ARKANSAS AGRICULTURE DEPARTMENT

Specialty Crop Block Grant Program

Award Number 14-SCBGP-AR0005

Final Report

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Project 1: Population Mapping and Characterization of Habitat of Small Hive Beetle, Aethina tumida Murray in Arkansas

FINAL REPORT

PROJECT SUMMARY

Many beekeepers are experiencing hive losses due to SHB weakening of hives leading to hive collapse. The University of Arkansas at Pine Bluff in conjunction with Arkansas Beekeepers Associations and non-associated beekeepers proposes to monitor presence of small hive beetles (SHB) in Arkansas and determine SHB-preferred habitats. Maps and pest management materials will be prepared and disseminated via workshops, Extension publications and news articles. Better understanding of where SHB are located and their preferred habitats will result in better preparedness to counter SHB infestations, improved honey production and increased honey income in Arkansas.

PROJECT APPROACH

The project was to conduct small hive beetle infestations throughout the state of Arkansas. The distribution of the small hive beetles is to provide strategies and knowledge to local beekeepers to minimize a loss of honey bee hives by the small hive beetles.

The PI used beetle jail traps to monitor presence of the small hive beetles in the beehive. The PI distributed the beetle jails to participants at least 40 traps to install 3 selected hives with 2 traps each hive for 6 months (3x2x6=36 traps). The PI visited the location once per every month to collect data (Fig. 1).

This project did not start on time because of issues over the sub grant agreement and breakdown in communications between UAPB and AAD. Therefore, the project did not start on time due to some communication issues and a misunderstanding over the subgrant agreement.

In March 2017, the PI has started the project, and the majority of the project work conducted over between April and October in 2017.

The PI re-contacted with possible participants throughout the state of Arkansas during March and April and recruited multi-participants who are keeping more than 10 beehives for more than 5 years in the same location.

GOALS AND OUTCOMES ACHIEVED

Although the project was delayed starting, data were collected and provided various aspects to interpret certain characteristics of the small hive beetle distributions in Arkansas. Only less than one year data collection was achieved, but there was interesting coincidence between higher

numbers of the SHB and lower ones in the beehive. The PI found that SHB nearby pasture with cattle caught extremely higher numbers than pasture without cattle. Secondly, SHB were collected much higher numbers in western Arkansas than central or eastern Arkansas in 2017.

However, both of the results need to continue collecting data in 2018 and 2019.

Even one year data helped local beekeepers understand distribution of the SHB in Arkansas, trends of population of the SHB seasonally, and understand Arkansas cases by the SHB during annual meeting and monthly meeting presentations.

However, it is too early to demonstrate targets or to show demonstration a certain trap or strategy to control the SHB, yet.

The PI had 8 workshops and presentations at different counties. Each workshop gathered between 50 and 150 beekeepers. They learned life cycle, sex differences, and possible factors influencing reproductive success of the SHB. The PI showed and demonstrated how and when to set up traps into beehives to reduce the number of the SHB.

Because of the delay and lack of complete data, a complete manuscript was not published on a public website during the performance period and therefore failed to meet the target of the project. Partial data was shared via workshops, reaching more than 650 beekeepers and other interested individuals, exceeding the targeted number of people reached. However, the PI is continuing to compile data and will publish when available.

BENEFICIARIES

The PI contacted with most Arkansas Beekeepers Association and shared partial information of the SHB in 2017.

The PI conducted simple treatment to break life cycle of the SHB between larvae and adults. It was extremely successful to achieve higher than 97% mortality in pupal stage so that only less than 3% of adults were able to emerge in the laboratory (Fig. 2). This manipulation will conduct in the field and will adjust treatment for beekeepers.

The PI had 8 different workshops and presentations and average participants in the workshop was 82 beekeepers and others (total at least 655 people in Arkansas).

LESSONS LEARNED

The data of year 2017 insight several questions to complete in near future. The number of the SHB collected in early spring and reduced the number during late spring and mid-summer, and

then the number of the SHB increased dramatically in the beehives. We need to answer this phenomenon of relationship between the beehive and the SHB.

The population of the SHB noticed in the beehives that were located nearby pasture with cattle. We need to investigate possible factors that influence the number of the SHB. We also continue to monitor the appearance of the SHB at eastern, central, and western regions of Arkansas so that we would know the tendency of the SHB in Arkansas.

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ADDITIONAL INFORMATION

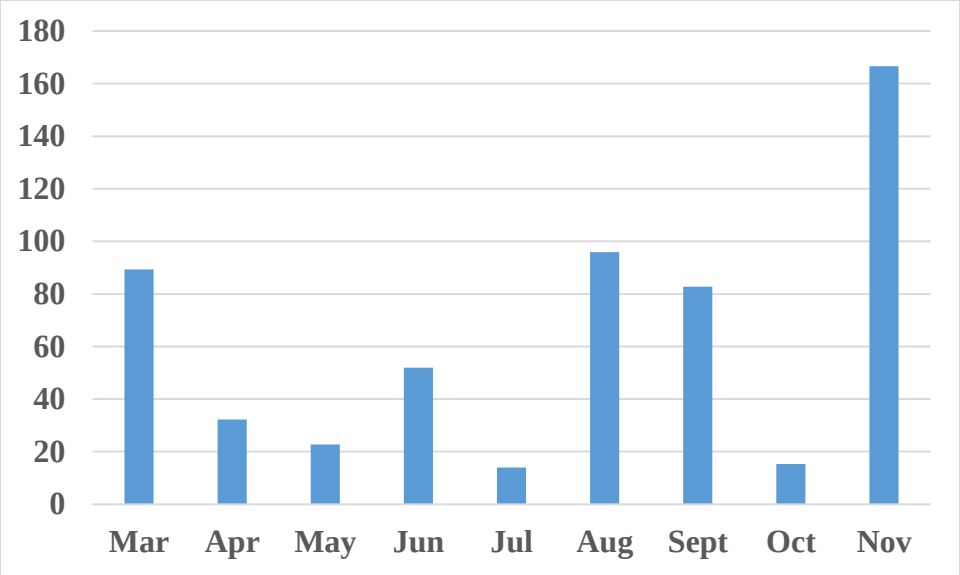

Figure 1. Monthly presence of the small hive beetles in beehives, Arkansas

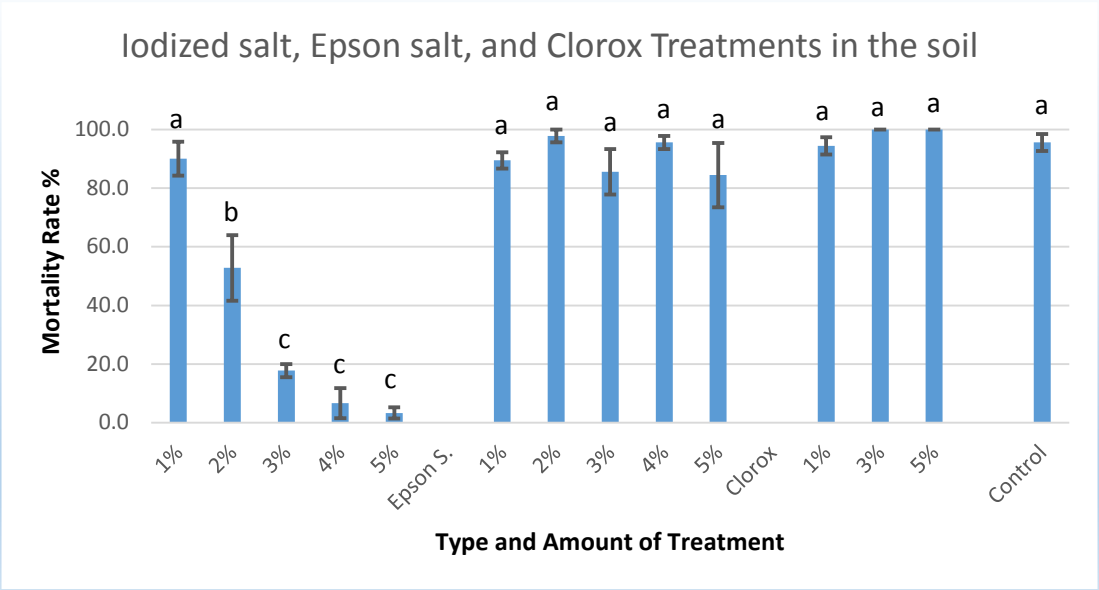

Figure 2. Treatments of the iodized salt, Epson salt, and Clorox (Means with the same letter are not significantly different, P>0.001)

Project 2: Equipping Farmers for Plastic Culture Farming While Reducing Chemical Application

FINAL REPORT

FINAL REPORT

The Project Director, Kerry Cunningham, with the Rural Community Alliance has not provided a final report, despite repeated requests. Others within the organization have also been contacted with no results. In September 2017, Ms. Cunningham indicated a final invoice would utilize all remaining funds allocated to this project. No final invoice was submitted, leaving budgeted funds unused. Funds remaining under this project (less than 20% of original project budget remain) have been reallocated to other expenses under the award. The project's final report will be included in a revised final report for award 14SCBGPAR0052 if received.

Project 3: Statewide Specialty Crop Industry Economic Assessment

FINAL REPORT

PROJECT SUMMARY

In 2002 the University of Arkansas System, Division of Agriculture conducted a survey and economic assessment of Arkansas' specialty crop industries. The survey, funded in part by the Specialty Crop Block Grant Program, gathered production, marketing, and sales information from industry businesses. The businesses surveyed included fruit, vegetable and specialty crop producers, greenhouses, nurseries, sod producers, and landscape maintenance and service firms. The results of the 2002 survey were used to conduct economic analyses which revealed the important economic contributions made by the horticultural retail and service sectors to the overall Arkansas economy.

While critical to the promotion of the state specialty crop industries at the time, this information is well over a decade old. To better understand and promote the current contributions of the specialty crop industry to Arkansas, a new study is needed. The goal of this study was to identify economic, and other contributions of specialty crops to Arkansas. Specifically, our objectives were to 1) estimate the economic contribution of the specialty crop industry to the Arkansas economy, 2) estimate the role that "local" production contributes to this sector, 3) describe the size, structure and components of the industry, 4) identify the issues and needs of the industry, and 5) highlight stories from within this industry that represent its strength, diversity, and social/economic importance within Arkansas.

In 2015, the specialty crop sector directly contributed 19,288 jobs, $580.7 million in labor income, and $874.6 million in value added to Arkansas' economy. Indirect and induced economic effects produced an additional 7,848 jobs, generating $207.6 million in labor income and $361.3 million in value added. In total, the sector contributed 27,135 jobs, $904,669,549 in labor income and more than $1.4 billion in value added. Arkansas' specialty crop industries generate employment, labor income, and value added in every sector of the economy (as defined

by NAICS 2-Digit aggregation). Methods developed during the project will allow researchers to overcome some limitations of secondary data to create reasonable estimates of specialty crop industry contributions – particularly when representative, reliable primary data are not available.

PROJECT APPROACH

A summary of the activities planned for implementation and evaluation are shown in Table 1. A more detailed description of each activity can be found in the paragraphs following the table.

Table 1: Status of Proposed Year 1 Activities

Project Activity	Timeline	Status
Survey Development – survey questionnaires that gather information related to 1) employment and sales, 2) production/marketing information/skill needs, 3) stories that highlight economic and social importance/uniqueness of a sector/business/operation	10/1/14-6/1/15	Completed
Survey Prioritization – determine order in which all sectors will be surveyed	10/1/14-12/30/14	Completed
Mail-out List Development	10/1/14-6/1/15	Completed
Survey Awareness – promotion of survey activities 1) at grower, county agent, and farm bureau meetings; through discussions with industry; newsletter and blog announcements.	10/1/14-4/1/16	Completed
Survey Execution – roll out surveys by sector, allowing 2 to 3 months for data collection for each sector with surveys scheduled for release 1/1/15, 4/1/15, 11/1/15, 3/1/16 Conduct via internet and mail.	1/1/15-6/1/16	Completed
Release Sector Reports – a series of reports that describe the size and structure of the various sectors that comprise specialty crop will be released throughout study	3/1/15-9/1/16	Adjusted, see below
Release Industry Profile/Success Stories – that describe and highlight the uniqueness or importance of a producer/business/sector to the economy or communities in Arkansas.	5/1/15- 4/1/16	Adjusted, see below
Conduct Economic Contribution Analysis – using IMPLAN software and data verified with survey data; conduct direct contribution analysis for individual sectors as data become available and then a complete contribution analysis for the entire specialty crop industry once all surveys are concluded	5/1/15 – 8/1/16	Completed
Complete and Release Final Research Report	8/1/16-9/30/16	December 2017

Survey Dev+elopment – five surveys were developed by the PI team for specialty crop industry subgroups: 1) producers, 2) processors, 3) sod producers, 4) golf course superintendents, 5) ornamental sales, services and production. While each survey was tailored to that particular subgroup, in general all surveys included 18-24 questions that sought to acquire the following information 1) type of operation, 2) location (by county), 3) age of business, 4) gross revenue, 5) value and percent of sales in and out of state, 6) change in sales over a two-year period, 7) ranking of challenges in their business, 8) demographics of their labor force, 9) demographics of the respondent. The choice of these types of questions was based on both the previous study conducted in 2002 as well as input from academics and extension employees interested in further studying the contribution of the Specialty Crop Sector in Arkansas. These questions are also consistent with questions used in similar studies conducted around the US. Surveys were pre-tested with small focus groups comprised of the relevant subsamples of the targeted population group to help ensure clarity of questions and proposed response options. All surveys received University of Arkansas Institutional Review Board Approval (University of Arkansas IRB#15-02-510).

