

**North Carolina Department and Agriculture & Consumer Services**

**State Point of Contacts: Nick Augustini**

**Tel. # 919-707-3125**

**[Nick.Augostini@ncagr.gov](mailto:Nick.Augostini@ncagr.gov)**

**2012 Specialty Crop Block Grant Program**

**12-25-B-1479**

**Final Report**

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## **Project Title:** Local Produce Safety Initiative II

### **Final Report**

#### **PROJECT SUMMARY**

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A 2012 USDA report found that, nationwide, sales through intermediated channels are a rapidly growing segment of the local food market. Intermediated channels are increasingly requiring GAP certification from specialty crop farmers. Moreover, industry members have reported to Carolina Farm Stewardship Association (CFSA) that traditional direct market outlets for locally-grown fruits and vegetables are also under pressure to impose food safety requirements. However, small-farm specialty crop growers have identified the food safety certification process as a roadblock to getting their fresh produce into food service, institutional, and retail markets. In order for specialty crop growers to remain competitive in the local food market, it is imperative that we build their capacity to develop scale-appropriate, best management practices that conform to USDA GAP standards.

The Local Produce Safety Initiative II (LPSI II) built upon CFSA's 2010 Specialty Crop Block Grant titled Local Produce Safety Initiative I (LPSI I). Under LPSI I, CFSA collaborated with North Carolina State University (NCSU) and North Carolina Cooperative Extension (NCCE) to conduct research with 12 specialty crop growers seeking USDA GAPs certification in order to identify the barriers they faced in attaining food safety certification. The following barriers were identified:

- Limited manpower, which makes GAP record-keeping more burdensome on the farm operators;
- Reliance on proven, low-cost fertility sources such as compost and manure, which are not permitted in some private GAP audit regimes and subject to extreme controls in others;
- Limited capacity to make capital investments, which are assumed as a cost of doing business in larger farming operations; and
- Reliance on multiple crops, including livestock, to diversify income streams and mitigate risk.

To address these barriers, CFSA and NCSU developed the manual *Good Agricultural Practices for Small Diversified Farms: Tips and Strategies to Reduce Risk and Pass an Audit* to provide farmers with practical, scale-appropriate GAPs audit guidance. A training curriculum based on the manual was also developed under LPSI I. LPSI II built upon LPSI I by providing an innovative training program that offered on-farm training, developed training videos, and provided cost share funding to specialty crop growers who participated in the project trainings and passed a USDA GAPs audit.

#### **PROJECT APPROACH**

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LPSI II involved three key pieces of work: 1) on-farm workshops and one-on-one

consulting for specialty crop growers based on the GAPs manual *Good Agricultural Practices for Small Diversified Farms: Tips and Strategies to Reduce Risk and Pass an Audit* to 190 specialty crop growers; 2) training videos based on the GAPs manual; and 3) cost share assistance to specialty crop growers who participated in the project trainings and passed a USDA GAPs audit.

## **YEAR ONE**

Applications for the one-on-one GAPs training and cost share program were developed and the program was promoted through CFSA's website and online newsletter. We contracted with NCSU to conduct four-hour *Navigating the GAP Audit* workshops and provide one-on-one training for farmers.

Published the manual *Good Agricultural Practices for Small Diversified Farms: Tips and Strategies to Reduce Risk and Pass an Audit* on CFSA's website July 22, 2013 and printed and distributed 2,000 paper copies between 2013 and 2014. Delays in completing the GAPs audit manual caused us to delay development of the training videos. We adjusted the original time line by postponing the deadline for contracting with a videographer from Jan, 2013 to Sept, 2013. While we met our adjusted goal of having a proposal from a videographer by Nov. 4th, 2013, we were not able to complete the training video by Dec. 2013. The reason for this is that we needed to be able to conduct filming for the video during the growing season. Therefore, we had to wait until spring, 2014 to film. Due to a colder than average spring, the farm we had identified to host the filming did not have crops ready to be harvested until May, which is when we conducted the filming. The training videos were published on our YouTube channel, with a link from our website in July 31, 2014 and was promoted heavily in order to reach our target goal of 400 viewers. We exceeded that goal and had 2,063 views.

## **YEAR TWO**

In April of 2014, CFSA was able to hire on staff a Local Produce Safety Coordinator to conduct workshops and provide one-on-one training for specialty crop growers. Through this project, we have been able to collaborate with the Center for Environmental Farming Systems (CEFS), the NC Growing Together Project (NCGT) and NCSU Extension to offer specialty crop growers the two-day Fresh Produce Good Agricultural Practices workshop series. Through this collaboration CFSA, CEFS, NCGT, and NCSU extension have pooled our resources to provide more comprehensive training to specialty crop growers starting with basic food safety practices on the farm, GAPs, hands-on assistance in creating a food safety plan, and mock audits. Therefore, rather than CFSA offering a four hour workshop on Navigating the USDA GAPs Audit, we are able to co-present two day workshops with NCSU extension offering Principles of Fresh Produce Safety and Food Safety Program and Plan Development in addition to Navigating the USDA GAPs Audit and follow up with growers, providing them feedback on their food safety plan and assisting them in preparing for a GAPs audit. This project has also strengthened the collaboration and partnership between CFSA and NC Fresh Produce Safety Task Force (NCFPSTF) and the Governor's task force on food safety and security. These groups exchange knowledge, challenges, approaches and materials in a collaborative manner through multiple venues.

## GOALS AND OUTCOMES ACHIEVED

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The goal of LPSI II was to provide specialty crop producers with the information they need to pass a USDA GAPs audit. In order to meet those goals we:

- Conducted 18 workshops to 234 specialty crop growers, exceeding our goal of 160 workshop attendees by 74. Twelve were two-day workshops covering the Principles of Fresh Produce Safety, Navigating the USDA GAPs Audit, and Food Safety Program and Plan Development and six were one day workshops covering the Navigating the USDA GAPs Audit. All workshop attendees have been added to the database and have been contacted regarding our GAPs audit cost share program and one-on-one trainings. Four program participants reported access to new wholesale markets due to GAPs certification and three have established vendor accounts in new wholesale markets.
  - Counties where two day workshops were held.

|            |           |          |         |
|------------|-----------|----------|---------|
| Wayne      | Henderson | Davidson | Chatham |
| Cumberland | Guilford  | Hoke     | Pender  |
| Yancey     | Forsyth   | Union    | Onslow  |
  - Counties where one day workshops were held.

|           |       |        |
|-----------|-------|--------|
| Haywood   | Moore | Durham |
| Cleveland | Polk  | Wake   |
- Conducted one-on-one trainings to 27 specialty crop producers. While we promoted the program heavily, we were unable to meet our goal of 30 one-on-one trainings. We are able to continue to offer one-on-one training for specialty crop growers though a third round of LPSI funding from the Specialty Crops Block grant, and are having no problem meeting our current deliverables. We believe our inability to meet our previous deliverable was due specialty crop growers not anticipating the demand for GAP certification from their buyers.. Twenty three one-on-one program participants obtained USDA GAPs certification, the other four decided to delay pursuing GAPs certification due to timing. One on-one trainings included mock audits and/or site visits to identify areas of potential produce contamination and ways to mitigate risk. All one-on-one training participants have been added to the database and have been contacted regarding our GAPs audit cost share program and one-on-one training. Twenty one of the one-on-one program participants received cost share assistance, developed eight training videos based on the manual *Good Agricultural Practices for Small Diversified Farms: Tips and Strategies to Reduce Risk and Pass an Audit*. Video topics included: Introduction to GAP, The Audit Process, Traceability, Worker Health & Hygiene, Water, Animals, Manure and Composting, and Equipment and Containers. Videos were available for free on CFSA's website as well as on our YouTube channel. They were also embedded into the online version of the GAPs manual so viewers could read the manual and watch the videos side-by-side.
- Provided cost share assistance to 23 specialty crop growers for a total of

\$13,586.50.

## BENEFICIARIES

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Direct beneficiaries of this project were specialty crop producers who received technical information about training to assist them in becoming USDA GAPs certified. Beneficiaries served are listed below:

| TYPE of INFORMATION DISSEMINATION                                     | NUMBER OF BENEFICIARIES |
|---|-------------------------|
| Viewed Online GAPs Manual   | 2,569                   |
| Viewed GAPs VIDEO   | 2,063                   |
| Attended a Workshop   | 234                     |
| Received One-on-One Training  | 27                      |
| One-On-One Training Participants Who Obtained USDA GAPs Certification | 23                      |
| Received Cost Share Assistance  | 23                      |

## LESSONS LEARNED

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We learned after year one that specialty crop growers need more technical assistance obtaining a USDA GAPs certificate beyond what can be offered during a one-day workshop or on-site training. Even with access to the GAPs manual and training videos, growers were still struggling to develop a food safety plan. Through additional support from the Center for Environmental Farming Systems (CEFS) and the NC Growing Together Project (NCGT), CFSA was able to collaborate with NCSU and NCCE to offer specialty crop growers the two-day Fresh Produce Good Agricultural Practices workshop series that included Principles of Fresh Produce Safety, Navigating the GAP Audit, and Food Safety Program and Plan Development. During year two, we found that even after taking the two day workshop series, specialty crop growers still needed assistance developing a food safety plan and preparing for an audit. We successfully submitted grant proposals to increase CFSA's staff capacity in order to provide growers with one-on-one consultation, which includes 1-2 site visits and direct assistance developing food safety plans.

While we struggled to meet our one-on-one deliverables during the project period, we have had an overwhelming number of applications for assistance in 2015. We believe this is because buyers are increasingly demanding GAP certification from the specialty crop growers they buy from. Timing remains an obstacle as most specialty crop growers wait until the start of the growing season to begin working on their food safety plans and preparing for an audit. This results in high demand for one-on-one training in the spring and early summer, when much of the work could be done during the off season. Future promotional efforts will focus on encouraging specialty crop growers to work on their food

safety plans in the off season, ensuring that they are ready for an inspection as soon as the crops are ready for harvest, and that CFSA has the staff capacity to meet grower's needs in a timely manner.

A no-cost extension of this Agreement was required in 2015 as CFSA had over \$8,000 in cost-share funds left to distribute. Due to issues of timing, growers who received one-on-one training the end of 2014 and early 2015 did not have sufficient crops in the ground to undergo a GAPs audit prior to the original end-date of this Agreement, therefore would not have been able to receive cost-share. Further delays to distributing cost-share funds were due to USDA Auditors being unaware of CFSA's capacity to distribute cost-share under the SCBGP.

### **CONTACT PERSON**

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Karen RM McSwain  
919-542-2402  
karen@carolinafarmstewards.org

### **ADDITIONAL INFORMATION**

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[GAPs training videos.](#)  
[GAPs Manual](#)

## **Project Title:** Organic Farming Conservation Outreach Project

### **Final Report**

#### **Project Summary**

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The organic market continues to grow, with organic food sales in the US totaling approximately \$29 billion in 2010, an eight percent increase over 2009. With its long growing season, high-quality agricultural resources, and proximity to large markets on the East Coast, North Carolina farmers could be grabbing a larger share of this market. However, North Carolina's farmers continue to face technical challenges in seizing a greater share of our state's organic market. The Environmental Quality Incentives Program (EQIP) Organic Initiative (OI) provides financial and technical assistance for organic and transitioning farmers. EQIP-OI enables farmers to invest in conservation practices that also enhance their ability to manage pests and diseases in compliance with the National Organic Program (NOP). However, NC farmers are not taking full advantage of this program. Between 2009 and 2011, the USDA set aside \$1 million per year for North Carolina farms under the EQIP-OI program. Unfortunately, NC NRCS entered into contracts for just a fraction of those funds each year: \$563,215 in 2009, \$394,830 in 2010 and \$451,869 in 2011. So over three years, almost \$1.6 million went unclaimed, which USDA redistributed to other states that received more applications. Through OFCOP, we tried to improve the competitiveness of North Carolina specialty crop producers seeking to take advantage of the high-value market for organic produce by providing farmers and NRCS staff with tools to better implement conservation practices on organic/transitioning farms. Specifically, we:

- Provided technical fact sheets to be included with ten job scenarios in order to provide district conservationists and organic and transitioning producers with technical information on how to implement the practice in an organic system.
- Assisted in training NRCS district conservationists on organic production practices and Implementing conservation activities in organic systems.
- Developed guidance documents in order to assist producers in the transition to certified organic production;
- Assisted farmers wanting to transition to certified organic production.

#### **Project Approach**

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CFSA worked to improve the competitiveness of North Carolina specialty crop producers seeking to take advantage of the high-value market for organic produce by increasing the utilization of the EQIP-OI program and providing technical information to specialty crop producers seeking to transition to certified organic production.

In order to increase the utilization of the EQIP-OI program we; 1) reviewed job scenarios and payment schedules for conservation practices specific to organic/transitioning producers, 2) developed technical fact sheets, 3) conducted training sessions for NRCS district conservationists on organic production practices, and 4) promoted the EQIP-OI program through our online newsletter, list serves, and at tabling and speaking events.

To increase the number of NC specialty crop producers transitioning to certified organic production we identified resource and training needs from one-on-one work with producers and certifying agencies and site visits we conducted between February and May, 2013. Based on this information, training and guidance documents focused on pest management and production techniques for high value crops, improved recordkeeping to demonstrate NOP compliance and reducing producer confusion over approved organic inputs.

## Goals and Outcomes Achieved

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The goals of OFCOP were to, 1) increase NRCS district conservationists knowledge about organic production, 2) increase utilization of the NRCS EQIP OI program by organic and transitioning producers by 25% in 2014, as a result of activities conducted in 2013, and 3) increase number of NC producers transitioning to organic production in order to take advantage of new markets for organic specialty crops. In order to meet those goals we:

### **GOAL 1: Increase NRCS district conservationists knowledge about organic production**

We tried to schedule two workshops with the NC NRCS state staff but they were only able to schedule one organic training session in 2013. This training happened in June and 73 NRCS/SWC staff participated. Due to failed communication between the Farm Services Director, and the Farm Services Coordinator who conducted the training, we did not conduct pre- and post-workshop surveys. Because of this, we conducted a survey of all NC NRCS employees who participated in the summer Field Day to quantify the value of the information they received at the workshop. In addition, we collected information about whether or not they have been able to use what they learned at the workshop to provide better technical information to the organic and transitioning specialty crop producers they work with.

Seventy-five percent of respondents said they had average or low expertise with respect to the training, 75% said they now had a good or high level of expertise with respect to organic production systems. While there was no increase in the number of

occasions respondents had to work with organic or specialty crop producers after attending the field day, 75% said they were more comfortable working with organic producers and 65% said they were more comfortable working with specialty crop producers. Eighty percent of respondents said the session gave them a better sense of the needs, concerns and management challenges organic growers face and 70% have been able to use the information presented at the field day to provide better information or technical assistance to the organic or specialty crop growers they work with. However, there is still a need to provide training and assistance to NRCS district conservationists, as 74% indicated the need for additional training. CFSA will continue to offer our assistance to NRCS and promote our workshops to them.

In lieu of conducting a second training just for NRCS staff, we promoted CFSA's Organic Broccoli and Organic Tomato workshops to NC NRCS district conservationists. Unfortunately, no one from NRCS attended. We also offered scholarships to eight NC NRCS employees to attend the Sustainable Agriculture Conference (SAC). We surveyed those who attended to determine which workshops they attended and how they are incorporating what they learned into the technical information they provide specialty crop growers. We also collected information about additional training needs they have in order to provide better technical information. Those who completed the survey found the information presented at the workshops they attended (Organic No-Till Farming, Cover Crop Selection and Management, Organic No-Till Farming, Reducing Chemical Use Through Soil Health, Lazy Beekeeping Understanding Organic Inputs for Your Farm, Soil Fertility in Organic Systems) very useful and have been able to use that information to provide better technical assistance to the organic and transitioning specialty crop growers they work with. They identified the need for additional information on cover crop varieties for the SE, high tunnel crop production, soil fertility management, and pest management in order to provide better technical assistance to the organic specialty crop growers they work with.

**GOAL 2: Increase utilization of the NRCS EQIP OI program by organic and transitioning producers by 25% in 2014, as a result of activities conducted in 2013.**

Reviewed 25 NRCS EQIP-OI job scenarios for implementing conservation activity practices on organic and transitioning operations. Developed and published ten technical fact sheets on conservation practices for organic operations on CFSA's website. Conservation practices include:

1) Conservation Cover (327), 2) Conservation Crop Rotation (328), 3) Cover Crops (340), 4) Field Borders (386), 5) Hedgerow Planting (422), 6) Mulches (484), 7) Nutrient Management (590), 8) Seasonal High Tunnel (798), 9) Pumping Plant (533), and 10) Forage & Biomass (512). Forage and Biomass Planting was included because it is required when receiving cost share for Conservation Crop Rotation (328) as two years of sod is required in a six year crop rotation when implementing the Conservation Crop Rotation practice.

Promoted the EQIP-OI program to 750 producers: NCA&T's Annual Small Farm Field Day (150), two Resource Rodeos (25) hosted by the Rural Advancement Foundation International (RAFI), a Cooperative Extension EQIP informational meeting (25), four of our workshops (64), and through CFSA's online newsletter and list serves (500). Producers were directed to our website for more information on the EQIP-OI program and our guide *Applying for the Environmental Quality* individuals.

NRCS in North Carolina contracted with 17 producers and obligated \$71,721 of financial assistance under the EQIP-OI program in 2013. NC NRCS will need to increase financial assistance to \$89,651 by the end of 2014 in order for CFSA to meet our goal of increasing utilization of the EQIP-OI program by organic and transitioning producers by 25% in 2014, as a result of activities conducted in 2013. We will contact the NC state office in Dec. 2014 to determine if that goal was met.

**GOAL 3: Increase number of NC producers transitioning to organic production in order to take advantage of new markets for organic specialty crops.**

Developed guidance documents and delivered organic production and transitioning information on the needs identified from one-on-one work with producers and site visits to organic or transitioning farms. Conducted and published a review of commercially available recordkeeping software on our website, which was viewed by 135 individuals. Published seven articles on organic production practices in our electronic newsletter, which were viewed by 272 of individuals. Provided organic-transition support and technical information to 291 NC producers through one-on-one consulting (47) and at workshops (244) that included:

- A 60-minute workshop, **Organic Disease Management in Organic Vegetable Production**, to 50 producers, at CFSA's Organic Commodities and Livestock Conference (OCLC).
- A four-hour on-farm workshop, **Organic Sweet Potato Production**, to 45 producers at Hocutt Farms in Sims, NC.

- A day-long **Organic Tomato Production** workshop to 20 organic and transitioning producers and professional consultants in Mills River, NC. Topics covered tomato production, disease management and grafting.
- A day-long **Organic Broccoli** workshop to 19 organic and transitioning producers and professional consultants in Waynesville, NC. Topics covered included organic production, disease control, and current research on variety trials.
- A day-long **Organic Certification** workshop to 25 organic, transitioning or sustainable producers and professional consultants at CFSA's Sustainable Agriculture Conference (SAC). Topics covered an introduction to organic production, organic crop rotation, completing an organic system plan, allowed and prohibited inputs, record keeping, and organic certification for value-added products.
- 90-minute workshop, **Understanding Organic Inputs for Your Farm**, to 25 producers, at SAC.
- 30-minute workshop, **Growing Opportunities in Organic Production: Enterprise Budgets**, to 30 producers at the NC Fruit and Vegetable Growers Association's Annual Fruit and Vegetable Expo.
- A 30-minute workshop on **Organic Tomato Production**, to 30 producers at the NC Fruit and Vegetable Growers Association's Annual Fruit and Vegetable Expo.

We sent a survey out to over 500 farmers, including CFSA program participants, to determine the number of participants who began the transition process to certified organic production and to collect information on the reasons participants choose not to transition to organic to help inform future training needs. Of the 133 responses, 27 are currently certified and 31 are in the transition process. Twenty-eight respondents had participated in a CFSA program, of those, 18 are transitioning to certified production and one will begin transitioning in 2014. Respondents (10%), lack of technical support from agricultural service providers (10%), and recordkeeping (6%) as obstacles most challenging during the transition process to USDA Organic Certification.

## Beneficiaries

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Direct beneficiaries of this project were specialty crop producers who received technical information about the EQIP-OI program, and specialty crop producers and NRCS district conservationists who received technical assistance about organic production practices. Beneficiaries served are listed below:

| <b>TYPE of INFORMATION DISSEMINATION</b>      | <b>NUMBER OF</b> |
|---|------------------|
| Viewed Online Resources                       | 1907             |
| Attended a Workshop (Producers)               | 244              |
| Attended a Workshop (NRCS employees)          | 81               |
| Received One-on-One Consultation              | 47               |
| Received information on the EQIP-OI Program   | 750              |
| Have Begun Transitioning to Certified Organic | 18               |

## Lessons Learned

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It is difficult to determine how many specialty crop growers are in the transition process to certified organic production because they are not required to contact a certifying agent until they are ready to submit an Organic System Plan near the end of the required 3-year transition period where no prohibited substances can be applied. Because of this, there is no data regarding the number of growers who are transitioning. There is data on the USDA's National Organic Program website regarding the number of certified organic operations in NC. However, this data does not include the number of certified organic acreage or the number of growers in the transition process. It would be very useful if it did so we could track changes in the amount of certified organic acreage in NC. There is data in the USDA's 2011 Organic Production Survey about the number of acres that are certified in NC, however, this information is not current and only includes information from growers who completed a survey. Moreover, it does not include information on growers who are in the transition process. Therefore, it is difficult to determine how many growers are in the transition process.

With respect to the NRCS EQIP Organic Initiative, it will take a concentrated effort and a willing partnership to promote this program to organic producers in the state. The fact that less than 20% of the available funds were expended in 2013, testifies to the fact that 1) organic producers are not aware of opportunities or are wary of what they perceive to be "conventional" agricultural programs and expertise, 2) that NRCS staff recognize that additional training is necessary for them to be fully capable of identifying resource concerns of organic producers and 3) the difficulty of bringing information about EQIP to organic producers as well as information about organic production to EQIP staff.

There is a lag time between initial conversations with growers that are eagerly considering the option of organic certification and when they actually begin the transition process. Many growers approach CFSA thinking that they understand and

meet the requirements of the National Organic Program but find that there are a number of nuisances of which they were unaware. A great deal of time can be spent discussing the particulars of a grower's operation and teasing out practices, inputs and recordkeeping issues that will be problematic when presenting an Organic System Plan very helpful at building baseline knowledge for growers. However, finding out the level of detail that is involved in certification may stifle the enthusiasm and progress of growers entering transition, thus staggering our ability to assist them. This realization has shifted how we approach working with growers, which begins with offering a short list of resources to review. We follow up with a phone call and take care to check back in with growers frequently to monitor their progress and be sure they are using the services we offer to clarify lingering, unasked questions.

### Contact Person

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Karen McSwain  
(828) 423-2463  
karen@carolinafarmstewards.org

### Additional Information

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<https://www.carolinafarmstewards.org/>

- [Technical fact sheets](#) on conservation practices for organic specialty crop growers
- [Review](#) of commercially available recordkeeping software
- [Record keeping templates](#)
- Seven articles on organic production practices in our electronic newsletter:
  - o [Sourcing Certified Organic and Untreated, Non-GMO Seed](#)
  - o [Develop an Organic Farm Recordkeeping Plan](#)
  - o [Estimating Nitrogen Production from Cover Crops](#)
  - o [Year-End Analysis of Your Farm's Profitability With Veggie Compass](#)
  - o [Tips for Taking Care of Transplants](#)
  - o [Crop Rotation and Reducing Wireworm Damage on Sweet Potatoes](#)
  - o [The Best Summer Cover Crops To Enrich Your Soil](#)

**Project Title:** Down East Connect Farmer's Fresh Market

## **Final Report**

### **PROJECT SUMMARY**

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Once a thriving agricultural region, Columbus County and its neighbors have struggled to regain economic footing after tobacco production collapsed as an income base. In the transition to specialty crop production, many farmers still face major barriers in marketing their products. Few of Down East Connect's member farmers had previously marketed their products beyond roadside stands and local markets, and most were not earning significant income from specialty crops. At the same time, the demand for local, fresh fruits and vegetables is growing strong in nearby urban centers.

The aim of Down East Connect is to bridge the gap between the two communities utilizing broadband Internet and a technology based market platform. Farmers and consumers alike have embraced the convenience and opportunities of the virtual farmer's market.

Down East Connect will continue the success of its program as it seeks to attain financial sustainability and to realize the promise of specialty crop farming as an economically viable employment option. The project will increase the variety and value of specialty crops grown in the region, and create a strong relationship between the producers and consumers. The overriding goal of this project is to foster an environment of entrepreneurship that will spread to the entire community and encourage farmers to look at their land as an entrepreneurial center that creates jobs in their community, produces a sought-after product, and provides a living wage for themselves and their employees.

### **PROJECT APPROACH**

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Down East Connect used grant funds to support outreach events in the community on a monthly basis including a tabling presence at each of our delivery locations. Quarterly farmer meetings were conducted to keep farmers updated on project activities and two farmer interest meetings were held to attract potential new farmers. A satisfaction survey was conducted separately for both the customers and the farmers to assess project strengths and areas for improvement. In fall of 2013, a customer focus group was conducted with 11 customers to more deeply assess customer's needs and experience with Down East Connect.

Down East Connect worked to increase customer membership as well as the number of actively selling farmers in 2013. Our attempts at marketing the project through outreach events, tabling, and farmer interest meetings during the first half of 2013 were successful and well attended, but failed to deliver our expected result. These findings prompted us to modify our budget in order to hire a part time Marketing Specialist to assess our current marketing strategy, bolster social media and newsletter reach, and develop a step by step marketing plan to move forward with in the New Year.

Down East Connect sold a total of \$42,472 in 2013, \$33,977 in farmer payouts. Our total sales to date at the end of December 2013 reached \$118,858. Membership more than doubled with total members at the end of 2013 at 1,117. We actively encourage farmers to seek out multiple revenue opportunities with their specialty crops and not to focus on selling exclusively through Down East Connect. While some older farmers ceased to sell through Down East Connect because of other opportunities, new farmers have shown interest and begun selling. This has resulted in new farmer specialty crop sales, but not an overall increase in the number of farmers actively selling their specialty crops through Down East Connect.

The scope of this project benefits commodities other than specialty crops, however all marketing, social media and newsletter content featured the promotion and education of specialty crops. While we work with farmers and independent business that sell things other than specialty crops we focus our efforts on recruiting new sellers who grow and sell specialty crops. **Approximately 15% of all Down East Connect sales are of non-specialty crop items. While Down East Connect's online marketplace sells meats, baked goods and other value added products, these items themselves are incidentals that function as added income support for the project so that the project can continue to support its main goal of increasing the production, value and sales of specialty crops. Sales of specialty crops on the site have shown a dramatic increase when the market itself boasts a variety of goods that count as "add-ons" to customer's orders. The in-kind work of the Columbus County Horticulture Extension Agent will allow for all other Specialty Crop Block Grant funded employees to focus solely on specialty crops.**

## **GOALS AND OUTCOMES ACHIEVED**

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1. Increase membership (consumers registered on the virtual farmers's market web site) from 500+ to 1000.

In order to meet this goal, Down East Connect has held 13 outreach events including Farmer Meet and Greets, informational tables, a farmer dinner and a customer focus group. **Specialty Crop Block Grant funds were not utilized to pay for the dinner.** A marketing specialist was hired part time to assist with social media marketing to boost member interest and attract new customers. Project has surpassed its original goal of 1,000 members during the first half of 2013. As of June 30<sup>th</sup>, the project has a membership of 1,055. As of December 2013, the project has a membership of 1,117.

2. Increase the number of farmers actively selling specialty crops from 21 to 50.

Project has advertised for farmers through the Cooperative Extension Service in Columbus County and held one farmer meeting. Project has had 16 different farmers actively sell specialty crops through the project during the first six months of 2013.

Five new farmers have registered to sell specialty crops through the Farmer's Fresh Market between June 30<sup>th</sup> and December. 31<sup>st</sup>.

Farmers who have participated in the program earned a total of \$33,977 from January 1 to December 31, 2013.

3. Reach total sales goal of \$230,000 by end of 2013.

Project sought to reach sales goal by bolstering membership and increasing the volume and variety of specialty crops sold on the market. Down East Connect sold a total of \$42,472 in 2013. Our total sales to date at the end of December 2013 reached \$118,858.

4. Crop season extension training

Season extension training has been postponed. This is due to funding being re-allocated for creation of a marketing specialist position.

## **BENEFICIARIES**

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Project has had 21 different farmers actively sell specialty crops through the project in 2013. Farmers who have participated in the program have earned \$33,977 through the program since January 1. This marks a significant amount of revenue generated and entering the economically distressed counties from metropolitan areas.

Down East Connect was also able to employ one full-time and two part-time positions throughout 2013. A project manager was employed full-time at a salary of \$24,000. An executive director was employed part-time at a salary of \$12,000. A marketing specialist was also employed part-time with pay totaling \$3,000.00.

## **LESSONS LEARNED**

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The biggest problem encountered this year was out of our control. Unexpected heavy rainfalls during the peak of the summer harvest led to several specialty crop farmers abandoning some of their crops in the fields and creating a limited supply of specific crops. We believe this also had a negative impact on the recruitment of new farmers, as many farmers who showed interest in selling specialty crops through Down East Connect had little to no product available due to the heavy rainfalls and chose not to participate this year. It is our hope that their interest will be maintained and that they will participate at a later time.

We also saw an increase in competition in the local foods market that the Down East Connect project targets. Two new grocery stores that aim to sell clientele local and organic products opened in the Wilmington market and have seen significant business. We feel that with more options in the market for local food that the number of participating clients has seen a slight decline. It is because of this increase in competition that we chose to shift our Specialty Crop Block Grant budget to allow for someone to come in and assist with marketing. We feel that a stronger visible presence will allow for Down East Connect to be a more competitive local foods option.

While outreach events in the community were well attended and celebrated by members and farmers alike, it was easy to recognize that the project needs a stronger marketing strategy. Down East Connect plans to launch an aggressive radio and print advertising campaign in 2014 to complement the impact of outreach events and hopefully achieve desired increase in sales and membership.

In addition to these challenges, Down East Connect has learned the value in customer surveys and customer focus groups. Through these mediums the project gleaned valuable input on many aspects of the program including desired specialty crops, delivery and packaging preferences, improving convenience for customers, and more.

## **CONTACT PERSON**

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Howard Wallace  
North Carolina Cooperative Extension – Columbus County Center  
45 Government Complex Road  
Whiteville, NC 28472  
Ph: 910 640 6606  
Email: howard\_wallace@ncsu

## **ADDITIONAL INFORMATION**

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Project website: <http://www.downeastconnect.com>

**Project Title:** North Carolina Blueberry Online and Social Media Consumer Campaign

## **Final Report**

### **PROJECT SUMMARY**

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There are more than 130 blueberry growers in North Carolina and as international sources open for import and export the competition is keen and opportunities are growing. The North Carolina Blueberry Council would partner, and match funds, with the NCDA & CS to optimize social media to further enhance the presence of North Carolina blueberries online. Efforts will go beyond the borders of our State and even our nation. The impetus for this focus is based on findings by the USHBC - consumers got their health information about blueberries in the following ways: Online 49% (includes social networks and special interest websites; Magazine 16.5%; Television 12%. Respondents were very likely to purchase blueberries based on the information they see and learn on their preferred social media sources. 57.36% of respondents gave a likelihood of 7 (out of 10) or higher.

Pew research came out with information showing that 87% of adults were using the Internet. The use of smartphones and tablets has doubled since 2012. We had to have a marketing presence in the non-traditional online model – but also smart phones, tablets and netbooks.

### **PROJECT APPROACH**

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The first step was a consumer website redesign that included video, contests, partnerships with other media and branding commensurate with Pinterest, Facebook, and Twitter. Secondly a website for growers was created to also meet needs for industry vendors, researchers and educators. This framework was completed by 4/6/13 – the development of the various locations is ongoing with the addition of newsletters added to the growers' online and email functions that improve communication within the industry in North Carolina.

### **GOALS AND OUTCOMES ACHIEVED**

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Website redesign with blogs, pre-design/consulting, design implementation and hosting began in mid February and completed by the end of April. Social media links and integration were initiated at the end of February and completed by mid April. Video player and media pages set up was initiated at the end of March and completed by the End of April. Maintenance and trouble-shooting continues.

Our goals are accomplished. We managed to stay under budget.

Grower membership has increased more than 100%. Income from the annual trade show and expo, promoted online, increased 25%, Facebook *likes* have increased more than 100%. Twitter followers have increased more subtly at 50%.

Because the North Carolina Blueberry Council had a presence in the hot areas of online media – we were able to partner with *Our State Magazine* magazine in a state-wide recipe contest. Their readers increased traffic to our websites and social media areas. Our matching funds were used to purchase print advertising from *Our State* as well as *Farm Bureau* magazine in order to strengthen the “N.C. Blueberry message” and further awareness of our product. The results were appreciable and another partnership will be funded during harvest of 2014 with additional incentives for participation. More importantly, despite treacherous rain and weather, the blueberry crop suffered only a minor loss of 2 percent despite a fear of 10-20%. More crop went to process (instead of fresh) but demand was healthy.

Goals and Outcomes: Elaborate on the completion of the expected measureable outcomes indicated in your approved project proposal. • Increase sales 7% or \$4.5 million in 2013 and \$5.5 million in 2014 for a total of \$10 million in increased sales.

In 2013 there was a loss of 1 million lbs. of fruit due to rainfall and wind. This translated into a dollar loss in 2013 of \$5.4 million when compared to 2012. The dollar total in 2012 was \$71 million and in 2013 \$64.5 million. Total volume in 2012 was 40 million lbs. and 39 million in 2013. Sales in 2014 were \$72.2 million and total pounds were 48.5 million. Rain affected the fresh/process mix. Process grew from 4.8 million pounds in 2013 to 11.2 million in 2014. Fresh went from 38 million pounds in 2014 to 37.3 million pounds in 2014. Sales increased from 2012 to 2014 by 1.6%.

The progress made on the completion of the expected measureable outcomes will be monitor through data supplied through USDA, NCDA & CS, shippers and U.S. Highbush Blueberry Council.

Information for comparison came from USDA Quick Stats, US Highbush Blueberry Council and the NC Department of Agriculture and Consumer Services..

## **BENEFICIARIES**

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Considering the model that consumer demand engines crop increase and yields – which generate assessments - various departments at NCSU benefit from assessments: Extension Education Programs, disease research, entomology, horticultural science, and plant pathology.

The growers have an assessment that provides funding for research (as outlined above), primarily at NCSU. Funding last year exceeded \$140,000 which exceeded assessments. This year at the annual meeting growers voted to increase the assessments by 50%.

## **LESSONS LEARNED**

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The outcomes for the project were positive and the Council will continue to invest in this direction – we keep a close eye on consumer behavior. One of the negative results of this award is the amount of documentation and revisal this grant requires. Other states have training for commodity grant awards. This becomes frustrating, discouraging and time-consuming.

Partnerships with other online or media entities with commensurate demographics will enhance these kinds of marketing efforts. In our experience, the result can become exponential.

## **CONTACT PERSON**

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Julianne J. Woodcock  
910-471-3193  
ncblueberry@bellsouth.net

**Project Title:** Promoting Environmental Benefits of Christmas Trees

## Final Report

### PROJECT SUMMARY

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The purpose of this project was to increase demand for real NC Christmas trees by focusing promotional efforts on the industry's record of environmental stewardship, a positive message that resonates with today's consumer. NC Fraser fir Christmas tree growers have seen a decrease in reported sales in excess of 15% in the past few years due to regional oversupply, increased national competition, and the economic recession. This project used targeted promotional activities to focus on consumer concerns about the environment and tree production practices. Over 1000 Christmas tree growers benefited from these targeted promotional activities. In addition, a set of criteria and standards was to be developed for a proposed environmental stewardship certification program along with an educational curriculum module fashioned in compliance with national education standards.

**Project Importance and timeliness:** North Carolina Christmas tree growers have been dealing with an overabundance of trees compared to demand for several years. USDA Agricultural Statistics have shown a decrease in tree sales in excess of 15% from 2007 through the 2010 sales season. Regional oversupply, increased national competition, and the economic recession have created the need for a more competitive marketing campaign.

This project was timely because "green marketing" continues to grow in popularity, in large part due to the fact that customers are increasingly integrating their environmental values into their purchasing decisions. NCCTA was able to develop a promotional campaign focused on consumer-driven concerns about the environment that highlights the industry's positive track record of environmental stewardship. These promotional efforts contributed to increased demand for NC Christmas trees, which in turn will allow all growers to benefit from a more stable market. This project also made it possible to expand marketing and promotional efforts to reach new potential buyers and consumers.

**Project Objectives:** This project focused on three primary objectives

1. Stabilize the market for real NC Christmas trees by increasing the demand for product.
2. Increase awareness of NC Fraser fir Christmas trees in local as well as out-of-state markets.
3. Increase consumer awareness of the environmental benefits of real Christmas trees.

### PROJECT APPROACH

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An annual grower survey was created and distributed to evaluate association marketing efforts. The survey was an opportunity to collect information on grower planting practices as well as their marketing perceptions. Along with its function as an evaluation tool, this survey provided some very interesting information about both the NC Christmas tree industry and marketing activities.

The 2015 NCCTA Grower Survey reflects a changing tide and an increase in optimism among NC Christmas tree growers.

Firstly, growers were asked to classify their business (please note that respondents were asked to choose all categories that applied to their business). Ninety-two percent of respondents sell trees wholesale, twenty-nine percent operate retail lots, thirty-four percent have Choose & Cut operations, and about ten percent add mail order to their diversified marketing strategies. It's important to point out that forty-two percent of respondents utilize two or more business strategies with several employing all four. The portion of growers who utilize multiple business strategies was greater for the 2015 pool of respondents than for those who responded in 2013.

In NCCTA surveys conducted over the last decade, approximately a third of respondents had stopped planting trees. Along with decreasing market access, increasing age has been a driving factor in the decision to quit planting Christmas trees. However, the average age of growers reported by the 2015 respondents was lower than that reported by the 2013 pool of respondents. In 2013, more respondents were in the 56 to 65 age class. In 2015, the greatest number of respondents was in the 46 to 55 age class. No mystery, this trend has been apparent as we see the next generation of growers attend meetings and take on leadership roles in the NCCTA.

