ARKANSAS AGRICULTURE DEPARTMENT

SCBGP-FB FINAL REPORT

Agreement Number 12-25-B-1447

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Project 1:

Muscadine Grape Variety Development for Arkansas Growers

PROJECT SUMMARY

• Provide a background for the initial purpose of the project, which includes the specific issue, problem, or need that was addressed by this project.

The muscadine grape, *Vitis rotundifolia*, is a southern native grape found from Arkansas eastward and throughout the deep south. The first varieties of muscadine, including the famous ‘Scuppernong’ were wild vines which were propagated for commercial production. In the early 1900s, formal muscadine breeding was undertaken by the USDA in conjunction with North Carolina State University and by the University of Georgia. Other programs have also been active at times including those at the University of Florida and Florida A & M University along with the private program operated by Ison’s Nursery in Georgia. The larger programs were most active from the 1940s to late 1980s. A number of improved varieties have developed from these efforts and these have served as the basis of the commercial production for fresh, juice, wine, and other uses. Only limited breeding has been done since the 1980s, however, and further improvements can be achieved to further expand muscadines as a fresh fruit choice.

Muscadine grapes are adapted to all but the extreme northwest corner of Arkansas, and are limited there by low winter temperatures. Although once commonly harvested from wild vines, improved varieties grown by farmers provide most of the fruit consumed currently. Muscadines offer a range of positive attributes. Foremost is that this is a native species, and has good to very high resistance to most diseases and insects that attack bunch grapes. This can allow more sustainable production than their more common grape cousins, which require 10-15 pesticide applications each growing season. Arkansans and southerners as a whole enjoy the very fruity flavor of muscadines, with a flavor profile much greater than most bunch grapes. The newer varieties (from the 1980s primarily) also have improved characters such as edible skins and a more desirable texture (crisper). Muscadines are a good source of antioxidants, another potential marketing attribute. A very limited number of varieties have been evaluated for some antioxidants such as resveratrol, ellagic acid and total phenolic compounds in North Carolina. Further research in Mississippi also indicated differences in muscadines sprayed with fungicides or not. The results indicate that vines not sprayed with fungicides produced fruit with higher levels of resveratrol. Finally, postharvest storage of important fresh market varieties and new selections would be valuable to determine the best varieties for storage and shipping for more distant markets or for holding fruit over a longer period for local markets. The investigation of the variables could result in expanded production which could be marketed at the ever-increasing number of farmers markets, with on-farm sales, and potentially in retail grocery store outlets.

The University of Arkansas Division of Agriculture began its muscadine breeding program in 2005, one of several crops involved with the substantial fruit breeding program. This program has developed numerous selections thus far, with thousands more seedlings under evaluation for further selection. New varieties will be forthcoming from this effort for Arkansas growers in the future.
The project purpose/objective is to evaluate existing varieties and new selection developments for postharvest storage potential along with determination of antioxidant levels. This knowledge will expand information for growers in variety selection for a range of markets, and provide information on the very desirable antioxidant levels of fresh-market genotypes. Supporting funding from the Arkansas Agriculture Department along with Division resources will provide a very viable partnership with a high level of potential success.

This report provides the work done for the project year 2012 when the studies outlined were fully done and completed as described in the original proposal.

• Establish the motivation for this project by presenting the importance and timeliness of the project.

The University of Arkansas Division of Agriculture began its fruit breeding program in 1964. This effort has been one of the most productive fruit breeding efforts in the United States in recent years. More than 60 varieties of fruits have been commercialized from the program, including blackberries, table grapes, peaches, nectarines, strawberries, and blueberries. These variety options have expanded fruit potential for Arkansas growers allowing enhanced profitability. The newest variety development effort was begun in 2005 focusing on fresh-market muscadines. Reasons to begin this endeavor included a potential for muscadine production in the State, Division personnel with training and experience to successfully carry out research activities, and a potential to make some substantial genetic improvements in muscadine postharvest quality. For muscadine production to increase for the fresh market, enhanced postharvest handling information on released varieties is needed, along with the measurements of potential new varieties among the developed selections from the breeding program. Information on what are the most important postharvest characteristics in storage is needed to fully proceed with developing a system for postharvest evaluation. It is timely because now there are several new varieties developed in recent years that need evaluation along with the new selections just developed by the University of Arkansas.

• If the project built on a previously funded project with the SCBGP or SCBGP-FB describe how this project complimented and enhanced previously completed work.

This is the first year of funding for this project.

PROJECT APPROACH
• Briefly summarize activities performed, targets, and/or performance goals achieved during the reporting period. Whenever possible, describe the work accomplished in both quantitative and qualitative terms. Include the significant results, accomplishments, conclusions and recommendations. Include favorable or unusual developments.

The complete and detailed materials and methods are provided at the end of this document.

Muscadine Vines Not Sprayed With Fungicides
Physiochemical and storability attributes were measured in 17 muscadine genotypes (selections and varieties) from the muscadine breeding program at the University of Arkansas or commercial varieties. The fruit of the vines in this portion of the study were not sprayed with any fungicides during the growing season. The postharvest and physiochemical attributes of the muscadines were measured at
harvest and during storage for 3 weeks at 2 °C. Nutraceutical compounds were measured initially after harvest.

The work was completed as proposed. The growing season was unusually hot and dry, with little disease pressure on the vines and fruit. However, the vines did experience some heat stress that likely impacted postharvest and nutraceutical values. However, we feel the data and conclusions are sound for the year’s work. Overall results included that genotypes significantly affected storage attributes (weight loss (%), and unmarketable berries (%)) and physiochemical attributes such as penetration force (force to penetrate berry skin), titratable acidity (TA), pH, soluble solids (%), berry color (L*, Chroma, and hue), as well as the nutraceutical compounds. The postharvest attributes of weight loss and unmarketable berries and the physiochemical attribute of penetration force were significantly affected by postharvest storage, but berry composition attributes remained fairly constant during storage.

In more detail the results included that after 3 weeks of storage, the genotypes with the least percent weight loss in 2012 were AM 27, AM 03, ‘Delicious’, and ‘Tara’ (4.3, 4.5, 4.7, and 4.7%, respectively). The genotypes with the greatest percent weight loss after 3 weeks of storage in 2012 were ‘Nesbitt’, AM 04, and AM 18 (6.5, 6.2, 5.9%, respectively). Fig. 1 shows examples of weight loss of berries. In 2013, the genotypes with the least percent unmarketable berries after 3 weeks of storage were AM 26, AM 28, AM 04, and AM 03, (8.9, 11.8, 12.6, 18.5%, respectively), while in 2012 AM 03, ‘Summit’, ‘Southern Jewel’, and ‘Supreme’ had the least percent unmarketable berries (15.3, 20.7, 23.2, and 24.1%, respectively) (Fig. 2). The genotypes in 2012 with the highest percent unmarketable berries were ‘Fry’, AM 04, and AM 26 (65.8, 64.8, and 60.7%, respectively). Unmarketability of muscadines was primarily due to browning (especially in bronze genotypes), leakage from torn or wet stem scars, and shriveling. Fungal growth was seen at times also (see Fig. 2).

