FY 2003 Annual Report of Accomplishments and Results

Agricultural Experiment Station, University of the Virgin Islands

Submitted by:

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Goal 1: An agricultural system that is highly competitive in the global economy

A. Overview:

The AES Agronomy Program conducted two interactive field and classroom seminars targeting local area farmers, landowners, governmental agriculture entities, and prospective agriculturalists. The first seminar focused on small ruminant production in combination with proper pasture management, forage selection, and rotational grazing techniques to increase production and economic viability. The second seminar focused on hay production techniques, proper hay harvesting and preservation, hay quality evaluation, and future legume hay production opportunities. Both seminars were well attended. From May through August 2003, the forage agronomy program hosted an exchange student intern from Texas A&M University. The student intern learned valuable tropical forage agronomic production techniques and scientific research protocol.

The AES Animal Science Program mentored an undergraduate student in the MBRS-RISE program in collaboration with the division of Science and Math. The student conducted research projects on sheep and cattle physiology and presented the results at regional and national meetings and within UVI. Two Students in the National Student Exchange program also conducted research projects in the lab for class credit. Collaboration between UVI-AES and Mississippi State University was continued as part of a regional project (S-299). Outreach activities included fertility evaluations of Senepol bulls for producers as well as technical support for managing breeding programs for local sheep producers. An Open House was held at the Sheep research Facility to allow community members to see the research that is being conducted as well as to educate them on the research methods and impacts of the research. Students from UVI, farmers and the general public were in attendance.

The AES Aquaculture Program annual short course (Aquaponics and Tilapia Aquaculture) attracted 33 students from three territories (including Guam), 11 states and seven countries (Hong Kong, Japan, Australia, Mexico, Jamaica, St. Lucia and British Virgin Islands). Seminars on the commercial aquaculture systems developed at UVI were given to students, faculty and farmers in St. Croix (26 people attended) and St. Thomas (21 people attended). As part a continuing partnership with Rutgers University, a workshop presentation on aquaponics was given to 36 people at the Rutgers University Extension Service. The Aquaculture Program worked with the Virginia State University Cooperative Extension Service to conduct a workshop on aquaponics for 71 participants from the Virginia Aquaculture Association and members of the university community. A presentation was given at the Subregional Workshop to Promote Sustainable Aquaculture Development in the Small Island Developing States of the Lesser Antilles. The FAO-sponsored workshop was held in St. Lucia and attended by 15 participants from seven countries in the region, from four regional institutions, from FAO headquarters (Rome) and from the FAO Subregional Office. Additional seminars were given at Wageningen University in Holland (16 faculty and staff) and the Asian Institute of Technology in Thailand (20 students and faculty). The Aquaculture Program developed a partnership with Michigan State University and the Asian Institute of Technology (AIT) through a CRSP grant in Pond Dynamics/Aquaculture and is overseeing a tilapia research project at AIT. The Aquaculture Program is working on a new project, a planning grant, with Rutgers University and Universidad Metropolitana in Puerto Rico to establish an EcoComplex at the San Juan landfill. The Aquaculture trained a summer intern from the Institut Superieur D'Agriculture de Beauvais in France.

The AES Biotechnology & Agroforestry program, in collaboration with the division of Science and Mathematics, mentored three students in the MBRS-RISE program with plant biotechnology related research projects. Working together with the Nature Conservancy and the US Fish & Wildlife service, native trees were grown and planted in wildlife refuges on St Croix.

The AES Horticulture Program conducted training courses, workshops and field days for students, local farmers and homeowners. It hosted two students from France on a summer internship program. The students received training on vegetable and fruit crops production while working the research and field staff. A workshop and field day was conducted on medicinal plants hosted by a local farmer. More than 30 participants, mostly homeowners and local farmers, attended it. In cooperation with the Cooperative Extension Service, the Horticulture Program conducted training workshop for local farmers in vegetable and fruit crop production. Lectures presented included, hot pepper, tomato, cucumber, culinary herbs, banana and avocado production. The program continued to work together with other universities on a regional project involving microirrigation. On-farm experiments were conducted on variety evaluation using drip irrigation. Farmers evaluated the significant contribution of drip irrigation in cucumber production.

By conducting workshops and participating in local events AES staff members have provided information to a large portion of the local stakeholders. In addition this information was also available to individuals who are from outside the region, but were interested in the topics being presented. Feedback from farmers on how they have incorporated the technology into their existing operation is one way that AES staff is able to gauge the success of the workshops and seminars.