Growers were asked to report the number of trees they harvested in 2014 by tree number classes. Based upon class midpoint, survey respondent's harvested 2.2 million trees in 2014 with a potential range of 1.3 to 3.3 million trees. While more growers reported harvesting between 5,000 - 50,000 trees, growers harvesting between 50,000 and 100,000 trees generated the most trees in any class. Twenty-nine growers in the three lowest categories (up to 5,000 trees) generated 60,000 trees or three percent of the total estimated harvest. The single major grower harvesting 300,000 trees represented fourteen percent of the total harvest captured by this survey.

When growers reported on their pattern of planting Fraser fir in comparison to last year, growers were more optimistic, with thirty percent of growers indicating that they planned to plant more in 2015 than in 2014 (12% more). When planting trends are compared to 2012 data from the 2013 NCCTA grower survey, the increase in planting is more apparent. From 2012 to 2015, those planting more Fraser fir jumped from fourteen percent to thirty percent.

When growers reported on their pricing for the 2014 season, sixty-eight percent increased their prices. Among those increasing price, thirty-six percent raised their prices less than

five percent; fifty-five percent raised their prices from five to ten percent; and eight percent raised their prices between eleven and twenty percent.

When the pricing question shifted to anticipate pricing for 2015, confidence was even greater. Seventy-nine percent planned to increase prices. At least half of the respondents who planned to increase prices in 2015 will be doing so for the second year in a row (this assumes that all of those who plan to maintain or decrease price in 2015 already raised prices in 2014). Clearly, this is a very positive trend.

When asked to identify their customer base, Sixty-seven percent of respondents identified both garden centers and fundraising groups as part of their customer base. Almost as many, (64%) identified retail lot operators as a part of their wholesale customer base. Fewer wholesale growers identified either box stores (23%) or grocery stores (13%) as part of their customer base. Growers attributed forty-six percent of their consumer sales to their own retail lots, thirty-eight percent to their choose & cut operations, and thirteen percent through mail order sales. Compared to the 2013 survey, the percentage of growers targeting every customer base increased across the board, suggesting that the 2015 sample of growers are engaged in more diverse sales to different types of customers.

The ranking of growers' customer bases is very useful information for the NCCTA. Many association activities are directed to one specific customer group or another. This ranking will help NCCTA leadership to prioritize promotional efforts that could help the greatest number of members.

Growers also identified the regions to which they sell and deliver trees. The top three regions identified were North Carolina, adjacent states and the South Atlantic region. Of course, North Carolina was the predominant region at eighty-two percent, followed by adjacent states with seventy-seven percent and the South Atlantic region with seventy-six percent. The number of growers who sell to a region declines with increasing distance from NC, but it is encouraging to see Fraser fir going to every region.

Several questions on the survey explore growers' perceptions about NCCTA promotional activities. The NCCTA website is considered by far the most effective promotional activity at eighty-four percent. This is a reflection of the trend toward web-based advertising and also exemplifies widespread support amongst both wholesale and choose & cut growers. The Buy-Sell Guide and Choose & Cut Memories directory each serve only a segment of the NCCTA, but are still rated highly at sixty-eight and sixty-four percent respectively. Another interesting pattern in the ranking of effectiveness is the greater popularity of online advertising compared to print (fifty to sixty percent vs. forty to fifty percent). While growers see an advantage to online advertising, social media tends to face mixed reception among growers. Facebook advertising has achieved a level of appreciation equal to consumer show exhibits at forty-nine percent, but blogs and twitter rank at the bottom of all activities. While attending nursery trade shows is only considered to be effective by a third of respondents, we need to keep in mind that the Buy-Sell Directory

was ranked second in effectiveness. Trade shows are still a primary method for distributing the Buy-Sell Directory.

Many of the NCCTA promotional activities are interconnected and are used together to drive a broader campaign. The printed and online versions of the Buy-Sell Guide are closely linked, as are the various methods of advertising them. Same for the Choose & Cut Memories Directory. With limited resources, the NCCTA must always choose which specific advertising to invest in. But instead of balancing a baker's dozen of promotional activities, there are really only three initiatives: consumer promotion, wholesale promotion, and retailer service (point-of-sale materials). The NCCTA can effectively maintain these promotional initiatives even as the use of specific activities waxes and wanes.

As the NCCTA continues to conduct promotional activities, develop a new strategic plan, and provide leadership to our industry, the work continues. An evaluation tool like this survey can help our organization to stay on track to make wiser decisions in the future.

Both consumer and trade oriented shows provide valuable "face-time" with consumers and potential customers of NC Christmas trees, providing the opportunity to directly educate the consumer about the environmental benefits of real Christmas trees.

NCCTA was able to increase and improve their presence at local, regional and national "Green Industry", consumer, and other trade show events. Wholesale buyer's guides are distributed at nursery oriented trade shows along with educational information for buyers. This year we were able to hand out information packets containing retail and buyer information, care tips for retailers and included a DVD featuring 3 short videos: Tree Care, NC Fraser Fir Attributes, and Tips for a Successful Retail Lot.

Promotion of REAL Christmas trees and education are the main goals of attending consumer oriented shows. Presence at consumer shows were enhanced with new full-color metal posters, environmental choice flyers, Get REAL stickers for children and "North Carolina Fraser Fir: The Perfect Christmas Tree" magnets. Premiums were purchased for nursery oriented shows including: hand sanitizer, thermal lunch bags and mesh tote bags.

The Trade Show and Consumer Education Committee along with Jennifer Greene (NCCTA) planned and organized the following trade show agenda for 2013-2014.

- NCNLA Green N' Growin', Greensboro, NC – January 2013, January 2014  
Attendees - 3,500-5,000  
Who - Industry professionals/potential wholesale buyers
- SCHI (South Carolina Horticulture Industry Show), Myrtle Beach, SC –February 2014  
Attendees - approx. 1,800  
Who - Industry professionals/potential wholesale buyers
- Mountain State Fair, Fletcher, NC – September 2013, September 2014  
Attendees - in excess of 180,000

Who – Great opportunity to connect with consumers and educate about the environmental benefits of REAL Christmas trees

- Christmas in July Festival, West Jefferson, NC – July 2013, July 2014  
Attendees - Approx. 20,000

Who - The annual Christmas in July Festival in downtown West Jefferson was started by Christmas tree growers in Ashe County to highlight the industry and draw outside buyers to see the bountiful Fraser fir in the area.

- Southern Christmas Show – November 2013, November 2014  
Attendees - in excess of 100,000

Who – Great opportunity to connect with consumers and educate about the environmental benefits of REAL Christmas trees

- North Carolina State Fair, Raleigh, NC – October 2013, October 2014  
The average attendance for the fair is 792,127

Who – Great opportunity to connect with consumers and educate about the environmental benefits of REAL Christmas trees

- Cleveland County Fair, Shelby, NC – September 2014  
Attendees – in excess of 165,000

Who – Great opportunity to connect with consumers and educate about the environmental benefits of REAL Christmas trees

NCCTA purchased advertising through web, E-Newsletter, magazine & newspaper ads. Larger ads to enhance exposure were purchased. Advertising efforts include:

- American Nurseryman Magazine – Quarter page ad in five targeted issues - June, July August, September, December 2013
- Fayetteville Observer - Full page ad and half page advertorial featured in a special “Buy NC” full color insert – July 2013
- Produce News - Full-Page 10 x 15,” Full-Color ad in two target issues of: June 3 (IFE Show Issue), July 1 (Fall Trends), 2013
- The Packer - ½ page ROP ad in: August 12, 2013
- Packer.com - Medium size web ad, 15000 impressions July 2013
- The Packer Daily E-Newsletter: Daily, July 29- August 10, 2013
- Purchased of over 4,000 direct mail contacts to target wholesale buyers, 2013
- American Nurseryman online - Digital tower banner on AmeriNursery.com - July – December 2013
- American Nurseryman online - Digital Leaderboard Ad on AmeriNursery.com – August, September 2013
- American Nurseryman online - Digital “ blow in ad” in the digital edition of AmeriNursery.com - August 2013
- Digital banner ad in American Nurseryman SPROUT E-newsletter – July 15- September 15, 2013
- Plant & Supply Locator – two half page color ads to run April – October 2013 & 2014
- Our State Magazine - full page ad October, November 2013
- Our State Magazine - full page ad October 2014

- Our State magazine – Online run-of-site promotion to enhance print ad, November 2013 & 2014
- WSOCTV.com text ads, banner, ads, & rich media ads – November 2013
- Half page ad in Southern Living magazine – November 2013
- In July 2013, 85,000 Choose & Cut rack cards were printed and distributed by professional distribution services to over 450 locations along I-85, I-40, & The High Country. Rack cards were also distributed at trade & consumer shows as well as to Chambers and Visitors Centers throughout North Carolina.
- Mailed in 4,000+ postcards promoting the Buy-Sell Guide to target wholesale buyers
- Facebook Ads – This was a new endeavor for the association. NCCTA ran five campaigns from 10/17/2014 – 12/15/14.
  - Target audience:
    - 3 Campaigns targeted consumers in five major urban areas on the east coast (DC, Chicago, NYC, Philly, Boston)
    - 2 Campaigns targeted consumers in NC and surrounding areas
  - Budget: \$1,674.22
  - Messages:
    - “Real trees are eco-friendly and grown by American farmers. Get Real this Christmas.”
    - “Real Christmas trees are an all-American product, farm grown, and environmentally friendly. Keep it real this Christmas.”
    - “Real Trees Make Scents. Get real this Christmas.”
  - Ad Directed Consumers to:
    - NCCTA webpage
    - NCCTA Facebook page
  - Results:
    - Reach: 143,516 Facebook users
    - Website clicks: 2,266 (unique clicks)
    - Page likes: 2,424 (unique likes)
    - Other:
      - 4,291 users liked our ads, 61 users commented on our ads, 316 users shared our ads

A budget revision was requested and approved to alter the use of funds originally budgeted for developing an environmental Stewardship curriculum program and creating an educational module. All NCCTA promotional activities drive consumers and buyers to the NCCTA website: [www.NCchristmastrees.com](http://www.NCchristmastrees.com). In order to add additional information to the website, an upgrade to software and programming was required. Funds were needed to update programming software on the website. This now allows NCCTA to continue to increase website traffic while making the site more user-friendly for buyers and consumers looking for NC farm-grown Christmas trees.

An Environmental Stewardship workgroup is actively developing preliminary components & guidelines for a proposed program. This project is still ongoing; however, plans for this

program have not progressed to the point to where the money that was budgeted for this project (\$2500) could be spent effectively.

In 2013 and 2014, additional point-of-sale materials were purchased and made available to all NCCTA grower members and their customers. These materials enhance the brand identity of North Carolina Fraser fir as the “Perfect Christmas Tree”, and educate consumers about positive attributes of farm grown Christmas trees, proper tree care and fire safety.

The project expanded branding efforts of North Carolina Fraser Fir “The Perfect Christmas Tree” by creating and distributing point of sale materials to growers and their customers.

- 12”x18” corrugated plastic “NC Fraser Fir, The Perfect Christmas Tree” signs
- 11”x14” laminated Fraser Fir Care Posters
- Real Trees Makes Scents brochures
- Fraser Fir care pads with 50 tear sheets each
- 36”x55” Fraser Fir outdoor banners

NCCTA staff used email, mailings and website to promote availability, distribution from the NCCTA office, and materials were made available at association meetings.

## GOALS AND OUTCOMES ACHIEVED

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The main **goal** of this project was to stabilize the market for real NC Christmas trees by increasing the demand for product. Results from our grower survey indicate an increase in sales which drives an increase in the wholesale price of Christmas trees. The first **performance measure** is to be determined by farm income. We have recently learned that the next economic data from USDA will most likely come with publishing of the Census of Horticulture Specialties in fall 2015. The second **measurable outcome** is the average wholesale price of Christmas trees. The grower survey indicates that thirty-six percent raised their prices in 2014 and Seventy-nine percent planned to increase prices in 2015.

Our second **goal** was to increase awareness of NC Fraser fir Christmas trees in local as well as out-of-state markets by engaging wholesale buyers. Our target was to increase sales which will drive the wholesale price of Christmas trees to increase. The first **measurable outcome** is the increase in web traffic on the [www.NCchristmastrees.com](http://www.NCchristmastrees.com) site and the engagement of visitors who are interested in wholesale trees. Statistics show an increase of eight percent in the visitors that conducted wholesale searches on the site. Also, the grower survey indicates that growers are selling to all regions in the US and beyond, showing expanded reach of potential buyers. The second **measurable outcome** is the number of Buy-Sell Guides that were distributed. Wholesale buyer’s guides are

distributed at nursery oriented trade shows and from the NCCTA office by request. There was a five percent increase in the number of guides that were distributed in 2014.

Our third **goal** was to increase consumer awareness of the environmental benefits of real Christmas trees. The first **measurable outcome** is the amount of promotional material distributed at consumer shows. The NCCTA Choose & Cut Memories directory is distributed at consumer oriented shows, as well as environmental choice flyers, Get REAL stickers for children, “North Carolina Fraser Fir: The Perfect Christmas Tree” magnets and select premiums. The number of directories that were distributed remained the same in 2014 when compared to 2013 and 2012. It can be determined that the reason for this is credited to the increase in website traffic for choose & cut information. The second **measurable outcome** is increase in web traffic on the [www.NCchristmastrees.com](http://www.NCchristmastrees.com) site. Environmental information that educates the consumer of the environmental benefits of real Christmas trees is now available on the site; items available include an Environmental Choice flyer that compares the benefits of real Christmas trees to artificial Christmas trees, facts and educational information about the eco-friendliness of real Christmas trees, and information on recycling real Christmas trees as well as a link to a site that tells consumers how and where they can recycle their tree in their city.

The project expanded on NCCTA efforts to use advertising to drive all potential buyers (wholesale, retail, choose & cut) to the NCCTA website [www.NCchristmastrees.com](http://www.NCchristmastrees.com) where buyers and consumers can find tree availability, tree care, positive attributes of real trees, fire safety tips, and locate wholesale suppliers, choose & cut farms, Mail order suppliers and retail lot locations.

Website statistics confirm a forty-nine percent increase in sessions over the life of this project. A new design and database platform allows for better ease of navigation on the [www.NCchristmastrees.com](http://www.NCchristmastrees.com) website. Customers can now target their searches based on their specific wants and needs. This targeted search results in those farms that meet the needs entered, as well as a Google mapping feature for retail lots and choose & cut farms allows the customer to easily contact and/or locate the farm or grower and find North Carolina Fraser Fir.

The increased value of point-of-sale materials to NCCTA members was supported by their elevated ranking in the grower survey.

We completed the activities in our amended project proposal and achieved the project performance goals and outcomes.

## **BENEFICIARIES**

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Direct beneficiaries include the 1,000+ Christmas tree growers in North Carolina and contiguous counties in Virginia and Tennessee. All of these growers are not claimed as members of the North Carolina Christmas Tree Association, but the vast majority of tree

production in these areas is from Association members. Furthermore, any promotion that stabilizes or increases demand for North Carolina Christmas trees will benefit all of these growers over time, regardless of association affiliation.

## LESSONS LEARNED

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Investments made by the NCCTA over the last two and a half years have expanded our promotional impact, and website usage has continued to increase. Not only does the association provide a higher quality presence on-line, but the total promotional effort driving potential buyers and consumers to the website has improved. Improvements to trade show presence has improved its professional appearance and visibility. The educational value provided at these shows has also increased. The continued ability of the NCCTA to provide point-of-sale materials to growers and their buyers was critical at this juncture in the Christmas tree market when so many growers were struggling to maintain market share. Additional promotional activities funded through the NCDA&CS Specialty Crop Block Grants have made it possible for the NCCTA to fulfill its mission to the North Carolina tree industry during some of the most difficult times that the industry has ever faced. With these investments in our strategic marketing plan, the NCCTA is well positioned to continue promoting North Carolina Christmas trees and the environmental benefits that real trees offer.

## CONTACT PERSON

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Jennifer Greene, Executive Director  
PO Box 1937  
Boone, NC 28607  
[Jennifer@ncchristmastrees.com](mailto:Jennifer@ncchristmastrees.com)

**Project Title:** Promoting Outstanding Performance, Outstanding Plants

## **Final Report**

### **PROJECT SUMMARY**

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Bedding plant are a \$140 million industry in NC and as such this project sought to increase awareness among consumers by providing needed marketing materials to growers and placing certain varieties at strategic points to increase visibility to those plant. This project assisted growers by increasing their success through disease management and marketing/promotion

### **PROJECT APPROACH**

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The NCCFGA board met with John Hammond of the NCDA&CS in early 2013 to develop a marketing strategy campaign. The main focus was to update the website with consumer materials, place promotional advertisements in the Triangle Gardener, and obtain plot spaces for display plants at the J.C. Raulston Arboretum.

The NC Selects website has been updated on a continual basis by the hired web design firm Signature Online Web Design The plan was to purchase advertisement space in the Triangle Gardener, while that occurred some additional marketing funds became available from the NCDA&CS Marketing division through John Hammond and those monies were used instead. The plot spaces at the J.C. Raulston Arboretum were obtained and NC Select plants were grown there. This allowed for trialing of the new candidate plants for the NC Select program. The plants were viewed by both professional growers and individuals interested in horticulture. Annual visits to the garden exceed 15,000 people. While it is not possible to quantify if each person viewed the trial, a large portion of the summer visitors view the flower color beds.

### **GOALS AND OUTCOMES ACHIEVED**

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The NCCFGA developed a marketing strategy campaign that successfully resulted in updates to the website with consumer materials, advertisements in the Triangle Gardener, and displayed plants at the J.C. Raulston Arboretum; all of which increased consumer awareness of locally grown NC plants.

The NC Selects website is continual updated by the hired web design firm Signature Online Web Design The purchase of advertisement space in the Triangle Gardener was supplemented with additional marketing funds. The NC Select plants were grown on plot spaces at the J.C. Raulston Arboretum. This allowed for trialing of the new candidate plants for the NC Select program. The plants were viewed by both professional growers and individuals interested in horticulture. Annual visits to the garden exceed 15,000

people. While it is not possible to quantify if each person viewed the trial, a large portion of the summer visitors view the flower color beds.

### Landscape Color Field Day

In June 2013 we had 151 people attend and in June 2014 there were 146. This industry professional event allows growers and landscapers to view the NC Select plants and other new introduction from the plant breeders. This field day has the third highest continued attendance of any NCSU field day. In addition to visiting the trial gardens, a series of speakers present the latest information in two concurrent sessions, one for landscapers and the other for greenhouse growers.

Another grower meeting was sponsored in March 2014. This one focused on trouble shooting production problems with the NC Select plants. A group of 6 professors and 10 graduate students' toured greenhouses in the Charlotte, North Carolina area to problem solve. After the initial introduction by the grower, the group then scouted the greenhouses for insect, disease, nutritional, and physiological disorders. Specimen plants were then discussed among the group and the grower to determine the cause of the problem and corrective procedures provided. Problem specimens were then collected for a grower workshop that was held at Rountree Plantation Garden Center. Thirty-one people attended. The graduate students presented the problems found in a quiz type format to enhance the learning by them and the growers. The teaching style worked very well for teaching the principles of diagnostics. In total, 9 greenhouses were visited on the tour, representing ~60% of total North Carolina greenhouse production area.

An added benefit to North Carolina growers and those in other states, the tour resulted in the writing of grower protocol information in the form of problem alert newsletters, called e-GRO Alerts. These Alerts notify growers of potential problems being encountered in greenhouses. The Alerts are available free of charge and there are ~2,500 subscribers.

#3.21 Correctly Applying Iron Chelates – Avoiding the Burn

#3.23 Sempervivum: Ringspots and Necrosis

#3.24 Leafy Gall (*Rhodococcus fascians*) on Geraniums, Wallflower, and Coreopsis

#3.29 Streptocarpus: Lower Leaf Purplish-Black Discoloration

#3.30 Ageratum: Lower Leaf Purplish-Black Discoloration

#3.34 Fusarium of Hiemalis (Rieger) Begonia

Each of these newsletters were opened up on average by 35% of the subscribers (~875 people).

Greenhouse growing protocols have also been developed. A focus at NC State was with *Plectranthus*. It is a versatile plant that can take the heat and humidity of North Carolina. An undergraduate student (Kara Pittman) conducted a series of greenhouse experiments to determine optimal growing information. The project also teamed up with industry experts, Dr. Rick Schoellhorn of Proven Winners and Dr. Matt Taylor of Longwood Gardens. Together the group wrote a 153 page guide to *Plectranthus*. It was published

as an iBook and available free for as a download. (See e-GRO Alert #3.03 Plectranthus eBook at <http://e-gro.org/alerts.php>). The book contained chapters on cultural requirements, disorder diagnostics, species, and additional information. This eBook was award the top book honor at the American Society of Horticultural Science Extension competition in 2014.

The total wholesale value of selected horticultural crop increased 13% from 2011 (\$223,887,000) to 2012 (\$254,020,000) in selected horticultural crops; thus higher than the 10% expected . Sourced from NCDA&CS ag Statistics

## **BENEFICIARIES**

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NC flower growers benefitted from this grant by taking advantage of the meetings that focused on production methods used to detect and treat disease and insect damage. Over 60% of NC greenhouses were on the tour for this meeting.

NC horticulture students involved in plant production approximately 10 touring a Charlotte greenhouse gained valuable insight into the detection and treatment of diseases which will further serve the industry.

## **LESSONS LEARNED**

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There must be more promotion of the landscape color field day and more involvement with horticulture students to increase the success of this project in the future.

## **CONTACT PERSON**

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Bonnie Holloman  
919-870-4999  
bonnie@seasag.com

**Project Title:** NC Growers Assistance Program

## **Final Report**

### **PROJECT SUMMARY**

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The demand for locally grown produce is extremely great and is expected to be so for the next few years. As more people look for locally produced foods there are certain obstacles for many growers to take advantage of the “local food” marketing opportunity. The purpose of this program is to remove or lessen the obstacles such as locating nearby sources of freshly produced foods, maintain current buyer requirements such as GAP certification and providing opportunities for growers to interact with buyers in a one on one setting. All of these components were properly addressed in this program and enabled growers to seize selling opportunities in the direct and wholesale channels of marketing.

The project occurred at a time when recent drought had begun to subside for the state causing a market surplus (in comparison to previous years) for many commodities. This was a critical time for growers to establish more connections to buyers thereby increasing demand for the product. The introduction to several buyers, the reduction of cost to maintain need food safety certifications and the production of advertising to increase demand proved to aid the growers in selling their product for the season.

This project did build upon previous SCBG supported project in term of Gap certification cost share. However, the addition of consumer awareness and Buyer visits were not a part of any previous SCBG projects.

### **PROJECT APPROACH**

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The project consisted of a GAP certification and water analysis cost share program, reducing the cost of certification for new growers by \$600.00 and recurring program participants by \$300.00 per year. In addition, buyers from across the country were brought in to meet with growers (who are GAP certified) on an individual basis. A mixed media campaign drove consumers and wholesale buyers to the appropriate websites for easy grower location. All three phases increased sales and awareness in the industry.

The GAP Cost Share aided 139 growing entities by reimbursing them for GAP Expenses. This enabled the growers to use these funds for other expenses.

There were 7 produce buyers transported to NC for the purpose of meeting growers and creating relationships. There were 6 growing entities that met with the buyers directly. These entities represented at least 70 growers among them. The buyers expressed appreciation and have done more business in NC since then.

The mixed media campaign was used to promote NC sweet potatoes. The funds were used to purchase advertising on local TV to increase awareness of the seasonality of

sweet potatoes. The advertising reached approximately 2,500,000 and was clicked through at a rate of 0.247%, more than double the industry standard of 0.10%..

## **GOALS AND OUTCOMES ACHIEVED**

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The goal of this project was to increase the sales of North Carolina grown horticultural crops. By maintaining or increasing the level of participation in GAP certification in NC. Reducing the extra costs of certification will enable some growers to obtain certification and become more active in the marketplace. There are approximately 60 growers certified yearly; the funds from this grant assisted 139 GAP participants over a 2 year period (slightly higher than average). Therefore, this section of the projects is considered successful as not only did NC maintain the number of growers receiving certification but actually grew.

The water analysis component of the GAP certification is also very important to the growers of NC. The number of growers that participated in the previous cycle totaled 63 with an estimated 20 participating per year. However, due to various conditions only 21 growers took advantage of the water analysis program a significant reduction in the expected numbers from years before.

The number of visitors to [www.ncfreshlink.com](http://www.ncfreshlink.com) is approximately 20,000 per month, or 240,000 per year. After this project an increase of 10% was realized with an average of 22,000 per month and a yearly total of 264,000 for a grand total of 528,000 for the two year project. The mixed media campaign lead to this increase. The total number of impression generated by the media companies gave us the effective reach and be used as the measurement. 1.2 million people were reached over the 2 year period.

The buyer visits were limited in number to a reduced amount of time for them to participate. We anticipated a total of 15 buyers representing at least 5 major wholesale companies with a total of 20-25 growers visited. However the project limited itself to 1 trip consisting of 6 buyers representing 2 companies meeting 6 growing entities representing 70+ growers for various specialty crops. The buyers had some experience in NC before however, they are purchasing more crops now as a direct result of the tour. An informal questionnaire at the end of the season (by December 31 of that year) for each participating grower was used to measure the result of the trips. The survey asked how much increase/decrease in business resulted from the visits in terms of quantity and cash value of such transactions. Each grower had a positive response.

## **BENEFICIARIES**

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The project encompassed the entire state of North Carolina. It enabled growers to reach a larger market share than previously held. The beneficiaries include but were not limited to growers of specialty crops including, Sweet-potatoes, lettuce and strawberries, an

estimated 6,000 farms (according to USDA Census of Agriculture for 2007). All growers received benefit from increased consumer awareness due to the mixed media campaign.

The funding for GAP certification cost share will assisted 139 growers at the \$300 -\$600 level of reimbursement within a 2 year period.

The water Analysis Cost share provided assistance to 21 growers over the 2 year period at the \$200 level.

## LESSONS LEARNED

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The growers across the state of NC have many needs concerning marketing. Increased food safety concerns and associated costs are but just a small part of their hindrances into the market. The biggest hurdle to abrogate would be the lack of time and affordable means to meet buyers on a one on one basis. This does not seem impossible but daunting to small and mid-sized farmers looking to get into the produce business.

## CONTACT PERSON

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Kevin Hardison  
919-707-3123  
[Kevin.Hardison@ncagr.gov](mailto:Kevin.Hardison@ncagr.gov)

**Project Title:** Promoting Greenhouse Vegetables throughout North Carolina

**Project withdrawn**

**A request to reallocate these funds to either an existing project or a new project will be forthcoming.**

**FUNDING**

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Total: \$0.00  
% of Grant: 0%

**Project Title:** Improving Nursery Employees Plant Marketing Knowledge

## Final Report

### PROJECT SUMMARY

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The purpose of this project was to enhance the competitiveness of the North Carolina nursery industry by improving workers professional marketing and customer service skills. Owners, managers, sales people, and all other employees that interact with customers must be able to provide accurate information about the plants they sell. This is necessary to effectively meet the needs of both wholesale and retail customers.

This project was to update and revise the training resources used in the Certified Plant Professional Program (CPP) and renovate the five plant CPP plant collections in the state. These resources will be used to train nursery employees and increase their professional knowledge of plants, allowing them to improve their plant marketing abilities.

The North Carolina Nursery & Landscape Association (NCNLA) operates the Certified Plant Professional program (CPP). The CPP promotes and recognizes professionalism in the wholesale and retail nursery industry. It includes an exam that requires a professional level of knowledge of the correct plant names and plant characteristics for 350 of the plants commonly grown in the nursery industry. Participants taking the exam must be able to accurately identify these plants and know how they should be used in the landscape.

The CPP resources available to train workers and prepare them for this exam were out of date and/or not available in all parts of the state. They were not meeting the needs of the North Carolina nursery industry in preparing workers to pass the exam and effectively serve their customers. Only about 40% of participants pass the exam. These resources include a Plant Identification CD, CPP study manual, and five CPP plant collections across the state. This project would revise the Plant Identification CD and CPP manual, create mobile apps for the plant identification and study manual, and renovate the plant collections including correct labeling of the plants. The study manual was last revised over 10 years ago. Many participants in the program have expressed a desire for a more useful plant identification resource.

This project builds on our previous SCBGP project, "Market Recovery Initiative for the North Carolina Nursery Industry" that seeks to increase demand for NC nursery crops. This new project will increase employee marketing abilities that are necessary to take advantage of this new demand.

### PROJECT APPROACH

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#### Task:

NCNLA meet with extension agents and arboretum directors with CPP plant identification collections. Determine specific list of plants and labels needed for each of the five plant collection sites.

NCNLA completed the list of label needs for the CPP plant collections around the state.

Task:

NCNLA - place order for plant identification labels and receive labels.

This task has been completed and labels were distributed to the CPP plant collection sites.

Task:

NCSU horticulture graduate student and specialist work on CPP manual and plant identification revisions.

This task has been completed and the CPP Study CD and Study Manual are in production.

Task:

NCNLA and NCSU review draft of new revised CPP manual and plant identification CD.

This task is completed with completion of the manual and CD.

Our partner Dr. Barb Fair, NC State University, has played a significant role in developing the new study manual and plant identification CD. In addition, nursery and landscape industry partners and extension agents have been involved in reviewing the study manual.

## **GOALS AND OUTCOMES ACHIEVED**

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All tasks and activities for the project were completed in order to achieve the goals and outcomes in the approved proposal.

Our original goals included having the new Certified Plant Professional study manual and Plant Identification CD completed by Spring of 2014. This would have allowed the new study materials to be used by industry employees to prepare for the CPP exams in 2014. However, the graduate student who was originally involved in the project decided not to participate in the project in 2014. The NCSU extension specialist has taken on the full role of writing, and editing the study manual. She has also taken on all the work of creating a new plant identification CD. This put the project behind schedule by six months. The new manual and plant identification CD completed by September 2014.

Our original goal for the plant identification collections was to have new plants installed in the fall of 2013 and spring 2014. Each plant collection site installed new plants in the fall of 2014. The plant identification labels were installed in August 2014.

### 1. Measurable Outcome: CPP Exam Passing Rate

The goal of this project was to improve the training of 250 nursery employees annually to increase their knowledge of plant identification, plant characteristics and their uses in the landscape. Data measuring this outcome will begin after the new manual and plant identification CD and collections are completed in 2014.

The performance measure was the percentage of participants in the Certified Plant Professional program that pass the exam. Our target was to increase the passing rate by 20% to 60% by 2014, compared to the 2011 benchmark passing rate of 40%. In 2015, NCNLA held 5 Certified Plant Professional exams. There were a total of 186 applicants with a passing rate of 60%.

## 2. Measurable Outcome: Participant Evaluation of Training Resources

Our goal was to improve the effectiveness of the training resources used in the Certified Plant Professional Program. The performance measure will be the percentage of participants in the Certified Plant Professional program that feel the training resources are effective in increasing their knowledge of plant identification, characteristics, and uses in the landscape. Our target is to have 75% of participants rate these resources as “effective” or “very effective”. Data was collected by survey and was concluded that 65% of the respondents thought that the training resources were “effective” or “very effective”. We have not surveyed participants in the past on their opinion of the training resources so we do not have benchmark data on this.

NCNLA completed a new 2014 version of the Certified Plant Professional study manual and created 4 new study sites for the Plant Identification exam. The Study manuals are digitally published for easier accessibility.

## **BENEFICIARIES**

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The beneficiaries of the project will be the nurseries, garden centers, landscapers, and their employees across North Carolina that participate in the Certified Plant Professional program. In addition, NC consumers and wholesale buyers will benefit from the improved customer service and information they receive about NC plants.

286 people representing 206 nursery businesses used the new CPP training materials and resources developed with this grant over the two year period. The CPP program was offered each year to all 2000+ nurseries and related green industry businesses in NC.

## **LESSONS LEARNED**

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Lessons learned with this project include the adaptability of changing roles. With the extension specialist taking full control of the project, delays were encountered. With more efficient timeline and better project controls this should not have happened.

NCNLA decided to use a “protected” USB drive instead of the CD or Mobile App to put the Plant ID Study information on. This will utilize better technology for ease of use for now and in the future.

**CONTACT PERSON**

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Cody Lewis  
919.816.9119  
clewis@ncnla.com

## **Project Title:** Potato Marketing and Variety Commercialization Strategy

### **Final Report**

#### **PROJECT SUMMARY**

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The purpose of the project was funding to support the NC Potato Association's (NCPA) ability to market potatoes produced in the State and promote new varieties in the commercialization pipeline that have been shown in NCSU research plots to perform well in NC. These funds, combined with matching funds from the NCPA and allied industry members would enable us to support a potato marketing and variety commercialization effort that will help the marketing and breeding teams to work more closely together so that as new conventional and specialty-type potato varieties are ready for commercialization, their potential could be realized.

Potato marketing in the eastern U.S. is highly competitive and market conditions continue to change. Over the course of the last decade potato acreage in NC has fluctuated from approximately 21,500 acres in 2002 to ca. 14,500 in 2008 and 16,500 acres in 2011. Continual potato marketing efforts are needed as they benefit our growers, and they help to stabilize markets, enhance competitiveness, and improve profits and the long-term sustainability of NC potato farms. Potato farming in NC is currently very competitive and conducted under very difficult circumstances. Our growers need to be creative in addressing current and future needs. Currently, the best opportunities for maintaining and/or even expanding into new markets as a potato farmer lie in the development of new, high quality potato varieties and the simultaneous establishment of good markets for these high quality varieties. Market trends, consumer preference, and buyer demands are constantly changing and farmers must be able to keep up with these conditions and supply the product that is needed for the industry

In this grant we used funds to continue the marketing effort and to expand the breeding program's efforts to develop or introduce new potato varieties into NC.

#### **PROJECT APPROACH**

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NCPA attended & exhibited at 2013, 2014, 2015 Potato Expo , the largest trade show for potato industry in US & Canada; attended by over 2,000 in the potato industry including buyers, growers, research, agri business reps in the industry giving great exposure of NC potatoes to the industry. Mark Clough of NCSU and Tommy Fleetwood of NCDA marketing set up and worked at the NCPA booth during the shows These were successful giving broad recognition to the NC potato industry. Many companies & individuals visited our booth at the shows with questions and interest in NC potatoes. During the 2015 Potato Expo, an individual company located in Maine that grows and markets purple potatoes for the chip market approached the NCPA booth with interest in locating a potato grower in NC to produce some acreage of purple potatoes to help his supply during June and July. Contacts were made and approx. 15 acres were grown

during the 2015 NC season. If this proves successful additional acres will be grown by NC growers in following seasons. Mark Clough was able to meet and collaborate with other potato researchers from other States and Provinces in Canada during the shows.

NCPA attended & exhibited at 2013, 2014 Produce Marketing Association(PMA) Convention; the largest produce trade show held in US.; attended by over 18,000, including buyers from retail, foodservice, brokers, etc. giving NC potatoes great exposure to the commercial buying industry. Many buyer contacts were made at these trade shows. Feedback received from growers and buyers determined that these contacts lead to sales of NC potatoes during the grant period and these sales relationships are established for future years. Examples of this can be identified by feedback from two buying companies met during the 2013 PMA that approx. 30 loads of NC potatoes were shipped to these companies in both 2014 and 2015 potato growing seasons.

NCPA placed ad in National Potato Council(NPC) 2013, 2014, 2015 Stat Book that is distributed throughout the potato industry to over 14,000, successfully giving recognition to NC potatoes to the industry.

During the NCPA annual meeting that was held in Elizabeth City, NC in 2014, 2015; a bus tour was held and took potato buyers to NCSU potato variety test plots and toured the area potato farms. Potato buyers and brokers from across the Eastern US and Canada attended and participated on the tours. These bus tours were successful in that it showed the potato buyers new potato varieties that are being developed for the industry.

In 2015 NCPA contracted with Harvest Design Creations to redesign the [www.ncpotatoes.org](http://www.ncpotatoes.org) website and design a new NC potato brochure. The new website is oriented to the potato buying industry as the site is linked together and provides different ways for buyers to find varieties and the farms that grow these varieties. The site also is consumer oriented as it provides potato nutrition information, recipes, and information on how potatoes are grown.

NCPA placed ad in June, 2015 NC insert of The Packer, one of the largest produce publications that is subscribed to by most of the produce industry growing, buying, distribution segments of the industry in the US and Canada. This gives great exposure to the industry for the NC potato growers. Feedback was received from growers that received contacts after the ad was in The Packer.

Two NCSU-PBP varieties (NC0349-3 and NCB2607-3) were placed into tissue culture and viruses removed to allow for the production of clean seed at Uihlein .farm in Upstate New York. After cleanup NC0349-3, a chip variety, was sent to a cooperator in Michigan (Skłarczyk seed farm) for seed increase and will be available in the 2016 season for small acreage grower trials. The other clone NCB2607-3, a small red skin yellow flesh variety was sent back to the NCSU-PBP from Uihlein farm for field evaluation and it's continuation in the program will be determined following the harvest of this seasons variety trials and yield and quality data is analyzed

This project had many partners in our efforts to advance materials and present them to the growers including the NC potato growers individually and collectively as the NCPA. Black Gold Farms in Tyrell County hosted four trials, James Brothers, Inc. in Pasquotank County hosted a variety trial, and Sackett Potatoes and International Farming Corporation jointly hosted one trial in Pamlico County. Black Gold also provided one of the standard chip clones for a chip trial at their farm and Sackett Potatoes provided a standard variety as well for their farm. John E Ferebee Farming in Camden County assisted the NCSU-PBP in acquiring a red skin table variety. Potato varieties were also supplied by US potato breeders (Univ. ME, USDA-ARS Beltsville, Cornell Univ., Michigan State Univ., Univ. Minn, North Dakota State Univ., Texas A&M, Colorado State Univ., USDA-ARS Aberdeen, and Univ. Wisconsin), Small lots of potatoes were collected for our program by Maine Farmers Exchange. Funding was provided through the NCPA, USDA-NIFA, US Potato Board, UTZ, and the NCDA-Specialty Crop grant.

## **GOALS AND OUTCOMES ACHIEVED**

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With the help of funding by this grant NCPA has been able to continue and enhance their approach to potato marketing by attending & exhibiting at Potato Expos, exhibiting at PMA trade shows, bus tours showcasing NCSU research of varieties for NC at NCPA annual meetings, placing ads in NPC Stat Books and The Packer produce publications, design a new NC potato brochure, and redesign the NCPA website. The marketing and breeding teams were able to collaborate and work closely in many aspects of the project. Both attended, set up NCPA exhibit, and worked at the NCPA booth during the Potato Expos. Both collaborated and worked together to coordinate the annual meeting bus tours that took buyers to the NCSU research plots. Both marketing and research are highlighted on the new NCPA website. These activities were successful in achieving the expected measurable outcomes.

