2013 University of the Virgin Islands Research Annual Report of Accomplishments and Results

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I. Report Overview

1. Executive Summary

The work conducted by AES scientists is production oriented. The small size of AES and limited physical and fiscal resources limit our ability to expand into new research areas. One way of addressing this issue is developing collaborations with other departments and institutions. AES has continued to collaborate with the other insular land grant institutions to obtain funds for student support in AES labs. The Resident Instruction funds at UVI are used to support students who conduct research projects in AES labs and present their results at local, regional and national conferences. AES has undergone contraction to four research programs and 3.2 faculty in order to deal with budget cuts and restrictions. The four programs in AES currently are Agronomy, Animal Science, Biotechnology & Agroforestry, and Horticulture & Aquaculture. The Director of AES has an 80/20 split between administration and research (Animal Science). The Director of AES has been appointed to the Board on Agriculture Assembly Policy Board of Directors as the Insular Areas Representative.

The Agronomy program continues to strengthen its research capacity and diversify research interests. The Agronomy research program is currently investigating innovative technical scientific advancements and progressive management methods in targeted agricultural disciplines. Research areas include a systems approach to their scope and experimental design. Current focus areas are mixed crop livestock production systems, integrated soil and crop science, water resource management, livestock production, cover crop technology and biofuel production. The Agronomy program is in its second year of the Southern SARE grant project and has completed the evaluation of eight cover crop species and in some cases the evaluation of multiple cultivars within a specific species. Promising cover crops were further evaluated in cover crop to horticulture rotations that examined the continued effect of the cover crop surface residue when utilized as ground cover mulch for subsequent pepper production. Both sunn hemp and sunflower exhibited strong suppression up to six weeks after pepper transplanting and yielded higher pepper weights than peppers grown under conventional methods. This research is being mirrored by collaborators at the University of Puerto Rico and the University of Florids. The Agronomy program is collaborating with the University of Tennessee on a biofuel production grant that examines different alternative fertilization methods that includes the intercropping of legumes into biofuel grass stands. Great success has also been obtained by the Agronomy program in demonstrating how sunn hemp can be no-till planted into poor quality native pastures and utilized as a high grazing value legume that has the ability to withstand extended periods of rotational grazing by sheep. Results from these projects and others were presented at a number of different workshops, seminars and professional meetings.

The Animal Science faculty continued collaboration with CES colleagues at the University of Hawaii to conduct livestock production workshops in the Northern Marianas Islands as part of a USDA Office of Advocacy and Outreach grant (Outreach and Assistance in Tropical Pasture and Livestock Management for Pacific Islanders). Using information generated at UVI, cattle producers in the Marianas Islands were trained in artificial insemination using Senepol semen to increase the genetic diversity of their cattle herds. Calves were born in the Fall of 2012 and more cows are being bred as part of the project. Two undergraduate students were mentored in the Animal Science program research lab with support from the Insular Grants Program for Resident Instruction. The students conducted work that was part of an ongoing USDA-NIFA TSTAR project and a multistate research project (W-2173). The TSTAR project is evaluating

evapotranspiration (sweating rates) of hair sheep in collaboration with U of Hawaii, University of Arizona and Cornell University as part of a multistate research project (W-2173). Hair sheep were evaluated during the summer of 2013 and compared across genotype and pregnancy using St. Croix White and Dorper x St. Croix White ewes. The Research Analyst that managed the cattle herd resigned in the Summer of 2013. The position has been advertised and candidates were interviewed, but none accepted the position. Staff members form within the Animal Science program will be promoted in to the position to fill the void.