Force to penetrate muscadine skin has been shown to be a useful characteristic to assess berry firmness and texture as well as berry quality. Fig. 3 shows the measurement of berry skin firmness. Penetration force ranged from 10.4 N (AM 28 at week 0) to 1.8 N (Tara at week 2). Overall, berry penetration force decreased during storage, but was occasionally lowest after 2 weeks of storage. It was found that the genotypes requiring the most force to penetrate the skin at date of harvest also required the most force to penetrate the skin after 3 weeks of storage), indicating force is a good indicator of storage performance.

Titratable acidity, pH, and soluble solids remained relatively constant during storage, which was consistent with the results of other studies.

The effect of storage on the exterior berry color attributes (L* value, Chroma, and hue angle) of muscadine grapes is widely unstudied. We found L* values were generally greater for the bronze genotypes compared to the black genotypes. L* values ranged from 45.2 (AM 03) to 26.3 (AM 02) in 2012. There was a negative correlation between hue angle and L* value (r=-0.80), showing that as L* increased (berries became lighter), hue angle decreased. In 2012, hue angles ranged from 359.4° (‘Supreme’) to 54.0° (‘Summit’). Fig. 4 shows the measurement of color method utilized.
The black genotype AM 27 had the highest anthocyanins (122.0 mg/100 g), but as expected no anthocyanins were detected in the bronze genotypes. In 2012, total ellagitannins ranged from 1.6 (‘Supreme’) to 12.4 mg/100 g (‘Ison’). Oxygen radical absorbance capacity (ORAC) is widely accepted as being a good estimation of antioxidant capacity of fruits. We found ORAC values that ranged from 47.7 (‘Tara’) to 110.6 (‘Ison’) μmol TE/g in 2012. Total flavonols ranged from 7.3 (‘Supreme’) to 70.6 mg/100 g (AM 03) in 2012. The bronze genotypes were generally higher in total flavonols than the darker genotypes, which may be attributed to the presence of the flavonol myricetin in the bronze genotypes. In 2012, total phenolics ranged from 354.5 (AM 28) to 797.3 mg/100 g (‘Ison’). Resveratrol ranged from 3.8 (AM 02) to 16.7 mg/100 g (AM 27) in 2012; no clear relationship between berry color and resveratrol concentrations were found. Overall, AM 03, AM 04, AM 27, and ‘Ison’ had the highest nutraceutical content (total anthocyanins, total ellagitannins, total phenolics, total flavonols, resveratrol, and ORAC), while AM 18, AM 28, ‘Supreme’, and ‘Tara’ had the lowest content.

**Muscadine Vines Sprayed With Fungicides**
The effect of field applications of fungicides on physicochemical attributes during postharvest storage and nutraceutical content at date of harvest was evaluated on five muscadine varieties (Nesbitt, Southern Jewel, Summit, Supreme, and Tara) and four breeding selections from the University of Arkansas Fruit Breeding Program in 2012. Due to less decay, less weight loss, and greater firmness during storage, AM 27, ‘Southern Jewel’, and ‘Supreme’ had the highest potential for postharvest storage, while AM 01, AM 15, and ‘Tara’ had the least potential. Total ellagitannins varied among the fungicide treatments. Total flavonols were generally greater in the no fungicide treatments, while ORAC was generally greater with fungicide treatments. Although field fungicide applications did not affect all postharvest attributes and nutraceutical components, differences among genotypes and fungicide treatments did occur. A key factor in these results was the high temperatures in 2012 that could have reduced fungal activity on the fruits.

**Major Accomplishments and Conclusions**
From this work, there are a few accomplishments and comments to be made from the single-year’s data:
- Varieties and breeding selections vary in almost all measurements, and support the need to study each variety to determine its best potential for postharvest performance. University of Arkansas selections AM 04, AM 26, AM 28, and the variety Southern Jewel had the highest potential for postharvest storage, while the genotypes AM 01, AM 15, and ‘Tara’ had the least potential. Total ellagitannins varied among the fungicide treatments. Total flavonols were generally greater in the no fungicide treatments, while ORAC was generally greater with fungicide treatments. Although field fungicide applications did not affect all postharvest attributes and nutraceutical components, differences among genotypes and fungicide treatments did occur. A key factor in these results was the high temperatures in 2012 that could have reduced fungal activity on the fruits.

- Effects of fungicides overall were less than anticipated overall, due to the high heat and drought of 2012.

- Many new nutraceutical measurements were made, and show interesting results for the many genotypes and compound studied. Muscadines were confirmed as a very good source of antioxidants, and the varieties and selections varied substantially for these measured compounds.

- A major need is a system to evaluate muscadines for postharvest potential. The initial results indicate that overall, both percent unmarketable berries and percent weight loss increased during storage, showing importance as storage parameters. Force to penetrate the berry skin generally
decreased during storage, also showing potential as an important postharvest storage parameter, particularly since some genotypes had significantly less reduction in force during storage. Physiochemical parameters TA, pH, and soluble solids remained relatively constant during storage, therefore are not important postharvest storage measurements to routinely use in evaluating storage potential. The berry color measurements, L*, Chroma and hue angle, generally showed no clear pattern during storage.

- At least one more year of data is needed in this study to provide more confidence in the results and verify trends observed in 2012.
Another significant activity for the year was a grower workshop to share about the studies and muscadine grape postharvest information and production. This workshop was held September 12 and had 73 people in attendance, an excellent turnout. The meeting was held at the University of Arkansas Fruit Research Station, Clarksville. The program follows:

**Muscadine Workshop and Field Day**

**University of Arkansas**
**Fruit Research Station**
**Clarksville, AR**
**Thursday, September 12, 2013**
**2:30-7:30 pm**
**Registration cost is $25.00**

**Agenda**

2:30-3:00 pm  
Registration

3:00-3:15 pm  
Welcome
  Dr. John Clark and Dr. Renee Threlfall, University of Arkansas

3:15-4:00 pm  
Issues in Muscadine Production
  Sara Spayd, Professor, North Carolina State University

4:00-4:45 pm  
Postharvest Issues with Muscadine and Selection and Cultivar Differences
  Penelope Perkins-Veazie, Professor, North Carolina State University

4:45-5:00 pm  
Update on Muscadine Postharvest Research Project
  Derek Barchenger, Graduate Assistant, University of Arkansas

5:00-5:30 pm  
Arkansas Muscadine Breeding Program Progress
  John Clark, University Professor, University of Arkansas

5:30-6:30 pm  
Catered Dinner

6:30-7:30 pm  
Vineyard Tour of the University of Arkansas Muscadine Breeding Program

**Registration**

For registration information contact
Katie Hanshaw
1749 State Highway 818, Clarksville, AR 72830
Phone 479-754-2406, Fax: 479-754-7529, E-mail: khanshaw@uark.edu

The registration fee for this workshop is $25.00.

