Farmer Rancher Grant Program

Final Report Form

Please fill out the final report form and post it on MySARE. If you do not have Internet access, return the form to the North Central Region-Sustainable Agriculture Research and Education (NCR-SARE) Missouri office. The report may be prepared on a computer or handwritten (please write or print clearly) but electronic reports are preferred. The final payment of your grant will be awarded when the final report and final budget report are received and approved.

Use as much space as needed to answer questions. You are not limited to the space on this form. The more details the better.

I. PROJECT IDENTIFICATION

- Name: Carolyn Orr
- Address: 6181 West State Rd 28
- City, State, Zip Code: West Lebanon, IN 47991
- Phone: 765-893=8209
- Website: http://strawridgefarm.us
- Project Title: Development of Cost and Labor Effective Produce Sanitation Methods for Small Farms
- Project Number: FNC 14-967
- Project Duration: two years
- Date of Report: 12.26.2015

II. PROJECT BACKGROUND

1. Briefly describe your operation (i.e. how many acres, what crops, types of cropping systems, type of livestock or dairy production, grazing systems, family operation, etc.)

We are a diversified family farm focusing on quality alfalfa and mixed hay, an embryo recipient cow herd and beginning in 2012, we purchased a 10,000 sq ft greenhouse that had been used for flower and vegetable starts. We converted the greenhouse into a hydroponic vegetable operation, experimenting with a variety of produce.

For our greenhouse, we have settled on early tomatoes for farmers markets and March to November English (seedless) cucumbers for a statewide distributor to white tablecloth restaurants.

2. Before receiving this grant, did you carry out any sustainable practices? If so, briefly describe what they were and how long you had been practicing them.

While sustainability has become a buzzword that some people might associate with organic, our view is that sustainability is a goal that one can make significant strides toward, regardless of production methods. Each farm has site specific issues that need to be addressed in an integrated fashion to produce a quality product while enhancing the environmental and natural resource base, sustaining the economic viability of the farm and improving the quality of life of the producers and their customers.

Sustainability needs to be a continual goal, making the most efficient use of all resources; natural, fiscal and human, while improving the base of each. We have continually strived to improve our natural resource base while increasing the quality of our output and our quality of life. We were enrollees in the first USDA- NRCS Conservation Stewardship Program, and have gone above and beyond all of the programs it provides. We use managed intensive grazing on legume improved pastures. We provide wildlife corridors, plants and grassways. We have converted all of our central Indiana corn ground into alfalfa and alfalfa-orchard grass hay ground. We use our cows as embryo recipients to maximize financial return from each calf. Calves from cows that don't take embryos are finished on pasture and locally grown corn and sold as freezer beef. We soil test, forage test and use the USDA Grazing Animal Nutrition Lab fecal analysis to match pastures and animal needs. We do not strive for organic production because our science training does not indicate that that method of production is the best for our cattle or crops.

When we bought the greenhouse, we felt it was better used for local food production than flowers and vegetable starts. Extensive research convinced us that hydroponic production was the best opportunity to maximize production with labor constraints and minimize environmental impact. Instead of using perilite, a glass based substrate for hydroponics used by most growers, we decided to use a coconut fiber based product that could be recycled and was less impactful on the environment in its production, essentially being a waster product of coconut production. The growing media we use is sustainability certified by VeriFlora, an agricultural sustainability certification and eco-labeling program recognized as the gold-standard in the floriculture and horticulture industries.

III. PROJECT DESCRIPTION

This is the core of the report. Consider what questions your neighbors or other farmers or ranchers would ask about what you did with this grant. Describe how you planned and conducted your research or education activities to meet your project goals and discuss the results.

GOALS

List your project goal(s) as identified in your grant application.

If you only sell at a farmers market, maybe you don't wash the produce. Some extension personnel even suggest that producers don't wash and most farmers markets post signage telling buyers to wash the produce. But farmers markets will not provide financial security and sustainability for every fruit and vegetable producer. And as a result of high profile foodborne outbreaks caused by contaminated fruits and vegetables and the pending FDA Food Safety Modernization Act regulations, increasingly distributors, stores and restaurants are requiring sanitation in their purchase agreements. Buyers are expecting growers to share in the food safety process and potential liability issues. Anyone wanting to move into a commercial produce sales stream is going to have to find a way to wash and sanitize their produce.

