23. EXTENSION PROGRAM

A. Extension Philosophy

The role of an Extension Specialist in the community goes beyond a simple transfer of information. As Extension Specialist and researcher, I must have a clear picture of the clients' needs and problems, and how the current governmental policies affect their farming practices. My role is to provide leadership, encourage innovation and promote changes in practices and behavior in order to achieve more sustainable agriculture. In practice, after identifying a given problem, it is necessary to raise the farmers' awareness of the issue by mobilizing interest and encouraging them to define a situation as problematic. In addition, I am committed to make the information accessible by publishing and transferring the knowledge that the research has provided to solve certain issues. During the entire process, the periodic evaluation of the impact and effectiveness of the extension program is essential to its success. The overall goal of my extension program is to develop, implement, and integrate educational activities to improve sustainable vegetable production in Florida. The clientele target of my extension program includes County Extension Faculty, vegetable growers, and industry partners.

Job Description

The goals of my statewide Extension Program are to improve sustainable vegetable production systems and provide leadership and coordination for statewide educational efforts in vegetable production and management. This Extension program contributes directly to the Super Issues of the UF/IFAS Extension Road Map 1) the awareness and appreciation of our food systems and our environment and 2) the sustainability and conservation of resources in our Florida communities and to the High-priority Initiatives 1) Increasing the sustainability, profitability, and competitiveness of agricultural and horticultural enterprises and 2) Enhancing and protecting water quality, quantity, and supply.

Professional development in Extension

- 2012 – IFAS-Certificate in Teaching and Learning in Extension (course with 12 on line modules, sponsored by Florida Cooperative Extension Service). Sponsored by FCES-IFAS.

Nature and Description of Program

My 60% extension effort is divided into three major Program Areas:

1) Increasing the knowledge and adoption of sustainable irrigation practices for water conservation by vegetable industry (20%)
2) Enabling awareness and adoption of sustainable fertilization practices vegetable production systems (20%)
3) Promote awareness and adoption of new vegetable varieties well adapted to Florida growing conditions (20%)

Summary of Extension Activities (2010-2016)

Activity	**Number**	**Attendance**	**Contact hours**
External/Internal Funding: 10 research projects with Extension components: $735,612			
Target: County Extension Faculty			
In-service training	6	164	1,289
Target: county extension agents, growers and vegetable industry			
Workshop – Organizer/presenter – National Level	1	150	600
Field days and meetings	35	1021	5,005
On-farm trials and demonstrations	23	50	905
On-farm visits	85	-	675
Outcomes (Print and media)			
Refereed Journal Publications	30	-	-
Extension publication (EDIS) and Vegetable Handbook	32	-	-
Trade Journal Articles	8	-	-
Irrigation Apps for Smartphones downloads	829	-	-
EDIS website hits (since 2011)	238,772	-	-

A. Program Area 1. Increasing the knowledge and adoption of sustainable irrigation practices for water conservation by vegetable industry

Situation Statement

The State of Florida has been revising water quality and use regulations affecting agriculture, primarily driven by increasing public concerns related to water quality and availability. Groundwater has been the primary source of water for both public supply and agricultural irrigation in Florida, and since aquifer levels have been dropping, incentives and stricter regulations have been put in place to improve water use efficiency in all types of uses, including agricultural irrigation. Furthermore, agricultural producers are now required to implement best management practices (BMP) to minimize pollution loading to surface water bodies. The BMP have been developed by Florida Department of Agriculture and Consumer Services (FDACS), the Florida Department of Environmental Protection (FDEP), Water Management Districts (WMD) and UF-IFAS to address agricultural water quality and water use impacts, including the reduction of nutrient loads in Florida's water bodies. Currently, the predominant irrigation system for vegetable crops in Florida is called "seepage irrigation". In this irrigation system, water is pumped from wells to a pipeline system that carries the water to individual furrows. Seepage has low irrigation efficiency because it requires a large volume of water to maintain a high water table to irrigate the crop. The St. Johns WMD estimates that a potato crop under seepage uses about 500,000 gal/acre per season. The combination of the large water withdrawal rate from the Upper Floridian aquifer and drought in the last few years has resulted in a drastic increase in salt content in deep wells due to seawater intrusion in some agricultural areas, which could completely jeopardize agricultural production in the northeast Florida. Thus, water conservation is imperative. New alternative irrigation systems for water conservation have been introduced in vegetable production areas across the state since 2011 supported by statewide cost-share programs. The available options to replace the seepage include tile drainage, drip irrigation, subsurface drip irrigation for water table management and sprinkler irrigation. These irrigation systems have higher irrigation efficiency and it has been shown, that if well managed, can greatly reduce water use while maintaining crop yield. To ensure that these new BMP for irrigation are properly adopted and managed by growers, my Extension program must share science-based information in a practical way that helps growers with their decision making.