Registration and payment deadline is **Thursday, August 29, 2013**.
This program brought in two experts on muscadines from NC State Univ. in addition to University of Arkansas speakers. A notebook of the presentations and other muscadine information was provided to participants. Results specifically from this funded research were presented by Mr. Barchenger. The workshop was rated very positively by participants. Registration fees were used to pay for the meal and workshop materials not covered by SCBGP funds.

- Present the significant contributions and role of project partners in the project.
The project leader (John R Clark) led this funded effort in his role as project leader and University Professor in the Division of Agriculture. He outlined the overall studies, directed the MS graduate student, provided guidelines for the management of the vines used, and was involved in data collection and conclusions. He played a major role in planning for the workshop also as well as providing a presentation at the workshop. Dr. Renee Threlfall played a very integral role in managing analytical aspects of the project, and managed the laboratories and the MS student that carried out the laboratory work. She also played a major role in data analysis and results interpretation. She was a key planner along with carrying out many aspects of the workshop. Derek Barchenger was the MS student in the Department of Horticulture that conducted the research work. He was funded by a Department assistantship. He did work at the Fruit Research Station (where the fruit was produced) and in laboratories at the Dept. of Food Science. He completed the first year of his MS thesis work in the project year.

GOALS AND OUTCOMES ACHIEVED
- Include the activities that were completed in order to achieve the performance goals and measurable outcomes for the project. The activities undertaken were fully described above. The field and laboratory work, data analysis, reporting, and overall conclusions of the work were completed as proposed. The measurable outcomes are fully described above also.

- If outcome measures were long term, summarize the progress that has been made towards achievement. This work resulted from a single-year proposal. A continuation of this work was conducted in 2013 (described in a subsequent report) and further validation of most of the results reported was done. However, developing a muscadine variety is a long term process, and this work contributed to this process as the breeding program moves forward with testing of developed selections for potential variety release in addition to using this information for new developments now and in coming years.

- Provide a comparison of actual accomplishments with the goals established for the reporting period.
All goals were accomplished as outlined in the proposal and -in this final report. The workshop was rated very positively by participants. Participants recorded an increase in the understanding of the postharvest storage potential and nutraceutical properties. Close to 73 people attended the workshop
• Clearly convey progress toward achieving outcomes by illustrating baseline data that has been gathered to date and showing the progress toward achieving set targets.
As described above, all activities proposed were carried out. Results described above report data collected, data results and interpretation, and the primary overall findings of the work. The sharing with the public in a workshop was achieved also as proposed. Many, many components of the proposed work came together to make this project a complete success as proposed. The MS student, Mr. Barchenger, was an outstanding person to carry out the majority of the work, the weather cooperated, a good crop of fruit was achieved, and the results provided very good conclusions, albeit a single-year’s data.

BENEFICIARIES
• Provide a description of the groups and other operations that benefited from the completion of this project’s accomplishments.
The intended beneficiaries were primarily twofold: growers and ultimately consumers. The initial beneficiary, the grower, will benefit from this project by receiving information on selected varieties of muscadines that performed well in storage (or did not). This was conveyed in the workshop, or in other communications from this work. Growers also benefitted from the workshop as additional topics on muscadine production were shared and discussed, all leading to an enhanced knowledge base by the grower in decisions related to muscadine production either in place or being considered for future plantings. Consumers will benefit in a longer-term manner from this work, in that this work will contribute to higher quality muscadines in the commercial marketplace. The workshop had at least 73 growers and other interested individuals attend.

• Clearly state the quantitative data that concerns the beneficiaries affected by the project’s accomplishments and/or the potential economic impact of the project.
Data on production of fresh-market muscadines (the primary fruit type targeted by this project) is not well documented in Arkansas. This is due to no viable statistics being gathered on this crop by statistical entities. Thus, there is no quantitative data to reflect impact at this point. It is known by observation and grower inquiry that muscadines are produced over much of the state, and are often found in farmers markets, and this marketing could be expanded to retail grocery store markets if more substantial plantings could be made of adapted varieties. This work therefore will flow directly to benefit this grower and production group. It is anticipated that acreage and production value will increase in Arkansas on muscadines due to this and other research underway to improve this crop.

LESSONS LEARNED
• Offer insights into the lessons learned by the project staff as a result of completing this project. This section is meant to illustrate the positive and negative results and conclusions for the project.
The results provide the information from what one can draw preliminary conclusions on a topic that takes multiple years to fully address. Lessons learned beyond or within the results would include:
- varieties and selections of muscadines have substantial differences in contents of various compounds and postharvest potential
- the hot and dry year of 2012 appeared to result in less disease on fruit on unsprayed vines, providing somewhat different results between sprayed and unsprayed than first anticipated - some variables such as percent unmarketable berries, percent weight loss increased during storage, and force to penetrate the berry skin generally were most important for differentiating the genotypes, as opposed to other variables that changed little during storage.
- a committed and talented person such as Mr. Barchenger was the key to getting this immense amount of work done fully.

• Provide unexpected outcomes or results that were an effect of implementing this project. There were no unexpected outcomes in the project activities for 2012.

• If goals or outcome measures were not achieved, identify and share the lessons learned to help others expedite problem-solving.
Outcomes were achieved as envisioned. Due to the long-term nature of this work, the commercial outcome is still several years from being realized. However, good progress is being made with it being additive progress in the overall effort.

CONTACT PERSON
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ADDITIONAL INFORMATION
• Provide additional information available (i.e. publications, websites, photographs) that is not applicable to any of the prior sections.

Publications


Presentations

Clark, J.R. 2013. Arkansas muscadine breeding progress. Presented at the Muscadine Workshop, Fruit Research Station, Clarksville, AR.
Fig. 1. Berry shrivel due to weight loss of varying degrees from storage in postharvest evaluations.