The goal of this project was to find a way to quickly wash and sanitize the ripe produce that minimizes cost and labor and maximizes sanitation.

There is little in published literature on small farm washing and sanitation methods in the U.S. Commercial washers begin at more than $4000, and aren't applicable to ripe, tender skinned fruit like tomatoes and English cucumbers.

Some producers use tubs to dip and rinse their fruits, but tub water needs to be held at a fairly consistent temperature and regularly tested for sanitation compound concentrations. There are inherent contamination issues anytime batch water is used.

With new FSMA regulations, any washing facility cannot contain wood, and needs to be easy to maintain in a sanitary condition. The process needs to be repeatable and with limited labor, it needs to be efficient in its use of labor. It needs to reduce bacteriological contamination without damaging fresh produce.

PROCESS

Describe the steps involved in conducting the project and the logic behind the choices you made. Please be specific so that other farmers and ranchers can consider what would apply to their operations and gain from your experience.

In year one we wanted to design a wash system that could be constructed on less than $500 dollars and a more automated one in year two on less than $1000.

The systems had to minimize water, energy and sanitizer use.

An in-depth literature search proved to be of little help. While there were some European articles on produce sanitation, they were all designed for commercial washers.

We began year one with a concept of some sort of surface over which we could spray wash and sanitize the produce in significant quantities.

We began by locating a surface that was plasticized to protect the fruit to serve as washing surface, the 2’ X 4’ slatted flooring used in agricultural environments and repurposed a stainless steel meat cart.

The greenhouse facility we purchased had a cooler room they had used for storing flowering plants. We skinned the room with painted metal roofing and installed lighting and brought in both hot and cold water lines. We used a dosatron to maintain the proper concentration of sanitizer. This provides a temperature controlled, washable environment to wash, sanitize and bag produce.

In designing the wash water system we included a thermometer to ensure that wash water could be maintained at 15° F warmer than the temperature of the produce being washed to prevent thermal shock and absorption of water and bacteria to the inside cells.

The choice of sanitizer solution is an issue as well. Dilute mixtures of chlorine bleach and water are often used for sanitizing raw fruits and vegetables. Contact times of one minute with approximately 200 ppm bleach in water effectively sanitizes raw produce. The produce then needs rinsed with potable water. While chlorine bleach is approved for use as a produce sanitizer, none of the readily available bleach for small farmers is labeled as such. It is also ineffective in high pH water like ours. In addition, chlorine bleach is very hard on stainless and metal equipment.

We looked at multiple sanitation products, some of which required extensive paperwork to

purchase, others were very expensive, all have added expenses in shipping by ground. We settled on a sanitizer product available in concentrated form at a reasonable price from many horticultural supply firms; Sanidate - which is made up of 23% hydrogen peroxide and 5.3% peroxyacetic Acid. It has an added bonus of worker safety, and not needing to be rinsed off.

We developed a very simple system of using a dosatron to produce the concentration of sanitizer needed for washing the produce. To facilitate sanitizing with agents that might require differing concentrations, we set up the dosamatic and tubing drawing from a simple bucket. Thus the concentration in the bucket could be varied to produce the desired concentration in the sanitizing solution.

For tomatoes, we found that using the same crate that we picked into was the most efficient to wash them in. We purchased a variety of different picking crates, with the additional requirement that the crates would work in our second generation produce washer. They also needed to stack, be tall enough for the largest tomatoes and fit on some kind of wagon or rolling wheels to move around the greenhouse. The best option turned out to be commercial open dishwasher racks. It was important that we used a sprayer head and sufficient water pressure that the produce was washed but not bruised. Since they are greenhouse grown we didn't have as much soil as field grown, but we tested the system on some field grown produce and it successfully washed off visible soil.

In a few minutes one person can quickly wash more than 90 English Cucumbers averaging 14-16" long. This process takes a fraction of the time compared to the previous method we used, which was hand washing and wiping each individual cucumber. The English cucumbers, like tomatoes, have a delicate skin and can be damaged easily. This process is improved by turning

the produce over by hand.

