstar, a pre-emergent herbicide, immediately after planting. This retarded the germination of common bermudagrass seed that was blown or carried onto the plots and gave the Habiturf extra time to become established. Ronstar could not be applied to seeded plot areas since it would effectively prevent germination of the desired species. Thus, sod producers wanting to establish production fields should do so using plugs followed by an application of Ronstar to minimize contamination by other seeded grasses.

The total project budget did not allow for project staff to develop the extension bulletin. After the proposal was awarded and further planning into the project happened, the project staff and TDA grants office discussed this issued and documented the issue during the negotiation stage of the grant agreement. However, the project results and information gained was presented to producers both through a recent article in 'The Pallet' (quarterly publication of the Turf Producers of Texas), as well as through a recent presentation to the Producers at their annual meeting in Bay City, Texas, in which 35 attendees were present.

Data Analysis

At the conclusion of the study, data for each parameter were evaluated for statistical significance using Sigma Scan ver. 22. Analysis of variance (ANOVA) was conducted using the general linear model and either univariate or multivariate analysis as appropriate at a significance level of $p \leq 0.05$. When significant differences were indicated, Tukey's HSD was used for means separation.

Goals and Outcomes Achieved

Our proposed goal was eventual increase sod production of native grass blends, with a target of allocation of 5-15% of sod production areas to native grass blends over the next 3 years. As of the current time, BladeRunner Farms of Poteet, TX has initiated small-scale sod production (approximately 3 acres) of this Native mixture (Habiturf). If successful, they intend to increase to greater production levels in the future. Given that there are an estimated 40,000 acres of sod production in Texas at the current time (John Cosper-TPT Director, personal communication), we have not yet achieved the 5-15% goal. We have also shared results of our project at the following meetings: County Extension Agents Field Day, College Station, TX (4/24/13, 25 attendees); Texas Turfgrass Assn. summer meeting (7/7/13, Arlington, TX, 50 attendees); Brazos County Master Gardeners (8/20/13, 20 attendees); Ft. Bend County Master Gardeners workshop (10/16/15, 20 attendees); Fayette County New Landowners Workshop (10/19/13, 20 attendees), as well as the Turfgrass Producers of Texas Annual Meeting (1/19/14, 35 attendees). ~~We have presented reports of our project at Texas Turfgrass Assn. annual meetings, county extension meetings, and other state meetings.~~ Additionally, we have also had discussions with some producers at TPT field days and annual meeting. This project has provided information that will allow producers to more confidently move forward with Native grass sod production, thereby working closer towards this goal.

Beneficiaries

Turf Producers (TPT): In recent discussions with Turfgrass Producers of Texas (TPT) Member David Doguet (Bladerunner Farms, Poteet, TX), we learned that he has already begun converting sod farm acreage to this same Native Grass blend (Habiturf). In addition, results have been shared with all of the producers within the TPT group (40 producers). Recently, the study results were made available to Texas Turf Producers through an article published in the fall issue of the Turfgrass Producers of Texas Quarterly Magazine 'The Pallet' (this magazine reaches a subscription list of roughly 200 producers and industry members (John Cosper, personal communication). Results were also shared with Karen Guz of San Antonio Water System. We will be sharing the results of this project with Mr. Doguet, as well as with John Cosper (Director of TPT) for publishing in the quarterly TPT magazine entitled 'The Pallet', so that this information can be made widely available to all turfgrass producers.

Water Purveyors: Through these results, we now hope to attract the interest of water purveyors in evaluating establishment and drought resistance in the landscape of native sod versus traditional sod. Plots will be managed for a second year (2014) at the Texas A&M Turfgrass Field Lab, and available for educational outreach and/or field day presentations.

Lessons Learned

We had to modify our initially planned treatment design to accommodate a manageable number of treatment factors. Due to the factorial nature and combinations of treatments, we decided to utilize a single nitrogen fertilizer rate across all plots, but did test and compare species, establishment method, mowing height, and irrigation in the project. We believed these to be the larger factors contributing to sod quality.

Herbicide tolerance screenings were delayed until the final months of the project due to the level of resources needed for devoting to field activities in the initial phase of the project, but we were able to accomplish these screenings as intended by the completion of the study.

PROJECT 14: PECAN SCREENING NURSERY FOR COTTON ROOT ROT RESISTANCE

Partner Organization: Texas A&M AgriLife Extension Service

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Project Summary

Texas pecan growers have no documented control techniques for cotton root rot disease (hereafter, CRR), caused by *Phymatotrichopsis omnivora* (hereafter, *P.o.*), an endemic soilborne fungal pathogen that causes root and crown decay in more than 2,000 dicotyledonous plants. Estimated statewide income lost is \$435,000 per year, with highest losses in warmer calcareous high-pH soils of Texas. The disease also kills pecan trees in regions of New Mexico, Arizona and northern states in Mexico with similar soils and high temperatures. Commercially recommended rootstocks appear to be more susceptible than native pecans in hot climates. Pecan co-evolved with *P.o.* because the ranges of native pecan (*Carya illinoensis*) and the cotton root rot fungus overlap in large areas of Texas and northeast Mexico. Within the plant kingdom, pecan has an intermediate reaction to *P.o.* but heavy nut production on currently available rootstocks favors disease. Some native pecan trees apparently have high resistance. Grafting pecan varieties on resistant rootstocks would reduce direct losses, allow replanting after tree losses, and improve profits. Past attempts to evaluate pecan seedlings for reactions to *P.o.* in greenhouse experiments failed.

A three-year high-density pecan screening nursery with 28 diverse populations and checks was established in 2013 at Uvalde where the disease previously occurred in a castor bean experiment. There was 97% transplant success (2,015 of 2,080 planting sites). No pecans died from cotton root rot in 2013 even though 3% of the interplanted alfalfa (*Medicago sativa*) plants did. Highly susceptible alfalfa was used to increase disease intensity and uniformity. If pecan seedlings had died at similar rates as alfalfa in the first season, disease intensity in the nursery would have been too intense. Year 1 activities included site preparation, collecting seeds, interplanting susceptible alfalfa, pecan seedling production, transplanting, plot maintenance, and evaluations.

Seedling heights were estimated in plots and borders on October 10, 2013 with an overall average of 14 cm. Average heights by entry were: VC-168 18 cm; 87MX4-5.5 and 87MX1-1.2 16 cm; Ideal, Elliott, 87MX5-1.7, and Frutoso 15 cm; Apache, Burkett, Riverside, Sioux, Shoshoni, Baker, Curtis, and Barton 14 cm; A-93, SanFelipe, Moore, and Wichita 13 cm; Choctaw, Stein, Giles, Allen4, and 97CAT11.3 12 cm; Colby, Major, and Peruque 11 cm; and Allen3 10 cm. Seedling growth rate will probably not predict *P.o.* disease reaction.

Pecan growers and interested local groups were informed about this project and updated on progress-to-date during educational events at College Station, Seguin, San Antonio, Blanco, Kerrville, Rockport, Robstown, and Uvalde, as well as numerous contacts with individual pecan

growers. Six graduate students enrolled in Diseases of Field Crops at TAMU-College Station toured the nursery site and discussed the strategies being used.

Larry Stein and L. J. Grauke contributed materials, labor, services, and expertise to make this project possible. Alfred Sanchez and Laci Bostic provided essential technical support. Texas A&M AgriLife Research made available plot space, access to irrigation, labor at planting, farm equipment, and services.

Project Approach

The center of origin for the pecan species is Texas and northeast Mexico where pecan co-evolved with *P.o.* Native pecans are considered moderately resistant, but losses in improved variety pecan orchards can be significant. Native populations from southern latitudes may have more resistance to *P.o.* than populations from more northern latitudes. Rare or near zero mortality in native pecan stands may be due to less fruit load, partial resistance and management differences, so documentation of resistance variation is needed under controlled plot conditions. Grauke previously collected or procured germplasm from or adapted to southern (south Texas, northeast Mexico), western (California, New Mexico, West Texas), northern (Kansas, Oklahoma, Illinois), and eastern (Louisiana, Georgia, Alabama, Florida) parts of the native and current cultivated range. In other plant species, early senescence (faded leaf color and early leaf drop) seems to be associated with CRR susceptibility. Good leaf color and condition late in the season, frequent among collections from southern latitudes, may be a useful indicator of CRR resistance.

Attempts to screen pecan, grape, cotton, and other plant species for *P.o.* resistance in greenhouse containers have failed because the fungus is very difficult to manipulate in container grown plants. Plant breeding and variety improvement projects selecting only for horticultural traits (yield, grade, winter hardiness, etc.) typically release varieties susceptible to disease. There is currently no fungicide effective and labeled for control. Various soil amendments and fumigation have not provided long term control and are prohibitively expensive and labor intensive. Replanted trees usually die from the same disease. High average temperatures in recent years favored growth of this high-temperature fungus for more weeks of each year, and in more Texas pecan acres.

Vacant places in affected orchards decrease production efficiency because irrigation and other inputs often continue on surviving trees. Growers are encouraged by recent high prices for pecans and need strategies to bring heavily diseased blocks back into production.

A robust and rapid (for a long-lived tree crop) screen will reduce time required for new rootstock development from decades to a few years. Seeds of commercially available rootstocks (control treatments) and diverse pecan populations (half-sib families from single trees because pollen is wind-blown) from a range of latitudes and longitudes were gathered and germinated for transplanting in replicated field plots. The long term plan is to make available a high quality resistant pecan rootstock. Clonal micropropagation techniques have recently shown promise for pecan and could soon be used to increase unique individuals within resistant families. Currently, named rootstocks are deployed as half-sib families with various male parents.

A high-density disease screening field nursery with subsurface drip irrigation was established at a southwest Texas site at high risk of CRR to compare survival of diverse pecan collections for *P.o.* survival. Alfalfa variety Genuity ‘WL662HQRR’ was interplanted to increase *P.o.* intensity and uniformity.

Information about the nursery and results-to-date was provided to growers and interested individuals in Texas during organized educational events and in face-to-face contacts.

Activity in Work Plan	Activity, accomplishment, or work conducted 2012-13
Collect seeds from germplasm collections, individual trees, or varieties including industry standard rootstocks for southwest and west Texas (Riverside, Burkett, Apache, VC1-68), secure at Somerville, freeze lots as necessary to eradicate pecan weevil	L.J. Grauke, Larry Stein and cooperator Michael Harvey collected or submitted seeds (half-sib families) for entries: 87MX1-1.2, 87MX4-5.5, 87MX5-1.7, 97CAT11.3, A-93, Allen3, Allen4, Apache, Baker, Barton, Burkett, Choctaw, Colby, Curtis, Elliott, Frutoso, Giles, Ideal, Major, Moore, Peruque, Riverside, SanFelipe, Shoshoni, Sioux, Stein, VC-168, and Wichita. No seed lots were frozen because no collections were made in pecan weevil counties.
Select site; negotiate terms & services	Black and technician Alfred Sanchez negotiated terms & services and selected a site with irrigation access adjacent to the Texas A&M AgriLife Center at Uvalde, between U.S. Border Patrol Headquarters and the Uvalde Airport on City of Uvalde property. The site is available for 3+ years, and has a recent history of cotton root rot on castor bean.
Prepare site (tillage & bedding, install drip irrigation, seed alfalfa)	Black and Sanchez finalized site dimensions and plot layout after consulting with Grauke and Stein on seedling inventory. Site was disked to minimize winter weeds. Fragments of drip irrigation tubes from a previous experiment at the site were picked up and discarded. Analysis of soil samples indicated that post-planting fertilizer supplements would be sufficient for good growth. Soil was ripped to 20-24” on 20” centers in March to break up any compaction zones. Black and Sanchez evaluated the existing buried irrigation main lines with options for connection to a well in Buda formation, or a well in Edwards Aquifer. Drip irrigation system design was drafted. Bids were solicited for components and the order was placed with expenses exceeding our projection in the proposal. Drip lines were buried in April. We gathered information on glyphosate-tolerant alfalfa varieties suitable for the Uvalde latitude, seed of Genuity ‘WL662HQRR’ was procured, and alfalfa was planted 29May after a rain.

Activity in Work Plan	Activity, accomplishment, or work conducted 2012-13
	<p>Sanchez and Black installed remaining above ground irrigation system components (filter, injector, pressure regulator, layflat, connectors) 22-30May and leaks were repaired.</p> <p>Due to clogged planter, selected row middles were re-seeded in June with hand planter to achieve uniform alfalfa stand.</p>
Prepare site (weed control, till a strip before transplanting seedlings)	<p>Sanchez and Black staked plot margins and row alignments 10April to prepare for burying of drip lines. Glyphosate was applied 21May and once in June before pecan seedlings were transplanted. Soil was sufficiently prepared weeds were under control, so it was not necessary to till a strip before transplanting. Clethodim (Intensity) post-emergence grass herbicide was applied 13June. Oryzalin (Surflan) preemergence herbicide was applied in a band around pecan seedlings 27June.</p>
Irrigate	<p>Sanchez and Black 30,31May; 3,4,5,6,7,21June; 2,3,12, 30July; 6,13,16,21,26August; 13September.</p>
Stratify seeds (Jan-Mar2013)	<p>Completed by Grauke, or Grauke avoided this step by maintaining sufficient kernel moisture to avoid inducing dormancy. Grauke used other funds for potting mix and related supplies. Goal accomplished.</p>
Germinate seeds	<p>Grauke completed at Somerville.</p>
Develop plot plans, lay out & label plots for a high-density seedling screening field nursery to begin multiple-year evaluation of diverse pecan germplasm for resistance to <i>Phymatotrichopsis ominvora</i>	<p>Black and Sanchez developed draft plot plans for 30 entries in 8 replications and borders. After consulting with Grauke on his greenhouse capacity at Somerville, Black and Sanchez revised draft plot plans for 26 entries in 8 replications with appropriate borders, configured for the space and dimensions of the available space (40" rows, 10 plants/plot, 2' plant spacing, 2' alleys between ranges, 2 ranges per rep) on 0.52 acre.</p> <p>Grauke germinated seeds of 28 entries at Somerville in anticipation of low inventory for some. Entries were randomized according to plot plans for 26 entries in 8 replications with appropriate borders. Inventories of 2 entries were below expectations, and 2 others especially low, so unused spaces in selected replications of the first 2 were was planted with seedlings of the remaining 2 entries for observation, or analysis as an unbalanced statistical design.</p>
Transplant seedlings [20 to 30 populations in Year 1 in replicated high	<p>Stein transported seedlings from Somerville, TX to Uvalde 17-18June in a covered trailer where they were</p>

Activity in Work Plan	Activity, accomplishment, or work conducted 2012-13
density (10 to 15 seedlings) plots]	<p>off loaded in a shaded screenhouse. Stein and Black ordered seedlings in trays according to randomization in field plot plans, with appropriate borders. We transplanted 19,20,21,24June followed by hand watering, then irrigation of whole test with drip system (Black, Stein, Uvalde Co. CEA Chet Smith, and Uvalde Center technical support staff). Surplus seedlings were potted and kept in a screenhouse for possible replacements in case of transplant shock mortality in field plots (selected replants 23,30July, 6Aug, 17Sept). Tube numbers for each transplanted seedling were recorded at the request of Dr. Grauke. Seedling tubes and racks were returned 8July to Somerville to Grauke's inventory. During pecan seedling establishment phase, Sanchez injected minor elements (Tracite 27June, 2,12July), nitrogen (ammonium sulfate 27June, 30July), and magnesium (magnesium sulfate 30July, 6,21,26Aug) fertilizers. Sanchez and Black side dressed pecan rows with phosphorus and potassium (Liquid Phos K 13July). In plots, 2015 of 2080 planting sites had living plants for 97% transplant survival. In borders, 644 of 656 planting sites had living plants for 98% transplant survival. Goal accomplished.</p>
Control weeds	<p>Sanchez treated isolated areas of perennial grass weeds (bermudagrass and johnsongrass) with glyphosate herbicide with backpack sprayer before plots were established.</p> <p>Before pecans were transplanted, Sanchez applied grass-selective herbicide and glyphosate herbicide in plot area over glyphosate-tolerant alfalfa seedlings for weed control. After transplanting, Sanchez applied surflan preemergence herbicide.</p> <p>Alfalfa grew vigorously and was trimmed frequently by Sanchez to avoid excess shading of pecan seedlings (all or in part 24-26July, 5,9,14,27-29, 12,13,16Sept, 7-9, 28-29Oct). Goal accomplished.</p>
Measure plant growth	<p>Black and L. Bostic estimated seedling heights in plots and borders 10October with overall mean of 14 cm. VC-168 at 18 cm was significantly greater than other entries. The next two mean groupings (within each group not significantly different) included 87MX4-5.5 and 87MX1-1.2 at 16 cm; and Ideal, Elliott, 87MX5-1.7, and Frutoso at 15 cm. The two lowest mean</p>

Activity in Work Plan	Activity, accomplishment, or work conducted 2012-13
	<p>groupings included SanFelipe (N=76), Moore (N=78), and Wichita (N=80) at 13; [Choctaw (N=33) non-estimable due to low plant numbers], Stein (N=80), Giles (N=61), Allen4 (N=80), and 97CAT11.3 (N=80) at 12; [Colby (N=10) non-est., Major (N=57) non-est., Peruque (N=37) non-est. at 11]; and Allen3 (N=79) at 10 cm height. Goal accomplished.</p>
<p>Evaluate disease in inter-planted alfalfa to indicate disease occurrence at the site, patchiness/uniformity of disease among plots and replications and intensity of challenge to young pecan seedlings.</p> <p>Representative dead pecan seedlings will be dug and examined for unique <i>P.o.</i> fungal strands.</p>	<p>Black developed techniques for quantifying <i>P.o.</i> infestation on pecan roots during separate work on grape rootstocks. Black observed no mortality in alfalfa or pecan as of June 30, 2013. Initial alfalfa mortality was observed in early-August, and 11 dead alfalfa samples with extensive root rot collected 16Aug were all positive after Black examined under magnification for <i>P. o.</i> fungal strands; 2 of 11 dead plants also had signs of <i>Macrophomina phaseolina</i> fungus, cause of charcoal rot disease. Cotton root rot in alfalfa was evaluated 21Aug and 20Sept as percent area around each pecan seedling planting site with disease.</p> <p>In plots, interplanted alfalfa had 0.1% area (0.5% of 6.7 ft²-planting sites with some disease) with cotton root rot on 21Aug, and 2.6% area (10% of planting sites with some disease) on 20Sept. In borders, these estimates were 0% (0%) on 21Aug, and 4% (10%) on 20Sept.</p> <p>Black attributed pecan seedling death in 2013 to transplant shock with one exception (mycelium of <i>Rhizoctonia solani</i> on lesion at the soil line; a common seedling pathogen on annual crops). No pecan mortality was attributed to <i>P. omnivora</i> even though interplanted alfalfa mortality had begun. This was consistent with known status of pecan as moderately resistant to <i>P.o.</i> vs. alfalfa being highly susceptible to the fungus. If pecan seedlings had died at similar rate at alfalfa in the first season, disease intensity in the nursery would have been too intense.</p> <p>Goal accomplished.</p>
<p>Plant evaluations including seedling survival over time, plant height, minor-element deficiency symptoms</p>	<p>See above for seedling survival summary and plant height summary. There were no noticeable minor-element deficiency symptoms, so this was not evaluated in 2013. Goal accomplished.</p>
<p>Present findings at the annual Pecan Growers Convention</p>	<p>The goal for 2013 was to increase awareness of work towards pecan rootstocks resistant to <i>P.o.</i> The target</p>

Activity in Work Plan	Activity, accomplishment, or work conducted 2012-13
	<p>was that at least 150 pecan growers would attend presentations and become aware of the project.</p> <p>Details: During training on Pecan Diseases, Black informed 85 growers at Texas Pecan Short Course, College Station 30Jan13 of the cotton root rot problem, project objectives, and progress to date.</p> <p>Multiple county (Guadalupe, Gonzales, Wilson) pecan growers meeting 25Apr13 near Seguin, TX, attendance 35. Black reviewed the cotton root rot problem in pecans, project objectives, and progress to date.</p> <p>Master Gardener Volunteer training (14Nov12 San Antonio, 5Feb13 Blanco, 19Feb13 Kerrville, 15May13 San Antonio, 17Sep13 Rockport, 18Sep13 Robstown, attendance 135 total) and garden club presentations (12Sept13 Uvalde attendance 15) by Black included information on pecan cotton root rot disease and project objectives, and progress to date.</p> <p>Dr. Young-ki Jo' class (6 TAMU-College Station students) on Diseases of Field Crops toured Pecan CRR Nursery at Uvalde 31Jul13 with Black.</p> <p>Black and Stein's one-on-one visits representing 10 contacts with pecan growers and consultants included information on this project.</p> <p>There were no data of particular interest to pecan growers in July 2013 just weeks after transplanting, so a presentation was planned for July 2014.</p> <p>At least 130 commercial pecan growers and consultants (at Texas Pecan Short Course, county & regional pecan grower meetings), plus 156 small scale growers (several Master Gardener Volunteer groups, Uvalde Garden Club, hobby and backyard growers) attended presentations where they became aware of the project and progress to date (286 total). Large acreage and small scale pecan growers had increased awareness of rootstock susceptibility and potential for new resistant rootstocks.</p>
Write reports	Reports for Quarters 1, 2, and 3 submitted on schedule by Black. Data entry and other information were gathered for preparing this annual report.
Measure outcomes outside grant period (3-year evaluation of each population, as outlined above); on-going job responsibilities with partial funding	Proposal for Year 2 (of 3) was submitted through Texas Pecan Growers Association on 22March13 and a revision for partial funding submitted 25June13 after preliminary positive feedback. Sanchez and Black

Activity in Work Plan	Activity, accomplishment, or work conducted 2012-13
from other donors and grants	continued plot maintenance and data collection after 30Sept13.

Goals and Outcomes Achieved

The goal for 2013 was to increase awareness of work towards pecan rootstocks resistant to *P.o.* The target was that at least 150 pecan growers would attend presentations and become aware of the project. At least 130 commercial pecan growers and consultants (at Texas Pecan Short Course, county & regional pecan grower meetings), plus 156 small scale growers (several Master Gardener Volunteer groups, Uvalde Garden Club, hobby and backyard growers) attended presentations where they became aware of the project and progress to date (286 total). Large acreage and small scale pecan growers had increased awareness of rootstock susceptibility and potential for new resistant rootstocks.

Beneficiaries

Approximately 500 pecan growers producing on 15,000 acres in the warmer production regions of Texas would benefit from a resistant rootstock. Growers will see increased yields and quality, improved production efficiency due to more uniform stands, and reduced replanting costs. Abandoned orchards will be replanted. Rootstock development for a perennial tree crop is a long-term project because new varieties must be evaluated over time at multiple locations. Cooperating pecan growers willing to test promising populations could receive superior seeds after 3 years for replanting skips in existing production blocks. Availability for planting entire production blocks would occur in 5 to 10 years. Replanting 2 to 3 percent of trees every year due to CRR incurs an additional cost to growers of \$65 an acre. Assuming 2 to 3 percent mortality rate each year on 15,000 acres in the U.S., there will be \$975,000 per year benefit when a superior resistant rootstock is available to growers at risk for CRR. Losses to *P.o.* are probably underestimated because some infected trees survive, but with reduced yield and quality due to compromised root systems. Assuming a resistant rootstock will improve yield and quality on trees with sub-lethal *P.o.* infections, production would improve by 5 percent a year (800 lb/ac, \$2/lb retail) on 15,000 acres, for an additional \$1,200,000 per year benefit. Total impact would be \$2,175,000 per year. There would be additional impact in Arizona and New Mexico.

Lessons Learned

Labor requirements to keep the alfalfa trimmed were greater than expected.