With regards to the production/development of new varieties to the point of pre-commercial scale testing we achieved our goal. Two NCSU-PBP varieties were placed into tissue culture and viruses were removed in preparation for commercialization. The NCSU-PBP chip variety NC0349-3 is being scaled up by Sklarczyk Seed Farm, greenhouse operation in Michigan and will be ready for commercial testing in 2016. The table variety NCB2607-3 has been identified by a table industry broker, Real Potatoes, as a variety of interest and following analysis of this years data may be selected for increase in their program.

Due to marketing segment of the grant, and attending/exhibiting at the 2013 and 2014 PMA, growers made contacts with buyers at the trade show that lead to significant sales relationships for the growers. Feedback from the growers and buyers determine that these relationships remain in place and should continue with multiple trailer load shipments to these buying companies in the future. Many of the same contacts were made at the Potato Expos and the annual meeting tours that further solidify grower/buyer relationships.

Two NCSU–PBP varieties were placed into the pipeline for commercialization through funding supplied by this project. Variety development in potato is a 12 to 15 year ordeal, from early generation selection to release. Funds from the specialty crops program supplied the NCSU-PBP the necessary resources to push forward two experimental varieties through a key choke point in the development process. It is costly and time consuming to remove pathogens from plantlets funding has provided a platform for the NCSU-PBP to continue commercialization of these varieties with industry partners. Success of the varieties themselves will be data driven in the future based on their performance against industry standards. Based on the performance of these varieties with unclean breeder seed we believe future trialing will be successful and lead to eventual release of the varieties as Southeast adapted commercial varieties.

On the marketing segment of the grant the goals to continue and enhance their approach to potato marketing were accomplished by completing the planned marketing activities of the grant proposal.

The primary goal of the variety development work carried out by the NCSU-PBP was to bring experimental varieties forward with market potential and have them at the stage of development just prior to commercialization. We achieved this goal with the NC0349-3, chipping, variety as it is ready for commercial scale field trials (0.5 acre in size) in the 2016 season. For the NCB2607-3, small early red skin yellow flesh table, variety we arrived at a state of pre-commercialization on a smaller scale. Industry members have shown interest in seeing this variety move forward but will need the 2015 field data analyzed prior to making commitments for evaluation.

Multiple retail, foodservice, produce brokers were met at PMA trade shows. Some of these contacts were existing customers and these contacts help to solidify relationships. Other contacts led to new sales. According to feedback from two buying companies that made contacts with NC growers at 2013 PMA, business relationships were established and approx. 30 loads were sold to these two companies during each of 2014 and 2015 potato growing seasons. Exact number of loads sold to the other new contacts are difficult to establish but multiple loads were expected to be sold. Also during the 2014 Potato Expo, contact was made and relationships established for an NC grower to trail approx. 15 acres of purple potatoes for chips. If this proves successful, additional acres will be planted for this company. Exhibiting at Potato Expo trade shows, ads in NPC Stat Book and The Packer, the new potato brochure, and new website significantly increases visibility and awareness of the NC potato industry. Approximately 25 buyers attending the NCPA annual meeting each year and participating on the bus tours and visit the NCSU research variety trails were able to see the new varieties that are being developed.

NC0349-3, chipping variety is ready for commercial scale field trials (0.5 acre in size) in the 2016 season. For the NCB2607-3, small early red skin yellow flesh table, variety we arrived at a state of pre-commercialization on a smaller scale. Industry

members have shown interest in seeing this variety move forward but will need the 2015 field data analyzed prior to making commitments for evaluation.

The NC potato industry received great exposure to all segments of the produce industry by using the Specialty Crops Grant funding to participate in the Potato Expo that is attended by over 2,000 people involved in the potato industry; and PMA trade shows that is the largest produce trade show in the US attended by approximately 20,000 people that includes growers, buyers, other industry reps; place ads in NPC Stat book that's is distributed to over 14,000 in the potato industry, placed ad in The Packer produce print and online version of the publication that has over 50,000 produce industry readers, redesigning NCPA website that will give great exposure to buyers and consumers, and a new potato brochure design that will be handed out at trades shows. Grower/buyer contacts were made at the PMA that led to significant sales of NC potatoes. Exact loads are difficult to determine but feedback from both grower and buyers establish that multiple loads were sold and these relationships remain in place and should continue into future years. Examples of this can be identified that due to NCPA exhibiting at the PMA, and feedback from two buying companies met during the 2013 PMA that approx. 30 loads of NC potatoes were shipped to these companies in both 2014 and 2015 potato growing seasons. Also during the 2014 Potato Expo, contact was made and relationships established for an NC grower to trail 10-15 acres of purple potatoes for chips. If this proves successful, additional acres will be planted for this company.

Production/development of new varieties by NCSU-PBP will be a major asset to the NC potato industry. The NCSU-PBP chip variety NC0349-3 is being scaled up by Sklarczyk Seed Farm, greenhouse operation in Michigan and will be ready for commercial testing in 2016. The table variety NCB2607-3 has been identified by a table industry broker, Real Potatoes, as a variety of interest.

## **BENEFICIARIES**

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Benefiting from this project were NC potato farmers that produce over 5 acres of potatoes annually and small to medium-sized farmers who operate roadside markets, who also sell potatoes that are either produced in small plots or purchased in bulk from larger potato farmers in NC.

Benefiting from this project are approx. 80 NC potato farmers that produce over 5 acres of potatoes annually and small to medium-sized farmers who operate roadside markets, who number in the 300's, also sell potatoes that are either produced in small plots or purchased in bulk from larger potato farmers in NC.

## **LESSONS LEARNED**

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This project shows that marketing is a very important aspect of potato farming in NC. As stated before, potato farming is a very competitive business and marketing plays

a major role in the business. We feel the funding from this grant played a major role in NCPA's ability to participate in the activities and achieve the marketing and research goals. Research plays a major role in the development of new varieties for NC potato farmers to maintain quality and quantity of production in order to enhance competitiveness, and improve profits and the long-term sustainability of NC potato farms.

### CONTACT PERSON

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Martha Ferebee  
252-338-6401  
[ferebee.ms@gmail.com](mailto:ferebee.ms@gmail.com)

### ADDITIONAL INFORMATION

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[www.ncpotatoes.org](http://www.ncpotatoes.org)

**Project Title:** Continuation of Turfgrass Sod Promotion Campaign

## **Final Report**

### **PROJECT SUMMARY**

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A 2010 sod producer's survey projected a 33% decrease in planted acreage for 2010-2012. Due to the housing market slump and economic downturn, several NC sod farms had gone out of business. In 2011, marketing efforts were initiated to reverse this trend. Sod farms have reported that these efforts made a positive impact on both branding of NC SPA sod and initial 2012 NC sod farm sales. NC sod producers felt that these efforts needed to be continued and expanded.

This project was designed to enhance the market and marketing of turfgrass sod grown and sold in North Carolina. Promotional efforts continued to focus on relaying the benefits of sod to consumers to help increase sales and prevent North Carolina sod farms from going out of business.

Using a combined marketing approach incorporating traditional (TV, print) and digital media (web, and social) media, potential new purchasers of sod were targeted and encouraged to choose locally grown and adapted sod to improve their surroundings while protecting the environment. End users such as superintendents, athletic field personnel and homeowners were encouraged to use the newly revised and user friendly website [www.ncsod.org](http://www.ncsod.org) to help identify and choose the correct sod for their particular situation.

### **PROJECT APPROACH**

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This project concentrated on meeting the growers' demand for electronic media, mass media with emphasis on public TV, 30 second videos as well as printed marketing messaging. Continued website redesign, incorporation of social media messaging and new marketing/branding efforts re-invigorated the North Carolina Sod Producers Association's (NC SPA) message to the consumer. A commitment to quality, local economy, product performance and a healthy environment were strongly relayed in all NC SPA marketing messages.

Using facts about natural turfgrass sod, the NC SPA worked to educate consumers about cost & environmental benefits, health & safety issues, and longevity of North Carolina grown sod.

This campaign focused on message creation and distribution encouraging informed purchase decision making and the implementation of correct installation and maintenance practices. Emphasis was placed on:

- The benefits of choosing locally grown sod specific species and regionally adapted cultivars which would help protect the environment, reduce costs and produce a more acceptable turf.
- Proper Installation and maintenance tips and techniques to help ensure successful turf
- The benefits of installing turf compared to more traditional methods of establishment

Focusing on a “how to” educational component, the SOD FOR SUCCESS marketing efforts worked toward improving consumer knowledge of product use and benefits. The project simultaneously enhanced consumer awareness of the significant environmental, economic and aesthetic advantages of professionally-grown North Carolina turfgrass sod through a communications campaign that included tv, video, and digital advertising, social media and information placed on the NC SPA website ([www.ncspa.org](http://www.ncspa.org)).

Targeted audiences for these messages included homeowners, homebuilders, landscape professionals, athletic field managers, golf course superintendents and others who are key purchasers of sod. Where possible, listings of North Carolina sod growers were included along with educational information detailing the benefits of natural turfgrass sod. A NC Sod Producers Association Membership Directory (printed and electronic versions) was produced that informed end users of available grasses developed specifically for their region along with corresponding North Carolina sod farms.

## **GOALS AND OUTCOMES ACHIEVED**

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1. Potential purchasers of sod were encouraged to use [www.ncsod.org](http://www.ncsod.org) to help choose the correct sod for their site (GOAL). Prior to implementation of this grant, 600 users visited the site per month (BENCHMARK). As a result of the marketing effort, the (GOAL) of 5,000 new user hits per quarter was surpassed by more than 1,000 users per quarter in 2014- almost three times the users of 2013. This increased performance trend directly correlates with the timeline and execution of this grant.

### **GO GREEN BUY LOCAL Campaign**

A commitment to quality, local economy and a healthier environment were strongly relayed in all NC SPA marketing messages.

Developed and distributed NC SPA Membership Directories (2000+) containing information regarding the benefits and proper selection of sod and sod facts.

FACEBOOK 'GO GREEN BUY LOCAL' AD with Click-through to NCSOD.org was designed and placed on Facebook. The 2013 Facebook ad produced 8,057,685 impressions reached 1,435,421 people and resulted in 1,612 clicks.

Promotional materials and information directing consumers to [www.ncsod.org](http://www.ncsod.org) were handed out at trade show events including the 'Green & Growin' and 'Southern Ideal Home' shows.

### **SOD FOR SUCCESS Campaign**

- UNC-TV horticultural host and Emmy award winning celebrity, Bryce Lane, featured a half hour episode on the production, selection, installation and care of sod reaching an estimated 400,000 viewers state wide. This episode, part of the "In the Garden" series, was aired for a total of 6 times during peak fall and spring planting seasons. UNC TV; Fall 2013-Winter 2014 In the Garden with Bryce Lane promotional show: <http://video.unctv.org/video/2365099146/>
- Two 15-second promos were shown three times weekly before and after each episode of "In the Garden" which ran from September, 2013 through February, 2014. The promos encouraged viewers to visit [www.ncsod.org](http://www.ncsod.org) for information regarding sod selection, installation and care. The fall season was underwritten by NC SPA.
- Creation and production of four 30-second educational video promos featuring Bryce Lane that encouraged the use of sod and its benefits. These were distributed on social media and through the [www.ncsod.org](http://www.ncsod.org) website.

### **NCSOD.org Google Analytic Results**

Google analytic results show that pageviews and user visits have doubled from 2012 to 2013, and were on a similar trend for the first six months of 2014.

| <b>Jan 1, 2012- Dec 16, 2012</b> | <b>Jan 1, 2013 – Dec 31, 2013</b> | <b>Jan 1, 2014 – June 26, 2014</b> |
|----------------------------------|-----------------------------------|------------------------------------|
| 5,634 visits (users)             | 11,254 users                      | 12,856 users                       |
| 24,749 pageviews                 | 52,696 pageviews                  | 53,770 pageviews                   |
| 72.75% new visitor increase      | 81.23% new sessions               | 82.74% new sessions                |

- 2 NC SPA helped growers increase the acreage and sales as a result of the consumer education promotional campaign (GOAL). In fact, most growers reported a shortage of certain sod cultivars such as 'Tifway' because of heavy demand in 2014. A 2010 grant

survey projected a 33% decrease in acreage for 2011 and 2012 (BENCHMARK). The (TARGET) set by NC SPA of projected increased sales of at least 10% in 2013/2014 was surpassed. Acreage increased by 14% whereas sales increased by 18% increase at the conclusion of this grant cycle.

A survey developed and sent to 40 members to determine the impact of the marketing effort on the industry during the execution of this grant. A total of 28 farms responded. A summary of results follows:

| <i>NC Grower Farms</i>           | <i>Did you increase or decrease your production acreage?</i> | <i>Did your sales change?</i> | <i>Did your number of employees change?</i> | <i>Do you plan to increase or decrease your production acreage in the next 12 months?</i> |
|----------------------------------|--|-------------------------------|---|---|
| <b>Number that Increased*</b>    | 57%  | 80%                           | 29%   | 71%   |
| <b>Number that Decreased</b>     | 7%   | 7%                            | 7%  | 0   |
| <b>Number that had No change</b> | 36%  | 13%                           | 64%   | 29%   |

Average increase in acreage production reported: 14%

Average increase in sales reported: 18%

Average increase in number of new employees: 16%

Expected increase in production acreage over next 12 months: 11%

Nearly all (96%) of the farms reported a moderate to great improvement of the ncsod.org website since 2011. Approximately half (46%) of the farms rated NC SPA’s marketing efforts as EXCELLENT whereas 40% rated it VERY GOOD. Only 14% rated the marketing efforts as FAIR over the course of this grant.

The were no closures of turf farms during the granting cycle. In fact, one new grower entered the industry and became a member of NC SPA. Several companies that provide support to the sod industry also chose to become active members of NC SPA.

## **BENEFICIARIES**

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Beneficiaries of this proposal include all North Carolina turfgrass sod producers (40+) and their employees; consumers, residential and commercial property owners and builders; users and designers of parks, athletic fields and golf courses; cemeteries; landscape professionals; designers and maintenance personnel of public spaces supported aesthetically with turf (e.g. highways, airports).

Impacts to beneficiaries include a heightened awareness of the health and environmental benefits of turfgrass sod compared to synthetic and non-turf alternatives, increased usage and sales of turfgrass sod and continued operation of turfgrass sod farms in North Carolina.

## **LESSONS LEARNED**

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Social media results exceeded expectations and as a result funding was re-allocated to contacting grower members regarding the project with emphasis on the creation, data collection and dissemination of the survey results.

Discussion with sod growers and survey responses indicated the efforts from this grant created a positive impact with sod sales. In fact, several major growers reported a limited supply of certain sod cultivars because of the demand by end users. Many of the growers plan to increase their acreage based on optimistic projections. Overall survey results demonstrated a holding steady or increased sales performance with NC SPA grower members. Given the current economic conditions and post housing market slump, the efforts put forth from the GO GREEN BUY LOCAL print and online campaign has impacted sod sales at the consumer level. We feel this approach is the right direction and look forward to enhancing existing efforts further.

## **CONTACT PERSON**

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Dr. Art Bruneau

North Carolina Sod Producers Association  
NCSU, 2415 Williams Hall  
Raleigh, NC 27695-7620  
Phone: (919) 302-7971

## **ADDITIONAL INFORMATION**

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### **TV**

UNC TV; Fall 2013-Winter 2014 In the Garden with Bryce Lane promotional show:  
<http://video.unc.tv/video/2365099146/>

## VIDEOS

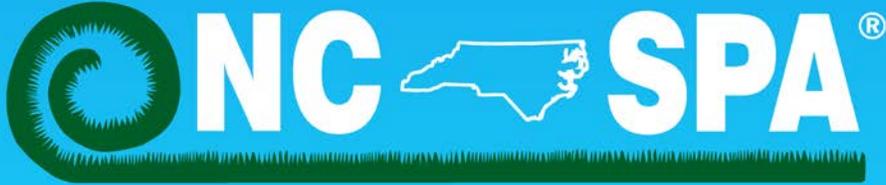
- “Choosing A Variety of Sod Adaptable to Your Area”
- “Sod vs Seed”
- “How to Find Locally Grown Sod from a Sod Farm”
- “Sod is Affordable”
- “Choosing the Right Sod Species/Cultivar for Your Area”

## SURVEY COMMENTS FROM GROWERS

“Have had numerous leads that led to direct sales off new website”

“Please keep up the great work!”

“I get good response from the NCSPA web site”



**NC SPA**<sup>®</sup>

NORTH CAROLINA SOD PRODUCERS ASSOCIATION

**GO GREEN  
BUY LOCAL**

got to be  
**NC** AGRICULTURE

**www.NCSOD.org**







**Project Title:** Connecting Farms and Kids with Healthful NC Strawberries

## Final Report

### PROJECT SUMMARY

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Strawberries are a healthful, nutritious food that most kids love, and children and their families are a key customer group for North Carolina's direct market strawberry producers. Reaching out to NC's youngest consumers is an important way to build the customer base for North Carolina strawberries and increase grower sales; school field trips to the farm also add value to the crop.

With heightened food safety concerns and new FDA requirements on the way, food safety was an important component of this project. Children are a high-risk group and strawberries, like many produce items that are consumed raw, not easy to wash, and sold PYO, face particular food safety challenges. High levels of interest among consumers in local foods, healthful eating, and safe food and the new food safety regulations being developed through FSMA made these efforts timely. Additional resources were needed to reach more children, expand the content and quality of information presented to them, and improve farm GAPs and food safety messaging.

This project was able to build on previous Specialty Crop Block Grants to NCSA (2009 and 2010) for Building the Market for NC Strawberries. Logos, branding, stickers, web and social media outreach, grower signs, and photos and video developed during those projects were important resources for this project as well.

### PROJECT APPROACH

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This project had two main areas of focus. One was to develop educational resources for farmers and teachers in grade K-5. These could also be used by after-school programs, 4-H, and other educational settings. A set of 33 lesson plans (5-7 per grade) keyed to the NC Course of Study was developed with the assistance of three experienced NC primary teachers and the retired head of NC Farm Bureau's Ag in the Classroom. This NC Strawberry Investigations (NCSI) curriculum was piloted in the 2013-2014 school year and then made public online at the beginning of the 2014-2015 school year. (See <http://www.ncstrawberry.com/docs/NCSI-Introduction.htm>) Along with the lessons themselves, NCSI includes a collection of supporting photos, diagrams, instructions, and other materials. The project also created a set of eleven "Teaching Prints": ten large format (18 x 24) photos illustrating the strawberry production year plus a black-and-white drawing of a strawberry plant, reviewing many dozen photos to find the best ones. 150 sets of these were printed and are being distributed to teachers and growers.

Potential users were informed about these new resources through the NCSA website and newsletter and various email networks (NC Dept. of Public Instruction, NC Strawberry Association, a School Strawberry Garden mailgroup, NC Ag in the Classroom, and NCSU

Cooperative Extension). The cooperation of these various institutions has been very helpful. Presentations about the new strawberry educational resources were made at the 2013 and 2014 Strawberry Expos and in an Ag in the Classroom workshop on July 8, 2014 in Williamston, NC (another Ag in the Classroom presentation is scheduled for May 30, 2015 in Charlotte, NC). An “Educational Innovation Contest” was offered in spring of 2015 to build interest and reward teachers doing exceptional work teaching with strawberries. News releases associated with the contest also provided an opportunity to promote both the NC strawberry harvest season and family-oriented educational activities at strawberry farms.

Another area of focus was to provide food safety resources and education for strawberry producers, with a special emphasis on PYO and the need to make PYO customers partners in food safety. The project subcontracted with the NC State University Fresh Produce Safety Task Force to work on this. Our subcontractors led educational sessions at the 2013 and 2014 Southeast Strawberry Expos (Durham, NC and Pinehurst, NC). They also conducted a webinar for growers and extension on January 22, 2015 (a recording is online at [https://collaborate.wolfware.ncsu.edu/watch/?recording\\_id=94iG5yYQ-50](https://collaborate.wolfware.ncsu.edu/watch/?recording_id=94iG5yYQ-50)) and a two-part workshop was held on March 10-11, 2015. An 18 x 24 corrugated plastic sign encouraging handwashing on PYO farms (see <http://www.ncstrawberry.com/docs/SignSample.pdf>) was developed by NCSA in 2013. 150 of these have been printed and made available to growers (free for the first sign and a small charge for additional signs). A set of smaller signs, each focusing on a specific food safety message was developed by our NCSU partner; drafts for these were reviewed by both food safety experts and NC growers. These are posted online at <http://www.ces.ncsu.edu/ncfreshproducesafety-good-agricultural-practices/ncfreshproducesafety-commodity-specific-guidance/ncfreshproducesafety-fruits/strawberry-notebook/>. Additional information and resources were posted on the NC Strawberry Association website (see the “Resources” and “Safety-Food Safety-Crisis Management” subsections at <http://www.ncstrawberry.com/NCSAtree.cfm?topic=Growers>).

## GOALS AND OUTCOMES ACHIEVED

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The project has been very successful in developing resources for both growers and educators that will provide benefit for many years. The decision to post materials online allows them to be easily updated and inexpensively distributed; donations and charges now being requested for signs and Teaching Prints will help make it possible to reprint them in the future.

A system of online registration for the NCSI curriculum allows tracking of numbers signed up, sector (teachers, farmers, etc), grade level, and further communication. The product went online in September 2015, and registrations show continuing growth:

|           |           |                                    |
|-----------|-----------|------------------------------------|
| 11-7-2014 | 160 total | 118 teachers (other categories not |
|-----------|-----------|------------------------------------|

|           |                       |  |
|-----------|-----------------------|--|
|           | registrants           | recorded)  |
| 2-19-2015 | 214 total registrants | 144 teachers, 17 extension, 28 other educators, 7 farmers, 2 parents, 6 other  |
| 3-31-2015 | 259 total registrants | 181 teachers, 18 extension, 40 other educators, 11 farmers, 7 parents, 7 other |

This project has been less successful than expected in its food safety outreach to growers. Due to lack of grower interest and sign up, only one two-day grower workshop was held rather than two, and sign up for that one was disappointing, though in a survey held to determine interest, 12 indicated plans to attend a workshop and 17 expressed interest (though not necessarily for the date/location chosen). Only a few people participated in the online webinar, though it remains available as an online recording.

An online survey to collect baseline data on what strawberry growers were doing in terms of educational activities and food safety collected only 13 responses, so it has been impossible to determine the effect the project has to improve grower food safety practices and increase school field trips (and almost certainly overambitious to try). And indeed, factors such as school budgets, snow days, and stressful schedules have a much greater effect on teachers' decisions to do field trips or special projects.

|  |                         |
|--|-------------------------|
| Event  |                         |
| 2013 Strawberry Expo- Food Safety workshop                   | 14<br>Growers/extension |
| 2013 Strawberry Expo- Food Safety Traceability breakout      | 16<br>Growers/extension |
| 2013 Strawberry Expo- Food Safety for Direct Market breakout | 70<br>Growers/extension |
| 2013 Strawberry Expo- NCSI/working with schools breakout     | 35<br>Growers/extension |
| 2014 Strawberry Expo Teaching Print presentation             | 60<br>Growers/extension |
| 2014 Strawberry Expo Food Safety breakout                    |                         |
| Jan 22, 2015 Food Safety Webinar                             | 6<br>Growers/extension  |
| March 2015 Food Safety Workshop (Wilson County)              | 9<br>Growers/extension  |

Materials created through this project:

- 33 lesson plans (5-7 per grade), plus photos, diagrams, on-farm activity recommendations, etc (online)
- Powerpoint of Strawberry Farming through the year
- Handwashing sign (corrugated plastic, 150 printed, more than 100 distributed so far)
- Set of 11 teaching prints (18 x 24, 150 sets printed (85 sets distributed so far)

- Food Safety Message signs – 8 for consumers, 5 for workers/managers, plus a four-part storytelling “what’s wrong here” series (online)
- Compilations of additional food safety resources (online)

## **BENEFICIARIES**

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North Carolina strawberry farmers (approximately 250) who have access to new tools to improve their on-farm educational programs and food safety on the farm, thus increasing the value of their crop. The project increased awareness of NC strawberry farms among teachers, students, and consumers, making them more likely to visit the farm. Anecdotal evidence is very strong that students who visit or study strawberry farms at school are likely to get their parents to visit again and become strawberry consumers as adults.

North Carolina teachers, who gained new tools to enhance educational activities with real-life understandings.

North Carolina children, who gain an increased appreciation for and understanding of farming, plant biology, and strawberries, a very healthful and nutritious food for life long eating. Often, students then share what they learn in school with their parents.

North Carolina consumers, who benefit reduced food safety risks as farmers adopt improved food safety practices on the farm (eg offering handwashing stations, not reusing picking containers without sanitizing them) and as they themselves become more aware of their own role in reducing food safety risk (eg handwashing, washing fruit, proper fruit storage, etc)

Secondary beneficiaries of the project are farmers, teachers, children, and consumers in other states. The NC Strawberry Association makes its resources equally available to the approximately 40% of its grower membership who live outside of NC. The NCSI lesson plans were designed around Common Core standards, which are also currently used in the majority of states. Teachers from as far away as Kansas are known to be using the lessons.

Teasing out the economic benefit of this project is difficult, as benchmark data and follow-up data proved difficult to attain, and because so many factors affect strawberry growers’ sales and school tour activities. The project offers benefits far beyond the life of the project as the lesson plans and signage created are both durable and easily modified. Awareness of the online resources should also continue to increase in the coming years.

## **LESSONS LEARNED**

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Response to online surveys is poor, and gathering useful quantitative data that way is very difficult. However, online surveys did yield very useful comments and suggestions from individual respondents.

Subcontracting is not necessarily a reliable way to accomplish goals. Our partnership with NCSU did not go smoothly. However, we're not too sure how we could have managed this better, as our lead subcontractor had many other demands on time and attention and it was difficult to keep to the timeline and hard to enforce. Delays in creating food safety materials and setting workshops may have contributed to low workshop/webinar attendance.

Food Safety is not a subject that farmers really want to focus on (no one gets really excited talking about portable toilets, handwashing, and trash cans), and delays in implementation of FSMA regulations have kept it somewhat on the backburner and most small farms don't expect to be regulated anyway. We just need to keep hammering away on it.

People will adopt a new practice or tool more easily if they see it than if they just read about it. Farmers were slow to see the value of the new Teaching Prints, but when they saw how big and beautiful they were at the Strawberry Expo, they could more easily see their usefulness and eagerly asked for them. Similarly, teachers are more likely to use lesson ideas if they see them demonstrated. We looked for opportunities to talk about them at teacher association meetings, but were only able to work this out for Ag in the Classroom workshops.

We are particularly proud of the "Teaching Prints" that we created. These were developed in response to comments from farmers that they wanted something their farms could use with groups of students sitting around at outdoor picnic tables or under trees – they needed hands-on, low-tech, non-electronic tools, not videos or slide shows that had to be shown indoors in a darkened room. As students' lives are more and more dominated by screen time, we are pleased to have instead invested in enhancing outdoor, face-to-face, personalized learning; after all, there is little "virtual" about the reality of farming.

## CONTACT PERSON

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Deborah S Wechsler, Project Coordinator  
919-542-3687  
[ncstrawberry@gmail.com](mailto:ncstrawberry@gmail.com)

NC Strawberry Association office:  
Kristy Phillips  
919-537-2287  
[info@ncstrawberry.com](mailto:info@ncstrawberry.com)

## ADDITIONAL INFORMATION

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- NC Strawberry Investigations Online Survey Summary

### NC Strawberry Investigations Online Survey Summary

This survey was conducted in April, 2015 (via Survey Monkey) of all those who had registered at the NCSI website as of March 31, 2015. Despite several requests for participation, response rate was low (only 10 responses). However, the responses are quite interesting, especially the open-ended responses.

#### Which of the following best describes you?

Teacher K-5 **50 % (5)**5

Teacher grade 6-12 **40 % (4)**4

Other institution (health dept., after school program, etc) **10 % (1)**

Other options offered: Grower, Other educator (administrator, college), Home school educator, daycare provider, Parent

#### Which of the following best describes what you have done with the NC Strawberry Investigations lesson plans and resources?

I have been using NCSI materials during this the school year. **77.78% (7)**

I have not been using the NCSI materials but will during the 2015 strawberry harvest season this spring. **11.11% (1)**

I have not used any of the NCSI resources yet, but plan to next school year or harvest season. **11.11%**

Other options offered: I don't have plans, but will keep this resource in mind for the future.

I took a look, but the materials were not useful or relevant to me.

#### What lesson or part of NCSI has worked best for you?

I reviewed the materials and then did the parts that worked for my situation.

The big pictures, the lesson plans that I can choose from, and the coloring pictures that show strawberry production.

We have used the website and the colored picture/posters we were sent.

Photos are up and have given explanation of them, preparing them for our gardens.

I have used the Grade 3 Strawberry Investigation. It has most of the component of my plant unit for the NC Extended Common Core.

Everything I've used is beneficial. It is different than Florida Strawberry growing practices.

The weather, matter and life cycle lesson plans have worked best

I thought they were all helpful.

#### What could we do to make these lessons more useful or accessible to you?

I'd love to be able to download all the lessons as a unit to print. It is time consuming to load each one and then print.

The strawberry plant coloring pictures need the plant parts added to it to make it more

educational.

I think the site is easy to navigate and the poster size was an added bonus.

They are great. I can't wait to use some of them. We have just switched our 9 weeks. no comment at this this. The lessons are appropriate to my students level.

Include different forms of strawberry growing practices from around the world.

I think they were great. Even offered extensions to the activities!

I think they were useful and accessible.

**Please share comments or stories about your students' reaction to the learning experience and its value in the classroom.**

This is our first year having a strawberry garden. All eight of our 3rd grade classes planted and maintained their section of the garden. We planted late in October/Early November (took us some time to get everything lined up this year). The students have continually checked on the strawberries over the winter. Starting at the beginning of April each class when out and collected data about the strawberry plants We measured the height of plants in millimeters, counted the number of leaves, number of white flowers, number of green strawberries, number of red strawberries, the soil temperature in Celsius, and the amount of sunlight. We dissected our first strawberries taking time to cut them part and look closely at the way they grow. Then we have been eating the products of our hard work!

Many did not understand how strawberries grew and that it is the only fruit with the seeds on the outside. My Kindergarten students also loved tasting strawberry jam on bread and fresh strawberries cut up while we watched the Jammer videos put out by the Florida Strawberry Association.

Students have taken an interest in this program and we have visited a local strawberry farm and have talked with an agriculture specialist. They are all 'junior farmers' now. We purchased plants from a local store to monitor and chart growth and compare with field planted plants at the farm.

The students are excited about the strawberry garden.

The strawberry lesson was a reinforcement lesson for my students with disabilities. It has taught them that food can be grown and enjoyed and not just bought at the grocery store. It gave my students the visual experience how plants grow, flower, and bear fruit. They love the material and find it interesting.

Very excited to incorporate strawberries and other living things into our curriculum instead of just relying on pictures.

We made strawberry shortcake at the end of the lessons and the students really enjoyed everything!

**For Teachers: Has studying strawberries helped your students in the following areas? Please rank.**

|   | A great deal | Some        | A bit       | Not at all | Not applicable |
|---|--------------|-------------|-------------|------------|----------------|
| Interest/involvement in language arts, social studies | 62.50%<br>5  | 12.50%<br>1 | 12.50%<br>1 | 0.00%<br>0 | 12.50%<br>1    |
| Interest/involvement in science, math                 | 87.50%<br>7  | 12.50%<br>1 | 0.00%<br>0  | 0.00%<br>0 | 0.00%<br>0     |
| Understanding of agriculture,                         | 87.50%<br>7  | 12.50%<br>1 | 0.00%<br>0  | 0.00%<br>0 | 0.00%<br>0     |

|  | A great deal | Some        | A bit      | Not at all | Not applicable |
|--|--------------|-------------|------------|------------|----------------|
| strawberry farming                                   |              |             |            |            |                |
| Understanding of nutrition, healthy eating           | 75.00%<br>6  | 25.00%<br>2 | 0.00%<br>0 | 0.00%<br>0 | 0.00%<br>0     |
| Working together (group projects, strawberry garden) | 85.71%<br>6  | 0.00%<br>0  | 0.00%<br>0 | 0.00%<br>0 | 14.29%<br>1    |

- Farmer Survey responses

### With regard to school group handwashing, do you

|   |        |   |
|---|--------|---|
| Require groups to wash hands before picking                       | 33.33% | 3 |
| Require groups to wash hands after visiting animals               | 33.33% | 3 |
| Provide handwashing facilities and verbally encourage handwashing | 66.67% | 6 |
| Have a sign encouraging handwashing                               | 55.56% | 5 |
| Have handwashing facilities but don't make a big deal of it       | 22.22% | 2 |
| Provide hand sanitizer but don't have water available.            | 33.33% | 3 |
| Don't have handwashing facilities available.                      | 0.00%  | 0 |

### Does your farm have any of the following food safety-related practices? Check all that apply.

|  |        |    |
|--|--------|----|
| Indoor restrooms with toilets and running water.                           | 36.36% | 4  |
| Port-a-potties.  | 90.91% | 10 |
| Outdoor hand-washing sinks or stations                                     | 81.82% | 9  |
| Informal handwashing area (hose or spigot)                                 | 18.18% | 2  |
| Covered trashcans  | 45.45% | 5  |
| Berry washing station for customers that is separate from handwashing area | 9.09%  | 1  |

These are selected responses from the Farm Tour/Food Safety survey conducted of farmers early in the project. It was intended to provide baselines and clues to where work was most needed, but response rate (13 responses) was too low to be statistically useful. Respondents were those who were already doing tours and generally aware of best practices.

- Timetable of NCSI lessons by grade and month

### Suggested Timetable of NCSI Lessons by Grade and Month



Many lessons can also be done at other times or over the whole year (lesson numbering is partly for file management). Also check related lessons in other grade levels for ideas, activities, and resources.

| Kindergarten                                     | Jul | Aug | Sep | Oct | Nov | Dec | Jan | Feb | Mar | Apr | May | Jun |
|--|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| 1. Becoming a Strawberry Farmer                  | █   | █   | █   | █   |     |     |     |     |     |     |     |     |
| 2. Farmers Growing Connections                   |     | █   | █   | █   | █   | █   | █   | █   | █   | █   | █   |     |
| 3. Farmers, Know Your Field                      |     | █   | █   |     |     |     |     |     |     |     |     |     |
| 4. I Spy a Strawberry (Plant)                    |     | █   | █   | █   |     |     |     |     | █   | █   | █   |     |
| 5. Sorting Strawberries                          |     |     |     |     |     |     |     |     |     | █   | █   | █   |
| 6. Strawberries – From Farmer to You             |     |     |     |     |     |     |     |     |     | █   | █   | █   |
| Grade 1  | Jul | Aug | Sep | Oct | Nov | Dec | Jan | Feb | Mar | Apr | May | Jun |
| 1. Location, Location, Location                  |     | █   | █   |     |     |     |     |     |     |     |     |     |
| 2. What Do Strawberry Plants Need?               |     |     |     | █   | █   |     |     |     |     |     |     |     |
| 3. Soil Matters                                  | █   | █   | █   |     |     |     |     |     |     |     |     |     |
| 4. Strawberries for All!                         | █   | █   | █   | █   | █   | █   | █   | █   | █   | █   | █   |     |
| 5. Strawberries are the Goods                    |     |     |     |     |     |     |     |     |     | █   | █   |     |
| Grade 2  | Jul | Aug | Sep | Oct | Nov | Dec | Jan | Feb | Mar | Apr | May | Jun |
| 1. What is the "Matter" with the Plastic?        |     | █   | █   | █   |     |     |     |     |     |     |     |     |
| 2. Time in the Sun                               | █   | █   | █   |     |     |     |     |     |     |     |     |     |
| 3. Weather Watchers                              | █   | █   | █   | █   | █   | █   | █   | █   | █   | █   | █   | █   |
| 4. Who's My Parent?                              |     | █   | █   | █   | █   |     |     |     |     |     | █   |     |
| 5. The Strawberry Life Cycle                     |     |     |     |     |     |     |     |     |     |     |     |     |
| Grade 3  | Jul | Aug | Sep | Oct | Nov | Dec | Jan | Feb | Mar | Apr | May | Jun |
| 1. Let's Get Dirty!                              |     | █   | █   |     |     |     |     |     |     |     |     |     |
| 2. Parts of a Strawberry Plant                   |     |     | █   | █   | █   |     |     |     |     |     |     |     |
| 3. It's Too Hot! It's Too Cold! It's Just Right! |     |     |     |     | █   | █   | █   | █   |     |     |     |     |
| 4. Who Grew My Strawberries?                     |     |     |     |     | █   | █   | █   | █   | █   | █   |     |     |
| 5. All About Strawberries by Me                  |     |     |     |     |     |     |     |     |     |     | █   | █   |
| Grade 4  | Jul | Aug | Sep | Oct | Nov | Dec | Jan | Feb | Mar | Apr | May | Jun |
| 1. What's with the Plants?                       |     | █   | █   |     |     |     |     |     |     |     |     |     |
| 2. What's with the Plastic?                      |     | █   | █   | █   |     |     |     |     |     |     |     |     |
| 3. What's with the Water                         |     | █   | █   | █   |     |     |     |     |     |     |     |     |
| 4. What's Going on with the Strawberries?        |     |     |     |     | █   | █   | █   | █   |     |     |     |     |
| 5. What's with the Market?                       |     |     |     |     |     |     |     |     | █   | █   | █   | █   |
| 6. How Did the Berries Get Here?                 |     |     |     |     |     |     |     |     | █   | █   | █   |     |
| 7. What's in the Strawberry for Me?              |     |     |     |     |     |     | █   | █   | █   | █   | █   |     |
| Grade 5  | Jul | Aug | Sep | Oct | Nov | Dec | Jan | Feb | Mar | Apr | May | Jun |
| 1. Producing Plants                              |     | █   | █   |     |     |     |     |     |     |     |     |     |
| 2. Water and the Weather                         | █   | █   | █   | █   | █   | █   | █   | █   | █   | █   | █   | █   |
| 3. Global Markets                                |     |     |     | █   | █   | █   | █   | █   | █   | █   | █   |     |

|                                |  |  |  |  |  |  |  |  |  |  |
|--------------------------------|--|--|--|--|--|--|--|--|--|--|
| 4. Interdependence             |  |  |  |  |  |  |  |  |  |  |
| 5. Advancements in Agriculture |  |  |  |  |  |  |  |  |  |  |

- Teaching Print Texts



## NC Strawberry Investigations Teaching Prints

This set of color prints includes images from several farms. We thank these farms for allowing us to share these images.