Fig 2. Examples of fungal growth observed in muscadine grapes; note the growth is found on the stem attachment end of the berries.
Fig. 3. Measuring berry skin firmness with the texture analyzer
Complete Materials and Methods
Vines of 17 muscadine genotypes used for the study were grown at the University of Arkansas Fruit Research Station, Clarksville, AR (lat. 35°31’58”N and long. 93°24’12”W). Vines were of varying ages within each genotype, most of the varieties were approximately six years old, while many of the selections were from younger vines three to four years old. The vines were grown in Linker fine sandy loam, in USDA hardiness zone 7a, where average annual minimum temperatures reach -15 – 17.7 °C. Vines were spaced 6.1 m apart and rows were spaced 3.0 m apart. A single-wire trellis was used, and vines were trained to a bilateral cordon. The vines were dormant pruned annually in February using spur pruning with spurs retained of two to four buds in length. Weeds were controlled with pre- and post-emergence herbicides as needed, and vines did not have any stress from weed competition. Vines were irrigated by drip irrigation as needed, beginning in early June (prior months received adequate rainfall) and continuing through the harvest period. Vines received N fertilization in March of each year at a rate of approximately 70 kg ha-1. No insecticides or other pest control compounds were applied to the vines, other than those vines that received the fungicide treatments (see below). The vines used in the study had full crops produced each year, and no crop reduction due to winter injury or other limitation occurred. Thus, the vines produced fruit under representative conditions. Daily maximum and minimum temperatures along with rainfall were recorded at the research location to characterize the environment the vines were subjected to and potential differences among years.

The vines of nine muscadine varieties and selections were used for fungicide treatments. Each genotype had a single vine treated with fungicide, while the other did not receive fungicide applications (berries from the fungicide-treated vines were referred to as fungicide-treated berries and berries from the no fungicide-treated vines were referred to as no fungicide-treated berries).
berries). A rotation of systemic field fungicide applications of Abound® (azoxystrobin: methyl (E)-2-\{2-\{6-(2-cyanophenoxy) pyrimidin-4-yloxy\} phenyl\}-3-methoxyacrylate*) and Rally® (myclobutanil: a-butyl-a-(4-chlorophenyl)-1H-1,2,4, triazole-1-propanenitrile) (a sterol inhibitor) were applied with a backpack sprayer every 14 d beginning when the fruit was approximately 3-5 mm in diameter and after approximately 400 growing degree units were accumulated beginning 1 Jan.

The muscadines were once over, hand-harvested. Harvest date/maturity was based on soluble solids (SS) of 18-22%, ease of release from the pedicel, and berry color. Both fungicide treated and non-fungicide treated vines within the same genotype were harvested on the same day. Fruit was harvested either early in the morning or late in the afternoon and transported to the University of Arkansas Institute of Food Science and Engineering, Fayetteville, AR., in an air-conditioned car on the same day. The fruit was stored at 2 °C upon arrival.

Berries were then hand-sorted to remove any split, shrunken, or decayed fruit before packaging to simulate commercial standards. Only sound berries, showing no signs of unmarketability, were used for this study. The fruit was packaged into hinged standard vented clamshells (18.4 cm x 12.1 cm x 8.9 cm) (H116, FormTex Plastics Corporation, Houston, TX) and placed in cold storage at 2 °C with 85-89% RH. From the randomly selected fruit from each vine, six vented clamshell containers were filled to approximately 500 g.

Three of these clamshells were used as storage replications for each treatment and genotype. Total clamshell weight was determined at date of harvest, and percent weight loss was calculated as percent weight decrease from this initial value. Weight loss and percent unmarketable fruit were evaluated on the storage clamshells every 7 d for up to 21 d. Storage performance was evaluated by removing all the fruit from each clamshell and counting the number of fruit that showed signs of unmarketability, which included individual or a combination of characteristics of browning, softness, mold, rot, leakage, splitting, and shriveling. Both the unmarketable and marketable berries were returned to the appropriate clamshell each week, and storage measurements were discontinued once the percent unmarketable in all three clamshells reached 50%, or after 3 weeks of storage.

The remaining three clamshells were used as replications for physicochemical analyses. For physicochemical measurements, every 7 d three berries were removed from each of the three clamshells and used to measure berry volume, Chroma, hue, L*, SS, titratable acidity (TA), pH, and firmness of the skin and flesh. Physicochemical measurements were discontinued once the percent unmarketable in all three clamshells reached 50% or after 3 weeks of storage. Titratable acidity and pH were measured by an 877 Titrino Plus (Metrohm AG, Herisau Switzerland) with an automated titrator and electrode standardized to pH 2.0, 4.0, 7.0, and 10.0 buffers. Titratable acidity was determined using 6 g of juice diluted with 50 mL of deionized, degassed water by titration of 0.1 N sodium hydroxide (NaOH) to an endpoint of pH 8.2, with results expressed as percent tartaric acid. Soluble solids were measured using a Bausch and Lomb, Inc. Abbe Mark II refractometer (Rochester, NY). Soluble solids, TA, and pH were measured from the juice of the whole berries, strained through cheesecloth to remove any solids.
Exterior skin color measurements were determined on each of the three berries every 7 d using a Chroma Meter CR 300 series (Konica Minolta Holdings Inc., Ramsey, NJ). The Commission Internationale de l’Eclairage (CIE) Lab transmission “L*” value indicates how dark or light the skin is, with 0 being black and 100 being white. Hue angle describes color in angles from 0° to 360°: 0° = red; 90° = yellow; 180° = green; 270° = blue; and 360° = back to red. Chroma is the aspect of color by which the skin colors appears different from gray of the same lightness and corresponds to intensity of the perceived color.

Firmness, or the maximum force to penetrate skin and flesh tissues, was determined using the three whole berries per replication. A TA-XT2 Texture Analyzer (Stable Micro Systems, Haslemere, UK) with a 2-mm-diameter probe was used to penetrate the skin and mesocarp tissues (flesh) to a depth of 10 mm in each berry at a rate of 10 mm.s⁻¹. Measurements are expressed as force in Newtons (N), and the data was analyzed using Texture Expert Version 1.17 (Texture Technologies Corp., Scarsdale, NY).

Three randomly selected berries from each physicochemical replication of each treatment were used from the harvest date sample to measure nutraceuticals including oxygen radical absorbance capacity (ORAC), and levels of total phenolics, total anthocyanins, total ellagitannins, total flavonols, and resveratrol.

The storage experiment was designed as a split plot with three replications of each genotype and fungicide treatment. The split was storage (weeks 0, 1, 2, and 3). The nutraceutical component was a complete randomized design with three replications of each genotype and treatment, (these measurements were only done on the harvest date, not during storage. A single vine was used as an experimental unit.

The data were analyzed by analysis of variance (ANOVA) using JMP® (version 11.0; SAS Institute Inc., Cary, NC). Tukey’s Honest Significant Difference and Student’s t Test was used for mean separations (p = 0.05).
Project 2:

Enhancing the Competitiveness of Specialty Crop Farmers in Underserved Communities by Enhancing Food Safety

PROJECT SUMMARY

In 2010 a group of farmers; UAPB Extension agent; East Arkansas Enterprise Community, a community based organization; and USDA employees met with representatives from Walmart and C H Robinson to discuss the possibility of small farmers in cooperatives selling fresh vegetables to Walmart. This marketing opportunity was a part of Walmart’s efforts to bring local fresh Arkansas grown vegetables to local stores in Arkansas. Thus providing another vegetable market for local farmers in eastern Arkansas.