Survey Prioritization – Our PI team, with input from industry leaders, laid out the following timeline for the surveys: Turf & Golf (Feb 2015), Producer & Processor (April 2015), Sales and Services (January 2016), and Bee Keeping (March 2016). These dates were picked based on what were expected to be the best time for participants to reply to the surveys, as well as when we hoped to have acquired mailing/email addresses for participants. As will be explained further in the challenges, the survey periods extended much longer than originally intended, with second, third, fourth and even fifth pushes to get responses for some types of surveys.

Survey Awareness – Since fall 2014, project PIs promoted the horticultural surveys in numerous ways. Announcements were sent to all 75 county extension offices with reminders sent every few months. Presentations were made at fruit producer meetings in NW Arkansas and specialty crop meetings in Little Rock. An article was written for the Arkansas Green Industries Association newsletter and announcements have gone out through the Arkansas Golf Course Superintendents Association. Additional promotion was run through the Bee Keeper Association and interviews/information sessions were conducted with producers at 2016 Horticulture

Industry Show in Tulsa. In 2017 team members attended several major industry meetings in January and February (Horticulture Industry Show, Arkansas Turf Association, Arkansas Green Industry Association). During these meetings, team members and other extension personnel distributed surveys (with postage paid return envelopes) to encourage more responses where possible. We relied on county Cooperative Extension Agents and industry groups to help promote the survey as well.

Mail-out List Development – A mailing list from the 2002 study was used as a starting point. Three team members worked carefully over a period of four months to revise and expand the mailing list for the first four surveys (the sales/services mailing list was scheduled for summer review as potential participant information was more easily gathered for these businesses than for the other groups). Mailing lists were compiled by gathering information from public and private websites, the Arkansas State Plant Board, The Arkansas Agricultural Department, industry associations, UA Cooperative Extension Service county offices and even a paid source. By February 2015 we had acquired email and/or mailing addresses for 843 producers, 85 processors, 93 sod farmers and 185 golf firms. In early 2016 we obtained mailing addresses from Cooperative Extension Service for 1,993 bee keepers. Throughout the survey process, the mailing lists were updated to remove identified bad addresses and to add potentially good mailing addresses as websites (such as the Arkansas Agricultural Department grower list, for example) were updated. The beekeeper/honey producer list was by far the most accurate (or at least yielded the most responses). The fruit/vegetable/nut producer and processor lists were the least reliable.

Survey Execution - all surveys were launched as scheduled, both electronically and by mail. Later surveys were also distributed in person during extension training meetings and professional meetings for each of the type of participants we were soliciting. By the end of the last survey push in Spring 2017, there were three complete survey mail outs and seven email reminders for all surveys.

While the targeted respondent groups were reminded through association newsletter releases, by cooperative extension offices, at producer meetings, and industry meetings obtaining sufficient numbers of good (completed survey) responses has been challenging. Although efforts

were made to obtain "current" membership lists from industry groups and other sources, many email/mail-out surveys were returned due to bad addresses, closed business or individuals no longer being in the industry.

As shown in Table 2, survey response numbers for each survey were very low. Accurate counts of the numbers of surveys distributed in person are not available but estimated in Table 2. Some of those individuals (particularly in the beekeeper group) took hard copies at meetings but mentioned that they had also received one in the mail. These in person deliveries yielded no good new data. While some surveys were returned, they were duplicates of those already submitted. Discussion at the meetings during the in-person deliveries revealed that many found the information requested on the survey to be either too personal or too difficult to gather in a timely manner. Some suspicion arose as to how we would use the data as well.

In the end was have 588 usable surveys. Bee and honey producers represented both the largest percentage of those surveyed to respond as well as the best response rate within group type. This was expected given that the mailing list obtained came from a list of attendees at recent Beekeeping workshops hosted by the Cooperative Extension Service. But even among beekeepers, output information was limited as many of them were new producers with little production, or hobby farmers who had no intention to sell any of their product(s). Producers were the next largest number of respondents but some of the surveys sent back were incomplete. Processors, on the other hand, were the smallest percentage of respondents and the smallest response rate within group type. The PIs have excellent relationships with those in the ornamental industry and large amounts of time were spent soliciting these individuals to respond to the survey. More often than not, business owners responded they either were tired of completing surveys, didn't have time to do it, or did not feel comfortable sharing sales information regarding their business.

It should be noted that a small number of responses didn't always mean poor representation within the industry. For example, the number of turf farms in the state is very small. Our Turf industry and academic experts believed that this response rate and actual responses were very representative of the status of the Turf Industry in the state.

Table 2. Number of Surveys Distributed, Returned and Completed, by Survey Sub-Group

Survey	**Distributed**[1]	**Non-Response**	**Returned** **(Bad Address)**	**Responded** **(Never was/no longer in this type of Business)**	**Responded** **(Currently engaged in this type of business)**
Turf/Sod	93 – mail 16 – email[1] 7- in person[2]	63 – mail	17 – mail	2 – mail 12 – email	11 – mail 6 – email
Golf	185 – mail 115 – email[1] 28 – in person[2]	129 – mail	34 – mail	4 – mail 10 – email	18 – mail 37 – email
Producer	1,385 – mail 428 – email[1] 40- in person[2]	1,170 – mail	45 – mail	83 – mail 13 – email	87 – mail 79 – email
Processor	95 – mail 13 – email[1] 0 – in person[2]	67 – mail	24 – mail		4 – mail 3 – email
Ornamental	2,083 – mail 718 – email[1] 39 – in person[2]	1,956 – mail	8 – mail	67 – mail 12 – email	62 – mail 50 – email
Bee/Honey	1,993 – mail 0 -email 14- in person[2]	1,594 – mail	1 – mail	167 – mail	231 – mail
Total	**5,834 – mail** **1,290 – email**[1] **128 -In person**[2]	**4,979**	**129**	**323**	**413 – mail** **175 – email**

[1] Denotes mailings to individual email addresses, does not include listserv or forwarded/shared email invitations

[2] In person distribution numbers are estimates as individuals at meetings did not track the numbers

Sector Reports and Industry Profile Releases – our ability to develop these reports and profiles was contingent on sufficient survey responses. We delayed development of those reports with the hopes that sufficient survey responses would allow their creation. However, as shown in Table 2 above, response rates were very low, compared to our actual mailouts/handouts. Further, available census numbers for these types of producers are dated as the last Census of Agriculture was for the 2012 year. Therefore, another approach was taken to highlight the importance of the Specialty Crop Industry.

Our team is in the process of creating five fact sheets associated with segments of the Specialty Crop Industry in Arkansas. To date, three fact sheets have been published/submitted for publication related to the Beekeeping Industry[1], Fruit and Nut Production[2] and Vegetable and Melon Production[3]. A fact sheet related to the Ornamental Sales and Services Industry[4] is currently undergoing final internal review and is expected to be submitted for publication around December 1, 2017. The final fact sheet related to the Golf Course and Turf Grass Production Industry[5] is still in development and expected to be submitted for publication in late December.

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[1] English, L. B. Anderson, J. Popp, J. Zawislak, M. Richardson and R. Rainey. 2017. **Arkansas Specialty Crop Profile: Beekeeping.** Fact Sheet Number FSA46. University of Arkansas System, Cooperative Extension Service. Little Rock, AR. Downloadable from the web at: https://www.uaex.edu/publications/pdf/FSA-46.pdf *also submitted with this report*

[2] English, L. B. Anderson, J. Popp, A. McWhirt, W. P. Miller, M. Richardson and R. Rainey. 2017. **Arkansas Specialty Crop Profile: Fruit and Nut Production.** Fact Sheet Number FSA47. University of Arkansas System, Cooperative Extension Service. Little Rock, AR. Downloadable from the web at: https://www.uaex.edu/publications/pdf/FSA-47.pdf *also submitted with this report*

[3] English, L. B. Anderson, J. Popp, A. McWhirt, W. P. Miller, M. Richardson and R. Rainey. Forthcoming. **Arkansas Specialty Crop Profile: Vegetable and Melon Production.** Submitted for publication to the Cooperative Extension Service in November 2017. (expected Fact Sheet Number FSA48) *also submitted with this report*

[4] English, L. B. Anderson, J. Popp, J. Robbins, M. Richardson and R. Rainey. Under internal review. **Arkansas Specialty Crop Profile: Ornamental Sales and Services Industry.** For submission for publication to the Cooperative Extension Service in December 2017.

[5] English, L. B. Anderson, J. Popp, J. Robbins, M. Richardson and R. Rainey. In development. Arkansas Specialty Crop Profile: Golf and Turf Grass Industries. For submission for publication to the Cooperative Extension Service in December 2017.

Fact sheets have been authored by PIs as well as other project staff. All fact sheets must go through a peer review process before being accepted by publication by the University of Arkansas System, Cooperative Extension Service.

We have taken a similar approach in the development of each fact sheet. Each one contains a section that provides an overview of the industry. Based in part on survey responses, Census of Agriculture data and expert industry opinion we list trends (over the last 10-20 years) and outlook for the industry. Major issues/challenges that each industry is facing is listed. Finally, we chose to highlight one or more businesses in that industry that are either leaders or up-and-coming in that industry. We purposely chose not to highlight some of the more well-known businesses but to place a spotlight on others, exemplifying the diversity in each industry.

While only recently produced, the first two fact sheets have been well received. Our CARS email account has received 28 emails related to those two fact sheets in the first two weeks of their releases alone. Individuals considering entering the beekeeping business seem to be particularly interested. We have referred most writers to the Cooperative Extension expert, Jon Zawislak to help ensure they receive important information before entering this industry.

Contribution Analysis – The contribution analysis was initially scheduled to be completed by August 2016. Completion of the analysis was delayed over a year for two reasons. First, from the onset of this project, data from surveys were desired to supplement data that are purchased from IMPLAN to get a more complete understanding of production, sales and labor used in the horticultural industry. Second (and more importantly), even if we had obtained what we believed to be a representative sample of responses to our surveys, the contribution analysis would have been delayed due to methodological changes made by IMPLAN in developing their databases for each state. The company's 2014-2015 initial data release (for the year 2013) was wrought with problems in the employment (jobs) and labor income categories. Personnel from this project helped sound the alarm and have worked with IMPLAN to review their methods and fix these issues and hoped-for improvements in the data that was to be released at the end of 2016 (for the 2014 calendar year) to better reflect employment and income in Arkansas.

The 214 data were released as expected in late 2016. The agricultural production sectors data (sectors 1-14) were better than previous releases but expert opinion at the Cooperative Extension Service and within the industry suggested that some of the values, particularly related

to employment in many of the agricultural industries, were still not accurate. (IMPLAN acknowledges the difficulties in estimating employment values in agriculture and suggests users replace with better data if they can find them.) Further, in previous years we had relied on USDA NASS and USDA ERS data to adjust the production sector data in the IMPLAN dataset. (IMPLAN data are generally developed using preliminary USDA values, we then update them with the final values released in the various reports). In this most recent year however, Arkansas was dropped from the reporting of many specialty crop value of production estimates. As such we were not able to make any adjustments to the IMPLAN values for sections 3 (Vegetable and Melon Farming), 4(Fruit Farming), 5(Tree and Nut Farming) and 6 (Greenhouse, Nursery and Floriculture Production).

In order to conduct our analysis, we had to first identify which of the 536 IMPLAN sectors should be included within the analysis. Our final choice of IMPLAN sectors is presented in Table 3. In some instances, it was determined that only a portion of an IMPLAN sector should be included within the analysis. For example, IMPLAN aggregates all Wholesale Trade under one sector, 395. As some, but not all, of this sector's activities involve specialty crops, methods were developed to estimate the value attributable only to specialty crops. (Otherwise, including the values associated with the entire sector would overestimate the contribution of the specialty crop sector.) Other IMPLAN sectors containing partial contributions include: 399 – Retail – Building material and garden equipment supplies stores; 400 – Retail – Food and beverage stores; 405 – Retail – General merchandise stores; 406 – Retail – Miscellaneous store retailers; and 449 – Architectural, engineering, and related services. For these cases, other data sources and industry experts were used to estimate sector employment.