Target audience
Agricultural producers, County Extension Faculty, state specialists, certified crop advisors, consultants, suppliers.

Goal and objectives
The overall goal of the program area 1 is to provide leadership to County Extension Faculty and growers with the most recent, updated science-based knowledge and technology that will aid their decision-making in adoption and management of irrigation systems.

Specific, measurable, achievable, relevant and time-bound (SMART) objectives of my Extension Program are divided in short, medium and long-term as follows:

The **short-term objective** is to increase awareness and knowledge of County Extension Faculty, growers and vegetable industry in general, regarding alternative irrigation systems and BMP for irrigation of vegetable crops. Following Extension Activities, two-thirds of the participants will gain additional knowledge on irrigation and BMP.

The **medium-term objective** is that at least one third of my program participants will convert to

more efficient irrigation system or improved management of existing irrigation systems based on the knowledge gained within three-years of the completion of the Extension activities.

The **long-term objective**s are to increase agricultural water conservation and water quality as well as the sustainability of the vegetable production in the state of Florida. The initial impacts of the Extension activities are documented as reduction in agricultural water use and economic savings occurred since the begining of the Extension activities. The full impacts of the Extension activities will require an assessment of greater than five years.

Educational methods and activities

My statewide educational program efforts combine a number of methods to effectively deliver information to growers, County Extension Faculty and the community. These activities include field days, In-Service Training, extension publications, workshops, on-site demonstration projects, and on-site visits, develop a relationship with stakeholders, growers, County Extension Faculty and industry in general and learn about their operations and needs

- Deliver In-service training (IST) statewide for County Extension Faculty (see section 33, Appendix 2)
- Organize and deliver in collaboration with County Extension Faculty annual commodity meetings (e.g. field days, workshops) with growers and industry (see section 33, Appendix 3)
- Conduct on-farm demonstration trials with effective participation of the growers and County Extension Faculty on planning, execution and evaluation of the activities (see section 33, Appendix 4)
- Clientele visits and consultations with county extension agents from St. Johns, Flagler, Putnam, Suwannee, Manatee, Sarasota and Brevard counties (see section 33, Appendix 5)
- Conduct one-on-one visits to commercial growers and provide technical assistance on irrigation management, design and operation
- Organize and conduct “Irrigation systems and current technology available for use in vegetable crop production” workshop at the American Society of Horticultural Sciences annual meeting
- Publish educational material (EDIS, field day handouts, fact sheets, trade journal articles)
- Develop tools to help grower to improve irrigation scheduling (Irrigation Apps for smartphones)
- Present research/extension outcomes at meetings

Summary of Educational Efforts and Activities on Sustainable Irrigation Practices

Activity	Number	Attendance	Contact hours
Target: County Extension Faculty			
In-service training	6	149	1,184
Target: county extension agents, growers and vegetable industry			

Workshop – Organizer/presenter – National Level	1	150	600
Field days and meeting with topic irrigation	33	1,133	2,742
On-farm trials and demonstrations	11	30	465
On-farm visits	52	-	157
Outcomes (Print and media)			
Refereed Journal Publications	18	-	-
Extension publication (EDIS) and Vegetable Handbook	11	-	-
Trade Journal Articles	8	-	-
Irrigation Apps for Smartphones downloads	829	-	-
EDIS website hits (since 2011)	114,608	-	-

Outcomes and impacts

The accomplishments and impacts of my Extension program regarding to Sustainable Irrigation Practices are described below according to the objectives:

The short-term objective was to increase awareness and knowledge of County Extension Faculty, growers and vegetable industry regarding to alternative irrigation systems and BMP for irrigation of vegetable crops.

- Development of infrastructure to support IFAS Research and Extension Programs on irrigation management at Hastings Agricultural and Extension Center: With over $561,905 in funding I developed an irrigation park at the research farm in Hastings with alternative irrigation systems to seepage. The irrigation systems are tile irrigation drainage, surface and subsurface drip irrigation and sprinkler irrigation. The irrigation infrastructure available allowed my Extension Program to provide hands-on training to County Extension Agents, growers, industry personnel, and 4-H students. Five graduate students to successfully conduct their research and it has been used by other Faculty members. Since then, aproximately 415 people have been trained on field days, In-service trainings and agricultural tours.
- Educational programs: Approximately 1,462 people have participated in education programs regard to sustainable irrigation practices since 2010. Based on pre- and post-training tests applied during these educational events, I quantified the knowledge attained as a result of the training.
- Between 2010 and 2015, an average of 84% of the participants (County Extension Faculty, crop consultants and state specialists) of In-service trainings reported a knowledge increase from 63% to 86%.
- As an outcome of the IST trainings, 75% of participants indicated that they were “likely” to use the information provided about irrigation in their newsletters or other media outlets, answer client questions or provide individual consultations, and incorporate what they learned into existing programming or even deliver new programming in this area.
- Directly trained County Extension Faculty (Mark Warren, David Dinkins, Steven Lands, Aparna Gazula) on principles of irrigation, irrigation scheduling for different systems, use of soil moisture sensors for irrigation scheduling.
- Since 2011, the number of web visits on EDIS publications was greater than 114,000. In particular, the EDIS AE459 “Step by step calculation of the Penman-Monteith