The group met with representatives from Walmart and decided to grow southern peas since many farmers had experience with southern peas. However, this market would require that the southern peas be shelled (semi-processed) and placed in clam shells. It would also require that the southern pea fields and processing areas (where peas were shelled) be Good Agricultural Practices (GAP) and Good Handling Practices (GHP) certified. No one in any of the groups (producers or processors) were either GAP or GHP certified. Consequently education and assistance was needed in the GAP and GHP area.

The Southern Pea Project (the group of farmers growing peas for Walmart) started in 2010. UAPB provided production assistance to growers in 2011 and 2012. In the first two years producers were not required to be GAP or GHP certified, however, producers and processors were required to be GAP and GHP Certified in 2013. To assist these producers and processors with GAP and GHP Certification in 2012 UAPB decided to apply for a Specialty Crop Grant to help farmers with their certification.

PROJECT APPROACH

Activities and Task Performed

(1). Planning meeting with Alcorn State University – 2 meetings conducted in Mississippi; approximately 10 individuals attended.

(2). Train-the–Trainer Workshops for professionals – 2 meetings held at UAPB and one at Alcorn State University. Approximately 12 attended at UAPB and 20 attended at Alcorn State. All 12 participants received Certificates of Completions.

(3). GAP/GHP Workshops for farmers – Three meetings held, two at UAPB and one in Marianna at the UAPB farm. Approximately 60 individuals attended. Fifty (50) individuals received Certificates of Completions which could be used in GAP Audits.
(4). Farmers assisted in developing food safety plans and with GAP Certification: D&S Produce Shed; Agricultural Demonstration Outreach Center (ADOC) Shed, two times; ADOC Fields, two times; R. Cole, Field; A Carpenter Fields, three times; and H Williams, Fields. All 10 received GAP/GHP Certification

(5). Farmers assisted in developing food safety plans only: Curtis Harris, Field, and S. Walker, Field.

(6). Networking with other universities and presentations made: Networked with Tuskegee University, Alcorn State University. Presentations on the project made at Tuskegee University, Alcorn State University, and at the National Small Farm Conference in Memphis.

(7). Video Development – Alcorn State University took the lead in developing the Food Safety Video which included farmers from Mississippi and the Carpenters from Arkansas.

Significant Contribution and Role of Project Partner

Alcorn State University, our partner university was very helpful to us. Ms. Nicole Bell, their food safety specialists, assisted with training at UAPB and in developing food safety manuals for producers. Ms. Bell was the only extension food safety specialists for the projects. She assisted us with all three of the Carpenters field audits and she even made food safety presentations at the Arkansas Land and Farm Development Corporation (ALFDC) Winter Conference. She was also the lead person for developing the video.

GOALS AND OUTCOMES ACHIEVED

Activities completed to achieve performance goals & measurable outcomes for project

The main focus of this project was to educate and train professionals like UAPB Extension associates and farmers selling vegetables on GAP because many stores would be requiring GAP Certification.

GAP/GHP Training Workshops for Professionals: The outcome from these activities were the development of UAPB Extension associates with the knowledge needed to educate and assist farmers with food safety training and GAP Certification. Consequently, all of UAPB’s Extension associates were trained in the GAP/GHP Certification requirements and they can now assist farmers in implementing GAP.

GAP/GHP Training for Farmers: The farmers targeted for this project were not familiar with the GAP/GHP Process. These farmers had never been required to be GAP Certified. Consequently, their fields or processing sheds were not GAP Certified. Also these farmers knew nothing about food safety or developing manuals. As a result of this workshop farmers now know what GAP/GHP is and they know the requirements for GAP Certification. However, they know many GAP to apply on their farms to prevent contamination from infectious bacteria or other infectious
organisms. These farmers now practice using GAP on their farms even though they may not be GAP Certified. They have learned the importance of washing, scouting fields before harvest, and the importance of having clean tools, trucks, etc.

**Expected Measurable Outcome compared with Actual Outcome**

1. Twenty five farmers will obtain GAP/GHP Certification. Ten certification were obtain for farmers and ADOC.

2. Ten Agricultural Professionals will receive GAP Training. Ten Agricultural professional received training in Arkansas. More than 10 received training in Mississippi.

3. Provide GAP reimbursement payments for 25 farmers. Ten reimbursements were made for GAP Certification.

The expected outcomes of 25 farmers receiving GAP Certification and reimbursements was not achieved because all of the southern pea growers did not go through with the certification process. Even though most of the growers were growing for the Walmart Market which required GAP Certification, the farmers did not get certification. It was expected to be about 20 growers for the Walmart southern pea project market.

The other vegetable growers (approximately 10) did not need GAP certification to sell their vegetables, but they were interested in keeping their vegetable safe or free from contamination. Therefore, these farmers were interested in using GAP and in developing a food safety plan for their operation.

The baseline data showed that only one individual had previous GAP training and certification. After the project 9 individuals had been GAP Certified and about 60 farmers had participated in GAP training. Although all farmers were not GAP certified, all were now using GAP in their operations. Participants also know that if they need assistance with GAP Certification that it is available at UAPB because of the specialty crop grant provided by the Arkansas Department of Agriculture.

**BENEFICIARIES**

The targeted group consisted of small socially disadvantaged farmers (SSDFs) in eastern Arkansas who were growing vegetable crops. These farmers are located in an area surrounded by large row crop (soybeans, wheat, rice, cotton, corn, and sorghum) farms with an average size of 1000 acres. Many of these farmers had between 5 to 50 acres which is considered small in the area. Approximately 99% of these farmers were not using GAP or food safety practices. As a result of the Specialty Crop Project these farmers are now familiar with GAP and using some of
the GAP. These producers are also knowledgeable about GAP and they know that they may need GAP certification to sells their vegetables in the future.

About 50 SSDFs were affected by the project. This probably represent about 1000 acres of vegetable land. These 1000 acres of vegetables are now being produced with some of the food safety practices that the farmers learned in the workshop. Consequently, by implementing these practices the producers are reducing their chances of spreading an infectious bacteria.

LESSONS LEARNED

Field training (on site) is just as important as classroom training for SSDFs. When possible GAP workshops should include a field component.

SSDFs will not pay to get certification unless it is absolutely required by the buyers.

All farmers will need assistance in developing and in putting their food safety manual together. An extension associate or a consultant will be needed to assist him or her.

It is probably best to spend the $70 dollars for a good water test as opposed to getting the free water test that only indicates the present or absent of coliform.
Project 3:

Hydroponic Specialty Crop Growing System for Southern Arkansas

Project Summary

Hydroponic production of food crops has the potential to increase food production in locales where large scale horticulture operations do not exist. By producing lettuce hydroponically a producer could have several crops per year thus providing a steady source of additional farm income and providing fresh, locally grown produce to local residents. There is an abundance of information on hydroponically produced lettuce available, however there is limited information regarding yield, natural lighted, artificially lighted and utilities cost differences for lettuce produced via hydroponic means. The purpose of this project was to investigate several methods of hydroponic lettuce production using artificial lighting and natural lighting in order to gain knowledge of the effects of climatic conditions, lighting, types and intensities, and respective utility cost associated with hydroponic lettuce production in Southern Arkansas.