The Biotechnology & Agroforestry program worked with the CES and the VI Department of Agriculture (VIDA) to conduct workshops on both St Croix and St Thomas involving fruit and vegetable production through a Beginning Farmer and Rancher Training project. The target audience was new farmers and backyard gardeners and involved over 30 participants on each island. Planting material was distributed from the new selected virus-free sweet potato varieties. Growers were eager to try the new varieties that included new types with purple or orange flesh as compared to the common red-skinned white-flesh varieties. A TSTAR project in collaboration with the University of Florida studying the causal agent of a wilt disease that is devastating to sorrel production indicated a Phytophthora strain not before seen in the Virgin Islands. Because of this disease, a screening of the USDA sorrel germplasm collection became part of a multistate (S-9) study and breeding to develop tolerant and/or resistant varieties. An on-going study of muscadine grapes through a Specialty Crops grant with the University of Florida and three other institutes has indicated that these grapes go through a dormancy period induced by short day length when grown in the Virgin Islands. Two Specialty Crops Block grants through the VIDA focus on two potentially new crops for the Virgin Islands, ginger and pitaya. Initial success has been obtained when these are grown on production high pH calcareous soil. Four prebachelorette student research projects have been funded through this and the Insular Tropical Grant funds which has allowed the students to present their results at national conferences and have their research published.

The Horticulture & Aquaculture program continued to investigate research interests under their USGS-WRRI, USDA-SCBG and Hatch projects. These projects are in collaboration with UVI-CES, the VI Department of Agriculture, local farmers and USDA to help improve crop performance and to develop technical strategies to address on farm challenges in the production of fruits and vegetables. Over the past year, these projects involved three student workers that provided project assistance and received valuable agricultural science experience. Projects involved the evaluation of okra and eggplant cultivars for growth, pest and disease resistance, and fruit yield. A study on the use of two newly released vegetable growth promoters was conducted on both okra and eggplant. Over 300 mango seedlings were started from local kidney mango trees to provide root stock for grafting improved fruit varieties. The grafted mangoes will be provided to the local Virgin Islands Department of Agriculture for distribution to local farmers for fruit orchard improvement projects. The Aquaculture Program conducted another season of aquaponic short courses, which consisted of four courses and instructed 60 students from around the world. The Aquaculture Program continued research into vegetable production within its world-renowned aquaponic production system. Aquaponic vegetable production methods were researched to examine the effects of different foliar applications of calcium and phosphorus on plant and fruit nutrient deficiencies such as blossom end rot in squash. New vegetables were tested and different vegetable cultivars were evaluated to determine the highest performing vegetable cultivars for use in aquaponic systems. Evaluations were conducted on multiple varieties and harvest methods of kale, swiss chard, pak-choi, bok-choy, eggplant, zucchini, basil, marigolds, lettuce, squash, chives, okra and sorrel.

Total Actual Amount of professional FTEs/SYs for this State

Year: 2013	Extension		Research	
	1862	1890	1862	1890
Plan	0.0	0.0	13.0	0.0
Actual	0.0	0.0	11.2	0.0

II. Merit Review Process

1. The Merit Review Process that was Employed for this year

- Combined External and Internal University External Non-University Panel

2. Brief Explanation

The Agricultural Experiment Station (AES) uses internal reviewers from academic faculty and Cooperative Extension Service as well as external professionals from the VI Dept. of Agriculture to review Hatch proposals. The AES has an advisory council of active farmers in the community that provide input on the research being conducted and ideas of areas to focus on to resolve agronomic challenges in the US Virgin Islands.

III. Stakeholder Input

1. Actions taken to seek stakeholder input that encouraged their participation

- Use of media to announce public meetings and listening sessions
- Targeted invitation to traditional stakeholder groups
- Targeted invitation to non-traditional stakeholder groups
- Targeted invitation to traditional stakeholder individuals
- Targeted invitation to non-traditional stakeholder individuals
- Targeted invitation to selected individuals from general public

Brief explanation.

Stakeholder participation is encouraged through our advisory council and interaction at workshops, yearly agricultural fair and World Food Day activities. AES is often featured on radio farm broadcasts and in government channel videos of select agricultural topics and workshops. AES actively engages our stakeholders also through on-farm research projects.