The text in this document may be clipped into sections and taped on the back of each photo as an informal script. Or, consider writing your own script for this same purpose.

The set also includes a drawing of a strawberry plant labeling the parts of the strawberry plant. This drawing along with an unlabeled version of the same image is also included in several of the lessons and in the online Resources as a pdf file.

For greater durability, consider laminating these photos.

This set of Teaching Prints is part of the NC Strawberry Investigations curriculum, which includes K-5 lesson plans and additional resources. The lessons can be accessed for free online, after a simple registration process, at <http://www.ncstrawberry.com/plan.cfm>. For more information, visit <http://www.ncstrawberry.com/docs/NCSI-Introduction.htm>.

A Few Discussion Suggestions for use with these photos:

Conditions and practices vary from farm to farm. For example, farms vary in size, in soil type and terrain, in the kinds of plants they set out (e.g., bare root or plugs), and in whether the work is done by family members or by hired workers. How do these pictures compare with farms you know or have visited?

Would you like to be a strawberry farmer? What parts of the job look like fun? What parts look like hard work? What would you need to know to raise strawberries?

*The NCSI project is supported in part by the North Carolina Department of Agriculture and Consumer Services Specialty Crop Block Grant Program.*

## NC Strawberry Investigations Teaching Prints



### Soil Preparation

In the summer, the strawberry farmer gets ready to plant. The farmer adds lime, fertilizer or compost to the soil as needed and disks the soil to work in the fertilizer and break up clumps. Then the farmer “pre-beds” the soil so it is ready to put on black plastic. If you look closely at this field, you can see the raised beds. This soil has a lot of clay in it, unlike the field in the next picture.



### Laying Plastic

This crew is laying out black plastic mulch. You can see the field has been “pre-bedded” first. The spool behind the tractor driver is drip tape for irrigation. As the tractor moves forward, it is being laid down the center of the bed just below the soil surface. The roll of black plastic is just in front of the woman riding behind the tractor and keeping an eye on everything. The disks on either side of the bed bury the edges of the plastic under the soil. Raised beds and black plastic help keep the soil warm so the plants can grow all winter. This is very sandy soil-- not all soil strawberries are grown on is this sandy and makes such nice, sharp beds.



## Strawberry Transplants

At left is a tray of strawberry transplants, or plugs, ready to go into the field. There are probably 50 plants in this tray. Farmers set out about 15,000 plants/acre each year. In the small pictures at right:

Top: This is a bare-root plant, another kind of transplant. This one has had its leaves cut off. New leaves will soon grow after it is transplanted. Bare-root plants need more irrigation when they are first planted.

Middle: This is a single plug plant. Each plant has a little rootball in its growing medium. Plugs are easy to transplant and are what school gardens usually use.

Bottom: This is a boxful of unrooted tips. To make plugs, tips are cut from the runners of the parent plants, then placed in the trays and misted frequently until they grow roots, which takes about three weeks.



## Setting Out Plants

These men are setting out plug plants with the help of a transplanter. The two wheels ahead of the workers make holes in the plastic at regular intervals. The yellow tanks on the back of the tractor contain water, and the machine puts water in each hole. Then the men riding in back set plants in the holes. The tractor driver goes slowly to give them time to do their job! Bare-root plants are set out entirely by hand and workers walk through the field rather than riding.



## Young Plants

This picture was taken in the fall, a few weeks after the plants were set out. They are doing very well. Do you see the vertical pipes in the field? If you look closely, you can also see a big pipe on the ground leading to them. These are for overhead irrigation. It was used to water the plants when they were first set out and will be used again for frost protection in the winter. There is drip irrigation tape under the plastic, too. The grass growing between the beds is ryegrass. The farmer planted it before the plants were set out to control erosion in the field. This is a clay soil, so beds are more lumpy than in sandy soil.



## Frost Protection with Irrigation

This picture was taken on a very cold morning in early spring after a long night of spraying water on the plants. These plants already have flowers on them, though you can't see them. Flowers are especially sensitive to freezing temperatures, and if they freeze, the flowers die and won't become strawberries. The ice does not hurt the plants. As the ice forms, it keeps the temperatures from dropping even lower to the temperatures that do. The farmer has to start spraying when the temperatures fall close to freezing and keep it going all night until the temperature rises above freezing in the morning. Sometimes farmers have to frost protect many nights in early spring. It is a cold, wet job!



### **Frost Protection with Row Covers**

Row covers are used to protect plants over the winter or to protect them against freezing nights in the spring. This picture was taken late in spring

– how can you tell? [By how big the plants are, by the flowers on them, and by the new leaves on the trees] These farmers are taking the row covers off. It is not an easy job putting on row covers or taking them off when it is windy. Farmers often use bags of gravel to weigh down the edges.



### **Flower with Bee**

Bees play an important role in strawberry production by pollinating the flowers in early spring. This is a honey bee. Farmers often have bee hives to encourage the bees to come to the field. The flower in the lower left corner has dropped its petals and the berry is just beginning to develop. Do you see two larger green berries? The strawberry is the only fruit that has its seeds on the outside. A strawberry has 150-200 seeds on it.



### **Plants with Flowers and Green Fruit**

This photo was taken in early spring. You can see flowers and green berries, but no berries are ripe yet. It takes about a month from when the flower blooms to having a ripe berry. This farmer has put straw down

between the rows. Why do you think the farmer did that?

[Keep down weeds, keep it from being muddy for pickers, keeps dirt from splashing up on the berries]



### **Plant with Ripe and Unripe Berries**

It's harvest time now! These plants have lots of berries and still have lots of flowers, so they will continue to make more berries. It takes about a month for a flower to turn into a ripe berry. Berries are tastiest and most nutritious when they are picked fully ripe – “The redder the better.” Which of the berries on these plants are ready to pick?

**Project Title:** 52 Ways to Love Sweet Potatoes

## **Final Report**

### **PROJECT SUMMARY**

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The purpose of the 52 Ways to Love Sweet Potatoes was to increase consumer awareness of the versatility and nutrition/health benefits of NC sweet potatoes and encourage families to eat NC sweet potatoes at least once a week. This project aimed to measurably increase the frequency of use of NC Sweet Potatoes among sweet potato users in the State and the Southeast by providing consumers with quick and easy serving ideas and by effectively raising their awareness about sweet potatoes' versatility and nutrition/health benefits. This project was completed during the time of January 2013 – May 2014.

This project builds on and compliments work funded by the 2010 SCBGP awarded to the North Carolina Sweet Potato Commission Foundation and seeks to proactively address specific issues learned with that grant that are critical to the sustained success of our entire NC grower base.

The 52 Ways to Love Sweet Potatoes addresses gaps in current sweet potato users understanding which were revealed in a 2010 Specialty Crop Block Grant where it was learned a sizable percentage of current consumers have limited usage, limiting attitudes and behaviors regarding sweet potatoes. The research, a consumer online survey of sweet potato purchasers/preparers conducted in November 2011, was held to better understand consumer awareness of sweet potato nutritional facts and to explore the potential barriers to increasing sweet potato usage among current users in the Mid-Atlantic/southeastern states. The research shows key areas of misunderstanding and lack of knowledge including:

- Sizable numbers believe misconceptions about sweet potatoes; 4 in 10 think sweet potatoes are only a winter food and one-quarter see them as “fancy” food.
- Truthful nutritional statements were mostly not believed nor viewed as relevant; of six statements tested ratings for two (“Good source of fiber” and “high in antioxidants”) were not strong, four other nutrition statements all had a negative reaction.
- Home preparation of sweets potatoes lacks breadth; baked and mashed are the most popular preparations. Only 20% had ever tried them on the grill. Only avid cooks are more likely to prepare sweet potatoes more ways (roast, grill, etc.)
- Close to 40% did not think sweet potatoes went very well with/in spicy dishes.

While many respondent users considered sweet potatoes a healthy food, they were not aware of just how nutritious they are. In fact, 15% or fewer of respondents actually believed that sweet potatoes are a good source of Vitamin C and fiber and an excellent source of Vitamin A and potassium, are rich in the primary purchase driver at the supermarket, health and nutrition are increasingly important considerations among food shoppers.

Even though sweet potato consumption has trended upward in recent years; the 2011 consumer research provides eye opening insight proving that accelerating enjoyment of NC sweet potatoes among current users as well as attracting new users requires enhanced consumer education to be developed and deployed to effectively and convincingly expand consumer knowledge.

The 52 Ways to Love Sweet Potatoes pilot program was proposed to address attitudes and behaviors revealed about sweet potatoes in the survey by educating consumers about their versatility and by expanding their usage repertoire to include more quickly prepared, easy and family-friendly ways to serve them. Further, it seeks to raise consumer awareness about the many health benefits of sweet potatoes and the nutritional value of including them more frequently in home meals.

The objective of this program is to increase consumer usage and at-home preparation of fresh market sweet potatoes by addressing and removing barriers to consumer understanding and implementation. Fresh market sweet potato sales are the most profitable market sector served by NC grower/packer/shippers.

## **PROJECT APPROACH**

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The 52 Ways to Love Sweet Potatoes pilot program featured a multi-part platform utilizing new and creatively purposed recipes (“52 Ways Z-Card”), a product spokesperson, a 52 Ways live media tour and supermarket partnerships to educate and enlighten sweet potato users of the versatility and nutrition/health benefits while encouraging preparation and consumption of sweet potatoes at least once per week using the theme “52 Ways to Love Sweet Potatoes.”

### **52 WAYS Z-CARD:**

The goal of this portion of the project was to develop a comprehensive creative platform for the 52 Ways program to encourage once per week usage which included repurposing many of the Commission’s archives recipes, recipe suggestions and photos

for the new 52 Ways Z-Card, a number of additional recipe ideas were created and tested. We developed a series of new healthful sweet potato serving suggestions reflecting contemporary home cooking trends. We consulted with a professional recipe developer to assist on this portion of the project. We developed the concept and wrote the 52 Ways piece, complete with intro, selected short recipes, serving suggestions and food/nutrition quotes.

In addition, we graphically designed the 52 Ways Z-Card for website download and printing; a 52 Ways Infographic was created and deployed via website, blogs and to journalists. This portion of the project was completed within 6 months.

#### 52 WAYS SUPERMARKET RD MEDIA TOUR:

The goal of this portion of the project was to deploy the 52 Ways educational program and media tour (TV, radio, print, internet) in 4-6 major markets in the Mid-Atlantic/Southern states. This portion of the program was completed within 6 months. The media tour's spokespersons were Pat Baird and Marie Spano, two high profile regional dietitians with extensive media experience. Throughout the media tour interviews, Pat & Marie informed audiences of the nutrition/health benefits of sweet potatoes, shared sweet potato recipes and offered sweet potato serving suggestions. Additionally, we worked in partnership with registered dietitians in at least two major supermarket chains, Ingles and Lowes Food, in the targeted region. Supermarket RDs reach their audiences in a variety of ways and a collaborative effort gave us access to motivated consumers at or close to point of sale.

Since the 2011 consumer research suggested that although consumers believe sweet potatoes to be healthy, their remarkable individual nutrition/health attributes are not as well recognized. Thus, we provided key messages about the nutrition/health benefits of sweet potatoes to be used throughout the 52 Ways Supermarket RD Tour. When spoken by a respected regional dietician, these key messages are trustworthy sources of nutrition information for audiences. The following are the nutrition/health benefit messages included as talking points:

- A small sweet potato has only 103 calories when baked in its skin.
- A medium sweet potato has 4 grams of dietary fiber
- Sweet potatoes provide Vitamins A and C, manganese, potassium and antioxidants.
- 50% of the nation's sweet potato supply is sourced from North Carolina

#### RETAIL PROMOTION:

The purpose of this portion was for the North Carolina Sweet Potato Commission (NCSPC) to partner with the North Carolina Department of Agriculture (NCDA) and at least one NC grocery chain to promote NC sweet potatoes. This project would address the issue of stagnant retail sales. It was paid for using funds from NCDA.

This project was implemented in February, which is sweet potato month, and typically a month of lower retail sales. It also coincided with the launch of the “52 Ways to Love Sweet Potatoes” campaign that was developed using specialty block grant funds. This theme was incorporated into the retail promotion campaign.

This project incorporated printed materials and a website for “52 Ways to Love Sweet Potatoes” that was developed as part of a project funded by the North Carolina Specialty Crop Block Grant Program.

The project included several components:

- Use of Point-of-Sale materials by three retail chains in and around sweet potato displays
- Use of NCDA and NCSPC logos in print advertising
- Sampling/Demonstration events held at each retailer (10 sampling events at Ingles and Lowes Foods and eight with Piggly Wiggly for a total of 28 events)
- A display contest for participating Piggly Wiggly stores
- A consumer contest asking participants to take a picture of the sweet potatoes they were purchasing and post in on the NCSPC Facebook page

We worked with the NCDA Marketing Specialist and Art Department to design the following point of sale materials which were put together in packets: 1 poster, 1 nutrition card, 2 recipe header cards, recipe tear sheets featuring two recipes and 1 consumer contest card. The materials all featured the theme “52 Ways to Love Sweet Potatoes.”

- Distributed point-of-sale materials to:
  - 55 Piggly Wiggly stores
  - 62 Lowes Foods stores
  - 65 Ingles stores
  - 10 military commissaries (North Carolina, Virginia and South Carolina)

Additional point-of-sale packets were available for sweet potato packers to give retail stores purchasing their product.

We contracted with Chefs USA to hold demonstrations at 10 Lowes Foods stores. The chefs prepared Savory Seafood Sweet Potato Chowder on-site, distributed recipes and also the “52 Ways to Love Sweet Potatoes” z-cards. A sheet of talking points was prepared and given to each sampler.

In addition, we contracted with NCiM (now PromoWorks) to hold 10 samplings at Ingles stores and 8 samplings at Piggly Wiggly stores. The samplers sliced raw sweet potatoes, dipped the slices in olive oil, sautéed in skillet and served with dip.

The retail promotion’s consumer contest had no participation. This was attributed to several factors including the failure of stores to post the consumer contest information card. This was the only method utilized to promote the contest and it did not succeed.

Piggly Wiggly was the only retailer interested in a display contest. Eight stores submitted pictures of displays they built featuring NC sweet potatoes. A first, second and third place were awarded.

#### RESEARCH:

The objective of this portion of the project was to measure and evaluate consumer response to the 52 Ways program. Specifically, the goal was to double the health awareness of sweet potato users (from the 15% BENCHMARK to 30%) and increase residual sales by 10%. The objective was to determine how much consumer awareness of the versatility and nutrition/health benefits of NC sweet potatoes has changed and to quantify if families were encouraged to eat NC sweet potatoes at least once a week. Two methodologies were deployed:

1. The first will be conducting quantitative market research among sweet potato users in the target region and comparing these finding with the preliminary benchmark.
2. The second measurement tool will be utilizing prior and current NCDA & CS Market News and USAD NASS statistics for NC fresh market sweet potato sales. This portion of the program was completed within 4 months.

#### SIGNIFICANT CONTRIBUTIONS & ROLES OF PROJECT PARTNERS

PadillaCRT, formerly Lewis & Neale, is a full-service, integrated marketing communications public relations agency with a focus on food. Their function included creative platform development, securing spokespersons, implementing media tour, working with supermarket RD’s, and providing support materials. Further, PadillaCRT took over the responsibilities of Kimber & Company collaborating with the NCSPC to

coordinate the development and implementation of the project. PadillaCRT has been the contracted marketing agency for NCSPC since 2008.

Lighthouse Market Intelligence is a leading market research firm specializing in quantitative research providing clients with quantifiable data or probabilistic projections. Upon deeper consideration, the NCSPC decided not to work with The North Carolina State University Sensory Applications Lab directed by Dr. MaryAnn Drake. NCSPC concluded that a broader, more probing analysis of consumer attitudes and perceptions needed to address the needs of this grant program. Further, to properly measure progress, comparability with prior efforts was important. Lighthouse Marketing Research conducted the quantitative market research among sweet potato users in the target region and compared these findings with the preliminary benchmark.

The Executive Director & Administrative staff of the NC SweetPotato Commission will provide in-kind support for this project in the form of needed administrative activities.

The partners of the retail portion of this project included NCDA, NCSPC, Ingles, Lowes Foods and Piggly Wiggly. Their responsibilities included:

#### NCDA

- Pitched project to retail chains
- Designed point-of-sale materials
- Prepared packets of point-of-sale materials for retail stores
- Distributed packets to the company headquarters
- Contracted with Chefs USA and NCiM for demonstration/sampling events
- Worked with retail chains to identify stores for demonstration/sampling events
- Visited events and conducted store checks during February

#### NCSPC

- Identified and prepared potential recipes to be featured on recipe tear sheets
- Photographed recipes for tear sheets
- Provided “52 Ways to Love Sweet Potatoes” Z-cards
- Prepared a list of talking points for demonstration chefs
- Visited events and conducted store checks
- Publicized events on Facebook page

## **GOALS AND OUTCOMES ACHIEVED**

**“52 WAYS” Z-CARD:** The **goal of this portion of the project is to develop a comprehensive creative platform for the 52 Ways program to encourage once per week usage.** The “52 Ways” Z-Card was distributed to 174 food, restaurant and lifestyle editors via email. The online 52 Ways Infographic was viewed 13,408 times since January 2014, with 10,804 unique page views.

Based in Ft. Lauderdale, *The Sun Sentinel* newspaper’s food writer, Claire Perez received the “52 Ways” Z-Card and absolutely loved it. Claire sourced the leaflet online, acknowledged the NCSPC and offered some of our suggestions for their readers. The piece is schedule to run online on July 3rd. *The Sun Sentinel* website reaches 6,465,606 pages views per month and 965,874 unique visitors per month. Further, the results of the quantitative market research conducted by Lighthouse Market Intelligence showed that 1/3 claim their sweet potato purchase frequency increased over the past year. Kid households, especially teen households, posted the highest claimed purchase frequency increases.

**52 WAYS SUPERMARKET RD MEDIA TOUR:** This portion of the project met its **goal of securing 6 TV placements in major markets in the Mid-Atlantic/Southeastern states.** The following lists the TV placements in order of date. The total viewership of the 52 Ways Supermarket RD Media Tour was 314,726, while the total advertising value was \$5,359.

| <b>DATE &amp; TIME</b>   | <b>NETWORK</b>             | <b>REGISTERED DIETICIAN</b> | <b>VIEWERSHIP</b> | <b>ADVERTISING VALUE</b> |
|--------------------------|----------------------------|-----------------------------|-------------------|--------------------------|
| November 24, 2013 at 9am | South Florida Today        | Pat Baird                   | 22,670            | \$994                    |
| December 27, 2013 at 6am | WUSA Morning News          | Marie Spano                 | 46,220            | \$457                    |
| December 31, 2013 at 9am | ABC Birmingham             | Marie Spano                 | 73,114            | \$685                    |
| January 3, 2014 at 8am   | WAGA Good Day Atlanta      | Marie Spano                 | 111,226           | \$2,235                  |
| May 12, 2014 at 9am      | WTVR Virginia This Morning | Pat Baird                   | 47,220            | \$464                    |

|                         |                                   |             |        |       |
|-------------------------|-----------------------------------|-------------|--------|-------|
| May 30, 2014<br>at 10am | WCIV News,<br>Low Country<br>Live | Marie Spano | 14,276 | \$524 |
|-------------------------|-----------------------------------|-------------|--------|-------|

We worked in partnership with registered dietitians in two major supermarket chains, Lowes Foods and Ingles, in our targeted region. The supermarket RDs reached their audiences through a twitter party and a radio interview which gave us access to motivated consumers at or close to point of sale.

The Lowes Food #LFSweetHeart Twitter Party took place on Thursday, February 20, 2014 from 8 pm – 9 pm. The twitter party had 82 participants contributing 451 tweets which resulted in 559,391 twitter accounts reached and 1,916,168 twitter impressions. During the twitter party, a form was available for participants to fill out to win Lowes Foods gift cards, a total \$250 in gift cards were awarded. Throughout the online conversation, Lowes Food recognized the NC Sweet Potato Commission and asked twitter party participants to follow the NCSPC twitter page. In addition, Loews Food announced in-store sweet potato promotions taking place. Lowes Food encouraged conversation around sweet potatoes by asking questions such as these, *“What is the official vegetable of NC that is an excellent source for many vitamins to help keep you healthy?”*, *“What are some reasons why sweet potatoes are good for you?”*, *“What are some of your favorite sweet potato dishes?”* and *“What are ways that you can use sweet potatoes that other people may not have tried?”*

On February 8, 2014, Ingles’ radio show “Ask Leah” interviewed NCSPC’s Executive Director Sue Langdon. Ingles’ registered dietician Leah McGrath hosts the 30 minute radio show on Saturdays at 8:05am on WVN570AM. The interview with Sue Langdon was also streamed online through Clear Channel Communications, the largest reach of any radio and television outlet in America. Furthermore, the interview played in 203 Ingles supermarkets. During the interview, Leah McGrath promoted the NCSPC website, recipes, social media channels and in-store promotions of 52 Ways to Love Sweet Potatoes.

**RETAIL PROMOTIONS:** The **goal of this portion was to partner with the North Carolina Department of Agriculture (NCDA) and at least one NC grocery chain to promote NC sweet potatoes.** The project included several components: use of Point-of-Sale materials by three retail chains in and around sweet potato displays, use of NCDA and NCSPC logos in print advertising, sampling/demonstration events held at each retailer (10 sampling events at Ingles and Lowes Foods and eight with Piggly Wiggly for a total of 28 events), a display contest for participating Piggly Wiggly stores, a consumer contest asking participants to take a picture of the sweet potatoes they

were purchasing and post in on the NCSPC Facebook page. The following activities were completed:

- Distributed over 200 point-of-sale packets to retail chains
- Held sampling/demonstration events at 28 retail stores

Once the retail promotions concluded, the retailers provided insightful information and feedback regarding the promotion.

- Piggly Wiggly reported an increase in sales of 49.6% (+11,408 lbs.) from the same time period in 2013 to 2014.
- Ingles reported a sales increase of 7% from 2013 to 2014.
- Lowes Foods has not reported their sales numbers.

Further, we received comments from the chefs who hosted the Seafood Sweet Potato Chowder sampling events at Lowes Foods. Their comments included:

- Customers loved the recipe.
- Average sale was 3 lbs. Had to fill the table twice.
- Happy customers and produce manager.
- Great response to the recipe.
- Not very busy but the customers that tried it bought NCSP.
- Good event. Many customers bought ingredients.
- Recipe was very well liked by the customers. Many never thought of using sweet potatoes in recipes in this way.

We also received comments from the customers at Piggly Wiggly who tasted the Raw Sweet Potatoes sautéed in olive oil and served with dressing. Their comments included:

- The customers took the recipes to learn how to prepare them.
- Potatoes with dressing were great. Most had never tried dressing on sweet potatoes.
- Like NC sweet potatoes because they are always the freshest.
- Most of the customers liked the sweet potatoes cooked in olive oil.

The “52 Ways to Love Sweet Potatoes” retail promotions resulted in multiple media clips. The full articles are included in Appendix I. Below are the reach statistics per clip.

| <b>OUTLET</b>            | <b>REACH</b>            |
|--------------------------|-------------------------|
| Perishable News (online) | 13,030 page views/month |
| The Produce News         | 12,848 circulation      |
| The Packer (online)      | 33,499 page views/month |
| Andnowyouknow.com        | 1,793 page views/month  |
| <b>TOTAL =</b>           | <b>61,170 VIEWS</b>     |

**RESEARCH:**

Lighthouse Market Intelligence conducted the research consisting of a brief Attitude & Usage Study. **The goal of this portion of the project was to measure and evaluate consumer response to the 52 Ways program, determine how much consumer awareness of the versatility and nutrition/health benefits of NC sweet potatoes has changed and quantify if families were encouraged to eat NC sweet potatoes at least once a week. Specifically, the goal was to double the health awareness of sweet potato users (from the 15% BENCHMARK to 30%) and increase residual sales by 10%.** In preparing the survey at the end of the program we uncovered a misinterpretation of the 2011 study from which the benchmark was pulled. The 15% referred to one nutritional aspect of sweet potatoes. The good news is that the perception of sweet potatoes as a healthy and nutritious food is around 90% and did not have a statistical change from 2011 and 2014. What we did find was that reported frequency of purchase increased, people are preparing them in more healthful ways, and many of the myths about sweet potatoes are waning, reducing a significant barrier to purchase.

The Attitude & Usage Study was conducted online May 20-26, 2014 among a national sample of adults 10+ in the Mid-Atlantic/Southeast. The sample size was 504 people.

- Research screening qualifications included:
  - Men and women 18+
  - Live in one of the following states: FL, GA, SC, NC, VA, MD, DE, PA
  - Are responsible for half or more of the grocery shopping/meal preparation
  - Purchased fresh sweet potatoes in the past 12 months

**GOAL-SPECIFIC RESEARCH FINDINGS:**

- Goal: Encourage families to eat NC sweet potatoes at least once a week.

- Research Findings:
  - 1/3 claim their sweet potato purchase frequency increased over the past year. Kid Households, especially Teen Households, posted the highest claimed purchase frequency increases.
- Goal: Determine consumer awareness of the versatility and nutrition/health benefits of NC sweet potatoes.
  - Research Findings:
    - 1/3 report that their sweet potato dishes have become more healthful over the past year. Healthfulness gains were strongest among Kid and Teen Households, Adults 18-34 and Adults 56-64.
    - Widely-held beliefs about sweet potatoes' good taste, nutritiousness and versatility have held constant over the past 2.5 years.
      - 9 in 10 view sweet potatoes as good tasting and very nutritious
    - "Fiber" proved the top 2014 nutrition message in terms of believability, relevance and purchase motivation for sweet potatoes. Its strong showing was highly driven by Adults 55+.
    - "Antioxidants" has unlocked potential as the second-most motivating message of 2014 for sweet potatoes. Unlike fiber, antioxidants enjoy quite even appeal across all age groups.
    - Sweet Potatoes are viewed as easy to cook and versatile.

#### OTHER FINDINGS:

- Core attitudes and usage are stable:
  - "Baked," then "Mashed" are still the top preparation methods.
  - Consumers' favorite ways to prepare sweet potatoes continue to be traditional, with sweet ingredients like brown sugar, cinnamon, marshmallows, etc.
- Some perceptions and behaviors are changing:
  - Three myths have declined steeply:
    1. Sweet Potatoes are a winter food
    2. Sweet Potatoes are a "fancy" food
    3. Sweet Potatoes are only for Thanksgiving.

\*Kid Households and Adults 25-34 are the most apt to have these misperceptions.
- Less than ½ now feel that "Kids love them"
- The percent (47%) who feel sweet potatoes go well with spicy food remained flat.
- More young adults do not find sweet potatoes easy to cook:
  - 20% of Adults 18-34 do not feel that sweet potatoes are easy to cook

- Since late 2011, the percent of Adults 18-34 not finding sweet potatoes easy to cook has grown by 6%
- Young adults' greater tendency to view sweet potatoes as "fancy" likely adds to their trepidation.
- 

In comparing the 2014 quantitative research to the research from the consumer online survey of sweet potato purchasers/preparers conducted in November 2011, we found:

| 2011 RESEARCH FINDINGS  | 2014 RESEARCH FINDINGS   |
|---|--|
| Sizable numbers believe misconceptions about sweet potatoes; 4 in 10 think sweet potatoes are only a winter food and one-quarter see them as "fancy" food.  | There was a steep decline in the percent who believe that sweet potatoes are a winter food or a "fancy" food.  |
| Truthful nutritional statements were mostly not believed nor viewed as relevant; of six statements tested ratings for two ("Good source of fiber" and "high in antioxidants") were not strong, four other nutrition statements all had a negative reaction. | <p>"Fiber" proved the top 2014 nutrition message in terms of believability, relevance and purchase motivation for sweet potatoes. Its strong showing was highly driven by Adults 55+.</p> <p>"Antioxidants" has unlocked potential as the second-most motivating message of 2014 for sweet potatoes. Unlike fiber, antioxidants enjoy quite even appeal across all age groups.</p> |

We were unable to quantify the goal of doubling the health awareness of sweet potato users from the 15% benchmark to 30%. The conclusion reached in the 2011 previous research showed only 15% of survey respondents actually believed that sweet potatoes are a good source of Vitamin C and fiber and an excellent source of Vitamin A and potassium, etc. This statistic addressed overall health messages of sweet potatoes whereas this research study gathered statistics for the believability of individual nutrition messages as they relate to sweet potatoes.

We were unable to quantify the goal of increasing residual sales by 10%.

## BENEFICIARIES

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The 52 Ways to Love Sweet Potatoes program benefits North Carolina sweet potato growers, a specialty crop industry, and the general public as represented by sweet potato consumers who viewed, read, listened or sampled sweet potatoes.

The direct beneficiaries are the 21 packers and shippers of NC sweet potatoes in the state. The 349 farmers who grow 64,000 acres of sweet potatoes in the state will also benefit as increased retail sales will increase demand.

Beneficiaries of the project:

- 8.7 million current consumers of sweet potatoes who are responsible for purchasing/preparing food for themselves and their family, living in the Mid-Atlantic/Southeastern states.
- 182 Food influencers (i.e. registered dietitians, traditional and new media)
- 375 NC sweet potato growers/packers/shippers

How the beneficiaries will be impacted by the project:

- Increased usage of NC sweet potatoes will occur as consumers in the target region become informed about quick and easy serving ideas and by raising their awareness of sweet potatoes' actual nutrition/health benefits and its relevance to their health.
- Food influencers will experience increased interest in their output (i.e. health advise, news, and media content).
- NC sweet potato growers/packers/shippers will benefit from increased sales.

Quantifying beneficiaries to be impacted:

- Increased frequency of use of NC Sweet Potatoes among sweet potato users will result in broadening the at-home usage of sweet potatoes in NC and the Mid-Atlantic/Southeastern US encompasses a population of about 60 million.
- Improved understanding of the health and nutrition implications of sweet potato consumption will provide motivation to eat better and have a healthier lifestyle.
- The existing 400+ sweet potato farmers in North Carolina and any potential new sweet potato growers will be benefited by sales upticks in their most prized market sector.

Potential Economic Impact:

- As the program unfolds and consumers engage, we conservatively anticipate a gradual expansion of usage in the target area that will build to a 25% increase with a sustained residual increase of 10%. This translates to a \$15 million annual

sales increase for the North Carolina's sweet potato industry. (Calculation: 10% increase = 0.63 #/person x 60 million/40#/box=945,000 boxes @ \$16/box = \$15,120,000 farm gate revenue).

- The increased tonnage would utilize about 1,500 additional acres requiring approximately 150 farm workers, added equipment and locally supplied inputs.
- It is recognized that the benefits of improved health from better eating will improve lives and reduce health care expenses however this is not economically quantified.

## **LESSONS LEARNED**

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### "52 WAYS" Z-CARD - LESSONS LEARNED

- People are enthusiastic to learn new and healthy ways to prepare sweet potatoes
- The Z-card was a convenient way for NCSPC to distribute and consumers to receive recipes and information
- Providing a digital option in addition to printed pieces is cost effective and convenient

### 52 WAYS SUPERMARKET RD MEDIA TOUR – LESSONS LEARNED

- RD's are enthusiastic about discussing the general health benefits of sweet potatoes with the media (not a hard sell)
- RD's are open to discussing foods/rather than products and brand names (looks less commercial)
- NCSPC has good recipes to share on-set
- Mentioning the "52 Ways" program specifically was not feasible with the TV producers
- Sometimes getting "NCSP" mentioned on air was difficult, many producers only allow for general comments

### RETAIL PROMOTIONS – LESSONS LEARNED

- There are challenges when working with retail stores:
  - Since most fall under one corporate umbrella it can be a challenge to getting the chain to participate.
  - Getting point-of-sale packets from the corporate office to the individual stores is not always efficient.
  - The produce manager of a store may receive the packet but that does not mean he/she will use any/all of the materials on the floor.

- There is a lack of communication within the corporate office. One example is the dietician within one chain did not know about the sampling events until they were concluded.
- Stores are receptive to demonstration events.
- Demonstrations where a chef actually prepares a recipe on-site and talks with customers about the product is more effective than a sampling when a taste of the product is given away.
- Point-of-sale materials need to be tailored to the individual chains as the size and use varies amongst them.
- The produce manager is the key contact with every store.

The Chefs from Chefs USA also made suggestions based on their experiences with this promotion:

- Signage for the promotion should be sent directly to the chefs doing the promotion. This would eliminate having to ask produce department staff to find it.
- The chefs had tasters take a photo of the recipe with their phone so they would have it with them.
- Since very few people participating in the consumer contest, Chefs USA suggested educating the chefs more about that aspect of the promotion so they could promote it.

We developed relationships with personnel within the chains as a result of this project, which was unexpected. As a result we will be working with them to tie-in to future promotions of local foods at individual stores. We also learned about training opportunities that the produce managers and staff attend so there is a possibility of future programming with these key individuals.

In the future, we will work directly with the retail chains to tailor a promotion to their needs. We have also identified the demonstration company that was the most efficient and effective and will partner with them for all future demonstration events. In addition we have discussed cross-promotion efforts (for example, sweet potatoes and wine) for future events.

## RESEARCH RECOMMENDATIONS

- Further mitigate consumers' misperceptions that sweet potatoes are a winter food, a "fancy" food and only for Thanksgiving by continuing the message that sweet potatoes can be enjoyed year round. Strive to tailor your message content and delivery particularly to Kid Households and to Adults 25-34.
- To build on the purchase-frequency momentum you have among Kid

Households, and ease the “hard-to-cook” fears of young adults, provide recipes or, better yet, “food ideas” that appeal to younger and/or novice (and often nervous) cooks:

- Include a photograph of the finished product.
  - Only call for a handful of ingredients, ideally on-hand ones, or those that are easy to find at the grocery store.
  - Keep recipe steps simple and few, using “how-to” illustrations/photos.
  - Avoid scary-sounding cooking terms like “puree” and “blanch” (most young adults don’t know what these terms mean or how to do them).
  - Do not call for specialized equipment or kitchenware that young cooks likely don’t own (ex. food processor, ramekins, etc.).
  - Food photography should be simple and aspirational, not overly gourmet-like or too perfect. Ideally, food photography should inspire cooks to *envision* the food in their own kitchens or at their own tables.
  - Include some very kid-friendly recipes, especially those that parents could easily make with their kids.
- Consumers already believe sweet potatoes are highly healthy, so keep nutrition messages short to allow more emphasis on prep ease and that sweet potatoes can be served year round.
  - In addition to Fiber communication, explore talking Antioxidants as a way to provide “news” and spur purchase motivation across consumers of all ages.
  - Consider doing research among consumers who stepped up their sweet potato purchasing to better understand what elements of “52 Ways” resonated most and least with them.

## **CONTACT PERSON**

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Sue Johnson-Langdon

919-894-1067

[sweetsue@ncsweetpotatoes.com](mailto:sweetsue@ncsweetpotatoes.com)

## **ADDITIONAL INFORMATION**

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**PerishableNews.com**   **Where's your Tectrol Service Network?**  
Sealing up your strawberry revenue potential. [transfresh.com](http://transfresh.com)

**Produce Highlights**  
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**Produce Highlights**  Wednesday, June 11, 2014 11:28:35 AM

## North Carolina Sweet Potato Commission Announces New Retail Promotion

by N.C. Department of Agriculture and Consumer Services  
Posted: Friday, January 31, 2014 at 9:00AM EST



RALEIGH – The N.C. Sweet Potato Commission and N.C. Department of Agriculture and Consumer Services will unveil a new retail promotion across the state this February in honor of Sweet Potato Month. The promotion, 52 Ways to Love Sweet Potatoes, will highlight the versatility and nutritional benefits of sweet potatoes. Components of the program include in-store displays, a branded website and a social media contest for consumers. The promotion will take place in February at 155 Lowes Foods, Piggly Wiggly and Ingles stores in North Carolina.

The in-store elements of the promotion will include recipe cards and point-of-purchase signage. In addition, cooking demonstrations will be held at select stores during the month to introduce consumers to new ways of preparing sweet potatoes.

The Sweet Potato Commission has created a branded website for the promotion which includes 52 sweet potato recipes, one for each week of the year. Another aspect of the promotion is a photo contest on the commission's Facebook page. Consumers can earn a \$100 gift card to one of the participating grocery stores by sharing their sweet-potato photos with the hashtag #loveNCSP on the social networking site. The promotion was made possible through funding from the N.C. Department of Agriculture and Consumer Services.

Sue Johnson-Langdon, executive director of the N.C. Sweet Potato Commission, says she welcomed the opportunity to work with the department to promote sweet potatoes. "North Carolina is the largest producer of sweet potatoes in the nation, and produces nearly half of all sweet potatoes grown in the United States," said Johnson-Langdon. "The N.C. Department of Agriculture understands the significance of supporting local growers, and we're happy to partner with them on great retail promotions like this one."

The North Carolina Sweet Potato Commission is a nonprofit corporation made up of almost 400 sweet potato growers along with the packers, processors and business associates that support them.

The N.C. Department of Agriculture and Consumer Services provides services that promote and improve agriculture, agribusiness and forests. The department's Marketing Division creates opportunities for farmers and food businesses to sell their products and be successful.

Source: N.C. Department of Agriculture and Consumer Services

"North Carolina is the largest producer of sweet potatoes in the nation, and produces nearly half of all sweet potatoes grown in the United States," said Sue Johnson-Langdon, Executive Director of the NC Sweet Potato Commission. "The N.C. Department of Agriculture understands the significance of supporting local growers, and we're happy to partner with them on great retail promotions like this one."

The program will include in-store displays, a branded website and a social media contest for consumers. The website created by the Sweet Potato Commission features 52 sweet potato recipes, one for each week of the year.

In-store elements will include recipe cards and POS signage. Cooking demonstrations will also be held in select stores during the month, to introduce customers to new ways of preparing sweet potatoes.

The promotion will also include a photo contest on the Commission's Facebook page. Consumers can earn a \$100 gift card to one of the participating grocery stores by sharing their sweet potato photos with the hashtag #loveNCSP.

NC Sweet Potato Commission

NC Department of Agriculture & Consumer Services

## Grocery Outlet said to Explore Potential Billion Dollar Sale



## In the Field with California Giant Berry Farms



## The Potato Became the First Vegetable Grown in Space with Help from...



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# APPENDIX I

## MEDIA CLIPS

THIS YEAR'S SWEET SUMMER ROMANCE

52 WAYS TO LOVE SWEET POTATOES



## New Retail Promotions from North Carolina Sweet Potato Commission

Thursday, Jan. 30th, 2014 by *Sarah Hoxie*

February is Sweet Potato Month! The North Carolina Sweet Potato Commission and N.C. Department of Agriculture and Consumer Services will unveil a new retail promotion across the state of North Carolina during the month of February, in honor of Sweet Potato Month, according to a press release. The promotion is called 52 Ways to Love Sweet Potatoes, and will highlight the versatility and nutritional benefits of sweet potatoes.