Funding for these programs was as follows:

Type	Federal	Local Match
Hatch	$677,542	$338,771
Regional	$116,123	$62,181
McIntire Stennis	$51,293	$0

Key Theme - Animal Production Efficiency

a. The impact of the tropical environment on the body temperature of Holstein cows was evaluated as part of a multistate research project. Dark- (> 50% black hair coat) and light- (< 50% black hair coat) colored, pregnant Holstein cows were evaluated for 48 hr while grazing pasture. Vaginal temperatures were recorded using a wireless data logger. Subcutaneous (under black and white hair) and vaginal temperatures were collected using implanted data loggers. Mean, minimum and maximum THI was 80.1, 75.0 and 85.9, respectively, indicating that the cows were under heat stress during the entire 48-hr period. Vaginal temperature was not different between dark and light cows. Dark cows had higher black coat temperatures than light cows but there was no difference in temperature under white hair between dark and light cows. Peak skin and vaginal temperatures lagged behind peak environmental temperature by 157 and 278 min, respectively. Temperature under white or black hair and vaginal temperature had low positive correlations with environmental temperature. Range in physiological temperature was smallest in the vagina (1.2 ºC) and greater under the white (2.1 ºC) and black hair (2.7 ºC). Dark cows tended to have higher maximum black coat temperatures than did light cows. Coat color did not appear to have a strong influence on the response of dairy cows to elevated environmental temperatures as measured by either subcutaneous or vaginal temperatures. This is most likely due to the fact that the cows were under conditions of heat stress at all times during the trial.

b. Impact – The ability to monitor the body temperature of dairy cows at frequent intervals is useful when conducting heat stress studies. The methods developed here will be utilized by collaborators in the multistate research project (S-299) as part of the joint data collection. The results of the cooperative projects will be used to further elucidate the impact of heat stress on dairy cows. The effectiveness of methods used to alleviate heat stress can also be evaluated.

c. Source of Federal Funds – Hatch Multistate Research

d. Scope of Impact - Multi-State Research
- With Mississippi

Key Theme - Animal Production Efficiency

a. St Croix White (STX), Barbados Blackbelly (BB) and Dorper X St Croix White (DSX) ewes were bred to rams of the same breeds during a 35-d period. Pregnancy rate was not different among the genotypes and was greater than 85%. The proportion of ewes having twin lambs was higher for STX than for DSX (90.9 vs. 18.2 % respectively) with the BB being intermediate (59.1%). All breeds had 100% live births with no stillborn lambs. The DSX ewes were younger at breeding than either the STX or BB ewes (0.7 vs. 3.7 vs. 3.1 yr of age, respectively). When adjusted for age of ewe at breeding, total litter birth weight was lowest in DSX ewes compared to BB or STX ewes (3.4 vs. 4.9 vs. 5.6 kg, respectively). The DX ewes had fewer lambs per ewe lambing than either STX or BB ewes (1.1 vs. 1.9 vs. 1.7 lambs, respectively). The proportion of ewe weight at lambing that was composed of the total litter birth weight was lower in DX ewes compared to STX or BB ewes (7.9 vs. 11.3 vs. 11.9 %, respectively). Birth weight of individual lambs was lower for DX lambs than for STX and BB lambs (2.6 vs. 3.1 vs. 2.9 kg, respectively). When adjusted for ewe weight at the time of breeding, ewe weight at lambing was lowest in BB and highest in STX with DX being intermediate (42.4 vs. 44.9 vs. 46.9 kg, respectively).

b. Impact – Dorper sheep can be successfully used in a crossbreeding program under tropical conditions. Ewe productivity is lower as yearlings but careful selection within the flock will make it possible to increase the lambing rate of the crossbred lambs. Producers in the VI have already incorporated Dorper genetics into their flocks, which has resulted in larger lambs and more revenue form sales.

c. Source of Federal Funds – Hatch

d. Scope of Impact – State Specific

Key Theme – Aquaculture

a. A second production trial was conducted with a unique, 1/20-acre tank (200 m^3) that treats the culture water through continuous aeration, mixing, daily solids removal and nitrification (ammonia and nitrite removal) in the water column. This technology is referred to as greenwater tank culture. The floor of the circular tank has a 3% slope from the perimeter to a 1-m^3, central cone (45% slope). A ¾-hp, vertical-lift pump, tilted sideways, creates a circular rotation in the tank, which moves settleable solids to the cone for daily removal by opening a drain line. The tank is aerated with three additional vertical-lift pumps. Five thousand tilapia fingerlings (25/m^3) were cultured for 201 days. Production (6,028 lbs.) was approximately 27 times greater than that obtained with pond culture. There was 19% mortality attributed to predation by herons. Bird deflection netting will be installed around the perimeter of the tank for the next production trial. The fish were fed *ad libitum* twice daily. The daily feed intake leveled off in the middle of the trial and declined slightly near the end. Total suspended solids (TSS) increased continuously to an exceedingly high level of 1,960 mg/liter. Water movement was too rapid for solids to settle out, but water mixing was essential for good nitrification. A 500-gallon, cylindro-conical clarifier with a 60% slope and a 50-minute retention time was installed outside the tank and operated for the last 3 weeks of the trial. During that period, 792 lbs of solids (dry weight) were removed, and TSS levels decreased to 600 mg/liter. Several other water quality parameters improved, and the