Excluding the room renovation costs (metal and trim $910, sealed light fixtures $100) one could replicate this wash set up for less than $500.

1) Stainless, polypropylene or other washable tank of some sort. While ours was a used commercial meat lug, new livestock tanks ($150) could be used. A new meat cart like we used would run $500-700, but the used one we purchased was $50.
2) Dosatron, $300
3) Hoses, spray nozzles, pex fittings, valves $70
4) in-line thermometer - $20 new
5) Agricultural flooring 2' X 4', $25 new
6) Picking lugs $11.00 a piece (minimum 10-20)

If you didn't want to invest in the dosatron and separate lines for the sanitizing solution, you could use a battery operated backpack sprayer mounted on the wall – for $200.

At this point we proved we can develop a cost effective, efficient washing station for delicate produce. The station can be completely sanitized. Now we wanted to make it even more labor efficient.

Once we had the low tech washing and sanitizing process completed, we moved to a higher tech process. We had originally planned on building a power conveyor with spray nozzles above and below. But we tripped on a used commercial cafeteria dishwasher, readily available on ebay, craigs list and similar auction sites for anywhere from $500. These dishwashers, even the simplest, have a wash and rinse cycle, which can be adjusted to wash and sanitize. They have nozzles above and below, are already enclosed and have a powered mover.

The problem with the commercial dishwasher was that it was 3 phase power and had recirculating pumps which ran 225 gallons per minute. We didn't want that much pressure or water used and we didn't want to recirculate our solutions. (Although others may want to.)

So this system was removed from the dishwasher and the drains were locked in an open position so the system would not recirculate. We replumbed the system with new nozzles, using warmed potable water first and water with sanitizer from the dosatron after. Using Sanidate meant that the sanitizer did not need to be washed off.

We replaced the 3 phase conveyor motor with a single phase 110 motor.

Installed renovated washer (left) and in operation washing cucumbers (right)

We also put a dryer from an electric automatic hand dryer after exit from the washer, but in the process of bacteriological tests we found that a drying step was not necessary.

Our greenhouse water tests potable with no bacteriological contamination, quarterly water tests confirm this, it is important that the water used is free of bacteriological contamination.

We added an additional step of using sanitation test strips to check the concentration of the sanitizer.

We also had to find lugs to hold the produce as it went through the washer and to wash the picking lugs.

At this point we have found the open lugs designed for commercial dishwashers to be the best choice, especially for cucumbers, but we would like to find a tray with more rounded edges in the bottom for ripe tomatoes.

PEOPLE

List farmers, ranchers, or business people who assisted with the project and explain how they were involved. List any personnel from a public agency, such as the Extension Service, Natural Resources Conservation Services or Soil and Water Conservation Districts who assisted with this project. List people from non-profit organizations who helped you.

Our family labor provided the majority of the labor. We did the designing, locating, deconstructing and reconstructing of the equipment, identification and purchase of sanitizer, lugs, materials and the washing. We had additional assistance from a local teen who helps us in the greenhouse.

Dr. Amanda Deering of Purdue and her graduate student, YooJung Heo, provided all of the bacteriological sampling and analysis.

RESULTS

What results did you achieve and how were they measured? For production projects, include yields, field analysis, and related data. How do these compare with conventional systems used previously? For education projects, include outcomes achieved and how you measured them through surveys, attendance, or other methods. Were these results what you expected? If not, why not? What would you do differently next time?

We were successful in producing two different methods for washing and sanitizing delicate produce. They save time, energy, water and chemical sanitizer over every method we viewed for small farms.

It took us 4.5 minutes to wash 18 cucumbers by hand, the dishwasher crates takes 18 cucumbers and goes through the washing machine in 1 minute. Time saved alone is tremendous, but not the most important thing. But were we successful in actually sanitizing the produce? Were we actually improving food safety outcomes?

To determine that, we had to evaluate the two different washing procedures. The rack and hand spraying and the mechanized modified commercial dishwasher with a washing chamber and sanitizing chamber.