Project Approach

Natural versus Artificial Lighting:
Systems were set up in a greenhouse location or in a metal building (Headhouse). Greenhouse systems utilized natural lighting, sun shading cloth and thermostatically controlled heating and evaporative cooling to modify the growing environment. The systems placed in the metal building utilized artificial lighting and the building was insulated and heated but not cooled.

Lighting Systems for hydroponics in metal building:
Four Florescent lighting fixtures with four 48 inch T-5 bulbs each
14 LED light arrays 12 inches by 12 inches
4 five foot coverage Solar Storm LED grow lights

Systems: Two Nutrient Film Technique trough units. One placed in the greenhouse; one placed in the metal building.
Two nutrient film technique tower units. One placed in the greenhouse; one placed in the metal building
Four Commercially available Volksgarden rotary hydroponic units. Two placed in the greenhouse; two placed in the metal building.
Nutrient Solution: Commercially available Flora Nova Hydroponic grow solution. Calcium nitrate and Magnesium Sulfate added to nutrient solution to prevent Tip Burn.

Lettuce Variety: Butterhead

Seeding medium- Rock wool Horticubes

Seeding protocol: Seed was placed in the horticube tray, placed in a misting chamber and seedlings were transplanted to hydroponic units at day 14.

Several trials were conducted using these hydroponic systems. Trials were designed to test for differences in energy consumption between LED lighting and florescent lighting and the differences in lettuce production yields between natural lighting and artificially lighting.

Trial One:
Two trough systems containing (10) 4” diameter PVC schedule 40 split pipes each were situated on metal racks that allowed a 2% slope draining into a collection reservoir. The troughs were bedded with clay pebbles that had been soaked in water. Buffer areas were created by placing small (diameter < 1”) gravels at intervals of four feet to slow the flow of the hydroponic solutions. Forty gallon rubber stock tanks were used for the nutrient solution reservoirs and submersible pumps were placed in each reservoir and fitted to manifolds constructed from 1/2 “ PVC pipe and fitted with a ball valve for each trough. The pumps were plugged into a timer and nutrient solution was pumped to the plants for 15 minutes out of each hour round the clock. The nutrient solution is a commercially available hydroponic solution. Calcium nitrate was added to maintain calcium levels to prevent tip burn in the lettuce plants. A system was placed in the greenhouse and the head house. The greenhouse is evaporatively cooled and utilized natural lighting. The head house is ventilated but has no cooling system and utilizes artificial light. The lighting system used was four (4) florescent four bulb fixtures each one 4 feet in length that were placed three feet above the plants. The lights were wired to a timer that provided 12 hours of light to the plants daily. Carbon dioxide, relative humidity and temperature levels were monitored via data loggers in each location. Electricity usage for the artificial lighting were measured by energy consumption meters.

The nutrient solutions were mixed 5ml per gallon of water (100 mls per 40 gallons) with 50 grams of calcium nitrate added to the 40 gallon mixture. This solution was pumped to the systems for the first 14 days after that the solution was increased to 200mls per forty gallons for the remainder of the trial. Calcium nitrate was added at the original rate. Solutions were adjusted for volume when the reservoirs became low.

Each trough system was planted with 140 lettuce plants. Var. butterhead that had been germinated in 1” rock wool horticubes.
RESULTS:
The trial ran for 26 days.
Plants under artificial light in the head house began etiolating on the outside edge which is characteristic of not receiving adequate lighting. 114 plants out of the 140 survived yielding 3 pounds of lettuce.
Plants under natural light in the greenhouse yielded 25.4 pounds of lettuce and 129 out of 140 plants survived.
Means were calculated for carbon dioxide, relative humidity and temperature were calculated for the times as follows:
  0600 hours
  1200 hours
  1800 hours
  2400 hours
Carbon dioxide levels:
Carbon dioxide levels, although different between locations, were not significantly different to effect or enhance plant growth. Carbon dioxide levels were higher in the head house during the times corresponding to increased ventilation of the greenhouse which was anticipated due to evaporative cooling of the greenhouse. Carbon dioxide means are reported in table 1.

Table 1

<table>
<thead>
<tr>
<th>Time</th>
<th>Greenhouse</th>
<th>Headhouse</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>509 ppm</td>
<td>512 ppm</td>
</tr>
<tr>
<td>0600</td>
<td>Std. Deviation 40.62</td>
<td>Std. Deviation 23.98</td>
</tr>
<tr>
<td>1200</td>
<td>447 ppm</td>
<td>476 ppm</td>
</tr>
<tr>
<td></td>
<td>Std. Deviation 7.62</td>
<td>Std. Deviation 20.8</td>
</tr>
<tr>
<td>1800</td>
<td>439 ppm</td>
<td>466 ppm</td>
</tr>
<tr>
<td></td>
<td>Std. Deviation 8.78</td>
<td>Std. Deviation 16.97</td>
</tr>
<tr>
<td>2400</td>
<td>491 ppm</td>
<td>485 ppm</td>
</tr>
<tr>
<td></td>
<td>Std. Deviation 30.17</td>
<td>Std. Deviation 18.38</td>
</tr>
</tbody>
</table>
Temperature:
The head house is an insulated building with exhaust fans for ventilation. It was built to be a companion building to the greenhouse complex to serve as a warehouse, tool storage and growing media storage.
There were temperature differences especially with the 1200 hour measurement between locations; however the temperature differences were not significant to impact plant growth at either location.
Temperature differences between locations are reported in table 2.

<table>
<thead>
<tr>
<th>Time</th>
<th>Greenhouse</th>
<th>Headhouse</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0600</td>
<td>22.8 C</td>
<td>26.75 C</td>
</tr>
<tr>
<td></td>
<td>Std. Deviation 1.42</td>
<td>Std. Deviation 1.05</td>
</tr>
<tr>
<td>1200</td>
<td>36.4 C</td>
<td>31.76 C</td>
</tr>
<tr>
<td></td>
<td>Std. Deviation 3.18</td>
<td>Std. Deviation 2.6</td>
</tr>
<tr>
<td>1800</td>
<td>32.6 C</td>
<td>30.1 C</td>
</tr>
<tr>
<td></td>
<td>Std. Deviation 3.08</td>
<td>Std. Deviation 1.64</td>
</tr>
<tr>
<td>2400</td>
<td>25.0 C</td>
<td>26.71 C</td>
</tr>
<tr>
<td></td>
<td>Std. Deviation 1.43</td>
<td>Std. Deviation 1.2</td>
</tr>
</tbody>
</table>

Relative Humidity:
Relative humidity levels were higher in the greenhouse during the 0600h and 2400h measurement and lower during the 1200h and 1800h measurement than those recorded in the
headhouse. This is consistent with the thermostatically controlled evaporative cooling system in the greenhouse. During the day as temperatures increased in the greenhouse the evaporative cooling system would engage and exhaust the greenhouse more frequently than the late evening or early morning hours thus reducing relative humidity by 50% during the hotter periods during the day. The headhouse differences in relative humidity during the 24 hour period did not fluctuate as greatly but they also followed the same pattern.
Relative humidity differences are reported in table 3.
Table 3.