Additional Information

Does transplanting depth affect cotton root rot in pecan? Growers sometimes transplant pecans deeper than the plants had grown in the nursery. Also, bareroot trees sometimes settle several inches in cloddy soil or where soil wasn't packed adequately during transplanting. Testing of that hypothesis is underway in a border area of the nursery with 50 surplus pecan seedlings that would have otherwise been discarded. Potted seedlings were planted shallow and deep in November 2013 in a replicated trial and will be evaluated for CRR.

PROJECT 15: ALTERNATIVE COMMERCIALIZATION PATH FOR SPECIALTY CROPS: PROMOTING STONE FRUIT AND PECANS BY TARGETING HIGH VALUE MARKETS ORIENTED TO HUMAN HEALTH (YEAR 2)

Partner Organization: Texas A&M University

Project Manager: Dr. Luis Cisneros-Zevallos

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Type of Report: Final Report

Date Submitted: March 2014.

Project Summary

The overall goal of our project was to establish an alternative commercialization path for stone fruits and pecans targeting high value markets oriented to Human Health. The approach is to use the health promoting properties of horticultural commodities as marketing tools to reach these alternative markets. This report covers the second year of our proposed 4 year project presented to TDA. The specific goals of the 4 year project included the generation of scientific information on health promoting properties related to chronic inflammation and events of metabolic syndrome like obesity and cardiovascular disease (Year 1), Type 2 diabetes using in *in-vitro* studies (Year 2), validation in *in-vivo* studies using animal models (Year 3) and establishing a pool of buyers in the alternative markets and a strong extension component to outreach and disseminate the successful story to other stakeholder including different grower associations, industry associated to alternative markets and consumers (Years 3 & 4). In this second year report we confirm that the extracted polyphenols can reverse insulin resistance in different cell lines including muscle and hepatic cells and reverse glucose insensitivity in pancreatic beta cells showing potential bioactive properties against Type 2 diabetes.

This project is important and timely because it uses an integrative approach based on the big picture of including different components of the value chain like farmers, processors and buyers using scientific information generated as marketing tools to reach new and needed high value markets. It is innovative in the sense that the model generated in this project can be applied to different specialty crops and can be easily adopted by stakeholder and be sustainable after the life of the proposed 4 year project.

Project Approach

The study was divided in three stages. First, we prepared polyphenol extracts that were free of sugars and acids by solid phase separation using C-18 cartridges and appropriate solvents. Four fractions were obtained, corresponding to 4 major phenolic groups including chlorogenic acid derivatives, anthocyanins, quercetin derivatives and catechins. These fractions were mixed again to resemble the original extract but without interfering sugars and acids or used as individual fractions according to the study performed.

A second stage corresponded in testing the polyphenols mixture in cell models of insulin resistance including muscle and hepatic cells as well as in a cell model of glucose insensitivity using pancreatic beta cells. The insulin resistance and glucose insensitivity states were induced using palmitic acid.

The third stage study corresponded in using the individual polyphenol fractions in a muscle cell model of insulin resistance to understand the molecular mechanism involved in the reversing effect by characterizing the expression of different markers of insulin resistance.

Goals and Outcomes Achieved

We were able to obtain polyphenol extracts that were free of sugars and acids interferences by using C-18 cartridges and that resemble the original extract once the obtained fractions were mixed. In addition those same fractions obtained were used in studies to determine the molecular mechanism involved in the biological responses. There were three polyphenol mixtures with distinct profiles characterized by HPLC used in this study.

Staff reports that the polyphenol extracts have multiple functions and could potentially work against insulin resistance and glucose insensitivity in different fronts simultaneously. All polyphenol extracts reversed the glucose insensitivity in pancreatic- β -cells induced by palmitic acid. These extracts, by possible antioxidant (AOX) and AOX-independent mechanisms, increase insulin secretion. On the other hand, only polyphenol mixture 1 reversed the insulin resistance in hepatic cells induced by palmitic acid. Polyphenol mixture 1 reversed the effect by a mechanism that increased glucokinase activity. Similarly, polyphenol mixtures 2 and 3 reversed the insulin resistance in muscle cells induced by palmitic acid. Both extracts reversed the effect in muscle cells in a similar fashion as the drug metformin by an increase in glucokinase activity and a possible increase in glucose uptake. These results are very promising and indicate that SFE have potential health promoting properties against Type 2 Diabetes, which is an important event of the metabolic syndrome.

Polyphenol mixture 3 was separated using SPE into different fractions, identified using HPLC-DAD and quantified with a wet based chemical assay. These phenolic fractions were tested in a muscle cell insulin resistant model for their effect on glucose uptake. Results showed that all fractions were able to restore intracellular glucose 6-phosphate to levels comparable to normal and control cells with the exception of F3 which showed no difference from insulin resistance induced cells. The fractions had no significant effect on ROS accumulation but were able to increase AKT phosphorylation and decrease phosphorylation of negative regulators of insulin signaling (JNK and IRS1ser307). Further research is needed to view if these compounds act directly on insulin receptors, or work through the AMPK mechanism similar to the positive control, metformin.

Beneficiaries

These results are promising and indicate that the extracted polyphenols have potential health promoting properties against the metabolic syndrome since they have exerted anti-obesity and anti-inflammatory properties (year 1 report) and now anti-diabetes properties (year 2 report). The information obtained will be submitted as papers in scientific journals (Journal of Agricultural and Food Chemistry and PLOS ONE) during 2014. We expect 3 papers to be published in 2014.

Papers are under evaluation at present time. In addition, press release generated through Texas A&M University by Ms Kathleen Phillips is still under evaluation to determine its impact on advertisement effects (e.g. dollars equivalent to advertisement generated by the press release will be reported by the end of the production season of 2014). For example, a press release of a single

work on health properties of stone fruits against breast cancer from our group on June 19, 2010, as of 9/23/2010 showed 116 clips in the internet that had a total circulation of **11,921,886** and a value of **\$124,501**.

The information generated could be used as the basis for promoting these selected specialty food crops as healthy foods. The generated data supports our initial proposal hypothesis that these polyphenols work against the metabolic syndrome through their anti-inflammatory properties (year 1) and now confirmed that these polyphenols work against insulin resistance and type 2 diabetes (part of the metabolic syndrome events). The information generated in years 1 and year 2 will support our work with animals to confirm our findings (proposal for year 3 to be submitted in 2014 lead by the industry initiative). Once the animal studies have been performed we will proceed with the marketing work on the fourth year through the promotion of these products as healthy foods in coordination with different grower associations (proposal for year 4).

Despite that year 3 funding was not secure in the 2013 round of funding, we were able to continue to strengthen relationships with the Texan Pecan Grower Association and PreMark Inc. Through these conversations we agreed in the need to continue with the original plan and the effort of submitting year 3 in the following round of request of proposals. The objective is still to promote stone fruits and pecans in alternative high value health markets including the cosmetic, functional foods and dietary supplements markets. We redirected efforts and Premark takes the major lead in the proposal submission with support of Texas A&M and the Texan Pecan Grower Association. Under this redirection of efforts we still envision that growers will benefit by obtaining better price for their products in these new markets while companies in these alternative markets will benefit since they will have access and utilize fundamental research from this project as marketing tools and through press releases. Year 3 is planned in using the successful story as a model in initial extension activities reaching different stakeholders associated to a range of specialty crops in Texas in production and commercialization.

Lessons Learned

Throughout this project, researchers have built strong relationships with the Texan Pecan Grower Association and PreMark Inc. and ultimately, this project will create a sustainable model to reach high value markets. It is crucial that researchers understand and develop relationships with stakeholders and work together to solve problems, create products/markets and overcome obstacles.

PROJECT 16: DEVELOPMENT AND PROMOTION OF QR CODES FOR INCREASING SALES OF TEXAS SUPERSTAR® PLANTS

Partner Organization: Texas A&M AgriLife Research and Extension Center

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Type of Report: Final

Date Submitted: 28 March 2014

Project Summary

The Texas Superstar® Program, a joint effort by Texas AgriLife Research and Extension faculty in cooperation with the Texas nursery and landscape industry, started in 1989 with the first statewide marketing promotion effort (see www.texassuperstar.com). Texas Superstar® plants are tested and determined to be adapted for state-wide use prior to promotion so that their use has the practical implication of increasing the sustainability of home and commercial landscapes in this region. This means that such plants should survive the harsh realities of most gardening years, be it drought, heat, and/or disease. This process also allows for industry notification prior to promotions to insure that plant numbers are available for sale that can satisfy the increased demand created by the promotion. In 1998, a logo was developed and the first Texas Superstar® plant tags were used to promote sales of these state-wide adapted plants. Recently, a marketing study has determined that only 15% of respondents were aware of the Texas Superstar® Program, though the approval rating of those that were familiar with the program was 88%. Thus, awareness of the program needs to be increased.

With the advent of smart phone technology, QR codes have been developed to make it easy for consumers to be directed to a website with video or text information about the product of interest. Use of QR codes to link to videos developed about each Texas Superstar® plant would be a very efficient way to increase consumer awareness of the program and to educate the user of these plants about their growth requirements and the added value they bring to the landscape. For example, the code below links the user to a video about the overall value of the Texas Superstar® Program. The QR codes developed with links to educational videos could then be used on Texas Superstar® tags at the retail level for instantaneous on-site education of consumers that will increase awareness of the program and increase sales for the ornamental industry. In one study, 81% of respondents said they were likely to use the technology if on a plant tag, and 74% said they are more likely to shop at a retailer with the technology than one without (see support letter from Horticultural Marketing and Printing). In addition, the codes would be used in the brochure described below. Links to the videos would also be added to the Texas Superstar® web site (see www.texassuperstar.com).

As the videos are created and linked to QR codes, a very effective way to promote awareness of their existence and their use would be via print media. Popular gardening magazines such as *Neil Sperry's Gardens and More* and *Texas Gardener* reach a large regional audience that would target the intended users of this information. This project proposes to place monthly advertisements for 8 months during the gardening season in these magazines to promote the use and awareness of this new information source.

Some years ago, a brochure was published featuring all of the Texas Superstar[®] plants that was a cooperative effort of the Texas Department of Agriculture GO TEXAN[®] Program, Texas AgriLife Research, Texas AgriLife Extension, and the Texas Nursery and Landscape Association. This brochure has been distributed widely at industry and consumer presentations and trade shows. It has been a very effective educational tool and has raised awareness of the overall Texas Superstar[®] Program. However, it does not include all of the Texas Superstar[®] plants that are now in the program and does not include QR codes. The updating of this brochure would aid our efforts immensely in expanding Texas Superstar[®] Program awareness and provide even more information in the same number of pages as the QR codes could be added as links to video websites that have a large amount of additional information.

There are five major trial sites in the state of Texas that test the plants that are included in the Texas Superstar[®] Program. Continuing validation of the value of these plants is a critical part of the success of this program. It provides invaluable feedback to producers and consumers and is the basis for the educational programming that is needed to increase the awareness of the Texas Superstar[®] Program. Current and past Texas Superstar[®] plants need to be grown for educational displays as well as to have good examples for collecting the images and video footage needed to develop the information that will be linked to the QR codes.

The Texas Superstar[®] Program and the Texas Department of Agriculture have been coordinating efforts for some time to promote the Texas Superstar[®] Program in cooperation with the Go Texan[®] Program. Working together began with the Texas Superstar[®] Program brochure as outlined above. Also, in 2010, ads were placed online and in the regional magazine *Texas Monthly*, and stakes and hang tags were made available on request to growers and retailers. In 2011, point-of-purchase materials were made available to retailers in addition to stakes and hang tags, and television and radio ads in English and Spanish were aired statewide. The proposed work will build on this strong partnership by supporting the development of educational materials that can be used to increase awareness of the Texas Superstar[®] Program, increase sales for the nursery greenhouse, and landscape industry, and compliment the continued efforts of the Texas Department of Agriculture in this regard.

Project Approach

Monitor website user sessions – Statistics for www.texassuperstar.com are shown in Table 1. Numbers from 2009 and 2010 were included to have a baseline of information and illustrates greater usage of the site since November 2012. Numbers for 2013 show a high level of use March to June with moderately high use in January to February and July to October. This corresponds to peak gardening activity and retail sales. Of interest is the fact that visits remain strong through the summer and pick up in September when autumn gardening is popular. Monthly Total Visits is an important gauge of website use. These numbers are illustrated in

Figure 1. The data from 2013 indicate that the months of January through June would be important months for advertising the Texas Superstar® program via magazine promotions. The new brochure was uploaded to the website in October 2013. Brochure downloads from www.texassuperstar.com are shown in Figure 2. The magazine promotions were started in November/December 2013 in one magazine and intensified in January through March/April of 2014. Daily average visits remained high in October to December 2013 relative to earlier years and increased along with brochure downloads and also with intensification of the media campaign. The spike of average daily visits in March 2014 (data stops at March 26, 2014) to over 900 is evidence of the popularity of the new brochure, the use of QR codes to access the web site, and the success of the media campaign.

Table 1. Web site use with all data available from 2009 to March 26, 2014.

	Summary by Month								
Month	Daily Average				Monthly Totals				
	Hits	Files	Pages	Visits	Sites	Hits	Files	Pages	Visits
Mar 2014	22164	18712	2319	911	24640	576270	486515	60295	23708
Feb 2014	11769	9228	1929	611	13917	329533	258406	54035	17127
Jan 2014	7386	5847	1467	497	11452	228988	181286	45501	15409
Dec 2013	4654	3717	1107	450	10820	144287	115245	34339	13965
Nov 2013	6113	4976	1224	498	14129	183413	149281	36722	14957
Oct 2013	8918	7233	1536	588	16904	281018	224231	47627	18252
Sep 2013	8759	7170	1612	592	16983	262789	215114	48370	17782
Aug 2013	9031	7296	1687	523	19308	279970	226205	52299	16226
Jul 2013	10501	8487	1898	589	21094	325552	263118	58859	18277
Jun 2013	13638	11054	2135	703	27012	409163	331645	64061	21116
May 2013	15962	13108	2313	720	29737	494828	406372	71725	22340
Apr 2013	20728	16704	3027	800	29457	621847	501149	90810	24026
Mar 2013	19369	15006	2924	768	25454	600462	465191	90658	23818
Feb 2013	14112	10773	2350	664	17251	395148	301660	65814	18602
Jan 2013	8732	6599	1599	534	13965	270718	204576	49583	16565
Dec 2012	4501	3477	1088	362	6535	139561	107814	33731	11230
Nov 2012	5811	4499	1213	405	6490	174356	134980	36410	12175
Dec 2010	4002	2941	853	274	5309	124084	91187	26445	8522
Nov 2010	5171	3712	977	315	6537	155130	111389	29320	9476
Oct 2010	7510	5405	1136	337	8229	232829	167572	35226	10471
Sep 2010	8770	6174	1253	355	7786	263124	185222	37617	10654
Aug 2010	7409	5236	1191	370	8461	229705	162337	36937	11491
Jul 2010	8270	5758	1304	412	9241	256392	178525	40424	12786
Jun 2010	9573	6613	1378	411	8965	287208	198412	41348	12353

May 2010	13868	9579	1928	470	10415	429916	296949	59770	14594
Apr 2010	22101	14733	2904	575	11179	663033	442017	87143	17263
Mar 2010	18906	12869	2616	541	10664	586090	398963	81103	16792
Feb 2010	8470	5677	1233	360	5908	237173	158958	34532	10097
Dec 2009	3042	2060	597	273	3878	94319	63880	18537	8476
Nov 2009	5724	4013	943	325	5328	171747	120416	28304	9768
Oct 2009	7393	4391	1039	371	6171	229204	136143	32233	11530
Sep 2009	8773	5669	1211	380	7177	263202	170074	36346	11411
Aug 2009	8024	5514	1455	375	8430	248747	170956	45122	11638
Jul 2009	10731	7282	1426	425	9513	332662	225752	44210	13188
Jun 2009	10398	6951	1325	305	6542	311955	208543	39776	9168

Figure 1. Average Daily Visit data from Table 1. Mar 2014 data is only through March 26, 2014.

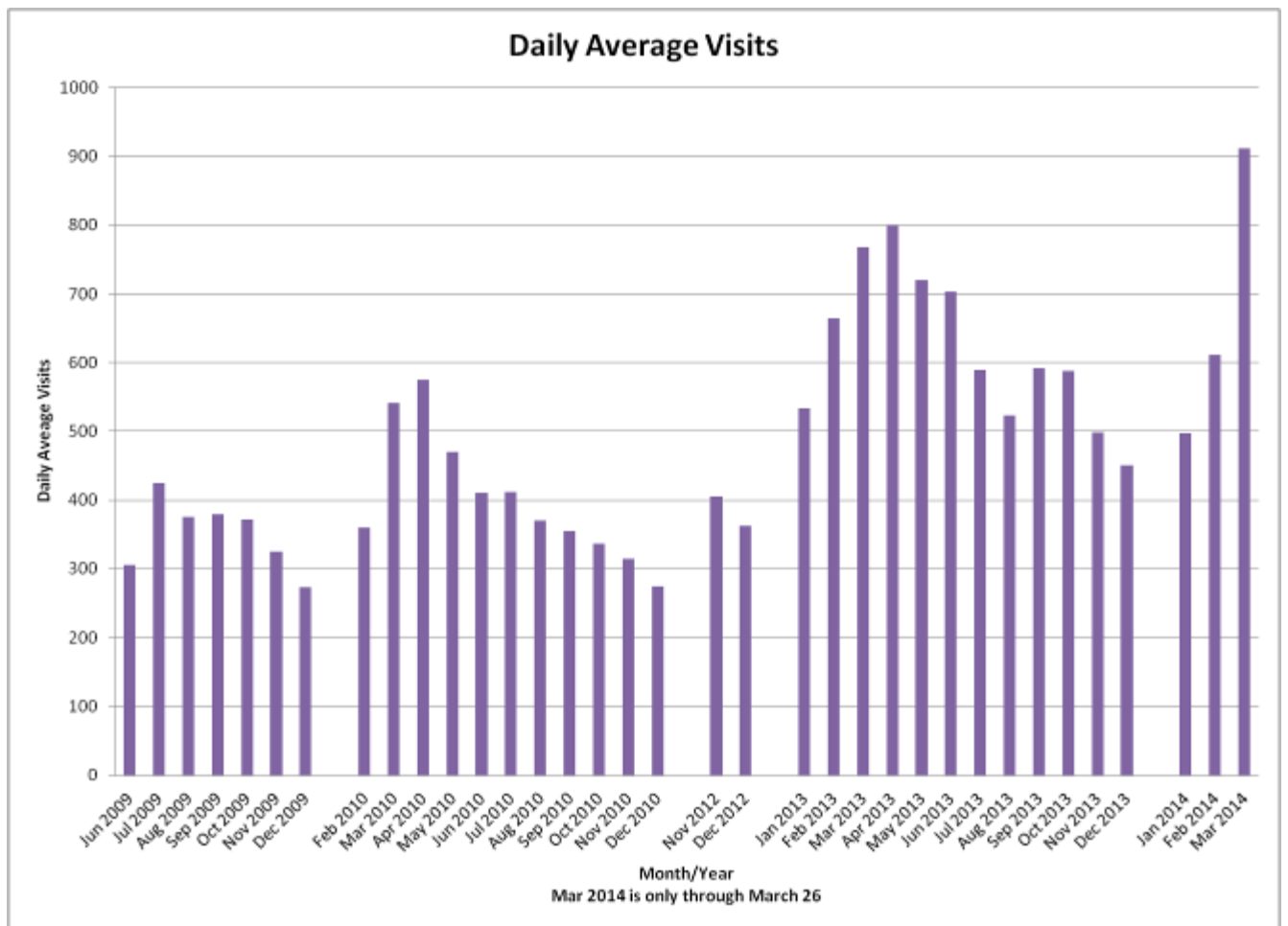
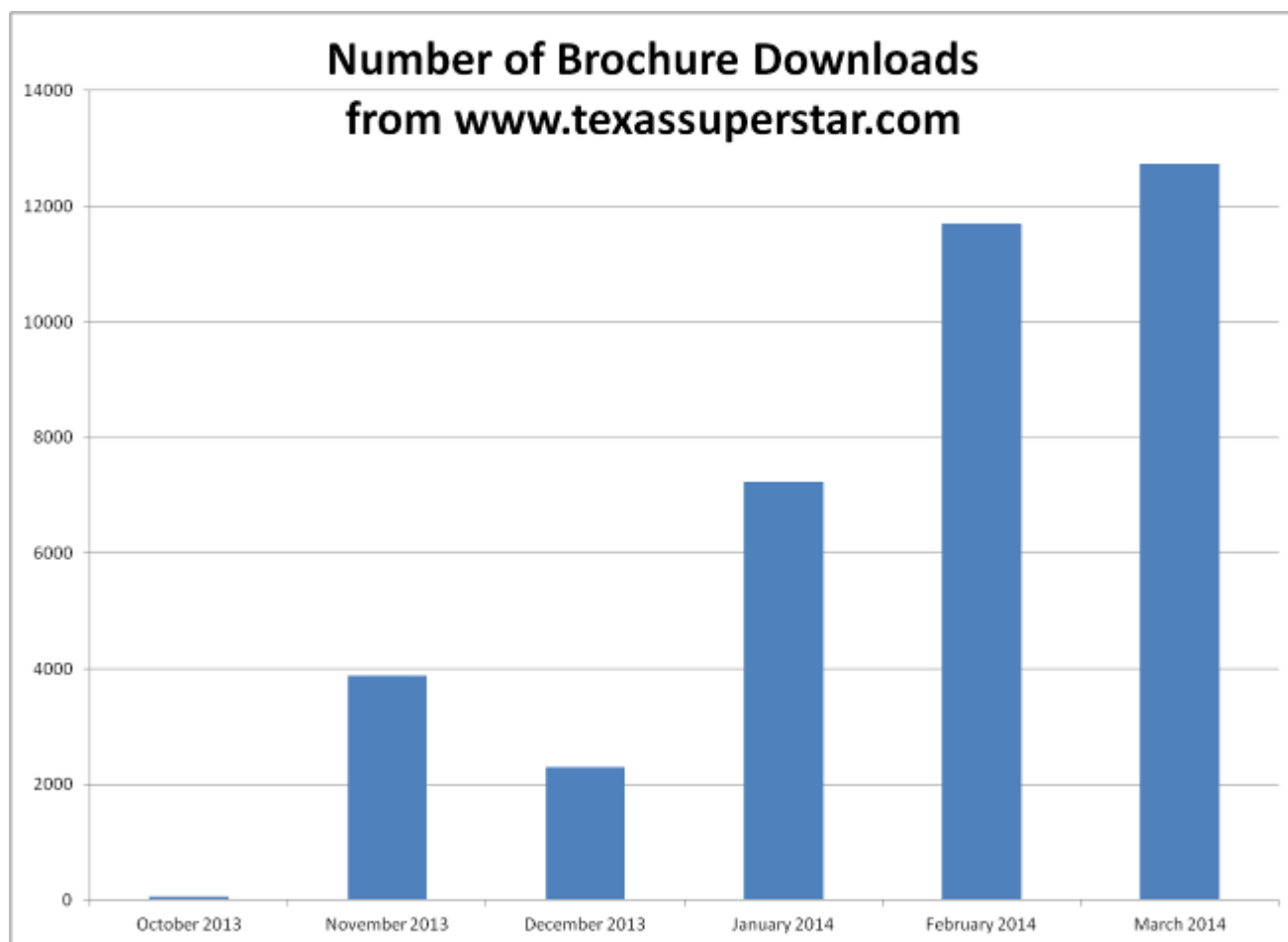


Figure 2. Number of downloads of the newly revised Texas Superstar® brochure from the time of uploading in October 2013 to the present. March 2014 includes data up to March 26, 2014.