The effectiveness of the two systems was evaluated by looking at the microbial populations on

unwashed produce as compared to the two washing methods. Total Plate Counts and Coliform counts were analyzed by Dr. Amanda Deering and her graduate assistant YooJung Heo from the Food Science Department at Purdue University. They used sterile collection techniques to obtain 10 replicate samples of untreated products and the two washing treatments. Each washing procedure was conducted on greenhouse grown tomatoes, greenhouse grown cucumbers and field raised tomatoes.

The sanitizing solution (Sanidate) was applied at a concentration of 45 ppm. The sanitizer was added to the water so that the concentration for both washing methods would be identical.

When comparing the Total plate count for bacteria in the untreated product, the field tomatoes had a much higher total bacterial load then the greenhouse produced product. Greenhouse grown tomatoes had an average total plate count of 6.12 $x10^5$ while field grown tomatoes averaged 1.61 x 10^7 CFU/gram of product.

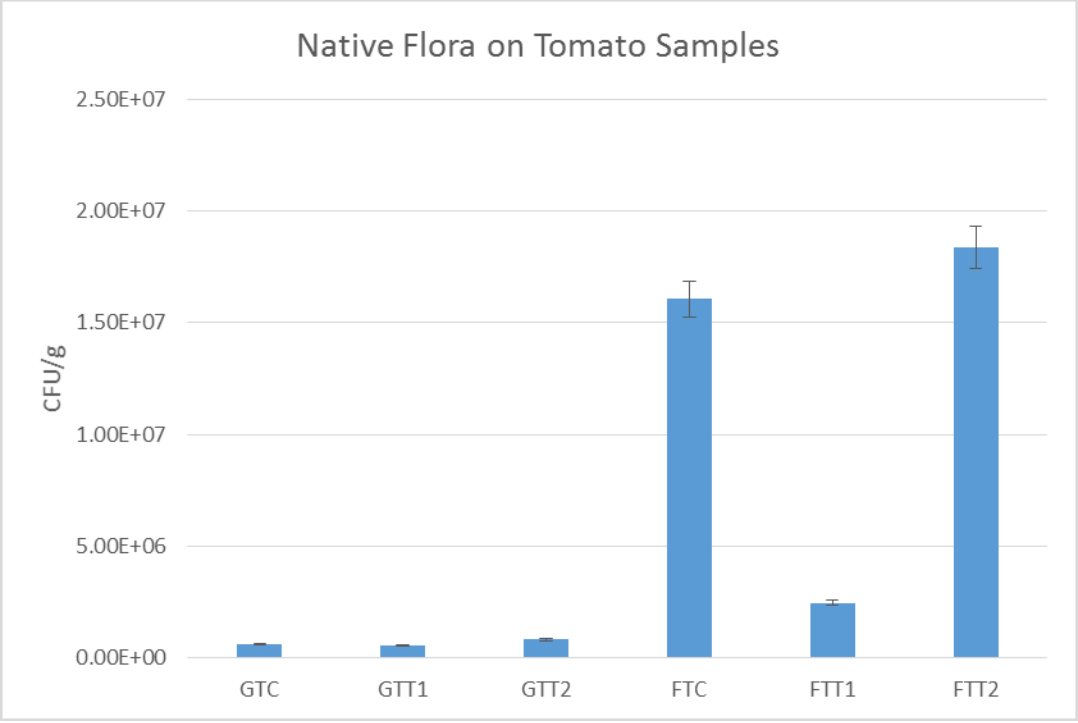

Figure 1. Native Flora on Tomato Samples

GTC= Greenhouse Tomato Control
GTT1= Greenhouse Tomato washed in modified dishwasher
GTT2= Greenhouse Tomato washed on flat system
FTC= Field Grown Tomato Control
FTT1= Field Grown Tomato washed in modified dishwasher
FTT2= Field Grown Tomato washed on flat system

Additionally, coliform bacteria (those bacteria most likely to cause a food borne illness) were present in both samples. Three samples out of 10 greenhouse tomatoes contained coliform bacteria. When looking at the field grown tomatoes, 9 out of 10 samples contained coliform bacteria. These tomatoes were purchased at a wholesale market place, we do not know if they had been washed in any way.

It is important that we understand that produce can and often times does contain coliform bacteria that we as produce suppliers need to address from a food safety perspective.

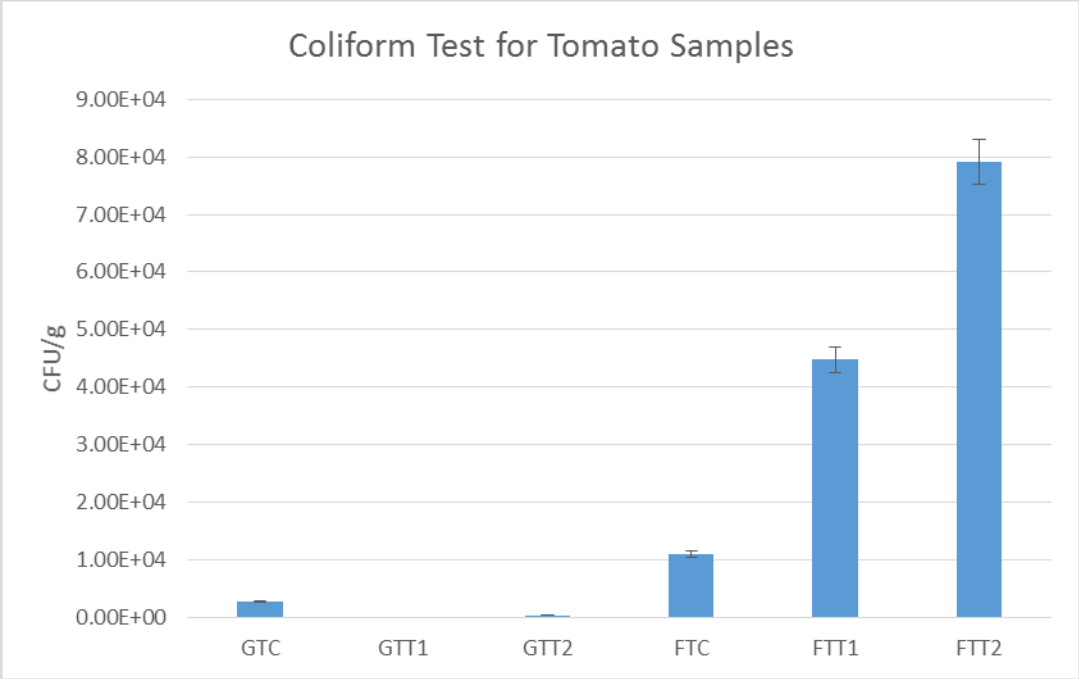

Figure 2. Coliform Test for Tomato Samples

GTC= Greenhouse Tomato Control
GTT1= Greenhouse Tomato washed in modified dishwasher
GTT2= Greenhouse Tomato washed on flat system
FTC= Field Grown Tomato Control
FTT1= Field Grown Tomato washed in modified dishwasher
FTT2= Field Grown Tomato washed on flat system

The two wash treatments had little impact on the levels of bacteria in field grown tomatoes. When looking at the field grown tomatoes the washing treatments higher coliform concentrations than the untreated product. It was hypothesized that the level of sanitizer may not have been adequate or that the contact time was not long enough to be effective.

A second project utilizing sanitizer concentration of 80 – 85 ppm PAA and maintaining sanitizer flow over produce for 45 seconds (the recommended contact time per label of Sanidate) was

conducted to determine if PAA alone could impact bacterial loads. The higher level of PAA did reduce total bacterial and coliform bacteria by .13 and .20 logs, respectively. PAA had a greater impact on mold and yeast levels. A .52 log reduction was observed for yeast while mold levels were reduced by a .76 log reduction.

In summary, the level of coliform bacteria present in produce would indicate that produce should be washed and sanitized as a way for vegetable producer to reduce their exposure to potential food safety liability issues. It is our opinion that both washing systems can effectively wash and sanitize produce. However, if Good Agricultural Practices are not followed, washing and sanitizing may not be effective. The most critical component to a sanitation program for produce is the selection of the correct sanitizer for your application. Using sanitizers that are stable and effective regardless of pH and that do not have to be rinsed off after application are two important factors to consider.

Although we did not focus on different production systems, it was evident that produce grown in a greenhouse environment had a lower level of bacterial load and thus a lower risk than produce grown in a field environment.

DISCUSSION

What did you learn from this grant? How has this affected your farm or ranch operation? Did you overcome your identified barrier, and if so, how? What are the advantages and disadvantages of implementing a project such as yours? If asked for more information or a recommendation concerning what you examined in this project, what would you tell other farmers or ranchers?

Lessons learned

- Essentially all the bleach that a producer might locally purchase is not food grade and thus legally should not be used to sanitize produce.
- Some lugs made for picking produce will leave indents on produce if kept in them for any length of time. We have tried four different company's lugs and have some specific recommendations, including that fact that for fragile produce, solid bottom sides are the best if storing or transporting them.
- Many of the commercial sanitizers, including some manufacturers of food grade bleach don't want to deal with smaller producers and may incur excess shipping charges because of the handling requirements
- The company we are selling much of our produce to, will begin requiring audits. Due to lack of auditors, getting a produce audit in Indiana will be expensive and hard to schedule.
- The greenhouse is a side operation for us, we all have either full time jobs or full time school, have 150 acres of alfalfa hay and 40 cows. Once produce/hay season starts, it is really difficult to find time to work on changing processes. Once we had this unit up and going, we couldn't take it apart and install the automatic washer.

- Sellers at farmers markets have dozens of ways they clean the produce for sale. As a group, the ones we spoke to at four different markets felt that posting signs saying "wash your produce before eating" will protect them from liability.

Sanitation Lessons learned:

- All produce has some level of naturally occurring bacteria that sanitizers may not impact.
- Production methods can have a significant impact on the microbial levels and microbial species present on vegetables at harvest.
- The effectiveness of sanitizers varies greatly. Chlorine from bleach is not effective when the pH of the sanitizing solution increases.
- A combination of sanitizers may be more effective than utilizing a single product.
- The best way to reduce your risk is to implement Good Agricultural Practices and a food safety plan that address points of potential contamination.

We think it is important to recognize that all produce, even that grown in a greenhouse, has the opportunity to carry bacteria. Small farm producers have as much responsibility to minimize food safety risks as the largest commercial producer. We have designed two systems that provide the opportunity to reduce produce bacteriological load, but the choice and use of sanitizing products is of utmost importance.

IV. PROJECT IMPACTS

Evaluate the economic, environmental and social impacts of this sustainable practice by completing the Benefits and Impacts form. Also, if possible, provide hard economic data.

This project was not designed to address production methods, but to improve the food safety outcomes of every producer. The modified dishwasher we designed to wash our produce drastically reduced the time required to wash our produce, which reduced our labor requirements. It also improved the food safety of our produce, and may do even better with the use of new sanitizers. In the long term, the safety of our produce may be the most important issue for the sustainability of all growers.

V. OUTREACH

What methods did you use for telling others about: 1. Your project, 2. Project events or activities, 3. Project results? How and to whom did you communicate this information? Be sure to include details on how many people attended field days or demonstrations, and how information was further disseminated by media covering any events. What plans do you have for further communicating your results? Include press releases, news clippings, flyers, brochures, or publications developed during this project. Also include photos which might be helpful in telling your story to others. (Mail items separately if you cannot send them electronically.)

We have developed a brochure on the project and will be making the brochure available to

produce extension specialists in the North Central SARE region. The brochure will also be distributed to all Indiana Farmers Markets supervisors. Data from our project is being used by food science graduate students at Purdue for presentation at professional meetings. We will be presenting our results at both the Indiana Hort Conference and the Indiana Small Farms Conference. We are open to presenting this information at additional horticulture meetings in the region.

VI. PROGRAM EVALUATION

This was the twenty-first year the North Central Region SARE Program sponsored a farmer rancher grant program. As a participant, do you have any recommendations to the regional Administrative Council about this program? Is there anything you would like to see changed? Please fill out the Evaluation form.

Please make the online submission forms match the downloadable forms.

VII. BUDGET SUMMARY

Complete the final budget form and return it with your report. You will only be reimbursed for expenses incurred and items purchased for conducting your project. If you made significant changes to final expenses listed by budget category ($1,000 or more), please include an explanation for the changes. Call Joan Benjamin with questions at: 573-681-5545.

Submit your final report to:

E-mail: BenjaminJ@lincolnu.edu or mail to:
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