2(A). A brief statement of the process that was used by the recipient institution to identify individuals and groups stakeholders and to collect input from them

1. Method to identify individuals and groups

- Use Advisory Committees
- Other (Individual, direct contacts from the community)

Brief explanation.

Individuals and groups are identified through farmers organizations, active members of the farming community and stakeholders approching us for advise.

2(B). A brief statement of the process that was used by the recipient institution to identify individuals and groups who are stakeholders and to collect input from them

1. Methods for collecting Stakeholder Input

- Meeting with traditional Stakeholder groups
- Meeting with traditional Stakeholder individuals
- Meeting with the general public (open meeting advertised to all)
- Other (Clients contact AES with specific requests)

Brief explanation.

Through listening to our stakeholders at previously described activities through which we interact and recording their input.

3. A statement of how the input will be considered

- To Identify Emerging Issues
- Redirect Research Programs

Brief explanation.

Information is gathered and reviewed. If the issues identified by the stakeholders can be directly resolved with the present AES focus and fund allocation, it is handled by the program within AES. If outside expertise is needed, other Land Grant programs are contacted. Issues that require multiple years are developed into a grant proposal for funding.

Brief Explanation of what you learned from your Stakeholders

The stakeholders needs in the US Virgin Islands are very diverse. New farmers have multiple questions and concerns that established farmers have resolved. The stakeholders have been very supportive of AES and have seen the benefit to the community. AES is repected for working on and resolving the issues of our limited resource stakeholders.

IV. Expenditure Summary

1. Total Actual Formula dollars Allocated (prepopulated from C-REEMS)			
Extension		Research	
Smith-Lever 3b & 3c	1890 Extension	Hatch	Evans-Allen
0	0	965224	0

2. Totaled Actual dollars from Planned Programs Inputs				
	Extension		Research	
	Smith-Lever 3b & 3c	1890 Extension	Hatch	Evans-Allen
Actual Formula	0	0	504499	0
Actual Matching	0	0	248484	0
Actual All Other	0	0	0	0
Total Actual Expended	0	0	752983	0

3. Amount of Above Actual Formula Dollars Expended which comes from Carryover funds from previous				
Carryover	0	0	0	0

V. Planned Program Table of Content

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%	
	Total			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
Actual	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

2013	Extension	Research	Total
Actual	0	3	0

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Abstracts presented at conferences

Year	Actual
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

Year	Actual
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 compreshensive 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/m2 which included both marketable and unmarketable fruit. The control group however produced a high amount of unmarketable zucchinis (28.5 kg/m2). The marketable yield of 7.5 kg/m2 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/m2. 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

KA Code	Knowledge Area
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

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

KA Code	Knowledge Area
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

Year	Actual
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 ± 9 vs. 562 ± 6 kg, respectively; 7.3 ± 0.1 vs. 6.8 ± 0.1, respectively). At calving the fall calving cows were heavier than spring calving cows (628 ± 9 vs. 586 ± 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

KA Code	Knowledge Area
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 devistate suceptible 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.

V(A). Planned Program (Summary)

Program # 2

1. Name of the Planned Program

Climate Change

☑ 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
102	Soil, Plant, Water, Nutrient Relationships			15%	
111	Conservation and Efficient Use of Water			15%	
132	Weather and Climate			10%	
205	Plant Management Systems			15%	
305	Animal Physiological Processes			10%	
306	Environmental Stress in Animals			10%	
307	Animal Management Systems			15%	
405	Drainage and Irrigation Systems and Facilities			10%	
	Total			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	2.0	0.0
Actual Paid Professional	0.0	0.0	2.1	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	32027	0
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
0	0	15774	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 research
- Publish results in scientific journals
- Present data at conferences
- Collaborate with other members of multistate project

2. Brief description of the target audience

- Beef cattle producers in the tropics, greater Caribbean, Central and South America and the southern US.
- Local crop farmers and back yard growers.