Evapotranspiration FAO-56" ranked 47th in the most visited EDIS in 2015 with more than 21,000 visits in that year and cumulative 44,412 visits since its publication.

The medium-term objective was achieved in the implementation of improvements in their irrigation system or management based on the knowledge gained within three-years of the completion of the Extension activities. The preliminary achievement of the **long-term objectives** were documented as agricultural land converted to efficient irrigation system, potential reduction in agricultural water use and economic savings of the adopted practice.

- Changes in irrigation practices: Between 2011 and January 2016, a total of 25 vegetable growers have converted part of their agricultural land to more efficient irrigation systems in the state through Florida Cost-Share Program[3]. The available options to replace the conventional seepage include tile drainage, subsurface drip irrigation for water table management (also called enhanced seepage) and sprinkler irrigation. During the spring 2015 and 2016 growing seasons, the research project "Irrigation, nutrients, and soil moisture sensor testing and crop modeling interface projects, Year 1/2", funded by FDACS (see section 18.a.), evaluated the water savings for each irrigation at the Hastings Agricultural and Extension Center. The reduction in irrigation water use was 51%, 58%, and 68% for tile drainage, subsurface drip irrigation and overhead irrigation compared to the conventional seepage. Similar water savings were reported by Liao et al. (2016) (see section 16.f). for overhead irrigation in potatoes cultivated in Manatee county. Overall, the agricultural land converted to more efficient irrigation systems in the state (approximately 4,397 acres) represent an estimated water savings of 979 million gallons of fresh water per growing season.

Specific impacts per irrigation system:

- Tile drainage systems: Seventeen growers installed tile drainage systems totaling 1,538 acres. The installation of tile drainage systems improves the capability to manage the water table, reduces water use, and increases the efficiency of drainage during rainstorms. Preliminary assessments of the energy savings comparing traditional seepage and tile drainage on a 65-acre grower's field showed a reduction of 40-60% of electricity consumption compared to a similar field under seepage. The estimated savings in energy costs are in the order of $19.5/acre with the tile drainage system. A conservative estimation of the water saving about 200,000 gal/acre/season (40% reduction in irrigation), which with the current converted land represents 307 million gallons of water conserved per season. An additional advantage of the system is the gain of 10-12% in cultivated land due to the removal of the existent irrigation furrows required for seepage irrigation. The increase in planted area makes the tile drainage out-perform the seepage system in $2,000/acre over a ten-year period (Rogers et al., 2014; see section 16.g). About 185 acres of furrows are now dedicated to crop production.
- Subsurface drip irrigation: In 2010, our Extension team met with a potato grower and worked out a plan to install 5 acres of subsurface drip for water table management. In 2012, the same grower had converted another 70 acres. As of January 2016, about 435

[3] It is the partnership between Florida Department of Agriculture and Consumer Services, Florida DEP, St. Johns River Water Management District and NRCS.

acres of potatoes (6 growers) were converted from seepage to subsurface drip irrigation. It has been shown that the conversion has the potential to reduce water consumption by 30% compared to the traditional seepage irrigation, which can be translated to saving 65 million gallons of fresh water per potato season in those 435 acres. One advantage of the subsurface drip is the lower cost of implementation compared to tile drainage systems.

- Sprinkler irrigation: Approximately 1,200 acres in southwest Florida and 1,224 acres of commercial land in northeast Florida have been recently converted from seepage to overhead/sprinkler irrigation. With the conservative estimated reduction in irrigation water use by 55% (Liao et al. 2015, see section 16.f), the 2,424 acres converted to sprinkler irrigation represents 606 million gallons saved per growing season.

- Surface drip irrigation for potatoes: One table-stock potato grower has tested viability to use surface drip irrigation for fresh market potatoes. On-farm demonstration plots of 4-8 acres were conducted at two large potato producers (400 and 800 acres, respectively) during 2010-2013. Our research findings (Reyes-Cabrera et al. 2014, 2016; Makani et al. 2015; graduate students see section 16.f) demonstrated that drip irrigation for potatoes has the greatest potential for irrigation water savings (48 to 88% compared to seepage). Although tuber quality may be higher under drip irrigation, the adoption of drip might not be an economic option considering the current production costs and selling prices of table stock potatoes. However, the knowledge generated from this effort can be expanded to other commodities.

