

**V(A). Planned Program (Summary)**

**Program # 1**

**1. Name of the Planned Program**

Global Food Security and Hunger

Reporting on this Program

**V(B). Program Knowledge Area(s)**

**1. Program Knowledge Areas and Percentage**

KA Code	Knowledge Area	%1862 Extension	%1890 Extension	%1862 Research	%1890 Research
101	Appraisal of Soil Resources			5%	
102	Soil, Plant, Water, Nutrient Relationships			10%	
201	Plant Genome, Genetics, and Genetic Mechanisms			5%	
202	Plant Genetic Resources			5%	
204	Plant Product Quality and Utility (Preharvest)			10%	
205	Plant Management Systems			10%	
206	Basic Plant Biology			15%	
216	Integrated Pest Management Systems			5%	
301	Reproductive Performance of Animals			10%	
302	Nutrient Utilization in Animals			5%	
303	Genetic Improvement of Animals			5%	
305	Animal Physiological Processes			5%	
307	Animal Management Systems			10%	
	<b>Total</b>			100%	

**V(C). Planned Program (Inputs)**

**1. Actual amount of FTE/SYs expended this Program**

Year: 2013	Extension		Research	
	1862	1890	1862	1890
Plan	0.0	0.0	11.0	0.0
Actual Paid Professional	0.0	0.0	7.6	0.0
Actual Volunteer	0.0	0.0	0.0	0.0

**2. Actual dollars expended in this Program (includes Carryover Funds from previous years)**

Extension		Research	
Smith-Lever 3b & 3c	1890 Extension	Hatch	Evans-Allen
0	0	472472	0
1862 Matching	1890 Matching	1862 Matching	1890 Matching
0	0	232710	0
1862 All Other	1890 All Other	1862 All Other	1890 All Other
0	0	0	0

**V(D). Planned Program (Activity)**

**1. Brief description of the Activity**

- Conduct resercah projects
- Present data oat conferences
- Publish results in sceintific journals
- Collaborate with other members of multistate projects

**2. Brief description of the target audience**

The target audience for this research is the farming and general community of the USVI, wider Caribbean region and tropical and subtropical areas throughout the world, and other scientists.

**3. How was eXtension used?**

n/a

**V(E). Planned Program (Outputs)**

**1. Standard output measures**

2013	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
<b>Actual</b>	0	0	0	0

**2. Number of Patent Applications Submitted (Standard Research Output)**

**Patent Applications Submitted**

Year: 2013  
 Actual: 0

**Patents listed**

**3. Publications (Standard General Output Measure)**

**Number of Peer Reviewed Publications**

<b>2013</b>	<b>Extension</b>	<b>Research</b>	<b>Total</b>
<b>Actual</b>	0	3	0

**V(F). State Defined Outputs**

**Output Target**

**Output #1**

**Output Measure**

- Abstracts presented at conferences

<b>Year</b>	<b>Actual</b>
2013	15

**V(G). State Defined Outcomes**

**V. State Defined Outcomes Table of Content**

O. No.	OUTCOME NAME
1	Number of new farmers adopting aquaponic technology
2	Number of local farmers that utilize cover crop technologies in mixed crop-livestock production systems.
3	The number of farmers who use the tested cover crops for soil improvement and as livestock forage.
4	Number of local farmers using proper fertilizer for papaya production, growing disease-free sweet potato, producing high starch content cassava and sorrel with high bioflavonoid content.
5	Selection of pest and disease resistant cultivars of vegetable crops for use by local farmers
6	Number of producers using later weaning in their sheep production.
7	Number of livestock producers that use a managed breeding system.

## **Outcome #1**

### **1. Outcome Measures**

Number of new farmers adopting aquaponic technology

### **2. Associated Institution Types**

- 1862 Research

### **3a. Outcome Type:**

Change in Action Outcome Measure

### **3b. Quantitative Outcome**

<b>Year</b>	<b>Actual</b>
2013	5

### **3c. Qualitative Outcome or Impact Statement**

#### **Issue (Who cares and Why)**

Interest in aquaponics is expanding rapidly on a global level. Aquaponics maximizes land use, recycles and conserves water, minimizes soil disturbance, recycles scarce nutrients, and produces a high valued protein source that in turn supplies nutrients to a comprehensive organic vegetable production system. Due to the growth of the vegetables in a soilless environment, the incidence of pests is greatly reduced which increases food quality and decreases pesticide use. Aquaponics systems are currently being maximized around the world and are of particular interest in tropical regions.