fish feeding response increased dramatically. This finding indicates that the sloped bottom and central cone can be eliminated from the tank design and replaced with an external clarifier, which will simply construction and reduce costs. The concentration of nitrate-nitrogen, the end product nitrification, increased steadily throughout the trial to 707 mg/liter, a level that may reduce fish growth. The process of denitrification removes nitrate under anaerobic conditions. Two denitrification channels (100 ft x 4 ft x 2 ft deep) have been constructed next to fish tank. In the next trial, a small stream of culture water will circulate through the channels to test their effectiveness in reducing nitrate levels.

b. Impact – Greenwater tank culture has the potential of replacing standard pond production in areas with limited water supplies because it requires only 3-4% of the water used in pond culture, and, unlike pond culture, it recovers solids and nutrients, which can be reused for field crop production. Greenwater tank culture is at a very early stage of adoption. One tank has been constructed and is in operation on the neighboring island of Antigua. Nearly 200 hundred people were informed of this technology during the year through seminars, workshops and conference presentations, and some may apply it. Three researchers from different institutions have expressed their intention to initiate greenwater tank culture studies in their locations.

c. Source of Federal Funds – Hatch

d. Scope of Impact – Territorial, Regional, International

Key Theme - Plant Germplasm

a. A two-year study assessed the physiological components of three guinea grass (*Panicum maximum*) cultivars (cv. Local, Tanzania, and Mombassa) by season (wet and dry). Physiological components measured are: plant height, sward width, stem/leaf ratio, number of inflorescence, crown area, number of tillers, dry matter (DM) herbage, and nutritive value [crude protein (CP) and in vitro organic matter disappearance (IVOMD)]. Grass cultivars were harvested at six-week intervals during both the dry and wet season. This study is currently ongoing, but preliminary results indicate that both cultivar introductions (cv. Tanzania and Mombassa) exhibit increased DM production, have a lower stem to leaf ratio, have greater crown area, and show increased tillering.*B. brizantha* cv. Marandu]. It is recommended that guinea grass cultivars Tanzania and Mombassa be incorporated into local and regional pasture management practices and used as stand-over forage in dry heavy clay conditions.

A two-year study assessed the physiological components and production parameters of *B. brizantha* cv. Marandu and the recently released *B. brizantha* cv. Mulato by wet and dry season effect. Physiological components measured are: plant height, sward width, stem/leaf ratio, number of inflorescence, crown area, number of tillers, dry matter (DM) herbage, and nutritive value [crude protein (CP) and in vitro organic matter disappearance (IVOMD)]. Initial results of this study indicate that *B. brizantha* cv. Mulato is suitable forage for dry heavy clay conditions with increased forage quality.

b. Impact- An improvement in physiological forage traits was noted for guinea grass cvs. Tanzania and Mombassa. Bracharia cv. Mulato exhibits physiological and growth production traits suitable for introduction into local livestock production as a viable forage feed source with increased nutritional components over existing forage grasses. Seed material of Bracharia cv. Mulato and guinea grass cvs. Tanzania and Mombassa have been made available to local farmers.

c. Source of Federal Funds- Hatch

d. Scope of Impact- State specific

Key Theme – Plant Germplasm

a. The calcareous soils and the semi arid climate of the US Virgin Islands pose a unique challenge to farmers and backyard growers. Tropical plant germplasm was collected and evaluated for its tolerance and production under this environment. Due to an overwhelming disease infection rate in the papaya plot used in the past ten years, a new papaya plot was established in another location. Breeding and selection continues toward the development of more red papaya lines, reduce the number of male/female varieties and increased development of the self-fruiting hermaphroditic lines. A fact sheet was also developed to assist farmers and backyard growers to identify the sex of the papaya plants. This color, picture oriented fact sheet explains the three sexes of papaya plants and how to identify them at an early age from the developing flower buds. Conservation of native endangered orchids has expanded to include *Epidendrum ciliare.* Seedpods were collected near maturity and the very small chaff-like seeds spread on a modified orchid tissue culture medium. The tissue culture germination of seeds from this rare Virgin Islands orchid provides a system to maintain the species as its native environment becomes populated by humans and developed. Development of seed germination systems was expanded to include the rare native palms of the Virgin Islands. These are the royal palm (*Roystonea borinquena*) and the thatch palm (*Coccothrinax argentea*). Seed treatments to assess the most efficient germination protocols are being developed.