- Converting seepage to plasticulture/drip irrigation for vegetable production: Barrett et al. (2015) and Paranhos et al. (2016) (graduate students; see section 16.f) have developed and refined the use of plasticulture/drip irrigation for high population cabbage production. Over 5 years of study, the plasticulture system yielded on average 548 cwt/ac, about 208 cwt/ac higher than seepage. Although, the plasticulture system was estimated to have a 36% higher fixed cost than the bare ground seepage, mean profit for plasticulture was 54% higher. A risk analysis revealed that plasticulture has a 40% higher likelihood of producing a profit above $2,363 on an acre basis than the bare ground system. On-farm demonstration and field day with growers were conducted in 2014 and 2015 (see section 33, Appendix 4;). The conversion from seepage to plasticulture/drip is still in the pilot stage, however, the interest in the technology has grown. Approximately, 25 acres of vegetable (cabbage, pumpkins, Asian vegetables, onions) in the northeast Florida have been converted to drip. The slow adoption of drip and plasticulture is due to the lack of information on the cost of investment, management required, and benefits of plasticulture for vegetable crops, and my Extension program is currently working on the dissemination of this information.

- Irrigation water salinity reduction: Our extension team has identified that several deep (>200 ft) irrigation wells in northeast Florida have shown higher salt water content due to salt water intrusion in deep aquifers. In 2012, after the potato growing season and the Salinity Meeting with growers in Flagler Co., three growers, in collaboration of with our team, have identified deep irrigation wells with salt problems. Those wells were plugged to become shallower, which reduced the irrigation water electrical conductivity by 90%. About 180 acres affected by the high salt contents are back in production with lower electrical conductivity in the irrigation water. According to pre and post-tests and post-

training and IST evaluations, salinity meeting attendees increased their understanding of salinity problems and practices to mitigate its effects on vegetable production (95%), and they felt they were better prepared to develop and implement strategies to mitigate salinity problems (90%).

- Irrigation scheduling: In collaboration with Dr. Kati Migliaccio, Dr. Clyde Fraisse (Ag. Bio. Eng. Dept.) and Dr. Kelly Morgan (Soil and Water Sci. Dep.) a series of irrigation application for smartphones were developed to help the vegetable, citrus and the turf industry to perform better irrigation scheduling practices. Currently, there are six Smartirrigation apps available (vegetable, strawberry, avocado, citrus, cotton and turf). As of December of 2015, there are a total of 829 users. The use of the vegetable app to determine irrigation scheduling for cabbage resulted in water savings of 23% and an increase in yield of 1,250 lb/ac and compared to a traditional irrigation schedule.

B. Program Area 2. Enabling awareness and adoption of sustainable fertilization practices for vegetable production systems

Situation Statement

The lower St. Johns River (LSJR) was classified as an impaired waterway by the State's Total Maximum Daily Load regulations in several segments of the main stream due to high concentrations of N and P. Nutrient loading from wastewater treatments is the largest contributor of nutrient pollution in the LSJR, but runoff from urban, suburban and agricultural areas was also identified sources of nutrient pollution in the river. The agricultural area within the LSJR Basin is responsible for 60% of the potato production in the state. The combination of high water table, coarse soil texture, and low soil organic matter content often leads to offsite movement of soluble N and P. In 2001, the Water Quality Protection BMP was established to reduce nutrient loading into the river from agricultural sources by cost-sharing the implementation of BMP like structures for water table monitoring and control, sediment control, soil test recommendation. Although that was an important step towards the increase of fertilizer use efficiency and sustainability of potato production, there was a lack of information about potato N demand, fertilizer rate and timing of application to maximize yield and minimize risk of nitrate leaching. In a survey conducted in 2012, potato growers reported applying a total N rate ranging from 178 to 280 lb/ac split into three applications throughout the season. Approximately, 75% of the growers broadcast N-fertilizer around 30 to 40 days before planting, supplying 0 to 60% of the total N fertilizer. The following fertilizer application is at plant emergence, and ranges from 0 to 70% of the total N and the final application at tuber initiation with 0 to 50% of total N applied in the season. In 2011, another cost-share program for northeast Florida was put into place with the objective to improve water quality and water conservation. In addition to the alternative irrigation systems, this cost-share program also identified the use of banding fertilizer equipment as an effective BMP practice. For many years, broadcasting was the predominant fertilizer method for potato production. This wide range of N rates at each application timing and fertilization broadcasting highlights that the strategies for seasonal distribution of N fertilizer application for potatoes was very variable among growers and not well established. Determining a proper combination of fertilizer rate with application timing can maximize potato yield while minimizing the environmental risk of N loss. My Extension program provides information about sustainable fertilizer practices that help growers to properly manage crop nutrients and to be compliant with BMP's guidelines.