Table 3 IMPLAN Sectors used in the Specialty Crop Contribution Analysis

Category		IMPLAN Sector
Specialty Crop Production	3	Vegetable and melon farming
	4	Fruit farming
	5	Tree nut farming
	6	Greenhouse, nursery, and floriculture production
Specialty Crop Processing	76	Nonchocolate confectionery manufacturing
	77	Chocolate and confectionery manufacturing from cacao beans
	78	Confectionery manufacturing from purchased chocolate
	79	Frozen fruits, juices and vegetables manufacturing
	81	Canned fruits and vegetables manufacturing
	83	Dehydrated food products manufacturing
	101	Coffee and tea manufacturing
	104	Spice and extract manufacturing
	109	Wineries
Specialty Crop Wholesale	395	Wholesale trade
Specialty Crop Retail	399	Retail - Building material and garden equipment and supplies stores
	400	Retail - Food and beverage stores
	405	Retail - General merchandise stores
	406	Retail - Miscellaneous store retailers
Specialty Crop Services	449	Architectural, engineering, and related services
	469	Landscape and horticultural services

The primary data source for employment estimations within these aggregated IMPLAN sectors was the U.S. Department of Labor, Bureau of Labor Statistics, *Quarterly Census of Employment and Wages* (USDOL BLS, 2017) [6]. This census report, known as the QCEW, breaks down employment and wages by state, all the way down to the 6-digit NAICS level. Using these data, specialty crop sectors were identified within the wholesale, retail, and services sectors. QCEW employment values were then used to estimate specialty crop industry sales, employee compensation, proprietor income, other property-type income, and taxes on production and imports using ratios developed by IMPLAN.

It should be noted that some specialty crop activities could potentially be captured through additional processing sectors such as: 82 – Canned specialties; 88 – Ice cream and frozen dessert manufacturing; 99 – Roasted nuts and peanut butter manufacturing; 103 – Mayonnaise, dressing, and sauce manufacturing; and 105 – All other food manufacturing. However, due to the lack of a reasonable means for separating the specialty crop components from these sectors, they were excluded from the analysis.

We compared this approach to the previous study (2002) and found expected differences in our estimates for the direct impacts for all sector areas (the newer values being higher to reflect growth in all of those areas since 2002) with the exception of retail. The previous report has values more than double (9697 then vs 4573 now) what we have estimated. After much discussion with the authors of the previous report it is understood that they used the value of the full subsectors in many cases because they did not have a better way to estimate that portion of the sector dedicated to the Specialty Crop Production. For example, the most recent data supplied by the Department of Labor suggests that there are many thousands of employees in the Retail Food and Beverage Stores. We are only interested in those whose jobs are connected to Specialty Crop Industry and through our procedures have estimated that portion as only 1,789 jobs. As a result, our overall values for direct employment today (19,288) are less than what was estimated at 19,640 in the 2002 study. We feel – and the authors of the previous study agree – that our

[6] USDOL BLS (U.S. Department of Labor Bureau of Labor Statistics). 2017. Quarterly Census of Employment and Wages. NAICS 6-digit industries, one area; 2015; Annual Averages; Arkansas. https://data.bls.gov/cew/apps/data_views/data_views.htm#tab=Tables. Accessed 28 September 2017.

values are more defendable than those previously released. Our study suggests that the Contribution of Arkansas' Specialty Crop Industry in 2015 is as presented in Table 4.

Table 4: Contribution Summary for Arkansas' Specialty Crop Industry, 2015

Contribution Type	Employment	Labor Income	Total Value Added
Direct Effect	19,288	$580,695,020	$ 874,628,057
Indirect Effect	2,696	$116,370,777	$ 204,875,760
Induced Effect	5,152	$207,603,751	$ 361,328,087
Total Effect	27,135	$904,669,549	$1,440,831,904

Final Research Report – We have created a report that highlights the work conducted under this grant. This report has two major sections, the first devoted to the Specialty Crop Industry Survey and the second devoted to the Economic Contribution Analysis.

We are submitting our report from this study, entitled *Arkansas Specialty Crop Industry: Economic Contribution and Characteristics,* for publication by the University of Arkansas System, Division of Agriculture, Agricultural Experiment Station as part of their Research Report Series. Submission is expected by December 1 with final publication sometime after the new year. In the meantime, a draft will be placed on the Center for Agricultural and Rural Sustainability Center website site. The website can be found at http://cars.uark.edu/. The navigation to the report will be : Our Work > Economic Contribution of Agriculture > Arkansas Economic Contribution of Agriculture Research. A new section will be added at the top of that page to highlight this new report for the Specialty Crop Industry.

GOALS AND OUTCOMES ACHIEVED

The overall goal of the project was to increase knowledge of the concerns, needs and economic contributions of the specialty crop industries in Arkansas through use of a survey instrument compiled into an industry-usable report, and published on our website. In general, we have achieved this goal. Through the economic contribution analysis, we have: (obj 1) estimated the economic contribution of the specialty crop industry to the Arkansas economy and (obj 2)

estimated the role that "local" production contributes to this sector. In our Research Report and individual fact sheets we have (obj 4) identified the issues and needs of the industry, and (obj 5) highlight stories from within this industry that represent its strength, diversity, and social/economic importance within Arkansas. Given the underwhelming response to our surveys we were unable to describe the size and scope of the industry better than existing sources (e.g. census of agriculture among others).

As our fact sheets and Research Report are newly released, we cannot fully examine the impact of our efforts to date. However, one unexpected positive outcome is that by having to rely more heavily on secondary data than we had hoped, we had to develop defendable science based procedures on how to derive special crop contributions (particularly in employment) to broader sectors (like retail and wholesale and restaurants). This should, in the future, allow researchers to estimate well the contribution of the specialty crop sector using secondary data, meaning studies can be replicated more regularly and at cheaper costs.

Unfortunately, unexpected illness delayed the online publication of the report beyond the performance period. As the report is not yet published, the number of downloads is zero. However, that number is very likely to grow after publication.

BENEFICIARIES

The beneficiaries are those individuals in the state directly involved in the specialty crop industry as well as those indirectly impacted. Highlighting the contributions of the specialty crop industry not only helps the 19,000+ who work within the specialty crop industry but also the almost 8000 additional individuals whose jobs exist because of the specialty crop industry contributions in the state. It is hoped that the Arkansas Agriculture Department, Industry Organizations, Farm Bureau and others who advocate for agriculture can use this information to help inform consumers and policy makers of the importance of supporting the Arkansas Specialty Crop Industry, in legislation, agricultural and industry supply services and in the marketplace.

LESSONS LEARNED

Many of the issues that arose throughout the project have been discussed under the project approach section. We continue to work with a team of economists nationwide to help make

improvements to IMPLAN data (related to specialty crops and other agricultural industries). The greatest challenge to this project by far was securing the primary data we desired to achieve our goals. The problem was two-fold 1) poor distribution lists for some types of industry businesses and 2) potential respondent survey fatigue and/or distrust of our use of the information. We anticipated some problems in both areas and set out early on (particularly the charge of our Cooperative Extension PIs) to advertise our efforts and explain the potential benefits of participating in our study. However, our efforts fell short. Without robust survey data we were unable to achieve our objective three (describe the size, structure and components of the industry) that would replace any existing secondary sources. More efforts are needed to develop better distribution lists of all specialty crop industry businesses that can be maintained centrally and shared with researchers for approved purposes.

There are many successes associated with the project. Survey data have allowed us to gain a better understanding of the role of local in the sector (obj 2) and also highlighted some of the important issues and needs of the industry (obj 4). A series of fact sheets developed through this grant and published by the University of Arkansas Cooperative Extension Service highlights stories from within this industry that represent its strength, diversity, and social/economic importance within Arkansas (obj 5).

The primary purpose of this project (objective 1) was to identify the contributions of the specialty crop industry to the state. This has been accomplished and represents the first study of its kind in over a decade. This information, when published on our website in the new year (still receiving internal approvals) will be circulated widely within agricultural communities and in consumer education programs. Most importantly, and unexpectedly, by having to rely on secondary data sources we have developed a peer reviewed method of estimating direct employment in specialty crop industries that is not easily discernable from heavily aggregated datasets. This method will allow us – and other researchers – to conduct analyses using researcher approved secondary data sources that will yield reasonable estimates of the contribution of specialty crop industry to a state's economy.

CHALLENGES

As discussed in the previous section, our team has experienced unexpected challenges associated with three activities: Mailing List Development, Survey Execution, Report/Profile Releases and Contribution Analysis Assessment. We addressed each challenge to the best of our ability. We continue to work with a team of economists nationwide to help make improvements to IMPLAN data (related to specialty crops and other agricultural industries). But the greater challenge is in establishing a comprehensive and current mailing list of specialty crop producers, processors and other businesses in the state. We have shared our mailing list with the Cooperative Extension Service personnel again, as they work on a related project. Our hope is that they can build upon our known good emails/street addresses to better contact producers/processors/businesses in the state.

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Project 4: Arkansas Fresh-Market Blackberries: Evaluating Postharvest Attributes that Impact Marketability

FINAL REPORT

PROJECT SUMMARY

Locally-grown fresh-market blackberries have potential for an increased role in United States. Although the agricultural data is sparse for small fruit specialty crops within each state, Arkansas is a prime example of a state with underutilized capability for the production of fresh-market blackberries. There is a critical need to determine the role that fresh-market blackberry genotypes (advanced selections and cultivars) will play in the potential expansion of U.S. markets. Since the University of Arkansas fruit breeding program is one of the world's largest blackberry breeding programs and has released many of the cultivars used in U.S. fresh-market production, Arkansas is the logical location to evaluate the postharvest storage capability of this fruit. This proposal from the University of Arkansas offers a collaborative approach to address challenges that face the blackberry industry, by identifying postharvest potential through the following objectives:

1. Identify quality-based attributes of fresh-market blackberries during postharvest storage
Measure berry attributes, pyrene attributes, and postharvest quality attributes of fresh-market blackberry genotypes during postharvest storage

2. Evaluate composition-based attributes of fresh-market blackberries during postharvest storage
Measure basic composition attributes and nutraceutical composition attributes of fresh-market blackberry genotypes during postharvest storage

3. Determine sensory characteristics of fresh-market blackberries during postharvest storage
Conduct descriptive analysis to determine key sensory characteristics of fresh-market blackberry genotypes during postharvest storage

4. Disseminate information to fresh-market blackberry industry to improve marketability
Provide the blackberry industry with information on the composition, postharvest quality, and sensory attributes that drive marketability for fresh-market blackberry genotypes and how marketability is impacted during postharvest storage.

This project was built on a previously funded project from the Specialty Crop Block Grant Program 2013 that focused on the composition and sensory (consumer and descriptive) attributes for blackberries.

PROJECT APPROACH

Summary of Activities Performed:
BACKGROUND: Since the consumption of fresh blackberries has increased, the demand for new cultivars with extended postharvest quality that meet consumer expectations has increased.
OBJECTIVE: The objective of this study was to identify fresh-market blackberry genotypes with high postharvest potential and evaluate changes in physiochemical and sensory attributes.
METHODS: Fruit quality, chemical composition and descriptive sensory attributes of five blackberry cultivars (Natchez, Osage, Ouachita, Prime-Ark® 45 and Prime-Ark® Traveler) and

six advanced breeding selections from the University of Arkansas Fruit Breeding Program were evaluated at harvest and after 7 days of storage (2◦C and 90% RH). Fruit quality (firmness, red drupelets, weight loss and unmarketability) and chemical composition (basic composition and phytochemicals) were evaluated, and a trained descriptive sensory panel (n = 8-9) evaluated blackberry attributes for appearance, basic tastes, feeling factors, aromatics and texture.
RESULTS: The blackberries had soluble solids of 6.6–10.9% and titratable acidity of 0.5–1.5% at harvest. 'Natchez' had the lowest percent of unmarketable fruit (2.9%) and A-2418 had the highest (53.6%) after 7 days of postharvest storage. After 7 days of storage, 'Natchez' and A-2453 had low incidence of red drupelets and high uniformity of color and 'Natchez'and A-2491 were associated with the sensory attributes of sweetness and overall aromatic impact. The sensory panelists could not perceive differences in color, uniformity of color, glossiness, firmness or sweetness after storage, but perceived blackberries as more astringent and less sour and bitter after storage. These sensory findings correspond with the fruit quality and chemical composition data that indicated no changes for incidence of red drupelets, firmness or soluble solids of blackberries after storage. However, blackberries had increased total phenolics, flavonols, anthocyanins and ellagitannins, and decreased titratable acidity after storage. After storage, total phenolics and total ellagitannins of blackberries were positively correlated to bitter and sour basic tastes.
CONCLUSION: Fruit quality and chemical composition analyses correlated to sensory attributes and may assist blackberry breeders in developing cultivars with extended postharvest storage and superior fruit attributes. 'Natchez', A-2453 and A-2491 showed positive fruit attributes in this study and have potential for the development of future cultivars or used as parents for crosses in blackberry breeding programs.