b. Impact – The production of papayas has continued to increase, as selected varieties are made available to farmers and backyard growers. Farmers and consumers have been satisfied with the early production and the quality of the fruit. Through the publication of information on the seed germination of the rare native orchids the general public is made aware of the rare status of these plants and the need to conserve and protect their limited habitat.

c. Source of Federal Funds – Hatch and McIntire Stennis

d. Scope of Impact – State Specific

Key Theme – Biotechnology

a. The papaya ringspot virus had been a major deterrent to large-scale papaya production in the US Virgin Islands. Genetically engineered papaya plants have been developed with the coat protein of the papaya ringspot virus. Six papaya lines have been developed that involve three locally grown papaya varieties. Papaya breeding and selection is ongoing to obtain inbred homozygous lines with stable virus resistance. Papaya seedlings are being screened for virus resistance using the marker gene, neomycin phosphotransferase, and for the ability to resist the foliar application of kanamycin. This initial in greenhouse screening reduces the number of plants set in the field that lack resistance. The greenhouse screening for transgenic plants also indicates which papaya lines are homozygous for resistance and which papaya lines segregate out and have susceptibility to the kanamycin.

b. Impact – The use of greenhouse screening for kanamycin resistant plants reduces the need for hand inoculation of the field material with the virus extract from papaya ringspot virus infected plant material. Plants infected with the papaya ringspot virus are more susceptible to other plant diseases. Eliminating the need to inoculate with the papaya ringspot virus eliminates the potential for co-inoculation of these other disease pathogens into the transgenic papaya lines.

c. Source of Federal Funds – Hatch

e. Scope of Impact – State Specific

Key Theme – Innovative Farming Techniques

a. Research continued on the production capacity of the UVI aquaponic system. Aquaponics is the combined culture of fish and plants in a recirculating system. The outdoor commercial-scale system at UVI consists of four 7.8-m^3 fish rearing tanks, a set of tanks for removing solid waste and six raft hydroponic tanks with a total growing area of 214 m^2. Fish grow rapidly on a formulated diet. Using staggered production, one tank is harvested every 6 weeks, and annual production of tilapia is approximately 11,000 lbs. Solid waste is removed from the system daily, aerated in lined ponds and disposed of through land application. Dissolved metabolic waste products and nutrients from the fish are removed in the hydroponic component. Water for the system is obtained through rainwater harvesting. Both fish and plants are raised intensively with minimal usage of land (0.05 ha) and water (110 m^3). An experiment was conducted to evaluate the production of three varieties of okra and two planting densities in the aquaponic system. One variety and planting density of okra in the aquaponic system was compared to okra production in a field plot. During the 11.7-week experiment, the highest production (3.04 kg/m^2) was attained by 'North South at the high density (4 plants/m^2). The variety 'Clemson' produced 2.67 kg/m^2 at the low density (2.7 plants/m^2), 2.87 kg/m^2 at the high density, and 0.15 kg/m^2 in the field plots (2.7 plants/m^2). Starting with transplants, the okra grew much faster in the aquaponic system and produced harvestable pods by week 5 compared to week 10 for the field okra. Annual okra production in the aquaponic system was projected to be 6,360 lbs.

b. Impacts – UVI aquaponic systems have been established in Beirut, Lebanon by a former short course student and in Alberta, Canada at the Crop Diversification Center South through a grant obtained by a former short course student. More than 300 people were exposed to this emerging technology through seminars, workshops and conference presentations, and some may pursue commercial application.

c. Source of Federal Funds – Hatch

d. Scope of Impact – Territorial, National, International

Key Theme - Plant Production Efficiency

a. The Fruit Crops Program maintained an orchard collection of minor tropical fruits suitable for growing under high pH soils of the Virgin Islands. Of the 40 species that were introduced and established 10 years ago, five species continued to perform very well on calcareous soils. These species include Wax Jambu (*Syzygium samarangense*), Black Sapote (*Diospyros dignay*), Egg Fruit (*Puteria campechiana*), Sapodilla (*Manilkara zapota*) and Star Apple (*Chrysophyllum caimito*). These species are steadily increasing production into their fourth year of fruit bearing. The minor fruits project continued to provide yield and production data that are useful for local fruit growers who will venture in crop diversification and remain competitive. Another major activity was the maintenance of germplasm as well as propagation of banana, plantain and avocado, potential economic crops for the Virgin Islands.