Development of QR codes - QR codes were created for all Texas Superstar® plants and were used in the development of the new brochure. The example that follows is for Gold Star Esperanza:



This QR code links to the web page for this plant at www.texassuperstar.com which is believed to be contributing to the increase in daily average visits for the web site seen for March 2014.

Planning meeting in Austin - A planning meeting was held in Austin, Texas at the Headquarters of the Texas Nursery and Landscape Association on 7 June 2013. Executive Board members B Pemberton, C McKenney, D Rodriguez, L Stein, T Davis, and D Lineberger were in attendance along with D Richards, County Horticulture Agent Travis County, and Richard De Los Santos, TX Department of Agriculture. The meeting was focused on further development of the new Texas Superstar® brochure that was in the planning stages and the distribution of the finished brochure. Also, validation trials were discussed along with educational program opportunities and website updates. The promotions for 2014 were also determined.

Design and Printing of new Texas Superstar® Brochure – Design work for the brochure was completed with input from the Texas Superstar® Executive Board, Texas A&M Extension County Horticulture Agents, Richard De Los Santos of TDA, and feedback from educational programs and Master Gardeners. Sixty thousand full color copies were printed in time for distribution at the TNLA Expo in Dallas, TX which is one of the largest ornamental industry trade shows in the country and the largest for this region. To date, 22,500 brochures (37.5% of the original printing) have been distributed at Expo and many other educational programs and by request from industry professionals for retail distribution. A downloadable copy may be viewed at http://www.texassuperstar.com/press/Superstar_13_rev2.pdf Downloads have increased dramatically since it was uploaded to the Texas Superstar® web site in October 2013 (see Fig. 2).

Educational Events and distribution of brochures – Presentations about the Texas Superstar® Program have been made at several events during the year.

TNLA Industry Winter Workshop, Houston, Texas

The Galveston Home and Garden Show, Galveston, Texas

Lindale Garden Club, Lindale, Texas

Texas State Master Gardener EarthKind® Training, College Station, Texas

Ball University Industry Day, Dallas, Texas

Dallas Arboretum and Botanical Garden Open House, Dallas, Texas

Horticultural Marketing Webinar for the Ellison Chair, Texas A&M University

TNLA Expo Educational Seminar, Dallas, Texas

Kilgore Garden Club, Kilgore, Texas

Texas State Master Gardener Convention, McAllen, Texas

Texas State Green Professional EarthKind® Training, College Station, Texas

A Field Day was held in June 2013 at the Texas A&M AgriLife Research and Extension Center at Overton, Texas which included the current field trials of Texas Superstar® plants. Over 230 persons attended which included the general public, Master Gardeners, Ornamental Breeding Company representatives, and Ornamental Plant Producers.

Surveys were distributed at several of the events and results were analyzed to determine impact of the Texas Superstar® Program.

Results from the Galveston Home and Garden Show indicated the following:

“The Texas Superstar® Program”

Date: 3 March 2013

150 attendees with a 28% response rate.

The information provided increased the familiarity with the plant species promoted by the Texas Superstar® program for 90.2% of the participants.

88.1% of the participants plan to adopt the use of Texas Superstar® plants.

73.7% of the participants would highly recommend the Texas Superstar® program to others.

The net promoter score was 60.5 out of a maximum value of 100.

Results from the Lindale Garden Club indicated the following:

“The Texas Superstar® Program”

Date: 11 March 2013

30 attendees with a 43.3% response rate.

The information provided increased the familiarity with the plant species promoted by the Texas Superstar® program for 90% of the participants.

75% of the participants plan to adopt the use of Texas Superstar® plants.

66.7% of the participants would highly recommend the Texas Superstar® program to others.

The net promoter score was 50 out of a maximum value of 100.

Results from the State Master Gardener Training indicated the following:

“The Texas Superstar® Program”

Date: 11 March 2013

25 attendees with an 88% response rate.

The information provided increased the familiarity with the plant species promoted by the Texas Superstar® program for 81.8% of the participants.

77.3% of the participants plan to adopt and 22.7% had already adopted the use of Texas Superstar® plants.

86.4% of the participants would highly recommend the Texas Superstar® program to others.

The net promoter score was 86.4 out of a maximum value of 100.

Results from the Horticultural Marketing Webinar indicated the following:

“An Update on Texas Superstars”

Date: 31 July 2013

Total number of attendees: 66 Green Industry Professionals

Level of satisfaction: 4.47/5

Knowledge before the webinar: 3.30

Knowledge after the webinar: 4.43

Increase in knowledge of 34%

Increase in profits: \$658,730

Additional views of the recording: 101

Estimated economic benefit for additional viewers: \$1,008,056

Total estimated economic benefits: \$1,666,786

This indicates that the viewers of this program estimated that the information given about the Texas Superstar® Program would generate over \$1.6 million in additional profits for their businesses.

Brochures were distributed at most of the educational events. Over 1000 of the new brochures were also distributed at the TNLA Expo in Dallas, TX which is one of the largest ornamental industry trade shows in the country and the largest for this region. To date, 22,500 brochures (37.5% of the original printing) have been distributed at Expo and many other educational programs and by request from industry professionals for retail distribution.

Establishment and evaluation of validation trial sites – Validation trial sites have been maintained in College Station, San Antonio, Lubbock, and Overton. Several species were evaluated for future promotion possibility. Examples of test site trial gardens are in Figures 1 and 2. These tests will be used to choose plants for future promotions.



Figure 1. Validation test site in San Antonio.



Figure 2. Validation test site in Overton.

Promotions and web site updates – An article announcing the 2013 promotions to the Green Industry was published in the January/February 2013 issue of TNLA Green magazine and can be found at <http://www.tnlagreen.org/tnlagreen/20130102#pg35> . Promotions for 2013 were accomplished. Press releases for the 2013 promotions can be found at:

<http://today.agrilife.org/2013/02/14/natchez-thornless-blackberry/>

<http://today.agrilife.org/2013/04/01/wbhn-968-cherry-tomato/>

<http://today.agrilife.org/2013/05/23/princess-caroline-texas-superstar/>

<http://today.agrilife.org/2013/08/28/mari-mums-texas-superstars-redux/>

<http://today.agrilife.org/2013/10/02/lady-bird-johnson-bluebonnet/>

The web site was updated with the current promotions. At the meeting in June, the promotions for 2014 were decided upon. These were also added to the web site so that they could be included in the updated brochure with working QR codes. These were announced in an article published in the January/February 2014 issue of TNLA Green magazine and can be found at http://www.tnlagreen.org/tnlagreen/january_february_2014#pg42 .

Print media distribution – Magazine advertisements were designed and placed in the following publications. An example of an online advertisement is below. QR codes were used in print ads.



**Check out our
New Brochure!**



Now including all promotions
through 2014 with
QR Codes
connecting to plant pages on
www.texassuperstar.com

Plan to grow our
Tycoon Tomato
Superstar
which will be
promoted in
March!



Look for the new
Purple Flash
ornamental
pepper during our
April promotion!

Download your **FREE** copy
at GOTEXAN.org or at
TexasSuperstar.com

Ads were placed in:

NEIL SPERRY'S GARDENS

Published bi-monthly and has a circulation of over 15,000 households with a demographic of upscale, educated Texas gardeners. Readers spend an average of 8 hours per week gardening, 98.8% are homeowners, and average household income is \$76,500. Advertised in 3 issues and for 4 months online.

TEXAS GARDENER

Published bi-monthly with a circulation of 18,000 with an average of 60,000 visits per month to the web site. Readers spend 6 or more hours gardening per week and own their own residence. Over 80% are 45 years old or older, over 70% are retired, and over 60% regularly use a computer. Advertised in 2 issues and 4 months online.

TNLA GREEN

Published bi-monthly and distributed to all Texas Nursery and Landscape Association members and 10,000 online subscribers. It is also posted on TNLA's website for perpetual, 24/7 access. The audience is 24% Supplier, 23% Grower, 21% Landscaper, 19% Retail Nursery/Garden Center, and 13% Government, University, Nonprofit, or other. Advertised in 2 issues.

TEXAS HIGHWAYS

Published monthly. Ninety three % of readers are over 45 with an average household income of \$110,000. Over 80% own their own homes and over 70% have traveled in Texas. Advertised in 2 issues and 2 months online. This magazine accepts requests for information and passes them on to advertisers. More than 80 requests for brochures have been processed in the past few weeks during which the hard copy ad was running.

TEXAS MONTHLY

Published monthly with a total readership of more than 2.5 million, 90% of which are subscribers. Circulation is over 300,000. The average age of readers is 62 and over 90 attended or graduated from college. Median household income is \$112,500 and 93% of readers took action as a result of reading. Advertised in 3 issues.

Monitoring plant sales – Information was gathered from select nurseries to get some baseline information on how Texas Superstar® promotions affect sales.

2012 and 2013 Texas Superstar® sales figures from select nurseries

2012 Plants

- Rio Mandevilla
- Globe Amaranth
- Lowery Legacy Texas Sage

Color Spot Nurseries

100 flats of Quart Rio Mandevilla with 8 plants per flat: Wholesale price per flat of \$24.00
Total Wholesale dollars: \$24,000
Approximate Retail dollars at \$5.00 each: \$40,000

1,000 plants of 10" Patio Rio Mandevilla: Wholesale price of \$12.00 each
Total Wholesale dollars: \$12,000
Approximate retail dollars at \$25.00 each: \$25,000

10,000 flats of 6" Globe Amaranth with 6 plants per flat: Wholesale price per flat is \$12.00
Total Wholesale dollars: \$120,000
Approximate retail dollars at \$3.00 each: \$180,000

2,500 plants of 10" Globe Amaranth: Wholesale price of \$10.00 each
Total Wholesale dollars: \$25,000
Approximate retail dollars at \$15.00 each: \$37,500

15,000 gallon containers of Lowry's Legacy Texas Sage: Wholesale price of \$3.50 each
Total Wholesale dollars: \$52,500
Approximate retail dollars at \$8.00 each: \$120,000

Peterson Brothers Wholesale Nursery

20 flats of 4.5/15 per flat Globe Amaranth: Wholesale price of \$13.70 per flat
Total Wholesale dollars: \$274
Approximate retail dollars at \$2.00 each plant: \$600

40 flats of Super 6-pk/8 per flat Globe Amaranth: Wholesale price of \$19.15 per flat
Total Wholesale dollars: \$766
Approximate retail dollars at \$4.00 each plant: \$1,280

3 flats of 2" 16 -6pk per flat Globe Amaranth: Wholesale price of \$18.85 per flat
Total Wholesale dollars: \$56.55
Approximate retail dollars at \$2.00 each plant: \$96.00

2013 plants

-Natchez Blackberry

Checking around with local retailers, it looks like about 400 1-gallon plants sold for \$8.00 each for a total of \$3,200.

-BHN 968 tomato

-Dakota Gold Helenium

Peterson Brothers Wholesale Nursery

173 flats of 4.5/15 per flat of BHN 968 tomato: Wholesale price of \$23.45 per flat
Total Wholesale dollars: \$4,056.85
Approximate retail dollars at \$3.00 each plant: \$7,785

952 gallon BHN 968 tomato: Wholesale price of \$2.65 each
Total Wholesale dollars: \$2,522.80
Approximate retail dollars at \$6.00 each plant: \$5,712

30 flats of 2" 16 -6pk per flat Dakota Gold Helenium: Wholesale price of \$18.85 per flat
Total Wholesale dollars: \$565.50
Approximate retail dollars at \$3.00 each plant: \$1,440

Greenleaf Nursery
1050 3-gallon Natchez
Approximate retail dollars at \$18 each plant: \$18,900

Goals and Outcomes Achieved

One of the goals of this project was to increase consumer awareness of the Texas Superstar® Program. Outcomes were successful on many fronts.

The Texas Superstar® brochure was revised and updated with QR code links to the plant pages on www.texassupersar.com and new information such as water requirements and deer tolerance was added. Sixty thousand were published and 22,500 have already been distributed. It has been very positively received. Downloads from the Texas Superstar® and Go Texan web sites have been increasing dramatically. Also, since the brochure was uploaded to the Texas Superstar® web site, average daily visits have reached the highest value in the history of the site.

Web site use was monitored as a measure of project success. Data from 2009 and 2010 as well as late 2012 and early 2013 was used to establish a baseline of activity. The 2013 data was used to indicate a good time to run the media campaign. The huge spike in average daily visits to the web site in March 2014 is strong evidence of the impact of the brochure, the use of QR codes to access the web site, and the success of the ad campaign.

The validation trial sites provided a strong background of information for future promotions to be gathered. In addition, the results were shared via educational programs and Field Days.

Educational Programs proved to be very successful in raising awareness of the Texas Superstar® Program to many different clientele groups. At the Galveston Home and Garden Show over 88% of the general public audience planned to adopt the use of Texas Superstar® plants. At the State Master Gardener Conference 75% of the Master Gardeners in attendance planned to adopt the use of Texas Superstar® plants. And, after the Horticultural Marketing Webinar, the Green Industry professionals participating estimated that the information given about the Texas Superstar® Program would generate over \$1.6 million in additional profits for their businesses.

Another goal was to increase sales of Texas Superstar® plants. Baseline data was gathered from select nurseries. It is evident from over \$400,000 in estimated retail sales value from just 3 nurseries during the first year of the 2012 and 2013 promotions that Texas Superstar® promotions have a strong impact on sales. A more comprehensive survey of the Green Industry performed after the 2014 spring/summer sales season could give a better picture of how the new

brochure and increasing awareness of the Texas Superstar® program through educational programs accomplished with the current project has impacted sales of Texas Superstar® plants. A very strong indication that the current project is having a positive impact on sales is the fact that the 167 Green Industry Professionals that participated in the Horticultural Marketing Webinar estimated that the information given about the Texas Superstar® Program would generate over \$1.6 million in additional profits for their businesses.

Beneficiaries

The groups to benefit most from the activities of this project are the Green Industry and consumer groups. Over \$400,000 in sales due to Texas Superstar® promotions are outlined above. Also, 167 Green Industry Professionals that participated in the Horticultural Marketing Webinar estimated that the information given about the Texas Superstar® Program would generate over \$1.6 million in additional profits for their businesses. Seventy five percent or more of the participants in the consumer oriented program surveys plan to adopt the Texas Superstar® program indicating a high degree of educational program success. Also, the strong increase in average daily web site visits indicate that consumers are getting more information about the program through educational programs, the ad campaign, brochure distribution, brochure downloads, and use of the QR codes in the newly printed and distributed brochure.

Lessons Learned

Since the ad campaign budget was not unlimited, we learned of a good period to focus the appearance of the ads from the web site usage statistics. We feel that this helped target the ad campaign making it more effective.

As reported in the Annual Report, we were not able to complete educational videos about the plants. The person on the Texas Superstar® Executive Board in charge of this project assumed additional responsibilities as Head of the Department of Horticultural Sciences at Texas A&M University after the grant was awarded. In addition, the person who was helping him complete the videos assumed a full time teaching position after the grant was awarded. We thought that we would be able to complete this part of the project despite the restraints, but this turned out not to be possible. The original purpose of the videos was for education and marketing. We, therefore, decided to use this money to augment the media campaign. Judging by the increase in web site daily average visits, we feel that this was a good solution to our problem.

Though some valuable plant sales figures were gathered, getting a broad picture of plant sales that would relate to the activities of this project proved to be a daunting task. A survey in industry sales needs to be done to try to get some insight. However, this needs to be done after the 2014 spring/summer sales season to truly gauge the benefit of the August 2013 release of the brochure and early 2014 media campaign. In spite of this, we feel that the best measure of the positive effect of these project activities on industry sales is the fact that the 167 Green Industry Professionals that participated in the Horticultural Marketing Webinar estimated that the information given about the Texas Superstar® Program would generate over \$1.6 million in additional profits for their businesses.

PROJECT 17: IDENTIFYING SUPERIOR PIERCE'S DISEASE RESISTANT GRAPE VARIETIES AND ROOTSTOCKS

Partner Organization: Texas A&M AgriLife Extension

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Type of Report:

Final

Date Submitted:

February 26, 2014

Project Summary

Pierce's Disease (PD) of grape is a devastating disease and a major limiting factor to further development of grape production in Texas. The use of susceptible, traditional varieties (*Vitis vinifera*) in areas which have moderate PD pressure represents a financial risk for producers. Current methods of disease management rely heavily on chemical control of vector insect populations, a costly strategy and one that could have negative environmental impacts--not an effective long-term solution. This project has two primary experimental components. Heirloom and new classically bred PD resistant or tolerant grape varieties are being evaluated at two diverse locations that have high risk of Pierce's disease, Austin County in southeast Texas and Real County in the southwestern part of the Texas Hill Country. Grape rootstocks, which have the capability of mitigating the effects of Pierce's disease are being evaluated in Austin County, Real County and Gillespie county in three very different soil/climatological settings.

Project Approach

Thirty two PD resistant or tolerant grape varieties and selections are planted in small plots at the two evaluation sites. In addition to confirming the true ability to withstand PD pressure, these accessions are being evaluated for their ability to produce commercial yields of high quality fruit in each location. Harvest weights as well as other components of yield were collected to obtain information on cluster size and berry weight. Analysis of fruit chemistry included fruit soluble solids, titratable acidity and pH. These varieties and selections were also evaluated for their ability to tolerate local climatological conditions (wind, temperatures and rainfall) and for their ability to resist fungal pathogens infecting fruit and foliage.

The rootstock evaluation plots are located in very different soil types and rootstock performance has been highly affected by site. In Gillespie and Real Counties, the common fruiting scion is 'Sangiovese' while the Austin County plot uses 'Blanc duBois' as the common scion. In addition to measuring the affect of rootstock on the expression of Pierce's disease, these research plots

allow us to measure important viticultural traits such as cold hardiness, vine vigor, date of bud-break, ability to absorb soil nutrients and tolerance to soil borne pathogens. Results of these research projects are delivered to growers and prospective growers at educational events sponsored by Extension or commercial industry groups.

Goals and Outcomes Achieved

With the older variety evaluation trial in Austin County, thirty percent of the previous accessions were removed because they did not produce fruit of high enough quality for commercial production. This kind of selection process is a necessary component of evaluations so that limited resources can be directed toward more promising selections and the propagation and incorporation of new introductions. In both the Austin and Real County evaluation sites, vines successfully cropped yield and fruit quality components were measured. 16 selections and varieties were identified for removal due to consistently poor fruit quality which was confirmed by 2013 data. These include: Fla 047-3-7, Fla A14-8-1, Fla C-30-5-1, Fla C30-7-1, Fla D16-13-1, Fla D6-12-4, Fla 044-6-5, Fla A14-8-1, 'Bailey', 'Carmen', 'El Campo', 'M.H. White', 'Nitodal', 'Delicatessen', 'Mortensen Hardy' and 'Ben Hur'. Further laboratory processing was conducted on promising selections from each evaluation site and organoleptic evaluation panels this fall have helped us identify six selections that have very high commercial potential. These include Fla 24-6-6, U05-02-38, U05-02-35, U05-02-10, U05-02-20 and U05-02-26. These six selections will be propagated in the spring of 2014 to establish new evaluation blocks in commercial vineyard/winery settings. In addition, new breeding selections will be propagated to take the place of removed accessions in evaluation plots. Variety evaluation is a process in which poor performing selections are removed and replaced by new, untested ones leading to a number of commercially acceptable varieties for commercial grape producers.

The rootstock block is beginning to show us trends as to how these different root systems perform under each of the distinct soil and climatic conditions. There have been no discernible differences on Pierce's disease incidence or severity, but distinct differences have been recorded on vigor and the ability to absorb iron and zinc. Rootstock evaluations are typically six to eight year projects and this past growing season was year two for Real and Gillespie County plantings and the establishment year for the Austin County site. Disease pressure from cotton root rot (*Phymatotricopsis omnivora*) is beginning to appear in the Real County site and trends will be analyzed after the 2014 growing season.

Results of both the PD tolerant variety trial and the rootstock trial have been reported at numerous extension and industry educational events including the 2013 Annual Conference of the Texas Wine and Grape Growers' Association (75 attendees), TWGGA Fall Grape Camp (185 attendees) and extension educational conferences in both the Texas Hill Country (80 attendees) and the Texas Gulf Coast (160 attendees). There is tremendous grower interest in both the variety trial and the rootstock trial because this information will be crucial to the future of grape growing in much of Texas.

Beneficiaries

Beneficiaries from these research projects include more than 380 existing, new and prospective grape growers across Texas. Data from the variety trial will be used to justify the release and commercial propagation of new Pierce's disease resistant varieties which will be widely planted

in areas at high and moderate risk of disease development. The information obtained from the rootstock trial will outline stock performance under three different soil and climatic zones and will be pertinent to growers in each of these regions and beyond.

Lessons Learned

We now have empirical to support the notion that many heirloom and exotic varieties either do not produce grapes with acceptable commercial quality, cannot withstand fungal pathogens or high rainfall events encountered in the Gulf Coast. We now have specific data to show that in two locations, own-rooted grapevines and those grafted on some rootstocks are not adapted to the conditions they were tested under. While we will need a few more years to complete these comparisons, there are some root systems that are certainly not acceptable.

Additional Information

These research projects are long term, multi-year efforts. While preliminary data has begun to provide insight, it will take ongoing testing of PD tolerant varieties, with establishment of new accessions and evaluation of promising selections on a larger, commercial scale. These projects also have tremendous value to growers across the southeastern United States where PD is also a limiting factor to the production of high quality grapes.

PROJECT 18: NEW TOOLS AND STRATEGIES FOR MANAGING THE DEVASTATING TEXAS (COTTON) ROOT ROT DISEASE IN TEXAS WINE GRAPES

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Type of Report: Final

Date Submitted: 6/2/2014

Project Summary

There are many challenges facing the wine and grape industry in Texas. Among the challenges are harsh environmental conditions, diseases and pests. As with any young and growing agricultural enterprise, the list of challenges increases as acreage of the crop expands. This is certainly the case with wine grapes in Texas. Among the diseases being encountered with increasing frequency by vineyard growers is Texas (cotton) root rot (TRR), *Phymatotrichopsis omnivora*. Texas root rot is of particular concern because infections of the grapevine root system can invariably lead to the death of the vine, and there are currently no satisfactory control measures. There are no good measures of the impact TRR is having on Texas winegrape production because symptoms can be confused with other diseases, such as the widely prevalent Pierce's disease. Field diagnosis of the disease is further complicated by the challenge of detecting the pathogen on the roots of an infected vine. These complications have led to significant frustration for growers as they manage their vineyards for maximum efficiency and productivity. The purpose of this study was to address the critical deficiencies in the understanding of TRR on grapevines by approaching the problem with two goals.

Project Approach

The first goal relates to a promising control measure with the potential to offer relief to growers, but there must be continued research. Recent field research has shown when the fungicide flutriafol was applied through drench applications in cotton; the impact of the disease was reduced. A similar method was implemented using the systemic fungicide flutriafol and has been applied to grapevines for 2 consecutive years. These treatments are being conducted in commercial and experimental vineyards under natural disease pressure. Additionally, a screening procedure was developed to artificially inoculate grapevines planted in rhizotrons with the pathogen and compare the outcome of treated vs. untreated grapevines.

The second goal was to have grower adoption of TRR research recommendations, resulting in increased yield. Outcome instruments were distributed at the completion of programs, workshops, and field days within the grape industry. Instruments will measure acceptance of information presented and the likely adoption rates.

Significant contributions of project partners

Dr. Mark Black was instrumental in obtaining the 5 acre experimental vineyard and plot design in Leakey, TX.

Dr. David Appel provided crucial experimental design methods of fungicide application and greenhouse experiments. His previous grape research provided a network of possible grape grower cooperation.