Expect  
**More!**



## APPENDIX II

### 52 WAYS SUPERMARKET RD MEDIA TOUR – CLIP REEL

PadillaCRT worked in partnership with supermarket registered dieticians to conduct media tour and press interactions resulting in morning news TV coverage. The goal of the RD TV placements was to circulate key media messages of the versatility and nutrition/health benefits of NC sweet potatoes. PadillaCRT worked with Pat Baird and Marie Spano to pitch morning news segments. We received coverage on WAGA-TV, WBMA-TV, WUSA-TV, WTVJ-TV and WTVR-TV resulting in +300,000 total viewership and almost \$5,000 in ad value.



To view the clip reel, please click visit this URL link and enter the password.

<https://vimeo.com/97844358>

Password: 4Padilla

Home > News > Marketing Profiles > North Carolina commission puts on retail promotion

## North Carolina commission puts on retail promotion

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**03/19/2014 02:52:00 PM**  
**Jim Offner**

The Benson-based North Carolina Sweet Potato Commission has joined "Got to be NC Agriculture," a state-focused program of the North Carolina Department of Agriculture, said Sue Johnson-Langdon, the commission's executive director.

"It's about homegrown," she said of the program, which urges retailers and foodservice purveyors to offer North Carolina-grown products first, if available.

As part of the commission's participation, the department of agriculture created a retail promotion, "52 Ways to Love Sweet Potatoes." Three chains — Piggly Wiggly LLC (part of Keene, N.H.-based C&S Wholesale Grocers Inc.), Lowes Foods and Ingles Markets — participated in the promotion, which ran in February.

The program included signage, as well as contests for consumers and participating produce department managers, Johnson-Langdon said.

Lowes also had chefs on hand to prepare sweet potato chowder for in-store sampling, she said.

Lowes and Piggly Wiggly also offered samples of sautéed sweet potatoes with a dip from Golding Farms, a North Carolina-based manufacturer of sauces and dressings, Johnson-Langdon said.

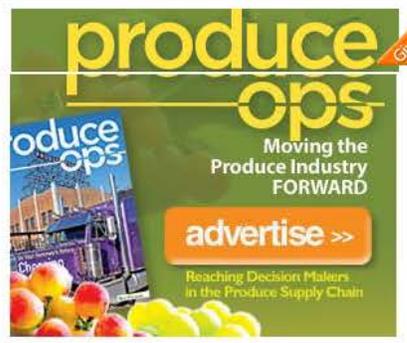
As February drew to a close, Johnson-Langdon said it was still too early to assess the promotion's success, but she said she was optimistic.

"We're extremely excited to do something with retail because that's where 70 percent of our sales are, and we want to try to move that needle even more," Johnson-Langdon said.

It was the commission's largest foray into retail promotions, although not its first, she said.

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## N.C. Sweet Potato Commission to unveil new retail promotion for Sweet Potato Month

JANUARY 31, 2014

The North Carolina Sweet Potato Commission and the North Carolina Department of Agriculture & Consumer Services will unveil a new retail promotion across the state in February in honor of Sweet Potato Month.

The promotion, 52 Ways to Love Sweet Potatoes, will highlight the versatility and nutritional benefits of sweet potatoes. Components of the program include in-store displays, a branded website and a social media contest for consumers.

The promotion will take place in February at 155 Lowes Foods, Piggly Wiggly and Ingles stores in North Carolina.

The in-store elements of the promotion will include recipe cards and point-of-purchase signage. In addition, cooking demonstrations will be held at select stores during the month to introduce consumers to new ways of preparing sweet potatoes.

The Sweet Potato Commission has created a branded website for the promotion which includes 52 sweet potato recipes, one for each week of the year. Another aspect of the promotion is a photo contest on the commission's Facebook page. Consumers can earn a \$100 gift card to one of the participating grocery stores by sharing their sweet-potato photos with the hashtag #loveNCSP on the social networking site. The promotion was made possible through funding from the North Carolina Department of Agriculture & Consumer Services.

Sue Johnson-Langdon, executive director of the commission, said she welcomed the opportunity to work with the department to promote sweet potatoes.

"North Carolina is the largest producer of sweet potatoes in the nation, and produces nearly half of all sweet potatoes grown in the United States," she said in a press release. "The N.C. Department of Agriculture understands the significance of supporting local growers, and we're happy to partner with them on great retail promotions like this one."

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### MARKETS AND TRENDS

#### Northwest pear growers forecast a full-size crop



During annual pear meetings that took place last week in Portland, representatives of the Northwest pear industry met to project t...

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.....  
**HOW TO BAKE  
A SWEET POTATO:**

PREHEAT OVEN TO 400°F. WITH A FORK, PIERCE SWEET POTATO SKIN 5-6 TIMES. PLACE ON BAKING SHEET LINED WITH FOIL. BAKE UNTIL TENDER, 45 MINUTES TO 1 HOUR.

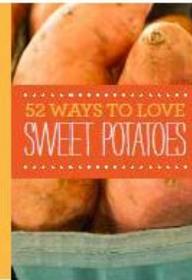
.....



.....  
**HOW TO MAKE  
SWEET POTATO PURÉE**

**BAKE A SWEET POTATO.** SET ASIDE TO COOL. CUT IN HALF LENGTHWISE. WITH A SPOON, SCOOP OUT FLESH; PURÉE UNTIL SMOOTH.

.....



.....  
**HOW TO MAKE ROASTED  
SWEET POTATO ROUNDS:**

PREHEAT OVEN TO 400°F. SLICE SWEET POTATOES INTO 1/4-INCH ROUNDS. TOSS WITH OLIVE OIL TO COAT, SEASON WITH SALT AND SPICES IF DESIRED. PLACE ON A COOLING RACK FITTED INTO A BAKING SHEET. BAKE UNTIL TENDER WITH BROWN EDGES, ABOUT 20 MINUTES.

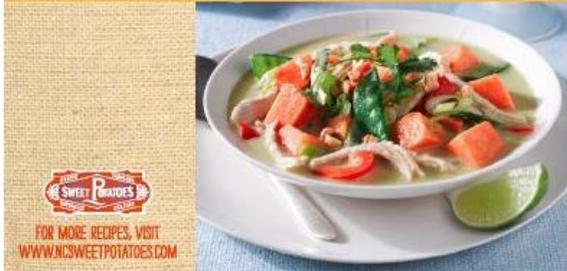
.....



.....  
**HOW TO MAKE ROASTED  
SWEET POTATO CUBES:**

PREHEAT OVEN TO 400°F. CUT SWEET POTATO INTO CUBES. TOSS WITH OLIVE OIL TO COAT, SEASON WITH SALT AND SPICES IF DESIRED. SPREAD ON BAKING SHEET LINED WITH FOIL. BAKE UNTIL TENDER WITH BROWN EDGES, ABOUT 20 MINUTES.

.....



.....  
**HOW TO MAKE ROASTED  
SWEET POTATO WEDGES:**

PREHEAT OVEN TO 400°F. CUT SWEET POTATOES INTO WEDGES. TOSS WITH OLIVE OIL TO COAT, SEASON WITH SALT AND SPICES IF DESIRED. IN A SINGLE LAYER, PLACE WEDGES ON A BAKING SHEET LINED WITH FOIL. BAKE UNTIL TENDER WITH BROWN EDGES, TURNING ONCE, ABOUT 20 MINUTES.

.....

## APPENDIX IV

### 52 WAYS Z-CARD INFOGRAPHIC

PadillaCRT designed 52 Ways to encourage consumers to eat fresh sweet potatoes once a week while raising consumer awareness of the versatility and nutrition/health benefits of NC sweet potatoes. After research showed consumers were interested in receiving more sweet potato recipes, we compiled the Commission's archived recipes, recipe suggestions and photos to include in 52 Ways. In addition, we worked with a recipe developer to come up additional recipe suggestions to include. 52 Ways was distributed to a large distribution list of online and print publications, blogs and websites.





# SWEEPSTAKES



## Red Eye Sweet Potato Soup

[www.ncsweetpotatoes.com](http://www.ncsweetpotatoes.com)



**Show Your Love for North Carolina Sweet Potatoes and You Could Win a \$100 Grocery Store Gift Card.**



# SWEEPSTAKES

1. Snap a photo of the NC Sweet Potato you are taking home from the grocery store.
2. "Like" NC Sweet Potato Commission on Facebook at [www.facebook.com/NCSPC](http://www.facebook.com/NCSPC)
3. Upload your photo telling us why you love NC Sweet Potatoes.
4. Use #LOVENCSP to be entered into the contest.

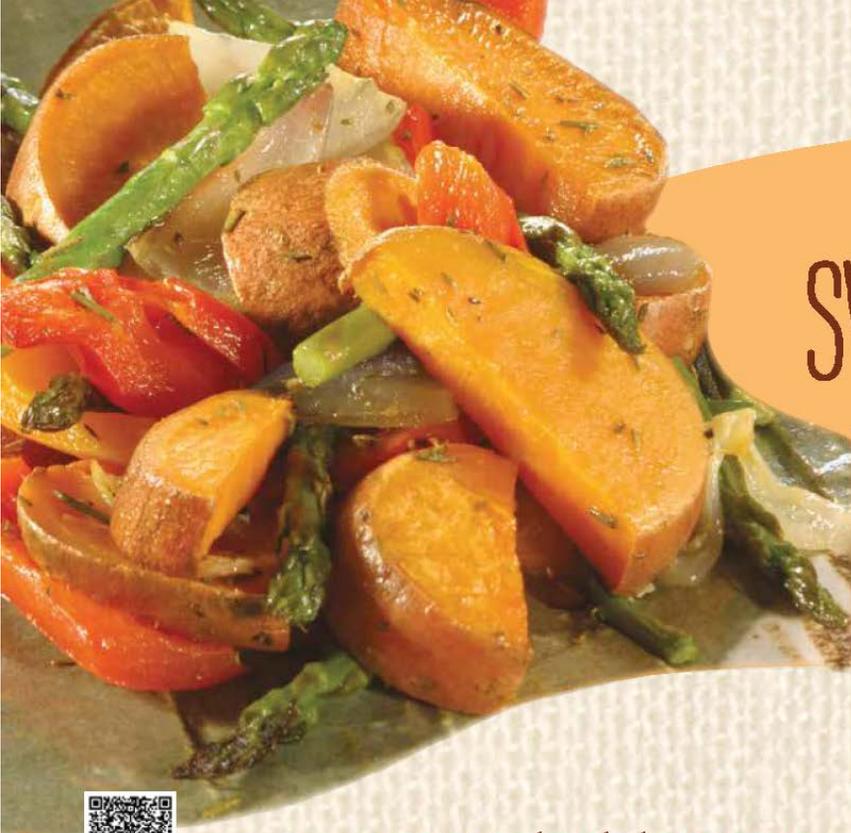


**Contest runs February 1 - 28, 2014.  
Winner will be notified by March 14, 2014.**



[www.ncsweetpotatoes.com](http://www.ncsweetpotatoes.com)





52 WAYS  
TO LOVE

# SWEET POTATOES



[www.ncsweetpotatoes.com](http://www.ncsweetpotatoes.com)





# SWEET POTATOES

[www.ncsweetpotatoes.com](http://www.ncsweetpotatoes.com)

# 1

## Choose:

Firm, fairly well-shaped sweet potatoes with no sign of decay.



## Store:

Store in cool, dry, well ventilated container at approximately 55°F. Never refrigerate raw sweet potatoes; only cooked sweet potatoes can be refrigerated or frozen. Use within 1 to 2 weeks after purchase.

# 2

## Use:

# 3

**Baked Sweet Potato:** Pierce with fork, place on baking sheet. Bake until tender, in a 400°F oven-45-60 minutes.  
**Sweet Potato Puree:** Cool baked sweet potato; cut in half lengthwise and spoon out the flesh. Puree until smooth.



got to be **NC** AGRICULTURE



## JANUARY

Sauté sweet potato cubes with apples, onion and curry, add coconut milk and cook until tender. Purée for a creamy spiced soup.



Accompany **roasted sweet potato wedges** with blue cheese dressing. Stir **sweet potato purée** into your morning oatmeal; top with toasted pecans.

Combine **sweet potato purée** and your favorite nut butter for a healthy breakfast spread on toast or muffins.

Top **baked sweet potato** with a dollop of Greek yogurt mixed with maple syrup. Sprinkle with cinnamon, if desired.

## FEBRUARY

Add **roasted sweet potato cubes** to your favorite chicken soup recipe. Sauté chickpeas, kale and tomatoes; serve over **baked sweet potato**.

Slimmer **sweet potato cubes** in your favorite chili for a hint of sweetness.

Whisk **sweet potato purée** into your favorite pancake recipe. Serve with maple syrup.



## MARCH

Replace white potatoes with mashed **sweet potatoes** in a traditional shepherd's pie.

Sauté **sweet potato cubes** with sliced onion until tender and caramelize, serve with fried eggs.



Combine **sweet potato purée** with tahini sauce for **sweet potato hummus**. Serve with pita chips or flatbread.

Stir **roasted sweet potato cubes** into your frittata with goat cheese and arugula.

## APRIL

Crack an egg into a split **baked sweet potato**. Bake another 10 minutes or until egg is set.

Add **roasted sweet potato wedges** to a salad of tomatoes, pexans, parsley, feta and lemon vinaigrette.



Did you know a small sweet potato has only 103 calories when baked in its skin?

Add **sweet potato purée** to your favorite muffin or scone recipe for extra moisture and sweetness.

Sauté kale and white beans with garlic; spoon over **baked sweet potato**.

Whisk **sweet potato purée** into your French toast batter for **sweet potato french toast**. Serve with maple syrup.



## MAY

Fill foil packets with **sweet potato cubes**, ground turkey, spinach and shredded cheese; bake until tender.

Add **roasted sweet potato cubes** to quinoa with apples, toasted pumpkin seeds and dried cherries.

Top **roasted sweet potato rounds** with blue cheese and candied pecans for a snack or appetizer.

Mix **sweet potato purée** with chipotle and add to quesadillas for a sweet n' spicy kick.

## JUNE

Dip raw **sweet potato sticks** in a creamy avocado hummus dip.

Combine **roasted sweet potato cubes**, black beans and guacamole in your favorite tortilla for a vegetarian burrito.

Make homemade chips by slicing **sweet potatoes** on a mandoline, toss in olive oil and salt and bake at 350°F until edges are brown.

Use **sweet potato purée** to bind your favorite veggie burger recipe instead of egg.

## JULY

Sprinkle **sweet potato wedges** with Cajun seasoning before baking; serve with creamy shrimp salad.

Mix leftover grilled meat or chicken with BBQ sauce and spoon over a **baked sweet potato**.

Shave **sweet potatoes** into thin strips with a potato peeler and sauté with butter for gluten-free pasta. Top with parmesan cheese shavings and toasted almonds.

Blend together **sweet potato purée**, a banana, maple syrup, cinnamon and milk for a powerful breakfast smoothie.

Combine **sweet potato purée**, puréed white beans and chopped parsley; form into patties. Pan-fry and serve with a green salad.

## AUGUST

Shred raw **sweet potato** into a salad or coleslaw to add color and texture.



Combine **sweet potato purée** and ground turkey and form patties; cook 5 minutes each side.



Combine **roasted sweet potato cubes** with black beans, corn, roasted peppers, lime juice and cilantro for a picnic salad with a Southwest flair.

Combine **roasted sweet potato cubes** with sliced radishes, scallions and jalapeño. Dress with olive oil and lime juice; serve over arugula.

Sweet potatoes are a nutrition powerhouse! They provide vitamin A, C, fiber, manganese, potassium and antioxidants.

## SEPTEMBER

Make homemade pizza with thinly sliced **sweet potatoes** instead of pepperoni.

Combine **sweet potato purée** with Greek yogurt and chipotles for a spicy and creamy side dish.

Make a vegetarian sandwich with **roasted sweet potato rounds**, goat cheese, fig butter and arugula on toasted bread.

Toss hot pasta with browned butter, garlicky greens and **roasted sweet potato cubes**. Sprinkle with chopped hazelnuts and blue cheese.

## OCTOBER

In a casserole, combine **sweet potato cubes**, red quinoa, dried cherries, milk and maple syrup. Bake and top with toasted pecans.

Sauté peppers, onions and **sweet potato cubes** for a Tex-Mex taco filling.

Combine shredded rotisserie chicken with black beans and scallions; spoon over **baked sweet potato**.

Accompany your favorite grilled meat with **roasted sweet potato wedges** and a side of sautéed kale.

Combine **roasted sweet potato rounds** with sundried tomatoes, scallions and toasted pumpkin seeds; toss with vinaigrette.

## NOVEMBER

Toss sliced **sweet potato**, brussels sprouts and cauliflower in olive oil and salt; bake until tender.



Replace pumpkin with **sweet potato purée** in your Thanksgiving pie for a major flavor boost.

Spread **sweet potato purée** on toasted bread; top with leftover turkey and cranberry sauce for an open-faced sandwich.

Spread baking sheet with thinly sliced **sweet potatoes**. Top with cheddar and chopped onions; bake until tender. Serve with tomato salsa and guacamole for a healthy nacho plate.

## DECEMBER

Combine **sweet potato purée** with Greek yogurt and warm spices in a casserole. Top with goat cheese and bake until bubbly and brown.

Layer thinly sliced **sweet potatoes** with Gruyère cheese and pancetta in a muffin pan. Top with heavy cream and bake.

Use glazed **sweet potato** for holiday lakes. Pair with Greek yogurt.

Stuff cannellonis with **sweet potato purée** and ricotta cheese for a sweet twist on a classic.



## Love North Carolina Sweet Potatoes Because...

### Sweet Potatoes are Local

- There are 350 sweet potato farmers who are located in almost every NC County.
- Almost 50% of the production in the USA comes from North Carolina.
- Local farmers produce 1.24 billion lbs every year.
- Available year round.

### Sweet Potatoes are a Superfood

- One medium (6-ounce) sweet potato:
  - 103 calories (baked with skin on)
  - Excellent source of Vitamin A, C & E
  - More fiber than a bowl of oatmeal
  - More beta carotene than 23 cups of broccoli
  - Good carbohydrate choice for diabetics
  - Fat and cholesterol free

### Sweet Potatoes are Versatile

- Excellent side dish with poultry, pork, beef and lamb.
- A savory addition to fish, shrimp or lobster
- Perfect for vegetarian dishes
- Can be substituted in almost any recipe using potatoes, apples or squash

### Sweet Potatoes are Flavorful

- Perfect if baked, micro-waved, grilled, broiled, boiled, fried, or sautéed
- Naturally sweet
- Naturally delicious in salads, soups, stews, wraps, pastas, breads and desserts.

| Date | Time             | Store         | Address                                   | City           |
|------|------------------|---------------|---|----------------|
| 7    | 4 p.m. - 7 p.m.  | Lowes         | 11711 US 70 Business West                 | Clayton        |
| 9    | 3 p.m. - 6 p.m.  | Lowes         | 1845 Aversboro Rd                         | Garner         |
| 15   | 11 a.m. - 2 p.m. | Lowes         | 341 South College Rd.                     | Wilmington     |
|      | 3 p.m. - 6 p.m.  | Lowes         | 1152 East Cutlar Crossing                 | Leland         |
|      | 11 a.m. - 5 p.m. | Ingles        | 550 Highway 9                             | Black Mountain |
|      | 11 a.m. - 5 p.m. | Ingles        | 140 Weaver Blvd.                          | Weaverville    |
| 16   | 11 a.m. - 5 p.m. | Ingles        | 120 Carbon City Rd.                       | Morganton      |
| 20   | 11 a.m. - 5 p.m. | Piggly Wiggly | 326 S. Fifth St.                          | St. Pauls      |
| 21   | 11 a.m. - 5 p.m. | Piggly Wiggly | 407 E. New Bern Rd.                       | Kinston        |
|      | 11 a.m. - 5 p.m. | Piggly Wiggly | 2715 Hwy 111-55                           | Kinston        |
|      | 11 a.m. - 5 p.m. | Piggly Wiggly | 2030 N. Main St.                          | Tarboro        |
|      | 3 p.m. - 6 p.m.  | Lowes         | 2205 Oak Ridge Rd.                        | Oak Ridge      |
|      | 11 a.m. - 5 p.m. | Ingles        | 85 Tunnel Rd. Innsbruck Mall              | Asheville      |
|      | 11 a.m. - 5 p.m. | Ingles        | Erwin Hills S.C 525 New Leicester Highway | Asheville      |
|      | 11 a.m. - 5 p.m. | Ingles        | 684 N. Broad St.                          | Brevard        |
| 22   | 11 a.m. - 2 p.m. | Lowes         | 1581 New Garden Rd                        | Greensboro     |
|      | 3 p.m. - 6 p.m.  | Lowes         | 5820F North Church St                     | Greensboro     |
|      | 11 a.m. - 5 p.m. | Piggly Wiggly | 615 N. Breazeale Ave                      | Mt. Olive      |
|      | 11 a.m. - 5 p.m. | Piggly Wiggly | 332 NE Blvd                               | Clinton        |
|      | 11 a.m. - 5 p.m. | Piggly Wiggly | 506 W Gannon Ave.                         | Zebulon        |
|      | 11 a.m. - 5 p.m. | Ingles        | 915 Merrimon Ave.                         | Asheville      |
|      | 11 a.m. - 5 p.m. | Ingles        | 201 Barber Blvd                           | Waynesville    |
|      | 11 a.m. - 5 p.m. | Ingles        | 1865 Hendersonville Rd.                   | Asheville      |
| 23   | 11 a.m. - 5 p.m. | Piggly Wiggly | 2960 Richlands Hwy                        | Jacksonville   |
|      | 2 p.m. - 5 p.m.  | Lowes         | 5400 Apex Peakway                         | Apex           |
|      | 11 a.m. - 5 p.m. | Ingles        | 2901 Hendersonville Rd.                   | Fletcher       |
| 28   | 1 p.m. - 4 p.m.  | Lowes         | 4961 Long Beach Rd. SE                    | Southport      |
|      | 2 p.m. - 5 p.m.  | Lowes         | 8100 Brier Creek Parkway                  | Raleigh        |



## Sweet Potato Demonstrations—Piggly Wiggly



Sweet Potato Demonstrations - Lowes Food



Sweet Potato Demonstrations - Ingles



**Project Title:** North Carolina Produce Promotion

## **Final Report**

### **PROJECT SUMMARY**

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The purpose of this project was to increase the awareness and demand for NC specialty crops (specifically fruits and vegetables grown in NC). The project was needed due to recent weather patterns that affected the state reducing accustomed yields and quality which translated to reduced sales for many growers.

The program was in place for 2 years with the intention of increased marketing efforts through local and national channels reaching both wholesale and retail markets for the entire NC produce industry.

### **PROJECT APPROACH**

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Through the course of this program the NCVGA has purchased advertising in The Packer for the May 27, 2013 issue. The total cost was \$3,928 with % coming from the growers who participated and the other % in SCBG funds. The growers who placed ads in the Packer with NCVGA were: Southeastern Growers Association, T.C. Smith Produce, Tull Hill Farms, Patterson Farms and Jackson Farming Company. The Packer reached over 1300 buyers in the Produce Industry. The association also purchased space in the 2013 and 2014 PMA Fresh Summit annual exposition. The association split a booth with the NC Watermelon Association in the North Carolina Pavilion. There were 8 other members who independently shown in the pavilion. The NCVGA also used funds to attract a variety of presenters for the Southeast Fruit and Vegetable Expo. The presenters brought information concerning both operation and marketing of fresh fruits and vegetables to over 250 growers from NC and SC. The SEFV Expo incurred costs associated with printing and promotional items that was paid for by the SCBG.

Through informal surveys with several growers across the state an increase in awareness and sales was made directly from this project. Several growers noted increase in awareness from outside NC borders to the extent of 10-12%. At the time of this report only the informal surveys are available for comparison of actual to anticipated goals

### **GOALS AND OUTCOMES ACHIEVED**

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1. Goal: Increase in awareness and sales of NC fruit and Vegetable through Trade shows and advertising in trade papers.

The association attended PMA Fresh Summit expo in 2013 and 2014. The trade shows attendance was in excess of 22,000 and an estimated 1000 people attended the NC pavilion over the 2 day event.

Several growers received calls from the participants at the event and directly related the participation in the event to increase in sales calls and inquiries.

The sales for the entire industry have not grown by 30% however, individual growers have noted an increase in sales by 12-15% yearly.

2. Goal to increase trade awareness of NC produce and growers the sponsoring the Southeast Vegetable and Fruit Expo.

The association's annual Southeast Vegetable and Fruit Expo was held in Myrtle Beach for 2013 for 2 days. There were in attendance 750 people from NC and SC. Most were growers with a few speakers. Attached is the agenda with names of presenters, titles of presentations and locations.

## **BENEFICIARIES**

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The primary group that benefitted from this program was produce growers from all across NC. The growers of sweetpotatoes, watermelons, and summer fruits and vegetables were specifically assisted more from the PMA and The Packer and all growers that attended the expo received a general benefit from the networking and buyer presentations.

## **LESSONS LEARNED**

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The primary lesson that was learned came from the expo itself. A more concerted effort to promote the expo to out of state attendees is needed in order to increase more networking and expand the awareness of NC grown products.

## **CONTACT PERSON**

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Bonnie Holloman, Executive Director  
Office (919) 870-4999  
Mobile (919) 607-1370  
bonnie.holloman@yahoo.com

## **Project Title:** Developing Management Strategies for Fruit Trees

### **Final Report**

#### **PROJECT SUMMARY**

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Commercial fruit growers in North Carolina have been modifying their orchard systems, rootstocks and cultivars grown to access the more profitable fresh retail and wholesale markets. Along with this change in management also come challenges that can threaten the long-term survival, productivity and profitability of these growers. Because of the practice of replanting one orchard after another due to land limitation and expense several major issues have developed which result in poor orchard survival and or reduced productivity over the life of the orchard. There is much promise and interest with newer apple and peach rootstocks to minimize and/or eliminate the need for soil fumigants. Peach tree short life (PTSL), which results in premature peach tree death, has been one of the limiting factors to profitable peach production in the southeast and is related to ring nematode populations in the soil. There is a relatively new peach rootstock that is resistant to PTSL, Guardian, that does reduce the incidence of PTSL, but fumigation is still required. There are several new commercial rootstock selections that may or may not be superior to Guardian that need to be evaluated. In addition to evaluating the rootstock, long-term studies are underway to evaluate the impact of varying weed-free areas under trees in both eastern and western North Carolina.

In apple replant sites there is a high probability that trees will exhibit reduced growth and productivity which has been documented and referred to as apple replant disease (ARD). Although not as clearly evident as in peach orchards where the tree dies, ARD can be more detrimental to the grower because the reduced productivity may mean that they are not covering costs and losing money over the life of the orchard (10+ years). There is much promise and interest with the newer rootstocks that can be used which may eliminate the need for soil fumigants. As growers are shifting to dwarfing rootstocks, tree density has been increased to offset reduced tree vigor which in many cases has been attributed to the rootstock, possibly incorrectly so. Research from New York indicates that possibly the most effective way to deal with apple replant problems is by using rootstocks that can tolerate replant sites. Initial results in a companion trial established in 2005 at the Mountain Horticultural Crops Research Station supports this claim. A majority of the dwarfing rootstocks commercially utilized in NC have been initially identified as doing poorly in replant sites. The apple rootstock breeding program at Cornell-Geneva has recently released several clonal rootstocks that are reported to perform well in replant sites in addition to several other advanced selections that may be commercially available over the next 4-5 years.

The need for this project has been identified by both apple and peach growers who are requesting information on rootstock recommendations and pre-plant strategies to maximize tree productivity and profitably. A Specialty Crop Block Grant in 2009 allowed the establishment of several long-term projects to evaluate management strategies to

increase orchard profitability and productivity. However, developing reliable and accurate replant strategies for tree fruit crops require long-term studies (10+ years) that in most cases are hard to fund. This project allowed the continuation of several projects and the completion of two projects while generating new information to assist apple and peach growers.

Several specific objectives of this project were:

--To maintain and evaluate replant orchard trials in grower orchards at the Mountain Horticultural Crops Research Station. Factors under investigation are new rootstocks (approx. 31) and need or benefit of preplant fumigation. The specific objective of this aspect of this proposal is to identify rootstocks for NC orchards that can be profitably and sustainably produced while minimizing pesticide inputs.

--To evaluate peach rootstocks and soil management strategies to minimize the potential for peach tree short life.

--To develop commercial recommendations for growers of tree fruit crops on rootstock selection and preplant strategies to optimize orchard productivity and sustainability and to educate NC growers and county extension agents on peach and apple replant issues and how to minimize the potential for replant problems through rootstock selection and preplant soil management.

--To evaluate Asian and European pear cultivars that commercial apple growers could implement in their orchards to increase cash flow and allow crop diversification.

## **PROJECT APPROACH**

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Funds for this project were not available until late April 2013 although the projected start date was January 2013. However, a no-cost extension allowed us to complete all of the objectives proposed. All of the projects included in this proposal, whether on a growers farm or a NCDA&CS Research Station, are set up as replicated experiments. The data collected annually are tree survival, tree growth, total fruit yield, fruit size and quality. Data are collected and analyzed by University personnel to formulate recommendations and design educational programs. Reports are given annually at grower meetings to present current information and recommendations for the future. Tree fruit growers, growing perennial fruit crops, are ordering trees 2-3 years in advance of planting and need to know what is currently available and what will be available in the future.

The apple studies included in this project were:

-- **2005 'Gala' Apple Replant Trial** - Planted at the Mountain Horticultural Crops Research Station in Mills River in March 2005. 'Gala' trees on 13 rootstocks were planted in a replicated replant trial to evaluate those that perform best in a replant site with or without pre-plant soil fumigation (Telone C-35). Data collected here is used to develop recommendations and data for advanced trials. Information was shared with apple growers through annual educational programs, newsletter articles, and grower tours. The first crop was harvested in 2008 and data for crop production is under continued investigation.

--**2006 'Gala' Apple Replant Trial** - Established with Wade Edney, a commercial apple grower in Henderson County in March 2006 with support from an NCSU IPM grant. 'Gala' trees on 12 rootstocks were planted in a replicated replant trial to evaluate those that perform best in a replant site with or without pre-plant soil fumigation (Telone C-17). This on-farm trial is located on a major road and is closely watched by apple growers. Data collected here was used to formulate grower recommendations for replant sites which was presented at educational programs, in newsletter articles and grower tours. The county agent is also involved with this study and will be able to use this trial as a tool for learning as well as educating others. The first crop was harvested in 2008 and the orchard was removed from experimental evaluation in 2015 although the orchard is still being maintained by the grower.

--**2007 'Red Delicious' Apple Pre-plant Soil Fumigation Study** - Greg Nix, a leading and progressive grower in Henderson County, contacted NCSU in mid-2007 requesting recommendations for pre-plant soil fumigants in apple. However, there was no current research-based information on which to make a recommendation. A cooperative project was established with NCSU field and campus (Horticultural Science and Plant Pathology) faculty to evaluate pre-plant soil fumigants on his farm. In October, 2007 three preplant fumigants (Telone C-35, Chloropicrin, and Basamid G) plus an untreated control were applied in a replicated trial in a replant site. Mr. Nix provided the trees ('Red Delicious'/ M.7) which were planted in March 2008. Initial tree growth measurements are being taken and the first significant yield was harvested in 2011 and is continuing.

--**2010 'Aztec Fuji' Apple Rootstock Trial** - Planted at the Mountain Horticultural Crops Research Station in Mills River in April 2010. 'Aztec Fuji' trees on 31 rootstocks from breeding programs across the globe are being evaluated for tree survival, growth and yield. This orchard is being trained as a tall spindle with 520 tree/acre with the first commercial crop in 2012 and this trial is continuing.

--**2015 Staton EverCrisp High-Density Demonstration**- Established with Richard and Jason Staton, commercial apple growers in Henderson County, in March 2015 to demonstrate and evaluate the benefits and techniques of high density systems on dwarfing rootstocks. The cultivar planted was EverCrisp, a very new cultivar and a cross between Honeycrisp and Fuji, that may have great commercial potential in

North Carolina. The rootstocks planted were M.9 337, G.11 and G.935 planted with an in-row spacing of 4 or 6 ft. This is a long-term trial with data collected each year on tree survival, growth and productivity once cropping begins.

Peach research trials for this project were also maintained annually and trees were measured, pruned, thinned and harvested. The peach plots under evaluation were:

**--2009 Peach 'Redhaven' Rootstock Trial** – This trial was established at the Sandhills Research Station to evaluate the 18 newest rootstocks available from across the globe. These rootstocks are being evaluated for survival and fruit yield potential in the Sandhills region of NC where peach tree short life is a real threat and an all too common occurrence. This trial is continuing.

**--2008 Peach 'Blaze Prince' 2<sup>nd</sup> Generation Guardian Trial** - A trial was established at the Sandhills Research Station in 2008 to evaluate advanced selections of Guardian rootstock that may have a greater tolerance to peach tree short life in terms of survival than the current Guardian rootstock. This trial is continuing.

**--2006 Peach 'Contender' Vegetation-free Area Study** - A study was established in 2005 at the Mountain Horticultural Crops Research Station and in 2006 at the Sandhills Research Station and to evaluate the effects of 0, 4, 8, 10 and 12 ft wide vegetation-free strips, with and without irrigation, on tree survival, growth and yield. Both of these trials are continuing and will be terminated at the conclusion of 2016.

The pear trials were established at the Mountain Horticultural Crops Research Station to evaluate tree survival, growth and productivity. Nine Asian pear cultivars were planted in 2010 and 7 cultivars of European pears were established in 2011. The management of pears is very similar to apples and may be a specialty crop that apple growers can use to diversify and increase their farm income. However, the potential devastation of the bacteria, fire blight, which pears are very sensitive to needs to be evaluated. The Asian pears had a light crop in 2013, frost damaged in 2014 and a full commercial crop is expected in 2015. The European pears, a year younger had an insignificant light crop in 2014 and the 2015 crop was lost due to spring frost/freeze injury.

Videos were developed over the period of this project and will be posted to the NCSU YouTube channel in the future. The videos are entitled:

--Apple Rootstocks for the Southeast

--High Density Training Systems in the Southeast

--SmartFresh Use in North Carolina

No formal partners are involved with this project, although grower cooperators and the Research Stations have fulfilled their responsibility with plot maintenance and management.

## **GOALS AND OUTCOMES ACHIEVED**

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All of the components of this proposal are long term (10+ years) in various stages of progression ranging from 1 to 10 years. All of the projects included in this proposal, whether on a grower's farm or a NCDA&CS Research Station, were set up as replicated experiments. Data is collected annually by University personnel and analyzed for use in formulating recommendation and educational programs. Data on tree growth, survival and production is measured annually from each tree. Information on the rootstocks with the greatest survival are determined and the most productive rootstocks from yield data collected annually is used to formulate recommendations. In addition, soil and preplant management strategies such as fumigants are evaluated with the new rootstocks to see if there is an added benefit to their use. A desired goal of this project is to identify rootstocks that can be used in replant sites without the need of soil fumigation. Increased tree survival and productivity will greatly enhance the economic return to the growers as well as to the economic growth of their communities. The elimination of soil fumigants would reduce the grower's cost of orchard establishment as well as eliminate any environmental and worker safety concerns from the use of soil fumigants.

Outcomes of this project have allowed us to initially identify apple and peach rootstocks that could be profitable for NC growers to utilize. For apples at present, G.41 and G.935 apple rootstocks have been identified as very good dwarfing rootstocks and G.30 and GH. 210 as semi-dwarf rootstocks for NC growers, even in replant sites. From initial data, it appears that these rootstocks can be used without any preplant treatments. Some of the current commercial semi-dwarfing rootstocks have shown improved tree growth and productivity with soil pretreatments which makes their future commercial viability questionable. For the 2010 fuji apple planting with 31 rootstocks, the poorest tree survival has been for trees on B.7-20-21, M.9 Pajam 2 and M.9 NAKBT337. The largest trees were those grown on B.70-20-20 with the smallest on B.7-20-21, which also had small fruit size. Trees had a good crop in 2014 that was aggressively thinned with the trees on CG.4004, M.9 Pajam2 and G.935 N having the largest crop and those trees on B.7-20-21 the smallest. The trees with the greatest cumulative yield (2012-2014) were grown on CG.4004 and M.9 Pajam 2 followed closely by G.935 N, 935 TC, CG.522 and M.26 EMLA with the smallest yield for trees grown on B.7-20-21. Valuable data and information is being generated looking towards the future.

For peaches in the 2009 planting, tree death has been an issue, primarily due to bacterial canker (*Pseudomonas syringae* pv. *syringae* van Hall) and all of the trees on Imperial California have died. Excessive tree death has also occurred with trees on Controller 5 and Mirobac followed by trees on Emphyrean 2 (Penta) and Krymsk 1.

Trees on Fortuna, although having only lost two replications at this time, drop their leaves much sooner in the fall, have a significant overgrowth of the scion and are very weak and unproductive. This information has shown, that although commercially available, these trees will not survive in the light sandier soils of eastern NC. The largest trees are on Mirobac with the smallest on Krymsk 1 and Fortuna and HBOK 10. Krymsk 1 and Fortuna have significant mortality issues and poor tree growth whereas HBOK 10 has no tree mortality and a high yield efficiency. In 2014, trees on Viking, Lovell, Guardian, Bright's Hybrid 5 and Atlas had the greatest yield and trees on Krymsk 1, Fortuna and Controller 5 the lowest with a similar trend observed for the cumulative (2011-2014) yield. Trees on HBOK 10 and HBOK 32 appear to be possible candidates for higher density planting in North Carolina due to their survival and reduced tree growth and high yield efficiencies. However, to date our studies have indicated that preplant soil nematicide treatments are still warranted in the sandier soils or eastern NC with any rootstock. Although, there may be newer rootstocks in the near future, Guardian is the only recommended rootstock to date for the sandier soils in eastern NC.

The groundcover trials have shown that in both the sandier soils of the Sandhills region and the heavier clay soils in western NC, significant increases in tree growth, crop yield and fruit size occurred with increasing vegetation-free area treatments. In addition, even under a commercial pesticide program, catfacing fruit injury can be reduced with wider herbicide strips.