Significant Contributions and Role of Project Partners:
This project was done as a collaborative effort between the Institute of Food Science and Engineering, Food Science Department and Horticulture Department at the University of Arkansas System Division of Agriculture. Dr. Renee Threlfall, PI for the project, designed and implemented this study working with Dr. John Clark and Dr. Luke Howard. Drs. Clark and Threlfall supervised the Horticulture Department visiting post doctorial associate, Dr. Daniela Segantini. Dr. Segatini's work was sponsored by Departmento de Horticultura, Produção Vegetal, Universidade Estadual Paulista/UNESP, Botucatu, SP, Brasil (Note: Dr. Segantini was financially sponsored by the CAPES Foundation, Brazil to work on this project.) Dr. Segantini worked at the Fruit Research Station, Clarksville, AR (where the fruit was grown) and in laboratories at the Department of Food Science. Cindi Brownmiller, Dr. Howard's technician worked with Dr. Segantini to complete the nutraceutical analysis of the blackberries. Dr. Threlfall worked with Dr. Segantini on the data collection and analysis for presentations, posters, and publications.

Dr. Renee Threlfall served as the Principal Investigator for the research, managed the funds, created the project design, coauthored the publication, presented invited talks, posters and presentations from data from this project, and supervised the post-doctoral working on the project.

Dr. John R. Clark contributed to the project by selecting the cultivars and advanced selections, providing input on the harvest dates, and coauthoring the publication, presentations and posters.

Dr. Luke Howard contributed to the project assisting with methods for phytochemical analysis, interpreting data and coauthoring the publication, presentations and posters from this project.

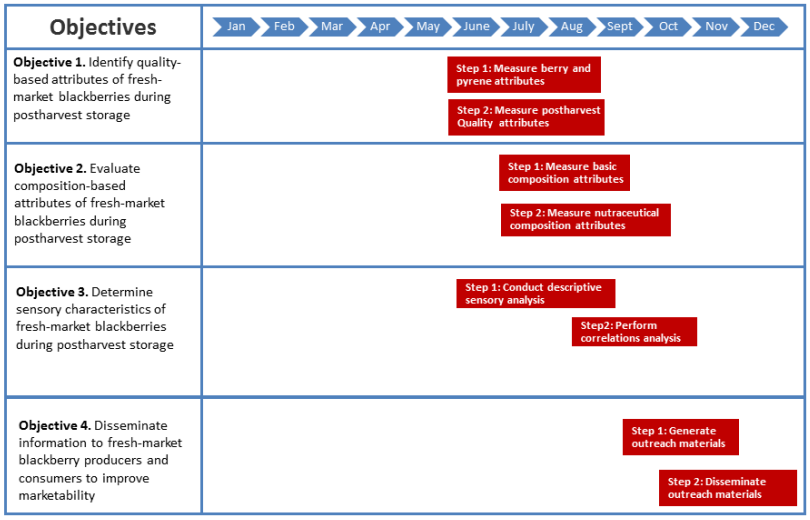
Dr. Daniela Segantini managed the research for this project, was the lead author of the publication, and presented posters and presentations from data from this project.

How Specialty Crops Benefitted:
Through this grant, we have identified University of Arkansas blackberry cultivars and advanced selections that have postharvest potential for commercial fresh markets. These fresh-market cultivars can be grown in Arkansas but also can be grown world-wide. The project directly benefited the University of Arkansas Fruit Breeding Program by producing data on cultivars and advanced selections for potential release.

GOALS AND OUTCOMES ACHIEVED

Activities Completed:
The following is the timeline for the project with the main objectives and steps for each objective of the project.

Project Timeline (January 2015-December 2015)
Arkansas Fresh-Market Blackberries: Evaluating Postharvest Attributes that Impact Marketability



Objective 1. Identify quality-based attributes of fresh-market blackberries during postharvest storage
Measure berry attributes, pyrene attributes, and postharvest quality attributes of fresh-market blackberry genotypes during postharvest storage

Step 1 Berry and Pyrene Analysis: The berry and pyrene attributes of 24 fresh-market blackberry genotypes were measured.

Status: Complete July 2015

Step 2 Postharvest Quality Analysis: The postharvest attributes of 18 fresh-market blackberry genotypes were measured.

Status: Complete July 2015

Objective 2. Evaluate composition-based attributes of fresh-market blackberries during postharvest storage

Measure basic composition attributes and nutraceutical composition attributes of fresh-market blackberry genotypes during postharvest storage

Step 1 Basic Composition Analysis: Soluble solids, pH and titratable acidity of the blackberry genotypes stored at 0 and 7 days were measured.

Status: Complete September 2015

Step 2 Nutraceutical Analysis: Nutraceutical analysis of the blackberry genotypes stored at 0 and 7 days were measured.

Status: Complete January 2016

Objective 3. Determine sensory characteristics of fresh-market blackberries during postharvest storage

Conduct descriptive analysis to determine key sensory characteristics of fresh-market blackberry genotypes during postharvest storage

Step 1 Descriptive Sensory Analysis: Descriptive sensory analysis of the 11 fresh-market blackberry genotypes stored at 0 and 7 days were conducted at the Sensory Research and Consumer Center, in the Food Science Department at the University of Arkansas.

Status: Complete July 2015

Step 2 Correlation Analysis: Correlation analysis of sensory and physiochemical data of 11 genotypes stored at 0 and 7 days were done.

Status: Complete August 2016

Objective 4. Disseminate information to fresh-market blackberry industry to improve marketability

Provide the blackberry industry with information on the composition, postharvest quality, and sensory attributes that drive marketability for fresh-market blackberry genotypes and how marketability is impacted during postharvest storage.

Step 1 Generating Outreach Plan: Information on sensory profiles and composition and nutraceutical attributes will be generated to support outreach initiatives of the project.

Status: Complete September 2017

Step 2 Disseminating Outreach Plan: The information will be presented at field meetings, workshops, web-based seminars, and written reports/handouts to introduce the evaluated genotypes.

Status: Complete September 2017

Progress towards Long Term Outcome Measures:

Awareness of the potential for University of Arkansas fresh-market cultivars for commercial use will increase because of this data.

Comparison of Accomplishment to Goals:
The accomplishments of the goals of the proposed work were on track with the work plan that was outlined in the project and stated in the summary of activities.

Baseline Data and Progress to Targets:
The major targets for the work plan outcomes were to successfully harvest blackberries for sensory analysis and physiochemical analysis, evaluate the genotypes during post-harvest storage, then to investigate major findings and disseminate findings with the public. This work is unique in that there has not been any investigation in fresh-market blackberries on this scale, particularly with sensory data. This project has generated data that can be used in further projects on blackberries and to assist the University of Arkansas Blackberry Breeding Program with the selection process for new blackberry genotype releases. Progress and targets for the year were discussed in the summary of activities. This project has the data that will be used to support the 2014 and 2016 work funded by the Arkansas Agriculture Department Specialty Crop Block grants for blackberries, which will provide three years of data on physiochemical and descriptive sensory for future presentations and publications.

The data showed there were significant interactions among the 11 blackberry genotypes and postharvest storage (day 0 versus day 7) for many of the fruit quality, chemical composition and sensory attributes (Tables 1 and 2). In general, the significant interactions were strongly influenced by the genotypes, rather than postharvest storage.

Objective 1. Identify quality-based attributes of fresh-market blackberries during postharvest storage

Post-harvest Quality Attributes. At harvest, the blackberries had a range of firmness (4.9-9.0 N) and red drupelets (0.3-4.4%), whereas after storage the range of firmness was 4.0-10.1 N and red drupelets was 0-6.4%. **For most genotypes, storage did not affect firmness**, except A-2491 had decreased firmness after storage (Table 3). Storage did not affect the development of red drupelets. The blackberry genotypes in this study had low red drupelets (<6%). A-2453, the only genotype evaluated with the unique crispy texture, had the lowest percent of red drupelets (0.7%) (Table 1).

Weight loss and unmarketable fruit of blackberries stored in clamshells were evaluated after storage. Weight loss was very low (< 3%) for all the genotypes. A-2491 had the highest weight loss (3.0%) and A-2453 the lowest (0.2%) (Fig. 1). There were large differences in the genotypes in terms of unmarketable fruit. **'Natchez' had the lowest percent of unmarketable fruit (2.9%), demonstrating the potential for 'Natchez' as a fresh-market fruit, while A-2418 had the highest unmarketable fruit (53.6%)** (Fig. 2). The more firm the blackberry, then the more potential for postharvest storage.

Objective 2. Evaluate composition-based attributes of fresh-market blackberries during postharvest storage

Basic Composition Analysis. At harvest, the blackberries had a range of soluble solids (6.6-10.9%), pH (3.1-3.9) titratable acidity (0.5-1.3%), and SS/TA ratio (4.7-19.5). In this study, the **level of soluble solids was not affected by storage**. A-2434 and A-2491 had the highest levels of soluble solids, 10.4% and 10.6%, respectively, while A-2418 had the lowest (6.9%).

However, **storage induced an increase in pH and a reduction of titratable acidity.** At harvest, genotypes had a pH of 3.3 and after 7 days of storage had pH of 3.4. A-2453 had the highest pH (3.8), while the pH of other genotypes ranged from 3.1 to 3.4 (Table 1). There was an interaction between genotype and storage for titratable acidity and SS/TA ratio. After 7 days of storage, the titratable acidity decreased by 28% for A-2418 and A-2434. The titratable acidity decreased by 40% in 'Ouachita', but increased by 28.0% in 'Osage' (Table 3). SS/TA ratio decreased 30.0% for A-2453 and 51.0% for 'Osage', and increased 53.0% for 'Ouachita' (Table 4).

Phytochemical analysis. The phytochemical levels varied among the genotypes but all increased after 7 days of storage at 2°C (Table 1). Before storage, the level of total phenolics was 382.2 mg GAE/100g, the level of anthocyanins was 206.0 mg C3GE/100g, the level of flavonols was 7.7 mg RE/100 g, and the level of ellagitannins was 27.1 mg EAE/100 g. After storage, the level of total phenolics increased 17.0%, anthocyanins 9.0%, flavonols 53.0% and ellagitannins 13.0%. The storage of blackberries for 15 days at 2°C, increased the level of total anthocyanins, total flavonols and total phenolics by 3.2%, 10.4% and 8.7%, respectively in 'Natchez', 38.0%, 19.8% and 32.0%, respectively in 'Ouachita', and 48.0%, 33.6% and 59.8%, respectively in 'Navaho'. Selection A-2450 had the highest level of total phenolics and total anthocyanins, 502.8 mg GAE/100 g and 271.8 mg C3GE/100 g, respectively, while 'Prime-Ark® Traveler' had the lowest levels (336.3 mg GAE/100 g and 124.4 mg C3GE/100 g). 'Prime-Ark® 45' had the highest level of total flavonols (14.8 mg RE/100 g) and 'Ouachita' the lowest (6.3 mg RE/100 g). 'Natchez' had the highest level of total ellagitannins (42.8 mg EAE/100 g) and A-2453 the lowest (18.2 mg EAE/100 g) (Table 1).

Objective 3. Determine sensory characteristics of fresh-market blackberries during postharvest storage

Descriptive Sensory Analysis. The panelists did not detect differences in the color and uniformity of color of the blackberries. On the 15-point scale the blackberries were scored as very dark and uniform. A-2453 was the glossiest genotype and 'Prime-Ark® 45' was the least glossy. **Glossiness of the blackberries was not impacted by storage.**

Storage did not impact the hardness of the blackberries, but hardness varied by genotype with 'Natchez', 'Ouachita', 'Prime-Ark® Traveler' and A-2491 as the softest and A-2453 the firmest. Panelists identified a decrease of the popping attribute for the genotypes A-2434, A-2450, A-2491, 'Natchez' and 'Prime-Ark 45®' after 7 days of storage (Table 4).Before storage, panelists identified A-2491 as the sweetest (soluble solids 10.9%) and A-2418 as the least sweet (soluble solids 6.6%) and found the sweetness of A-2491 and 'Natchez' decreased during storage. In terms of sourness after storage, A-2434, A-2450, A-2491, 'Natchez', 'Prime-Ark® 45' and 'Prime-Ark® Traveler' showed a reduction of sourness, while 'Osage' showed an increase. After storage, A-2418 was the sourest, while A-2491 the least sour. Panelists did not find differences among genotypes for bitterness, but found that berries were bitterer before storage, but overall bitterness was low. Astringent feeling factor varied among genotypes and increased from after storage. The metallic feeling factor (biting into tin foil as a reference) of the blackberries was very low. There was not a difference between genotypes found, but the metallic feeling increased after storage. The intensity of overall aromatics ranged from 7.0 to 8.3 with A-2491 having the highest intensity,

but the **overall aromatics were impacted by storage with a decrease in the intensity of overall aromatics after 7 days of storage.**

Correlation Analysis: Principal component analysis was used to segregate genotypes into different organoleptic groups (Table 5). The perception of sensory attributes and analytical attributes was reduced to three principal components, which explained 71.1% and 72.2% of data variance, at harvest and after storage, respectively. At harvest, the positive loadings in component 1 were astringent feeling factor, metallic feeling factor and titratable acidity associated with APF-268 and A-2434, while the negative loadings were pH and SS/TA ratio associated with A-2453. The positive loadings in component 2 were sour taste, popping, total flavonols and total phenolics associated with A-2450 and 'Prime-Ark® 45', while the negative loadings were red drupelets incidence and color associated with 'Ouachita'. The positive loadings in component 3 were sweet taste, overall aromatic impact, uniformity of color and soluble solids associated with A-2491 and 'Natchez', while the negative loading was hardness associated with A-2418. After storage, the positive loadings in component 1 were sour taste, astringent feeling factor, metallic feeling factor and titratable acidity associated with A-2418 and A-2450, while the negative loadings were sweet taste, soluble solids and SS/TA ratio associated with A-2491. The positive loadings in component 2 were glossiness, hardness and popping associated with A-2453, while the negative loadings were bitter taste, overall aromatic impact, total flavonols and total ellagitannins associated with 'Prime-Ark® 45' and 'Natchez'. The positive loadings in component 3 were color, uniformity of color, total phenolics and total anthocyanins associated with A-2453 and 'Natchez', while the negative loading was red drupelet incidence associated with 'Ouachita'. **The shifts in the multidimensional sensory and analytical dimensions between 0 and 7 days of storage indicate the need for examining changes in genotypes over time.**

Objective 4. Disseminate information to fresh-market blackberry industry to improve marketability

Generating Outreach Plan: Outreach was generated in the form of manuscripts, workshops, presentations and posters.