b. Impact - Increasing number of local growers using UVI/AES plant materials has been observed in the past year. The request for planting materials of banana, plantain and promising minor tropical

fruits has also increased particularly with Star Apple and Wax Jambu. The white and purple varieties of Star Apple are in great demand among local growers. Although this is a relatively new fruit in the VI, it has already gained popularity with local farmers and has excellent potential for export market.

c. Source of Federal Funds - Hatch

d. Scope of Impact - State specific

Key Theme - Plant Production Efficiency

a. Evaluation of new and improved vegetable cultivars for yield and quality with farmer's collaboration was a continuing effort and activity by the vegetable crops program. Improved cultivars of cucumber were tested and compared with standard and commonly grown cultivars. New cultivars produced higher marketable yield than standard cultivars. Top two high yielding cultivars were 'Olympian F_1' and 'Cobra'. Yields of these two cultivars were almost similar to a standard cultivar 'Dasher II'. 'Cobra' is a pickling type cucumber ideal for fresh market, while 'Olympian F_1' is a slicing cucumber with better fruit quality than 'Dasher II'. These new cultivars will soon replace common cultivars including 'Calypso' a popular cultivar in the Virgin Islands.

b. Impact - Acreage planted to cucumbers is increasing and more farmers are growing cucumbers for local fresh market. New and improved cultivars when grown by farmers will boost total production in the Virgin Islands resulting in increased self-sufficiency and improved income.

c. Source of Federal Funds - Hatch

d. Scope of Impact - State specific

B. Stakeholder Input Process

The AES Advisory Council met to discuss issues of concern to the agriculture community and AES scientists continued to work in close contact with farmers as part of several research projects. These actions provided continuous input and feedback from the community regarding the work being done by AES as well as providing a means for identifying the concerns of the agricultural community. Workshops and seminars on various topics were conducted and input was received from individuals, cooperatives and agribusinesses. Because of the small size of the agriculture community in the USVI, anyone who contacts AES regarding information on agriculture is considered a stakeholder. In most cases, input from stakeholders is directed at a specific program and the program leader is charged with deciding how to consider the input and what action to take. The response may be just a simple matter of providing information to the stakeholder in the form of verbal communication or technical bulletins. In other instances it may involve a visit to the farm to provide technical assistance with a crop (plant or livestock).

C. Program Review Process

There has been no change made to the process as described in the initial Plan of Work submitted.

D. Evaluation of the Success of Multi and Joint activities

AES has three ongoing multi-state research projects: 1) Plant Genetic Resource Conservation and Utilization (S-OO9), and 2) Microirrigation of Horticultural Crops in Humid Regions (S-264), and 3)

Enhancing Production and Reproductive Performance of Heat-Stressed Dairy Cattle (S-299). AES will participate in a new multi-state research project: Genetic (Co) Variance of Parasite Resistance, Temperament, and Production Traits of Traditional and Non-*Bos indicus* Tropically Adapted Breeds (S-1013). In addition, AES has continued to work closely with the University of Puerto Rico and the University of Florida in the Tropical and Subtropical Agricultural Research Program (T-STAR).

AES worked closely with CES, ARS, the Virgin Islands Agriculture Department and a St. Croix farming organization to organize a 2-day Virgin Islands Agricultural Forum, which was held April 22 and 23. More than 100 participants attended the Forum and discussed the constraints and potential of agricultural development in the Virgin Islands. AES worked with a legislative committee to provide input to Bill No. 25-0183, *Sustainable Farming and Fishing in the Virgin Islands*.

AES and CES worked together on World Food Day activities and the Virgin Islands Annual Agriculture and Food Fair, a 3-day event attended by nearly 25,000 people. AES and CES created educational displays in the same exhibition area and had staff members present throughout the fair. CES personnel attended AES seminars, and AES personnel participated in relevant CES workshops. In areas where CES did not have expertise, AES initiated workshops and short courses for the farming community. In a collaborative effort AES and CES conducted a production short course for farmers to attend and become trained in the planning, scheduling, production and marketing of fruits and vegetables. Participants applied what they had learned to develop a model farm and production schedule.

AES continued to develop and operate an integrated, small model farm, which demonstrates the benefits of integrating fish, vegetable and fruit production in an intensive farming operation that utilizes rainwater harvesting and nutrient recycling. AES is working closely on this project with the University of Guam, which is establishing a similar farm to conform to conditions in a Pacific island. Other partners in this project include CES, ARS, the Water Resources Research Institute and the V.I. Department of Agriculture.