<table>
<thead>
<tr>
<th>Time</th>
<th>Greenhouse</th>
<th>Headhouse</th>
</tr>
</thead>
<tbody>
<tr>
<td>0600</td>
<td>87.3</td>
<td>75.65</td>
</tr>
<tr>
<td></td>
<td>Std. Deviation 6.92</td>
<td>Std. Deviation 4.84</td>
</tr>
<tr>
<td>1200</td>
<td>42.3</td>
<td>55.45</td>
</tr>
<tr>
<td></td>
<td>Std. Deviation 9.96</td>
<td>Std. Deviation 6.71</td>
</tr>
<tr>
<td>1600</td>
<td>52.8</td>
<td>62.59</td>
</tr>
<tr>
<td></td>
<td>Std. Deviation 13.64</td>
<td>Std. Deviation 7.45</td>
</tr>
<tr>
<td>1200</td>
<td>83.6</td>
<td>77.47</td>
</tr>
<tr>
<td></td>
<td>Std. Deviation 4.31</td>
<td>Std. Deviation 6.33</td>
</tr>
</tbody>
</table>

Lighting:
The artificial lighting used for this trial was obviously inadequate for growing lettuce based upon the total yield in pounds and the observance of etiolation of the seedlings early in the trial. However total kilowatt hours of electricity used to produce artificial light during this trial was 238KWH.

Trial two:
Trial two was conducted following the completion of trial one and everything was held the same except the artificial lighting was doubled to eight fluorescent fixtures arrayed in two rows of four fixtures each to provide full light coverage to the system and to prevent the etiolating of the plants on the outside perimeter of the system.

Results of Trial Two;
Greenhouse system 116/140 plants survived to yield 20.1 pounds of lettuce.
Headhouse system 116/140 plants survived to yield 8.6 pounds of lettuce

The relative humidity, carbon dioxide and temperature measurements followed the same pattern as in trial 1.
Increasing the amount of artificial light greatly improved the lettuce yield of the headhouse system. Observed etiolation of the plants was much less than in trial 1 but did occur at the perimeter of the system.
536 KWH were used in artificial lighting for trial 2

Subsequent trials to test LED vs. Fluorescent lighting effects on lettuce production clearly indicated that with the LED light arrays used for the trial were not producing the light intensity needed for optimum production and clearly indicated that a different type of LED panels were needed.

Subsequent trials testing greenhouse lettuce production via hydroponic production clearly indicated that lettuce production decreased substantially during the months of June, July, August and September and that ambient temperature had an effect on both the quantity and quality of the lettuce produced.

Subsequent trials testing headhouse lettuce production via hydroponic production clearly indicated that lettuce production was reduced as compared to the systems under natural lighting.

All trials involving the commercially available rotary units had sub-par performance. The design of the units were such that the drum containing the seedlings rotated very slowly into the hydroponic growing solution via an electric motor. The drum shielded the seedlings to the point that natural lighting was not effective and the 650 watt sodium vapor bulbs provided by the manufacturer created too much heat to allow for plant survival. The sodium vapor bulbs were replaced with LED light strips and on every trial there were several incidences of the drum failing to rotate and plants did not receive adequate nutrition or water to survive.

Conclusions:
The data collected indicates that artificial lighting results in reduction of the quantity of lettuce produced. The trials that utilized natural lighting produced higher lettuce yields and plant death loss was less. LED lighting used less KWH than did the florescent lighting, however yields were much less from plants grown under LED lighting. The data collected indicates that lettuce can be produced hydroponically under greenhouse conditions economically but as the ambient temperature reaches 95 degrees F lettuce yield and lettuce quality decreases. The tower units were cumbersome to operate compared to the trough units.

**Recommendations**

The rotary units failed. The rotating mechanisms were prone to hanging up and leading to plant death or the heat generated by the lighting was too hot for plant survival. Also the drum shielded the plants from natural lighting therefore limiting their usage to artificial lighting.

Hydroponic lettuce can be grown in southern Arkansas; however more research is required to test alternative housing options. It is not cost effective to construct a climate controlled greenhouse large enough to produce lettuce in quantities to market thru retail or farmer’s market outlets in order to cash flow the cost of the greenhouse. Trials need to be developed to test the feasibility of hydroponically produced lettuce in high tunnel structures to limit the initial investment costs.

Additional research needs to be completed on more effective LED lighting in order to lower the electrical cost to make it more comparable to natural lighting production cost. LED lights are in their infancy and I have purchased LED lights specifically designed for plant growth. Trials will be conducted this winter to determine their efficacy in lettuce production and to determine the KWH electrical usage for these lights. The rationale for investigating lighting is to provide information to the producer that has a metal building or perhaps an older poultry house that could be converted to hydroponic production.

The tower units will be converted to tomato production this spring and some of the pipe will be used to build more trough units.

**Goals and Outcomes Achieved**

Since hydroponics are new to the Southwest quadrant of the state, that every student and educator that have worked in or toured the project has an increased understanding of hydroponics. As far as the testing goes it would be limited to the horticulture class and
they were tested during lab on the hydroponics systems and they all had an increased understanding of hydroponics.

Research:
Several trials have been conducted during the course of this grant. We have tested three different hydroponic systems and have concluded that the most efficient system for lettuce production is the trough type, nutrient film technique.
We have done some preliminary work on researching lighting methods and this research will continue into 2016.
As mentioned previously, the recent purchase of new age LED lights specifically designed for plant production will allow us to continue trials regarding lighting and electricity costs of hydroponic production.

Teaching:
The hydroponic systems have been incorporated into the following Plant Science courses at Southern Arkansas University:
PLSC 2002/2001 Principles of Horticulture/Laboratory
PLSC 3032/3031 Greenhouse Management/Laboratory
Students in these classes perform all the work on the hydroponic production of lettuce as a laboratory exercise. They gain a tremendous amount of knowledge on plant production, propagation and nutrient requirements during the process.

Extension:
Several 4H groups and high school FFA students visit our campus to tour the Agriculture facilities as well as Master Gardener’s organizations from Cooperative Extension. Each tour group spends time with the hydroponic units.
The fact that we have the hydroponics project on campus is paying dividends in exposing our current students along with some external stakeholders to the science of plant production. We have used the hydroponic systems as a teaching tool for our students as well as touring future students during their campus visits. The project has been featured in the magazine “Arkansas Grown” which is a publication from the Arkansas Department of Agriculture.