Jim Kamas throughout the project has been our primary viticulture advisor with regards to maintaining the vines. He also had access to the tractor and tank we used to apply the fungicides.

Sheila McBride was Project Coordinator. She scheduled all treatment applications, statistical analyses, ordered supplies, arranged visits with the cooperators, and wrote reports.

Jacy Lewis was the AgriLife Extension Assistant hired to assist with visiting the grower's vineyards, collecting data and generating maps of where the disease was present. She also helped in planting, applying treatments and general maintenance of the vines.

Goals and Outcomes Achieved:

GOAL 1: Develop control methods to reduce losses of grapevines due to Texas root rot (TRR) and subsequently increasing yield.

- For two years fungicide treatments were applied to experimental plots/vines in the experimental vineyard in Leakey, TX in Real Co. and a commercial vineyard, Flat Creek Estates in Travis County.
- Rhizotrons were built, planted and inoculated with *Phymatotrichopsis omnivora* for greenhouse rootstock trials. (See figs. 3, 4, 5)



Fig. 3 Rhizotrons prior to planting



Fig. 5 Rhizotrons inoculated with *Phymatotrichopsis omnivora*. Showing roots being infected with pathogen



Fig. 4 Rhizotrons planted with grapevines

- Acquisition of pathogen for completion of proposed studies,

Isolated *Phymatotrichopsis omnivorum* from infected vines, (see fig. 6)

- a. Conducted DNA sequence studies for confirmation,
- b. Demonstrated *in vitro* sensitivity levels of *P. omnivora* toward flutriafol and a related fungicide, propiconazole.

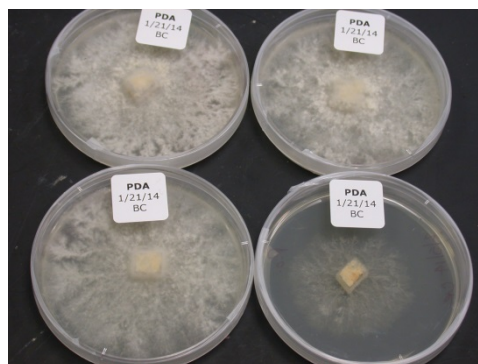


Fig. 6 *Phymatotrichopsis omnivora* in culture

Grapevines in the experimental vineyard and the commercial vineyard (See fig. 7) have been treated with the various fungicides and disease ratings have been recorded with statistical studies showing the efficacy of the fungicides (see tables 1 and 2). In the experimental vineyard there was no significant difference in the overall treatments. One reason maybe the incidence of the disease within the plots is very low. Rootstock trials in the experimental vineyard have also been examined for the presence of the pathogen when there has been vine death. This has also shown to be insignificant due to disease pressure.



Fig. 7 Control vines in the commercial vineyard showing symptoms of *Phymatotrichopsis omnivora* infection.

However, in the commercial vineyard where the disease was known to occur within the plots, there was a significant difference between treatments with flutriafol. Flutriafol appears to be a promising control method and should be researched further with more locations where disease has been recorded/observed so in the future the fungicide can be labelled for TRR on grapevines.

within the grape industry. Instruments will measure acceptance of information presented and the likely adoption rates.

- Instrument were developed and distributed at Grape Camp November 3-4 2013 and Grower Field Day November 22, 2013. (McBride, Appel) Since the fungicide is still in the experimental stages, growers are not yet able to adopt the fungicide as a control method. However, we were able to discourage growers in their attempt of using impractical, non-efficacious control methods. In addition, growers were provided with realistic expectations of cotton root rot control in the near future, saving them money, time and increasing their confidence for future plantings. Support letters from a few growers can be viewed under the Additional Information section at the end of the report.
- Fruit and Nut Conference presentation entitled “Texas Cotton Root Rot” October 2012 with 120 fruit and nut growers in attendance. Sponsored by Texas A&M AgriLife Extension Service, (McBride)
- Presentations at two annual Grape Camps sponsored by the Texas Wine Grape Growers Association,
 - November 7, 2011 “Texas (Cotton) Root Rot of Grape Research Efforts”
 - November 4-5, 2012, entitled “Recognizing and Managing Cotton Root Rot (CRR)”.Approximately 120 people were in attendance during each meeting. (McBride, Appel)
- Presented a paper at the American Phytopathological Society Southern Division Meeting on February 9, 2013, entitled “Field trials for control of *Phymatotrichopsis omnivora* on grapevines in Texas” 75 people in attendance (McBride)
- “Cotton Root Rot on Wine Grapes: Past and Present” Poster presentation at the Texas Congressional Educational Evening March 2013 approximately 120 people in attendance (Fig. 3 McBride and Appel).

Fig. 3 Poster session at the Texas Congressional Education Evening



- American Phytopathological Society annual meeting. Field trip showcased field trials at the commercial vineyard in Travis Co. August 10, 2013. 50 scientists from around the country in attendance. (See fig 4 below)(McBride, Appel, Black, Kamas, Lewis)



Fig. 4 APS field trip

- Presentations at Texas Hill Country Grower Field Days –
 - William Chris Vineyards September 27, 2013 80 people in attendance
 - Flat Creek Estates Vineyard October 25, 2013 90 people in attendance.
 - Bending Branch Vineyard November 22, 2013 50 people in attendance.

Beneficiaries

- Vineyard (more than 380) and winery owners from the Texas Hill Country region have been especially impacted by this devastating disease and have benefited from the research. Others who attended the Grape Camps hosted by the Texas Wine Grape Growers Association were prospective growers, viticulture consultants, and county agents. We were fortunate to be invited to attend the Texas Congressional Educational evening where grape growers, wineries representatives, and congressmen and their staffs were present to view posters providing an understanding of the work being conducted in grape research. During some of the educational meetings when Texas A&M AgriLife administrators were in attendance, we were able to promote awareness as to the research being conducted within the agency.
- When present, TRR causes significant economic losses on many other specialty crops, such as peanuts, pecans, peaches and apples. Through our educational efforts, we were able to provide outreach to many of these growers as to the impact of TRR and the current research being conducted on winegrapes.
- With the potential for disease control with the fungicide, the chemical company, Cheminova may benefit from growers adopting the practice.

Lessons Learned

- This project stimulated new project cooperators with commitments of their time and resources setting up additional experimental plots to continue the objective of trying to control TRR.

- One of the chemical companies has become interested in exploring the possibility of having the fungicide registered for use in grapes.
- Obtaining information on disease occurrence was an unexpected obstacle. We were confronted with some growers who were reluctant to share information pertaining to any problems they may be experiencing, in their vineyard.
- As with many young and expanding industries, there can be difficulties in addressing the needs of a large group of stakeholders when there are varying views on priorities needed to advance the agendas of individuals in different grape growing regions in Texas.
- As the grape growers began to become knowledgeable through our educational efforts, we were inundated with offers to set up experimental plots in their vineyards. We had to decline expanding the project with these offers due to lack of resources.
- It became apparent growers expected the research to go faster so that they could implement the use of the fungicides. This occasionally led to some level of grower resentment.
- Unforeseen availability of plant material delayed the planting at the experimental commercial vineyard requiring the vines to be overwintered in a greenhouse. It also delayed the greenhouse experiments using the rhizotrons.
- The unpredictability of the pathogen was greater than we anticipated in the Leakey experimental vineyard.
- The fungicide application method proved to be practical only on a small scale. When approved, an entirely different application method will be needed.
- There were difficulties in training and retaining technical staff because of the lack of qualified applicants and the short duration of the grant.
- In order to obtain better outcome measures a more aggressive approach is needed for growers respond to survey instruments.

Additional Information

Vineyard survey instrument, map and results

Vineyard Survey for Texas (Cotton) Root Rot

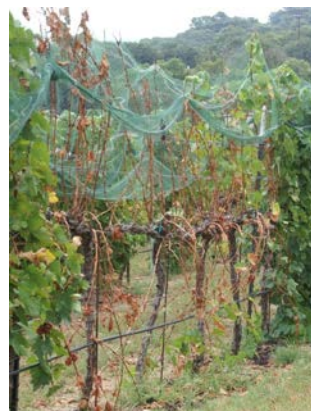
Vineyard Size

1. How many acres of vines are managed in your vineyard?

2. How old are the vines? (If various ages, give a range)_____

Vineyard Site

1. What county is your vineyard located? _____
2. What is the soil pH in your vineyard? _____
3. Do the soils in your vineyard have? (Circle the best fit)
 - A. Excellent drainage
 - B. Adequate drainage
 - C. Poor drainage
 - D. Variable drainage types



Presence of Texas (Cotton) Root Rot (TRR) in Vineyard

1. Have you ever observed symptoms in your vineyard such as: **leaf scorch** **sudden death of vine** **dried leaves remaining on vine** (circle all that apply)
2. Has TRR ever been implicated/confirmed a problem in your vineyard? **Yes** **No**
If yes, how was it diagnosed? (Circle one) **Laboratory** **Field observation**
3. Do you believe you lost vines in the 2010 growing season due to TRR? (circle) **Yes** **No**
If yes, approximately how many vines were lost? _____
4. Would you be interested in a diagnostic confirmation of TRR for your vineyard? **Yes** **No**

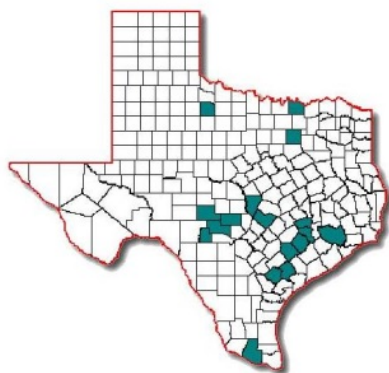
Rootstocks

List the names of the own rooted or scion/rootstock varieties in your vineyard, vines affected by TRR (yes or no) approximate acreage of each.

Scion/Rootstock	Affected by TRR	Acreage	Scion/Rootstock	Affected by TRR	Acreage
	Yes No			Yes No	
	Yes No			Yes No	
	Yes No			Yes No	
	Yes No			Yes No	

Questionnaire completed by: _____ Date Completed: _____

Vineyard name: _____



Current map of counties confirmed with TRR on grapevines: Knox, Kerr, Kimble, Hidalgo, Grayson, Travis, Harris, Dallas, Austin, Lavaca, Goliad, Real, Gillespie, Burnet, Washington, Colorado, Victoria.

Grower survey results

Vineyard Information		Vineyard Size		Vineyard Site		Observed Symptoms			Presence of TRR in Vineyard			
Vineyard Name	Acres	Age of Vines (years)	County	Soil pH	Soil Drainage	Leaf Scorch	Sudden Death	Dried Leaves on Vine	TRR Confirmed	Diagnosis	Is TRR responsible for loss of vines?	Interest in Confirmation
Vineyard 1	4	3-25	Austin	6	adequate	x	x		N		N	No
Vineyard 2	0.25	1-2	Washington		adequate				N		N	Not Yet
Vineyard 3	2	11-16	Austin	6.7	excellent		x		Y	Lab	N	Yes
Vineyard 4	0.33	0-3	Goliad	6	adequate				N			Yes
Vineyard 5	1	1-3	Live Oak		adequate				N		N	Yes
Vineyard 6	1.5	.5-1.5	Fayette	7.8	adequate			x	N		N	Not Now
Vineyard 7	480	3rd Leaf	Houston		excellent				N		N	No
Vineyard 8	1	1-3	Grimes	6.4	excellent				N		N	Yes
Vineyard 9	2.1	3-5	Burleson	4.5	variable	x	x	x	N		N	Yes
Vineyard 10	5	1	Grimes	7.6	adequate	x		x	N		N	No
Vineyard 11	5	10+	Walker	6	poor				N		N	No
Vineyard 12	0.5	2-8	Harris	6.5	excellent				N		N	
Vineyard 13	1	5-34	Victoria	7-8.2	poor-adequate		x		Y	Lab	N	Yes
Vineyard 14	1	1-5	Kimble	7.3	excellent		x		N		Y (1)	Yes
Vineyard 15	15	1-5	Kerr	>7	excellent			x	N		N	Yes
Vineyard 16	10	0-16	San Saba	8-8.3	adequate	x	x	x	N		Y (1-10)	Yes
Vineyard 17	13	1-5	Terry	7.3	excellent				N		N	
Vineyard 18	17	6-15	Gillespie		adequate		x	x	N		Y(3)	No
Vineyard 19	5	9-10	Gillespie	7.3	excellent		x	x			Y(2)	Yes
Vineyard 20	0.5	0-1	Gillespie	7.8-8	adequate	x			N		N/A	Yes
Vineyard 21	4	2,4,12	Blanco	7.5	excellent		x	x	Y		Y(300)	
Vineyard 22	0.5	3-4	Gillespie	7.8	adequate	x			Y	Field		Yes
Vineyard 23	1.25	3rd Leaf	Mason	7	adequate				N		N	Yes
Vineyard 24	3	3	Lampasas	6-7	adequate	x	x		N		Y	Yes
Vineyard 25	15	15	Gillespie	6.2-6.7	adequate				Y	Field	N	Yes
Vineyard 26	2	3 or 6	Kimble	8-9	adequate	x	x		N		N	Yes
Vineyard 27	2	1	Gillespie	6-6.5	adequate							
Vineyard 28	10	1-13	Travis	7	variable	x	X	X	N		N	Yes
Vineyard 29	3.5	1-10	Blanco	8+	adequate	x	x		N		Y(10)	Yes
Vineyard 30	3	5-7	Gillespie		excellent			x	Y	Lab	N	Yes
Vineyard 31	10	1-3	Sutton	8.2	adequate		x	x	N		N	Yes
Vineyard 32	1	2 mos	Llano	5.9	adequate							
Vineyard 33	20	10-12	Travis	7.9	excellent	x	x	x	Y	Lab	Y(100)	Yes
Vineyard 34	1	3-4	Kerr	7.9	excellent	x	x	x	N		Y(2)	Yes
Vineyard 35	4	0-6	Blanco	7.5-8.5	excellent	x	x	x	Y	Lab	Y(50)	
Vineyard 36	0.25		Bell Cove		excellent							

PROJECT 19: A RESEARCH AND HANDS-ON APPROACH FOR STUDENTS TO UNDERSTAND THE IMPORTANCE OF SPECIALTY CROPS FOR GOOD HEALTH

Partner Organization: Texas A&M AgriLife Extension Service (and Friends of Carver).
Carver=Carver Elementary Academy, Amarillo, TX.

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Type of Report: Final

Date Submitted: February 28, 2014

Project Summary

The purpose of this project is for students to be actively engaged in specialty crop production so that they are aware of where food comes from, the nutritional value of each specialty crop of interest, pests and diseases that limit crop production, soil and plant nutrition, and differences in growing crops under field, greenhouse, and/or hydroponic conditions. This region (Texas Panhandle) has a high rate of obesity, diabetes, and a lack of knowledge where food actually comes from. Even though it is a highly agricultural productions area, the main crops are not specialty crops but rather wheat, corn, sorghum, cotton, peanuts, soybeans, and other field crops. This project will focus on crops that are grown locally, are valued for their nutritional content, and may have important roles in the lives of one or many ethnic groups that may consume such crop. In the process, students will be actively engaged in growing several of these specialty crops and will learn of the huge diversity in crops that Texas has to offer, from sub-tropical crops like papayas and citrus, to more temperate leafy vegetables and other specialty crops commonly grown in this area. By conducting experiments themselves, young students will be able to compare differences in yield, nutritional content, and problems involved in growing a crop under different growing conditions (indoor and outdoor). Although other projects may have focused on nutritional benefits of specialty crops, this project actively engages youth populations who are supposed to benefit from good eating and nutritional habits by including students into the project. Although most crops are used for food (i.e. tomatoes), others such as Stevia (diabetes) or Aloe Vera (vitamin E) can be of medicinal type of benefit.

Because this is a specialty crops project focusing on vegetables and/or fruits, the idea is to showcase how important these crops are for child nutrition and for overall nutrition for all ages. Crop production in and outside the greenhouse will feature specialty crops such as tomato, lettuce, potato, and squash. The greenhouse facility at Carver has a tropical crop section where students will be exposed to banana, oranges, lemons, and new additions such as the cacao or chocolate tree. Children will learn what it takes to grow specialty crops such as vegetables. Educational material will shine the spotlight on the benefits of specialty crops in terms of vitamin content, mineral content, fiber content, protein content, and other beneficial compounds such as lycopene. Any mention of non-specialty crops will be to educate children (and adults, such as their parents) that specialty crops can provide equal or better nutritional components than their non-specialty crops counterparts. Any material produced will be checked thoroughly to ensure that grant funds are only used to enhance the competitiveness of specialty crops.

The project is unique because while other programs may teach about nutrition and health, this project also teaches students (and their parents) where food comes from, which might help infuse pride into some students who may trace their heritage to a region in the U.S. or a country. It also teaches them how a crop is grown, where in the plant does that fruit, leaf, or tuber come from. By participating in food production, students may realize that food does not just “come” from the store or supermarket, but that food crops take time to grow, face constraints like insects and diseases, and may grow in the soil, as leaves, or as fruits hanging from stems.

This project was a one-year project at the time. Hopefully, future projects can build on the success and obstacles faced on this project.

Project Approach

Activities Performed

1) **Seed, transplant crops, and tend crops.** This was a continuous (yearly) timeline so that crops such as lettuce, tomato, and basil were present in the greenhouse, including the winter months. Prior to start of funding this was carried out on a volunteer basis by Friends of Carver. Outside Garden crops were planted in May and were still growing until the first massive freeze in November. Other crops, in the greenhouse and in the outside garden include: Tomato, Chile pepper, potato, squash, avocado, pineapple, lettuce, aloe, olive, cacao, Satsuma orange/mandarin, Meyer lemon, trailing rosemary, mint, lime, basil, stevia and banana. Post-project, lettuce and tomato were still being grown, and lettuce will be grown during the winter months.

Students realized how difficult it is to grow a plant as they participated in Outside Garden. For Quarter 3, all 389 students were given the chance to take home packages containing seeds from a specific specialty crop (vegetable) such as tomato, squash, or cantaloupe, in addition to potting soil mix, small pot, and directions for them to grow their own seedlings and transplant to their garden or bigger pots.

2) **Monitor plant growth, scout for pests, and diseases.** This was also a continuous (yearly) timeline. Some of the insect pests encountered include: aphids, scales, thrips, spider mites, and whiteflies. Some of the diseases encountered include: blossom end rot (calcium deficiency), early blight (caused by the fungus *Alternaria solani*), leaf mold (*Cladosporium fulvum*), and powdery mildew (caused by the fungus *Podosphaera xanthii*). Plants were treated with organically labeled chemicals and sprayed when students would not be around (after school, or Friday afternoon when students do not come back until Monday).

3) **Conduct surveys on crop production, where food comes from, nutritional value of crops, and health benefits.** Select surveys were conducted. Because the curriculum is already set a couple years in advance, we were graciously included by the science coordinator on. A few open houses and planting activities were made available to the press, Carver elementary students and their families, and tours were made available upon request. During such events, which were hosted in the greenhouse and/or outside vegetable garden, attendees were given handouts with information on nutritional value of crops, where crops originated, what dishes can be made with the crops, and a map of the location of origin of the crop. Timeline began late January 2013 since funding was only made available in December 2012 when hiring began. A major event (Open

house) took place on September 26, 2013 and attracted approximately 300 people (100 students, 100 parents, and 100 siblings).

4) Film and edit videos made by students on crop profiles, growing crops, and other learning experiences. Due to privacy issues, videos were made by the project staff and posted in the Facebook page for Friends of Carver for this project <http://www.facebook.com/friendsofcarver>. Any videos or pictures where students appear needed to have approval from the school (and parents) or students could not show their face. Popular videos on our Facebook page include “lady bug release” and “vermicomposting of vegetables”. The written press (Amarillo Globe) was invited and several TV channels were also invited to profile what was done.

One article written and titled “AgriLife Extension Teaming up With Friends of Carver and Carver Elementary Academy” can be found on: <http://www.myhighplains.com/story/d/story/agrilife-extension-teaming-up-with-friends-of-carv/38712/rleMzzK4D0yQkpGIg6VrwA>

Another article titled “Carver garden offers hands-on lessons” can be found at: <http://amarillo.com/news/local-news/2013-05-26/carver-garden-offers-hands-lessons>

5) Bulletins on diseases or pests found in the research greenhouse and garden experiments. Bulletins were handed out on-site and were made available via the Facebook page for Friends of Carver for others to see. Other bulletins have been posted at <http://healthygardens.tamu.edu>. Some of the insect pests encountered include: aphids, scales, thrips, spider mites, and whiteflies. Some of the diseases encountered include: blossom end rot (calcium deficiency), early blight (caused by the fungus *Alternaria solani*), leaf mold (*Cladosporium fulvum*), and powdery mildew (caused by the fungus *Podosphaera xanthii*).

Other factsheets made available include: Southern Blight of Tomato, Powdery Mildew of Tomato, Blossom End Rot of Tomato, Alternaria Fruit Rot of Pepper, Powdery Mildew of Cucurbits, Bacterial spot of Tomato and Pepper, Alternaria Leaf Spot of Cabbage, Fruit Cracking of Tomato, Angular Leaf Spot of Cucurbits, Seedling Damping-Off, Bacterial Fruit Blotch of Watermelon, and Late blight of potato and tomato. Information on insect pests can be found on aphids, stinkbugs, thrips, cutworms, leafminers, spider mites, and whiteflies. All publications have been translated into Spanish.

6) Factsheets on where a specific crop is native to. Factsheets have been made available on-site and have or will be posted at: <http://healthygardens.tamu.edu>. So far, factsheets produced include: avocado, banana, bell peppers, cantaloupe, cacao, sweet corn, jalapeño pepper, lettuce, lime, melon, Meyer lemon, pineapple, pumpkins, purple potato, Satsuma orange, squash, tomatoes, grapefruit, stevia, and watermelon.

7) Harvest crops, weigh crops, and collect data. Some crops were affected by hail that occurred in May 29, 2013 and which not only affected the outside garden but it caused structural damage to the greenhouse as well. Tomatoes, squash, and jalapeño peppers on both greenhouse and outside garden were able to survive in decent numbers to showcase their production in both locations.

8) **Garden tips, cookbook, artwork.** Artwork by students that relate to specialty crops are displayed in the school halls. Garden tips and other information on specialty crops have been made available via the Facebook site as entries with links or information directly on the entry. The cookbook was not done because it would be difficult to determine if the recipes were original or not and very few people volunteered to donate a recipe. Many people have their own recipe for chili and salsa but some of those recipes are generations old. We did post a couple of recipes at the friends of Carver Facebook page. And because we are still collaborating with Carver, this might still get done.

9) **Conducting surveys/questionnaires.** Because of strict curriculum by students at Carver Academy, there was little maneuver space to conduct such survey (during school time). Some questionnaires were handed out to students but were strictly optional as to getting them done. We did give out a questionnaire for students to relate their experience with planting seeds at home (from our seed packages given out the last days of spring 2013). We also asked students “why are fruits and vegetables important to you?” Thirty-three students answered this question.

In one voluntary survey (33 participants), students were asked “Why are fruits and vegetables important for your diet?” Twenty-four students (73%) answered “because it is healthy for you”, five students (15%) answered “it’s good for you”, two students (6%) answered “you can lose weight”, and another two students (6%) answered “can help you grow”.

10) **Interviewing and Documentation.** The need to document how many people we reached (ie via Facebook) and who we made contact with us by replying to them was important.

For Quarter 3, all 290 (approximately) elementary students were given the chance to take home packages containing seeds from a specific specialty crop (vegetable) such as tomato or cantaloupe, in addition to potting soil mix, small pot, and directions for them to grow their own seedlings and transplant to their garden or bigger pots. That way they would learn how crops grow and how difficult it is to grow them.