#### **What has been done**

Evaluated production of leafy green vegetables in the commercial aquaponic system that included kale, collards, Swiss chard and pak choi. Evaluated regrowth yields of sweet basil. Evaluated different foliar application concentrations of calcium and phosphorus on yield of zucchini.

#### **Results**

Some fruiting crops have difficulty with fruit set because of improperly balanced nitrogen and phosphorus. Zucchini also has some marketable fruit loss because of Blossom End Rot, a condition of insufficient calcium. The purpose of this study was to quantify zucchini production when foliar sprayed with different levels of calcium and phosphorus. To determine the effect of calcium on the zucchini production we looked at both the marketable and nonmarketable production. In the calcium group, five set of plants were treated including a control group that was not treated. The application rates of 0.0 (control), 1.25, 2.50, 3.74 and 5.0 mg/l where applied weekly to the plant leaf surfaces. The plant that was sprayed with a 3.75 mg/l concentration of calcium was most effective and had the highest level of total zucchini production at 33.9 kg/m<sup>2</sup> which included both marketable and unmarketable fruit. The control group however produced a high amount of unmarketable zucchinis (28.5 kg/m<sup>2</sup>). The marketable yield of 7.5 kg/m<sup>2</sup> from the

3.75 concentration was most effective.

The same method was used to determine the effect of different levels of phosphorus on the zucchini plants. Five sets of plants were used for this experiment including a control group. The application rates of 0.0 (control), 0.5, 1.0, 1.5 and 2.0 mg/l where applied weekly. The plant that received the 1.00 mg/l concentration of phosphorus was most effective and had the highest production of marketable zucchinis with a mass yield of 7.4 kg/m<sup>2</sup>. The plant that received 0.50 mg/l concentration of phosphorus yielded the highest number of unmarketable zucchini. Foliar application of both calcium and phosphorus was effective in increasing fruit number and mass for zucchini grown in an aquaponic system. Future research will evaluate combined nutrients to further enhance production.

#### 4. Associated Knowledge Areas

KA Code	Knowledge Area
205	Plant Management Systems
307	Animal Management Systems

#### Outcome #2

##### 1. Outcome Measures

Number of local farmers that utilize cover crop technologies in mixed crop-livestock production systems.

##### 2. Associated Institution Types

- 1862 Research

##### 3a. Outcome Type:

Change in Action Outcome Measure

##### 3b. Quantitative Outcome

Year	Actual
2013	4

##### 3c. Qualitative Outcome or Impact Statement

###### **Issue (Who cares and Why)**

Tropical smallholder farmers that operate under low external input (LEI) conditions often have integrated agricultural systems that include different combinations of agronomic, horticultural, and livestock interests. Biological and chemical relationships within agroecosystems are complex, particularly when agricultural crop and livestock systems are combined, and system dynamics are in need of deeper study. Traditional farming practices that include both crop and livestock production components are common models for farmers in the United States Virgin Islands (USVI) and many farmers in the United States of America are choosing to diversify their agricultural interests by moving towards crop/livestock systems. The USVI is characterized by a tropical/subtropical environment with a bimodal rainfall climate that consists of a rainy season and

a dry season. The dry season can last up to 6 months of the year with highly variable rainfall. Farmers face a number of increased challenges in the USVI which include drought, water shortage, soil infertility, increased pest pressure and abundance, rapid soil degradation, low forage availability, and poor pasture quality. Farmers have limited access to external resources and must rely on farm derived resources to maintain productivity. Cover crops can serve the dual purpose of providing ecosystem services and providing high quality forage for livestock production.