Beneficiaries:
All agriculture students of Southern Arkansas University have benefited from this research project being on our campus and located in close proximity to the Agriculture building. Several classes tour the operation and the operation is imbedded into two of our classes in Plant Science and will possibly be imbedded in more classes as time progresses.
Local 4H and FFA chapters visit and tour the campus often and the hydroponic operations are used in teaching these students and the hydroponics operations play a role in attracting students to our program.
Southern Arkansas STEM Center works with grade schools students from Arkansas and Texas. Some of the classes travel to our campus for increased hands on exposure to the science of Agriculture. Some students attend the STEM camp for one week during the summer for more intensive learning opportunities. Every student from the stem center spends time with the hydroponic operation.

50 horticulture students each year for 2 years = 100 students  
15 greenhouse management students each year= 30 students  
6 student workers = 6 students  
Over 500 students from K-12 each year = 1000 students  
30 plus k-12 educators = 30 educators

Master Gardeners is program ran via the Arkansas Cooperative Extension Service. We have hosted the Master Gardeners on our campus for tours and instruction on hydroponic plant production.

**Lessons Learned**
Small scale hydroponic plant production systems can be constructed with minimal input cost. The climate of Southern Arkansas is not ideal for growing lettuce hydroponically on a year round basis although it could be accomplished with increased production cost by using enhanced temperature modulation equipment. There is a market for hydroponically grown lettuce in our locale, especially with the University’s food service provider. However, the food safety protocols required by the food service company were much too cost prohibitive for the amount of lettuce we could supply. A Farmer’s Market scenario would serve as a marketing avenue. Greenhouse hydroponic production proved to be the best as far as plant survival and pounds of saleable product. However, the cost of constructing new greenhouses for the purpose can be capital intensive and difficult to cash flow.
Additional research is required for lighting and temperature modulating systems regarding non greenhouse production methods. Hydroponic plant production has the potential to add value to poultry houses in the area that no longer are used to produce chickens. However, more research is required in lighting and other utilities cost in order to cash flow the operation.

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Project 4: Produce Marketing Association Fresh Summit Show

Project Summary

Seven specialty crop companies participated in the Arkansas Agricultural Department’s (AAD) booth at the 2013 Produce Marketing Association (PMA) Fresh Summit International Convention and Exposition in New Orleans, Louisiana October 17-20, 2013. The companies are:

- Mathews Ridgeview Farms
- Clanton Farms
- Post Familie Winery
- JYC/Edamame
- Old Dominion Farms
- Triple M Farms
- Williams Produce

Triple M Farms and Williams Produce were new participants in the AAD booth at the PMA Fresh Summit.

The companies were surveyed and the results are given under the goals section.

Project Approach

Seven specialty crop companies participated in the Arkansas Agricultural Department’s (AAD) booth at the 2013 Produce Marketing Association (PMA) Fresh Summit International Convention and Exposition in New Orleans, Louisiana October 17-20, 2013. The companies are:

- Mathews Ridgeview Farms
- Clanton Farms
- Post Familie Winery
Triple M Farms and Williams Produce were new participants in the AAD booth at the PMA Fresh Summit.

The following crops were showcased:
- Sweet Potatoes
- Grapes/Muscadines/Juice
- Tomatoes
- Cucumbers
- Squash
- Watermelons
- Edamame

The participant companies produce the following:
- Sweet Potatoes
- Grapes/Muscadines/Juice
- Tomatoes
- Cucumbers
- Squash
- Watermelons
- Onions
- Hot Peppers
- Bell Peppers
- Edamame

These growers are a very broad representation of AR specialty crops. They represent some of our biggest specialty crops, such as tomatoes, watermelons, and sweet potatoes.

Participants were recruited by a letter and email to all Arkansas producers who were GAP/GHP inspected or that AAD had knowledge of and were of a size that could benefit from the event.

Participants asked for a redesign of the booth. The department bid out the redesign and rental of the booth in accordance with state regulations. Stand-Out services of Georgia was selected as the winning bidder.
This was probably the biggest year for Arkansas at the PMA. The crowd appeared to be very southern centric.

Verbal reports from participants and the notable increase in the number of buyers visiting the AAD booth indicate participation in the AAD booth was successful and beneficial for the companies. The increase in the traffic at the AAD booth is a direct result of the better booth location which AAD earned by being a seven year participant at the PMA Fresh Summit. All participants have indicated to AAD they want to participate in the AAD booth at the 2014 PMA Fresh Summit.

Twenty-two sales were reported by attending companies as having taken place due to attending the PMA show. One attendee alone picked up 12 sales to a chain of supermarkets. The goal of 20 sales leads was met.

The survey below was sent to all participants after the event:

2013 PMA FRESH SUMMIT
New Orleans, LA

1. WAS THIS SHOW HELPFUL?
   1 2 3 4 5 6 7 8 9 10
   YES → No
2. WILL YOU RETURN NEXT YEAR?
   1       2        3        4        5        6       7       8       9       10
   YES →  No

3. DID YOU THINK ATTENDING “DID OR WILL” INCREASE YOUR SALES?
   1       2        3        4        5        6       7       8       9       10
   YES →  No

4. ARE YOU HAPPY WITH THE BOOTH SETUP?
   YES   NO: ___________________________________________________
   ______________________________________________________

5. HOW MANY SALES LEADS OR POTENTIAL SALES LEADS WERE MADE?
   __________

6. HOW MANY CONTACTS WERE MADE? -
   ______________________________________________

7. HOW MANY LEADS OF:
   
   NATIONAL: __________
   REGIONAL: __________
   LOCAL: __________

8. HOW ELSE WAS THIS SHOW HELPFUL?
   ___________________________________________________
   ___________________________________________________

9. SUGGESTIONS: ___________________________________________________
   ___________________________________________________

Goals and Outcomes Achieved

AAD achieved its goals and outcomes by constructing a booth at the 2013 PMA show and recording 22 potential sales leads as indicated in the survey results below.

Survey Results:

1. Average Score 1.2
2. Average Score 1.0
3. Average Score 1.0
4. All attendees responded with “Yes”.
5. Average sales leads were 22
6. Average contacts were 41
7. Averages were: NATIONAL: 5 REGIONAL: 13 LOCAL: 3
8. One of the response that was commonly reported was, ”With this south in the deep south, more attendees seem to be regional”.

Beneficiaries

Beneficiaries were the specialty crop producers of Arkansas and especially those that attended the show with AAD. When Arkansas has a presence at these national shows all of Arkansas can benefit.

Lessons Learned

AAD has been attending this show and constructing this booth for a number of years now and thus most of the problems have been worked out.

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