Since posting project related entries in Facebook from April through October 2013, a total of 109 entries were posted and had a reach of 10,809 unique people who have seen the post. A total of 245 people liked our page. On average, a person has 303 friends on Facebook, with teenagers having approximately 500 friends on average, while those over 55 have around 114 friends. That would explain why we had over 10,000 unique people who have read all our posts.

The staff was solely committed to the project: a part-time staff consisted of a Greenhouse coordinator/Garden project manager, and Educational Coordinator, and one intern who were just available for the project. The intern was actually hired by the Project coordinator once the project was over and he started officially on January 2014. The other two ended their employment with the end of the project. Other personnel like Research Technician or Bilingual educator/Plant Diagnostician were also hired part-time for the project, although they were also employed in other capacities within Texas A&M AgriLife Extension Service. The bilingual educator and plant diagnostician departed once the project was over and began her Ph.D. studies in plant

pathology. The research technician is still employed and under the Supervision of the Project Coordinator.

Goals and Outcomes Achieved

The goal is to have not only an educational impact but an economic impact as well. All those engaged in specialty crop production and the research and education material generated with this project or who become familiar with this project could potentially become more active in growing not only specialty crops, but crops which might be of benefit to their dietary needs, good nutrition, and which may save them money at the grocery stores. If many can devote 1/6 of an acre to food production, they could potential save, on average, \$600 on specialty crops that would normally be bought at the grocery store.

Our goal #1 was to increase specialty crop consumption by students and parents in Amarillo, and beyond, in order to improve their health habits by consuming specialty crops for better nutrition and health. By targeting a school with a population of 384 (fluctuates yearly), these students will learn, the teachers will learn, parents will be engaged as well. Because all students were involved one way or another in the educational process of the project, 100% of them received specialty crop information and hands-on knowledge. By partnering with the science/environmental teacher who teaches all elementary students, 100% of them were reached.

The project aimed at increasing specialty crop consumption in 75% of its target audience of approximately 300 students, parents, teachers, and community volunteers. We had a year to achieve this goal. As the project was ending in December 2013, a survey asked elementary students if 1) they were consuming more vegetables as a result of their learning experience with the project; and 2) if their parents were consuming more vegetables. A total of 79 students voluntarily answered both questions. A total of 54 (68.4%) students answered that they were consuming more vegetables. A total of 55 students (69.6%) answered that there parent(s) were eating more vegetables since the project started. Although the percentage is approximately 6% below the target, the project was able to reach more than the 300 person target. The project reached 389 elementary students and their family unit. The fact that the open house for the project on September 26, 2013 was attended by approximately 100 students, 100 parents, and 100 older siblings meant that there was an interest of approximately the exact target number. It was gratifying to see that 25% of elementary students were able to make it to this after-hours afternoon event. The average increase of vegetable consumption per person was not gathered. Because most students were able to take vegetables, such as lettuce or tomato, to their homes, they were introducing them to their households.

Our goal #2 was to significantly increase student knowledge of specialty crop availability, and nutritional values. Engage a core group of students in specialty crop production and their nutritional and health benefits. Although the goals were to reach 100 students, by targeting the environmental science class that is taught in the greenhouse facility, the project was able to target all 384 students. Most were very engaged in learning about specialty crops.

Students were given surveys about the experience of taking home a seed package kit to try growing specialty crops at home. Below is one survey that students filled after coming back from summer recess and when harvest of vegetables or fruits were taking place or were taking place soon.

3

Texas Agrilife Planting Packages

Name K

Seed name Watermelon

1. Did you take seeds? yes
2. Did your seeds germinate? yes
3. Did you harvest fruit or vegetables? not yet
4. Were there any problems? no
5. Did your plant die? no
6. Did your plant survive? yes
7. What did you learn about tomatoes, watermelon, and cantaloupe?
I learn that watermelons take a long time to grow.

So that students could have a hands-on approach (and they were out of school during the summer), harvesting of crops such as jalapeño pepper, tomatoes, and squash were conducted during Fall 2013 so that students could see the garden and field crops and observe and participate in harvesting and weighing of the produce on September 10, September 19, September 30, October 8, and October 15.

Jalapeño pepper

Harvest Date		Greenhouse Production		Outside Garden
		Weight		Weight

		lbs	oz.		lbs	oz.
9/10/2013		2	6		2	3
9/19/2013		0	4		3	9
9/30/2013		1	6		3	8
10/8/2013		0	8		1	7
10/15/2013		1	3		2	10
Total		5	11		13	5

Tomatoes (beefsteak)

Harvest Date		Greenhouse Production			Outside Garden	
		Weight			Weight	
		lbs	oz.		lbs	oz.
9/10/2013		8	2		2	13
9/19/2013		5	4		0	4
9/30/2013		7	1		4	3
10/8/2013		4	14		2	13
10/15/2013		6	4		3	9
Total		31	9		13	10

Yellow Squash

Harvest Date		Greenhouse Production			Outside Garden	
		Weight			Weight	
		lbs	oz.		lbs	oz.
9/10/2013		7	10		11	10
9/19/2013		10	9		19	4
9/30/2013		4	9		11	6
10/8/2013		11	0		26	3
10/15/2013		4	2		15	3
Total		37	14		83	10

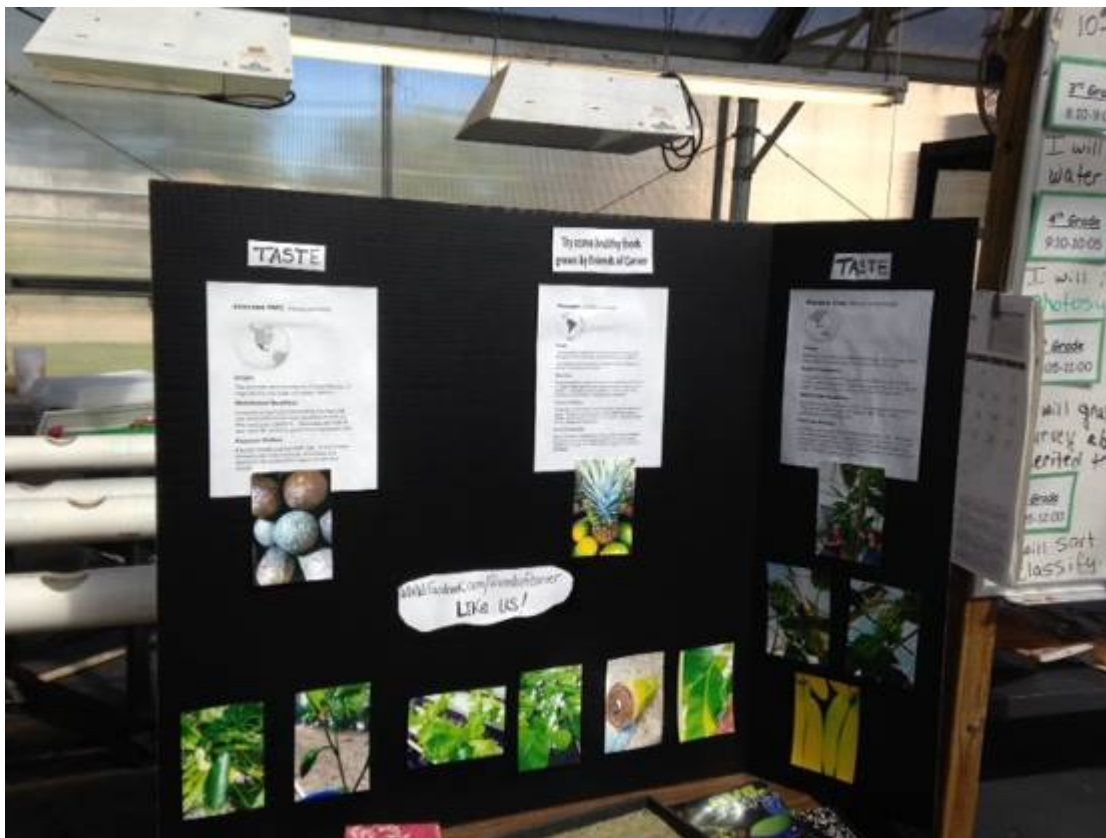
The Friends of Carver Facebook page has done well. We reach as far as Austin (10 hour drive) and Fort Worth area (six hour drive). From April through October 2013, a total of 109 entries were posted and had a reach of 10,809 unique people who have seen the post. A total of 245 people liked our main page.

We surveyed students as to “why are fruits and vegetables important to you?” Thirty-three students voluntarily answered this question.

Twenty-four students (73%) answered “because it is healthy for you”, five students (15%) answered “it’s good for you”, two students (6%) answered “you can lose weight”, and another two students (6%) answered “can help you grow

Other questions and answer scenarios for adults have been done via the Facebook page and with posts.

A significant open house was held September 26, 2013 in Carver Elementary. Students, parents, and siblings attended this afternoon event which had approximately 300 attendees during the whole event. Attendees not only saw greenhouse and garden production, but also production systems such as hydroponics (i.e. tomatoes) and tropical specialty crops (i.e. bananas) grown in the greenhouse. A Display was set up to promote specialty crops and their benefits.



Beneficiaries

- The intended beneficiaries of this project are elementary-aged children in Carver Elementary Academy, which is part of the 32,000 student population that comprises the Amarillo Independent School District (AISD) of Potter and Randall Counties. During the project there were approximately 389 students who received education as part of the project.
- Other students and teachers that are part of the AISD that will benefit from research, educational material, and activities generated by this project. Other schools, groups (i.e.

Boy Scouts), and ‘friends of carver’ via the Facebook page have attended the open house, have received tours, and are receiving information via the Facebook page. We have ‘friends’ who live far away (Austin, Fort worth, and Puerto Rico)

- Specialty Crop producers (local), markets, supermarkets, will have new clientele that will have been exposed to the benefits of consuming specialty crops. Links to the Facebook page for the Golden Spread Farmer’s Market (Amarillo) and Cimarron organics (vegetable farm) has been mutually beneficial in that these Facebook pages can disseminate their crop specialty crop information and Friends of Carver can also post information and it is made available through those pages.
- Because there will be an increased awareness of the benefits of specialty crops in terms of nutrition and health benefits, this will benefit consumers who will consume more specialty crops and improve their diet by purchasing or growing more specialty crops. Students have learned the importance of specialty crops for good health and a healthy diet, as inferred from surveys, Facebook posts, and personal feedback.
- Those that access the educational material online or in person will be exposed to new specialty crops they may not know about, their nutritional benefits, and accessibility of obtaining them locally.
- Parents who will become aware of what their children are actively learning and who will be asked to participate in volunteer efforts in the school garden and greenhouse throughout the specialty crop growing season (March-November for food gardens and year-round for greenhouse production). The project was lucky that the open-house brought in 100 parents, 100 students, and about 100 siblings.
- Interns and volunteers will be exposed to specialty crops and their health benefits by actively participating in this project. The project assisted in teaching 4 high school volunteers per semester on how to carry on crop production in the greenhouse.
- The general population who may not be aware where certain food or food products actually come from and may read about the project, visit a website dedicated to this project, or participate in open-houses and field days at the garden and greenhouse at Carver Elementary Academy. By opening the project to the press (written, TV) we were able to reach a TV population that is close to one million (Texas panhandle and surrounding areas), newspapers and their websites that reach more than 50,000 readers, and press bulletins by Texas A&M AgriLife that can potentially reach a national audience.

Lessons Learned

Problems and Delays

1) We lost our educational coordinator and grant coordinator, Ariella Kay, who passed away in January 2013. She was the moving force behind this project, which needed this grant to take it to the next level. We finally replaced her in late April when the project was in full force with greenhouse and future outside vegetable garden set-up and activities. Time was made-up by putting extra hours of work to make sure that the objectives were met. Dr. French also spent a lot of hours (in-time contribution) helping with this project, as he was the project coordinator.

2) The school systems have their curricula already set so there was very little we could introduce to the students. However, we were lucky that the school's Science teacher and coordinator, who teaches all students, was able to find some time to engage all students in activities in the greenhouse, outside garden, take home seed packages, planting, and harvesting. Regardless, it is very difficult to incorporate teaching material as part of the class curriculum. So knowing what is being taught may allow utilizing the scope of the project for those lectures (i.e. photosynthesis, plant cell growth, oxygen and water needs for plants).

3) We lost numerous crops to hail (May 29, 2013) and the greenhouse was also damaged, which delayed summer tomatoes in the greenhouse. Luckily, this allowed for students coming back from summer vacation to see tomatoes in full bloom, producing fruit and being harvested as they took their environmental science class, which is held in the greenhouse. Growing more seedlings in the greenhouse would help but hail was not expected that late. We did have a back-up greenhouse facility.

4) Because there are privacy issues, the school had to be asked permission when conducting events such as open houses, inviting the press, taking pictures or videos of students, taking pictures of videos and facilities. We had to respect the school's wishes to limit such events. However, they have been the most supportive in letting us achieve our goals. The Principal, a master gardener, was very accommodating. So was the environmental science coordinator that uses the greenhouse for her environmental biology course that reaches all 384 students.

5) Limitations for surveys are related to privacy issues such as what can be asked, can names be mentioned, can ages be mentioned, and can pictures be taken. When working with children, it is best to find out what the school policies are, what the school district rules demand, and always check with the principal, assistant principal, or the environmental science coordinator (as was the case with the project). For some video footage or pictures, there was the need to ask permission from parents, and if necessary, have them sign a waiver. Our cookbook was also not produced due to lack of interest and potential for recipes not to be authentic. It is hard for participants in Texas to give up their recipes for such foods as chili, salsa, or mole, because those are family recipes and have been with them for generations in some cases.

Positive Experiences

1) The project was able to reach all students at Carver Elementary.

2) The Friends of Carver Facebook page had 245 likes and more than 10,000 unique visitors by the end of the project. The Facebook page is still being used by Texas A&M AgriLife to reach those who benefitted from the project by liking the Facebook page.

3) The Carver Elementary school principal welcomed the project: "gardening teaches her students perseverance and creative problem-solving skills", "It's always exciting to see something growing when you go out to the garden," and "Instead of reading about it, they're able to learn about science in a hands-on way that's exciting for them." This was a quote to the press. <http://amarillo.com/news/local-news/2013-05-26/carver-garden-offers-hands-lessons>

4) The open house was a success. The tour of the project and greenhouse crops had 300 participants almost equally divided into students, parents, and siblings (not in elementary). This was the perfect opportunity to display the value of specialty crops by having a display (picture, below)

5) Although the project is over, a partnership is being built with Carver Elementary so Texas A&M AgriLife Extension Service Plant Pathology can continue to be active with Carver by utilizing their greenhouse for experiments that Carver students can look at and see any differences, if any. Students are exposed to scientific research Extension Plant Pathology has a place to conduct experiments since space is always an issue.

Additional information

The project purchased a digital weighing scale and a stereomicroscope (i.e. dissecting scope) for insect identification and similar work. The scope was made available in mid-December 2012 to elementary students learning about photosynthesis, plants, and oxygen production at Carver Elementary Academy. And they have also used it to look at insects and disease plant tissue as part of the project. Below is a picture of the scope that has aided in teaching elementary students. Although in a limited capacity, Texas A&M AgriLife Extension Service Plant pathology will assist Carver with any problems in greenhouse or field production. Because the greenhouse facility grows specialty crops such as lettuce, squash, stevia, tomato, and herbs, and the outside garden grows numerous vegetable crops such potatoes, watermelon, pumpkins, melons, squash, and tomato, the equipment purchased is solely used for specialty crops only. The tropical garden located in the greenhouse, contains specialty crops that are not found in the Texas Panhandle and which include lemons, limes, Satsuma orange/mandarin, avocado, cacao, and banana.



Hydroponic tomato production growing in perlite (left, below) and hydroponic production of basil and tomato in hydroponic solution (right, below) is taking place at Carver Elementary Academy in Amarillo, Texas.



Alternaria blight on tomato can be a serious problem as it can not only infect the leaves but potentially infect the tomato fruit. Typical leaf spot symptoms associated with the fungus *Alternaria solani* can be seen in the leaves (below, left). In basil, aphids were observed mostly in the underside of the leaves (below, right). Some aphids not only cause feeding damage but may transmit plant viruses. Pictures taken at Carver Elementary Academy in Amarillo, TX.



Tomatoes that had been planted in Quarter 1 had issues with aphids (insects) and early blight (disease), as reported previously. For this quarter, because they were fruiting, there were issues with blossom end rot, a calcium deficiency (picture, below left). Aphids that attacked tomatoes were managed by releasing ladybugs (picture below, right). This will help us plan for issues during our greenhouse vs. garden production and comparisons.



The tropical specialty crop garden (located in the greenhouse) has become an important tool in educating students, faculty, and adult visitors on where food comes from and their nutritional content (picture below, left). Each crop grown has a factsheet close by where information on that crop is available. Further, all are taught about the value of composting with or without specialty crops (Picture below, right, has a compost “pile” where tomato fruits have been added)



Lettuce growing hydroponically on May 26, 2013 (picture, below). All students were able to observe how lettuce grew from seed into seedlings and into full blown plants. The sheet of paper that is hanging contains the common and scientific name for lettuce, country or region of origin, growth requirements, nutritional benefits, and famous dishes made with the crop.



A significant open house was held September 26, 2013 in Carver Elementary. Students, parents, and siblings attended this afternoon event which had approximately 300 attendees during the whole event. Attendees not only saw greenhouse and garden production, but also production systems such as hydroponics (i.e. tomatoes) and tropical specialty crops (i.e. bananas) grown in the greenhouse (below, left). The Day of Caring event, via United Way, gathered almost 100 volunteers that helped weed, clean, repair, and assist with greenhouse and garden needs. This event took place September 6, 2013 (below, right)



Our educational coordinator was contacted via Facebook by other educators about implementing inexpensive programs such as the “seed packets/kits” so that other schools can benefit their students as well. Because the project was in the news (newspaper, internet, TV), others in Amarillo and the Texas Panhandle were able to see what was being done at Carver Elementary. And because the Texas Panhandle suffers from high incidence of diabetes and obesity, the focus from the press was on good nutrition via vegetable consumption, a perfect fit for our project.

The economic impact of the project may be that there will be an increase if specialty crop consumption which may lead to more spending on these crops and hopefully in detriment to less healthy alternatives. By providing a hands-on experience with specialty crops and providing

information on specialty crops, participants were educated on the benefits of specialty crop consumption, including some tropical crops that cannot be grown in Texas. If those who benefitted from our project decide to grow vegetables or focus on certain high nutritional value vegetables for their home garden production, they could potentially save hundreds of dollars in high value specialty crops such as tomato, cucumbers, and peppers.

PROJECT 20: BROWNSVILLE COMMUNITY GARDEN PROJECT

Project Partners: Brownsville Wellness Coalition

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Project Summary

This project addresses nutrition through the planting, harvesting and development of specialty crops. The purpose has been accomplished through establishing a network of community gardens in low income areas for new farmers and gardeners. This program supports them by teaching all aspects of gardening and farming, 2) facilitating marketing of crops at farmers' markets and 3) enhancing dietary intake through fresh produce. The Brownsville area has a chronically high incidence of obesity and diabetes, higher than the national average and affecting the health of a high percentage of local families. This project is helping by teaching families about dietary planning, better eating and the role of fresh fruits and vegetables in their lives. Because the issue of health is intimately connected to diet the Department of Public Health in the University of Texas-San Antonio developed this project to make a difference in the lower income areas of the city.

In order to ensure that grant funds were only spent on enhancing the competitiveness of specialty crops we did the following: 1) The participants were given a gardening class on plants defined as specialty crops according to the USDA guidelines. 2) The programming created by BWC included giving participants the seeds and transplants of only specialty crops. 3) The participants were required to use only the organic, non-GMO plants and seeds given to them in their garden plot. 4) The Brownsville Wellness Coalition only allowed specialty crops to be sold at the Brownsville Farmers Market in order to create the environment for competitiveness.

Project Approach

Our project was described in two parts; Pre-award Activities and Post-Award Activities. The Post-award Activities will be emphasized with reference as needed to the Pre-award Activities.

Pre-Award Activities

Task: Establish written agreement with the City of Brownsville for the first garden and begin the garden development



We have developed and signed a general agreement with the City of Brownsville covering the establishment of the first community garden and that agreement has been very effective in establishing the next several gardens and we anticipate the ongoing cooperation of the City. City employees cleared the area, cleaned up the debris, and trimmed trees, with a lot of assistance from the gardeners.



Three Angels Garden at the start

Task: Complete the plowing and soil amendments

The City has been very cooperative and has become a critical partner in



First Garden after some cleanup

this project. The City with the help of the gardeners cleared the debris and weeds from the lot. The staff then rototilled the entire area in preparation for installing the raised beds. Doing so has made the gardens much easier to maintain and much neater in appearance. Some 60 cubic yards of compost-soil mixture was delivered to fill the raised beds in preparation for planting. A composting area has been designated in each garden to help create more soil amendments.

Task: Provide water access to the garden areas

The City established water access for the gardens and has constructed sun shelters with benches, have assembled the raised beds and have installed the security fences. Grant funds were used for these materials. Project funds were used for the materials for the beds, fence, and sun shelters and for the compost.

Task: Layout and mark individual plots.

We chose to install raised beds which were started as soon as funding was available. Raised beds are better for defining the garden spaces and are easier for the gardeners to work. The City supplied shredded wood for the spaces between the beds. That allows much cleaner access especially in wet weather and gives the garden a much tidier appearance. All the gardens are strictly natural; no chemical fertilizers, no insecticides, no herbicides. All fertilizing is to be done with compost or other natural fertilizers.

Task: Begin establishing Garden Rules

Post-Award Activities

Task: Locate two additional garden sites

Identifying the second and third gardens took place after the Award date. We now have two gardens established and a third is underway.

Our first garden is called "El Jardin de Tres Angeles" (Garden of the Three Angels) in a low income neighborhood near the Brownsville Farmers' Market. It immediately was fully

subscribed with 26 families and is now producing fruits, vegetables and salad greens. The area is the backyard of an apartment building where a tragedy occurred some 10 years ago that took the lives of three very young children. The building is abandoned and owned by the city. The city plans to demolish the building this year and create a children's park. The area was seriously weeded and contained a lot of trash that was cleaned up by the gardeners and the City.

The raised beds were installed and by the time the beds were done, all of them were subscribed. Our gardener families took over and planting started promptly, including the whole family. Grant funds were used for the seeds and plants. Family participation is important to the mission of dietary education. We have already observed that kids will eat greens and vegetables when they help grow them. The opportunity for the youngsters to sell excess produce at the Brownsville Farmers' Market on Saturday mornings is another important incentive.

The Three Angels Garden has become a gathering point for the neighborhood including pot-luck lunches and dinners. The Garden hosted a tour and passed out apples at City's Halloween Party. Several pictures of the Halloween party and other events are included in the Attachment.



Kids are great learners

Second Garden:



Lemon Grass Garden

The second garden, named Lemon Grass Garden is also fully subscribed. Lemon Grass has 34 raised beds and is especially exciting since it is located on the shore of one of the City's Resaca's. The City plans to install a kayak rental facility at the site to afford family oriented recreational activities. The garden is now fully subscribed and planted and the Lemon Grass gardeners are now using the produce in their meals and bringing excess produce to the Brownsville Farmers' Market. Because this garden is larger than Three Angels, the City has installed two sun shelters. We have held dedications at both

gardens with the City officials present. The Lemon Grass gardeners are included in the training sessions.

Another interesting feature is the inclusion of fruit and nut trees outside the security fence. The products from these trees are intended for the benefit of the gardeners but also of the neighbors. An off-street parking area was also provided by the city.