Target audience
Agricultural producers, County Extension Faculty, state specialists, certified crop advisors, consultants, suppliers.

Goal and objectives
The overall goal of the program area 2 is to provide County Extension Faculty, growers, certified crop advisors, consultants and fertilizer suppliers with the most recent, updated science-based knowledge on fertilizer management of vegetable crops. Through a cooperative model of partnership between the vegetable growers and the Research/Extension team to develop fertilization strategies that will allow growers to become more efficient and sustainable in their fertilization practices.

The **short-term objective** is to increase awareness and knowledge of County Extension Faculty, growers and vegetable industry in general regarding to proper fertilizer management for vegetable crops. Following Extension Activities, two-thirds of the participants will gain additional knowledge on BMP for sustainable fertilizer practices for vegetable crop systems.

The **medium-term objective** is that at least one third of my program participants will adopt more efficient fertilization practices based on the knowledge gained within three-years of the completion of the Extension activities.

The **long-term objectives** are to reduce fertilizer input and maintaining vegetable production, and therefore increase sustainability of the vegetable production in the state of Florida. The preliminary impacts of the Extension activities are documented as reduction in fertilizer use and agricultural land converted to more efficient fertilization practices. The full impact of the Extension activities will require an accessment longer than five years.

Educational methods and activities
- Conduct large on-farm demonstration trials with effective participation of the growers and County Extension Faculty on planning, execution and evaluation and discussion of the activities and results (see section 33, Appendix 4)
- Develop a relationship of trust with stakeholders, growers, County Extension Faculty and industry
- Conduct one-on-one visits to commercial growers and provide technical assistance on fertilization practices
- Clientele visits and consultations with county extension agents from St. Johns, Flagler, Putnam, Suwannee, Manatee, Sarasota and Brevard counties
- Deliver In-service training statewide for County Extension Faculty
- Organize and conduct field days
- Organize and deliver in collaboration with County Extension Faculty annual commodity meetings (e.g. field days, workshops) with growers and industry
- Publish educational material (EDIS, field day handouts, fact sheets, trade journal articles)

- Present research/extension outcomes at meetings

Summary of Educational Efforts and Activities for Objective 2. Fertilization Practices

Activity	Number	Attendance	Contact hours
Target: County Extension Faculty			
In-service training of fertilizer management	5	135	1,173
Target: county extension agents, growers and vegetable industry			
Field days and meeting with topic irrigation	22	360	1,748
On-farm trials and demonstrations	10	30	360
On-farm visits	80	-	432
Outcomes (Print and media)			
Refereed Journal Publications	11	-	-
Extension publication (EDIS)	2	-	-
EDIS website hits (since 2011)	4,149	-	-

Outcomes and impacts

This Extension program has achieved the **short-term objective** which was to increase awareness and knowledge gain of County Extension Faculty, growers and vegetable industry in general regarding to proper fertilizer management for vegetable crops.

- Since 2012, 164 County Extension Faculty and Crop Advisors statewide have been trained by my Extension program regard to fertilization practices. For example, the IST "Irrigation management strategies and 4R plant nutrition" (Clearwater and Balm, see Appendix 1 of Section 33), pre and post-program survey responses were collected from 60 participants. The results showed that 65% of the participants had gained knowledge and the average knowledge gain was from 78% to 89% as a result of the training.
- Approximately 525 people (including growers) have participated in education programs (field days, meetings, presentation) regard to fertilization practices for horticultural crops since 2010.

The **medium-term objective** is being achieved with the implementation of more efficient fertilization practices based on the knowledge gained within three-years of the completion of the Extension activities. Initial results indicate that the **long-term objectives** of reducing fertilizer input and maintaining vegetable production is in progress.

- Improved fertilizer application: As a result of the research and outreach efforts of the "Potato fertilizer rate and timing BMP and banding fertilizer applicator (2010-2014)" Demonstrations (See Appendix 4, Section 33), in 2011 one potato grower (900 ac) converted from broadcast fertilizer application to a banded fertilizer application with a similar machine used in the BMP trials. This grower's testimonial was that he is progressively decreasing fertilizer rate every year, and, according to him, it has resulted in an annual savings of $25,000 in his 900 acres (savings of $28/acre). As of January 2016, 13 growers have converted their fertilizer application to banding, which covers a

total of 9,840 acres under banding fertilization instead of broadcasting (representing 48% of the 20,300 acres cultivated with potatoes in northeast FL). The estimated savings in fertilizer is on the order of $ 275,520 annually. As the banding fertilizer machine become more popular among growers, with an estimated reduction of N fertilizer of 8 to 12%, it can be translated in a reduction of 360,000 to 400,000 lb of N fertilizer not applied if only 50% of potato production in the state adopt this technology.