## **BENEFICIARIES**

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Results and information generated from this project will benefit all of the 200+ apple growers and 110+ peach growers currently in North Carolina in addition to new and potential growers. There are significant financial and social benefits from increasing the sustainability of the production systems as well and providing a greater supply of fresh fruit for NC citizens. The combined value of these two industries is in excess of \$35 million annually. Assuming a modest production and sales increase of 10% from using newer rootstocks to increase yield could result in a \$3.5 million benefit annually. This is a very real benefit assuming that production of orchards could be increased in addition to increasing tree survival and increasing the profitable life of the orchard. If fumigation can be eliminated with an appropriate rootstock, there would be a significant increase in profitability by reducing the sizeable financial input at planting. In addition, there would be an increase in worker safety during planting. With newer high density systems with earlier production and reduced labor inputs, there is a trend for new fruit growers to emerge to address niche markets created by the interest in local foods.

Educational programs were presented annually from 2013-2015 at the Southeastern Apple Growers Meeting, the North Carolina Peach Growers Meeting and multiple regional stakeholder meetings with current information and recommendations to all commercial apple and peach growers in NC. For peach growers there were 3

educational meetings, 3 field days, multiple regional pruning workshops as well as on-site consultations with field faculty and growers with a total attendance in excess of 500 growers. For apple growers there were more than 6 educational programs, 2 orchard tours, 6+ pruning workshops and on-site consultations with field faculty and growers with an attendance of more than 1,500. In addition, written reports were prepared and distributed annually at the NC-140- Technical Research Committee meeting and included in the Proceedings of the SE Apple Growers Meeting and were available electronically as well.

To evaluate impact, a change in practice is a key indicator. However, orchard establishment is a labor and capital intensive operation and requires 2-3 years to get the trees of the proper variety and rootstock. At present a majority of the peach growers in the eastern portion of NC are using Guardian rootstock based upon recommendations made by research conducted at NCSU. Preplant soil treatment with a nematicide is still recommended to minimize the impact of peach tree short life. Multiple apple growers are also utilizing high-density orchards with size-controlling rootstocks in many orchards being planted. There are also many trees on order and contracted with commercial nurseries on dwarfing rootstocks to be planted in the next year or two. The trend for both peach and apple plantings described above is expected to continue and increase in the coming years. However, rootstock and orchards system recommendations are not a stagnant issue and research must and will continue to provide refinements. It is imperative that North Carolina apple and peach growers have the most up-to-date information on which to base their decisions to remain profitable and sustainable for generations to come.

Assessment of the educational efforts and adoption of the knowledge developed from this project was done via farm visits, interaction with the stakeholder commodity groups and from the county based field faculty working directly with the growers. County extension agents are involved in both the apple and peach projects.

## LESSONS LEARNED

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This project provided data and information for the project staff to interpret and understand the performance of different orchard systems in field conditions in North Carolina. We now have a better understanding of how some rootstocks will perform in NC and the research is continuing.

## CONTACT PERSON

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**Contact:** Michael L. Parker  
**Phone:** (919)515-1198  
**E-mail:** mike\_parker@ncsu.edu

**Project Title:** Developing *Phytophthora*-resistant Fir Christmas Trees

## Final Report

### PROJECT SUMMARY

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Fraser fir (*Abies fraseri* [Pursh] Poir.) Christmas trees are one of North Carolina's largest specialty crops, producing revenue of over \$100 million annually. Root rot primarily caused by *Phytophthora cinnamomi* Rands is the most severe disease of this crop causing significant mortality in nurseries and plantations. Although this disease can be controlled via chemical methods in seedling and transplant beds, chemical control in plantations is transient at best. Severely infested sites are often abandoned for Fraser fir cultivation.

Although genetically resistant planting stock would be of significant benefit to the industry, unfortunately, no resistance to this disease has been found in Fraser fir. This research investigates two alternative fir species, Turkish fir (*A. bornmuelleriana* Mattf.) and closely related Trojan fir (*A. equi-trojani* Aschers. and Sint.) that possess varying frequencies of resistant trees.

The ultimate goal of this project is to diminish the adverse impact of *Phytophthora* root rot on North Carolina's Christmas tree industry through the development and use of *Phytophthora*-resistant fir planting stock. Toward this end, **this project had two specific objectives: 1) to determine the degree of interaction between fir host genotypes and specific genetic isolates of *Phytophthora*, and 2) to develop DNA markers to rapidly select for resistant genotypes.**

This NCSCBGP project has complemented ongoing *Phytophthora* research at Washington State University and North Carolina State University under the five-year-long Specialty Crops Research Initiative project 2012-51181-19940, "Development and Use of Genomics Tools to Improve Firs for Use as Christmas Trees". The knowledge generated from this NCSCBGP project will be used under that SCRI project to continue development of techniques to select for *Phytophthora*-resistance in fir species.

### PROJECT APPROACH

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#### Objective 1. Genetic Interactions between Fir and *Phytophthora*

A large *Phytophthora*-resistance screening trial was completed using 1600 seedlings from 12 Turkish and Trojan fir families with Fraser and momi fir (*A. firma* Sieb. et Zucc.) seedlings included as susceptible and resistant controls, respectively. Each family (or species) was inoculated with each of eight *Phytophthora* isolates, six *P. cinnamomi* and two *P. cryptogea*. The isolates were collected from a number of different diseased plant hosts (*Abies*, *Camellia*, and *Juniperus* spp.) within North Carolina. Plants were grown in Conetainer tubes under 55% shade with daily irrigation at a research nursery in Raleigh.

Mortality was assessed as percent shoot necrosis bi-weekly for 16 weeks with a final observation the following year after bud break.

Overall, fir species resistance rankings confirmed previously reported results; momi fir was most resistant, followed by Turkish and Trojan fir with Fraser fir being most susceptible. *P. cinnamomi* isolates were generally more aggressive on all fir species than *P. cryptogea* isolates. There was a significant interaction between host fir species and *Phytophthora* isolates although the relative resistance rankings of fir species was consistent across *Phytophthora* isolates. *P. cryptogea* has recently become more prevalent in Fraser fir Christmas tree plantations in the Southern Appalachian region. The two *P. cryptogea* isolates used were originally isolated from Fraser fir and resulted in 50% and 100% mortality on Fraser fir in this study. Turkish and Trojan fir families appear to possess quantitative resistance to *Phytophthora* species common in North Carolina.

## **Objective 2. DNA Markers for *Phytophthora* Resistance**

### **GBS Approach**

DNA was extracted from foliage of progeny in an open pollinated Trojan fir family (n=161), which was then screened for root rot resistance against *Phytophthora cinnamomi* with an overall mortality of 71%. Libraries were prepared for Genotyping by Sequencing (GBS) to identify genetic marker loci. A small subset of individuals from other inoculated Turkish, Trojan, Fraser, and momi fir families were also genotyped for comparison. The DNA libraries were sequenced on 2 Illumina HiSeq lanes, returning 342 million reads. The resulting sequence was filtered to 413,000 unique tags via the Tassel pipeline, 117,000 of which segregate within the selected Trojan fir family. The segregating tags were tested for association with the disease resistance phenotype with a contingency test, and significance was determined by a permutation test. 205 tags were identified as significantly associated with root rot resistance, with an expected false discovery rate of 12.5%. The tags were mapped to a draft genome assembly of loblolly pine (*Pinus taeda*), to help identify putative markers, and significant tags were also blasted against the NCBI database to identify tags that overlap genes with known function.

### **RNA Seq Approach**

An independent set of 180 seedlings of the same open-pollinated family of Trojan fir as was used for the GBS experiment were inoculated with the same strain of *Phytophthora cinnamomi* by transplanting seedlings into potting medium colonized with the pathogen at four weeks after germination. After an additional week of growth in that medium, the seedlings were removed and 2.5-3.0 cm of the growing root tip was removed as a tissue sample. The seedlings were re-planted in individual Conetainer tubes with fresh uncontaminated potting medium after tissue sampling and allowed to grow under conditions favorable to development of *Phytophthora* root rot disease. The seedlings were observed for 16 weeks following the second transplantation and the time of death recorded for all seedlings that died. In parallel, the same set of manipulations were

conducted on a set of non-inoculated control seedlings that were treated identically, except that none of the potting medium into which they were transplanted was colonized by the pathogen. After the phenotypes were collected for all the inoculated experimental seedlings and non-inoculated control seedlings, tissue samples were pooled in groups of ten based on similarity of survival time. Four pools contained samples from seedlings that died soon after inoculation, four contained samples from seedlings that survived the longest after inoculation, and two pools contain samples from non-inoculated control seedlings. Total RNA was extracted from these ten pooled samples, and the RNA samples were sent to the sequencing facility at David H. Murdock Research Institute in Kannapolis NC. At DHMRI, ribosomal RNA was removed using a recently-developed technique that does not rely on selection of polyadenylated mRNAs, cDNA libraries were prepared for each of the ten RNA samples using unique index adapters for each library, and two lanes of Illumina Hiseq 2500 single-end sequences were obtained from a pool of the ten libraries.

### **Bioinformatics Approach (RNA Seq)**

DNA sequences were provided by DHMRI for each of the ten pooled RNA samples. These sequences were filtered to remove regions similar to oligonucleotide adapters used in library construction and fragments similar to the genome of *Phytophthora sojae*, and the remaining sequence data were used to assemble a draft transcriptome for Trojan fir roots. The relative abundance of the putative transcripts in this assembly was estimated using k-mer counting, and statistical significance of differential gene expression was tested using the DESeq2 package in the R/Bioconductor environment. Three pair-wise comparisons were conducted – the four replicate pools of seedlings that died soon after inoculation were compared with the two replicate pools of non-inoculated control seedlings and with the four replicate pools of seedlings that survived the longest after inoculation, and the long-surviving seedling pools were also compared with the non-inoculated controls. About 240 to 250 putative differentially-expressed genes were identified in each of these three pair-wise comparisons; many of these genes are quite similar to sequences from bacterial or fungal genomes in the Genbank database while others are similar to plant genes. The ribosomal RNA depletion method used for library construction provides the opportunity to detect both microbial and plant mRNAs in parallel, allowing analysis of the role of rhizosphere microbes in resistance to or progression of *Phytophthora* root rot disease.

### **Roles of Project Partners**

Implementation of this project was largely the responsibility of Masters of Science graduate student, Will Kohlway. Dr. Frampton was the general project overseer and served as coordinator of the research team. Dr. Ross Whetten supervised the molecular genetics and bioinformatics aspects of the project. Dr. Michael Benson's lab provided the *Phytophthora* inoculum used in the project. Dr. Mike Wang at DHMRI collaborated on preparing and sequencing the cDNA libraries.

## GOALS AND OUTCOMES ACHIEVED

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The ultimate goal of this project is diminish the adverse impact of *Phytophthora* root rot on North Carolina's Christmas tree industry through the development and use of *Phytophthora*-resistant fir planting stock. Long-term measurable outcomes will include: 1) volume of resistant planting stock deployed, 2) amount of reduction in the incidence of *Phytophthora* root rot on Christmas trees, and 3) amount of reduction in economic losses to this disease. These outcomes will be beyond the grant period.

Short-term measurable outcomes that demonstrate the credibility of the results and progress toward our long-term goal are peer-reviewed publications and presentations at scientific conferences. We are drafting one refereed journal publication on genetic interactions between fir and *Phytophthora* that we will submit in January 2016 to be reviewed for a special Christmas tree issue of the *Scandinavian Journal of Forest Research*. We anticipate publishing a second manuscript describing results from both the GBS and rna-seq approaches after the data analysis is finalized.

Graduate student, Will Kohlway carried out this research as part of his Masters of Science degree in functional genomics. His thesis has been accepted and will soon be available electronically:

- Kohlway IV, William Henry. Mapping *Phytophthora* root rot resistance in fir species through genotyping by sequencing. MS thesis. Functional Genomics. N.C. State University. Raleigh.

Additionally, this research was presented at an international forest tree breeding conference in the Czech Republic and will soon be presented in two talks at an international Christmas tree research and extension conference in Norway:

- Kohlway, W., J. Frampton and R. Whetten. 2014. Mapping *Phytophthora* root rot resistance in fir species through genotyping by sequencing. IUFRO Forest Tree Breeding Conference, Book of Abstracts. Czech University of Life Sciences. August 25-29. Prague, Czech Republic. p20.
- Kohlway, W., R. Whetten, D.M. Benson, A.M. Margaret Braham and J. Frampton. 2015. Response of Turkish and Trojan fir seedlings to *Phytophthora cinnamomi* and *P. cryptogea*. 12<sup>th</sup> International Christmas Tree Research and Extension Conference (IUFRO WP 2.02.09). Honne, Norway. Sept. 6-11.
- Kohlway, W., J. Frampton and R. Whetten. 2015. Mapping *Phytophthora* root rot resistance in fir species through genotyping by sequencing. 12<sup>th</sup> International Christmas Tree Research and Extension Conference (IUFRO WP 2.02.09). Honne, Norway. Sept. 6-11.

## BENEFICIARIES

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Short-term, the outcomes from this project will benefit researchers using genomic tools to understand plant disease resistance, particularly, in conifers.

Long-term, Christmas tree growers in North Carolina and other regions will benefit. Our state has over 1,600 growers cultivating an estimated 50 million Fraser fir Christmas trees on over 25,000 acres. *Phytophthora* root rot losses averaged 9% in a survey of Fraser fir plantations. One estimate of annual economic losses to this disease was \$6 million but yearly losses vary and are in large part dependent on weather conditions. Growers with infected plantations currently have little recourse since chemical control is economically, logistically, and environmentally unappealing and yields only transient disease reduction, at best. The utilization of genetically resistant planting stock for establishment of Christmas tree plantations is a relatively inexpensive and simple solution to ameliorate the impact of this most destructive pathogen. The economic benefits also include reclamation of infested sites previously abandoned for Fraser fir production and perhaps, expansion the state's Christmas tree production region considering that Turkish and Trojan fir are more tolerant of lower elevations than is Fraser fir. This may provide the industry with some relief from increasing land costs in the region due to pressures from development and tourism.

## LESSONS LEARNED

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1) Genetic segregation analysis of disease resistance in open-pollinated families of conifers is easiest when single genes control the resistance phenotype; resistance to *Phytophthora cinnamomi* seems to follow a more complex inheritance pattern. The maternal contribution to each embryo can be genotyped by extracting DNA from the megagametophytes of the seeds and tracking the identities and disease resistance phenotypes of the seedlings that correspond to each megagametophyte sample; this experiment will be carried out as part of the ongoing SCRI project. The fir genome is large (about five-fold larger than the human genome), and no reference genome sequence is available as yet, but the loblolly pine genome sequence has provided some framework for analysis of the fir GBS and RNA-seq data.

2) Analysis of gene expression in early stages of *Phytophthora cinnamomi* colonization of fir seedling roots required development of an inoculation technique, optimization of methods for extraction of RNA from very small tissue samples, and development of methods to deal with the relatively low quality of RNA extracted from necrotic diseased root tissues. Multiple preliminary trials were conducted to develop the seedling inoculation and RNA extraction methods, and the ribosomal RNA depletion technique was used to allow recovery of fragmented mRNAs that could not be isolated by the standard oligo(dT) affinity chromatography method. The reagents and methods developed in this study will enable further research into the molecular mechanisms of disease resistance and susceptibility in many plant species.

## CONTACT PERSON

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John Frampton  
919-515-7580  
[frampton@ncsu.edu](mailto:frampton@ncsu.edu)

## ADDITIONAL INFORMATION

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In order to keep the North Carolina Christmas tree industry informed about this research, Drs. Frampton and Whetten made a presentation on DNA sequencing and Christmas tree research including a description of this project at the 2014 North Carolina Christmas Tree Association Winter Meeting in Boone. We anticipate presenting an update at the 2015 NCCTA Winter Meeting. Additionally, this project was featured in articles published in two trade journals:

- Frampton, J., R. Whetten, L. Matallana, Y. Kurt and W. Kohlway. 2014. DNA sequencing and Christmas tree research. *Am. Christmas Tree J.* 58(2): 24-26. (publication of the National Christmas Tree Association)
- Frampton, J. and R. Whetten. 2014. DNA sequencing and Christmas tree research. *Limbs & Needles* 41(1): 20-23. (publication of the North Carolina Christmas Tree Association)

## **Project Title:** Growing the North Carolina Hops Industry

### **Final Report**

#### **PROJECT SUMMARY**

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Farmers were starting to grow hops (*Humulus lupulus*) in North Carolina in response to the rapidly expanding craft brewing industry. Centuries ago there were some hops grown in the Southeast, but there was no production information available for farmers to use. The information from the Pacific Northwest, where most hops are grown in North America, is not well-suited for an emerging industry or for our environmental conditions. Growers were in need of information on varieties, trellising, equipment, processing, and marketing of hops.

When this project started there were an estimated 50 hop growers in the state with many more expected to start production over the next two years. Extension agents and state agronomists were getting requests for assistance but had no production information at hand or experience to draw on.

The first hops project, that we referred to as Phase I, was to determine if hops could be grown on a commercial scale in North Carolina. The project provided information on how to establish a hop yard and gave information on varieties based on two years of growth. This project built on that foundation and provided information on how to maintain a mature hop yard, addressed some production problems, provided variety information based on five years of growth, and brought numerous educational and networking opportunities to the growers.

#### **PROJECT APPROACH**

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The objective of this project was to continue to help NC farmers meet the growing demand for locally grown hops by identifying the best hop cultivars; developing production recommendations; providing educational programs for growers, agricultural consultants, and breweries; and continuing to build relationships.

- Two hop conferences and a beginning grower session were held. Over 100 people attended the first hop conference in March 2013. In March 2014 over 200 people attended the Beginning Hop Grower Session. Over 200 (many were duplicates) people also attended the NC-VA Hops Conference on the following day.
- We held an industry roundtable discussion in March 2014 to bring leaders together to discuss the state of the industry (summary provided at end of document).
- We held several grower workshops, an advanced grower class, and numerous research yard tours. Over 200 people participated in these events.

- We modified, improved, and maintained the hop variety trial in Mills River. In 2013 new varieties were added and we experimented with several cultural practices and fungicide products to increase yields and plant health. Growers have reported that the information from this study has been invaluable in helping them manage their hop yards.
- We conducted two hop yard field days. The research hop yard was also included in many other field days on the research station. It is the most popular research project. Over 300 people visited the hop yard during the project period. Over 1,000 people have visited it since its construction.
- We have provided information on hops growing through our website, blog, Facebook pages, Twitter feed, and emails. We don't know precisely how many people we have impacted through these avenues, but we estimate that it is over 80,000.
- We provided extension agent training to 50 agents on hops production.
- We helped North Carolina growers continue to expand their informal growers group known as the Southern Appalachian Hops Guild and encouraged many to join the Old Dominion Hops Cooperative.
- We brought in many new partners from industry and academia.
- We gave numerous presentations on hops growing at conferences, festivals, and workshops in NC, VA, PA, and MI.
- We have written a hops growing guide. We are still editing it and adding photographs.
- We analyzed the data and presented results at a professional meeting (American Society for Horticultural Science). A research manuscript is in process. Initially it contained just the first two years of data, but after consultation with other hop researchers, we have decided to include four years of data.
- This project led to additional grant funding to continue the work.

This project was solely devoted to hops.

Project partner contributions include:

- Three NC hop growers were presenters at the March 2013 conference along with a brewer and a hop breeder. Hop growers in the mountains and piedmont welcomed us to their farms to see their production, take photos and notes, and collect data.

- We worked with the NC Bionetwork to offer educational programming on hops production. Two experienced hop growers were the team teachers.
- Growers and brewers participated in the Beginning Hop Growers Session and NC-VA Hops Conference in March 2014.
- Growers and Virginia Tech researchers and extension personnel have all been very supportive of working together to have the two states grow their industries together.
- Commercial hop growers in North Carolina and Virginia were excellent partners on this project. They readily provided information on their hop growing experiences and shared pictures and yield data. They were willing to get up in front of a group at field days and workshops and share their knowledge. I think this is one of the key factors to why the Southeastern hops industry is expanding as rapidly as it is.

## GOALS AND OUTCOMES ACHIEVED

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Goal 1: Conduct two field days and one workshop and update website and blog to educate growers, extension agents, and other crop advisors on how to improve the viability of hops as a new crop in NC (GOAL). Although there have been hops classes offered by others over the past few years, region specific, research based information on variety selection, fertility requirements, and pest/disease/weed management has not been provided (BENCHMARK). We anticipate that more than 1,500 people will be more knowledgeable about hops production by the end of the project (TARGET). This will be measured by pre- and post-event surveys and by measuring website and blog hits (PERFORMANCE MEASURE).

- A pre-season hops conference (TARGET) was held in March 2013 which over 100 people attended. Presentations were given by experienced growers, brewers, and a hops breeder. All growers in attendance indicated that the knowledge they gained would help them be better hop growers (PERFORMANCE MEASURE).
- We wanted to make more farmers aware of the hops project and the potential opportunity hops presents to them as a new crop (BENCHMARK). A hop yard tour was offered at the research hop yard in Mills River in mid-July 2013. Over 50 people attended and spent several hours discussing hops production, particularly disease and insect control. The research hop yard in Mills River was included in the Tomato and Vegetable Field Day in August 2013. Over 200 people were in attendance and heard about the project and had the opportunity to view the yard. A presentation was given on hops production at the NC Herb Association annual conference in July 2013 with 30 people in attendance. Over 280 people were educated about hop growing at these events (TARGET). Official evaluations were not conducted after the field events, but growers stayed to ask questions about growing hops and requested more information. The hops presentation received a rating of 4.9 on a scale of 1-5.

We have also received many email and phone call follow-ups after these events (PERFORMANCE MEASURE).

- Growers had requested that hops production information be offered in a more structured format than just field days and conferences (BENCHMARK). So on October 28, 2013 a day long class was offered to 17 people (TARGET) which covered all aspects of hops production, marketing, and economics. This class was done in cooperation with the Bionetwork. On the course evaluation all attendees indicated that the class met or exceeded their expectations (PERFORMANCE MEASURE).
- On November 5, 2014, hops were included in extension agent training on new and emerging crops at the Extension Conference in Raleigh, NC. Over 50 extension agents were registered for the training (TARGET). Formal feedback on the training was not received, but the comments from extension agents have been quite positive, six asked for a copy of the hops PowerPoint for them to use in their own counties, and three requests to provide a presentation on hops growing for farmers in their counties were received (PERFORMANCE MEASURE).
- On February 18, 2014 Jeanine Davis served as the keynote speaker at the Growing Hops in the Southeast conference in Afton, VA. There were over 100 people in attendance, with several from North Carolina. One of the other speakers was also a well-established NC hops grower. People who could not attend the conference asked for the PowerPoint to be made available to the public. It was posted on the ncherb.org website and we refer potential growers to it all the time.
- On April 14, 2014 an in-depth workshop for experienced growers was held at the Research and Extension Center in Mills River. This was one more workshop than we planned to hold for this project, but the growers in the Southern Appalachian Hops Guild asked for another opportunity to get together and discuss the research and their experiences growing hops. Fourteen experienced growers were in attendance either in person or by phone (TARGET). The main topics covered were downy mildew, the practice of spring cutting back, the Old Dominion Hops Cooperative for getting hops to market, and future research needs (BENCHMARK). The notes from this session were then posted on the blog for growers who could not attend to read. Those have been accessed by over 200 people to date. The evaluation at the end of the session revealed that all growers thought these workshops with lots of time for grower discussion were very valuable (PERFORMANCE MEASURE) and that future research should involve breeding hops for the Southeast.
- The second field day for this project was held on July 18, 2014 (GOAL) at the research hop yard in Mills River. There were about 50 people in attendance (TARGET). The educational objectives at this field day, besides updating growers on the variety trial, was to teach them how to identify downy mildew and spider mites and to begin learning how to identify different varieties (BENCHMARK). The

attendees were asked to fill out a questionnaire at the beginning and end of the field day. Thirty-one of them turned the questionnaires in (PERFORMANCE MEASURE).

- The questionnaire revealed that for 65% of the attendees this was the first of our educational programs that they attended. This demonstrates that we continue to reach new audiences.
- Thirty-nine percent of them had not started growing hops yet. Twenty-six percent of them had been growing hops for 1 to 2 years and 23% had been growing hops for five or more years. This demonstrated to us that our educational program was of interest to a wide audience. Having experienced growers in with new growers was very beneficial; the established growers were very willing to share their experiences.
- Of those in attendance who were already growing hops, the average size of their hop yards was about one-third of an acre. This is a good size to start a commercial hop yard with; small enough for a new grower to manage but large enough to provide hops to sell to a craft brewery.
- Nineteen percent of those in attendance have a hop yard of one acre or more.
- We taught the attendees how to identify downy mildew, spider mites, and the damage they cause. Examples in the hop yard were pointed out and we had microscopes and hand lenses for people to use. We then discussed control strategies.
- Eighty-four percent of the attendees reported that they were better able to identify downy mildew than before they took the class. Ten percent said they already knew how to do it. For spider mites, 77% said they were better able to identify them after the educational session than before. Twenty-three percent said they already knew how to identify spider mites.
- Through our interactions with hop growers, we thought it would be beneficial to teach them how to be more observant of their plants; to start learning how to tell one variety from another by the leaf shape, growth habit, and cone formation. We also demonstrated the differences in cone set and development from one variety to another.
- Focusing on the variety Cascade, 78% of the attendees reported that they were better able to identify that variety than before the field day. Six percent said they already knew how.
- We also had concerns that potential growers did not appreciate how much it cost to establish a hop yard. We discussed this and afterwards 26% of the attendees increased their estimate of how much it would cost to establish a hop yard. Fifty-five percent kept their estimate the same (about \$10,000 per acre).

- The research hop yard in Mills River was also included in the annual Tomato and Vegetable Field Day tour on August 7, 2014. Approximately 50 people visited the hop yard and listened to a short presentation on the status of the industry and how to grow hops. About 160 members of the International Plant Propagators Society toured the research hop yard during their annual meeting on October 28, 2014.
- Presentations on hops growing in 2013-2014 were given by Jeanine Davis at the Mother Earth News Fair, Asheville, NC (about 75 in attendance), Polk Co. Agricultural Breakfast (about 70 in attendance), Foothills Farm School (about 50 in attendance), and Mother Earth News Fair, Seven Springs, PA (about 125 in attendance).
- A poster on the hops research was presented at the American Society for Horticultural Science meeting in Orlando, FL in August.
- Part of a documentary on the economic impact of the craft brew industry in North Carolina was filmed in the research hop yard in June 2014. Kelly Gaskill and Jeanine Davis are featured in the film. This documentary can be viewed (pay per view) at <http://brewconomy.com> and is being shown at small theaters throughout the state.
- Kelly Gaskill visited several commercial hop yards in the state in mid-summer of 2014 and was impressed with the health and vigor of the yards (BENCHMARK). Growers were able to sell all the hops they grew (PERFORMANCE MEASURE). Some reported making a profit when they didn't take labor into consideration. At this stage of the industry, many are relying on family and friends to help with harvests.
- In early March 2014, we held the first NC-VA Hops Conference, an industry roundtable, and a Beginning Hop Grower Session. The Beginning Grower Session was held on Friday afternoon and the conference all day on Saturday. Attendance for both days exceeded all expectations and registration had to be cut off at a little over 200 people for both days. The evaluations were excellent and another event is being planned for 2016. The program, evaluation summary, and roundtable discussion summary are included at the end of this report.
- Early in this project, NC hop growers organized informally to form the Southern Appalachian Hops Guild. They still use this vehicle to communicate, mostly over Facebook and sometimes through a blog. They see the need to become more formally organized. The Old Dominion Hops Cooperative is a well-organized entity based in Virginia. They reached out to North Carolina farmers to join and formed a chapter for them. It makes sense to make that a multi-state effort and it looks like that is what most of the larger growers will choose to do.
- During the first reporting period, ending in June 2013, updates on the hops

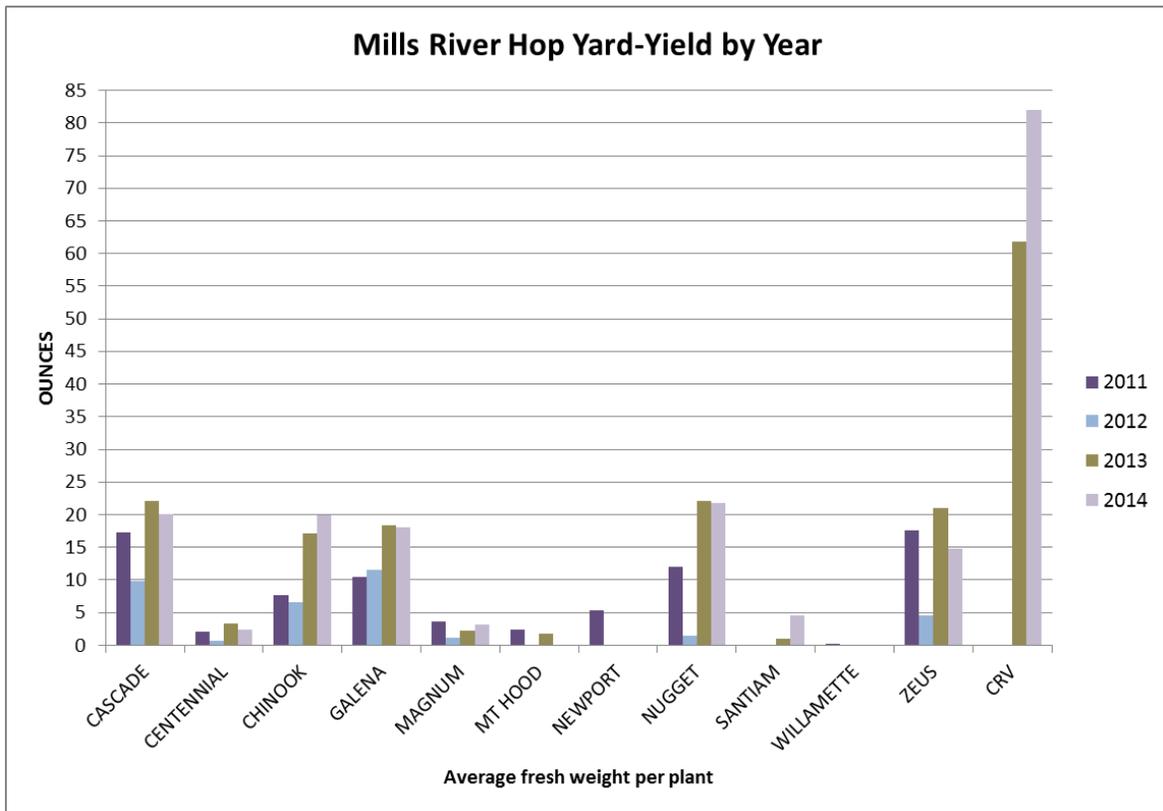
project were made to the NC Alternative Crops and Organics blog and the Southern Appalachian Hops Guild Facebook page and blog (TARGET). Growers requested they wanted more networking opportunities with other growers and researchers (BENCHMARK) and the 2,000 plus views (PERFORMANCE MEASURE) of the posts just on the NC Alternative Crops and Organics blog indicate that the information was of value.

- During the next reporting period, ending in September 2013, new growers requested access to more information on growing hops in North Carolina (BENCHMARK) and the 2,600 plus views and numerous comments (PERFORMANCE MEASURE) of the posts that can be tracked indicate that the information provided was of value.
- During the next reporting period ending in June 2014, social media, including Twitter and Facebook, were very popular with this industry. The blog alone reached over 2,500 people with hop related articles during this report period (BENCHMARK). We conservatively estimate that another 5,000 were reached through the websites and social media.
- From June through September 2014, the blog reached about 2,800 people per month during that reporting period and a majority viewed the hop related articles (BENCHMARK). We conservatively estimate that another 6,000 were reached through the websites and social media.
- Numerous phone calls, emails, and visits to the research hop yard were handled by Jeanine Davis and Kelly Gaskill. This included many calls from the media.

Goal 2: Maintain our hops variety trial in Mills River. Yields when the plants were young (BENCHMARK) will be compared to mature yields obtained during the proposed grant period (PERFORMANCE MEASURE). Mature hop plant yields from varieties grown in the region are necessary for growers to make informed decisions about the economic viability of hops production (GOAL).

- As of June 2013, big changes had been made in the yard to evaluate new varieties, improve production practices, and control insects and diseases in an effort to increase yields and quality. We wanted to increase yields over the current one pound wet weight per plant (BENCHMARK) to help move our industry towards an economically viable production system.
- The final determination of whether a hop yard is successful is based on the yield of cones produced (TARGET). Yields over one pound wet weight per plant (BENCHMARK) are necessary to have an economically viable production system. In 2013, yields of close to two pounds wet weight per plant were obtained on many varieties and one yielded over 3.5 pounds (PERFORMANCE MEASURE). These yields should be sustainable if growers receive a fair price for their cones.

- By the 2013 growing season, hop growers had adopted many of the practices that we had developed and demonstrated in the research hop yard in Mills River, including using of polypropylene silt fencing for weed control; using a high trellis system; using coir twine for stringing hops; cutting back plants to encourage high, concentrated yields; using a winch system to raise and lower the top wire for ease of management; and using an elevated drip irrigation system. Several growers shared with us that these practices have reduced their production costs and increased yields.
- In 2013 we experimented with cutting back plants in the spring to delay flowering and synchronize cone harvests. Over 90% of the growers we have surveyed have now adopted this practice and consider it worthwhile (PERFORMANCE MEASURE). We also planted flowering plants (farmscaping) to hold beneficial insects, such as predator mites. Several growers have reported adopting this practice also. In 2012, yields had been reduced because of Downy Mildew. In 2013, we experimented with new fungicides to control Downy Mildew and yields increased for most varieties. The variety Newport had been killed out completely by Downy Mildew in 2012 and did not emerge in 2013. Yields for Willamette were so low they are barely visible on the graph. With the exception of Magnum and Mt Hood, all the varieties produced yields higher than they did in 2011 (no Downy Mildew) and 2012 (extensive Downy Mildew).
- In 2013, three new varieties were planted in the open spaces where the Newport variety had been. They were Santiam, Vojvodina, and Canadian Red Vine. On Santiam and Canadian Red Vine (CRV) are included on the graph; Vojvodina produced so few cones it would not be visible on the graph. Santiam was a very low producer also, but Canadian Red Vine produced yields about three times greater than the next best varieties, Cascade, Chinook, Galena, Nugget, and Zeus.
- In 2014 we continued to experiment with new cultural practices to improve yields, including a regular spray schedule to control downy mildew (BENCHMARK). We experimented with topping out the bines that had not reached the top wire by the summer solstice. Harvest was conducted on mature hop plants and completed on schedule. Cones were hand-picked and fresh and dried weights were recorded. Samples were sealed and sent for analysis. Of the 10 original varieties, 7 varieties (Cascade, Centennial, Chinook, Galena, Mt. Hood, Nugget, and Willamette) yielded higher in 2014 than they did in the first year but often slightly less than in 2013. Of the three varieties planted in 2013, Canadian Red Vine produced yields approximately four times greater than the other best performers (PERFORMANCE MEASURE). Yields this high would make hops production economically feasible. Unfortunately, little is known about the brewing properties of Canadian Red Vine. In summer 2015, however, Sierra Nevada did a test brew with CRV hops from our research hop yard. The head brewer was pleased with the first test round with these hops.



- There were many questions about the quality of the hops grown in the Southeast. To date, brewers have been pleased with hops provided by experienced growers who had learned how to grow them, when to harvest them, and how to handle them correctly. Analytical analysis has revealed that North Carolina hops can produce the levels of alpha and beta acids expected within the industry.

**Alpha and Beta Acid Testing Results by Year and Laboratory**

| Variety               | White Labs<br>2011 | ASU 2012 | Alpha<br>Analytics<br>2013 | ASU 2013 | BioNetwork<br>2013 | Alpha<br>Analytics<br>2014 | Average<br>Range % |
|-----------------------|--------------------|----------|----------------------------|----------|--------------------|----------------------------|--------------------|
| Cascade Alpha Acid    | 4                  | 1.2      | 5.2                        | 3.4      | 4.2                | 4.4                        | 4.5-7              |
| Cascade Beta Acid     | 2.6                | 0.9      | 4.5                        | 3.2      | 4.4                | 4.5                        | 4.5-7              |
| Nugget Alpha Acid     | 8.9                | 9.5      | 12.1                       | 6.8      | 12.6               | 12.2                       | 11-14.5            |
| Nugget Beta Acid      | 2.8                | 4.8      | 4.7                        | 2.7      | 4.3                | 4.9                        | 4.5-5.5            |
| Chinook Alpha Acid    | 6.7                | .        | 8.1                        | 3.1      | .                  | 10.8                       | 10-14              |
| Chinook Beta Acid     | 1.7                | .        | 2.5                        | 1.7      | .                  | 3.2                        | 3-4                |
| Centennial Alpha Acid | 6                  | .        | 5.9                        | 3.3      | .                  | 4.5                        | 9.5-11.5           |
| Centennial Beta Acid  | 2                  | .        | 2.6                        | 2.7      | .                  | 2                          | 3.5-4.5            |
| Galena Alpha Acid     | 9.6                | .        | 6.8                        | 4.1      | .                  | 6                          | 10-14              |
| Galena Beta Acid      | 5.3                | .        | 5.5                        | 5        | .                  | 4.7                        | 7-9                |
| Magnum Alpha Acid     | 6.9                | .        | 8                          | 5.2      | .                  | 8.9                        | 13-15              |
| Magnum Beta Acid      | 2.6                | .        | 3.5                        | 3.6      | .                  | 4.1                        | 4.5-5.5            |
| Zeus Alpha Acid       | 5.5                | 4.9      | 6.1                        | 2.4      | .                  | 7.9                        | 13-17              |
| Zeus Beta Acid        | 3.8                | 3.6      | 4.1                        | 3.6      | .                  | 5.2                        | 4.5-5.5            |
| Mt. Hood Alpha Acid   | 3.9                | .        | .                          | .        | .                  | 2.8                        | 3-7                |
| Mt. Hood Beta Acid    | 4.1                | .        | .                          | .        | .                  | 4.9                        | 5-7                |
| CRV Alpha Acid        | .                  | .        | 6                          | 2.2      | .                  | 6.2                        | 2-5.5              |
| CRV Beta Acid         | .                  | .        | 7                          | 2.4      | .                  | 7.2                        | 5-6                |
| Santiam Alpha Acid    | .                  | .        | .                          | 3.2      | .                  | 5.1                        | 5-7.9              |
| Santiam Beta Acid     | .                  | .        | .                          | 3.6      | .                  | 7.3                        | 5.3-8.5            |

- Growers now average over one pound of wet hops per string with two or more strings per plant. Several are reporting producing 2 to 3 pounds per string. Many of the growers have expanded their hop yards, purchased hop harvesters, constructed dryers, and a few even have pelletizers. Growers who have established relationships with brewers report that they can sell all that they produce and are looking to expand their hop yards.
- Some of the notable hop growers in the state include:
  - Julie Jensen, Echoview Farm, Barnardsville, NC
  - Phillip Davis, Sticky Indian Hops, Candler, NC
  - Hop'n Blueberry Farm, Black Mountain, NC
  - Blue Ridge Hops, Marshall, NC
  - Steven Brown, Piedmont Hops, Chapel Hill, NC
  - Farm Boy Farms, Pittsboro, NC
  - Three Horses Hops, Saxapahaw, NC
  - Cedar Ridge Hops, Yadkinville, NC
  - Holmes Brothers Hops, Leicester, NC
  - Cardinal Pine Hops, Wilson, NC
  - Fool's Errand Farm, Laurel Springs, NC
  - New River Hops, Laurel Springs, NC

Activities that were completed in order to achieve the performance goals and measurable outcomes include:

- media, emails, personal visits, and phone calls.
- We have helped educate growers and brewers about the opportunities and challenges of hops production in North Carolina.
- We trained extension agents on how to assist growers.
- We have established a relationship with Sierra Nevada Brewery.