#### **What has been done**

Sunn hemp (SH; *Crotalaria juncea* L.) has historically been cultivated as a multi-purpose fiber crop that has received increased interest as a cover crop and green manure in both temperate and tropical climates. Sunn hemp may serve as a useful livestock forage when harvested as hay from mixed crop-livestock systems. A pen trial measured growth traits of post-weaning St. Croix White hair (n = 36) lambs fed a mixed ration containing a concentrate diet (16% crude protein) fed at 2% body weight and either SH or sorghum-sudan hay (SS; *Sorghum bicolor* x *S. sudanense* cv. Mega Green) fed ad-libitum for 84 days. Both SH and SS were cultivated on St. Croix, USVI prior to the feeding trial as part of a mixed cover crop-livestock systems experiment.

#### **Results**

The SH hay had an average of 116 g/kg crude protein, 556 g/kg acid detergent fiber, 713 g/kg neutral detergent fiber, and 557 g/kg in vitro dry matter digestibility. The SS hay had an average of 83 g/kg crude protein, 468 g/kg acid detergent fiber, 669 g/kg neutral detergent fiber, and 605 g/kg in vitro dry matter digestibility. Lambs receiving SH hay did not exhibit increased growth performance over lambs receiving the SS hay. Sunn hemp hay resulted in an average daily gain (ADG) of 80 g compared to SS hay with an ADG of 75 g. However, as previous research indicates, castrated male lambs had greater ADG than female lambs with 89 g compared to 70 g, respectively (P<0.05). This study indicates that St. Croix White Hair Lambs will consume SH hay and attain growth performance similar to that of the conventional forage SS. Sunn hemp hay is a tropical legume that can grow without the need for nitrogen fertilizer and has plant tissue quality characteristics that make it a viable option as an alternative livestock forage resource.

#### **4. Associated Knowledge Areas**

<b>KA Code</b>	<b>Knowledge Area</b>
204	Plant Product Quality and Utility (Preharvest)
205	Plant Management Systems
302	Nutrient Utilization in Animals
307	Animal Management Systems

#### **Outcome #3**

##### **1. Outcome Measures**

The number of farmers who use the tested cover crops for soil improvement and as livestock forage.

##### **2. Associated Institution Types**

- 1862 Research

**3a. Outcome Type:**

Change in Action Outcome Measure

**3b. Quantitative Outcome**

Year	Actual
2013	0

**3c. Qualitative Outcome or Impact Statement**

**Issue (Who cares and Why)**

Tropical smallholder farmers that operate under low external input (LEI) conditions often have integrated agricultural systems that include different combinations of agronomic, horticultural, and livestock interests. Biological and chemical relationships within agroecosystems are complex, particularly when agricultural crop and livestock systems are combined, and system dynamics are in need of deeper study. Traditional farming practices that include both crop and livestock production components are common models for farmers in the United States Virgin Islands (USVI) and many farmers in the United States of America are choosing to diversify their agricultural interests by moving towards crop/livestock systems. The USVI is characterized by a tropical/subtropical environment with a bimodal rainfall climate that consists of a rainy season and a dry season. The dry season can last up to 6 months of the year with highly variable rainfall. Farmers face a number of increased challenges in the USVI which include drought, water shortage, soil infertility, increased pest pressure and abundance, rapid soil degradation, low forage availability, and poor pasture quality. Farmers have limited access to external resources and must rely on farm derived resources to maintain productivity. Cover crops can serve the dual purpose of providing ecosystem services and providing high quality forage for livestock production.

**What has been done**

We evaluated live animal performance of Dorper X St. Croix White lambs managed in two different types of post-weaning grazing systems. The first grazing system represented conventional grazing on low quality native pasture (NP), and the second grazing system was comprised of the same NP grasses, but improved with the tropical legume *Crotalaria juncea* L. cv tropic sunn (IP) which is being widely used as a cover crop. After weaning and background grazing on native pasture for six months, lambs (n = 38) were stratified by weight and sex into either the NP or IP treatment. Both treatment grazing systems consisted of a mix of predominantly hurricane grass (*Boithrocloa pertusa*) and guinea grass (*Panicum maximum*). The IP treatment was improved with sunn hemp which was directly seeded into the hurricane grass sod using a Great Plains No-Till Drill at a seeding rate of 45 kg/ha.