- Timing and rate of N fertilizer for potatoes: From 2010 to 2014, a total of 28 field trials (randomized and replicated design) were conducted in commercial potatoes fields in close collaboration with growers and County Extension Faculty. The objective of these trials was to identify the most appropriate timing and N-fertilizer rate that maximize yield with higher N-fertilizer use efficiency by the crop. Six peer-reviewed publications with results from these trials were published in well-recognized journals such as Agronomy Journal, Field Crops Research, Potato Research and Nutrient Cycling in Agroecosystems (Zotarelli et al. 2014, 2015; Rens et al. 2015abc, 2016; see section 16.f). The main outcomes of the combined effort of research and extension identified that the N-fertilizer use efficiency (NFUE) is significantly increased between planting time and 55 days after planting. The pre-plant N application has a NFUE of only 8%, which means that if a grower applied 50 lb/ac 30 days before planting, approximately only 4 lb/ac would be uptake by the potato plant; while N-fertilizer applied at emergence and tuber initiation stages (25-55 days after planting), the NFUE is 60%. The complete absence of N-fertilizer application before planting reduced marketable yields, thus alternatively application of N days before or at planting can increase FNUE. The optimum N-rate for emergence application is between 90-126 lb/ac at emergence; while application of N-fertilizer above 50 lb/ac at tuber initiation did not increase tuber yield in any situation. Overall, N-fertilizer rates above 250 lb/ac had no effect on yield or plant N uptake in any farm even under high precipitation seasons. Our research team and County Extension Faculty met with growers after each growing to present and discuss the findings. The N fertilizer timing and rate knowledge acquired in this effort will continue to be transferred to growers in other regions as well as industry partners. The expected **long-term impacts** of this effort are that growers will gradually reduce N rates as they increase confidence in their new banding equipment and proper application timing in the near future.

C. Program Area 3. Promote awareness and adoption of new vegetable varieties well adapted to Florida growing conditions and improved cultivation practices

Situation Statement

There is an enormous amount of vegetable varieties available in the market today. Most of the varieties available have been bred or developed in production regions other than Florida. Frequently, these varieties become available to growers without being tested for performance and adaptability of climate, soil and environmental conditions of Florida. Over the years, my Extension program has become an important unbiased reference to vegetable growers looking for alternative varieties to explore different markets, improved characteristics, and yield. The Extension program focus on three vegetable crops: potatoes, cabbage, and broccoli.

- Potatoes: Approximately 30,500 acres of potato are cultivated during winter and spring in Florida producing one-third of the nation's winter/spring crop, making the state an important supplier of freshly harvested potatoes from December to June in the United States. Although potato cultivars do not reach their crop potential yield in Florida, a favorable market window allow growers to receive an average price of $20.3/cwt compared to the national yearly mean of $8.6/cwt. Quality requirements are rigorous and many existing varieties are deficient in one or more key characteristics. Improved varieties need to be developed, evaluated, and released to meet the diverse and ever changing needs of growers and their markets. New varieties with outstanding fresh market quality and visual appeal are especially critical for small-scale markets. Improved pest resistance, environmental stress tolerance, and nutrient use efficiency will reduce the need for pesticides and agriculture's impact on the environment while maintaining profitability. In particular, the Florida potato industry that focuses on a processing market could benefit of varieties with earliness, good chip quality from the field, and tolerance to abiotic stresses such as high temperatures and intermittent drought. Internal heat necrosis brought on by these two environmental factors is a serious and costly quality defect in the state. New fresh market varieties are needed that combine attractive appearance, high yields, pest resistance (e.g. late blight and scab), tolerance to handling damage, and excellent boiling and baking quality. Ideally, new varieties will be distinctive and will offer growers new marketing opportunities. Red-skinned and specialty-type varieties provide a higher value market. Excellent skin appearance, stable skin color in storage, resistance to skinning, and resistance to superficial diseases such as silver scurf are critical. Specialty-type varieties (e.g. fingerlings, purple-skinned, blue-skinned, and colored-flesh types) are growing in popularity in the high-value, direct-sale "local-regional foods" markets.

- Cabbage: Florida is a top producer of cabbage in the United States with an annual value close to $50 million cultivated in about 10,500 acres in Florida. Currently, the cabbage production in Florida relies on few cabbage varieties (e.g. Bronco, Bravo, Danish varieties). As the cabbage growing season in Florida ranges from September to April with a wide variation in weather patterns, more varieties adapted to Florida climate with resistance to black rot and sclerotinea are needed.