Third Garden



Beds at Lemon Grass garden

This garden will be designed using the "Sprouting Kids" system from the Sustainable Food Center of Austin, Texas. This education system integrates classroom learning and cafeteria meals with the community garden and the families of the children involved. This is a very exciting concept and will be a model for many future gardens in the City. Sprouting Kids is an integrated education program that includes classroom and hands-on activities for middle school students, including cooking classes. The school administration is very excited about the idea and the school has agreed to construct a classroom at the garden for teaching the course material. The area designated for the garden is owned by the Brownsville Housing Authority. We have established an agreement with them that will serve not just this area but all of their housing properties, for possible future gardens. Since these tend to be located in low income areas it fully meets our objective of serving low income families and individuals. All gardeners are provided seeds and plants of their choice from grant funds.

Other Post-Award tasks

Task: Recruit Families, Begin Classroom Sessions, Establish Garden Rules

Families were recruited quickly, by our assigned volunteers. The first garden was fully subscribed even before the raised beds were completed. The staff of "Promotoras" from the Department of Public Health of the School of Public Health at Brownsville was instrumental in helping with recruiting since they work in the neighborhoods regularly.

Using on-line resources from as far away as Australia and New Brunswick, Canada, we developed a set of enrollment documents including discharge of liability, agreements to pay the \$15 annual fee and the Garden Rules. The rules cover the all natural growing requirements, keeping their garden cleaned and weeded, harvesting crops and participating in Garden events. The gardeners have followed these rules and the gardens are remarkably clean and productive. The rules also encourage gardeners to sell excess produce at the Brownsville Farmers' Market. Many of the gardeners do so and the Farmers' Market has designated on vending tent for the gardeners.

Task: Training sessions (minimum of 20 hours)

The first training session took place in March, 2013. These sessions are typically 2 hours long and cover the complete range of topics. We started with "Dirt 101" and proceeded to the full curriculum we planned. Those sessions are continuing and will be until all the gardeners for all three gardens are trained. Training sessions are held by Texas Certified Master Gardeners, faculty members from several universities, and gardeners and content experts. The trainers were given a \$100 honorarium from grant funds. We have exceeded the 20 hour minimum and classes will continue for the indefinite future.

Sessions are held in a room in the City's Boys and Girls Club. Some very important sessions were held in the garden itself as hands-on learning. The gardeners took the first session to discuss the rules and understand their responsibilities. The rules state that the gardens would be managed by the gardeners so at the second training session, they elected a Garden Manager. The

manager coordinates work sessions, contacts gardeners regarding classes and acts as general supervisor.

Task: Oversee planning, planting and growing

Our staff, volunteers and Garden Managers have done an outstanding job of both overseeing growing and marketing for both gardens. The staff and garden managers have been very effective in applying the Garden Rules, resulting in no significant conflicts and very neat and tidy gardens.

Task: Development of a "Best Gardening Practices Manual"

The garden manual was part of the initial outcomes described in the grant application. However, after implementation began of the grant, we quickly realized that our expertise to write such a manual paled after receiving specialty crop training from other professionals. For example, the staff of this grant attended a training at Sustainable Food Center in Austin, which has been doing gardening and farmers markets since 1978. The training covered many topics including managing community gardens and creating garden managers. We adopted their training manuals and approaches. As such we have used their manual "Basic Organic Gardening" to teach simple gardening principles to our novice gardeners. We have also used several educational resources from Texas Agrilife that are specific to the Rio Grande Valley. These resources provided detailed information about the specific varieties of crops and dates for planting and harvesting specific for this area. Therefore, in order to meet this objective we trained our gardeners using a combination of these materials and also provided gardeners who requested a copy of the Sustainable Food Center manual, one copy.

Task: Survey test and results

Part of the initial project included surveys of incoming gardeners with a longitudinal component. To accomplish that goal, we have interviewed individuals and found that uniformly, gardeners are very satisfied with the gardens, with the training, and the whole concept. All of them reported significant increases in fruit and vegetable intake. We also have learned that about half of the gardeners are now planting home gardens to expand their output and try different crops. Most of these had little or no experience with gardening.

Brownsville Wellness Coalition
Gardening Knowledge Survey given to gardeners at Tres Angeles (14
participants) and Lemon Grass (22 participants)
from August 2013 - August 2014

	Initial	6month	One Year
GARDENING	Survey		

Have you gardened before	50%	75%	77%	Only half the gardeners had any experience
What level of gardener do you consider yourself	71%	63%	45%	are novice gardeners or have never gardened
What will you do with your harvest	78%	85%	78%	will consume/15% sell/71% give
Why do you want to participate in a community garden	78%	78%	78%	majority garden for access to healthier food
How many hours do you spend in the garden a week	50%	42%	42%	majority spend 1-2 hours in the CG a week
What do you like to grow	50%			majority likes to grow vegetables
What SPECIALTY CROPS				
would you like to grow	100%	100%	100%	100% would like to grow everything
If you have been planting longer than one season do you plan on continuing	NA	100%	87%	majority of the participants return for the next season

Goals and Outcomes Achieved

The initial survey gave a benchmark for all the participants' general gardening skills and dietary habits. The first garden was established August 2013 with 14 participants. The second garden was established November 2013 with 22 participants. The results indicate that gardeners are growing foods for enhancing their nutritional status, and that the majority of gardeners plan to continue gardening the next season.

Gardens

Our first goal was to start one garden and locate two more. We are very satisfied with our results. As explained herein, we now have two gardens up and running and the third in process with negotiations and plans underway. We have also identified other potential locations for future gardens. The City administration is very supportive and has expressed the desire for BWC to continue this effort.

Changes in diets for families

Just as the gardeners have expressed satisfaction with their participation in the gardens, they also report that they and their families have increased their intake of fruits and vegetables. Additionally, since many of the gardeners visit the Brownsville Farmers' Market to sell produce and shop, they are also exposed to a wide variety of produce, many of which they had never experienced before. From other funding sources, gardeners are occasionally provided vouchers for products at the market. They also report using fresh vegetables to make 'smoothies' at home for themselves and their families. One of the outcomes is that the gardeners report feeling better as a result of their dietary change.

Brownsville Wellness Coalition
Dietary Survey given to gardeners at Tres Angeles (14 participants)
and Lemon Grass (22 participants)
from August 2013 - August 2014

	Initial Survey	6month	One Year	
<u>DIETARY</u>				
How many meals do you eat a day	20%	20%	20%	eat more than 3 meals a day
What two beverages do you prefer	14%	7%	7%	chose soda
Do you eat sweets every day	35%	21%	21%	eat sweets everyday
How many times do you eat at fast food restaurants a week				ate at fast food restaurants less than 6 times a week
	21%	35%	28%	
How many times do you cook at home?	57%	64%	64%	cooked at home more than 10X a week
Do you cook with the vegetables you harvest.	85%	92%	92%	cook with vegetables they harvest
What do you cook with	92%	92%	92%	cook with healthy oils
How many times do you eat vegetables a week	42%	57%	57%	Eat vegetables more than 10X a week
Do you eat fruits everyday	50%	57%	57%	50% eat fruit everyday
How many times do you eat fruit a week	57%	57%	57%	Eat fruit more than 6X a week
Have you been eating more fruits and vegetables since you joined the community garden	NA	92%	92%	agree that they eat more fruits and vegetables
Do you discuss healthy eating with your family	50%	64%	71%	they discuss
Do you get support from your family to eat healthy	64%	71%	71%	Get support
Do you have any of the following				the following are overweight, obeses, diabetic, high cholestrol, heart disease or high blood pressure
	71%	64%	57%	

Another important outcome is that the gardeners are starting home gardens, which speaks for the effect on them and their family's diet. They are using the knowledge gained in the training sessions to plant their own gardens and multiply the positive results.

We also collected information from some of the gardeners about their views regarding the program. Here are highlights from their comments.

Rosie Bustinza – “The program has allowed me to keep my eye on my health consistently. It has also allowed me to teach my grandchildren a very important skill that will help them throughout their lives” Participant at Tres Angeles, backyard gardener and vendor

Maria Huizar – “Growing our own food has been a beautiful miracle to witness with every seed. It has been a wonderful community to be part of” Participant at Lemon Grass and vendor

Isai Ramirez – “The program has helped me to get outside more and enjoy nature. I have made many friends that I will have for the rest of my life. It is always a joy to walk into the garden and tend to the plants and talk to others.” Participant at Tres Angeles

Beneficiaries

Obviously, the primary beneficiaries are the gardeners and their families. They have benefitted from the experience of gardening, growing their own food, exposure to classroom learning on a wide range of topics from how to plant and tend gardens to healthy eating and its effect on wellness. On a number of occasions, BWC has arranged for outdoor cooking demonstrations at the Farmers' Market using the products available in the market and making samples available to customers of the market.

Another benefit has developed as gardeners meet new people and form new friendships. The social aspect of the community garden project was not anticipated until it became real. Three Angels garden for example holds informal 'pot luck' meals based on their produce and their favorite recipes with little to no 'junk foods' on the menu. These often actually take place in the garden itself, before, during or after work sessions.

Other beneficiaries include the neighbors. Although they may not be gardeners, the beauty of the gardens enhances the attractiveness of the neighborhood and they appreciate seeing a neglected eyesore replaced by an attractive asset. In the case of Lemon Grass garden, fruit and nut trees have been planted outside the security fence for the use by the gardeners and the neighbors.

The City of Brownsville has also benefitted by the 'greening' of neighborhoods. We have observed that many neighbors in the area have begun to pay more attention to their yards by cleaning up and even planting small gardens and ornamentals. We have no data on this change but many from BWC have noticed it. In fact, the City administration expects to see more and more community and home gardens springing up.

Another beneficiary of the program is the Brownsville Farmers' Market and the diversity and number of growers who attend the market. This market is the only market in the city and thus by this grant increasing the availability of specialty crops in the city, there is far greater access. At this point the garden program increased access to specialty crops by just over 25% as we had 20 growers at the time the grant program began and an additional 5 community garden participants are now regular vendors at the market. This is a significant increase.

Lessons Learned

Staff

Our staff has been critical to our success. They have exerted enormous and effective efforts toward accomplishing our goals. They are to be congratulated for their success.

One of the important lessons learned came from not having enough qualified staff in place at the start of the project. However by March, 2013, Brownsville Wellness Coalition interviewed and selected three additional people to help implement the project. Two of these are Master Gardeners, which has helped immensely in the training program.

Inclement Weather

The weather played an important role early in the project period. Late winter rains continued into spring so there were many days when work could not be done. Additionally, during the summer months we had just the opposite problem; some days were simply too hot to work in the garden. There is no way to predict the effects of weather so additional time should be planned for in projects that involve outdoor activities.

Partners

From the start of the project, the Parks and Recreation Department was very cooperative and became an invaluable partner. If there was a lesson learned there, it is that BWC staff has consulted with affected City agencies very effectively since the beginning of the project on tasks, responsibilities and expectations. Other partners have been The Home Depot; (building materials, plants), Perennial Favorites; (plants, training), Earthwise Organics; (compost, wood chips, training), Texas Department of Agriculture (TDA); (funding), Anita's Gourmet Restaurant; (garden plot sponsorships). More partners include the local Boy Scouts troop and

children from the Boys and Girls Club who planted pumpkins and other veggies in open beds areas.

This entire project and its successes are a result of the funding provided by the Texas Department of Agriculture and the efforts, skills and knowledge of our Staff and volunteers. We are all indebted to TDA for providing this opportunity. Community gardens have been a desire of the BWC for a long time but this grant and others made it possible.

Relationships

This project has established new and positive relationships with the City of Brownsville and many of its departments, in particular the Parks and Recreation Department, PUB (Public Utilities Board), Brownsville Independent School District (PUB) and all of our partners and sponsors. These relationships are smoothing the way for continuing the establishment of more community gardens. We refer you to the newspaper article at the end of this report.

Media Support

We learned the importance of media in spreading the word about the gardens to build momentum for other organizations to join in and also for community members to realize the value of locally grown produce and coming together for community improvement.

Additional Information

We have attached a few of the pictures taken at the gardens that illustrate the success of this project.

Family participation is very important in this project. Children who grow up gardening are more likely to continue to garden and to understand the importance of fresh produce in their meals. All the older children are invited to the classroom sessions.



Some members of the BWC and staff at the formal dedication of Three Angels Garden. All of them have been instrumental in the project's success.



Halloween was a festive time at Three Angels. The City's Parks and Recreation Department held a big Halloween party next to the garden. Our volunteers passed out apples to the Trick or Treaters. The garden was open for visitors during the festivities.

Costumes by the gardeners and garden staff added to the fun.



Staff and families in costumes

We took the opportunity to introduce community gardening to many party goers. Notice Mr. 'Wolf Man' in the background.



Garden visitors at Halloween



Lemon Grass Garden

Lemon Grass garden is larger than Three Angels with 34 garden spots compared with 26 in Three Angels.



Overview of Lemon Grass

Since it is larger, the Parks and Recreation Department provided two sun shelters and several picnic tables. In the foreground are the fruit and nut trees that have been planted. Grant funds were used for materials for the shelters and benches. This picture shows the parking area that the City is developing in the foreground.



Lemon Grass in production

when they help grow them.

Crops are already growing at Lemon Grass garden. Gardeners have planted seasonal vegetables and greens along with a variety of herbs, including lemon grass. Both gardens have common areas where plants like herbs are grown for the use of all the gardeners.

Kids and families work together in the garden. Kids learn to eat vegetables



Several of the cabbages have been harvested but the green are nutritious too.



An Early article from the Brownsville Herald newspaper

Posted: Monday, February 13, 2012 12:00 am | *Updated: 4:27 pm, Fri Feb 8, 2013.*

Community gardens springing up in Brownsville By JACQUELINE ARMENDARIZ/ The Brownsville Herald

In Brownsville a local green thumb movement of sorts may be under way as the city and other groups team up to create community gardens. The vibrant green of fresh produce and herbs like carrots, dill, peppers, basil and more was evident Friday in the community learning garden at Lincoln Park off of University Boulevard. The produce and the garden are the product of a working relationship between the Rio Bravo Wildlife Institute and the City of Brownsville's Parks and Recreation Department.

Parks Director Chris Patterson said plans for another community garden downtown are in the works with the hope that the projects will encourage all residents to help improve life in Brownsville. "It's the whole community's job to make sure that revitalization occurs," he said while discussing future plans.

The Lincoln Park garden was established in winter 2010, said Joe Boswell, RBWI outreach and development director. The non-profit entered into a memorandum of understanding with the city for use of the public land.

The garden is a place for residents to learn what works and what doesn't in order to hone their own gardening skills, Boswell said, and in turn people gain understanding about where their food comes from. With this, the RBWI's conservation mission is promoted because they've become better stewards of the land, he said. "It doesn't take much," he said of creating a community garden. "You just need space, dirt and man hours."

There are thousands of community garden listings across the U.S. and Canada, while there are 45 in Texas, according to the American Community Garden Association's informal database. With the help of other groups like the RBWI, a garden near the city recreation center at Eighth and East Tyler streets may soon be organized for area children, Patterson said.

"I don't have the personnel, and we probably never will have the personnel, to be able to handle what needs to be done in this city," he said. "It's tough for any city to just do stuff on their own. They've got to have your churches, community groups, volunteers, people with community service hours."

He said the Brownsville Farmer's Market, with its experienced vendors, has also expressed interest in working with the city to create another community garden. Market manager Jack Moffitt said plans are in the brainstorming stage and the organization is looking into applying for a Texas Department of Agriculture grant that might help.

"We've got a lot of enthusiasm," he said.

Boswell said the RBWI — which hosts gardening classes, yoga and other activities at Lincoln Park — sees the garden as a tool in the fight against obesity and diabetes, both prevalent health conditions here. He said that people become more active outside while tending the garden and there's the added benefit of eating the healthy greens grown there. "I want to create another dozen," he said. "What we'd like to see is one in everyone's backyard and in back of every church. Boswell also said he hopes to bring such projects to Brownsville Housing Authority developments.

"Food has always brought people together," he said.

Community gardens do require the dedication of an entire group. In the RBWI garden's case, the caretaker is Lyle Muzingo, Boswell said. Currently, the Lincoln Park land still has room for gardens created by other groups, he said, adding that interested organizations should call the RBWI. Beyond some potential health benefits, gardens will bring better use of urban lands, Patterson said.

Brownsville has the benefit of having lots of green space, which urban areas usually lack, but the dilapidated spaces that are here can be taken back by communities who want to create a garden, he said. "You know how people talk about the economy and all this kind of stuff. If we use everybody's resources, it doesn't matter if they cut our budget, we're going to get it done," he said. "We just have to be more resourceful. ... If you have a vacant lot, you're attracting all kinds of stuff. Whereas if you have a garden, the people in that neighborhood tend to take care of it." He encouraged residents to tap into resources like the RBWI for help in creating community gardens on their own private lands. He also said residents should suggest potential vacant lots that might be transformed or areas with rundown buildings that might be razed.

"I've pretty much said it since I've been here: In the City of Brownsville we have a pool of 175,000 people that can help out the parks," Patterson said. "That means every citizen has the opportunity to come to our department and just tell us what they want to do for the community. We don't turn them down."

A more recent article from the Herald, October 7, 2013



Yvette Vela/The Brownsville Herald

Rosie Bustinza, garden manager and neighborhood organizer, stands along rows of flourishing garden plots at Tres Angeles Community Garden in Brownsville.



Yvette Vela/ The Brownsville Herald

The community garden has 26 plots with 26 families participating in growing fresh herbs and vegetables.



Yvette Vela/The Brownsville Herald

Melissa Delgado, executive director for the Tres Angeles community garden, tends to a row of plants.



Yvette Vela// The Brownsville Herald

Wayne Wells, grant writer and manager for the Tres Angeles community garden.

GET INVOLVED

Each month, the Tres Angeles Community Garden brings in master gardeners from the area to talk about the finer points of gardening. The next garden talk is scheduled for Thursday at 6 p.m. at the former Boys & Girls Club, where attendees can learn more about gardening and find out more information about getting involved with the community garden.

Posted: Monday, October 7, 2013 10:20 pm

Community project plants seeds of change BY TY JOHNSON THE BROWNSVILLE HERALD

It has taken just more than a decade, but the roots of healing have finally taken hold at the Tres Angeles Community Garden at East 8th and Tyler streets and organizers are now seeing the fruits of their labor. Vegetables, too.

The inaugural growing season at the community garden has begun, and the 26 flower bed plots are filled with promising-looking plants bearing peppers, eggplants and an assortment of other fresh produce community members have planted.

The garden has come a long way since its time as a vacant lot, littered with trash and overgrown by weeds, explained Rosie Bustinza, who oversees the garden.

Bustinza began recruiting prospective gardeners from the surrounding area last fall, after the group received a grant to reclaim the lot from its disarray and transform it into a garden that honors the memory of three children who were slain in 2003 in the building next door.

The garden is the first step toward replacing those grim memories with a new sense of community, as the city, which purchased the lot and building, is aiming to eventually demolish the building.

Brownsville Planning Director Ramiro Gonzalez said there is no rigid schedule for the building razing, but it is not a matter of if but when the building will come down.

The plan, Bustinza said, is to expand the community garden project into a small children's park complete with a playground, to help heal wounds still tender from the heinous crime committed at that corner more than 10 years ago.

But Bustinza pointed out that is not just about honoring the three children, known as the Tres Angeles or three angels, but also looking forward and creating a future Brownsville where residents are conscious of where their food comes from.

Hopefully the next generation will know more about nutrition, Bustinza said, noting that her grandson has a plot and that a local Boy Scout troop has the beginnings of a pumpkin patch poking through the soil. We'll be in full bloom in maybe a month.

From mint and broccoli to spinach and squash, the garden bears a resemblance to the Brownsville Farmers Market, where Bustinza has sought out gardeners.

The goal, she explained, was to give downtown residents an area for their plants outside of their yards, which sometimes can be cramped.

Each plot is as active as the gardener wants it to be, she said.

And for those who aren't naturally blessed with gardening skills, the group hosts talks with green thumbs□ twice monthly as master gardeners talk about the finer aspects of growing plants.

The garden also focuses on sustainable approaches to gardening, using collected rainwater to water plants. The gardeners also don't use pesticides.

We try and use natural things, she said.

The garden also makes use of compost, which is renowned for its naturally occurring, plant-nourishing nutrients.

That's what our body needs, Bustinza said, noting that plant growth depends on good nutrition just like human growth does.

Bustinza said having the garden as an option has increased her own confidence as a gardener, especially as she has learned tricks of the trade from experienced gardeners. She joked that while her husband, Rolando, was a gifted gardener, she felt defeated when she planted things that didn't thrive.

I just didn't want to plant because nothing ever grew, she said.

That's not the case anymore, though, as she harvests broccoli, one of her favorite vegetables, from the plot that she has grown herself.

It's a feeling she hopes to share with others who join the garden, either through purchasing a plot or attending the gardening lectures.

It's something to be proud of, she said.

PROJECT 21: STRENGTHENING A NASCENT SNAP PROGRAM AT DALLAS

Project Title: Strengthening a Nascent SNAP Program at Dallas Farmers Market to Benefit Specialty Crops in North Texas

Partner Organization: North Texas Food Bank

Project Manager: Debbie Bozeman-Zook

Contact Information: dfmfriends10@gmail.com or cell phone: 214.236.5476

Type of Report: Final

Date Submitted: December 31, 2013

Project Summary

The Dallas Farmers Market (DFM) is an iconic city landmark that has been open, with the exception of Christmas and New Years day, 7 days a week for 75 years. No other Farmers Market in Dallas County is allowed to operate with that frequency. The DFM is located on the southern border of downtown Dallas and is determined to be one of the few sources of fresh fruits and vegetables to many neighboring communities that have been designated ‘food deserts’. Research proved that ‘big-box’ grocery stores were hard to locate in these zip codes and convenience stores and fast-food brands were often the only source for any accessible food.

When the City of Dallas began the process to sell the city-owned DFM to private investors in 2012, the Dallas Farmers Market Friends (DFMF) were left to provide the bulk of market support to its local farmers. The DFMF accepted this challenge and took the lead in applying for the grant money designated by the Texas Department of Agriculture (TDA) for the promotion of fruits and vegetables. The DFMF saw an opportunity in the Specialty Crop Block Grant (SCBG) to encourage local growers’ efforts by connecting them to a new and larger customer base in the nearby neighborhoods of southern Dallas.

Statistics showed the DFM was not only the closest and most convenient source for fresh and nutritious foods for these areas but also revealed that two-thirds of these food insecure residents were eligible for Supplemental Nutrition Assistance Program (SNAP) benefits. By facilitating the first-ever SNAP program at the DFM, the DFMF laid the groundwork in combating the lack of nutrition plaguing in-need residents of Dallas and providing local farmers the opportunity to be part of that solution.

The core goal of the grant request was to create a thriving commercial environment for specialty crop growers in North Texas. The success of this was to be measured by the number of new farmer participants at the DFM and the number of new and eligible SNAP customers to shop at the market for their fruits and vegetables.

Project Approach

To extend the reach and impact of our SCBG, the DFMF utilized the effectiveness of SNAP as well as the unique location of the DFM to support our efforts in promoting specialty crops and the success of its growers. With the SCBG guidelines regarding the exclusive promotion of fruits

and vegetables, DFMF developed a token system that could only be used for purchases of fruits and vegetables by area farmers. Initially it was thought there would be a need for different tokens to separate SNAP purchases for specialty crops and non-specialty crops (in this case, meats or produce resellers). However, the SNAP Pilot Program, initiated and funded by the DFMF four months prior to the awarded grant program proved that this critical information was captured in the receipt process and additional (and visually different) tokens were not necessary. Specific signage was given to area growers to indicate program inclusion and qualification.

With the limited grant period time of one year, the DFMF sourced Dallas-based Firehouse Agency to create a strategic and creative campaign designed to augment the message that fresh and nutritious foods were a better choice and could be easily and affordably accessed, direct from the farmer, through the SNAP program at the DFM.

The results were an eye-catching series of posters and flyers that were circulated throughout the most fresh food-deprived areas in Dallas. There was no copy on the printed materials as the single impressive graphic of fresh fruits and vegetables taking the place of recognizable candy and less healthy treats delivered our message of the importance of healthier foods, fruits and vegetables. Attaching the DFM and SNAP logo emphasized that it was affordable and accessible. Concurrently, a direct mail campaign was created to reach the local farmer announcing that the SNAP program was being facilitated on their behalf at the DFM with the goal to attract more customers and buyers of their produce.

The DFMF, as earlier noted, had funded and facilitated a SNAP Pilot Program four months prior to the SCBG time period. It was during this time that Mr. Kris McLauchlan (future part-time administrator of the SCBG program) was hired and trained to run the SNAP office. With the SCBG approval (October 1, 2012), McLauchlan, along with Program Coordinator Debbie Bozeman-Zook, spent three days a week researching and creating an area farmer database, meeting with stakeholders for volunteer support and hopeful collaboration, soliciting and then educating new SNAP farmer participants. In addition, the two-person SCBG team developed the token and receipt system as a performance gauge in attracting new fruit and vegetable farmers (sellers) as well as using the SNAP EBT system to provide overall documentation of new customers (buyers) of their produce.

Support was necessary and the DFMF reached out to a variety of stakeholders for reinforcement. The City of Dallas (replaced by the new management in June 2013) provided free rent for a SNAP office at the DFM for the duration of the grant period. The DFM proved helpful in providing their lists of North Texas farmers. Separately, the DFMF afforded support in sharing the costs of running the SNAP office.

The DFMF also partnered early with North Texas Food Bank (NTFB) who backed these efforts by providing names and addresses of clinics, food pantries, community centers and such as well as serving as distributors of our creative materials at their own functions. To compound the exposure, various churches and non-profits whose efforts included outreach to schools and public aid programs were included in the distribution process.

To relieve the farmer the burden of SNAP management responsibilities, the DFMF created a 'Market Token' system to enable the SNAP card user to meet the farmer that grew their produce.

The token system served to monitor the purchase by the SNAP customer, the cash reimbursements to the farmer and ultimately, measure the success of the program.

Goals and Outcomes Achieved

In May 2013, the four 'Fresh & Tasty' posters, mini-posters and Resident Flyers (both English and Spanish) were printed and delivered and the distribution process began. Bloggers, local news media, national news media featured our poster series and applauded its relevant message. And, for the creative execution of the design, the series was named in the top 100 best designs out of 5000+ international entries in the esteemed Communication Arts 2013 Photography Annual and was displayed on its cover. In regards to the projects' creative excellence in promoting fruits and vegetables, the campaign won four Gold and two Silver Awards in addition to the Judges Choice in the Dallas ADDY Awards, 2014.

Mid-way through the grant period, initial SCBG educational plans that included cooking instruction for seasonal produce were shelved. The transfer of ownership of the 13-acre market came with many internal issues that affected the ability to plan with any confidence. With Texas Department of Agriculture (TDA) approval, those funds were transferred toward more media exposure for the successful promotional campaign. Billboards and bus signage were the chosen media vehicles to boost the reach of the campaign in more targeted demographic areas and were contracted for September 2013, the last month of the SCBG period.

In summer 2013, United States Department of Agriculture (USDA) representatives took note of the promotion and contacted the DFMF for potential use of the visually appealing creative materials. Since that time, Firehouse Agency has offered USDA all usage rights at no cost. Conversations are on going at this time with all groups hopeful that the effective campaign will be utilized in the promotion of specialty crops.

The change in DFM ownership and management during the SCBG period did afford us more access to the farmer and vendor records and local farmers using best practices in farming was a lower number. In 2012, the DFM had 74 vendors on its roster. After eliminating wholesalers and re-sellers, a remaining 21 were exclusively area Specialty Crop farmers. Within the 12 months SCBG project, 6 new farmers became a vendor at the DFM and enrolled in the SNAP program. Our project goal was a 50% increase in specialty crop farmers. At the end of the grant period, our actual number of new farmers resulted in a 40% increase. With the general confusion in the privatization of the property (many Dallas residents thought the DFM was closed) compounded with difficult growing conditions (drought), we feel very successful in the results of our efforts.

Token sales comparison (Pilot Program vs SCBG Program):

June 2012	\$1048	June 2013	\$2420
July 2012	\$1290	July 2013	\$2479
Aug 2012	\$1579	Aug 2013	\$1625
Sept 2012	\$1384	Sept 2013	\$1493

As a result of the SCBG opportunity and DFMF's efforts, an extra \$19,163.00 was brought to the local farmer at the DFM through the SNAP program in the 12 month period and six new local farmers were added to the Market's vendor list.

Beneficiaries

Our initial research showed that as recently as 2008, 15 zip codes in Dallas County qualified as food deserts. This SCBG project provided the bridge to reach these vast numbers of Dallas residents that have the undeserved misfortune of living in these food-disadvantaged neighborhoods. In promoting specialty crops with the SCBG poster and flyer series, community centers, schools, food pantries were able to direct their groups to the closest source of locally grown foods at the Dallas Farmers Market.

The area farmers were not the only groups to be introduced to this new customer base as the local ranchers and Produce Dealers that sold at the DFM also appreciated the uptick in business. There were an estimated 40 farmers/producers that sold at the market. More importantly, all groups had the opportunity to witness SNAP benefits used for healthy choices and had the chance be part of the solution to hunger and childhood obesity and help curb future decades of costly academic and health consequences.

Earlier efforts to encourage SNAP participation at the DFM was unsuccessful due in short, to the perception that reimbursements would be slowed by the city's processes. The local North Texas Specialty Crop farmer didn't necessarily possess the time and ability to manage their own individual SNAP account or their own marketing and promotion. By way of the SCBG, the DFMF proved to be a nimble partner and relieved the farmer of this marketing and accounting burden by providing targeted promotion as well as an internal token system for accounting

And certainly, the DFM as a whole benefitted from the new customers the SCBG program attracted. The market had been neglected by the City of Dallas and subsequently, mis-managed for a number of years and stood at risk of being shut down. The unexpected bonus of the SCBG project was the attention it brought to the market at a time when it was most needed. As well, the new owners were able to see the importance of supporting local farmers and to realize the possibilities a revived, vibrant market could bring to the downtown community.

Lessons Learned

The DFM is unique in that it provides two 60,000sf sheds for both local farmers and 'produce dealers' (defined as a produce vendor but not a farmer). Within the SNAP guidelines, the DFMF was restricted to working with only the original farmer of the produce. If this project could be extended, the DFMF would definitely contact the federal groups that award SNAP licenses and explain that any DFM 'produce dealer' is only re-selling fruits and vegetables and thereby should be included in the SNAP token program.

Unknown until this grant was in process, the City of Dallas has very restrictive guidelines for any other market than the DFM to follow. There is a limit on the number of consecutive days in operation, how many locations and how many markets one person or group can operate. To provide the North Texas farmer more market share, all farmers markets in Dallas should have the

same chance to build a following and subsequently encourage all farmers to ‘grow’ their businesses. An alliance of Dallas area Farmers Market managers is being discussed.

Additional Information

Listed below are links to the media coverage the SCBG project attracted:

Observer: http://blogs.dallasobserver.com/cityofate/2013/05/posters_aim_at_putting_vegetab.php

Egotist: <http://www.thestlouisegotist.com/news/national/2013/april/23/farmers-market-fast-foods-campaign>

Egotist: <http://www.thenyegotist.com/news/national/2013/april/23/i-scream-you-scream-we-all-scream-fresh-fruits-vegetables>

Ads of the World: http://adsoftheworld.com/taxonomy/brand/dallas_farmers_market

Ad Forum: <http://www.adforum.com/creative-work/ad/player/34485091>

AdWeek: <http://www.adweek.com/news/advertising-branding/firehouse-combines-business-consulting-advertising-work-149613>

Coloribus: <http://www.coloribus.com/adsarchive/prints/dallas-farmers-market-ice-cream-cone-17038305/>

We Love Ad: <http://www.welovead.com/en/works/details/082EllxA>

AdRuby: <http://www.adruby.com/advertising-agency/firehouse>

Creative Ad Awards: <http://www.creativeadawards.com/dallas-farmers-market/>

Trend Hunter: <http://www.trendhunter.com/trends/dallas-farmers-market>

The New York

Adspire: <http://adspire.tumblr.com/>

Creative Bloq: <http://www.creativebloq.com/inspiration/print-ads-1233780>

The Poster Series



The Outdoor and Bus Signage





Direct Mail Farmer Postcard (w/copy from reverse side)



**WE'RE BRINGING MORE
MOUTHS TO THE MARKET.**

The Dallas Farmers Market now accepts the Lone Star EBT Card. That means more folks can get the fresh produce you grow.

It's a healthier, more affordable option for those that truly need it and a moneymaker for hardworking farmers like you. Doesn't get more win-win than that.

TO LEARN MORE VISIT DFMFRIENDS.ORG
OR CALL US AT (214) 741-1088



PROJECT 22: SPREADING THE NEWS ABOUT HERBS AND HEALTHY EATING

Partner Organization: The San Antonio Herb Market Association (SAHMA)

Project Manager: Marilyn Magaro

Contact Information: mmagaro@hotmail.com; 210-363-1620

Type of Report: Final

Date Submitted: December 2013

Project Summary

With daily notices concerning the public's health, there remains a need to encourage healthy eating habits among Texas residents. The San Antonio Herb Market Association (SAHMA) focus is to expand outreach efforts on the way culinary herbs fit in to the cultural, geographical and historical setting of San Antonio, culminating in consumers diets. One of the primary goals of the SAHMA is to educate the public regarding the benefits of herbs. The purpose of this project was to increase awareness and knowledge of herbs that grow well in the San Antonio and surrounding area of Texas; differentiate the landscape plants from the culinary ones; promote healthy eating and nutritional awareness across the city through classes and educational venues; channeling information thru chefs; bolster relations with growers; and increase the numbers of visitors to the San Antonio Herb Market.

Project Approach

As a follow-up to the 2011 SCBG awarded to the SAHMA, the current grant allowed for an expansion of the educational outreach to the general public. In addition to the annual Herb Market and Basil Fest, the SAHMA held numerous classes, affording the opportunity to see, feel and touch the herb plants and talk to experts. By expanding the nutritional and healthy aspects of herbs regionally, project staff encouraged healthy eating habits in conjunction with cooking demos and seminars at various venues. Work with the project partners provided the expansion of the outreach efforts, both with locations and speakers and various topics. Public support was beyond project staff's expectations with the number of speaking invitations and public attendance. Staff's recommendation is to keep the momentum by bringing on additional speakers to provide more coverage for the area. A consideration would be to publish an herbal cookbook.

Activities performed within the work plan were varied. Among these activities was to reprint the *Herbs: Nutritious and Delicious* booklet for distribution. The SAHMA was able to add an additional five herbs to the existing 15 top herbs for this area, along with nutritional information. Staff was also able to identify trainers, develop a nutrition program and curriculum and educational packets. Working with partners, locations for classes were established and scheduled and performed as was the Chefs Tour. As a result, there were 20 classes given to area participants; scheduled classes served over 800 participants, while other venues impacted over 10,000 people. Participants were surveyed before and after the sessions to establish about their knowledge level of herbs, and found the classes and demos were a great way to expand their knowledge base. The SAHMA worked with the Gardening Volunteers of South Texas, the Bexar County Master Gardeners, the San Antonio Herb Society, and the Texas AgriLife Extension Service – Bexar County to establish venues for the culinary and landscape classes, and develop an herbal nutrition program for presentation. The Round Table Discussion tied in with the Chefs Tour, calling on local experts to expand everyone's knowledge of familiar and ethnic herbs. There were 4 chefs, along with 4 food educators, and 5 "herbies" that participated.

Goals and Outcomes Achieved

Goal 1 was to increase awareness of herbs that grow well in Texas, their many uses and their health benefits. Ultimately the target was to increase knowledge and awareness of 500 people in a year through educational outreach in the San Antonio area.

The SAHMA worked with the Gardening Volunteers of South Texas, the Bexar County Master Gardeners, the San Antonio Herb Society, and the Texas AgriLife Extension Service – Bexar County to establish venues for the culinary and landscape classes, and develop an herbal nutrition program for presentation. At these sessions, participants were surveyed before and after the sessions to establish their knowledge level of herbs, and found the classes and demos were a great way to expand their knowledge base. Although some had previous experience with herbs, the majority of participants had a little to no knowledge of herbs. After classes, the overall consensus was that the herbs were not scary, they were not afraid to try “new” herbs to their culinary efforts, and were glad to find out that by including herbs into their diet, additional vitamins, minerals and nutrients present would help them achieve a healthier diet. All noted that they would definitely use the herbal recipes and add herbs to their existing ones. In response to a questions posed at the beginning of each presentation, 31% of the respondents had no prior experience with herbs. The survey at the end of the presentations, 95% of the participants said that they would grow/include herbs in their cooking.

The goal for was for 500 people to increase their knowledge on herbs. SAHMA held 20 classes with more than 10,000 participants. Scheduled classes impacted 817 participants while larger venues (Rodeo, Herb Market and Basil Fest) accounted for an additional 10, 150.

The second goal was to increase grower and vendor sales at the San Antonio Herb Market by 10% to \$23,100. Sales at the Herb Markets amounted to \$ 23,650. This was an increase of 11.2% from the 2011 figures.

Beneficiaries

This grant provided the SAHMA the ability to expand their outreach to many area participants. Clearly, the beneficiaries of this grant include the general public, as evidenced in the results of Goal 1. Lastly, vendors of the Herb Market, Basil Fest and the Pearl Farmers Market (location of Herb Market and Basil Fest) benefited monetarily from the events. The number of consumers touched by the efforts of the SAHMA, and this grant, would be in excess of 10,000. The number of Vendors were:

2013 Basil Fest – 3 (considered an outreach event); Pearl Farmers Market Vendors – 32.

2012 Herb Market Vendors 15; Pearl Farmers Market Vendors – 27.

2013 Herb Market Vendors -17; Pearl Farmers Market– 32.

Lessons Learned

Project staff learned to include outreach efforts in geographic areas that may not be familiar with the SAHMA. Assisting with the development of different outreach programs was another aspect that benefitted the project staff. It also forced them to plan the volunteer recruitment efforts to insure enough assistance in working various events.

Lessons learned would include time management and resources. This grant showed that increased advertisement can expand the number of visitors and the customer base. Printing the

educational booklet on the top 20 herbs with nutritional information, added to the positive impact the Herb Market and the educational seminars provided. And with the updating of the website, the SAHMA was able to reach out to consumers and answer their questions in a timely manner. A negative experience would be that the SAHMA learned that they need to attract more volunteers to assist in the preparation of both the Herb Market and the Basil Fest.

Additional Information

Staff will continue educational outreach, and have already scheduled for outreach events for 2014. The recommendation of bringing presenters in to provide a wider scope on the herbal front, followed by publishing an herbal cookbook is on the horizon.

Outreach events and activities can be found at www.sanantonioherbmarket.org

PROJECT 23: GRAPE GROWING WORKING – CONTINUING EDUCATION FOR GROWERS

Partner Organization: Texas Wine and Grape Growers Association

Program Contact: Debbie Reynolds (817) 421-3201

debbie@twgga.org

Type of Report: Final

Date Submitted: April 2013

Project Summary

This project was the development of grape growing workshops providing needed continual education for grape growers in Texas. The workshops focused on experienced as well as new growers providing information and hands-on practice on planting, varieties, production techniques and issues, equipment, management, and planning. This project built on the accomplishments in 2012 which had an increase in grape production acres and tons harvested. In 2013 we raised the level of education and information to grape growers in Texas leading to more success in growing grapes. Expertise from Dr Erika Winter, Viticultural Knowledge Management from Australia, was provided in a workshop on how to increase the flavors derived from the grapes grown in Texas.

Tracks and topics included:

Growing/Viticulture

- Achieving Crop Balance for Yield and Quality
- Business Planning and the Economics of Grape Growing
- Determining Berry Flavor and Mouthfeel Development
- Harvesting the Sun's Energy – Solar Energy
- Vineyard Canopy Management: Maximizing Timing, Efficiency, & Profitability
- Current and Future Strategies for Managing Disease

Marketing

- Social Media
- Email Marketing for Small Business Owners
- Marketing Strategies and the Customer Experience
- Creating a Website to Draw Consumers and Convert Sales
- Mobile Marketing

Compliance:

- Presentations from representatives with the Texas State Comptroller, Texas Alcohol and Beverage Commission, and TTB
- Update of the 2013 Legislative Session
- Contracting for Grape Sales
- Death and Taxes

In each of the workshops, industry experts and viticulture/enology educators were presenters providing much needed knowledge to move the Texas grape crop forward and grow the economic impact to the State of Texas.

Project Approach

The Association's Education Committee is comprised of winery owners/winemakers, grape growers, industry advisors, and educators. This committee's role is to build a meeting program that covers all facets of the industry and interest of the attendees. The Committee begins their selection tasks approximately nine months in advance. They had suggested topics from the previous conference survey and used those suggestions to match speakers. The Committee was successful in confirming speakers with low associated travel and expense costs.

Securing of speakers and topics far enough in advance was vital to promote registration, which must be available no less than 90 days before the workshop. The Education Committee constructed a program agenda with keynote presentations for large groups and small, interactive sessions for small groups and the small sessions may be repeated once. Staff has also learned the vital and current information conference exhibitors can provide in a small group setting. Staff added a small demonstration stage area in the Conference Exhibit Hall for vendors who provided short, timely educational sessions.

The Association staff working with the Education Committee developed and conducted a short five-question survey that served as a pre-test for the Annual Conference programming. Areas of concentration were identified and helped serve as the core to build the programming around. Staff learned that Grape Camp is a perfect venue to conduct the informal pre-test. It is a small educational event occurring 3.5 months before the Annual Conference and provides the sufficient time to finalize the Annual Conference programming. Post-tests were conducted in April at Newsom Grape Day, another small educational venue.

Meet with speakers to develop customized presentations and develop/print handouts: Staff created a speaker handbook outlining requirements for PowerPoint presentations, A/V needs, handout specifications and due dates. Each speaker was provided with a PowerPoint template for uniformity and ease of viewing. From past experience workshop attendees prefer written materials in hand during the workshop presentation. PowerPoint files were received beforehand so handouts could be given to attendees at registration. Thirty days after the conclusion of the workshop, speaker presentations and handouts are posted on the Association website. Workshop attendees and website visitors can download these files.

For this project staff was able to video tape some presentations. Being able to view the video later would be a great way of building an educational library for grape growers in Texas. What staff did not consider was the video format and expertise needed to post the videos on the website using the Association's current website host. This task took much longer than anticipated and while in the end the videos are on the website and can be viewed, we are not completely pleased with the "look" of the web page. We will continue to explore other ways to post the videos, perhaps using YouTube as the video library source.

Host workshops: For the more than 12 year TWGGA has held the annual conference in February. They have found that following the Midwest Grape and Wine Conference (which is held the weekend before our conference) is most convenient for exhibitors, speakers and attendees. The workshops were a success with 475 attendees. Coming off a year that was plagued with weather issues including hail and drought, attendees were seeking information and answers to help them with the means to go back home, plant, and become more prepared for obstacles that they might face.

Survey workshop attendees: The survey was released, through an email marketing service on February 26, 2013 and closed on April 2, 2013. There were 92 responses.

Goals and Outcomes Achieved

The primary goal was to develop a grape growing workshop to increase the knowledge of grape growers on the production of grape varieties as well as how to overcome major production issues. The association created multiple workshops conducted within a three-day period and created a learning library with printed materials and videos. The attendance was 475 attendees. Post-test questions asked at Newsom Grape Day indicated an average 15 percent increase in knowledge. The outcomes of the workshops will be measured over the long term as to the number of new vineyards established and new varieties planted. In 2006, there were approximately 3,200 acres of vineyards in Texas. Today, that number has grown to close to 4,500 acres.

Twelve new vineyards have joined the Association since January 1, 2013 with 20 more new growers experimenting with growing grapes on a non-commercial scale. The workshops created a source for interested parties to seek more information online through the videos as well as reach out to the experts getting answers to their questions. It is predicted that Texas will need between 18,000 and 20,000 acres to keep up with the demand. The continued partnership with the Texas Department of Agriculture, Texas A&M AgriLife Extension Services, and Texas Tech University will provide the needed assistance to move toward this lofty goal. It will take time, work, and money to grow the industry to where it must be.

Beneficiaries

Clearly the primary beneficiaries of this project are the Texas wine makers and grape growers. The more knowledgeable the grape growers, the more grapes are grown. The more grapes are grown, the more wine produced. There were 259 bonded Texas wineries at the beginning of this project and now there are 290 bonded wineries. The secondary beneficiaries are the consumers and the State of Texas. More growth, sales, taxes, and increased tourism will have a more favorable impact to the economy of the State of Texas. In 2007, the Texas Wine Industry's economic impact to the State of Texas was \$1.35B. That number grew to \$1.7B at the end of 2009 and \$1.8B at the end of 2011

Lessons Learned

The event staff held a post-meeting to discuss the logistics and determine where improvements could be made.

The Learning Library located on the TWGGA website must be the first source of information in between conferences and events. When inquiries are being made about how to do something, we should direct them to the TWGGA Learning Library. Therefore, staff will spend time reviewing software, additional websites, and those with online video expertise to improve and grow the library.

Staff found the repeating track of workshops was not the best scheduling. We will offer workshops that are time scheduled and may not repeat. This will pull in more attendees and make better use of their time.

There will be 13 hours of devoted time in the Exhibit Hall with vendor demonstrations and presentations on the Main Stage. The vendors will focus on new products/enhancements for growing grapes.

PROJECT 24: TEXAS PRODUCE CAMPAIGN – PROMOTING TEXAS’ SPECIALTY CROPS

Partner Organization: The Texas Department of Agriculture (TDA) completed the projects described within this final report and collaborated with specialty crop industry associations, including, but not limited to: Texas Watermelon Association, Texas Pecan Growers Association, Texas Produce Association, Texas Vegetable Association, TexaSWEET Citrus Association, Texas Organic Farmers and Gardeners Association, Texas Certified Farmers Market Association, Texas Olive Oil Council and the Texas Restaurant Association.

Project Manager: Lindsay Baerwald, Richard De Los Santos

Contact Information: (512) 463-7476; Richard.DeLosSantos@TexasAgriculture.gov

Type of Report: Final

Date Submitted: December 2015

Project Summary

Marketing and promotion continues to be key to the success of the Texas produce industry. Millions of dollars of produce moves through Texas via Mexico and other states. In order to showcase Texas produce to consumers, TDA developed a three tier project plan that included *Advertising, Consumer Education and Industry Outreach*. Advertising was developed to enhance the success of the retail and Market to Menu promotions TDA conducted vegetable and watermelon online advertisements. Online advertisements were purchased in the Dallas, Lubbock, Tyler, Houston, Waco, Austin, San Antonio, Corpus Christi and the Rio Grande Valley markets. These ads directed consumers to visit the GO TEXAN website for delicious recipes using Texas fruits and vegetables. TDA purchased billboard advertisements in select cities to direct consumers to purchase Texas vegetables at their favorite retail grocery store. The GO TEXAN Restaurant Round-Up media buys were designed to reach consumers directing them to visit local restaurants and enjoy Texas produce. The chefs at the participating restaurants were able to showcase their Texas grown fruits and vegetables on their menus. TDA promoted Texas fruits and vegetables during the week long restaurant promotion.

Consumer Education included five direct-to-consumer marketing projects and one industry retail promotional project. These projects included marketing on several fronts to cover a wide spectrum of consumers. The ten Market to Menu events reached consumers that buy produce at their local farmers market. The Market to Menu events were very beneficial for small Texas fruit and vegetable producers. They also helped educate consumers on how to prepare fresh fruits and vegetables in their home regardless if they were purchased at the farmers market or their favorite grocery store. TDA also conducted five chef farm tours which were designed to educate producers on what chefs are looking for in terms of types of produce, seasonal needs, packaging and delivery. The tours also helped educate chefs on what Texas fruit and vegetable growers produce and when they are available. The chef farm tours were done in advance of the GO TEXAN Restaurant Round-Up weeklong events to ensure consumers had access to a variety of seasonal Texas produce. In addition, TDA developed the retail grant opportunity in which retailers could apply for funds to conduct retail promotions related to Texas specialty crops. Retailers that actively purchase Texas specialty crops including, but not limited to, produce, olive oil, honey, tree nuts, floriculture and/or horticulture products and are marketing directly to consumers may apply for funds to promote these products using in-store demonstrations, advertisements or store flyers. TDA also made grants available to industry through the Industry

Retail grant program. Applicants that sell directly to retailers applied for funds to be used for in-store Texas produce and/or tree nut demonstrations. These promotions helped producers directly showcase their produce to consumers at the retail level and allowed consumers to “meet the farmer”.

Success of the projects depended completely on *Industry Outreach* and on both retail and producer participation. TDA participated in various conferences to showcase the opportunities available to both the retail participants and Texas producers.

Project Approach

Advertising to promote fresh Texas fruits, vegetables and tree nuts and enhance the success of the retail and Market to Menu promotions was an important part of the Specialty Crop Project. TDA conducted vegetable and watermelon online advertisements in the Dallas, Lubbock, Tyler, Houston, Waco, Austin, San Antonio, Corpus Christi and the Rio Grande Valley markets. These ads directed consumers to visit the GO TEXAN website for delicious recipes using Texas fruits and vegetables. The GO TEXAN Restaurant Round-Up media buys helped direct consumers to local restaurants where chefs showcased their Texas grown fruits and vegetables. TDA purchased online ad space to run produce advertisements between March 1, 2013 and October 1, 2013. TDA purchased 7.2 million impressions from 9 different media outlets.

Consumer education represented the major portion of the Specialty Crop Block Grant project. These projects included marketing on several fronts to cover a wide spectrum of consumers. Ten Market to Menu events reached consumers that buy produce at their local farmers market. The Market to Menu events were very beneficial for small Texas fruit and vegetable producers. They also helped educate consumers on how to prepare their fresh fruits and vegetables at home. TDA also conducted five chef farm tours. These tours were designed to educate producers on what chefs are looking for in terms of types of produce, seasonal needs, packaging and delivery. The tours also helped educate chefs on what Texas fruit and vegetable producers offer and when they are available. The end goal was to offer the restaurant consumers seasonal Texas produce.

TDA created the *Retail Grant Program* in which retailers could apply for funds to conduct retail promotions related to Texas specialty crops. Proposals were submitted to the Department and three of them were funded. In order to qualify for the grants, retailers were required to actively purchase Texas specialty crops including, but not limited to, produce, olive oil, honey, tree nuts, floriculture and/or horticulture products and are marketing directly to consumers may apply for funds to promote these products via in-store demonstrations and/or advertisements or store flyers.

TDA also made grants available to industry through the Industry Retail grant program. Applicants that sell directly to retailers applied for funds to be used for in-store Texas produce and/or tree nut demonstrations. These promotions helped producers directly showcase their produce to consumers at the retail level and allowed consumers to “meet the farmer”.

In order to ensure that funds are only used on the promotion of allowable specialty crop items TDA implemented a strict application process for the Market to Menu, Chef Farm Tours and the Produce Industry Retail Promotions. In addition, since the project had to be completed before any funds are distributed, TDA required a complete report on how the projects were conducted, products promoted and results of the promotions. In addition, TDA required that photos are

submitted with all reports. When possible, TDA staff attended events in order to verify that the project was completed in accordance with the USDA established parameters.

Industry Outreach

Success of the projects depended on Industry Outreach and on both retail and producer participation. TDA participated in various conferences to showcase the opportunities available to both the retail participants and Texas producers. TDA participated in the Produce Marketing Association (PMA) to showcase retail opportunities to promote Texas fruits and vegetables to consumers both in Texas and across the United States. TDA also worked closely with the Texas International Produce Association and their convention to inform retailers of the opportunities.

Goals and Outcomes Achieved

The goal of this project was to increase sales of Texas produce at the retail level by developing a 3-part program that included:

1. Advertisements
2. Consumer education
3. Industry Outreach

Advertisements

Outcomes

TDA created retail point-of-purchase (POP) materials to identify produce as grown in Texas. TDA created 50,000 hang tags, 50,000 retail signs, and 100,000 channel strips. The retail signage was distributed to more than 100 retail grocery stores that participated in the Retail Grant program as well as those that did not. The billboard impressions totaled 1,412,820 while the online advertisement impressions totaled 7,245,664. The online ads ran May 15, 2013 through Oct. 1, 2013, and the target audience was men and women ages 25-55. As a result of the ads, there was a 180 percent increase in visits to the GO TEXAN webpage showcasing recipes with Texas produce. TDA also developed 25,000 recipe books to distribute to consumers and chefs at the retail demonstrations and the Market to Menu events. In addition to the recipe books for the Market to Menu events, TDA also created 40 chalkboards and banners to help the farmers markets showcase their produce and their events. The GO TEXAN Restaurant Round-Up media buys helped direct consumers to local restaurants where chefs showcased their Texas grown fruits and vegetables. Initial reports indicated that TDA would have had 600 participants but the final count showed 458 restaurants participating in the GO TEXAN Restaurant Round-Up events. Unfortunately this was a decrease from previous events. TDA surveyed participating restaurants and results indicated that participating restaurants increased sales of Texas fruits and vegetables by 9 percent. Surveys also indicated that on average 30 different Texas fruits and vegetables were showcased in these events.

Consumer education

Four retail grocery stores received funding to conduct Texas produce promotions. These stores included Whole Foods, In-gredients, Koch Ranches and Wheatsville Co-op. In addition, two producer grants were awarded grants to the Salud Corporation and Home Sweet Farms to conduct retail promotions using multiple growers' products. In total, these companies conducted more than 800 retail demonstrations in their stores over the course of the grant period. Retailers reported that the produce demonstrations resulted in 11,802 pounds of Texas produce sold during the promotional period. In addition, it was reported that 2,316 pounds of grapefruit was sold over 12 days. This resulted in an average increase in sales of 46.5 percent from the previous year.

Consumer education included direct marketing to consumers with the Market to Menu promotions. This resulted in \$31,645 in sales of Texas produce at participating farmers markets which is up from \$20,805 from the prior years of not conducting Market to Menu events. This is a 35 percent increase in sales.

Industry Outreach

TDA participated in various conferences to showcase the opportunities available to both the retail participants and Texas producers. TDA participated in the Produce Marketing Association (PMA) to showcase retail opportunities to promote Texas fruits and vegetables to consumers both in Texas and across the United States. TDA also worked closely with the Texas International Produce Association and their convention, Viva Fresh, to inform retailers of the opportunities.

TDA chose to participate in PMA due to the connections that reach across the supply chain and around the world, attracting buyers and decision makers. Participating in the PMA also helps anticipate change, identify emerging trends and educate Texas producers. PMA reported that 7,798 industry representatives attended PMA. TDA distributed 250 packets to retailers with information on grant programs available. TDA also distributed 300 packets listing Texas produce availability and sources for produce to buyers from across the United States and some international markets as well.

TDA also participated in the Viva Fresh Expo which is a local Texas expo with world-wide outreach. The Viva Fresh Expo reported that 950 industry personnel attended the expo and the breakdown was as follows: 34 percent retail and foodservice buyers, 52 percent were growers and shippers, 5 percent were brokers and 4 percent were wholesale suppliers. The Viva Fresh Expo provided TDA the opportunity to continue to inform retailers about the TDA specialty crop grant opportunities available as well as distribute 200 packets listing Texas produce availability and sources for produce to buyers from across the United States and some international markets as well.

Beneficiaries

- 4315 consumers sampled and learned about Texas produce at the farmers markets
- 100 retail grocery stores received point-of-purchase material or participated in the retail grants
- 200 producers/growers benefitted from the consumer education events

Lessons Learned

Retailers develop their marketing plans at least a year in advance and can change direction much faster than state governments can process the change. Some retailers are so big that they do not need the financial incentive to create promotional events and materials. For example, we did have one retailer that was awarded funds and conducted the promotional events but failed to provide the documentation necessary for reimbursement. The retail grants seemed to benefit the smaller retailers better, maybe because they had more to gain and are on tighter budgets than the larger chains. Even though project staff had good exposure and good online results, future

projects will need to have better restaurant partner participation. Restaurant partner recruitment materials and methods will need to be developed and improved to have better participation.

Additional Information

Advertisements





Photos of Retail Promotions



Retail Grant advertisements and Billboards





GO TEXAN Specialty Crop Recipe Book – Samples of book and recipes below.




Serves 12

INGREDIENTS
12 fresh Texas jalapeño peppers
6 oz. cream cheese, softened to room temperature
1 1/2 cups shredded pepper jack cheese
1 tsp. ground cumin
1 tsp. garlic powder
6 slices bacon, cooked crisp and crumbled
1 cup panko crumbs, or cracker crumbs
2 tbsp. melted butter

Baked Jalapeño Poppers

APPETIZER



Makes 2 Cups

INGREDIENTS
1 Texas Red grapefruit, peeled, sectioned and chopped
1 large Texas orange, peeled, sectioned and chopped
1 medium tomato
1 cup diced green, red and yellow bell peppers (use a mixture of all three peppers for best color contrast)
1 Texas jalapeño pepper, seeded and minced
3 tbsp. red onion, chopped
1 tbsp. fresh cilantro, chopped
1 1/2 tsp. sugar
1/2 tsp. salt

Texas Citrus Salsa

APPETIZER



Serves 4

INGREDIENTS
4 ears of fresh Texas corn, shucked
1 Texas jalapeño pepper, seeded if desired, minced
1/2 red bell pepper, diced
2 tbsp. Texas olive oil
2 tsp. butter, unsalted (optional)
Sea salt and coarse ground black pepper, to taste

Optional additions:
Lime wedges
Chili powder
Queso fresco
Parmesan cheese

Quick-Roasted Corn with Jalapeño and Sweet Peppers

SIDE DISH



Serves 4

INGREDIENTS
2 Rio Star grapefruits, peeled, sectioned and chopped
2 Texas oranges, peeled, sectioned and chopped
1 cup fresh pineapple chunks
1/2 cup packed brown sugar
2 tbsp. butter, softened

Warm Texas Citrus with Brown Sugar

DESSERT



Makes 12 Bars

INGREDIENTS
For the Crust
1 1/2 cup flour
1/4 cup cornstarch
1/2 cup brown sugar
3/4 cup butter, softened

For the Filling
3/4 cup light corn syrup
1 cup sugar
3 eggs, lightly beaten
1 1/2 tsp. vanilla
4 tbsp. butter, melted
2 cups Texas pecans, chopped
1 cup semi-sweet chocolate chips

Chocolate Chip Pecan Pie Bars

DESSERT

Market to Menu Events

Chalkboards banners and cooking demos



El Centro de Laredo

**Saturday,
June 15th
9AM - 12PM**

**Jarvis Plaza
Historic Downtown
Laredo**

Farmers Market



GO TEXAN

Locally grown produce, natural products and healthy cuisine!
FREE El Metro parking with market purchase.



LAREDO MAIN STREET



PH | 956-823-8817
laredofarmersmkt@att.net
www.laredomainstreet.org









PROJECT 25: GROWING THE TEXAS HORTICULTURE INDUSTRY– PROMOTING TEXAS’ SPECIALTY CROPS

Partner Organization: Texas Department of Agriculture (TDA) (*primary*)

1. Texas State Florists’ Association (TSFA)
2. Texas Nursery and Landscape Association (TNLA)
3. Turfgrass Producers of Texas (TPT)
4. Texas A&M AgriLife Extension

Project Manager: Richard De Los Santos

Contact Information: (512) 463-7476; Richard.DeLosSantos@TexasAgriculture.gov

Type of Report: Final

Date Submitted: December 2015

Project Summary

The purpose of this project was to strengthen the specialty crop industry in Texas by expanding horticulture visibility and consumer education and ultimately increase sales for this industry. As the largest segment of the specialty crop industry in Texas, horticulture crops such as landscape and floral plants significantly contribute to the state’s economy. The trends that are showcased via online ads and television commercials highlight the importance of buying local food products. There is very little mention if any of the importance of buying locally grown or Texas grown plants and flowers. Consumer education is very important to the success of any product on the market. The Texas Department of Agriculture (TDA) understands this need and collaborated with partner organizations to create and implement a marketing program targeted at Texas consumers to support horticulture industry producers as they build their customer base. The project’s goal was to increase overall sales of Texas horticultural products by incorporating specific product promotions, consumer-educational programs, in-store events and advertising campaigns. Specialty Crop Block Grant (SCBG) funding supported TDA’s efforts to assist industry members’ ability to market horticulture products, educate consumers and strengthen Texas agriculture and its economy.

Project Approach

In order to complete this project, TDA began by utilizing the growing popularity and efficiency of online advertising to promote Texas horticulture. TDA purchased online advertisements on Facebook to promote Texas-grown plants and Texas Superstars to encourage consumers to use Texas grown plants for Spring and Fall planting. The ads ran from March 1 – April 31, 2013, and from September 19 - October 10, 2013. TDA also purchased Texas Local Florist Valentine's Day ads and Mother’s Day ads which ran February 1 – February 14, 2013, and from May 1 – May 10, 2013.

TDA participated in the 2014 TNLA EXPO, 2014 TSFA Convention, 2014 Texas Christmas Tree Growers Association and 2014 Texas Forestry Association Conference. At all events, booth space and sponsorship placement were purchased to educate producers about Texas-grown marketing initiatives. In addition, TDA sponsored the Blanco Lavender Festival that highlights the importance of lavender in your landscape, culinary preparations and lifestyle. TDA also hosted Miss Texas in the Food and Fiber Pavilion at the State Fair of Texas where she helped TNLA with a Best Landscaping Practices seminar.

Goals and Outcomes Achieved

The project's goal was to increase Texas horticulture sales by increasing product visibility and awareness through producer-driven and TDA-executed marketing projects.

The outcomes achieved were as follows:

Online advertisements – Paid Facebook ads promoting Texas-grown plants, Texas Superstars and other horticulture ideal for fall planting ran from September 19-October 10, 2013. The ads generated 14,217 clicks to the GO TEXAN retail nursery page and reached 225,000 unique Facebook users who had an interest in gardening and sustainable landscaping. These figures do not include impressions and interactions gained through the ads' more than 700 shares by the site's users. The online advertisement impressions totaled 7,245,664. The target audience was men and women ages 25-55. As a result of the ads, there was a 180 percent increase in visits to the specific GO TEXAN webpage showcasing Texas floral and landscape products.

Conventions – TDA participated in the 2014 TNLA EXPO which had 4,723 registered attendees, 2014 TSFA Convention which had 900 registered attendees, 2014 Texas Christmas Tree Growers Association which had 75 registered attendees and 2014 Texas Forestry Association Conference which had 250 registered attendees. At all events, booth space and sponsorship placement were purchased to educate producers about opportunities for Texas-grown horticultural products and recruit Texas nurseries, florists and farms.

TDA sponsored the Blanco Lavender Festival that highlights the importance of lavender in your landscape, culinary preparations and lifestyle. About 10,000 visitors attended discussions by the Blanco County Master Gardeners and Texas Lavender Association. TDA also hosted Miss Texas in the Food and Fiber Pavilion at the 2014 State Fair of Texas where she helped TNLA with a Best Landscaping Practices seminar. During the seminars, more than 100,000 visitors passed through and learned about best practices for the landscape over a two-day period.

TDA worked with TNLA and TSFA to survey producers and retailers to determine the success of the project. TSFA reported a 94 percent increase in website traffic as a result of the ads. However, their surveys did not show any increase in sales as a result of the project. TNLA surveys indicated a 1 percent increase in website traffic but surveys did not indicate any increase in sales as a result of the promotions.

Beneficiaries

The TDA and TNLA partnership resulted in 4,794 nursery professionals learning about the retail opportunities available to them. In addition, TNLA reported Facebook impressions during the Expo to be 374 monthly active users with an additional 1,153 weekly reach to the TNLA page as well as 1,249 wall posts/comments which resulted in 5,616 post views (# of times people viewed wall posts).

About 10,000 visitors attended discussions by the Blanco County Master Gardeners and Texas Lavender Association. TDA noted that 100,000 consumers learned about the landscape best practices at the State Fair.

Lessons Learned

Horticulture retail promotions are much more difficult to organize than the produce related retail demonstrations. Retail nurseries and producers are much more involved in the care and production of the plants and have a difficult time scheduling promotions and coordinating advertising. Even though project staff had good online results, future projects will have to be simplified to give retail partners easier methods to monitor and report sales.

Additional Information

A Texas Florist can help you say "I love you, Mom."

Click here to visit TexasLocalFlorist.com

COMMISSIONER TODD STAPLES
TEXAS DEPARTMENT OF AGRICULTURE

GO TEXAN.

Mother's Day and Texas Flowers go Hand in Hand

Click here to visit TexasLocalFlorist.com

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Texas Superstar® Plants

Strong Plants for Texans.

Click here to find a retailer for spring planting.

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Texas Superstar® Plants

Stunning Plants for Texans.

Click here to find a retailer for spring planting.

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GO TEXAN.

Texas Superstar® is a registered trademark of Texas AgriLife Research, Texas A&M University System.

Texas Superstar® Plants

Strong Plants for Texans.

Click here to find a retailer for spring planting.

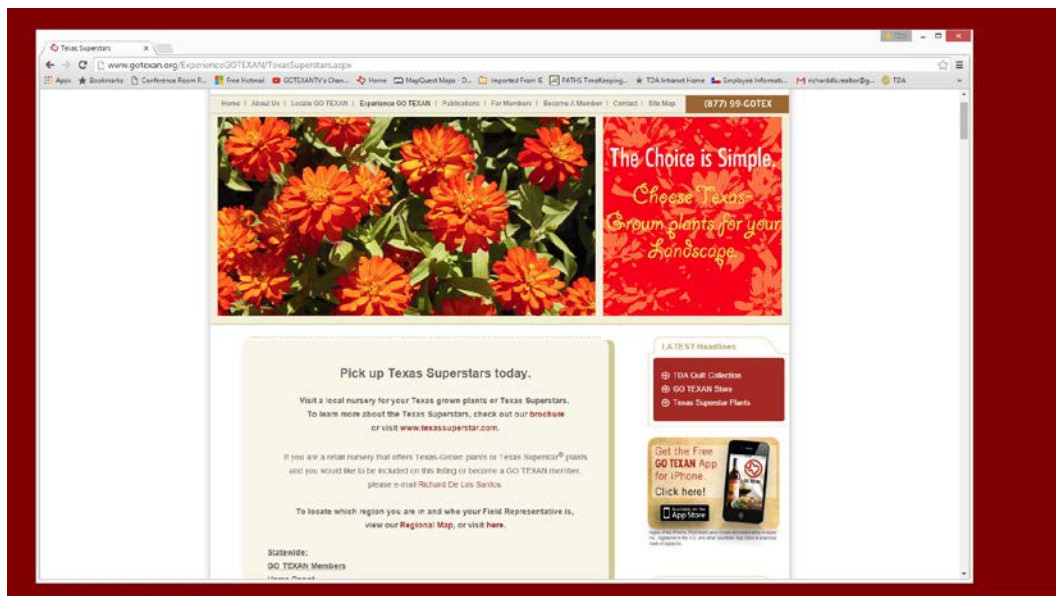
COMMISSIONER TODD STAPLES
TEXAS DEPARTMENT OF AGRICULTURE

GO TEXAN.

Texas Superstar® is a registered trademark of Texas AgriLife Research, Texas A&M University System.



GO TEXAN webpage. Link from banner ads



<http://www.gotexan.org/ExperienceGOTEXAN/TexasSuperstars.aspx>

Facebook ads

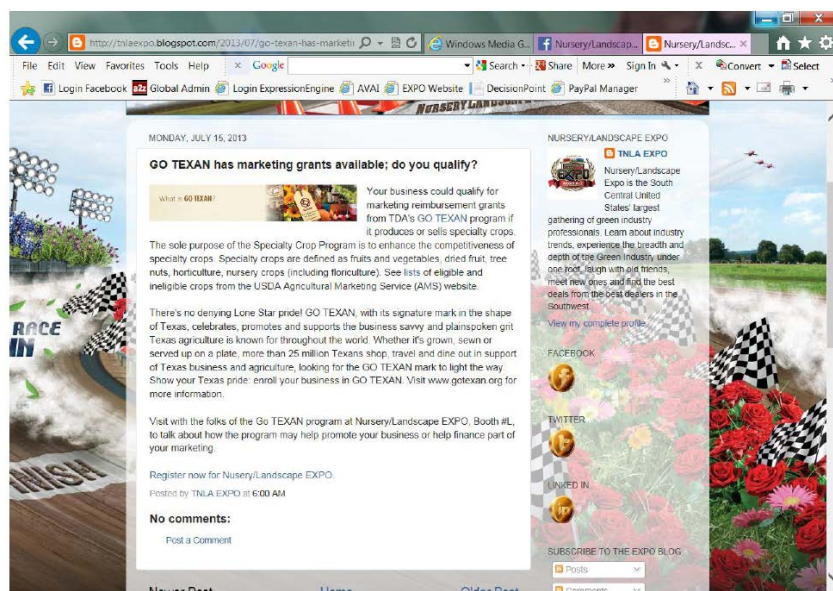


Texas Nursery And Landscape Association (TNLA) banner



TNLA advertisement promoting retail grant opportunities

EXPO BlogSpot (7-15-13):



State Fair of Texas 2014 Daily Event Schedule

Welcome to the Food and Fiber Pavilion Proudly Presented by Southwest Dairy Farmers	
FOOD AND FIBER PAVILION	
Tuesday October 8, 2013	
GO TEXAN Gazebo Stage	
12 p.m. – 2 p.m.	Miss Texas - TNLA's Best Landscape Practices
4 p.m. – 6 p.m.	City of Dallas Recycling: Waste Diversion
GO TEXAN Sampling Kiosks	
10 a.m. – 12 p.m.	GO TEXAN Product Sampling
2 p.m. – 4 p.m.	GO TEXAN Product Sampling
Daily	
10 a.m. – 6 p.m.	Enjoy FREE Ice Cream at the Southwest Dairy Exhibit
10 a.m. – 6 p.m.	Meet Elsie the Cow and Beauregard in the Borden Exhibit

Welcome to the Food and Fiber Pavilion Proudly Presented by Southwest Dairy Farmers	
FOOD AND FIBER PAVILION	
Wednesday October 15, 2013	
GO TEXAN Gazebo Stage	
12 p.m. – 2 p.m.	Miss Texas - TNLA's Best Landscape Practices
4 p.m. – 6 p.m.	City of Dallas Recycling: Waste Diversion
GO TEXAN Sampling Kiosks	
10 a.m. – 12 p.m.	GO TEXAN Product Sampling
2 p.m. – 4 p.m.	GO TEXAN Product Sampling
Daily	
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