**Results**

Compared to NP lambs, IP lambs were heavier at slaughter with a mean weight of 34.7 kg compared to NP lambs at 28.2 kg (P < 0.05). During the grazing trial IP lambs had greater total weight gain than NP lambs (7.9 vs. 3.7 kg, respectively) and higher ADG than NP lambs (74 vs. 34.5 g/d, respectively; P < 0.05). Results of this study indicate that the tropic sun cultivar of sunn hemp can be no-till drilled into low quality hurricane grass pasture, achieve a stand capable of

increasing lamb performance, and can improve pasture quality through the inclusion of a palatable leguminous forage that withstands grazing pressure for over 100 days.

#### 4. Associated Knowledge Areas

KA Code	Knowledge Area
101	Appraisal of Soil Resources
205	Plant Management Systems
302	Nutrient Utilization in Animals
307	Animal Management Systems

#### Outcome #4

##### 1. Outcome Measures

Number of local farmers using proper fertilizer for papaya production, growing disease-free sweet potato, producing high starch content cassava and sorrel with high bioflavonoid content.

##### 2. Associated Institution Types

- 1862 Research

##### 3a. Outcome Type:

Change in Action Outcome Measure

##### 3b. Quantitative Outcome

Year	Actual
2013	35

##### 3c. Qualitative Outcome or Impact Statement

###### **Issue (Who cares and Why)**

Local farmers and backyard gardeners as well as local consumers. Farmers and backyard gardeners want to employ the most efficient methods for production and see substantial gain from their inputs. Local consumers want access to fresh, locally-grown quality produce. Sweet potato weevil is the most serious pest of sweet potato, not only in the Virgin Islands and throughout the Caribbean. It causes damage in the field to leaves, stems and tuberous roots.

###### **What has been done**

Evaluation of potassium levels on papaya production continued in this crop normally grown for 1.5 years in the Virgin Islands. Fruit set, size, length, width and soluble sugar content were recorded. Cross pollination of inbred sorrel plants (*Hibiscus sabdariffa*) normally results in hybrid with vigor that out-perform both parents. Two varieties of red sorrel, ?TTB?, which is deep crimson and open, and a ?KDN?, which is day neutral and red, were use as parents. ?TTB? was late flowering with a crimson fruit and ?KDN? was day-neutral with red fruit. Two parental sorrel lines and the F1 and F3 progeny to evaluate plant vigor for production, floral initiation, fruit color and shape. Selection of plants from the F2 population were used to obtain seed for the F3 progeny.

Plant vigor was determined by measuring plant height and number of branches at two week intervals as well as recording when floral buds became visible. Twelve sweet potato varieties were from in vitro virus-free material and six were Caribbean farmer varieties. The varieties were established from six node cuttings in a replicated trial at one foot in-row spacing and five feet between rows. Weevil traps with a male pheromone were distributed throughout sweet potato plantings and monitored weekly. Harvest was conducted at 100 and 130 days.

### Results

All papaya varieties became infected with papaya ringspot virus over time and this reduced the vigor, fruit production and quality over time. The weakened plant became more susceptible to secondary infections of virus and pathogens. In the sorrel, the F1 population of ?TTB? x ?KDN? had a trend of being taller than the parents, it wasn't significant for plant height and branch development. The F3 populations were significantly taller than the F1 and parent varieties. The F1 and F3 ?TTB?x?KDN? plants initiated flowers at the same time as ?TTB? which was two weeks later than ?KDN?. However, the F3 line of ?KDN?x?TTB? initiated flowers at the same time as ?KDN? indicating a new day neutral variety. The day neutral characteristic can be recovered in F3 population where ?KDN? was the female parent.

Sweet potato weevils were found to increase during the initial four weeks and stabilized during the rest of the growing season. Through the course of the trial, nearly 2,000 male weevils were captured and destroyed. These numbers however indicate that sweet potato weevils were at a high pressure throughout the growing period. All varieties had weevil damage at 100 days (4-15%), however by 130 days the weevil damage ranged from 4-75%. Six varieties were selected for early production to avoid the weevil tuberous root damage and six varieties for late production that resist weevil damage due to the deep development of the tuberous roots.

## 4. Associated Knowledge Areas

KA Code	Knowledge Area
201	Plant Genome, Genetics, and Genetic Mechanisms
202	Plant Genetic Resources
204	Plant Product Quality and Utility (Preharvest)
205	Plant Management Systems
206	Basic Plant Biology

### Outcome #5

#### 1. Outcome Measures

Selection of pest and disease resistant cultivars of vegetable crops for use by local farmers

#### 2. Associated Institution Types

- 1862 Research

**3a. Outcome Type:**

Change in Knowledge Outcome Measure

**3b. Quantitative Outcome**

Year	Actual
2013	3

**3c. Qualitative Outcome or Impact Statement**

**Issue (Who cares and Why)**

Current economic development strategy in the United States Virgin Islands (USVI) aims to enhance horticulture production through sustainable methods in order to meet local demands of horticultural commodities. Vegetables are important commercial crops for producers within the USVI and are grown for fresh market. Consumers have begun to give more consideration to the vegetables due to nutritional benefits and popularity because of their high levels of vitamins and minerals. 2007 Census of agriculture for the US Virgin Islands indicates that production has decreased in many vegetables such as tomato, eggplant, okra, cabbage, squash, lettuce etc. since 2002. Geographic position, limited production and declining economy have considerable constraints for the economic development and vegetable production in the USVI. Quality and production of vegetable crops has affected severely due to high production cost, spread of soil borne diseases and pests, natural disasters, superior varieties, weeds. Cultivar trials are an important tool for increasing production efficiency, therefore, the objective of the proposed research project is to observe improved cultivars of selected vegetables for yield, quality, weed control and adaptability in the local soil and climatic conditions of the US Virgin Islands. Any improvement in these economically important crops by applying modern scientific techniques will directly affect the quality of life of the farmers and overall population of the community. The expected output of the project are; i) Introduction of new varieties of vegetables, which possess good eating and growing quality with superior agronomic characteristics, ii) New varieties introduced, individually potted and planted in the greenhouse and field, iii) Establishment of field research blocks for variety testing, iv) Collection of data, and information obtained from the field trials and evaluations of the vegetables, v) Publications of research papers and presentation of findings in journals of international repute and conferences. By developing improved varieties

**What has been done**

Vegetable variety trials for eggplant and okra were conducted during the 2013 growing season. Ten varieties of eggplants were obtained from commercial seed companies and were evaluated at the Agriculture Experiment Station. The eggplant varieties tested were Orient Charm, Machiaw, Fairy Tale, Dancer, Beatrice, Calliope, Barbarella, Rosa Blance, Nubia, and Shooting Stars. Within each variety treatment, non-data rows within each plot were treated with one of two types of biostimulants. The biostimulants tested were Biozest and Stimplex.

**Results**

Data collected from the 2013 eggplant and okra trials are currently being analyzed and results will be disseminated to local farmers.

**4. Associated Knowledge Areas**

KA Code	Knowledge Area
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201	Plant Genome, Genetics, and Genetic Mechanisms
202	Plant Genetic Resources
204	Plant Product Quality and Utility (Preharvest)
205	Plant Management Systems

**Outcome #6**

**1. Outcome Measures**

Number of producers using later weaning in their sheep production.

**2. Associated Institution Types**

- 1862 Research

**3a. Outcome Type:**

Change in Action Outcome Measure

**3b. Quantitative Outcome**

Year	Actual
2013	2

**3c. Qualitative Outcome or Impact Statement**

**Issue (Who cares and Why)**

Hair sheep produce lightweight carcasses and tend to be marketed at light live weights ( 30-35 kg). In an accelerated lambing system weaning hair sheep lambs later than 63 days of age could result in heavier lambs at weaning and lower feed costs, at \$600/ton, to get lambs to reach market weight. Minimizing the costs associated with lamb production would benefit sheep producers in the USVI.