Disseminating Outreach Plan: Outreach was disseminated in the form of manuscripts, workshops, presentations and posters.

Papers Published

Segantini, D.M., R.T. Threlfall, J.R. Clark, C.R. Brownmiller, L.R. Howard, and L.J.R. Lawless. 2017. Changes in fresh-market and sensory attributes of blackberry genotypes after postharvest storage. J. Berry Research 7: 129-145.

Invited Presentations

Perkins-Veazie, P., and R.T. Threlfall. 2017. Picking, Cooling, Storing, Shipping and Consumer Tasting Small Fruits. Southern Region Small Fruit Consortium Agent Training. Southeast Regional Fruit and Vegetable Conference, January 5-8, 2017, Savanah, GA.

Threlfall, R.T. 2017. Postharvest Management of Blackberries. Arkansas Blackberry School. June 13, 2017, Clarksville, AR.

Abstracts Published

Threlfall*, R.T., D.M. Segantini, and J.R. Clark. 2016. Descriptive Sensory Attributes of Arkansas Blackberries Harvested Multiple Years. American Society for Horticultural Science Annual Conference, August 8-11, 2016, Atlanta, GA. Poster #264 Add supplement info

Segantini*, D.M., R.T. Threlfall, J.R. Clark, C.R. Brownmiller and L.R. Howard. 2016. Changes in Nutraceutical Compounds during Postharvest Storage of Blackberries. American Society for Horticultural Science Annual Conference, August 8-11, 2016, Atlanta, GA. Poster #183

Segantini*, D.M., R.T. Threlfall, J.R. Clark, C.R. Brownmiller and L.R. Howard. 2016. Identification of Sugars and Organic Acids in Arkansas Blackberry Genotypes that Impact Sensory Perception. Southern Region-American Society for Horticulture Science Annual Meeting. February 5-7, San Antonio, TX.

Segantini*, D.M., R.T. Threlfall, and J.R. Clark. 2016. Changes in Composition and Descriptive Sensory Attributes of Blackberries during Postharvest Storage. American Society for Horticultural Science Annual Conference, August 8-11, 2016, Atlanta, GA.

Segantini*, D.M., R.T. Threlfall, and J.R. Clark. 2016. Fresh-Market Attributes Impacted by Postharvest Storage of Blackberry Genotypes. Southern Region-American Society for Horticulture Science Annual Meeting. February 5-7, San Antonio, TX.

Poster Presentations

Threlfall*, R.T., D.M. Segantini, and J.R. Clark. 2017. Descriptive Sensory Attributes of Arkansas Fresh-market Blackberry Cultivars Harvested Multiple Years. Southern Region-American Society for Horticulture Science Annual Meeting. February 3-7, Mobile, AL. Poster #4

Segantini, D.M., R.T. Threlfall*, J.R. Clark, L.R. Howard, and C.R. Brownmiller. 2017. Physiochemical Contents Impacted by Post-harvest Storage and Harvest Season of Primocane Blackberry Genotypes. Southern Region-American Society for Horticulture Science Annual Meeting. February 3-7, Mobile, AL. Poster #12

M.H. Yin*, B.M. Sebesta, R.T. Threlfall, and J.R. Clark. 2017. Blackberry Red Drupelet Incidence After Cold Storage and Associated Fruit Quality Implications. Physiochemical Contents Impacted by Post-harvest Storage and Harvest Season of Primocane Blackberry Genotypes. Southern Region-American Society for Horticulture Science Annual Meeting. February 3-7, Mobile, AL. Poster #2G

Threlfall*, R.T., D.M. Segantini, and J.R. Clark. 2016. Descriptive Sensory Attributes of Arkansas Blackberries Harvested Multiple Years. American Society for Horticultural Science Annual Conference, August 8-11, 2016, Atlanta, GA. Poster #264

Segantini*, D.M., R.T. Threlfall, J.R. Clark, C.R. Brownmiller and L.R. Howard. 2016. Changes in Nutraceutical Compounds during Postharvest Storage of Blackberries. American Society for Horticultural Science Annual Conference, August 8-11, 2016, Atlanta, GA. Poster #183

Segantini*, D.M., R.T. Threlfall, J.R. Clark, C.R. Brownmiller and L.R. Howard. 2016. Identification of Sugars and Organic Acids in Arkansas Blackberry Genotypes that Impact Sensory Perception. Southern Region-American Society for Horticulture Science Annual Meeting. February 5-7, San Antonio, TX.

Oral Presentations

Threlfall*, R.T., D.M. Segantini, and J.R. Clark. 2017. Determining How Sweetness and Sourness Perception Impacts Consumer Sensory of Presh-market Blackberries. Southern Region-American Society for Horticulture Science Annual Meeting. February 3-7, Mobile, AL.

Segantini, D.M., R.T. Threlfall*, and J.R. Clark. 2017. Physiochemical Attributes Impacted by Post-harvest Storage and Harvest Season of Primocane Blackberry Genotypes. Southern Region-American Society for Horticulture Science Annual Meeting. February 3-7, Mobile, AL.

Segantini*, D.M., R.T. Threlfall, and J.R. Clark. 2016. Changes in Composition and Descriptive Sensory Attributes of Blackberries during Postharvest Storage. American Society for Horticultural Science Annual Conference, August 8-11, 2016, Atlanta, GA.

Segantini*, D.M., R.T. Threlfall, and J.R. Clark. 2016. Fresh-Market Attributes Impacted by Postharvest Storage of Blackberry Genotypes. Southern Region-American Society for Horticulture Science Annual Meeting. February 5-7, San Antonio, TX.

Segantini*, D.M., R.T. Threlfall, and J.R. Clark. 2016. Postharvest and Storage of Fresh-market Blackberries. University of Arkansas System Division of Agriculture Blackberry Workshop and Field Day. June 9. Clarksville, AR.

Successful Outcomes in Quantifiable Terms:

1 refereed manuscript published in journal
6 abstracts published in journals
2 invited presentations at workshops
6 posters presented at conferences
5 presentations presented at conferences
1 self-funded postdoctoral scientist recruited to assist with the project

BENEFICIARIES

Groups Benefited from Project:

Blackberry farmers and consumers benefited from this project that identified University of Arkansas blackberries that have postharvest potential for commercial fresh markets. These fresh-market cultivars can be grown in Arkansas but also can be grown world-wide.

Quantitative Data or Economic Impact of the Project:
The economic impact of these actions are difficult to establish at this time, we estimate that the production of blackberries will be increased.

Number of Beneficiaries:

Dissemination of data from this project has reached over 100 growers and 200 researchers and extension agents throughout the United States, exceeding the target of 100 individuals reached through presentations.

According to ResearchGate.net, the refereed article produced by the project and published in the Journal of Berry Research had 42 online "reads", reaching 42% of our target of 100 downloads.

LESSONS LEARNED

Our biggest concern with this project was the unpredictability of working with fresh fruit and planning the analysis. A collaborative approach with partners from other research areas was beneficial to identifying postharvest potential and should be considered with addressing similar issues. Results identified in this research may assist blackberry breeders in developing cultivars with extended postharvest storage and superior fruit attributes.

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ADDITIONAL INFORMATION

See Below.

Table 1. Main and interactive effects of storage and genotypes on fruit quality and chemical composition of fresh-market blackberry genotypes at harvest (day 0) and after storage at 2°C for 7 days, Clarksville, AR, 2015.

	Firmness (Newtons)	**Red drupelets (%)**	**Soluble solids (%)**	**pH**	**Titratable acidity (%)**	**SS/TA ratio**	**Total anthocyanins (mg/100 g)**	**Total Flavonols (mg/100 g)**	**Total ellagitannins (mg/100 g)**	**Total phenolics (mg/100 g)**
Storage (S)										
Day 0	6.7 a	2.5 a	8.5 a	3.3 a	1.0 a	9.5 b	206.0 b	7.7 b	27.1 b	382.2 b
Day 7	6.5 a	2.2 a	8.6 a	3.4 b	0.9 b	10.8 a	225.0 a	11.8 a	30.7 a	447.0 a
(S) main effect (P value)	0.2619	0.6364	0.6491	0.0010*	0.0031*	0.1385	0.0462*	<0.0001*	0.0093*	0.0002*
Genotype (G)										
A-2418	7.4 bc	1.3 ab	6.9 d	3.2 b	1.3 a	5.8 c	202.4 abc	7.8 bc	33.1 ab	398.5 abc
A-2434	6.2 cd	1.8 ab	10.4 a	3.2 b	1.2 ab	9.0 bc	176.9 cd	7.9 bc	32.6 ab	424.9 abc
A-2450	8.8 a	1.7 ab	7.2 cd	3.3 b	1.1 abc	6.8 c	271.8 a	13.8 ab	29.2 bc	502.8 a
A-2453	9.6 a	0.7 b	8.9 abc	3.8 a	0.6 d	16.6 a	254.1 ab	8.5 abc	18.2 d	423.2 abc
A-2491	5.3 d	1.3 ab	10.6 a	3.4 b	0.8 cd	14.5 ab	226.9 abc	7.7 bc	21.8 cd	362.1 bc
APF-268	7.4 bc	3.4 ab	7.2 cd	3.1 b	1.1 abc	6.4 c	192.1 bcd	10.8 abc	36.1 ab	366.8 bc
Natchez	5.2 d	1.0 ab	9.1 ab	3.4 b	0.9 abcd	10.4 abc	244.9 abc	10.6 abc	42.8 a	497.4 a
Osage	5.2 d	1.7 ab	8.4 bcd	3.4 b	0.9 abcd	11.3 abc	265.6 ab	10.2 abc	19.7 cd	420.4 abc
Ouachita	5.1 d	6.1 a	9.2 ab	3.4 b	1.0 abcd	11.4 abc	197.3 bcd	6.3 c	20.0 cd	356.5 bc
Prime-Ark® 45	5.9 cd	1.6 ab	8.0 bcd	3.4 b	0.9 abcd	9.3 bc	213.1 abc	14.8 a	37.1 ab	471.7 ab
Prime-Ark® Traveler	6.6 cd	4.9 ab	8.5 bcd	3.4 b	0.9 bcd	10.6 abc	124.4 d	8.8 abc	27.5 bcd	336.3 c
(G) main effect (P value)	<0.0001*	0.0191*	<0.0001*	<0.0001*	<0.0001*	<0.0001*	<0.0001*	0.0007*	<0.0001*	<0.0001*
(G) x (S) interactive effects (P value)	0.0344*	0.9225	0.0881	0.5249	0.0287*	0.0157*	0.8164	0.5066	0.2411	0.6420

Genotypes were evaluated in triplicate (n=3).
* Significant for the *F-test*.
Means with different letter(s) for each attribute within main effects are significantly different (p<0.05) using Tukey's HSD test.
Titratable acidity expressed as % citric acid.
SS/TA ratio is soluble solids/titratable acidity ratio.
Fresh weight of blackberries for total anthocyanins (mg cyanidin 3-glucoside/100 g); total flavonols (mg rutin equivalents/100 g); ellagitannins (mg ellagic acid equivalents/100 g); total phenolics (mg gallic acid equivalents/100 g).

Table 2. Main and interactive effects of storage and genotypes on descriptive sensory attributes of fresh-market blackberry genotypes at harvest (day 0) and after storage at 2°C for 7 days, Clarksville, AR, 2015.