One of the objectives of this project was to initiate a long-term hops research and extension program. That has been accomplished. Four grant proposals were submitted during this project period to fund continuing efforts to develop the hops industry and continue the research. Two proposals were funded. One is a three year federally funded project in collaboration with Virginia State University. It will allow us to continue to modify and maintain the hops variety trial, continue a hops extension program, and offer three annual NC-VA hop conferences. The other proposal is an internal grant project with NCSU colleagues in Kannapolis and on main campus. It will allow us to explore alternative uses for hops as a natural product and to initiate a hops breeding program with a focus on overcoming the photoperiod limitations. The third proposal was a federal pre-proposal for an IPM project on hops in collaboration with Virginia Tech. We have been invited to submit a full proposal for that project. The fourth federal proposal in collaboration with other colleagues at Virginia Tech is still pending.

We have developed a relationship with Sierra Nevada Brewery that has already proved to be beneficial to growers and our research program.

We have met or exceeded all the stated goals and targets for this project. The field research, including hop harvests and lab analyses, was completed in the fall of 2014. A Beginning Hop Farmer Session, industry roundtable, and a NC-VA hops conference were held in Winston-Salem, NC in March. We were prepared for 200 attendees each day and were not able to accommodate everyone who wanted to attend. We videotaped the sessions and those will be posted on-line as soon as the volunteer professional videographer completes his edits. Here is a link to a local cable TV report on the hops conference:

<http://www.twcnews.com/nc/triad/news/2015/03/15/new-industry-spurred-from-breweries-opening-in-nc.html> . A research paper on this project is being written and a hops production guide is almost ready for review; photographs are being added to it before being submitted for internal review.

We demonstrated that hops can be grown commercially in North Carolina.  
We identified varieties that are reliable producers in North Carolina.  
We created and demonstrated cultural practices for successful hop production.

We have educated tens of thousands of growers and potential growers through conferences, workshops, field days, tours, website, blog, social

## **BENEFICIARIES**

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Hop growers and potential hop growers have benefited from the educational and research aspects of this project. The hop yard and educational materials will continue long after the project is completed.

Extension agents, state agronomists, and researchers in universities up and down the east coast have benefited from the work of this project. We are considered leaders in East Coast hops production.

An economic study was outside the scope of this project, but many of the growers are now reporting that they are making a profit from their hop operations. Craft breweries are purchasing all the quality hops the growers can provide. This industry is in its infancy, and these are all estimates and not hard figures. There are an estimated 40 acres of hops in North Carolina and expected returns for a mature yard are currently about \$18,000 per acre (wet hops), giving an annual return of \$720,000.

## **LESSONS LEARNED**

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This has been a very rewarding project to work on. As the first institution to start a hops project in the South, we are considered the leaders in the industry. This brings us into contact with many growers, brewers, researchers, and industry representatives, which in turn, provides us with more information for our growers.

Because of all the budget and staff cuts that occurred at the university over the course of these two hops projects, we have felt pressed for time staff wise. With this new reality in mind, if we had to do it over again, and as we move forward with new projects, we would budget more funds for 1) outreach-to hire someone part-time with the skills to build and maintain a website that could grow with the industry and 2) research-hire someone part-time to help write up the research.

This project helped move the industry in the Southeast along much faster than anyone anticipated.

We met and exceeded the goals set for this project.

As stated earlier, this has been a very rewarding project. Its popularity, however, made it a much more time consuming project than we anticipated. Kelly Gaskill and Jeanine

Davis could work on hops full time and not meet the demand the project and crop has generated.

## CONTACT PERSON

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Jeanine Davis  
828-684-3562  
Jeanine\_Davis@ncsu.edu

## ADDITIONAL INFORMATION

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Website with links to this project: <http://ncherb.org>,

PowerPoint on hops production:

[http://www.ces.ncsu.edu/fletcher/programs/herbs/2014%20Virginia%20Hops%20Davis\\_2\\_actual%20presentation%20given%20in%20Feb.pdf](http://www.ces.ncsu.edu/fletcher/programs/herbs/2014%20Virginia%20Hops%20Davis_2_actual%20presentation%20given%20in%20Feb.pdf)

Research posters links:

<http://www.ces.ncsu.edu/fletcher/programs/nchops/2012%20ASHS%20Hops%20Poster.pdf>

<http://www.ces.ncsu.edu/fletcher/programs/nchops/2014l.pdf>

News article and video from the 2015 NC-VA Hops Conference:

<http://www.twcnews.com/nc/triad/news/2015/03/15/new-industry-spurred-from-breweries-opening-in-nc.html>

Some of the hops blog posts:

<http://ncalternativecropsandorganics.blogspot.com/search/label/hops>

# NC-VA Regional Hops Conference: Bringing Hop Growers and Brewers Together

March 13 and 14, 2015

Winston Salem, NC



This event was organized by:  
Jeanine Davis, NC State University  
Stan Driver, Hoot 'n Holler Hops and Old Dominion Hops Cooperative  
Mary Jac Brennan, Forsyth County Extension

Thank you to our **Exhibitors** and **Sponsors**:



This conference is the finale of a four year hops research and extension project managed by Jeanine Davis and Kelly Gaskill at NC State University and funded by the Specialty Crops Block Grant Program, a USDA program administered by the NCDA&CS. You can learn more about this project on our websites at: <http://ncherb.org> and <http://www.ces.ncsu.edu/fletcher/programs/nchops>.

## Friday Schedule

- 1:00 Registration begins
- 2:00 Introduction: **Rita Pelczar**, Blue Ridge Hops
- 2:10 Piedmont Hops: **David Goode**, Piedmont Hops
- 2:40 Blue Ridge Hops: **John Wright**, Blue Ridge Hops
- 3:10 Break
- 3:20 The hop plant: **Rita Pelczar**
- 3:50 The trellis: **David Goode**
- 4:20 Harvest and handling: **Rita Pelczar**
- 4:50 Break
- 5:00 Hop economics: **John Wright**
- 5:30 Lessons learned and Q&A: All Speakers
- 6:00 End

## Saturday Schedule

- 8:00 Registration begins
- 9:00 Welcome: **Jeanine Davis**: researcher and extension specialist, NC State University  
**Stan Driver**, consulting grower, owner: Hoot 'n Holler Hops; founder: Old Dominion Hops Co-op
- 9:15 Building an Eastern Hops Industry: Lessons Learned in the Northeast:  
**Steve Miller**, Cornell Hops Specialist
- 10:15 Challenges Growing Hops in the Southeast and an Introduction to the Old Dominion Hops  
Cooperative: **Stan Driver**
- 10:55 Break
- 11:10 What it Costs to Grow Hops and Marketing and Selling Hops:  
**Devon Kistler**, grower: Huguenot Hops
- 12:00 Lunch
- 12:45 Sponsor presentations
- 1:15 Harvest and Post-harvest Guidelines to Provide Quality Hops to the Customer: **Steve Miller**
- 1:45 Hop and Brewing Research from NCSU and VT: **Sean O'Keefe**, brewing science researcher, and  
**Ken Hurley**, beer chemist: Virginia Tech, and **Jeanine Davis**
- 2:30 What Brewers Want When They Buy Hops:  
**Sean Lilly Wilson** and **Brian Mandeville**, Fullsteam Brewery
- 3:15 Break
- 3:30 Experiences Buying Hops from Local Growers: **Favio Garcia**, Lost Rhino Brewing
- 4:15 Panel discussion- All speakers
- 5:15 Wrap-up
- 5:30 End

**2015 Beginning Hop Growers Session  
Post Conference Survey**

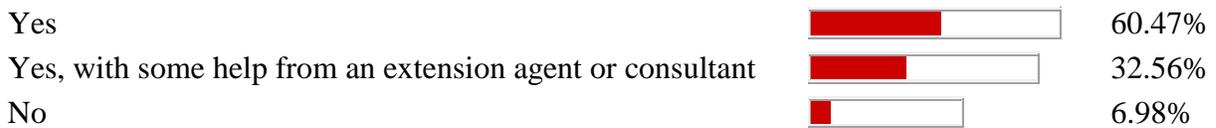
**The Beginning Hop Growers Session was designed and taught by three experienced hop growers. How useful was the information they presented to you?**



**Do you know more about what is involved in growing hops in the Southeast then you did before you attended the session?**



**Do you feel you have enough information to start a hop yard now?**



**Are you going to grow hops, or are you doing so already?**



**Would you recommend this session to other beginning hop growers?**



**This conference was designed to bring growers and brewers together so they could gain a better understanding of the needs and challenges each other**

**faces and work together to grow the industry. Do you think we met our objective?**



**Did you increase your knowledge about growing hops in the Southeast?**



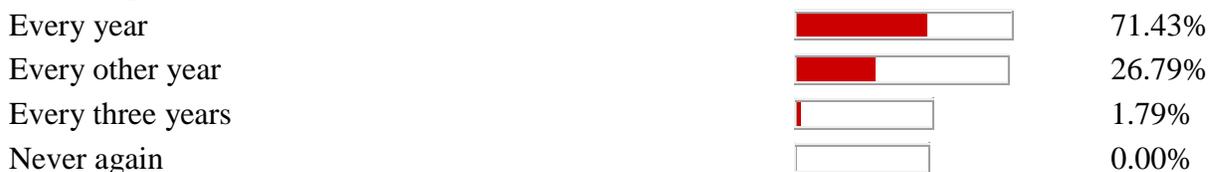
**Will the information you gained help you make decisions about growing hops, brewing with locally grown hops, selling products to growers or brewers, or advising growers or brewers?**



**Looking ten years down the road, do you think we will have an established commercial hops industry in the Southeast?**



**How frequently should we hold a conference like this?**



**Other Information Gained from the Post Conference Survey**

48% of the respondents were from Virginia  
 45% were from North Carolina  
 The others were from Tennessee, South Carolina, and Maryland

Acreage reported ranged from 1/8 of an acre to 2.5 acres.

#### Comments:

- I met some great contacts at the event.
- Helpful info presented on coops & shared equipment. Would be good to get more on technologies for irrigation/harvesting/processing.
- You should have the event in Virginia (Roanoke or Charlottesville) next time, and alternate in the future. If the industry grows as it looks like it will, a bigger venue will be essential.
- Thank you for the conference. Keep populating the NCSU site. Having "hop" on soil test kits is nice.
- More tips on hop harvesting would be helpful. The hops are much, much easier to grow and sustain vs. actually picking the hop flowers efficiently
- The class was very informative. Definitely improved my crop this year.
- I would like to have had a better discussion on the financial viability of starting / operating a hops yard. While I found the info helpful, I had a difficult time assessing how much time and resources are required to generate a certain level of revenues. While there are lots of variables, a realistic business plan separating fixed and variable costs would be helpful. What is the market to sell the product? How much might I make growing say one acre? The presenters tried to share information, but some of the details were buried in the fact that they do this in addition to other farming activities.
- Thank you for the survey and thank you for setting up the conference.
- Howdy! Holly Scoggins here. I don't want to skew your data with the trials yard, but if you want to include it, 1/2 acre by 2016. Please let me know how I can help with next year's conference. The past one was outstanding - I'm sure you're going to get overwhelmingly positive feedback.
- I thought the conference was well run and very informative. Very well done.
- I am currently growing 100 plants. The conference went into deeper details from experienced growers with good tips vs the info available on the web.
- Marketing info. Business license, taxes, grants, marketing options, chemical controls for disease, insect, weeds, packaging, pelletizing, storage.
- The information presented was somewhat disjointed. One presenter was saying that there was no good way to measure moisture content of dried hops without a lab while another provided a clear and easy at-home method. One presenter said "Grow what works - brewers will learn to accept it" while the brewers all said "If you charge too much or grow something we don't want we'll just go somewhere else."
- These general purpose meetings are fine for beginners, but not of much value to any grower with a year or more in the field. Need to distinguish between hobbyists and those seeking commercial operations.
- Thanks for taking on the "hops project" with a broad view towards the future of the industry.
- The conference convinced me to drop the idea of growing hops. I returned my grant money in hopes of getting it next year to apply it to my ginseng farm. The numbers on growing hops small scale do not add up. The demand for specialty hops is going

to have to be raised to the point where the price for them equals the work going into growing them. I did not talk to one person at the conference who was truly making positive money growing hops.

- Good conference.
- Live in Richmond, so biased towards something next time in that area. I actually thought Blacksburg/Roanoke would be a good location for next conf., but it wouldn't be any closer than W-S. Would like to see more collaboration with local breweries, etc.
- Just getting started and we are starting small.
- Great job all!
- I grow my hops differently than other folks.
- Please provide more product information on fertilizers, herbicides, and pesticides approved for hops.
- Stan should wear the hop cone outfit the entire conference and create a dance for our entertainment!
- We would like to see additional hop growers in southern Virginia.
- Would like to see the establishment of a NC Hops Cooperative similar to the Old Dominion Hops Cooperative.
- Maybe offer a class on hop disease and pests and how the organic and non-organic growers can deal with them.
- Great job with the conference!
- I plan on expanding my yard to three acres over the next five years.
- Growing for my own use. So far yields are not good enough for commercial.

Hops Roundtable Discussion-Summary  
March 13, 2015  
Forsythe County Extension Center  
Winston-Salem, NC

Present at the meeting:

- 1) Sean O'Keefe, Virginia Tech, Food Science Department
- 2) Catherine Maxwell, North Carolina Agricultural Foundation, NCSU
- 3) Julie Jensen, Echoview Farm, Hops Grower
- 4) Erik Myers, Brewer and President of North Carolina Brewer's Guild
- 5) Lee Galligan, John I. Haas, Hops breeders and growers, distributors
- 6) Brian Mandeville, Fullsteam Brewery
- 7) Sean Wilson, Brewer/Owner Fullsteam Brewery
- 8) Ron Fish, North Carolina Department of Agriculture and Consumer Services (NCDA&CS), Marketing
- 9) Favio Garcia, Brewer, Lost Rhino Brewing, Virginia
- 10) Nick Anderson, Brewer Lost Rhino Brewing, Virginia
- 11) Steve Brown, Piedmont Hops, North Carolina
- 12) Rusty Kuhfeld, Appalachian State University, Enology Laboratory and grower
- 13) Justen Dick, Kelly Ridge Farms, Virginia, grower
- 14) Ken Hurley, Virginia Tech, Enology Laboratory
- 15) Debbie Hamrick, North Carolina Farm Bureau
- 16) Bill Scruggs, Virginia Department of Agriculture and Consumer Services (VDAC), marketing
- 17) Suzy Trefsgar, Maple Spring Farm, Virginia, grower
- 18) Stan Driver, Old Dominion Hops Cooperative, grower Blue Mountain Brewery
- 19) Jeanine Davis, Department of Horticultural Science, NC State Univ.
- 20) Steve Miller, Extension Specialist, Cornell University
- 21) Laban Rutto, Alternative Crops, Virginia State University
- 22) John Bryce, Master Brewer's Association

**Discussion:**

**Why are so many farmers growing hops here?**

**What are the brewer and grower expectations?**

**What is the current status of hops production and processing in VA and NC?**

**What are brewers' interest in and use of local hops?**

**Summary:**

- Growers have numerous issues. Sustainability is number one.
- Developing the market and development of East Coast varieties compatible with conditions are also important.
- Fresh dried is better for testing and for brewing. Dried to 10% moisture content is the ideal and critical for brewing and testing. 55°C is the max temperature for drying and processing from bine to pellet.
- Combustion is a serious problem especially in bales. 0°C is best for storage.

Checking bales regularly is critical to prevent combustion.

- Oxidizing is a serious problem. Using nitrogen flushing when packaging should be done twice.
- Working directly with brewers is critical in use of fresh hops due to freshness and lack of preservation of product.
- Performing testing is critical to brewers and to the industry. The more information we have the better off we will be in sustaining the industry and providing a useful and profitable product for the brewing industry.

Agreed we should meet again and revisit these issues at least yearly.

Select Photos from the Project





## Table of Contents for NC Hops Production Guide

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**Project Title:** Investigating boxwood blight and its management

## Final Report

### PROJECT SUMMARY

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The purpose of this project was to develop integrated management tools to reduce the occurrence and spread of a new disease of boxwood in North Carolina known as 'boxwood blight' and caused by the fungus *Calonectria pseudonaviculata* (previously known as *Cylindrocladium buxicola*). Boxwood blight was first found in the United Kingdom during the 1990s and is now considered to be endemic throughout Europe. In the US, boxwood blight was first identified in North Carolina in October 2011 and rapidly acknowledged as a highly destructive disease of boxwood in the national ornamental production and landscape sectors. This disease was further identified across major boxwood nursery production regions in the eastern and western US and has been currently found in 18 different states and at least two Canadian provinces. The science-based research in this project has provided critical and valuable information for managing boxwood blight disease with fungicide and resistant varieties. The project has also provided insight on other plant species that may serve as potential hosts for the boxwood blight fungus in the nursery and landscape settings as well as information on the ability of fungus to produce spores and survive from season to season in absence of the boxwood plant. In addition, a webinar for improved dissemination of boxwood blight disease management information to the general public, growers, the ornamental industry, and stakeholders was developed and conducted.

### PROJECT APPROACH

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For this project, we proposed to 1) evaluate and identify best management practices for preventing and limiting boxwood blight disease using an integrated toolbox of management strategies that included fungicides, plant host resistance and cultural practices, 2) determine the environmental conditions that contribute to boxwood blight disease development and pathogen survival, and 3) to evaluate the susceptibility of plants closely related to boxwood to determine whether they could serve as potential hosts for the boxwood blight fungus.

### GOALS AND OUTCOMES ACHIEVED

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The primary goal of our research was to identify and demonstrate the most successful grower practices that prevent boxwood blight disease. In this project, we focused on investigating the use of plant host resistance and fungicides. Our research provided the first documented scientific evidence on the relative susceptibility of commonly grown commercial boxwood cultivars to the fungus in the US. For the experiments, we

simulated natural spread of the pathogen by artificially inoculating the plants on an outdoor shaded container pad to identify field resistance in 27 and 25 cultivars of boxwood in 2014 and 2015, respectively. A wide range of resistance was observed, but no cultivars were identified that were free of disease and had complete resistance (immunity) to the fungus. In general, the Asiatic types of boxwood expressed higher levels of partial resistance than others. For example, the cultivars and species *B. harlandii*, *B. microphylla* 'John Baldwin', *B. microphylla* var. *japonica* 'Green Beauty', *B. sempervirens* 'Dee Runk', and *B. sinica* var. *insularis* 'Nana' expressed field resistance, whereas the cultivars *B. microphylla* var. *japonica* 'Morris Midget', *B. sempervirens* 'American' and 'Vardar Valley' were susceptible. In the 2015 experiment, the boxwood cultivars *Arborescens* 31793, Baby Gem, Jim Stauffer, and Pincushion also expressed a high level of disease resistance. The results obtained from the field experiments were consistent with results from experiments conducted on detached branches in a humidity chamber under laboratory conditions and whole plants in a controlled environment chamber at NC State University to examine the basis of the observed resistance. Resistance in the cultivars *B. sinica* var. *insularis* 'Nana', *B. harlandii*, and *B. microphylla* var. *japonica* 'Green Beauty' was attributed to their minimal severity of disease, longer time for disease symptoms to appear (incubation period), and longer time for spores to be produced (latent period). The Asiatic cultivar *B. microphylla* var. *japonica* 'Morris Midget' had higher disease severity, shorter latent period, and higher spore production. The susceptibility of *B. sempervirens* 'American' was attributed to shorter incubation and latent periods, large lesion area, and high disease severity.

In this study, we also determined whether closely related species of plants other than boxwood (*Buxus*) were susceptible to and could serve as a host for the fungus *Calonectria pseudonaviculata*. The plant species examined included *Rhododendron* L. 'Nova Zembla', 'English Roseum' and *Pieris japonica* 'Mountain Fire', *Pachysandra* (Japanese spurge), and *Sarcococca* (sweet box). The fungus was capable of causing disease on *Pachysandra* but not on *Pieris* and *Rhododendron*. The results for *Sarcococca* suggest that the fungus can infect this plant under laboratory conditions, and possibly under naturally infected field conditions. In July 2015, we collected leaves that appeared to have disease symptoms from two species of sweet box (*S. humuli* var. *hookeriana* and *S. ruscifolia*) from plants growing in a commercial production field in North Carolina with a history of boxwood blight disease. We are currently continuing this research beyond the term of this project to determine if the boxwood blight pathogen is causing the observed disease symptoms on sweet box.

To develop strategies for rapid response to this newly emerging disease, we evaluated commercially available fungicide in two separate experiments for their ability to reduce boxwood blight disease. For the first experiment, 22 fungicides were evaluated as a preventive treatment for managing boxwood blight disease. The second experiment evaluated and compared the eight most effective chemistries as preventive (prior to infection) and curative (after infection occurred) applications for the management of boxwood blight based on the results from experiment one. The results from the two experiments suggest that the fungicides Strike Plus, Daconil WeatherStik, Concert II

Spectro, and Disarm C were effective in managing boxwood blight when applied before the plants were exposed to and infected with the pathogen. However, none of these fungicides provided acceptable levels of disease control when applied after initial infection by the fungus (curative activity). Research in the future will need to focus on the length of time between fungicide applications and use of weather-based disease forecasting models to predict the timing of fungicide application for managing boxwood blight disease.

In addition to documenting the effectiveness of fungicides and plant host resistance strategies for managing boxwood blight disease, we conducted research to better understand how the boxwood blight fungus survives from season to season in diseased leaves on the surface of the soil and soilless potting mix. The pathogen *C. pseudonaviculata* forms survival structures called microsclerotia in diseased leaves and stems that serve as a source of inoculum by producing spores for future disease epidemics. Survival of *C. pseudonaviculata* was investigated within infected leaves placed on the surface or subsurface (5 cm) of field soil or soilless potting media for two years from September through May in 2012 to 2013 and in 2013 to 2014. Throughout the duration of both field experiments in 2012 to 2013, the percentage of leaves with spores was reduced for leaves on the surface compared to the subsurface. Additionally, in 2013 to 2014, results from both experiments indicated that the percentage of leaves with spores and microsclerotia were greater for leaves from the subsurface treatments compared to the surface treatments. There was a statistically significant correlation between the percentage of leaves with spores and microsclerotia. These results demonstrate that *C. pseudonaviculata* can survive over the winter in infected leaves in boxwood production fields in western North Carolina. During this project, we also determined the inherent genetic diversity and variation in spore production by three naturally occurring field isolates of *C. pseudonaviculata*. Preliminary results suggest that spore production conditions vary among isolates and may need to be optimized for each strain. Also, we observed that the resulting fungal colonies that formed from single spores sampled from infected plants in the field varied in appearance. To mitigate the effects of this genetic variation, we developed methods for producing spores in the laboratory that can be used by extension agents and researchers for future field experiments to evaluate management practices.

The **primary GOAL** of this research was to identify and demonstrate efficacy of commonly deployed practices that involve the use of fungicides and/or host plant resistance to effectively manage boxwood blight disease. Our **TARGET** in this project was to provide science-based information and best management practice recommendations to the North Carolina Nursery and Landscape Association and North Carolina Department of Agriculture and Consumer Services (NCDA&CS) for their use in the new NCPlants program, which was developed in response to boxwood blight disease to better support the ornamental industries in North Carolina. This was accomplished with the assistance of Michelle McGinnis by determining the number of nurseries in North Carolina under the optional NCPlants compliance agreement and working closely with associated members of the NCDA&CS Plant Industry Division to

provide tailor made approaches for the NC ornamental industries. According to our assessment metrics, greater than 90% of the boxwood growers in North Carolina have adopted our recommendations for best management practices to reduce the occurrence of boxwood blight disease. **The second GOAL** of this project was to provide outreach to both growers, horticultural professionals and stakeholders who work with the nursery industry in North Carolina and around the US about the best management practices we developed using several resources that included NCSU Elluminate (or similar software), webinars, presentations at grower meetings and expositions, and development of on-line fact sheets. Success (**performance**) was measured by determining the number of audience members present during each outreach point. Statistics using the golinks feature at NCSU ([www.go.ncsu.edu/](http://www.go.ncsu.edu/)) and Google Analytics allowed us to track the number of hits. We were able to achieve our proposed target to reach more than 500 growers throughout North Carolina and the US to accomplish our goal, objective and benchmark for this component of the project. To date, the webinar site currently has received over 3600 hits [http://go.ncsu.edu/box\\_blight\\_webinar](http://go.ncsu.edu/box_blight_webinar) from 1 January 2013 to 30 June 2015.

For this project, we published three peer reviewed journal articles, two trade and professional magazines articles, three abstracts and one thesis. We are currently in the process of submitting two additional journal articles in fall of 2015. Results from the project were presented at 10 grower's meetings and five scientific conferences. The project provided training for one undergraduate and one graduate students. The project also generated valuable information from the webinar and provided additional information to boxwood growers, extension agents, producers, specialists and stakeholders.

## **BENEFICIARIES**

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For this project, the primary beneficiaries were extension agents, growers, homeowners, landscapers, landscape architects, and stakeholders in North Carolina. In addition, the beneficiaries extended beyond the borders of North Carolina as many non-profit and for-profit organizations such as the National Arboretum, Longwood Gardens, and the Mount Vernon Estate were concerned about the introduction of this pathogen into their historical colonial gardens. Prior to initiating this project, there were no mechanisms for rapid and timely dissemination of science and research-based information on the management of boxwood blight disease in a timely manner. There was also a sense of urgency associated with boxwood blight disease since the nursery and landscape sectors of North Carolina were not well informed to reassure their clients and stakeholders about the health of NC produced boxwood plants to effectively market and sell their plants. The resources, webinars, and on-line fact sheets developed as a result of this project now provide this information to boxwood growers, extension agents and producers associated with the industry in NC. There were more than 3600 hits on the boxwood blight webinar as defined by golinks and Google Analytics from 1 January 2013 to 31 June 2015, which has received national and international attention. We also

provided an opportunity for growers and people associated with the ornamentals industry to observe boxwood cultivars used in our experiments. Based on our results we can confidently recommend boxwood cultivars that express high levels of disease resistance to boxwood blight disease. However, some of these resistant cultivars may be sensitive to periods of cold weather commonly encountered by growers in western NC.

## LESSONS LEARNED

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The science-based research information generated as a result of this study has provided tools for boxwood growers to manage blight disease with fungicides and resistant cultivars. However, a more comprehensive understanding of the biology of the fungus at different stages of boxwood production is needed, particularly during propagation of cuttings and growing mature plants in the nursery or landscape. The results of our survival studies also suggest that other cultural management strategies need to be integrated with the use of fungicides and resistance cultivars. While conducting our experiments, we often observed boxwood leaves with inconspicuous disease symptoms manifested a small black spots on the leaves and stems that went unnoticed by growers. Further studies are needed to determine if the fungus can survive in the leaves and stems of actively growing boxwood plants treated with fungicide that are not expressing disease symptoms. Boxwood plants with inconspicuous or no symptoms may serve as a mechanism for the fungus and disease to spread to other boxwood production region in and outside of North Carolina. In this project, we had hoped to assess the economic impact of our research for growers that deployed the use of fungicides and/or resistant cultivars, but metrics were not available to develop these statistics.

## CONTACT PERSON

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Marc A. Cubeta  
(919)-513-1227  
macubeta@ncsu.edu

## ADDITIONAL INFORMATION

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### a) Thesis

Ganci, M.L. 2014. Investigation of Host Resistance in *Buxus* Species to the Fungal Plant Pathogen *Calonectria pseudonaviculata* (= *Cylindrocladium buxicola*), the Causal Agent of Boxwood Blight and Determination of Overwinter Pathogen Survival, Master of Science Thesis, North Carolina State University, Raleigh, NC.

## **b) Peer-reviewed publications**

Ivors, K. L., Lacey, L. W., Milks, D. C., Douglas, S. M., Inman, M. K., Marra, R. E., and LaMondia, J. A. 2012. First report of boxwood blight caused by *Cylindrocladium pseudonaviculatum* in the United States. *Plant Disease* 96:1070.

Ivors, K.L., Lacey, L.W., and Ganci, M.L. 2013. Evaluation of fungicides for the prevention of boxwood blight, 2012. *Plant Dis. Manag. Rep.* Online publication. doi: 10.1094/PDMR06.

Ivors, K.L., Milks, D. C., Lacey, L.W., and Ganci, M.L. 2013. Evaluation of fungicides as preventive vs. curative applications for the management of boxwood blight. *Plant Dis. Manag. Rep.* Online publication.

## **c) Conference proceedings and abstracts**

Ganci, M.L., Ivors, K.L., and Benson, D.M. 2013. Susceptibility of commercial boxwood cultivars to *Cylindrocladium buxicola*, the causal agent of box blight. *Phytopathology* 113:434-P (abstract).

Ganci, M.L., Ivors, K.L., and Benson, D.M. 2013. Field and laboratory evaluation of resistance to boxwood blight in *Buxus* cultivars. *Phytopathology* 114:91-O (abstract).

Ganci, M.L., Benson, D.M., LaMondia, J.A., and Ivors, K.L. 2014. The show must go on: Boxwood and beyond. *Phytopathology* 114:106-S (abstract).

## **d) Trade journals and websites**

Ganci, M.L., Benson, M., and Ivors, K.L. 2013. The Trojan Horse experiment. Understanding reservoirs of boxwood blight inoculum. *Nursery Management* <http://www.nurserymag.com/Author.aspx?AuthorID=6424>

Ivors, K.L. 2013. Fungicides for the Prevention of Boxwood Blight. <https://www.youtube.com/watch?v=9F1rzbVq-DQ>

## Project Title: Sweet Potato Micronutrient Additives

### Final Report

#### PROJECT SUMMARY

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The purpose of this project was to increase the existing nutrition knowledge of sweet potato in children and adults. When people learn of the excellent nutritional profile of sweet potato, they often consume more of this crop. New scientific research on sweet potato nutrition, new processing method development, and new value-added products provide opportunities for informing the public and the press about the nutritional value of sweet potato.

Sweet potato is a rich source of vitamin A/beta carotene and a good source of vitamin C and high in some minerals. However, the nutritional contribution of sweet potato to some products or diets could still be improved if additional nutrients were supplied through restoration, fortification, or enrichment. A goal of this project was to enhance the existing scientific data through new formulations of sweet potato flour, first to create an enriched sweet potato flour, and second, to use sweet potato flour as a base for a vitamin-mineral mixture that can fortify other foods. Enriched sweet potato flour could be substituted for enriched wheat flour in baked goods and other products and provide the same level of thiamin, niacin, riboflavin, folate and iron, so there would be no need for manufacturers to change the label. The second concept created a fortified product that could be used in a meal packet. The aim of this new product was to increase the marketing options for sweet potato. The scientific ground that was broken in this project was the foundation of a marketing plan based on innovation and product differentiation in a low cost fortified product.

The project's main goal was to expand value-added uses of North Carolina's sweet-potato crop and create fortified sweet potato flour with several **specific aims**:

- Low-level fortification can supply comparable micronutrient fortification to other enriched grains and flours.
- Higher levels of fortification can be the base for product fortification, such as an ingredient that could be used in a meal packet for different organizations that are fighting against global hunger.
- Extend existing knowledge to determine whether the endogenous nutrient packaging in sweet potato eliminates adverse chemical interactions between pro-oxidant and anti-oxidant micronutrients.
- The final aim of this project was to expand the utilization and market for sweet potatoes in a processed form. The scientific results of this project focus attention on the excellent nutrient profile of sweet potato and the nutritionally improved sweet potato flour to serve as a strategy for market expansion based on innovation and product differentiation in a low cost fortified product.

There were three major beneficiaries the outcomes of this project:

- 1. The sweet potato industry in general;
- 2. Organizations that strive to end world hunger with the meals packets;
- 3. The consumers of the meals and food products.

A new sweet potato processing plant based on microwave pasteurization (Yamco, Snow Camp, NC) and a production facility for sweet potato fries and wedges for restaurants (Conagra Foods Lamb Weston Division, Delhi, LA) were indicative of the employment growth associated with this crop at the time of the application. We recognized that further potential growth in the sweet potato processing industry could be associated with sweet potato flour production. A further 1% increase in sweet potato sales that might come from improved marketing of the nutritional benefits could add nearly \$2 million to this sector of the N.C. agricultural economy. The profits, jobs, and the multiplier effect on the economy of local communities where the value-added processors are located would be even greater. We needed to address the issue of sweet potato flour micronutrient fortification before major commercial production of this product commenced. A commercial processing plant for sweet potato juice and flour will be opening in the next few months.

We were also interested in the use of sweet potato flour as a carrier for micronutrients to fortify foods supplied by relief agencies in developing countries and disaster areas. Our work in this area has led us to a collaboration with the International Potato Institute (CIP) for development and nutritional testing of sweet potato based bread and biscuits.

No previous SCBGP funding had been received.

## **PROJECT APPROACH**

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Sweet potatoes are a versatile food security crop ranked among vegetables with the highest in nutritional value available in the United States and worldwide; they are known to be rich in nutrients that include carbohydrates, protein, fiber, beta-carotene, vitamin C, E and anthocyanins and contain significant iron and zinc. Sweet potato flour (SPF) was derived from this nutrient-rich crop using simple processing methods.

This study was designed to modify SPF by fortification to be equivalent to enriched wheat flour in micronutrients. For the purpose of this project the Covington variety was used to produce the SPF. Selected sweet potatoes were stored in a refrigerated room maintained at 15 °C. The sweet potatoes were selected and cleaned in order to eliminate all the dirt. All damaged portions were removed to increase the quality in the process. Upon completion of the selection process the sweet potatoes were cleaned by washing them with tap water and brushing them gently. This was done carefully to avoid breaks on the skin of sweet potatoes.

Sweet potatoes were cut into thin slices with a semi-automatic slicer (Presto PS-10 Eau Claire, WI) with the blade at 3 mm (0.11 inches). There was no need to peel the

potatoes as the skin of the sweet potato was extremely thin and contributes to the low glycemic index of sweet potato.

The slices or chips were dehydrated in an industrial cabinet dehydrator. This cabinet was manually constructed and dehydrated at a temperature of 60 °C for 12 hours. A built-in hammer mill for milling grain with a #14 screen was used to crush the chips into smaller pieces. The end product was similar to a powder with 4.72% moisture. For analysis, the flour-like product was further ground with the use of Foss™ Tecator™ Cyclotec™ model 1093 Sample Mill (Eden Prairie, MN) designed for uniform grinding with a mesh screen of 0.24 mm (0.009 inches). Sweet potato flour (SPF) was stored at -80° C to avoid enzymatic and chemical degradation, which could result, in a visible loss of color due to the transformation or loss of the conjugated double bond structure of beta-carotene.

Vitamin content analyses for thiamin, riboflavin, niacin and folic acid was determined in pre- and post-fortified SPF using VitaFast® Thiamin, VitaFast® Riboflavin, VitaFast® Niacin and VitaFast® Folic Acid assay kits (Sigma-Aldrich, St. Louis, MO) and compared with enriched wheat flour. Microtiter plates coated with specific microorganisms that require a supply of each vitamin in their growth media and vitamin standard solutions were supplied in each kit.

Data were analyzed with a 4-parameter equation from RIDA®SOFT or using the linear portion of the curve for microbial growth, which relates the light absorption by the bacterial suspension to vitamin content. The quantity of iron was analyzed by an acid digestion of the sweet potato flour followed by atomic absorption. Results showed between 0.51 mg and 0.66 mg/100 g of thiamin; 0.48 and 0.848 mg/100 g of riboflavin; from 1.54 to 1.60 mg/100 g of niacin; 6.00 µg of folic acid and between 3.5 to 5 mg/100g of iron. Data provided 100% recovery of expected amounts for thiamin and riboflavin in sweet potato flour based upon the USDA Nutrient Database published values for baked sweet potatoes. The lower folic acid and iron values in SPF were expected based on previously published analysis in baked sweet potato. These results show that the amount of niacin (B<sub>3</sub>) that should be added to SPF to make a fortification level comparable to enriched wheat flour is 4 mg/100g; 0.15 mg/100 g additional fortification is needed for folic acid, and 0.5 mg/100g of iron. Sufficient recovery of thiamin and riboflavin show that there is no need to fortify with these vitamins. Further research is needed to ensure that these vitamins will be stable in SPF during processing, storage, and baking conditions

The SPF produced in this manner is a nutrient-rich, shelf-stable product that can be further improved with nutrient fortification. SPF was prepared in a pilot plant and then analyzed for several important nutrients. The second phase of this project included design of a prototype product that incorporated sweet potato flour as the base for instant noodles. These noodles were made by blending SPF with soy and mung bean flours and xanthan gum (as a cohesive ingredient) and can potentially provide the base

for a malnutrition-preventing food to be produced locally by relief agencies, especially in regions where these ingredients are locally available.