**What has been done**

St. Croix White (STX; n = 25; 4.1 yr of age) and Dorper x St. Croix White (DRPX; n = 23; 3.3 yr of age) ewes were assigned to treatment groups at lambing based on breed, age, number and sex of lambs. Treatments consisted of weaning lambs at 63 (n = 21), 90 (n = 21) or 120 (n = 20) days of age. After weaning lambs were provided with a concentrate ration fed at 2% body weight/hd/day while grazing guinea grass pastures. All lambs were weighed at 63, 90 and 120 d of age. At these times lambs were scored using the FAMACHA system and fecal and blood samples were collected from to determine fecal egg counts (FEC) and packed cell volume (PCV) as indicators of parasite burden. Lambs were also monitored using the FAMACHA method each week between these time points (63, 90 and 120 d of age) and treated with an anthelmintic if they had a FAMACHA score of 4 or higher. All ewes were sampled when their lambs were 63, 90 and 120 d of age. At these times ewes were scored using the FAMACHA system and fecal and blood samples were collected to determine FEC and PCV as indicators of parasite burden. Ewes were also monitored using the FAMACHA method each week between these time points (63, 90 and 120 d of age of lamb) and treated with an anthelmintic if they had a FAMACHA score of 4 or

higher.

### **Results**

Weaning hair lambs later than 63 days of age results in heavier lambs at weaning. Parasite burdens increase in all lambs regardless of weaning age but this was not detected using the FAMACHA scores. Because of the parasite resilience of hair sheep breeds in the USVI the FAMACHA system may not be as applicable as it is for other more susceptible breeds.

### **4. Associated Knowledge Areas**

<b>KA Code</b>	<b>Knowledge Area</b>
301	Reproductive Performance of Animals
303	Genetic Improvement of Animals
307	Animal Management Systems

### **Outcome #7**

#### **1. Outcome Measures**

Number of livestock producers that use a managed breeding system.

#### **2. Associated Institution Types**

- 1862 Research

#### **3a. Outcome Type:**

Change in Action Outcome Measure

#### **3b. Quantitative Outcome**

<b>Year</b>	<b>Actual</b>
2013	1

#### **3c. Qualitative Outcome or Impact Statement**

##### **Issue (Who cares and Why)**

Managing cattle production to coincide with market demand and forage availability is critical to producers in the USVI. Using managed breeding allows more rapid selection to take place because pedigree information is known and can be evaluated.

##### **What has been done**

This study was conducted to evaluate production traits of Senepol cows calving in the spring or fall on St. Croix. Cows were bred by natural service for a 60-d period each year starting in June or December and calved in the spring of 2009, 2010, 2011 and 2012 (n = 332 data points) or the fall of 2009, 2010 and 2011 (n = 93 data points). Cow data collected at breeding, calving and weaning was BW, hip height (HHT) and condition score (CS; 1 = thin, 9 = fat). Calf data (n = 190

data points) included birth (BRWT), weaning weight (WWT) and 205-d adjusted weaning weight (AWWT). Cow efficiency was calculated as the ratio of calf WWT to cow BW at weaning.

### **Results**

At breeding cows calving in the fall were heavier and had higher condition scores than the spring calving cows ( $624 \pm 9$  vs.  $562 \pm 6$  kg, respectively;  $7.3 \pm 0.1$  vs.  $6.8 \pm 0.1$ , respectively). At calving the fall calving cows were heavier than spring calving cows ( $628 \pm 9$  vs.  $586 \pm 6$  kg, respectively). There was no difference ( $P > 0.10$ ) in hip height, condition score or calf birth weight. At weaning the fall calving cows were heavier, had greater hip height, lower cow efficiency and weaning rate compared to spring calving cows.

## **4. Associated Knowledge Areas**

<b>KA Code</b>	<b>Knowledge Area</b>
301	Reproductive Performance of Animals
303	Genetic Improvement of Animals
305	Animal Physiological Processes
307	Animal Management Systems

## **V(H). Planned Program (External Factors)**

### **External factors which affected outcomes**

- Natural Disasters (drought, weather extremes, etc.)
- Economy
- Appropriations changes

### **Brief Explanation**

Hurricanes can impact all of the research activities by damaging facilities and crops. Local economic issues can reduce appropriations to UVI from the local government which can curtail hiring or filling critical vacancies. New invasive pests and diseases can devastate susceptible crop plants and livestock.

## **V(I). Planned Program (Evaluation Studies)**

### **Evaluation Results**

Stakeholders are pleased with the amount of research being conducted and have implemented the strategies when and where it was appropriate.

### **Key Items of Evaluation**

The tropical environment has unique issues not encountered under temperate conditions. Limited resource stakeholders are not always able to afford the technologies they need to make their farming enterprise the most economically sound.