	Color	**Uniformity of color**	**Glossiness**	**Hardness**	**Popping**	**Sweet**	**Sour**	**Bitter**	**Astringent feeling**	**Metallic feeling**	**Overall aromatic impact**
Storage											
Day 0	13.6 a	13.5 a	10.8 a	3.8 a	7.5 a	4.3 a	4.7 a	2.2 a	6.0 b	1.3 b	7.9 a
Day 7	13.7 a	13.4 a	11.1 a	3.8 a	6.8 b	4.1 a	4.4 b	2.0 b	6.3 a	1.7 a	7.6 b
(S) main effect (P value)	0.3509	0.4221	0.2182	0.2214	0.0009*	0.0800	0.0200*	0.0250*	0.0060*	<0.0001*	0.0005*
Genotype											
A-2418	13.7 a	13.46 a	11.1 ab	4.1 ab	7.5 a	3.6 d	5.4 a	1.9 a	6.3 a	1.7 a	7.4 def
A-2434	13.7 a	13.46 a	11.0 ab	3.9 bc	7.3 a	4.7 ab	4.6 abc	2.2 a	6.2 ab	1.6 a	8.2 abc
A-2450	13.6 a	13.52 a	10.6 abc	3.8 bc	7.1 a	3.9 bcd	5.1 ab	2.4 a	6.4 a	1.5 a	7.8 abcde
A-2453	13.8 a	13.31 a	11.8 a	4.4 a	7.7 a	4.0 bcd	3.9 c	2.1 a	5.7 b	1.4 a	7.0 f
A-2491	13.5 a	13.55 a	11.1 ab	3.6 c	7.1 a	5.0 a	3.9 c	2.0 a	5.9 ab	1.3 a	8.3 a
APF-268	13.7 a	13.37 a	10.9 ab	3.8 bc	7.2 a	3.9 bcd	4.8 abc	2.0 a	6.3 ab	1.6 a	7.5 def
Natchez	13.7 a	13.73 a	11.4 ab	3.6 c	7.2 a	4.4 abc	4.5 abc	2.1 a	6.1 ab	1.4 a	8.3 ab
Osage	13.6 a	13.41 a	11.3 ab	3.7 bc	7.0 a	4.1 bcd	4.2 bc	2.1 a	6.2 ab	1.5 a	7.4 ef
Ouachita	13.6 a	13.12 a	11.6 a	3.6 c	7.0 a	4.3 abcd	4.1 bc	2.0 a	6.1 ab	1.6 a	7.6 cdef
Prime-Ark® 45	13.2 a	13.11 a	9.4 c	3.8 bc	7.2 a	3.8 cd	5.0 ab	2.3 a	6.2 ab	1.3 a	7.7 bcde
Prime-Ark® Traveler	13.6 a	13.52 a	10.3 bc	3.6 c	6.9 a	4.6 ab	4.3 abc	2.0 a	6.1 ab	1.4 a	8.0 abcd
(G) main effect (P value)	0.0776	0.1430	<0.0001*	<0.0001*	0.8229	<0.0001*	<0.0001*	0.2963*	0.0250*	0.6497	<0.0001*
(S) x (G) interactive effects (P value)	0.0989	0.1422	0.0002*	0.9059	0.0209*	0.0278*	<0.0001*	0.4444	0.4632	0.9668	0.4293

Genotypes were evaluated in duplicate by 8-9 trained panelists.
*Significant for the *F-test*.
Means with different letter(s) for each attribute within main effects are significantly different ($p<0.05$) using Tukey's HSD.
Attributes evaluated on a 15-point scale (0=less of the attribute and 15=more of the attribute in terms of intensity).

Table 3. Fruit quality and chemical composition of fresh-market blackberry genotypes at harvest (day 0) and after storage at 2°C for 7 days and interactions, Clarksville, AR, 2015.

Genotype	**Storage**	**Firmness (Newtons)**	**Red drupelets (%)**	**Soluble solids (%)**	**pH**	**Titratable acidity (%)**	**SS/TA Ratio**
A-2418	Day 0	7.2 abc	3.1 a	6.6 d	3.1 b	1.5 a*	4.7 c
A-2434	Day 0	7.0 abc	3.2 a	9.7 ab	3.1 b	1.5 a*	7.0 bc
A-2450	Day 0	8.4 ab	2.0 a	7.1 cd	3.2 ab	1.1 abc	6.7 bc
A-2453	Day 0	9.0 a	1.4 a	9.5 abc	3.9 a	0.5 c	19.5 a*
A-2491	Day 0	6.7 abc*	1.2 a	10.9 a	3.3 ab	0.9 abc	12.1 abc
APF-268	Day 0	7.2 abc	4.4 a	7.3 bcd	3.0 b	1.3 ab	6.0 bc
Natchez	Day 0	5.7 bc	0.3 a	8.7 abcd	3.3 ab	1.0 abc	9.0 bc
Osage	Day 0	4.9 c	1.4 a	9.2 abc	3.4 ab	0.7 bc*	15.2 ab*
Ouachita	Day 0	4.9 c	5.7 a	8.8 abcd	3.1 b	1.2 abc*	7.3 bc*
Prime-Ark® 45	Day 0	6.0 abc	1.0 a	7.9 bcd	3.3 ab	0.9 abc	8.8 bc
Prime-Ark® Traveler	Day 0	7.2 abc	4.4 a	7.9 bcd	3.3 ab	1.0 abc	8.6 bc
P value		0.0021	0.5899	<0.0001	0.0012	0.0068	0.0014
A-2418	Day 7	7.5 ab	0.3 b	7.1 c	3.3 b	1.1 a*	6.9 ab
A-2434	Day 7	5.4 bc	0.4 ab	11.1 a	3.3 b	1.0 a*	11.0 ab
A-2450	Day 7	9.2 a	1.5 ab	7.2 c	3.3 b	1.1 a	7.0 ab
A-2453	Day 7	10.1 a	0.0 b	8.3 abc	3.8 a	0.6 c	13.6 a*
A-2491	Day 7	4.0 c*	1.4 ab	10.2 ab	3.5 ab	0.6 c	16.9 a
APF-268	Day 7	7.6 ab	2.5 ab	7.2 c	3.2 b	1.1 a	6.8 b
Natchez	Day 7	4.7 c	1.6 ab	9.5 abc	3.4 ab	0.8 ab	11.8 ab
Osage	Day 7	5.6 bc	2.0 ab	7.5 bc	3.4 ab	1.1 a*	7.5 ab*
Ouachita	Day 7	5.3 bc	6.4 a	9.7 abc	3.6 ab	0.7 a*	15.4 ab*
Prime-Ark® 45	Day 7	5.7 bc	2.2 ab	8.0 bc	3.4 ab	0.9 ab	9.7 ab
Prime-Ark® Traveler	Day 7	5.9 bc	5.5 ab	9.0 abc	3.5 ab	0.7 bc	12.7 ab
P value		<0.0001	0.0171	0.0002	0.0067	0.0124	0.0098

Genotypes were evaluated in triplicate (n=3).
Means followed by an asterisk (*) within a genotype are significantly different for storage using Slice test ($p<0.05$).
Means with different letter(s) for each attribute within storage are significantly different ($p<0.05$) using Tukey's HSD test.
Titratable acidity as % of citric acid.
SS/TA ratio is soluble solids/titratable acidity ratio.

Table 4. Descriptive sensory attributes for fresh-market blackberry genotypes at harvest (day 0) and after storage at 2°C for 7 days, Clarksville, AR, 2015.

Genotypes	Storage	Glossiness	Popping	Sweet	Sour
A-2418	Day 0	11.0 a	7.3 a	3.3 a	5.0 a
A-2434	Day 0	10.9 a	7.9 a*	4.9 a	5.5 a*
A-2450	Day 0	9.8 a	7.8 a*	4.1 a	5.8 a*
A-2453	Day 0	11.5 a	7.3 a	3.7 a	3.7 a
A-2491	Day 0	10.8 a	7.8 a*	5.4 a*	4.4 a*
APF-268	Day 0	10.7 a	7.3 a	3.9 a	4.4 a
Natchez	Day 0	11.7 a	8.0 a*	4.9 a*	5.1 a*
Osage	Day 0	11.3 a	7.0 a	4.0 a	3.7 a*
Ouachita	Day 0	11.4 a	7.0 a	4.2 a	3.7 a
Prime-Ark® 45	Day 0	9.9 a	8.1 a*	4.1 a	5.6 a*
Prime-Ark® Traveler	Day 0	10.3 a	7.5 a	4.9 a	4.8 a*
P value		0.2822	0.8733	0.0523	0.1648
A-2418	Day 7	11.1 a	7.7 a	3.9 a	5.7 a
A-2434	Day 7	11.1 ab	6.6 a*	4.5 a	3.7 b*
A-2450	Day 7	11.3 a	6.4 a*	3.8 a	4.4 ab*
A-2453	Day 7	12.0 a	8.2 a	4.3 a	4.1 ab
A-2491	Day 7	11.5 a	6.4 a*	4.5 a*	3.4 b*
APF-268	Day 7	11.2 a	7.0 a	3.9 a	5.2 ab
Natchez	Day 7	11.1 ab	6.4 a*	4.0 a*	4.0 ab*
Osage	Day 7	11.3 a	7.0 a	4.1 a	4.7 ab*
Ouachita	Day 7	11.9 a	7.0 a	4.3 a	4.6 ab
Prime-Ark® 45	Day 7	9.0 b	6.3 a*	3.5 a	4.5 ab*
Prime-Ark® Traveler	Day 7	10.3 ab	6.4 a	4.4 a	3.8 b*
P value		0.0013*	0.6404	0.8844	0.0044*

Genotypes were evaluated in duplicate.
Means followed by an asterisk (*) within genotype are significantly different for storage using Slice test ($p<0.05$)
Means with different letter(s) for each attribute within each storage date are significantly different ($p<0.05$) using Tukey's HSD test.
Attributes evaluated on a 15-point scale (0=less of the attribute and 15=more of the attribute in terms of intensity).

Table 5. Principal component analysis on descriptive sensory attibutes and fruit quality and chemical composition (analytical) attributes of fresh-market blackberries at harvest (day 0) and after storage at 2°C for 7 days, Clarksville, AR, 2015.

		Harvest		
		Component 1 Astringent → Higher pH (less acidic)	**Component 2 Sour and Phytochemicals → Red Color**	**Component 3 Sweet and Soft → Hard**
Positive loadings	**Descriptive attributes**	*Astringent feeling* *Metallic feeling*	*Sour taste* *Popping*	*Sweet taste* *Uniformity of color* *Overall aromatic impact*
	Analytical attributes	*Titratable acidity*	*Total flavonols* *Total phenolics*	*Soluble solids*
	Key samples	*A-2434 and APF-268*	*A-2450 and 'Prime-Ark® 45'*	*A-2491 and 'Natchez'*
Negative loadings	**Descriptive attributes**	*	*Color*	*Hardness*
	Analytical attributes	*pH* *SS/TA ratio*	*Red drupelets incidence*	*
	Key samples	*A-2453*	*'Ouachita'*	*A-2418*
		After storage		
		Component 1 Sour → Sweet	**Component 2 Hard → High Phytochemicals**	**Component 3 Dark Color → Red Color**
Positive loadings	**Descriptive attributes**	*Sour taste* *Astringent feeling* *Metallic feeling*	*Glossiness* *Hardness* *Popping*	*Color* *Uniformity of color*
	Analytical attributes	*Titratable acidity*	*	*Total phenolics* *Total anthocyanins*
	Key samples	*A-2418* *A-2450*	*A-2453*	*A-2453* *'Natchez'*
Negative loadings	**Descriptive attributes**	*Sweet taste*	*Bitter taste* *Overall aromatic impact*	*
	Analytical attributes	*Soluble solids* *SS/TA ratio*	*Total flavonols* *Total ellagitannins*	*Red drupelets incidence*
	Key samples	*A-2491*	*'Prime-Ark® 45'* *'Natchez'*	*'Ouachita'*

*No attributes have high loadings on this side of this dimension.
SS/TA ratio means Soluble solids/titratable acidity ratio.
Three principal components explained 71.1% and 72.2% of data variance, at harvest day and after storage, respectively.