Disaster relief may require long-term feeding of nutrient-balanced food products. Recipients complain of lack of variety and little autonomy if ingredients are not those produced locally and familiar. The high levels of carbohydrates and  $\beta$ -carotene, in some varieties, and wide geographical distribution allow sweet potatoes to be used as a functional ingredient in dehydrated products. The purpose of this study was to develop a new malnutrition-preventing food product using ingredients commonly grown in tropical countries for use by relief agencies in disaster situations. After creating the sweet potato, soy, and mung bean flour-based instant noodle product, chemical changes in an accelerated shelf life study were recorded. The noodles were stored up to 5 weeks at 28, 35, 45 and 55 °C. Statistical analysis showed decreases in protein ( $P = 0.0027$ ), lysine ( $P < 0.001$ ), water activity ( $< 0.0001$ ), moisture content ( $P < 0.001$ ), compressive load ( $< 0.0001$ ), and  $\beta$ -carotene ( $< 0.0001$ ). The initial protein concentration of 20.7% decreased by 1.2% per week. Initial  $\beta$ -carotene concentration of 12 mg/kg decreased by only 0.4 mg/kg per week in noodles made with defatted soy flour and by 1.0 mg/kg per week in a higher fat formulation. Although these components were not stable over the testing period most of the change occurred between weeks 3 and 5. Fat content, compressive extension and measurement of L, A and B color seem to remain stable over time ( $P > 0.05$ ). The ingredients for these noodles are produced in many disaster-prone countries; therefore, the product can be easily manufactured and distributed within a 3-4 week shelf life. Using sweet potato as an ingredient in a new malnutrition-preventing food product using ingredients commonly grown in some tropical countries for use by relief agencies in disaster situations was shown to be a viable way to improve their food insecurity status.

One issue with the use of SPF as the base for a relief agency food product is the relatively low protein content of most sweet potato relative to dietary requirements and calories. Many protein sources are expensive relative to the other ingredients used in relief foods. Entomophagy is the human consumption of insects and arachnoids as food and is predominantly practiced in Africa, Asia and South America. Insect nutrient analysis shows them to be high in fat, protein, vitamins, fiber and minerals (including copper, iron, magnesium, manganese, phosphorous, riboflavin and zinc). Insects are a good alternative to traditional animal protein sources. To produce an insect based high protein ingredient for our extruded noodle product, we bred and grew mealworms, *Tenebrio molitor*, which can be a sustainable ingredient due to the fact that they can be bred quickly, at low cost, and with few unwanted safety variables. The mealworms were dried and ground into a powder or flour. The extruded noodle was composed of mealworm flour (MWF), highly fortified sweet potato flour (SPFF), vegetable shortening, xanthan gum and water, which were all mixed together to create a dough-like product that was then dehydrated and extruded into a spaghetti noodle. The sweet potato flour was fortified, by pre-mixture fortification, to 100% of the DV for vitamins B3, folic acid and iron so that our product could be high in all micronutrients. The extruded noodle product was mixed with other ingredients to create a highly nutritious trail-mix like

product (called Mighty-Mix), particularly high in protein and caloric content, which could be used by meal relief agencies to prevent malnourishment in areas of food deprivation and distress. Mighty-Mix is made up of 3 main components: the sweet potato and mealworm based extruded noodle, peanuts, and dehydrated banana chips.

In making the fortified sweet potato flour for this product, we start by cleaning 5 kilograms of sweet potatoes, which is done by rinsing the potatoes with water and gently scrubbing, if necessary. Since the skin of sweet potatoes is so thin, we decided to leave it on to minimize waste. We then slice the potatoes using a Presto Deli Meat P-12 Slicer with a 12-inch blade and dehydrate the slices at 60 degrees Celsius (140 degrees Fahrenheit) for 12 hours. This yields about 1 kilogram of dehydrated chips or 20% of the initial mass. After dehydration, we ground the dried chips using the Robot Coupe Blixer 3 Series D grinder. The chips are ground several times in order to make the flour as fine as possible so that grittiness is minimal. Once this is complete, the flour is fortified. Since the proportions of vitamins B<sub>1</sub> and B<sub>2</sub> are equivalent to that of enriched wheat flour we did not add any more of these two vitamins, but instead added vitamin B<sub>3</sub>, folic acid and iron. We first mix these levels of nutrients into a 100-gram sample of the ground flour and once thoroughly mixed, we then mix this 100 gram highly fortified mix into the whole 1-kilogram sample of sweet potato flour. This process ensures that all of the flour is equally fortified. Once fortification is complete, the flour is stored in a freezer at -80°C.

In the fortification process, the sweet potato flour was fortified to supply 100% of the recommended daily values of vitamin B<sub>3</sub>, folic acid and iron for a 2,000-kilocalorie diet. Five kilograms of whole sweet potatoes were dehydrated to yield 1.0306 kilograms of dehydrated sweet potato chips, or 20.612% of initial weight. After the sweet potato chips were ground into flour, we calculated the desired amounts of vitamin B<sub>3</sub>, folic acid and iron that needed to be fortified into the flour in order to achieve 100% fortification. We calculated the levels of micronutrients needed in a 15-g portion of trail mix to be 20 milligrams vitamin B<sub>3</sub>, 400 micrograms folic acid and 18 milligrams of iron. We then multiplied these values by 66.7, which is the number of 15-g portions in 1.0 kg. We then weighed out a 100-gram sample of the sweet potato flour and the required micronutrients. We poured the measured flour and micronutrients into the Kitchen-Aide Food Mixer and mixed the ingredients until all of the micronutrients were fully mixed into the flour. After the micronutrients were fully mixed into the 100-gram premix, we added the 100-gram micronutrient rich sample into the remaining 900-grams of flour that had not yet been fortified and mixed this flour so that all micronutrients were mixed well and dispersed evenly. After fortification, the sweet potato flour was stored while the mealworm flour was made.

Mighty-Mix is a nutrient dense, high calorie, high protein, trail-mix like product that uses entomophagy (the consumption of insects) to create a shelf-stable meal-relief product that can be used in global areas of food deprivation or distress. Mighty-Mix includes three components: an extruded snack derived from the mixture of sweet potato and mealworm flours; dry roasted peanuts; and dehydrated banana chips dusted with

mealworm powder. Peanuts (*Arachis hypogaea* L.) are one of the most widely used and available legumes in the world; they were included to increase density and caloric content. Bananas and plantains (cultivars of the genus *Musa*) are also one of the major fruit crops in the tropics and subtropics. The cost of 1 serving of Mighty-Mix was \$0.56 when worms were bred on-site. Mighty-Mix satisfies the guidelines according to Food & Agriculture Organization (FAO), for products to target the Prevention of Moderate Acute Malnutrition (MAM).

The use of sweet potato fortified flour (SPFF), as a major ingredient; in combination with white rice (WRF), potato (PF) and soy flour (SF) can create a gluten-free bread (GFB) with acceptable organoleptic characteristics and a higher protein level than the ones currently found in the market. This project developed and analyzed some of the physical characteristics of 10 different breads with different proportions of the above-mentioned ingredients. A focus group of twenty people helped create the product concept and evaluated parameters such as general acceptability, color, mouth-feel and flavor. All breads were made with a Panasonic Bread Maker, Model SD-YD250. Bread color for different treatments, was measured with Hunter Lab D25L optical colorimeter equipment to measure the variables  $L^* a^* b^*$ . Bread texture was measured with an Instron 5542 universal testing machine according to AACC method 74-09. The analyses were conducted on all formulations after reconstitution. Results indicate that the 3 treatments with the lowest volume correlated to the breads made with higher content of PF (60 g). The results for the analysis of color for L value showed no statistical difference between any of the treatments. The results for the color value a, indicate significant difference between some of the treatments. Focus group data showed one treatment that scored the highest for general acceptability:  $6.41 \pm 1.60$ , preference in terms of visible appearance evaluated by color:  $7.50 \pm 0.95$ , and overall flavor  $7.16 \pm 1.34$ . Treatment 3, which had the highest SPFF content, had the greatest loaf volume, but darkest color (lowest  $L^*$  value and less yellow  $B^*$  color). Treatment 3 bread also had the greatest compressive strength. The chosen formulation included 420 g of WRF, 120g of SPFF and 30g of PF and SF respectively; this combination of ingredients per 100 g allow a nutritionally superior bread with a protein content comparable to the one offer by wheat products. Our conclusion from this project was that SPFF adds to the baking quality of gluten-free breads

Contributors to this project in our department include; Sofia Feng, Graduate Research Assistant; Emily Strum, undergraduate honors researcher, Rini Basyamfar, Graduate Student Researcher; Ruth Watkins, Laboratory Manager; Dr. Van Den Truong, collaborator; Dr. Lisa Dean, collaborator; Rong Reynolds, USDA research technician. Technical assistance and use of facilities were provided by Dr. Mike Boyette, NCSU Department of Biological and Agricultural Engineering. Christofer Martinez was an undergraduate intern/honors research student from the University of Honduras who assisted with the research for the summer of 2014.

As a result of this project collaborative arrangements for future research have been developed with John Kimber and Nathan Holleman, Carolina Innovative Food

Ingredients, who are starting a production facility for sweet potato flour; and Dr. Tawanda Muzhingi, (CIP, Kenya) for testing of glycemic index in sweetpotato based breads and biscuits.

## GOALS AND OUTCOMES ACHIEVED

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The deliverables, or **measurable outcomes for this project** were projected to be:

- *Open access peer reviewed publications in the scientific literature on stability and shelf-life of nutrients in a) sweet potato flour enriched with micronutrients; b) a sweet potato-based micronutrient ingredient for development of nutritionally balance meals;*
    - A portion of our research has been published in a freely available M.S thesis, (Feng, Sofia. MS Thesis, Nutrition and Food Science (May 2015) Current Research Advances in Micronutrient Fortification on Sweet potato Flour and Development of an Affordable Nutrition Product, <http://www.lib.ncsu.edu/resolver/1840.16/10311>).
    - Additional papers for peer-reviewed journals are in preparation.
  - *Presentation of the results at the Institute of Food Technologists Annual meeting, attended by more than 10,000 scientists and industry professionals; and The NC SweetPotato Commission annual meeting and field days, attended by 100 growers and processors;*
    - Feng S., V.D. Truong, J.C. Allen. Nutrient fortification in sweet potato flour. Institute of Food Technologists Annual Meeting, Chicago, IL, July 13-16, 2013. 312-22.
    - Feng, S., Cai, Y, Basyamfar, R., Allen J.C. Sweet Potato-Soy-Mung Noodles: stability of nutrients in an accelerated shelf life study. Institute of Food Technologists Annual Meeting, New Orleans, LA, June 2014.
    - Feng, S. and Allen JC. Nutrient fortification of sweet potato flour. Oral presentation via Internet at, "International Conference on Nutritional Therapies against Lifestyle Related Disorders" held on May 29-30, 2014 at University of Agriculture, Faisalabad, Pakistan.
    - Emily Strum, Sofia Feng and Jonathan Allen, Ph.D Mighty-Mix: Using Bugs To Feed The World. Poster Presentation at NC State University Undergraduate Research Symposium, April 2015. {Winner of outstanding poster competition in College of Agriculture and Life Sciences}
    - Feng S, Martinez C, Allen JC. Utilization of sweet potato flour (SPF) in a gluten-free bread (GFB) formulation. Institute of Food Technologists Annual Meeting. July 13, 2015. Poster 066-135.
    - Feng S, Allen JC, Martinez C. sweet potato flour characterization: Relationship between particle size and thiamin content. Institute of Food Technologists Annual Meeting. July 13, 2015. Poster 066-121.
- Demonstrated Sweet Potato flour based noodles and breads at North

- Carolina Sweetpotato Field Day, September 18, 2014 at the Cunningham Research Station, Kinston, NC. Approximately 200 growers, processors, and scientists in attendance.
- Presented poster on Sweetpotato Noodle shelf life study at NC SweetPotato Commission Annual Meeting, Wilson NC, February 2015. Approximately 180 growers and board members in attendance.
  - Oral presentation by Sofia Feng on sweet potato fortification at Borlaug Summer Institute for international scholars, July, 2013, Purdue Univeristy, West Lafayette , Indiana.
  - Oral presentation by Sofia Feng on “Improving micronutrient fortification in NGO meal packages”, at 2013 Fulbright Fellows Global Food Security Networking Event, Nov 5, 2013. 80 international graduate students supported by the Fulbright Foundation from various US universities attended.
- *Citation of these publications in the consumer press and webpages aimed at sweet potato marketing or providing nutritional information to consumers;*
    - Mighty Mix project noted on NC State webpage and recognized at CALS Celebration of Teaching, April 28, 2015.
    - Mighty Mix project submitted to Institute of Food Technologists product development competition “Developing Foods for Developing Countries”
  - *One or more processors or co-packers that will make enriched sweet potato flours and/or the micronutrient fortifying ingredients for use in the meals for hunger relief organizations;*
    - Carolina Innovative Food Ingredients (<http://www.cifingredients.com>) is opening a large processing plant in Nashville, NC, in the Fall of 2015 for pressing sweet potato juice and producing flour with the remaining solids. After discussing our research progress with the Chief Operating Officer and vice president, we are contracting with them for product testing in comparison with our whole sweet potato fortified flour prototype.
  - *Continued year-to-year increases in sweet potato production and sales, using NC Department of Agriculture data.*
    - Sweet potato production increased 49% in NC for 2013 to 2014. Although the consumer market for fresh sweet potato is also increasing, such rapid increases highlight the need to be able to process and excess production, such as for flour, and create new market outlets. It is too early to tell if publication of our research will impact these long range trends.

- *The final aim of this project will be to increase child and adult nutrition knowledge and consumption of sweet potato, as well as expand the utilization and market for sweet potatoes in a processed form.*
  - Based on the expertise we developed in this project, we are collaborating with the International Potato Center office in Nairobi, Kenya, to test some sweet potato based breads they are developing to promote the consumption of orange sweet potato with higher levels of vitamin A in Africa.
- We accomplished research related to each of our objectives during the 2.5-year duration of this project. Most of our work focused on the fortification and application of sweet potato flour in bakery products.
- We did not interact extensively with the Stop Hunger Now organization after the first few months because they found a corporate donor that solved their micronutrient packaging problems a few months after we began this project. Our work on the Mighty Mix project could, in theory, be used by some of these organizations as a ready to use therapeutic food. We did establish a contact interested in marketing any proprietary RUTF we would produce.
- Data were presented to the research community through a published MS thesis, six oral or poster presentations at symposia or national meetings, and two undergraduate Honors papers.
- The project and its outcomes were presented to North Carolina sweet potato producers at their annual informational and educational meetings on 3 occasions.
- International recognition of this work occurred through presentations and contact developments in Indonesia, Honduras, Costa Rica, Pakistan, Kenya, Uganda, and Malawi.

## **BENEFICIARIES**

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- Potato producers will benefit from an increased demand for the product and an outlet for excess production or roots that are not of appropriate grade for the fresh market.
- Employees at the newly opening processing plant will benefit from our promotion of a sweet potato flour market.
- Our students benefit from the research, educational and financial support and opportunities from this project.
- Consumers will benefit by increasing intake of the nutrient dense sweet potato, or

greater availability of gluten-free bakery products.

- Carolina Innovative Food Ingredients were marketing their products at the 2015 IFT meeting. They reported significant interest but did not share any economic impacts. They plan to hire 69 employees in Nash County, NC, as soon as their processing plant is completed to commence processing the 2015 sweet potato crop.
- There will be a continued need to monitor the production and sale of sweet potato flour in comparison with canned and aseptically processed sweet potato puree.

## LESSONS LEARNED

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The demand for sweet potato flour, and hence, its contribution to the overall demand for the sweet potato crop, is high. We found significant interest in the sample products we developed for this ingredient by the sweet potato growers. Our characterization of the nutrient content of the flour and recommendations for micronutrient fortification was of interest to representatives of the food processing industry when we presented at the Institute of Food Technologists Annual Meetings and Food Expos.

Greater interest in the fortified sweet potato flour was due to its potential ability to lower glycemic index of bakery products and use as a principal ingredient in gluten-free bakery products, whereas we expected the micronutrient content to be the driving force. We conclude that the micronutrient fortification or restoration to match enriched wheat flour or enriched rice should be done routinely for this product, but marketing to the food industry and consumers can emphasize the other characteristics that are higher on the consumer needs listing.

In our work on products for use by international food relief agencies, we did not derive a clear target for the level of micronutrient fortification the product should supply. We developed a snack product that would meet the daily need for a few vitamins. The potential impact would be unclear if the consumers would have access to greater quantities of this snack as a substantial part of the diet; intake of multiple servings per day might result in an unbalanced diet. Thus, two-way exchange of information in the supply chain is needed to connect food product developers with those who manage the product distribution and consumption.

Overall, the project was a very positive experience for our program. It enabled use to train several student researchers who will bring a positive attitude toward utilization of specialty crops in US and international food industries and programs as they move into influential research or government career positions. Consumers of our products in taste

and acceptance panels were made aware of new ideas about sweet potato as a processed food ingredient. Negative aspects of the project involved unanticipated delays in various administrative procedures. We also expected the commercial sweet potato flour operation we collaborate with to become operable a year earlier than now seems likely. Had that occurred, we would have more real world data to present and less reliance on our lab-scale production. However, the additional planning and marketing time for this company has allowed us to have more in-depth conversations and to move forward in an additional collaborative arrangement.

## **CONTACT PERSON**

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Jonathan C. Allen  
919-513-2257  
jon\_allen@ncsu.edu

## **ADDITIONAL INFORMATION**

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# Mighty-Mix: Using Bugs To Feed The World

Emily Strum, Sofia Feng and Jonathan Allen, Ph.D.

Department of Food Science, Bioprocessing and Nutrition Science, North Carolina State University

## ABSTRACT

The biggest problem that people in food deprived areas experience is the lack of protein in the food that is available to them. Food aid programs work to solve this problem by distributing products that are highly nutritious in macro- and micronutrients, in particular high protein products. Insects are a good alternative to traditional animal sources due to their high protein content and low availability. Mighty-Mix is a nutrient dense, high caloric, high protein, shelf-stable product that uses entomophagy (the consumption of insects) to create a shelf-stable meal-replacement product that can be used in global areas of food deprivation or distress. Mighty-Mix includes three components: an extruded snack derived from the mixture of sweet potato and meshworm flour, dry roasted peanuts, and dehydrated banana chips dusted with meshworm powder. The extruded snack is a noodle shaped product made from a highly fortified flour (SPFF), which provides 100% of the DV for vitamins B1, B2, folic acid and iron, in combination with meshworm flour (MWF), natural gas, vegetable shortening and water. Sweet potatoes (*Ipomoea batatas*) are grown worldwide, even in regions of low soil fertility, so are considered a food security crop. Sweet potato flour (SPF) is a nutrient-rich, shelf-stable product made with simple processing methods and further improved with nutrient fortification (SPFF). Meshworm flour (MWF) is a powder derived from *Tenebrio molitor* Linnæus 1758 which were bred in lab, selected, and reared at 20°F for 7 years. Peanuts (*Arachis hypogaea* L.) are one of the most widely used and available legumes in the world; they were included to increase density and caloric content. Bananas and plantains (cultivars of the genus *Musa*) are also one of the major fruit crops in the tropics and subtropics. The cost of 1 serving of Mighty-Mix was \$0.56 when worms were bred on-site. Mighty-Mix satisfies the guidelines according to Food & Agriculture Organization (FAO) for products to target the Prevention of Moderate Acute Malnutrition (MAM). Furthermore, spices can be modified to account for cultural preferences. The goal of this project is to one day have Mighty-Mix dispersed by established agencies to help feed and nourish underserved communities all over the world.

## BACKGROUND

Entomophagy is the human consumption of insects and arachnoids as food and is predominantly practiced in continents such as Africa, Asia and South America [1].  
 • Insects are consumed because of their their beneficial nutritious aspects such as; high fat, protein, vitamins, fiber and minerals (including copper, iron, magnesium, manganese, phosphorus, riboflavin and zinc) [1].  
 • Mealworms, *Tenebrio molitor*, are a very sustainable ingredient due to the fact that they can be bred quickly in order to limit cost and unwanted safety variables. The original cost, when purchasing worms from internet suppliers, to produce one serving of Mighty-Mix was \$10.55; however when breeding the worms ourselves, we were able to cut the cost of one serving to \$0.56.  
 • During the breeding process, the worms start as larvae, 10 days later pupas begin to appear, 2 weeks after pupa development begins to appear and finally the beetles mate, which produces more worms. As seen in Figure 1 [2].



Figure 1. Mealworm Breeding Process

## PURPOSE

To produce a Trail-Mix like snack, using food technology and the practice of entomophagy, that is high in protein, highly caloric and high in micronutrient content that can be used as a ready-to-eat food for meal relief agencies.

## METHODS



Figure 2. Mighty-Mix Process

## ACKNOWLEDGEMENTS

• Dr. Jon Allen (Research Mentor), Dr. Keith Harris and Ruth Wilkins (for letting us use their equipment) and FS301 class for being participants in the sensory analysis  
 • USDA-NCSA Specialty Crop Block Grant 040100023713MST

## RESULTS

Table 1. Sensory Analysis (n=33)

| Mean of Analyzed Variables |       |
|----------------------------|-------|
| Appearance                 | 6.697 |
| Flavor                     | 7.388 |
| Aftertaste                 | 6.455 |
| Like/Distlike              | 7.948 |



Participants stated that the overall taste was good, but suggested we add salt or spices for additional flavoring.

8 participants ranked as 5 out of 10 and 8 participants ranked as 8 out of 10

Overall, most participants really liked the product and suggested that we add more color to make it more appealing to the eye

Appearance and Flavor (1= worst, 10= best), Aftertaste (1= no aftertaste or bad aftertaste, 10= aftertaste present or good aftertaste), Like/Distlike (1= Distlike, 10= Like)

Table 2. Analysis of Variables

|                    | Water Activity | Moisture Content |
|--------------------|----------------|------------------|
| Final Measurements | 0.306 ± 0.012  | 4.72%            |
| P-value            | < 0.0001       | < 0.001          |

P-values < 0.01: very significant

## Nutrition Facts

Serving Size 1 package (90g)  
 Servings Per Container 1

| Amount Per Serving     |                       |  |                |
|------------------------|-----------------------|--|----------------|
| Calories 450           | Calories from Fat 300 |  | % Daily Value* |
| Total Fat 35g          |                       |  | 81%            |
| Saturated Fat 11g      |                       |  | 58%            |
| Cholesterol 0mg        |                       |  | 0%             |
| Sodium 170mg           |                       |  | 7%             |
| Total Carbohydrate 18g |                       |  | 6%             |
| Dietary Fiber 8g       |                       |  | 32%            |
| Sugar 4g               |                       |  |                |
| <b>Protein 25g</b>     |                       |  |                |
| Vitamin A 130%         | Vitamin C 10%         |  |                |
| Calcium 4%             | Iron 10%              |  |                |

\*Percent Daily Values are based on a diet of other people's secrets. Your daily values may be higher or lower depending on your calorie needs: 2,000 2,500

|                    |                 |         |
|--------------------|-----------------|---------|
| Total Fat          | Less than 35g   | 80g     |
| Saturated Fat      | Less than 11g   | 25g     |
| Cholesterol        | Less than 0mg   | 300mg   |
| Sodium             | Less than 170mg | 2,400mg |
| Total Carbohydrate | 20g             | 310g    |
| Dietary Fiber      | 25g             | 75g     |

Calories from protein: Fat 0 • Carbohydrate 4 • Protein 4

Figure 3. Nutritional Label for Prototype

## DISCUSSION

• Because the values for water activity and moisture content are so low, microorganisms cannot grow which increases the shelf-life and makes Mighty-Mix a shelf-stable product; however, further shelf-life studies are required to determine the exact number of weeks/months for which our product is safe and has an acceptable quality.  
 • On average, the participants liked the product and found the appearance and flavor appealing.  
 • The participants suggested that we add more color to the product, change the shape of the noodle (which we decided against) and incorporate additional flavors/spices on a per cultural basis.  
 • In the sensory analysis, we found that the results for aftertaste were unclear and variable due to the ambiguity of the rating scale. Because of this, "aftertaste" could have been rated as having an aftertaste vs. not having a good aftertaste vs. a bad aftertaste.  
 • The nutritional label shows that Mighty-Mix is high in caloric and protein content, as well as high in fat and dietary fiber due to the 62 grams of noodles and the 28 grams of peanuts that makeup the product.  
 • The serving size is 90 grams, which although this seems like a lot, it is feasible for someone to eat this much in one sitting, especially a malnourished person.

## CONCLUSION

Mighty-Mix is a shelf-stable, highly nutritious product that can be produced and distributed all over the world through meal-relief agencies in areas that suffer from food deprivation or distress. Due to the combination of the many ingredients in our product, Mighty-Mix complements the guidelines set by the FAO for a product that can be used to prevent moderate to acute malnutrition due to its high caloric output and high protein and micronutrient concentrations.

## REFERENCES

[1] Food and Agriculture Organization (2012). The State of Food Insecurity in the World. Rome, Italy. <http://www.fao.org/docrep/012/i1200e/i1200e00.htm>  
 [2] Turpin, T. Personal Communication, September 2014.  
 [3] Turpin, T. (2008). What's Buggin' You Now? Bees, Knees, Bug Lines and Beetles. West Lafayette, Indiana: Purdue University Press.

**Project Title:** NC Watermelon Consumer and Trade Promotion

## **Final Report**

### **PROJECT SUMMARY**

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This Project helped increase the market size of NC Watermelons through a promotional program involving the North Carolina Watermelon Queen. The Queen program is a very active program involving qualified young women from North Carolina who compete in a rigorous program in order to become queen for a year. The queen program assists young women by preparing them to be role models and spokespeople through media training and other, similar training. By utilizing the queen in retail and other promotions the association will raise consumer awareness of North Carolina watermelons. The queen talked about the desirable traits of North Carolina grown watermelon, when it is available and where to find it. The project team up the North Carolina Watermelon Association with the North Carolina Department of Agriculture's (NCDA) Marketing Division in order to promote NC watermelons to North Carolina consumers and to domestic buyers at the Produce Marketing Association's annual trade show. Increasing consumer purchase will strengthen the economic vitality of the watermelon industry in NC. Increasing awareness of local producers helped sustain them into the future by building on national trends in which consumers like to buy food products from local sources. The project has seen continued and expanded participation in and sponsorship of annual North Carolina watermelon festivals. Such festivals are well attended and give consumers opportunities to learn about NC watermelon as to when it's in season, where available, and other, useful information about how to use and store the product. Consumers have the chance to sample watermelon and meet the Queen. No grant funds from other sources are being used for these projects.

### **PROJECT APPROACH**

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The NC Watermelon queen attended 35 events in 2013 and had a phenomenal year. Informal surveys of growers resulted in high levels of satisfaction for the season. A survey of buyers also resulted in a high rating of the queen's performance at various events.

The NC Watermelon queen attended 5 festival in 2013 and which resulted in a higher than normal interest in watermelons in NC. The festivals had approximately a combined attendance of 250,000 people. This exposure for the queen and the NC watermelon association was well worth the time and expenditure.

The PMA Fresh Summit was well attended for the watermelon growers. A booth was rented for the Fresh Summit held October 19-20, 2013 in Baton Rouge LA. There were several NC companies represented well over the 5 that usually attended. The Packer ad was to be done for the 2013 season. However, due to unforeseen circumstances the ad was not placed and growers agreed that the ad should be placed in 2014. The ad will reflect local growers and the cost will be divided between the growers (50%) and the grant funds (50%).

## **GOALS AND OUTCOMES ACHIEVED**

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**Goal 1)** To increase the number of activities involving the North Carolina Watermelon Queen promotional program. The queen will participate in activities at various retail and other venues and attend the PMA and National Watermelon Association trade shows and NC Festivals.

**Performance Measure:** Association staff will track the number of activities the queen participates in and survey retailers, venue sponsors, etc. as to their satisfaction with the events.

**Benchmark:** 2011 Queen Activities: 16: satisfaction and sales figures not measured in the past: establish baseline.

**Target:** 36 Queen promotional activities per year.

The NC Watermelon queen attended 35 events in 2013 and had a phenomenal year. Informal surveys of growers resulted in high levels of satisfaction for the season. A survey of buyers also resulted in a high rating of the queen's performance at various events.

**Goal 2)** To increase consumer awareness by 10% of North Carolina watermelon through participation in and sponsorship by NC Watermelon festivals.

**Performance Measure:** Festival organizers will be interviewed and festival participant numbers gathered.

**Benchmark: Baseline:** awareness information has not been gathered in the past. Establish baseline. Festival attendance: 2011: 7,000 plus attendees in 3 major events.

**Target:** Continual sponsorship and participation in festivals: Increases in attendance and awareness by 5-10% per year. Increase to 6 festivals and fairs per year.

The NC Watermelon queen attended 5 festival in 2013 and which resulted in a higher than normal interest in watermelons in NC. The festivals had approximately a combined attendance of 250,000 people. This exposure for the queen and the NC watermelon association was well worth the time and expenditure.

**Goal 3)** To increase trade awareness of NC watermelon through participation in the PMA Fresh Summit and through the use of cooperative advertising in the PMA Packer trade publication during the same week as the trade show. Approximately 24 watermelon producers will participate in the PMA show and attend a related buyer reception. 5 companies are expected to participate in the cooperative advertising program.

**Performance Measure:** Association staff will compile the number of participants in the trade show and in the cooperative advertising program. Participants will be surveyed as to the number of trade contacts and potential sales resulting from participation in the program.

**Benchmark:** 12 companies have participated in the past. Establish baseline on number of contacts from participation in the show and cooperative advertising.

**Target:** Participation in the PMA yearly by the NC Watermelon Association.

The PMA Fresh Summit was well attended for the watermelon growers. A booth was rented for the Fresh Summit held October 19-20, 2013 in Baton Rouge LA. There were several NC companies represented well over the 5 that usually attended. The Packer ad was to be done for the 2013 season. However, due to unforeseen circumstances the ad was not placed and growers agreed that the ad should be placed in 2014. The ad will reflect local growers and the cost will be divided between the growers (50%) and the grant funds (50%).

## **BENEFICIARIES**

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The North Carolina watermelon industry in 2010 generated an estimated \$24 million in farm income on 7,200 acres according to NCDA agricultural statistics reports. The recent economic downturn has had severe consequences on the industry and has negatively impacted the income of most of these producers through less spending on fresh produce items. This campaign should help stabilize this industry through increased consumer recognition of the value and health benefits on North Carolina watermelons resulting in increased sales of locally grown watermelons. It should also help to build awareness of and loyalty to North Carolina produce watermelons. There are over 600 farms in North Carolina that will benefit directly or indirectly from association activities, and the promotional campaign should contribute directly to their bottom line through increase recognition of North Carolina watermelons and related sales. The anticipated increase in sales will be at least 10% from all activities conducted through this grant.

In 2010 Watermelon growers averaged \$3,333.00 per acre grown. In 2013 the average per acre grown increased to \$3,725.00 which represents an 11.77% increase per acre. Although the numbers of acres decreased because of a rainy summer the average farm gate increased by the 11.77%.

## **LESSONS LEARNED**

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2013 was a wet summer in NC curtailed planting and harvesting of watermelons. Even though production was down per acre farm gate was up. If it hadn't been for the exposure at events such as the PMA and the Queen's promotion it could have been a disastrous year for NC Watermelon growers.

Even in a year with lower than average production it is necessary to maintain or increase marketing efforts to offset production losses.

The numbers of acres decreased because of a rainy summer but the average farm gate increased by the 11.77%.

## **CONTACT PERSON**

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Bonnie Holloman  
PO Box 58220,  
Raleigh, North Carolina 27658  
Phone: 919-782-3058  
Fax: 919-882-8533

**Project Title:** Mountain Wine Grape Growing Educational Initiative

## **Final Report**

### **PROJECT SUMMARY**

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This project was to provide an educational workshop to increase the technical proficiency of the wine grape growers and future growers, by the use of classroom instruction and provide hands-on experience.

Tobacco farmers, Christmas tree farmers and land owners looking for alternative crops are looking into wine grapes. There are no educational resources located within 75 miles of our area, teaching viticulture. The High Country is experiencing a rapid growth of wineries and there is a shortage of wine grapes grown in our area.

This project was not built on a previously funded project

### **PROJECT APPROACH**

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The class met 16 times, 14 meetings were class room lectures and guest speakers. The following topics were covered in the classes: vineyard site selection, wine grape and rootstock varieties, vineyard design and establishment, grape vine canopy management, crop yield estimation, grape vine irrigation, disease and insect management and spraying, and wine grape quality; when to pick? There were 2 field days, one for hands on grape vine planting and one for hands on pruning of grape vines. We had 21 students start the class, 18 finished the course. We had projected 30 students. We had 5 scholarships for cooperative extension agents but of the 3 starters only one agent completed the course. The final test results were a 85% average. The end of class survey indicated that 95% of the students stated they thought they learned something (survey attached), We learned, we should schedule weekly classes next time, instead of bi-weekly, five months were a little too long as we overlapped into the growing season. Everyone involved seemed to enjoy learning the materials and networking with other students and instructors.

The overall scope of this project benefitted only the specialty crop of wine grapes.

The High Country Winegrower's Association provided two people at each event and /or class to provide support to the instructors and students. The HC Winegrowers arranged for the meeting space, provided refreshments and arranged for member owned vineyards to be used for field days instruction.

### **GOALS AND OUTCOMES ACHIEVED**

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Thru the use of the workbooks (Wine Grape Production Guide for Eastern North America) the instructor and guest lecturers were able to provide students the most up to date information available. The class instructor, Gill Gisie made sure students understood the materials. Our instructor had been teaching viticulture as Surry Community College for the past ten years and knew how to motivate our students young and old. The guest speakers included Hans Walter-Peterson, Cornell, NY. He talked about growing hybrid wine grapes in New York and problems encountered and the future of hybrid wine grapes in the High Country. Speaker two, Molly Kelly, Virginia state enologist, she talked about producing high quality hybrid wines and conducted a blind wine tasting between Virginia and North Carolina wines. Our third speaker, Sara Spayd, NC state viticulturist, she conducted a two day inspection of area vineyards. She advised growers on spraying program for diseases and grape training systems.

Outcome measures in the long term were for the continual educational of the grape growers. This class was the first in a series of continual educational program.

We were able accomplish most of our goals, by providing primary background education to the wine grape growers. We did not have a projected increase in new farmers but we did expose some future farmers to the wine grape farming experience.

We did not achieve our desired outcome of a 75% increase in new vineyards, it was 25%. The membership goal of the HCWGA was 50% increase, but the number was 20%. Out of the 21 students to start the class, one was a cooperative extension agent, 10 were vineyard owners/workers and 10 were new to the industry. Out of the three students who did not complete the course, two were outside the industry and one a vineyard owner. All stated they did not have the time to complete the course. The major successful outcomes were that 10 members of the winegrape growers were willing to take classes to increase their knowledge of the industry. Ten new potential growers made the commitment to learn about growing wine grapes.

The major successful outcomes were the knowledge base of the current winegrape growers increased allowing the growers to work smarter and exposed 10 new potential growers to growing wine grapes properly.

## **BENEFICIARIES**

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The five wineries, the existing vineyard owners and workers, the future potential growers and the High Country Winegrower's Association, were all beneficiaries of the educational series by providing grape growing educational classes and hands on instruction. The existing vineyard owners are better informed and prepared to produce a better crop by learning the how, when and why. The potential new growers now know what to do and what varieties to plant and now have a network of buyers and growers established.

By providing the educational series to the existing winegrape growers, the knowledge acquired will allow the growers to increase yields by improved farming techniques and the use of hands-on training improved the day to day operations.

## **LESSONS LEARNED**

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We learned that classes should not be longer the 3 hours, and that we should do weekly classes not bi-weekly. We should advertise the class longer and more personal contacts with other farm groups whose members might be interested in attending.

We did not have any problems with the course of studies.

Our goals were a little lofty; we needed to lower our expected outcomes to a more realistic number.

We found that having a expert instructor and expert guest lectures created a professional college grade class experience for out students. Our only unexpected outcome was that we did not have more cooperative extension agents attend the classes even though the classes were free to them. Although most of our goals were achieved, our desirable outcomes were higher than could be reasonably expected.

Our budget was \$18,000.00 spent \$14,189.15 to accomplish our goals.

## **CONTACT PERSON**

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Robert Johnson, High Country Winegrower's Association

828-295-9831

[rojmail@bellsouth.net](mailto:rojmail@bellsouth.net)

## **ADDITIONAL INFORMATION**

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[www.highcountrywines.com](http://www.highcountrywines.com)

**Project Title:** Polk Fresh Foods Distribution Center

**Project withdrawn**

**A request to reallocate these funds to either an existing project or a new project will be forthcoming.**

**FUNDING**

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Total: \$0.00

% of Grant: 0%

**Project Title:** NC Specialty Crop Promotion Program

## **Final Report**

### **PROJECT SUMMARY**

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The purpose of this project was to increase the sales of NC fresh fruits and vegetables throughout the state and to increase awareness of the seasonality of produce. Most people (not-involved in agriculture) have a weak grasp on the seasonality of NC produce and how truly available it is for a relatively short time. The NC Department of Agriculture has a strong marketing presence. However, funds have become limited over the past few years and as such some areas of marketing have been reduced. This project enabled the marketing section to increase the presence and awareness of NC produce for the current season.

### **PROJECT APPROACH**

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The campaign centered mainly on advertising to the general public and thereby increase a demand for locally grown fruits and vegetables. The advertising consisted of print radio and TV to cover a substantial area of the state. The promotion mainly targeted the shoppers of the household encouraging them to buy NC fresh fruits and vegetables. A primary emphasis was on seeking these items at local farmers markets, roadside stands and local retailers. Most of the ads promoted the use of [www.ncfarmfrsh.com](http://www.ncfarmfrsh.com) as a way to find local growers near them. Furthermore, the analytics of this website proved to be a great method by which to track the success of the project.

### **GOALS AND OUTCOMES ACHIEVED**

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The primary benchmark for success of this project was an increase in sales from the previous year. There was an informal survey conducted among fruit and vegetable growers throughout the state. The results of the survey are very positive in that most growers had an increase in sales of 5%-10%, whereas some growers maintained sales even though they had a wet season that hurt some of their yields by up to 3% in a few circumstances. A secondary benchmark used to determine the effectiveness was analytics from ncfarmfresh.com website. In previous years the website averaged 3,000 visitors during the year with a small spike in the summer months. However, this year there has been a dramatic increase in the visits of the website. During the promotion months visits increased up to 6 fold with over 17,000 hits during the month of September alone. This is a direct correlation to the advertisement during this time frame.

### **BENEFICIARIES**

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The main beneficiaries are growers of fresh fruits and vegetables in NC. There are over 3000 growers of fresh fruits and vegetables in NC; with a majority of the growers harvesting between April and September. All of these growers have received a portion of the benefits of this project.

## **LESSONS LEARNED**

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That regardless of all planning and forethought into the project one must have some flexibility to take advantage of any potential opportunities that can have a positive impact on the project.

## **CONTACT PERSON**

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Kevin Hardison  
919-707-3123  
[Kevin.Hardison@ncagr.gov](mailto:Kevin.Hardison@ncagr.gov)