- Broccoli: Currently, Florida has about 2,500 acres cultivated with broccoli. Northeast Florida has perfect climate conditions to grow broccoli in the winter. However, if improved varieties with extended harvest season (end of March to early April) are introduced in the region, that would open an opportunity to growers to explore higher market prices. The demand for broccoli grown in the east coast exceeds the supply. My Extension program is collaborating with a Cornell University and USDA Vegetable Laboratory at Charleston to improve genetic population of broccoli by combining resistance to diseases, improve yield potential, and quality characters.

Target audience
Agricultural producers, vegetable breeders, County Extension Faculty, certified crop advisors,

consultants, seed companies.

Goal and objectives
The overall goal of the program area 3 is to provide County Extension Faculty, growers and vegetable industry with reliable information on improved and adapted germplasm to Florida growing conditions.

The **short-term objective** is to increase knowledge and awareness of vegetable producers, county faculty and crop advisors of research-based information on improved vegetable germplasm and alternative crops. Following the Extension Activities, two-thirds of the participants will gain additional knowledge on alternative crops, new vegetable variety options and cultivation practices.

The **medium-term objectives** are to facilitate commercial adoption of improved vegetable cultivars with superior traits, cultivation practices, and alternative crops by coordinating initial commercial trials and by developing management recommendations.

The **long-term objective** is to promote a sustainable vegetable industry based on solid science knowledge regarding vegetable cultivars adapted to Florida's soil and climatic conditions, which will contribute to Florida's economy. The full impact of the Extension activities will require an assessment longer than five years.

Educational methods and activities

- Evaluate the most promising lines into commercial-scale demonstration trials to begin the final assessment for commercial potential according considering broadly-adaptability, market purpose: fresh-market, processing, and specialty-type varieties.
- Maintain close contact with growers, processors, and marketers (e.g., National Potato Council, US Potato Board, grower associations, processors, etc.) to establish priority areas cultivar selection efforts and to guide cultivar release.
- Clientele visits and consultations with county extension agents from St. Johns, Flagler, Putnam, Suwannee, Manatee, Sarasota and Brevard counties
- Organize and conduct field days
- Organize and deliver in collaboration with County Extension Faculty annual commodity meetings (e.g. field days, workshops) with growers and industry
- Publish educational material (EDIS, field day handouts, fact sheets, trade journal articles)
- Present research/extension outcomes at meetings

Summary of Educational Efforts and Activities on new vegetable varieties

Activity	Number	Attendance	Contact hours
Target: County Extension Faculty			
In-service training	1	13	204
Target: county extension agents, growers and vegetable industry			
Field days and meeting with topic irrigation	8	552	522

On-farm trials and demonstrations	6	20	120
On-farm visits	6	20	86
Outcomes (Print and media)			
Refereed Journal Publications	7	-	-
Extension publication (EDIS) and book chapters	16	-	-
EDIS website hits (since 2011)	120,115	-	-
Potato cultivar released "Elkton"	1		

Outcomes and impacts

The **short-term objective** was to increase knowledge and awareness of vegetable producers, county faculty and crop advisors of research-based information on improved vegetable germplasm and alternative crops.

- Approximately 635 people have participated in field days and workshops regard to new cultivars of potatoes, pumpkins, broccoli and cabbage since 2010.
- Since 2011, the number of web visits on EDIS publications was greater 120,000 hits. In particular, the EDIS HS993 "Growing Potatoes in the Florida Home Garden" had more than 52,000 visits.
- The Extension program has maintained close contact with growers, processors, and marketers. Growers are introduced to new clones and varieties from the breeding programs through presentations at meetings, research reports, field days, demonstration trials and web sites. Growers have shared their perceptions of the strengths, weaknesses, and optimum production practices for new clones. The final decision for recommending and releasing a new variety is typically based on grower and/or industry input. The average attendance of our annual field days where we discuss the potato variety performance is about 40 people.
- Florida Potato Variety Trial Report is a publication released every year during our Annual Potato Meeting in April with all the results of the potato variety evaluation performed in by our Extension Program. Every attendant of the meeting receives a copy of the book. The book is also available at: http://hos.ufl.edu/extension/variety-trials/variety-trial-crops/potatoes
- Our Extension program is an active partner of the Eastern Potato Variety Development Project (NE1231) which direct collaborate with potato breeder. The project web site and interactive searchable database continues to grow in importance and popularity (http://potatoes.ncsu.edu/NE.html). The web site provides current contact information for project cooperators and recent research reports, as well as access to our regional variety database and a dynamic summary generator for all released varieties. This is a very important tool that helps the potato industry (growers, processors, breeder, etc) on the decision making.