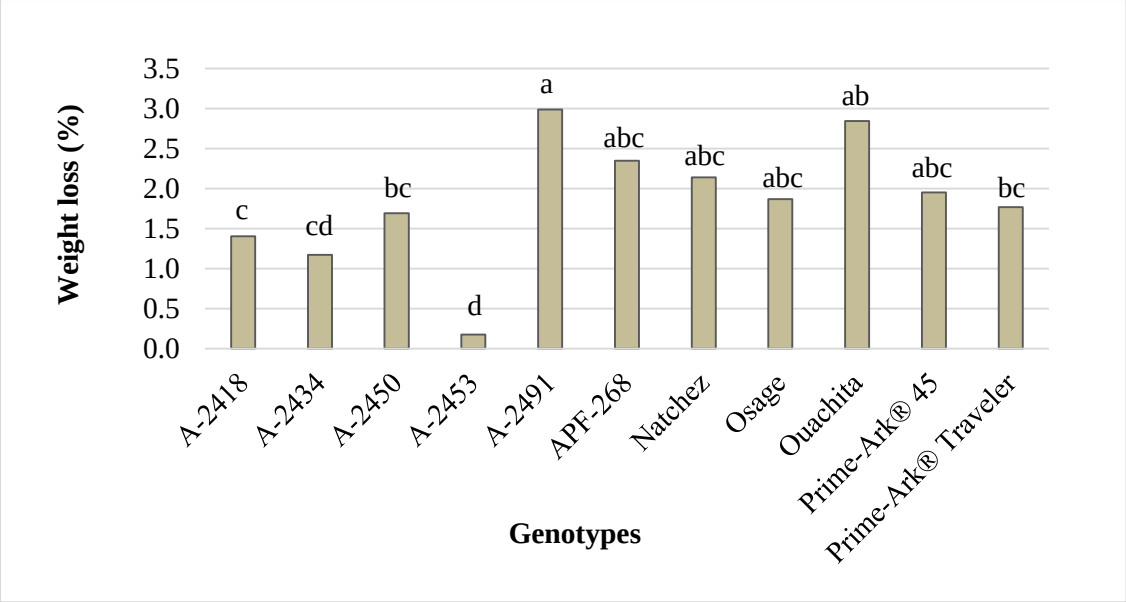

Fig. 1. Weight loss (%) after 7 days of storage at 2°C for blackberry genotypes in 240-g, low profile, vented clamshells, Clarksville, AR, 2015.
Means with different letter(s) are significantly different ($p<0.05$) using Tukey's HSD test.

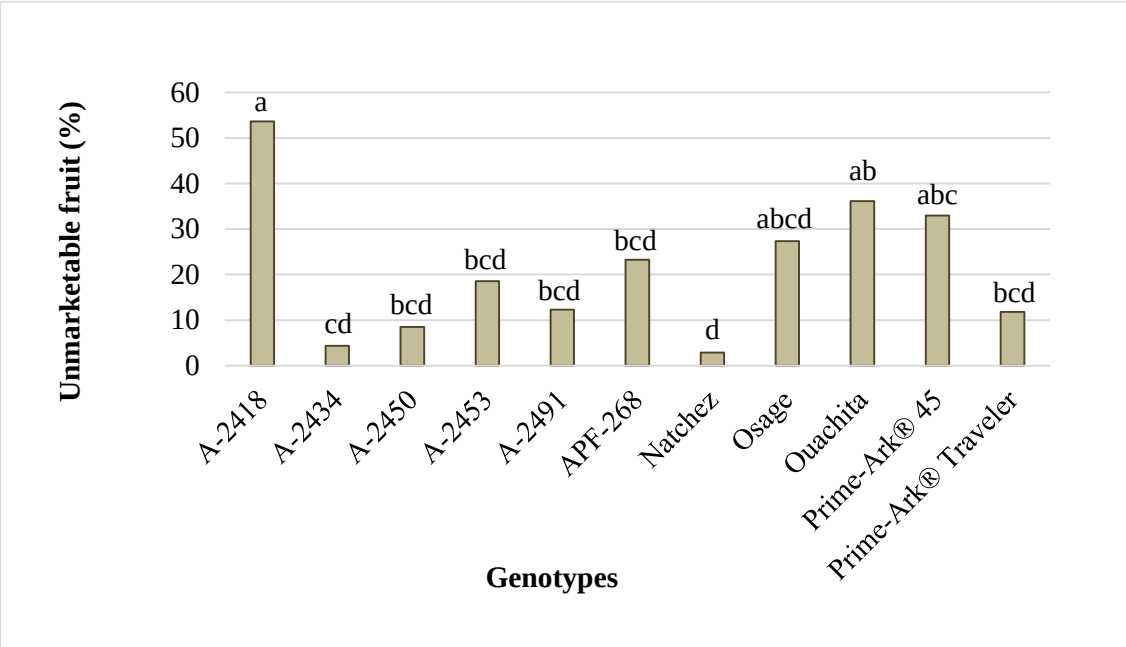

Fig. 2. Unmarketable fruit (%) after 7 days of storage at 2°C for blackberry genotypes in 240-g, low profile, vented clamshells, Clarksville, AR, 2015.
Means with different letter(s) are significantly different ($p<0.05$) using Tukey's HSD test.

Project 5: Strengthening local food systems by enhancing food entrepreneurship in Arkansas

FINAL REPORT

PROJECT SUMMARY

The purpose of this project was to establish a statewide assistance program to specialty crops farmers and entrepreneurs to facilitate the utilization of specialty crops for value-added products in local food systems. Consumer's food purchasing habits have significantly changed in the past few years toward an increased focus on locally produced foods. As a result, retail outlets such as Farmers Markets have flourished in Arkansas. However, specialty crop farms are typically small and have to rely on limited retail outlets that are seasonal. Processed local foods are an essential component of sustainable local food systems because they allow year round retail and distribution of processed specialty crops products and the utilization of excess crops. This project has had a direct economic impact on the profitability of small to medium-sized specialty crops farms and entrepreneurs in Arkansas by removing the limitations of seasonal marketing through the production of processed value-added foods and further developing the local process foods markets. This project had the following objectives:

1. Develop a one-day educational workshop "Food Entrepreneurship: from Dream to Reality" providing a general overview of the issues and challenges associated with launching a food manufacturing business.

The workshop addresses market research, product development, food regulations, food safety, packaging, labeling, pricing and cost analysis, and product introduction and sales.

2. Deliver this workshop in 4 locations within Arkansas in collaboration with local partners (Extension agents). Tentative locations include Little Rock, Jonesboro, Pine Bluff and Fayetteville

We seek to recruit 20-40 participants at each location. Each participant will fill out a survey to determine their suitability for receiving free consulting services from AFIC.

3. Provide consulting to select entrepreneurs from product conceptions to sales.

AFIC's staff will work with 10-15 entrepreneurs statewide on the development of commercial product by analysis survey results and performing individual interviews with workshop participants. Initial product manufacturing will be done in AFIC's pilot processing plant.

PROJECT APPROACH

Objectives 1 & 2

The Arkansas Food Innovation Center (AFIC) developed and delivered Plan Produce Profit Arkansas: Starting a Food Processing Business workshops in four Arkansas locations: Little Rock (October 6, 2015, Pine Bluff (October 7, 2015), Forrest City (October 8, 2015), and Fayetteville (May 18, 2016).

The workshops at each location in 2015 took place from 9 am to 3 pm. There were 35 participants registered for the Little Rock workshop, 20 for Forrest City and 20 for Pine Bluff, but there were a few additional onsite registrants at each location. In 2016, the workshop was extended to an 8 hour workshop based on lessons learned from 2015. The 2016 Fayetteville workshop had 35 registrants. At each location there were about 10 speakers. The workshop speakers from the University of Arkansas included, Dr. Jean-Francois Meullenet, Department of Food Science, Dr. Steve Seideman, Cooperative Extension Service, Dr. Renee Threlfall, Institute of Food Science and Engineering, Dr. Pam Brady, Department of Food Science, Dr. Dan Rainey, Department of Agricultural Economics and Agribusiness, and Rusty Rumely, National Agriculture Law Center. Additional speakers included Will Hastings, Arkansas Department of Health, Ron Rainey and Amanda Perez, Cooperative Extension Service, John Auker, Delta Cuisine, and Dr. Jaheon Koo, University of Arkansas Pine Bluff. The workshop topics included: product concept to reality, cottage food law, business plans and marketing. Product parade and tasting, food safety and preservation, discussion panel with existing food entrepreneurs, food ingredients, food processing and equipment, food packaging and labeling, food processing regulations, and food liability.

Overall, the workshops were attended by participants from a wide range of counties in Arkansas. For example, the 2016 workshop held in Fayetteville had participants from the following counties: Washington: 16, Howard: 1, Crawford: 1, Benton: 4, Stone: 1, Drew: 1, Pulaski: 5, and Madison: 1.

In 2015, participants were from the following counties: Crittender: 1, Marianna:3 , Jefferson:11, Grant:1, Lee:2 , Desha:2, Benton:1, Little River:1, Washington:1, Hot Springs:1, Izard:1, Sebastian:1, Lee:3, Bowie:1, Johnson:1, Crawford:1, Monroe:2, Montgomery:2, Saline:2, Pulaski:8, Faulkner:4, Lonoke:2, Craighead:1, St. Francis:7, Phillips:1, and Cross:2.

Overall, we met the intent of the grant by exposing a broad geographic range of Arkansans to starting a food manufacturing business. From the level of interest expressed in these workshops,

there is no doubt that there is significant interest in the state of Arkansas regarding food entrepreneurship and that specialty crops are a part of most food entrepreneurs product ideas.

The workshops were also well received by attendees. When asked how well the workshops met expectations of participants, 57 ratings were "Better than Expected", 45 were "as Expected" and 1 was "Not as Well as Expected".

In addition, to the question: "If you are considering becoming a food entrepreneur, will the information presented help you launch a product in the marketplace?" 78 participants said yes while 15 said no. Of the 15 participants answering no, a majority commented that the information presented made the process of starting a food business overwhelming and that they were unlikely to move forward.

Objective 3:

The second phase of the project was to select potential entrepreneurs for consulting and assistance by the Arkansas Food Innovation Center. These services included assistance by an intern with product development, scale up, labeling, and FDA and AR department of health permits.

In 2015 we selected 15 potential clients to receive free consulting from AFIC. Products selected included dehydrated oyster mushrooms, several BBQ sauces, Piccalilli, fermented salsa verde, a salad dressing, fruitcakes, pepper sauce, hickory smoked pepper powder, hot sauces, jalapeno lime pepper jelly and yellow mustard.

In 2016 we recruited 8 potential clients to receive free consulting services. Products selected included a sweet apple cider, dried tusli tea, spinach artichoke dip, spice jar punch, jalapeno pepper jelly, fresh salsa, mustard vinaigrette, and a veggie soup.

Of the 23 entrepreneurs we provided assistance to in 2015 and 2016, 12 actually released products in the marketplace and used or are using AFIC's facility to manufacture their products.

GOALS AND OUTCOMES ACHIEVED

There were two measurable outcomes for the project. The first was to develop outreach materials, deliver the materials at 4 locations in Arkansas and make available the contents of the workshop to the public.

The workshop was delivered in Fayetteville, Little Rock, Pine Bluff and Forrest City and presentations captured using Adobe Connect. Presentations are available to the public at http://afic.uark.edu/PPPworkshop1.html. This outcome was met.

The second outcome was related to the number of products launched as a result of the project. We had anticipated for 20 food products to be launched. From the assistance provided through the grant, only 12 products were launched. However line extensions from companies involved

with the project resulted in additional product launches getting us very close to the 20 launch benchmark we had initially anticipated.

Finally, we have put in place a system to track weekly production for afic clients to monitor the value of products manufactured at AFIC. The value of products manufactured weekly at AFIC currently exceeds $10,000 per week. Additional information about the economic impact directly attributed to this project can be found in the next section.

BENEFICIARIES

Through this grant, we have assisted food entrepreneurs, small farmers and small food companies located in the state of Arkansas.

Through these workshops, we have reached 110 food entrepreneurs throughout the state of Arkansas. AFIC provided direct assistance through consulting services to 23 different small companies and farms, and the grant specifically resulted in the launch of 12 new food products in the marketplace. Of the 23 companies we have assisted, 6 are currently manufacturing products in AFIC's manufacturing facility. Although the economic impact of these companies is a little difficult to establish at this time, we estimate the retail value of products manufactured by these companies to be at least $20,000 monthly.

LESSONS LEARNED

There are several key observations that we can make at the end of this project. First, there is overwhelming interest in food entrepreneurship in the State of Arkansas. Through our limited advertising networks, we were able to reach 110 potential entrepreneurs throughout Arkansas. We suspect that there many more potential food entrepreneurs in the state who could benefit from assistance.

Second, we have experience significant attrition between the selection of entrepreneurs for assistance and actual product launches. There are several reasons for this. First, many of our food entrepreneurs have full time jobs and realize that the time commitments to a new business is overwhelming and in some cases not workable. Second, we experienced especially high attribution with clients located far from our facility. Some of the clients drive several hours to reach our facility and for some, it becomes obvious that this is not feasible long term. We therefore recommend that efforts to create similar facilities to AFIC in strategic locations throughout the state be made a priority.

Lastly, the nature of the assistance we have been able to provide to entrepreneurs is largely on the technical side of food manufacturing. After 3 years of operation, we are realizing that many burgeoning food companies need more business related assistance than what we are able to provide (e.g. financing, marketing or distribution channels). In addition, capitalization for these companies is very difficult, especially to establish their own manufacturing facilities. Costs are

high and the angel investor landscape seems to be difficult in the food manufacturing arena. AFIC needs to develop stronger networks with the business and entrepreneurship communities. To the end, we entered in a partnership earlier in 2016 with Startup Junkie Consulting, a NWA based consulting firm offering a wide variety of free business services to startup companies.

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Project 6: P. Allen Smith and Food & Farm

FINAL REPORT

PROJECT SUMMARY

- Importance and timeliness of the project
- Did the project build on previously funded Specialty Crop Block Grant Program projects? If so, how did this project complement and enhance previously completed work?

This was the second phase of the P. Allen Smith specialty crop marketing project. A contract with Hortus, Ltd, a state based marketing group that has experience of marketing in the specialty crop realm, was renewed. Hortus Ltd is the marketing group of gardening and home celebrity P. Allen Smith (PAS). Mr. Smith is the author of a number of gardening publications in addition to being the host of his own horticulture program on PBS. He is also the spokesman for Bonnie Plants and a number of other specialty crop related groups.

Mr. Smith's group was again a natural fit for the continued emphasis of Arkansas Grown specialty crops because P. Allen's audience includes house-proud adults, DIYers, gardeners and farmers, who yearn for beauty, sustainability and affordability. They have an affinity for horticulture, local foods, and gardens. They think of their homes and gardens as places to create memorable occasions that bring friends and family together. Center of target is adults 35-56, primarily college-educated women with families who own their own homes.

Hortus employees sat down with the Arkansas Agriculture Department (AAD) and decided that we needed to continue the following:

- To further educate and engage consumers in Arkansas about the Arkansas agricultural community and create a call-to-action and preference to "Buy Arkansas" grown specialty crop products.

- To increase recognition of participating Arkansas specialty crop growers, producers, processors, wholesalers, retailers and restaurants within the Arkansas Grown programs.

- To continue to highlight the accessibility and amplify the awareness of where to find and purchase Arkansas Grown Specialty Crops and products to an audience of potential buyers.

This project builds upon the 2013 P. Allen Smith specialty crop promotion project. The 2013 project looked at a study that was commissioned on the specialty crops market in Arkansas and how Arkansas grown fit into the picture. After the study, AAD worked with Hortus to highlight Arkansas Grown specialty crop producers through radio blurbs, written media, and social media. The new project builds upon the 2013 project by increasing the dialogue between producers and end users through scheduled events. It also builds upon the project by further continue to educate consumers through a vast array of media.

PROJECT APPROACH

- Briefly summarize activities and tasks performed during the grant period, addressing the tasks provided in the project proposal or work plan. Include significant results, accomplishments, conclusions and recommendations, as well as favorable or unusual developments.

  Did non specialty crops benefit from the project? If yes, how did the project ensure SCBGP Funds were used solely to enhance the competitiveness of specialty crops?

  Detail the significant contributions and role of project partners in the project.

P. Allen Smith (PAS) was established as brand champion and voice of Arkansas Grown Specialty Crops. This was done to establish and grow the Arkansas Grown Specialty Crop brands and to increase awareness and participation, by consumers, growers and retailers through PAS media channels. Mr. Smith, as the talent and personality, educated and engaged consumers and used his established PAS audience to increase the popularity of Arkansas Grown Specialty Crops.
Hortus produced AAD-Arkansas Grown Specialty Crop segments to air within the PAS Radio Show. The
Arkansas Grown Segments contained interviews with Farmers, Chefs, Consumers (Moms/Food Bloggers), and AAD.

Those radio segments covered the following during 2015:

- February: Local Conversations
- April: Springtime harvest
- May: Preparing for Summer
- July: Preserving your specialty crops- North Pulaski Farms

- August: The Tomato- Arkansas Farms
- September: Local Menus

Hortus also produced television segments on the following:

- October: Farm to Table talks about local sourcing your menu
- November: Making spices at home.
- November: Fermenting Dill Pickles

Hortus developed a quarterly newsletter that went out to consumers and AG members. The newsletter contained a member profile, along with an article on some technical aspect of specialty crops, and a listing of upcoming events.

AAD conducted the 2nd Annual Local Food Conversation hosted by P. Allen Smith for a special gathering of local farmers, farmer's market managers, and merchants/potential customers (chefs and store managers). This event was to get a dialogue going about what they want to see from the Arkansas Grown program in relation to specialty crops. Restaurateur Mark Abernathy spoke about what restaurants look for in establishing a relationship with a local grower. A representative of Harps supermarkets spoke about what they and Affiliated Wholesale Grocers looks for in a relationship with local specialty crop growers. A secondary goal was to link farmers with potential retailers. It was held at the restaurant South-On-Main rather than the Governor's Mansion do to a change in availability.

PAS and AAD worked together to create and implement a yearly (in season) social media campaign positioning an Arkansas Grown Contest-Giveaway. We engaged followers to make comments about and share images of Arkansas Grown specialty crop products that they had purchased locally and to post recipes using those products for a chance to win prizes. A monthly contest winner was randomly selected and the prize "giveaways" are P. Allen Smith items. PAS engaged followers on Facebook, Twitter, Pinterest and Instagram with messaging related to Arkansas Grown program initiatives (i.e. community events, recipes or lifestyle-oriented messaging with Arkansas Grown products, etc.)

During June of 2015 PAS and AAD launched the 2nd Annual Farm2Home Blogger Event co-hosted by P. Allen Smith and Arkansas Agriculture Department as a gathering of Arkansas bloggers at Allen's Garden Home Retreat at Moss Mountain Farm for a day of learning about local specialty crops. A market of AG specialty crop producers was put together to allow attendees to buy and see what specialty crop products are part of the AG program. An opportunity was given for top level Arkansas Grown specialty crop members to participate and help educate Arkansas bloggers about their farms and the local produce available to Arkansas families. A panel of four specialty crop farmers was put together for a Q & A season. Lunch was sponsored by Farm Credit and highlighted local Arkansas fruits and vegetables.

Hortus wrote and provided images related to the Arkansas Grown Programs to local (statewide/regional) publications (i.e. *AY* and *Front Porch* [Arkansas Farm Bureau]. In addition, Hortus also searched out other free media opportunities for the AG program to receive coverage.

Lastly, Arkansas Grown Specialty Crops was recognized sponsor of the PAS Garden Home Retreat at Moss Mountain Farm, which allowed PAS to position/promote the Arkansas Grown program during PAS Garden Home Retreat-Moss Mountain Farm Events. PAS recognize Arkansas Grown Specialty Crop products in use at the PAS Garden Home Retreat.

For the Food and Farm magazine, 4 issues were published during 2015. Arkansas Grown specialty crop producers were listed in the magazine. Over 15,000 copies were printed of each issue.

GOALS AND OUTCOMES ACHIEVED

- Supply the activities that were completed to achieve the performance goals and measurable outcomes identified in the approved project proposal.
- If outcome measures were long term, provide a summary of the progress made towards this achievement.
- Provide a comparison of actual accomplishments with the goals established for the reporting period.
- Clearly convey completion of achieving outcomes by illustrating baseline data that has been gathered to date and show the progress toward achieving set targets.
- Highlight the major successful out comes of the project in quantifiable terms.

Goal 1: the goal was to increase the number of specialty crop growers and processors participating in and benefiting from membership in the Arkansas Grown program by 25%. The baseline number of specialty crop members was 500. During the course of this project, 157 specialty crop members joined, helping us increase specialty crop members by 31%, exceeding our goal.

A final survey was conducted in 2016, indicating eighty-three percent of those surveyed are aware of the Arkansas Grown Program. When asked if they are more likely to buy a specialty crop if it's identified as Arkansas Grown, one hundred percent responded with a yes.

Ultimately, this project was successful in connecting specialty crop producers, processors, and retailers with restaurants, chefs, bloggers, and regular everyday consumers, and highlighting the availability of locally produced specialty crops.

BENEFICIARIES

- Provide a description of the groups and operations that benefited from the completion of project's accomplishments.
- State the number of beneficiaries affected by the project's accomplishments and/or the potential economic impact of the project.

All specialty crop stakeholders in Arkansas, including Christmas Tree producers, nut producers, fruit growers, vegetable growers, horticulture growers, honey producers and all the other producers of products list on the AMS/SCBGP Specialty Crop list, that use the Arkansas Grown label benefited from this project as more customers are made aware of the Arkansas Grown label

and how to find Arkansas Grown specialty crop products. We assume that increased marketing of the label will increase sales of specialty crops thus creating a positive economic impact.

Beneficiaries include the 657 Arkansas Grown specialty crop growers, as well as the estimated 15,000 consumers reached through the project, totaling 15,657 beneficiaries.

LESSONS LEARNED

- Provide insight into the lessons learned as a result of completing the project.
- Provide unexpected outcomes or results of the project.
- If goals or outcome measures were not achieved, identify and share the lessons learned

This project went as planned. However, lessons learned include the importance of sharing information that is beneficial to multiple groups; there is demand for locally grown specialty crops; and that providing a forum to help identify local producers and consumers works to benefit the community.

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Project 7: Produce Marketing Association Fresh Summit Show

FINAL REPORT

PROJECT SUMMARY

Six specialty crop companies participated in the Arkansas Agricultural Department's (AAD) booth at the 2015 Produce Marketing Association (PMA) Fresh Summit International Convention and Exposition in Atlanta, GA October 22-25. The companies are:

- Mathews Ridgeview Farms
- Delta Blues Sweet Potatoes
- Dominion Farms
- Post Familie Winery
- Peebles Farms

- Lowry Farms
- Harvest Fresh Farms

Peebles Farm and Harvest Fresh Farms were the 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 2015 Produce Marketing Association (PMA) Fresh Summit International Convention and Exposition in Atlanta, GA October 22-25. The companies are:

- Mathews Ridgeview Farms
- Delta Blues Sweet Potatoes
- Dominion Farms
- Post Familie Winery
- Peebles Farms
- Lowry Farms
- Harvest Fresh Farms

Peebles Farm and Harvest Fresh Farms were the new participants in the AAD booth at the PMA Fresh Summit.

The participant companies produce the following:

- Sweet Potatoes
- Greenbeans
- Grapes/Muscadines/Juice
- Tomatoes
- Cucumbers
- Squash
- Watermelons
- Onions
- Hot Peppers
- Bell Peppers
- Edamame
- Zucchini

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. An online survey was sent to all participants after the event and survey results will be tallied and used to prepare for the 2015 show.

This year's booth was a different design as the 2014 booth. Rental costs had gone up on the old design so AAD rented a new but cheaper design to stay within budget.

Interest in the Arkansas booth was very high. The lingering drought on the west coast in 2015, helped to steer interest towards the Arkansas booth as retailers were looking to diversify where they buy their specialty crops from as west coast supplies were tight. Also with the show in the south more southern retailers turned out for the show.

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

2015 PMA SURVEY

This is a blind survey to gather feedback on your experience in the Arkansas Grown booth. We will not be able to match feedback to particular participants. As part of the federal funding we use to pay for the experience of PMA we are required to survey participants.

1. WAS THIS SHOW HELPFUL?

○ Yes ○ No

2. WILL YOU RETURN NEXT YEAR?

○ Yes ○ Maybe ○ No

3. THE PMA SHOW ACCOUNTS FOR THE FOLLOWING RANGE OF GROSS SALES FOR MY BUSINESS:

○ $0 to $250,000

○ $250,001 to $500,000

○ $500,001 to $1,000,000

○ $1,000,001 to $5,000,000

○ $5,000,001 plus

○ Would rather not say

4. THIS PMA SHOW ACCOUNTED FOR THE FOLLOWING AMOUNTS IN NEW AND/OR RETAINED BUSINESS:

New Business

Retained Business

5. DO YOU THINK ATTENDING "DID OR WILL" INCREASE YOUR SALES?

○ Yes ○ Maybe ○ No

6. ARE YOU HAPPY WITH THE BOOTH SETUP?

○ Yes ○ No

7. WHAT CHANGES WOULD YOU LIKE TO SEE DONE TO THE BOOTH?

8. HOW MANY SALES LEADS OR POTENTIAL SALES LEADS WERE MADE?

Sales Leads

Potential Sales Leads

9. HOW MANY CONTACTS WERE MADE?

10. HOW MANY LEADS ARE A:

National Company

Regional Company

Local Company

11. HOW ELSE WAS THIS SHOW HELPFUL?

12. SUGGESTIONS:

GOALS AND OUTCOMES ACHEIVED

AAD achieved its goals and outcomes by constructing a booth at the 2015 PMA show and recording 35 potential sales leads as indicated in the survey results below.

Survey Results:

1. 100% answered yes
2. 100% answered yes
3. Total of $4.5 million
4. $1.0 million in new and $3.5 Million in retained business.
5. 100% yes
6. 100% yes
7. 100% none
8. Average of 7 leads per producer
9. 411 contacts

10. N=140 R=151 L=20
11. Got to see the industry leading tech in packaging and marketing
12. none

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. Beneficiaries include the 30 specialty crop producer/growers attending as booth exhibitors and guests, as well as the 411 contacts of buyers looking for fresh produce, for a total of 441 beneficiaries.

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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