3. How was eXtension used?

eXtension was not used in this program

V(E). Planned Program (Outputs)

1. Standard output measures

2013	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	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

2013	Extension	Research	Total
Actual	0	1	0

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Abstracts presented at conferences

Year	Actual
2013	1

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	Number of farmers adopting irrigation strategies based on soil moisture
2	Knowledge of fertigation and chemigation use in vegetable crop production
3	Determine traits for heat tolerance by using indirect measures.

Outcome #1

1. Outcome Measures

Number of farmers adopting irrigation strategies based on soil moisture

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2013	6

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
The "Challenge of the 21st century" will be coping with water scarcity according to the Food and Agriculture Organization of the United Nations (FAO) Director-General, Dr. Jacques Diouf. Much effort will be required to meet food and freshwater demands for an anticipated 2030 global population of 8.1 billion. Fresh water is presently a scarcity in the US Virgin Islands since there are no flowing rivers and stream so that municipal water is derived from desalination. The US Virgin Islands also has an extended dry season during five months of the year. Microirrigation is the most efficient use of water for crop production. The vine crops that comprise the cucurbits are important vegetable in the US Virgin Islands and the use of fertigation has potential to increase crop production and water use efficiency.

What has been done
Three different types of drip irrigation were tested during the production of 4 different vegetable crops. Polyhose and T-Tape with varying drip emitter spacing was tested at different row spacings to minimize water loss and decrease weed development. Standard fertilizer levels were applied as fertigation through the various microirrigation arrangements tested. Findings of the projects are currently being analyzed for dissemination and fact sheet publication. A low-external-input water delivery system was built that utilizes pedal power to pump water from a reservoir to an elevated holding tank. Gravity then delivered the water through microirrigation to vegetable plots. This system was demonstrated to small farmers and home gardeners as a low input water delivery system

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
102	Soil, Plant, Water, Nutrient Relationships
111	Conservation and Efficient Use of Water
132	Weather and Climate
205	Plant Management Systems
405	Drainage and Irrigation Systems and Facilities

Outcome #2

1. Outcome Measures

Knowledge of fertigation and chemigation use in vegetable crop production

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2013	4

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Issue (Who cares and Why)
The "Challenge of the 21st century" will be coping with water scarcity according to the Food and Agriculture Organization of the United Nations (FAO) Director-General, Dr. Jacques Diouf. Much effort will be required to meet food and freshwater demands for an anticipated 2030 global population of 8.1 billion. Fresh water is presently a scarcity in the US Virgin Islands since there are no flowing rivers and stream so that municipal water is derived from desalination. The US Virgin Islands also has an extended dry season during five months of the year. Microirrigation is the most efficient use of water for crop production. The vine crops that comprise the cucurbits are important vegetable in the US Virgin Islands and the use of fertigation has potential to increase crop production and water use efficiency.

What has been done
Fertigation experiments were conducted in 2013 to determine the best management practices for fertigation of vegetable crops under different drip irrigation systems and emitter type/spacing. Systems were specifically designed and evaluated for use in low external input farming to reduce

fertilizer loss.

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
102	Soil, Plant, Water, Nutrient Relationships
111	Conservation and Efficient Use of Water
132	Weather and Climate
205	Plant Management Systems
306	Environmental Stress in Animals

Outcome #3

1. Outcome Measures

Determine traits for heat tolerance by using indirect measures.

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2013	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Adaptation to a tropical climate is a trait that most livestock in the UVI possess. Determining how the physiology of these animals is impacted can be used when making management decisions ro when selecting for these traits in breeding programs.

What has been done
Multiparous, pregnant STX and DRPX ewes were evaluated at 126 d of gestation and 46 d postpartum over 4 d in the shade and in the sun. Each ewe had a spot on her right flank shaved prior to data collection (Shaved). The right side of the coat was left intact (Unshaved). Temperature data loggers, programmed to record vaginal temperature (VT) at 10-min intervals,

were removed after 96 hr. Rectal temperature (RT) was also measured. Eye temperature was measured using infrared images (IREYE). Surface temperature over Shaved and Unshaved areas was measured using a hand-held infrared thermometer (IRR). Respiration rate was measured as breaths per minute (bpm) using visual observation (RR) and sweating rate (SWR) was measured at Shaved and Unshaved areas of each ewe

Results

Mean temperature, relative humidity, THI and solar radiation during the data collection were 27.4 °C, 84 %, 79.1 and 232 W/m2, respectively. Surface temperature of Shaved was higher in STX than in DRPX ewes (37.0 ± 0.1 vs. 37.7 ± 0.1 °C, respectively). Unshaved surface temperature was 35.2 °C for both breeds. Surface temperature of Shaved was higher ($P < 0.0001$) than Unshaved for both STX (37.0 ± 0.1 vs. 35.2 ± 0.1 °C) and DRPX (37.7 ± 0.1 vs. 35.2 ± 0.1 °C) ewes. Ewes had higher RR and surface temperature of Shaved and Unshaved in the sun than in the shade. Eye temperature was higher in the sun than in the shade for DRPX ewes but there was no difference in STX ewes. Sweating rate was higher in STX ewes in the sun than in the shade but there was no difference between DRPX ewes. VT was higher in DRPX ewes compared to STX ewes

4. Associated Knowledge Areas

KA Code	Knowledge Area
132	Weather and Climate
305	Animal Physiological Processes
306	Environmental Stress in Animals
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

V(I). Planned Program (Evaluation Studies)

Evaluation Results

The AES advisory council assists as an external evaluator of our results.

Key Items of Evaluation

V(A). Planned Program (Summary)

Program # 3

1. Name of the Planned Program

Childhood Obesity

☐ Reporting on this Program

Reason for not reporting

Not conducting any research in this area.

V(B). Program Knowledge Area(s)

1. Program Knowledge Areas and Percentage

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	0.0	0.0
Actual Paid Professional	{NO DATA ENTERED}	{NO DATA ENTERED}	{NO DATA ENTERED}	{NO DATA ENTERED}
Actual Volunteer	{NO DATA ENTERED}	{NO DATA ENTERED}	{NO DATA ENTERED}	{NO DATA ENTERED}

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

Extension		Research	
Smith-Lever 3b & 3c	1890 Extension	Hatch	Evans-Allen
{NO DATA ENTERED}	{NO DATA ENTERED}	{NO DATA ENTERED}	{NO DATA ENTERED}
1862 Matching	1890 Matching	1862 Matching	1890 Matching
{NO DATA ENTERED}	{NO DATA ENTERED}	{NO DATA ENTERED}	{NO DATA ENTERED}
1862 All Other	1890 All Other	1862 All Other	1890 All Other
{NO DATA ENTERED}	{NO DATA ENTERED}	{NO DATA ENTERED}	{NO DATA ENTERED}

V(D). Planned Program (Activity)

1. Brief description of the Activity

No activities planned

2. Brief description of the target audience

No activities planned

3. How was eXtension used?

{No Data Entered}

V(E). Planned Program (Outputs)

1. Standard output measures

2013	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	0	0	0	0

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

Patent Applications Submitted

Year: 2013

Actual: {No Data Entered}

Patents listed

{No Data Entered}

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2013	Extension	Research	Total
Actual	0	0	0

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- {No Data Entered}

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

Outcome #1

1. **Outcome Measures**

{No Data Entered}

V(H). Planned Program (External Factors)

External factors which affected outcomes

Brief Explanation

{No Data Entered}

V(I). Planned Program (Evaluation Studies)

Evaluation Results

{No Data Entered}

Key Items of Evaluation

{No Data Entered}

V(A). Planned Program (Summary)

Program # 4

1. Name of the Planned Program

Sustainable Energy

☐ Reporting on this Program

Reason for not reporting

Not conducting any research in this area.

V(B). Program Knowledge Area(s)

1. Program Knowledge Areas and Percentage

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	0.0	0.0
Actual Paid Professional	{NO DATA ENTERED}	{NO DATA ENTERED}	{NO DATA ENTERED}	{NO DATA ENTERED}
Actual Volunteer	{NO DATA ENTERED}	{NO DATA ENTERED}	{NO DATA ENTERED}	{NO DATA ENTERED}

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

Extension		Research	
Smith-Lever 3b & 3c	1890 Extension	Hatch	Evans-Allen
{NO DATA ENTERED}	{NO DATA ENTERED}	{NO DATA ENTERED}	{NO DATA ENTERED}
1862 Matching	1890 Matching	1862 Matching	1890 Matching
{NO DATA ENTERED}	{NO DATA ENTERED}	{NO DATA ENTERED}	{NO DATA ENTERED}
1862 All Other	1890 All Other	1862 All Other	1890 All Other
{NO DATA ENTERED}	{NO DATA ENTERED}	{NO DATA ENTERED}	{NO DATA ENTERED}

V(D). Planned Program (Activity)

1. Brief description of the Activity

No Activities planned

2. Brief description of the target audience

No Activities planned

3. How was eXtension used?

{No Data Entered}

V(E). Planned Program (Outputs)

1. Standard output measures

2013	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	0	0	0	0

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

Patent Applications Submitted

Year: 2013

Actual: {No Data Entered}

Patents listed

{No Data Entered}

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2013	Extension	Research	Total
Actual	0	0	0

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- {No Data Entered}

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

Outcome #1

1. **Outcome Measures**

{No Data Entered}

V(H). Planned Program (External Factors)

External factors which affected outcomes

Brief Explanation

{No Data Entered}

V(I). Planned Program (Evaluation Studies)

Evaluation Results

{No Data Entered}

Key Items of Evaluation

{No Data Entered}

V(A). Planned Program (Summary)

Program # 5

1. Name of the Planned Program

Food Safety

☐ Reporting on this Program

Reason for not reporting

Not conducting any research in this area.

V(B). Program Knowledge Area(s)

1. Program Knowledge Areas and Percentage

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	0.0	0.0
Actual Paid Professional	{NO DATA ENTERED}	{NO DATA ENTERED}	{NO DATA ENTERED}	{NO DATA ENTERED}
Actual Volunteer	{NO DATA ENTERED}	{NO DATA ENTERED}	{NO DATA ENTERED}	{NO DATA ENTERED}

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

Extension		Research	
Smith-Lever 3b & 3c	1890 Extension	Hatch	Evans-Allen
{NO DATA ENTERED}	{NO DATA ENTERED}	{NO DATA ENTERED}	{NO DATA ENTERED}
1862 Matching	1890 Matching	1862 Matching	1890 Matching
{NO DATA ENTERED}	{NO DATA ENTERED}	{NO DATA ENTERED}	{NO DATA ENTERED}
1862 All Other	1890 All Other	1862 All Other	1890 All Other
{NO DATA ENTERED}	{NO DATA ENTERED}	{NO DATA ENTERED}	{NO DATA ENTERED}

V(D). Planned Program (Activity)

1. Brief description of the Activity

No Activities planned

2. Brief description of the target audience

No Activities planned

3. How was eXtension used?

{No Data Entered}

V(E). Planned Program (Outputs)

1. Standard output measures

2013	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	0	0	0	0

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

Patent Applications Submitted

Year: 2013

Actual: {No Data Entered}

Patents listed

{No Data Entered}

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2013	Extension	Research	Total
Actual	0	0	0

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- {No Data Entered}

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

Outcome #1

1. **Outcome Measures**

{No Data Entered}

V(H). Planned Program (External Factors)

External factors which affected outcomes

Brief Explanation

{No Data Entered}

V(I). Planned Program (Evaluation Studies)

Evaluation Results

{No Data Entered}

Key Items of Evaluation

{No Data Entered}