The **medium-term objectives** were to facilitate commercial adoption of improved vegetable cultivars with superior traits, cultivation practices, and alternative crops by coordinating initial commercial trials and by developing management recommendations.

- Potato cultivation practices: Determination of proper potato seed piece spacing: results from three-year study of potato seed spacing indicated that by modifying the standard seed spacing of 8-inches to 10-inches did not affect marketable yield for chipping varieties Atlantic, Harley Blackwell and Elkton. By spacing the seed pieces at 10-in, grower save 20% in seed costs (not accounting for seed freight) which can be translated in addition revenue of $120-131/acre. For example, a 300-acre farm could save up to $39,000/season in seed costs.
- Broccoli: Two broccoli varieties were identified with superior yield and extended harvest season suitable for early spring harvest compared to the standard variety (Green Magic). With the identification of more adapted broccoli varieties to Florida conditions is fundamental for future expansion of the eastern broccoli industry and consequently reduce the dependency from west broccoli supply.
- Chipping Potato: Joint release of 'Elkton' by USDA and UF in 2012. 'Elkton' is a new processing potato cultivar adapted to Florida conditions and resistant to internal heat necrosis (serious problem for Florida growers). 'Elkton' has been tested at Hastings Research Farm since 1998 and in cooperation with local growers since 2011. 'Elkton' was named after the little berg in potato country in St. Johns County. In 2007, Florida grew 18,285 acres of processing potatoes. In 19 location-years of evaluation in Florida, 'Atlantic' (standard chipping variety) produced an average of 326 cwt/acre; Elkton produced 368 cwt/acre. At an average price of $15.5/cwt for chipping potatoes, if all the acreage were replaced with 'Elkton,' growers would receive $11.9 M/year more than with 'Atlantic.' This estimation does not take into consideration the number of acres plowed under when Atlantic goes off-grade because of internal heat necrosis. On a per acre basis, replacing Atlantic with Elkton would generate $651 in revenue.
- Advanced selected potato clones with superior traits: The Eastern Potato Variety Development Project (NE1231) places special emphasis on breeding and selecting clones with resistance to late blight, early blight, scab, golden nematode races Ro1 and Ro2, Colorado potato beetle, potato virus Y (PVY), and heat necrosis. Every season my Extension program evaluates from 250 to 500 different clones and select the promising clones with potential for higher yield and improved traits. Breeding clones (n=112) in the University of Maine program showed high levels of late blight resistance during 2014 and have been further evaluated in Florida. Particularly, the clone BNC182-5 has shown moderate early blight resistance in Pennsylvania trials and have yielded 15% higher than standard chip potato Atlantic in Florida trials.
- Specialty potatoes: *Papa criolla* is a very popular potato in South America that can be mashed, boiled, baked or fried, and is very flavorful. The variety is a diploid, yellow and orange flesh potato with high levels of lutein and zeaxanthin selected by USDA-ARS. In collaboration with the USDA breeder, my program has tested more than 500 clones since 2013 for adaptability to Florida production systems and two promising clones were selected. In spring 2016, I started the commercial testing of these clones in collaboration with growers.
- Specialty potato markets: There has been an increase in demand for specialty potato market (Creamers, golf ball-sized potatoes) from Florida. These potatoes sell for a

premium in grocery stores and in higher-end restaurants. Our Extension program has supported these growers with guidelines for N, fumigant and crop management. I have conducted demonstration trials at research farm and promoted field days. In spring 2016, about 400 acres have been cultivated with specialty potatoes varieties dedicated to alternative market.

- Chipping potatoes: About 50% of the chipping potato growers have exclusive production contracts with Frito Lay PepsiCo. to produce FritoLay chipping varieties. My Extension program evaluated Frito Lay early generation clones for yield and tuber. This effort directly helps the industry to fast track the selection of new potato varieties with improved traits and adaptability to Florida conditions.

24. CLINICAL SERVICE OR CLINICAL ACTIVITIES

N/A

25. SERVICE TO SCHOOLS

- Alachua County School Volunteer Program - Served as a Science Fair Judge for Lincoln Middle School. Dec. 2013.
- Alachua County School Volunteer Program - Served as a Science Fair Judge for Bishop Middle School. Nov. 2012.

26. MEMBERSHIP AND ACTIVITIES IN THE PROFESSION

A. Memberships

International

None

National

- 2014 – present – Member, American Society of Agricultural and Biological Engineers
- 2010 – present - Member, Potato Association of America
- 2010 – present - Member, American Society for Horticultural Science
- 2005 – present - Member, American Society of Agronomy
  2006 – present - Member, Soil Science Society of America

Regional

None

State

- 2010 – present – Member, Florida State Horticulture Society.

Local

None

B. Activities in the profession: