

Annual Report of Accomplishments and Results
Fiscal Year 2002

College of Tropical Agriculture and Human Resources
University of Hawai`i at Manoa

Research and Extension Programs

GOAL 1: AN AGRICULTURAL SYSTEM THAT IS HIGHLY COMPETITIVE IN THE GLOBAL ECONOMY

Overview:

In the area of agricultural competitiveness, researchers made progress on several fronts. The effects of irradiation on fruit, cut flowers, and foliage for export were tested, with results suggesting that this disinfestation approach holds promise. Novel heat-based disinfestation techniques were developed for use on heat-sensitive commodities, including cut flowers and propagative materials. Corn grown locally for silage, bred for viral resistance, and requiring no pesticides, is being promoted as an affordable alternative to imported feed for dairy cows and poultry. Building on previous work, an additional macadamia cultivar was identified that minimize kernel shrinkage.

Agricultural profitability was promoted through research on taro. Field studies demonstrated the irrigation requirements of dry-land taro so that farmers can minimize water consumption while optimizing yield. Tasting events introduced taro enthusiasts and members of the general public to new varieties of taro, increasing consumer awareness for this crop.

In the area of animal production efficiency, a device was tested successfully that monitors intravaginal temperature in dairy cows, helping identify conditions under which high body temperature interferes with milk production. Cows cooled using a combination of shade, fans, and misters were able to maintain milk production during the summer months, which would translate to approximately \$1 million in annual farm gate value to the Hawaiian dairy industry. Artificial insemination classes and improved management techniques have helped local pig farmers increase feed efficiency by 50 pounds (or \$10) per pig per year.

A local aquaculture firm is benefiting from economic feasibility studies, conducted by the Hawai'i Offshore Aquaculture Research Project, that detail how best to lower production costs. The firm is raising Pacific threadfin in offshore cages for local and U.S. mainland consumption.

Many CTAHR researchers are applying biotechnological solutions to problems in agriculture. Progress was made in pineapple toward understanding nematode resistance and the etiology of mealybug wilt. Improved transformation methods are being used to develop transgenic banana cultivars that resist bunchy top virus. Automated, high-throughput techniques are being combined with ethnobotanical research to identify the genes and characterize the gene expression patterns associated with plant production of valuable bioactive compounds, such as pharmaceuticals. Real-time monitoring of transgenic protein secretion now provides unprecedented opportunities to investigate protein expression in plant cell culture.

Innovative techniques such as hydroponic farming were investigated. Lettuce yield losses were characterized to help farmers choose hydroponic system designs that meet their labor, construction, and maintenance needs.

A new niche market has been identified for a flavoring agent produced by mechanical demucilagination (low-water processing) of Hawaiian coffee. This innovation promises to increase economic returns to coffee farmers by conserving water and producing a new salable product. Near-infrared reflectance, a spectroscopic technique, is being used to assess the active ingredient content of kava ('awa) to allow more orderly marketing of that herbal supplement.

Efficient plant production was the focus of numerous research projects. One project identified basaltic dust, a quarry waste product, as a useful source of calcium that may diminish the amount of iron solution farmers must spray on pineapples leaves. The chemical characteristics of soil and water in wetland taro paddies were correlated to taro yield and disease risk. Eleven new parasitoids were introduced to Hawai‘i and deployed as biological control agents against fruit flies. Mixed populations of bacteria that colonize anthuriums were used to protect the plants against a blight-causing bacterium, *Xanthomonas campestris* pv. *dieffenbachiae*. Chemical methods were tested and registered to control pathogenic fungi on papaya, protect the plants from papaya ringspot virus, and keep papaya farming economically viable in some local districts. Techniques were developed for field propagation of taro. Nuclear transplantation was identified as an effective new method for generating hybrid vigor in fungi that have industrial and biocontrol applications. The development of mechanical pruning techniques is saving the \$23 million Hawaiian coffee industry more than \$3.5 million per year.

In the area of rangeland/pasture management, advances were made in combating fireweed infestation. Herbicide application trials identified an effective and economical combination of herbicide and surfactant, so that 25% more area could be treated with the funds available. Eradication of fireweed on 800 acres has significantly cut the number of seeds, estimated at 30,000 per plant, that will have an opportunity to germinate during winter rains.

CTAHR subtropical location provides unique opportunities to study tropical agriculture. The vegetative propagation of native plants and the development of methods to distinguish native plants from closely related introduced plants promote environmentally sound, site-appropriate gardens and support the Hawaiian landscaping industry.

ALLOCATED RESOURCES -- GOAL 1

Fiscal Year	Research Hatch Funds (\$)	Research State Funds (\$)	Research Other Fed & Non Fed Funds (\$)	Research Total Funds (\$)	Research Scientist Years (SY)
2002	918,098	7,185,285	1,104,032	9,207,415	44.0

Fiscal Year	Extension Smith-Lever Funds (\$)	Extension State Funds (\$)	Extension Other Funds (\$)	Extension Total Funds (\$)	Extension Faculty Years (FY)
2002	400,145	1,197,196	0	1,597,341	22.3

Key Theme – Agricultural Competitiveness

- a. Description of activity. The goal of the project is the genetic improvement of tropical field corn. The specific objectives are (1) to develop corn for feed that is pest-, disease-, and stress-resistant, (2) to identify quantitative trait loci (QTLs) for resistance and selected agronomic traits and (3) to apply molecular probes to the chromosomal mapping of the QTLs and/or genes of high commercial value. (866H)
- b. Impact/Accomplishment. The project is completing the conversion of 21 tropical inbreds to gene *Mv* for virus resistance. Some of these inbreds are being disseminated into Hawai‘i’s commercial hybrids for silage and grain production. All silage production in Hawai‘i used CTAHR hybrids this

year. While the corn industry is still small, the future looks good for dairy and even beef use of Hawai'i-grown silage. No pesticides are required on CTAHR hybrids, as the parents have all been bred under a no-pesticide regime for 40 years. Discussions have been held with poultry growers and with large-scale ranchers, encouraging them to buy and feed locally grown grain that one O'ahu corn grower is now able to provide.

- c. Source of Funding. Hatch.
- d. Scope of Impact. State Specific.

Key Theme – Agricultural Competitiveness

- a. Description of Activity. The goals of this project are (1) to evaluate pest management of flowers and foliage by minimizing the use of chemical pesticides and by maximizing the use of biorational and non-chemical control tactics, and (2) to develop post-harvest disinfection treatments, including heat treatment and irradiation, to ensure pest-free flowers and foliage for export. (944H)
- b. Impact/Accomplishment. The bulk media sterilization unit was demonstrated to the public. The California Department of Food and Agriculture is not currently enforcing the requirement that all plants, including epiphytic orchids, be planted in sterilized media. However, larger growers of export plants are confident that when the CDFA requirement is instituted, the sterilization unit can serve as a prototype sufficient to treat the volume of media required. Use of preconditioning prior to exposure to hot air at target temperature greatly reduces phytotoxicity in certain *Protea* species, perhaps by increasing thermotolerance of the plant material. This finding holds potential for the use of heat treatment in post-harvest disinfestations of other heat-sensitive commodities. For propagative material that cannot tolerate hot water dipping, such as *Aglaonema* top cuttings, a 10-minute basal dip that does not expose the leaves and meristem to hot water, prevented leaf loss associated with phytotoxicity. Initial studies indicate that irradiation provides another potential method for post-harvest disinfestation of cut flowers and foliage. Use of pots with inner surfaces impregnated with Spin Out alone or with bifenthrin showed tremendous potential for use as part of an IPM program in containerized nursery crops to manage root-infesting mealybugs. On *Anthurium*, a number of effective pesticides for anthurium thrips (*Chaetanaphothrips orchidii*) and banana rust thrips (*C. signipennis*) were identified, Tame 2.4 EC, Scimitar GC, and Marvik with and without the synergist Incite, which reduced the numbers of thrips-damaged flowers. On fishtail palms, Acetamiprid provided the greatest initial and residual efficacy against coconut mealybugs, (*Nipaecoccus nipae*), followed by Dursban 50 W.
- c. Source of Funding. Hatch.
- d. Scope of Impact. State and National.

Key Theme – Agricultural Competitiveness

- a. Description of activity. The goals of this project are (1) to evaluate *Anthurium andraeanum* horticultural cultivars for performance as containerized plants, and (2) to develop efficient cultural practices for production of quality plants for export. (850H)
- b. Impact/Accomplishment. Five out of the eight cultivars found unsuitable as potted plants in 4-in pots show promise as multiple plantings in 8-in pots. Cultivars Hidden Treasure, Anuenue,

Kozohara, Rudolph, and Fujii Pink may be suitable with cultural modifications, such as the use of differing shade levels and/or application of 250 ppm BA. Plants of cultivars Flamingo, Pele, and UH931 show potential as attractive plants when exposed to 65% shade for 3-5 months and/or application of 250 ppm BA. Uniconazol applied at 0.1 to 5.0 mg/7-cm pot decreased plant height, but also had undesirable side effects, such as excessive height suppression, and decreased and abnormal flower production at all but the lowest rate; some effects were still apparent 18 months after treatment. A subsequent trial comparing 0.1, 0.3, and 0.5 mg drench /plant and 10, 30, and 50 ppm spray/plant of uniconazol indicated that 0.5 mg drench and 30 and 50 ppm spray treatments were most effective in reducing the height of the plant and flowers without undesirable effects. *Anthurium* potted plant producers have several effective cultural methods to improve the quality of *Anthurium andraeanum* cultivars as potted plants. Exposing juvenile plants to 65% shade, and/or applying 250 ppm BA can increase sucker production and decrease plant height of some cultivars. Uniconazol can be used as a spray or drench for height suppression.

- c. Source of Funding. Hatch.
- d. Scope of Impact. State and National.

Key Theme – Agricultural Competitiveness

- a. Description of activity. The goal of this project is to evaluate kernel quality of macadamia nuts. (831H)
- b. Impact/Accomplishment. Kernels with oil content greater than 72% have a specific gravity of less than 1.0 and are graded as Hawai'i No. 1 Kernels. Quality data from eight macadamia selections grown at the University of Hawai'i Waiakea Research Station was obtained for the 2001-2002 harvest season. Overall, kernel quality was lowest (87% No. 1 Kernels) during the initial harvests, but increased to 94% No. 1 Kernels as the season progressed. The selection HAES 896 exhibited large increases in kernel quality, from 75% No. 1 Kernels at the initiation of harvest to 96% during the peak nut drop period. Makai (HAES 800) maintained very stable quality over the entire harvest season. At the onset of the harvest season, the No. 1 Kernel percentage was 92%. This value increased to 100% during the two months of peak nut drop. These results were similar to the 2000-2001 harvest data obtained from another orchard in the Kea'au area where there was an improvement in kernel quality as the harvest season progressed. In the Kea'au area, Kakea (HAES 508) and Purvis (HAES 294) exhibited the least variation in kernel quality over the entire season.
- c. Source of Funding. Hatch.
- d. Scope of Impact. State Specific.

Key Theme – Agricultural Competitiveness

- a. Description of activity. The goals of this project are (1) to evaluate the impact of irradiation on various tropical fruits, and (2) to analyze the physical, chemical, nutrient, and sensory quality of the products. (525H/337H).
- b. Impact/Accomplishment. Irradiation experiments were conducted to compare qualities of tropical fruits treated by gamma radiation vs. x radiation. The fruits studied included: papaya (cv. Rainbow and Sunset), carambolas (cv. Kari), rambutans (cv. No. 167), and longans (cv. Biew Kiew). The

effects of dose rate on fruit quality were also compared for x rays and gamma rays (which differed by a factor of 100) on papayas, carambolas, rambutans and longans. No differences were observed. We found that, in general, there were no significant differences in chemical, textural, and nutritional quality between fruits that were x-irradiated and those that were gamma-irradiated, though some taste panelists reported minor differences in sensory quality. By knowing the effects of gamma radiation and x radiation on the chemical, texture, nutrient, and sensory quality of major marketable tropical fruit crops and cultivars grown in Hawai‘i, fruit growers, packers, and marketers in Hawai‘i have gained pertinent information and confidence in using radiation as a quarantine treatment of various fruits for the export markets.

- c. Source of Funding. Hatch.
- d. Scope of Impact. State Specific.

Key Theme – Agricultural Competitiveness

- a. Description of Activity. The goal of the project is to establish a taro huli-growing industry on Moloka‘i to supply planting material for farmers. (21-031)
- b. Impact/Accomplishment. The huli production system has been successfully established. Enough planting material was generated using an “early” harvest production system to establish commercial production fields. The production fields are providing a consistent and sustainable supply of taro huli.
- c. Source of Funding. Smith-Lever
- d. Scope of Impact. County

Key Theme – Agricultural Competitiveness

- a. Description of activity. The goal of this project is to educate growers on use of research-based technology that reduces losses due to pests such as disease agents, arthropods, and weeds. (22-016)
- b. Impact/Accomplishment. Promoted development and implementation of an Insecticide Resistance Management (IRM) program for Diamondback Moth (DBM). The continued use of the only effective insecticide (Success, an environmentally friendly product) was being threatened. As a result of very intensive grower education programs the resistance levels in certain areas dropped to normal levels. Growers in these areas were asked to use Success exclusively and always according to a well-planned rotation schedule. Growers obtained the appropriate rotation schedule for their area through their Extension Agent
- c. Source of Funding. Smith-Lever
- d. Scope of Impact. County

Key Theme – Agricultural Competitiveness

- a. Description of activity. The goal of this project is to coordinate activities related to the needs of orchid, protea, and tropical flower producers. (18-809)

- b. Impact/Accomplishment. The project organized the program and presided over the 6th International Society for Horticulture Science Protea Research Symposium, which was held in conjunction with the 11th International Protea Association Conference. Local growers made new contacts for expanded sales of their flowers and related products. Protea producers from Israel, New Zealand, Australia, Zimbabwe, and Portugal have offered to pay royalties to be licensed to grow the new CTAHR cultivars. Forty new *Leucospermum* cultivars were introduced among 6,373 cuttings distributed to local growers. The project has introduced 61 new cultivars to the floral trade since 1999.
- c. Source of Funding. Smith-Lever
- d. Scope of Impact. Statewide

Key Theme – Agricultural Competitiveness

- a. Description of activity. The goal of this project is to provide commercial growers of banana and papaya with the tools and educational programs needed to address pest problems in order to promote sustainability. Specific objectives include (1) identifying and managing pests, (2) instituting production practices such as irrigation and fertilization based on regular soil and tissue analysis, and (3) providing educational sessions that are required by the sublicense agreement for commercial producers and home gardeners to obtain seeds of the transgenic papaya varieties. (22-057)
- b. Impact/Accomplishment. A grower reported severe scarring damage of banana fruit for two consecutive years, with as much as 20% of the fruit being damaged during severe pest infestations. Several attempts to collect and rear the causal agent led to its identification as the caterpillar of the sugarcane bud moth. Affected growers were provided with information to manage this pest. The project conducted numerous transgenic papaya educational sessions so that commercial growers and gardeners could obtain seeds of the new transgenic papaya varieties. Two commercial growers and 11 home gardeners were certified as having completed the educational sessions.
- c. Source of Funding. Smith-Lever
- d. Scope of Impact. County

Key Theme – Agricultural Competitiveness

- a. Description of activity. The goal of this project is to develop information resources available to extension personnel, growers, and the public to provide timely, accessible information to clients. (18-808)
- b. Impact/Accomplishment. Growers, extension personnel, and researchers in Hawai‘i need current information and news on tropical crop production. Such information aids them in making management and policy decisions. The Farmer's Bookshelf Web-based information system provides information on various crops and up-to-date news about agriculture in Hawai‘i. During this reporting period the project: (1) added a "Nutraceuticals" section, an ‘awa file, and a link to "The Noni Website"; (2) revised and updated the taro, lychee, and guava files of the Farmer's Bookshelf; (3) updated agricultural news items from the Honolulu Star-Bulletin, Honolulu Advertiser, and Pacific Business News daily; (4) created and updated on a monthly basis links to magazine articles

on agriculture in Hawai‘i; (5) updated a list of upcoming events, e.g., agricultural-related meetings in Hawai‘i; (6) identified and listed the websites of local agriculture organizations and mainland organizations with local affiliation; and (7) periodically updated and changed links to on-line agricultural publications.

c. Source of Funding. Smith-Lever

d. Scope of Impact. Statewide

Key Theme – Agricultural Competitiveness

a. Description of activity. The goal of the project is to promote adoption of Integrated Pest Management (IPM) on 75 percent of total macadamia crop acres. (16-911)

b. Impact/Accomplishment. The Hawai‘i Macadamia Nut Association 42nd Annual Conference was the principal venue to educate macadamia growers that implementation of sound IPM practices for macadamia orchards is achievable and can lead to reduced pesticide input and costs, increased worker safety, and environmental protection. The annual meeting was used to educate growers on recognizing pests and diseases of macadamia, strategies involved in pest management, planting and training macadamia trees, the use of mulch to enhance macadamia root health, and managing orchard nutrition through the use of soil and tissue analyses. Hawai‘i’s largest producer/processor of macadamia nuts has been implementing the IPM verification requirements during 2001-2002. This voluntary verification program has been developed to assess the comprehension and implementation of environmentally responsible IPM practices. Participation of this single grower in the program equates to approximately 25% of the macadamia orchards in Hawai‘i being farmed under this verification system.

c. Source of Funding. Smith-Lever

d. Scope of Impact. County

Key Theme – Agricultural Competitiveness

a. Description of activity. The goal of this project is to publish descriptions for tropical plant diseases and pests of diversified crops, either as stand-alone, extension-type leaflets or as part of the UH-CTAHR internet web sites. (16-923)

b. Impact/Accomplishment. Two print publications and at least 20 internet-style write-ups now posted on the CTAHR web sites for noni and ‘awa were completed during the reporting period. The publications include *Managing Coffee Nematode Decline* and *Growing Bananas in Hawai‘i*. The following noni pests and disease fact sheets were put on-line: a) Anthracnose, b) stem blight, c) root knot, d) shot hole, e) stem canker, f) scale insects, g) aphids, h) whiteflies, i) sooty mold, j) *Cassythia filiformis*, and k) eriophyid mites. The ‘awa diseases and pests Internet fact sheet publications include: a) shot hole, b) ‘awa dieback, c) root knot, d) root rot, e) aphid damage, f) scale insects, g) mites, and h) caterpillars. As a result of this project, growers of ‘awa and noni now have access to all the knowledge needed to identify and manage the various pests and diseases of those crops. Farm management for these diseases is now greatly improved for most growers.

c. Source of Funding. Smith-Lever

d. Scope of Impact. County

Key Theme – Agricultural Competitiveness

- a. Description of activity. The goal of this project is to develop information on plant-parasitic nematode control in Hawai‘i and on the biology of *Rotylenchulus reniformis* and *Radopholus similis*. (16-925)
- b. Impact/Accomplishment. A demonstration was conducted on a cooperator's farm showing how an intercycle cover crop of sunnhemp, *Crotalaria juncea*, is beneficial in controlling nematodes and fungi. Anthurium growers are now aware of which products can control burrowing nematodes. Papaya growers can make informed choices about planting intercycle cover crops such as sunnhemp, marigold, or rapeseed. These cover crops have the potential to reduce both soil erosion and losses to certain fungi and nematodes. Pineapple plantations are aware of the potential to use Actigard and DiTera as alternatives and replacements to Namacur in their cropping system. Anthurium, papaya, and pineapple growers can use less toxic pesticides, thereby increasing worker safety and protecting the environment.
- c. Source of Funding. Smith-Lever
- d. Scope of Impact. Statewide

Key Theme – Agricultural Profitability

- a. Description of Activity. The overall goal of this project is to improve the production, efficiency, and profitability of upland-grown taro as an alternative crop for the Hamakua Coast of Hawai‘i. Specific objectives are (1) to determine irrigation requirements of upland-grown taro, (2) to compare the effectiveness of mulching versus supplemental irrigation for upland taro production along the Hamakua Coast of Hawai‘i, and (3) to evaluate newly introduced *Phytophthora* blight-resistant taro cultivars and hybrids developed by Dr. John Cho for yield and consumer acceptability. (832H)
- b. Impact/Accomplishment. Taro (*Colocasia esculenta*) is a tropical root crop that is grown primarily for its starchy, underground stem, or corm. It can be grown under flooded or dry-land (non-flooded) conditions. To determine the water requirement of dry-land-grown taro, cv. Maui Lehua, and to validate SUBSTOR-Aroid v3.5, an aroid simulation model, four levels of irrigation were applied (50, 100, 150, and 200% ET) during a field trial conducted in 2000-2001. Plants grown at 100% ET had greater fresh and dry weights of corms than those grown at 50% ET, but did not differ from those grown at higher irrigation levels. Outputs from a revised model showed improved prediction of growth response to irrigation and N in the experiment described here. A taro variety trial was conducted along the Hamakua Coast of Hawai‘i during 2001-2002, and taste tests were conducted. Taro variety Bun-long was grown for Chef Paul Heerlein at the West Hawai‘i Community College. He prepared a taro patty for Taste of the Range, which was held in June 2002. Armed with better information on the water requirements of dry-land-grown taro, farmers will be able to provide adequate, but not excessive irrigation for optimal taro production. Through taro taste tests, researchers discovered which taro varieties are preferred by consumers while consumers discovered that many different taro varieties exist. Over 50 people participated in these taste tests; over 1,000 people attended the CTAHR Open House; approximately 1,300 people attended Taste of the Range.

- c. Source of Funding. Hatch
- d. Scope of Impact. State and other Pacific-region areas..

Key Theme – Agricultural Profitability

- a. Description of activity. The goal of this project is to educate clients to provide skills, knowledge, and understanding of markets and marketing, and to assist clients with economic analyses and solutions to marketing problems. (11-409)
- b. Impact/Accomplishment. The project conducted a two-part computerized Cost of Production (COP) Workshop, which reviewed electronic spreadsheets, demonstrated the use of COP budgets in typical farm decision-making situations, and introduced participants to software for creating their own budgets. Written comments indicate participants found material useful for their operations. The project also collaborated in evaluating the promotion and marketing programs of the Papaya Administrative Committee (PAC). The study concludes that PAC's marketing program generated a high rate of return to Hawai'i producers; estimated producer surplus in 1996-2000 increased by at least \$148,000 and possibly as much as \$2.43 million (1982-84 dollars). On average, each \$1 spent on promotion and marketing generated at least \$3.20 and possibly as much as \$52.40 in additional income to growers. This analysis may enable papaya growers and PAC to quantify benefits of their market order and associated activities.
- c. Source of Funding. Smith-Lever
- d. Scope of Impact. Statewide

Key Theme – Agricultural Profitability

- a. Description of activity. The goals of this project are (1) to improve the viability of Maui County's diversified agricultural industry by increasing efficiency and productivity of the farming system, (2) to develop and maintain an integrated approach for the management of diseases and insect pests affecting edible crops, and (3) to increase growers' involvement in resolving problems facing industry (e.g. marketing, water, transportation, etc.). (21-030)
- b. Impact/Accomplishment. Head cabbage growers experienced yield losses due to diamondback moth (DBM) of 20 to 40%, and in some cases up to 100%. From 1990 to 1994, the head cabbage industry was in severe financial distress with losses up to \$1.8 million. In an attempt to eliminate the resistant DBM populations in cole crop production areas, CTAHR worked to develop and implement a DBM resistance management program. Growers were able to obtain very good control of DBM and to maximize their production to the 1999 levels. The success of CTAHR's Resistance Management Program for DBM in Hawai'i serves as the foundation for resistant management of DBM throughout the world. The use of new and improved adapted varieties is among the most cost-efficient tools available to farmers to increase profit margins. The use of these new vegetable varieties often increases yields, improves production efficiency, and minimizes farm inputs, because these varieties often require less pesticide, fertilizer, and labor to reach optimum yields than do less adapted varieties. Tomato spotted wilt tospovirus (TSWV) reduced tomato production by over 25% since the mid-1980. In response, plant pathologists developed multiple disease-resistant parental tomato lines that produce tomato hybrids with high quality fresh market fruits and high yields. These fresh market hybrid tomatoes contain genes that confer resistance to TSWV, tomato mosaic

virus and root knot nematode. Local chefs and produce buyers are also excited about obtaining new and exciting specialty produce for their niche and local markets.

c. Source of Funding. Smith-Lever

d. Scope of Impact. County

Key Theme – Animal Health

a. Description of activity. The goals of this project are (1) to survey all swine farms in the State of Hawai‘i to determine the extent of spread of porcine reproductive and respiratory syndrome, (2) to develop a program to certify PRRS-negative swine-herds in Hawai‘i and to educate swine producers, and (3) to test the blood of cattle egrets as potential carriers for PRRS and attempt to experimentally infect cattle egrets with PRRS. (14-205)

b. Impact/Accomplishment. The survey of all swine farms in the state of Hawai‘i has been completed. At least three strains of PRRS virus have been identified in Hawai‘i: The testing schedule, the number of pigs to be tested, and the projected costs have been developed for the herd certification program. The costs of the program were found to be higher than the expected benefits from sales of breeding stock to participating producers. Serum from 30 cattle egrets and 2 pigeons has been tested for PRRS virus. The results do not strongly support a role for cattle egrets in the transmission of PRRS, but indicate that further investigation would be of value.

c. Source of Funding. Smith-Lever

d. Scope of Impact. Statewide

Key Theme – Animal Health

a. Description of activity. The goal of this project is to improve pig farming in Hawai‘i. The specific objectives include (1) increasing the use of record keeping and analysis by individual farms, (2) improving the genetic base of Hawaiian and Pacific Island swine,(3) implementing proper herd health maintenance programs, (4) increasing the number of producers certified at Level 3 under the Pork Quality Assurance program. (14-211)

b. Impact/Accomplishment. Farms using the PigCHAMP record keeping program have increased their herd size, whereas the swine population as a whole has seen a slight decline. Two artificial insemination (AI) classes have been held in the Wai‘anae area to help farmers improve their herds’ genetics without introducing diseases. Breeding stock that was selected by farmers from prior AI workshop litters is now in production on several farms. The impact of using AI-sired stock and improved management can be seen in the State Farm Fair carcass results, with quality improving from year to year. This year’s average percent lean yield for swine carcasses was 59.4%, up 2.1% from last year. As lean yield increases, feed efficiency improves. The amount of feed required to produce one pound. of gain this year totaled 2.94 lbs., down from 3.19 lbs. last year. This equates to 50 lbs. less feed per 200-lb. pig, a saving of approximately \$10 a pig for the farmer. Vaccination programs for controlling respiratory disease have been reviewed and revised with the assistance of swine veterinarians on the mainland and at the Hawai‘i Department of Agriculture.

c. Source of Funding. Smith-Lever

- d. Scope of Impact. Statewide

Key Theme – Animal Production Efficiency

- a. Description of Activity. The goals of this project were (1) to identify appropriate measures of animal stress and well being, (2) to characterize factors affecting the biology of the stress response, and (3) to evaluate management strategies that minimize the detrimental effects of animal stress. Studies were conducted jointly with Cornell University and the University of Arizona (Tucson, AZ) on the effect of radiation on sweating rate, rectal temperatures, and respiration rates in cows in the new environmental chambers at Tucson. Continuing work on the new sensor for cooling cows in freestalls was conducted at Michigan State University with Cornell collaborating. (257R)
- b. Impact/Accomplishment. Preliminary studies suggest variations within breed and hair/coat color in ability to regulate thermal stress. A modified device was tested for intra-vaginal acquisition of temperature in dairy cows; the correlation between intra-vaginal temperature (as measured by the modified device) and rectal temperature was found to be 0.99. Studies showed that when cows reach a vaginal temperature of 102 degrees F, they became uncomfortable and sought avenues to cool themselves. The ability of the Hobo watertemp probe, with the modified holder to acquire an accurate body temperature, means that we can use this system to monitor cows' homeostasis without interfering in their routine or behavior.
- c. Source of Funding. Hatch and MRF.
- d. Scope of Impact. State, Michigan, New York, and Arizona.

Key Theme – Animal Production Efficiency

- a. Description of activity. The goals of the project are to evaluate new micro-environment modifiers (fans and misters) to cool cows, and to plan and develop a new system of nutrient management, ensuring all nutrients are contained within the operation. (14-208)
- b. Impact/Accomplishment. Cows with shade but without fans and misters had significantly higher respiration rates (RRs) than those with both shade and misters. Cows under shade with fans and misters had the lowest RRs. Their RRs were within the physiologic range. Preliminary studies suggest that shade at the manger would enhance feed intake and sustain homeostasis. Following exit lane wetting, the rectal temperatures of cows that lack shade could rise to over 102F within 20 min. Studies on the efficacy of the cooling system should help alleviate the 25% summer slump in milk production. Animals in pens with fans and misters did not experience a drop in milk production in the summer months. These cows were able to maintain over 89 lbs. of milk production even when the temperature-humidity index outside the pens was higher than 82F. For Hawai'i, this translated to about \$1 million in farm gate value of raw milk sales. Reproduction was enhanced with higher numbers of cows being bred in the first service. Pregnancy targets were met. This research demonstrates that milk producers in hot, humid regions like Hawai'i can compete in the marketplace. The dairy industry diversifies Hawai'i's economy, creates three jobs in processing and marketing for each dairy farm job, utilizes land vacated by sugarcane, job creation, and prevents shortages that result from the flow of goods from the mainland being disrupted.
- c. Source of Funding. Smith-Lever

d. Scope of Impact. Statewide

Key Theme – Aquaculture

- a. Description of activity. The goal of the project was to conduct a feasibility study for an offshore Pacific threadfin (*Polydactylus sexfilis*) cage production system for Hawai‘i. The hypothetical six-cage system was based on the biotechnology requirements of, and productivity demonstrated by, the Hawai‘i Offshore Aquaculture Research Project (HOARP). (540H)
- b. Impact/Accomplishment. At a farm-gate price of \$4.00/lb, the six-cage system is not profitable in Hawai‘i. The total cost of production is estimated at \$3.97/lb for the production system projected to yield 914,271 lbs of Pacific threadfin annually. The largest costs contributing to annual operating expenses of \$3,626,556 were feed (30%), labor (17%), stocking (12%), and shipping (11%). Sensitivity analyses suggest that increases in stocking densities, survival rates, and average growth rates have the largest potential for reducing production costs. HOARP is among the first reported successful deployments of a fully submerged cage system in the United States. This study details the technological requirements, associated costs, and report recommendations for farm management in light of the financial strains of full-scale commercial deployment. A local aquaculture firm has recently entered into a 20-year lease with the State of Hawai‘i to use 28 acres under water at the site of the HOARP. The lease was the first issued in the country for off-shore culture. The firm is currently producing about 5,000 lbs of Pacific threadfin a week from two cages. The fish are sold to local markets and restaurants, as well as on the U.S. mainland. This is a positive sign favoring the commercial viability of cage culture in Hawai‘i.
- c. Source of Funding. Hatch and Grant.
- d. Scope of Impact. State Specific.

Key Theme – Biotechnology

- a. Description of activity. The major goal of this research project is to address the hypothesis that DNA and mRNA-binding proteins mediate light-activated transcription and translation, respectively, of genes that encode photosynthesis functions in higher-plant chloroplasts. The specific objectives are (1) to clone and characterize the *Arabidopsis* cDNAs that encode proteins that bind to the *psbD*-promoter-cis elements, and to the 5' UTR of *psbA* mRNA, (2) to clone and characterize proteins that recognize the *psbD* 5' UTR, and (3) to determine the roles of the DNA- and RNA-binding proteins in plant chloroplasts. (670H)
- b. Impact/Accomplishment. The project has been investigating genetic mechanisms that control plant productivity and photosynthesis, isolating those genes, and using the genes in biotechnological applications to increase plant productivity. In pineapple, the project cloned and characterized two DNA sequences: a genetic switch, termed a “promoter,” that activates genes only in root tissue, and a gene for cystatins, which inhibit the digestive enzymes of nematodes. In *Anthurium*, the project has cloned a gene that is turned on during aging.
- c. Source of Funding. Hatch and Grants.
- d. Scope of Impact. State, National, and Worldwide Specific.

Key Theme – Biotechnology

- a. Description of activity. The goal of this project is to develop viral-disease-resistant tropical fruits. Specifically, the objectives are (1) to produce and evaluate banana bunchy top virus (BBTV)-resistant transgenic banana plants and (2) to evaluate alternative strategies to control mealybug wilt of pineapple (MWP). (976H)
- b. Impact/Accomplishment. A new tissue-culture system was developed that has high regeneration efficiency and a high potential to produce wholly transformed plants instead of chimeras. This regeneration system was used to develop procedures for the efficient production of transgenic banana using micro-projectile bombardment-mediated transformation. Because the system is so efficient, it can also be used to produce transgenic banana plants for other goals, including engineering of resistance to other banana diseases, such as *Fusarium* wilt and Black Sigatoka. The banana regeneration system developed will be useful for banana growers in Hawai'i. Using this system, approximately 600 transformed banana plants were produced in a period of one year, a large increase in time- and resource-efficiency in comparison to our previous results using the meristem transformation system. Several hundred plants regenerated through this system are currently being grown at Mauna Kea Banana in collaboration with Mr. Richard Ha, a grower who is working to transfer this technology to his production system.
- c. Source of Funding. Hatch.
- d. Scope of Impact. State, National, and Worldwide.

Key Theme – Biotechnology

- a. Description of activity. The goal of this project is to develop biological resources for identifying novel genes and bioactive compounds from higher plants originating from the phytochemically under-explored flora of Hawai'i and Fiji. The initial hypothesis will test whether vascular plants from Hawai'i and Fiji yield extracts that show biological activity in mechanism-based assays relevant to cancer. It will further hypothesize that genes that encode regulators or enzymes involved in the biosynthesis of these bioactive compounds can be identified and characterized using functional plant viral-based assays. The accumulation of bioactive plant compounds may be altered by modulating the expression of biosynthetic genes. The extracts obtained during this project will provide a biological resource for identifying novel genes and bioactive compounds. Establishment of a teaching program in molecular conservation that will integrate genomic, ethnobotanical, and anti-cancer data is intended. (515H)
- b. Impact/Accomplishment. On October 16, 2001, U.S. patent 6,303,848 entitled "Method for conferring herbicide, pest, or disease resistance in plant hosts" was issued. The project described novel methods for the identification of new herbicides and the construction of herbicide- and disease-resistant plants. On April 23, 2002, U.S. patent 6,376,752 entitled "Cytoplasmic inhibition of gene expression in a plant" was issued. The project described novel methods to silence endogenous genes in plants. On July 30, 2002, U.S. patent 6,426,185 entitled "Method of compiling a functional gene profile in a plant by transfecting a nucleic acid sequence of a donor plant into a different host plant in an anti-sense orientation" was issued. The project described novel methods to identify genes and compile functional profiles in plants using anti sense RNA.

- c. Source of Funding. Hatch
- d. Scope of Impact. State, National, and Worldwide

Key Theme – Biotechnology

- a. Description of activity. The goal of this project is to employ modern molecular biology and bioengineering to accelerate the exploitation of higher plants to produce pharmaceuticals and industrial proteins. Specifically, the objectives are (1) to establish tissue-culture-based systems for rapid production of recombinant proteins, (2) to employ novel and tested molecular strategies to enhance the level of recombinant protein expression, (3) to use online green-fluorescent-protein-(GFP-) fusion monitoring and dynamic-process optimization to improve protein production in high-density cell/tissue cultures, and (4) to design dual-function fusion tags to aid protein monitoring and purification. (532H)
- b. Impact/Accomplishment. The project has succeeded in developing a dual-function green fluorescent protein (GFP) tag useful for reporting gene expression and for purifying proteins. A detailed study was conducted on the secretion of GFP from transgenic tobacco cells, and achieved online monitoring of GFP secretion. In addition, the project developed two GFP-fusion proteins and characterized their expression. For one of these two fusion proteins, the project achieved high-protein purity necessary for subsequent characterization of the glycosylation pattern of the protein. This study led to the development of a powerful platform technology that offered unprecedented opportunities to probe protein expression in plant cell systems. Such biological information is vital before effective production systems of proteins based on transgenic plants can be established. The project succeeded in optimizing production of various recombinant proteins in transgenic tobacco cell cultures using this technology.
- c. Source of Federal Fund. Hatch.
- d. Scope of Impact. State, National, and Worldwide.

Key Theme – Biotechnology

- a. Description of activity. The goal of this project is the breeding of dendrobium orchids using innovative biotechnology techniques for improved color and disease resistance. (842H)
- b. Impact/Accomplishment. One set of promising potted plant crosses is between tetraploid *Dendrobium* Jaquelyn Concert K327-4 and a tetraploid hybrid K1417-1 (*Dendrobium* Mae Teramoto x Mānoa Beauty) and its reciprocal. Hybrid offspring are fairly uniform and floriferous. Flowers are deep purple, and measure about 2.75 inches in diameter. The breeding program continued maintenance and rejuvenation of parent plants and production of new tetraploids for breeding. For commercial cropping, 224 seed pods of 12 different cut flower and potted plant cultivars were provided to three dendrobium grower associations in 2001. In addition, five flasks of UH1224 D were released. For commercial orchid cropping in Hawai‘i, 224 seed pods of 12 different cut flower and potted plant *Dendrobium* orchid cultivars were provided to three dendrobium grower associations in 2001.
- c. Source of Federal Fund. Hatch and Grants.

- d. Scope of Impact. State and Worldwide.

Key Theme – Biotechnology

- a. Description of activity. The goal of this project is the breeding of aroids for quality, productivity, and disease/pest resistance, with an emphasis on anthuriums. (841H)
- b. Impact/Accomplishment. The University of Hawai‘i breeding program released three new *Anthurium* cut flowers for production in Hawai‘i: "Hokuloa" (white), "Hilo Moon" (white) and "Waimea" (red). These are two potted selections under consideration for patenting. "Hokuloa" anthurium, UH1349, has a glossy white, medium-sized, heart-shaped flower with an excellent vase-life of about 33 days. Its leaves are dark green. It is a fast propagator in tissue culture. "Hilo Moon" anthurium, UH1450, is a sibling to UH1349 and shares its glossy white flower with a light yellow nose. It features an excellent yield and good sucker production. "Waimea" anthurium, UH1311, has a bright red, medium- to large-size flower that retains its vibrant color, even under hot summer conditions. Its vase-life is almost five weeks with a BA dip. It is notably fast in tissue culture. UH1554 is an attractive, compact potted plant selection with small triangular, light red flowers and a red-purple nose. Bountiful flowers are accented with triangular, dark green leaves. Its excellent sucker production produces a full plant. UH1211 has large formal, light red obake flowers carried above the foliage on thick and sturdy stems, with a vase-life of four weeks. Its moderate internode length and high yield makes it also very attractive as a blooming potted plant for interiorscapes. Its potential for cut and potted use and fast propagation make it a candidate for plant patenting.
- c. Source of Funding. Hatch and Grants.
- d. Scope of Impact. State and Worldwide.

Key Theme – Diversified/Alternative Agriculture

- a. Description of activity. The goal of this project is to introduce alternate crops to low-elevation areas and evaluate them for adaptation and quality. (21-010)
- b. Impact/Accomplishment. Over 33 varieties of plumeria are being grown at the Low Elevation Farm. Cuttings of six varieties were provided to a major producer of plumeria lei flowers and will be in commercial production within a year, providing the grower an opportunity to diversify his product line. The farmer's decision to adopt these varieties was influenced by CTAHR's recommendations and by evaluations of the plumeria flowers for lei quality provided by volunteer Master Gardeners.
- c. Source of Funding. Smith-Lever
- d. Scope of Impact. County

Key Theme – Innovative Farming Technique

- a. Description of activity. The goal of this project is to study sheltered and field vegetable production. Specifically, the objectives are (1) to adapt and improve passive, non-circulating hydroponic methodologies, (2) to develop, improve, and test crop shelters and their materials, and (3) to develop, improve, and test alternative growing methodologies and nutritional regimes of crop production. (872H)

- b. Impact/Accomplishment. Grade schools, high schools, colleges, correctional institutions, handicapped groups, hobbyists, senior citizen groups, and commercial vegetable growers utilize non-circulating and simple hydroponic technology developed by this project. Non-circulating hydroponics allows for very efficient water use. For example, a 200-gram lettuce head can be produced with four liters of water. It is possible to predict potential yield of several vegetables based upon the amount of water available prior to planting the crop. For example, the "fill it and forget it" tank with 750 liters of water produced nearly 25 kg of tomatoes. Only seven percent yield loss of lettuce can be predicted when expanded polystyrene top covers are floated initially and then supported as plants grow in a non-circulating hydroponic tank. This presents growers with a choice of constructing nearly level tanks and supporting plants above the nutrient solution to achieve 100-percent yield capability or utilizing less labor for construction and maintenance of level tanks which might result in a loss of only seven percent of the potential yield. Non-circulating hydroponic systems with stagnant nutrient solution may cause increased mosquito populations. Experiments demonstrate that the sub-irrigated sump system can eliminate this nuisance and health hazard.
- c. Source of Funding. Hatch.
- d. Scope of Impact. State, National, and Worldwide.

Key Theme – Innovative Farming Techniques

- a. Description of activity. The goal of the project is to increase the usage of Hawaiian homestead lands by promoting the development of new agricultural enterprises. (21-026)
- b. Impact/Accomplishment. Through the numerous hydroponics workshops and activities, homesteaders and kūpuna (elders) learned a new way to grow food. The homesteaders received a grant from Moloka‘i Agriculture Development Program in December 2001 through, allowing them to put up two greenhouses and build hydroponic tanks on their five-acre homesteads. Through a corresponding program, the Healthy Hawai‘i Initiative taking place statewide, in which CTAHR on Moloka‘i is a partner, involved senior citizens in gardening. As a result, one senior citizen has built a small (6' x 4') tank, has produced two crops of kai choy and lettuce, and has shared hydroponics knowledge with other seniors. Another program, Ho‘ikaika, serves youth who are majority native Hawaiians or are from homestead families. The youth group demonstrated their new knowledge and skills by growing green onions and broccoli.
- c. Source of Funding. Hawaiian Home Lands
- d. Scope of Impact. County

Key Theme – Niche Market

- a. Description of activity. The goals of this project are (1) to develop sensor technology for quantitative measurement of coffee and kava properties indicative of quality, and (2) to integrate sensor technologies and handling systems that will retain postharvest quality in coffee and kava. (538R)
- b. Impact/Accomplishment. Coffee Processing: trained taste panels could not detect an effect on the quality of the cup—taste, etc.—of coffee grown in Hawai‘i (all islands) when using low-water

processing (i.e., mechanical demucilaging) of coffee. The results have been reported at a coffee-processing workshop in Kona in the past year, and a food flavoring product was developed from the material produced by mechanically demucilaging coffee. Licensing of a patent covering this food product is now in negotiation (OTTED TLG document #00377). Low-water processing uses 2.5% of the water used when fermenting and washing coffee in the parchment. The savings in the cost of water alone will be significant to Hawai'i's growers. The new food flavoring from mucilage will add several million dollars to Hawai'i's agricultural revenue through a new source of revenue for Hawai'i coffee growers/processors. Kavalactone Concentration: ground-dried kava root samples from growing areas in Hawai'i have been scanned using near-infrared reflectance (NIRS, 700-2,500 nm). Equations have been developed with PLS (partial least squares) algorithms to predict the total kavalactone concentration and the concentration of six kavalactone species. Concerns over variations in the quality of kava root have caused problems in marketing for Hawai'i kava growers. The NIRS methods would quickly and objectively determine kavalactone content, allowing for a more orderly market for the product.

- c. Source of Funding. Hatch and MRF.
- d. Scope of Impact. State Specific.

Key Theme – Ornamentals

- a. Description of activity. The goal of this project is to provide growers with new ornamental planting material and appropriate information regarding marketing, pest management, and nutrition for those materials. (23-040)
- b. Impact/Accomplishment. Two additional accession clones of *Heliconia* were released to eight grower-cooperators for release to the tropical flower industry in 2004. This will provide the tropical flower industry with greater variety, volume, and value.
- c. Source of Funding. Smith-Lever
- d. Scope of Impact. County and Statewide

Key Theme – Ornamentals

- a. Description of activity. The goals of this project are (1) to maintain below 0.1% of total shipments by Hawai'i County cut flower shippers the annual number of export shipments rejected due to insects under the California/Hawai'i Origin Inspection Program (OIP), and (2) to increase the overall wholesale value of cut flowers from Hawai'i County by 2% per year over the next year. (20-024)
- b. Impact/Accomplishment. The goal to maintain the annual number of export shipment rejections due to insects below 0.1% of the total number of shipments by Hawai'i County cut flower shippers under the California/Hawai'i Origin Inspection Program) was met. During the reporting period, 14 Hawai'i County flower shippers exported 8,724 lots (shipments) containing 12,292 parcels (boxes) with no rejections. The continued success of this Origin Inspection Program allows shipments to be exported with minimal inspection, provides expeditious movement of products to consumers, and maintains a high standard of cleanliness of products by Hawai'i's shippers while securing against the possible introduction of unwanted quarantine action pests.

- c. Source of Funding. Smith-Lever
- d. Scope of Impact. County

Key Theme – Plant Germplasm

- a. Description of activity. The goals of this project are (1) to cooperate and participate as key elements in the NPGS , a coordinated national acquisition and management program of plant germplasm valuable for agricultural, horticultural, environmental, medical, and industrial uses in the S.R. and throughout the U.S. (in this role, to promote cooperation among elements of the NPGS, and the SSAESs), (2) to acquire, conserve, and distribute seed and/or vegetative stock of 1,369 plant species, (3) within the S.R., throughout the U.S., and internationally, to encourage the use of a broad diversity of germplasm by evaluating germplasm for specific desirable traits, and disseminating this information through the GRIN database, and (4) to develop infrastructure and to conduct research that enhances project effectiveness. (820R)
- b. Impact/Accomplishment. Soil applications of 250 and 500 g/tree of $KClO_3$ fertilizer stimulated flowering of longan trees within 2 months after application and resulted in earlier, more profuse, and more synchronous flowering, and also in increased fruit set within the tree canopies. Flowering was independent of shoot maturity, since both newly emerged and mature terminals responded to the treatment. In some instances, flowering occurred from auxiliary buds situated below the cut surface of a recently pruned branch. The response to $KClO_3$ was not restricted to soil applications since foliar application of 2.0 g/L $KClO_3$ also induced flowering at about two months after treatment. This technology will enable growers to stimulate flowering of longan trees and obtain consistent seasonal and off-season production of this crop.
- c. Source of Funding. Hatch and MRF.
- d. Scope of Impact. State and National.

Key Theme – Plant Health

- a. Description of activity. The goal of this project is to identify and develop management strategies for diseases on crops important to agricultural diversification in Hawai‘i. (16-921)
- b. Impact/Accomplishment. New disease agents were isolated from naupaka, taro, ginger, and papaya. Discovered that increased levels of nitrogen resulted in increased disease incidence in taro. Application of nitrogen after the sixth month may actually promote disease incidence. Using cover crops while allowing taro lo‘i to remain fallow between plantings increased both taro survival (+86%) and total biomass (1090%). Fallowing also breaks the disease cycle, reducing future losses. Growers agreed this was an obvious benefit that had to be weighed against the cost of leaving the lo‘i fallow.
- c. Source of Funding. Smith-Lever
- d. Scope of Impact. Statewide

Key Theme – Plant Production Efficiency

- a. Description of Activity. The goal of this project is to evaluate the yield of taro grown under wetland conditions, specifically (1) to show that rhizosphere redox potential and its consequences, i.e., Fe and/or Mn toxicity, are highly correlated to yield in farmers' paddies, and (2) to demonstrate that both pre- and post-planting draining are effective in raising redox potential and taro performance. (103H)
- b. Impacts/Accomplishments. Results of surveys at farms to test the redox potential in taro paddies showed that taro growth was related to redox potential and oxygen content in the water. In areas where taro grew well, the redox potential averaged 585 mV and oxygen content averaged 7.0 mg/L. In contrast, the redox potential averaged 339 mV and oxygen content averaged 2.5 mg/L in places where taro grew poorly. Taro growth did not seem to be related to other measured characteristics. The survey results suggested that nitrogen (N) was being lost to denitrification and nitrogen-use efficiency was probably low. Toxicity was not likely, except under unusually stagnant conditions. Results of the project demonstration showed that nitrogen-use efficiency was highest with polycoated urea, intermediate with calcium peroxide/urea, and lowest with regular urea. The project also found that organic matter, such as compost applied to wetland conditions, could provide a sustained release of N over a period of many months. Analyzing the soil for total N prior to planting a wetland taro crop may be useful for estimating the existing level of N from crop residue and previously applied compost. A significant finding was that N fertilization appeared to have delayed the physiological maturity of the taro crop, and increased the incidence of taro pocket rot disease. This has important implications on the management of N fertilization and the timing of harvest for taro. These findings will lead to improved N management in taro grown under wetland conditions, reducing production cost, improving taro quality, and benefiting the environment. It is envisioned that farmers will be able to greatly increase their nitrogen-use efficiency through such practices as applying organic matter, using slow-release fertilizer, and making smaller but more frequent fertilizer applications, and improving nitrogen redox potential and taro performance budgeting based on soil analyses.
- c. Source of Funding. Hatch.
- d. Scope of Impact. State Specific.

Key Theme – Plant Production Efficiency

- a. Description of Activity. The goal of this project is to identify key environmental factors leading to dormancy and erratic emergence of purple nutsedge and its invasiveness in crops. (802H)
- b. Impacts/Accomplishments. An important output of this research is the finding that conditions that promote high solar radiation to existing purple nutsedge populations also promote dormancy release from individual tubers and from tubers in chains. Future purple nutsedge management strategies must consider the effect of these environmental factors on tuber dormancy and sprouting. For example, enhanced sprouting synchrony in the field is dependent on eliminating apical dominance, which can be promoted by physical disruption of rhizome chains with tillage implements. Another strategy might be to promote purple nutsedge to grow actively with maximum solar radiation, which would cause more tubers on a chain to emerge, to be followed by application of systemic herbicides like glyphosate to deplete the tuber reservoir.

- c. Sources of Federal Funding. Hatch.
- d. Scope of Impact. State and National.

Key Theme – Plant Production Efficiency

- a. Description of Activity. The goal of this project is to evaluate management strategies for papaya production. Specifically, the objectives are (1) to evaluate and register effective chemicals and biocontrol agents for papaya disease management programs, and (2) to develop more efficient survey procedures for early outbreaks of papaya ringspot virus (PRSV). (735H)
- b. Impacts/Accomplishments. A field fungicide trial was completed for the control of the new black spot fungal disease caused by *Asperisporium caricae*. Results confirmed that mancozeb (already used by growers), when applied on a regular basis, will control *Asperisporium* black spot disease. A newer fungicide, azoxystrobin, also provided control, but was no better than mancozeb. Assurance was provided to papaya growers that the fungicide they currently use to control other fungal disease also controls this new disease, but must be applied on a regular basis. The fungicide has slowed the spread of PRSV in the Puna District on the Big Island of Hawai‘i enough to make papaya growing profitable. Without this project, many papaya growers would not be able to grow papayas in the Puna District.
- c. Sources of Federal Funding. Hatch.
- d. Scope of Impact. State-Specific.

Key Theme – Plant Production Efficiency

- a. Description of Activity. The goal of this project is to evaluate post-harvest management strategies for tropical fruits. Specifically, the objectives are (1) to determine the factors that control the sugar/acid ratio in the new low-acid pineapple varieties, (2) to develop, via backcrossing and selection, papaya varieties that possess slow-ripening traits that have commercial potential, (3) to determine the storage potential of the newer virus-resistant papaya varieties, and (4) to assist industry in finding solutions to new problems as they arise. (660H)
- b. Impacts/Accomplishments. Low-acid pineapple hybrids (D-10, CO-2) show less variation in titratable acidity than published for canning varieties. The papaya variety "4-16" is firmer and softens slowly to the eating stage after 21 days of storage. Transgenic papaya varieties can be held in storage (8-10 and #778;C) at the color break stage for up to two weeks; longer storage times lead to a significant loss of quality and disease incidence. Irradiated "Rainbow" and "Kapoho" fruit had a slower ripening time and better quality than non-irradiated fruit after two weeks' storage at 8-10 and #778;C. Vapor-heated "Rainbow" and "Kapoho" fruit had a slower ripening period and were firmer than non-vapor-heated fruit after two weeks' storage at 8-10 and #778;C. Surface decay on vapor-heated fruit was much less than on non-vapor-heated fruit. Some flesh lumpiness was found on vapor-heated "Kapoho" fruit.
- c. Sources of Federal Funding. Hatch.
- d. Scope of Impact. State, National, and Worldwide.

Key Theme – Plant Production Efficiency

- a. Description of Activity. The goal of this project is nematode control on coffee. Specifically, the objectives are (1) to characterize genetic variability as it relates to the responses of plant parasitic nematodes to resistance, environment, biological processes, and morphology, and (2) to determine nematode fitness and adaptability relative to the environment of the host plant and relative to host plant resistance. (707R)
- b. Impacts/Accomplishments. Overall, of the three *M. konaensis* esterase phenotypes, MKF1 was the only isolate having the ability to infest coffee, and MKI1-F1 was the most aggressive isolate of *M. konaensis* on tomato and cucumber. As a result of this project, we can better monitor the spread and distribution of the nematode, now that its multiple esterase phenotypes are recognized. We may also be able to develop additional control tactics exploiting the inability of certain isolates to reproduce on coffee after several generations on a more suitable host. This biologically based control will be safe for the environment and workers in the coffee orchards.
- c. Sources of Federal Funding. Hatch and MRF.
- d. Scope of Impact. State and Worldwide.

Key Theme – Plant Production Efficiency

- a. Description of Activity. The goal of the project is genetic manipulation of sweet corn quality and stress resistance. The project seeks (1) to acquire, enhance, and distribute sweet corn germplasm, (2) to identify new genes or novel allelic combinations useful in improvements, and (3) to utilize marker-assisted selection. The objective is to reduce environmental impacts of sweet corn production, while maintaining or improving product quality. (864R)
- b. Impacts/Accomplishments. Major conversions of inbred parents of commercial hybrid #10 were completed and growers were given 20-lb samples of one of the 10 or more new versions; these are marked by green inner silks and generally by improved tenderness. Additional data were obtained, confirming the discovery of an aphid-resistant gene, *aph*, which is recessive and stops aphid development on leaves and inflorescences of corn in Hawai'i.
- c. Sources of Federal Funding. Hatch and MRF.
- d. Scope of Impact. National and International Specific.

Key Theme – Plant Production Efficiency

- a. Description of Activity. The goals of this project are (1) to identify, evaluate, and make available to Hawaiian and American taro farmers new taro cultivars resistant to taro leaf blight and pocket rot, and (2) to identify resistance to *Pythium* soft rot in Palauan and Polynesian taro cultivars. (711H)
- b. Impacts/Accomplishments. Early cutting of the apical shoot (huli) of taro plants approximately three months after planting induces proliferation of shoots from the corm remaining in the soil. Planting material production after the first cutting averages three hulis per hill five months after planting, and after the second cutting, six hulis per hill seven months after planting. This method will be useful to rapidly increase taro-planting material of new cultivars by growers. "Palehua" corms produced

under drip irrigation made commercially acceptable poi. This method will enable growers to rapidly increase planting material of new U.H.-patented cultivars once these become available.

- c. Sources of Federal Funding. Hatch.
- d. Scope of Impact. State and the wider American Pacific region.

Key Theme – Plant Production Efficiency

- a. Description of Activity. The objective of the project is to preserve Hawaiian taro and to improve taro varieties for desirable agronomic traits, disease resistance, select colors for the nursery and landscape and the restaurant industries. (914H)
- b. Impacts/Accomplishments. Genetic crosses made in 1999 between commercial taro (*Colocasia esculenta*) and taro leaf blight-resistant cultivars generated 34 hybrids that demonstrated potential as possible replacements for the disease-susceptible commercial cultivars being grown in Hawai'i primarily for consumption as poi. To validate their potential, two taste trials were made in December 2001 and in February 2002 using taro hybrids that were grown on upland conditions on Maui. Taro were prepared as poi (cooked and made into a paste) and table taro (cooked and cubed to be consumed like potatoes) for the taste test. After the two taste tests, nine hybrids were selected for further evaluation under wetland paddy conditions.
- c. Sources of Federal Funding. Hatch.
- d. Scope of Impact. State-Specific.

Key Theme – Plant Production Efficiency

- a. Description of Activity. The specific objectives of this project were (1) to characterize the bacterial species responsible for biological control of plant diseases caused by *Xanthomonas*, (2) to develop strategies for the application and delivery of biocontrol agents (BCAs), and (3) to evaluate the efficacy of the BCAs for disease reduction under greenhouse and field conditions. The focus was on bacterial blight of anthuriums, but principles were extended to the control of other bacterial diseases. (741H)
- b. Impacts/Accomplishments. Bacterial blight of anthuriums was controlled using mixtures of antagonistic bacteria to reduce infection by the pathogen, *Xanthomonas campestris* pv. *dieffenbachiae*. Individual bacterial strains and specific mixtures were evaluated for ability to suppress infection. Certain mixtures were effective at all growth stages of *Anthurium*, from micro-plants to mature, flowering anthuriums. Bioprotection was most pronounced on highly susceptible *Anthurium* cultivars. A secondary benefit of applying the bacterial mixtures was a distinct growth enhancement of anthuriums and other aroids. The effect was greatest during the first three months as plants were established in community pots and later transplanted to greenhouse benches. Mixtures of biological control agents provide a more robust control than application of single antagonistic bacterial species. The beneficial bacteria protect *Anthurium* microplants from infection during overhead irrigation, when plants are most susceptible to disease. Use of bacterial species for both growth-promotion and biological control is new for the *Anthurium* industry and shows promise for commercial greenhouse production of ornamentals.

- c. Sources of Federal Funding. Hatch.
- d. Scope of Impact. State and National.

Key Theme – Plant Production Efficiency

- a. Description of Activity. The goals of this project are (1) to add value to quarry fines by transforming a low-value by-product of quarry operation into a valuable soil amendment, and (2) to transform the low-productivity, aluminum-toxic, manganese-toxic, and acidic soils of O‘ahu and the State into high-productivity land for diversified agriculture. (855H)
- b. Impacts/Accomplishments. Pineapple growers correct manganese-induced iron deficiency with foliar application of iron. In October of 2001, personnel from Dole Pineapple Company and the University of Hawai‘i installed an experiment to investigate the effects of calcium source and rate of calcium application on two industry problems, namely (1) manganese-induced iron deficiency, and (2) fruit translucency. The calcium sources were gypsum, limestone, and basaltic dust. Gypsum was applied at a low and high rate, but basaltic dust and limestone were applied at a single rate adjusted to avoid root rot. A limestone-gypsum mixture was also included in the treatments. To study the effect of calcium on manganese-induced iron deficiency, the treatments were split to receive, or not receive, foliar application of iron. One year after installation, all treatments receiving iron are green and healthy, but those receiving no iron show iron deficiency to varying degrees. Of the three calcium sources, basaltic dust appears at this stage to produce greener plants than limestone or gypsum, and may help growers reduce the frequency of iron applications. Because basaltic dust is a waste product of rock quarries, it will be a cheap and readily available soil amendment. Basaltic dust, a waste product of rock quarrying on O‘ahu, appears to be a possible inexpensive source of calcium to the pineapple industry. If proven to be true, the rock quarry industry may be able to dispose of their waste product to meet EPA standards while providing the agricultural sector with an inexpensive source of calcium. For the pineapple industry on O‘ahu, this may provide improved fruit quality at lower input costs. The economic and environmental impacts to both industries and the State have great potential.
- c. Sources of Federal Funding. Hatch.
- d. Scope of Impact. State-Specific.

Key Theme – Plant Production Efficiency

- a. Description of Activity. The goals of this project are to evaluate ‘awa dieback disease in Hawai‘i, and screen varieties for disease-resistance. Specifically, the objectives are (1) to determine the pathogenicity of cucumber mosaic cucumovirus (CMV) to *Piper methysticum*, (2) to determine the geographic distribution of the ‘awa strain of CMV and to determine if distinctly different strains of the virus exist, (3) to determine the severity of kava dieback in Hawai‘i in different environments, (4) to identify all aphid and ant species involved in disease and virus transmission, (5) to identify all significant weed and alternate hosts of CMV in and near Hawaiian ‘awa farms, and (5) to screen existing ‘awa varieties for resistance, symptom expression and/or growth response to CMV. (716H)
- b. Impacts/Accomplishments. ‘Awa farms with severe ‘awa dieback disease problems in Hawai‘i are now difficult to find, largely because of the disease management practices recommended as a result of this project. Thus, ‘awa dieback is no longer the primary disease threat to Hawaiian ‘awa.

Farmers now have a good understanding of a disease (dieback), which was previously unreported in Hawai'i and for which no disease management practices were in place prior to this project. The cucumber mosaic cucumovirus (CMV) disease-resistant variety, "Isa", is being planted on expanded acreage, which has enhanced the profitability of 'awa farms by reducing costs of 'awa dieback disease and pest (aphid) control.

- c. Sources of Federal Funding. Hatch.
- d. Scope of Impact. State-Specific.

Key Theme – Plant Production Efficiency

- a. Description of Activity. The goal of this project is to evaluate weed management strategies for noxious weeds of pastures and forests by conducting trials on weed species representative of the problems typically encountered by ranchers and foresters. Specifically, the objectives are (1) to determine the impact of sequential or split applications of herbicides on the efficacy and efficiency of treatments, (2) to evaluate the efficacy of crop oil adjuvants and carriers in foliar applications of herbicides on weeds that tolerate herbicides applied using water carrier and standard surfactants, (3) to evaluate the long-term efficacy of herbicides with pre-emergence activity, (4) to evaluate the efficacy of pre-emergence herbicides on weedy grasses, and (5) to evaluate the efficacy of very low-volume basal bark treatments. (130H)
- b. Impacts/Accomplishments. MCPA has become the standard treatment for *Senecio madagascariensis* by the Maui Fireweed Task Force, and is now recommended to ranchers who have reported good to excellent control. Current recommendations include the addition of the acidifying surfactant that should improve efficacy. Triclopyr ester with a crop oil adjuvant, cheaper than standard surfactants, is now recommended for *Clidemia hirta* control. Very-low-volume basal bark treatments have been utilized on trails on Kaua'i and Hawai'i to kill invasive plants and will be found to be a safer, much more economical way to do so. The addition of crop oil to 0.5% v/v of the spray mixture increased the efficacy of triclopyr on *Clidemia hirta* over that of a conventional and a silicone surfactant. MCPA and dicamba were ineffective. *Senecio madagascariensis* was most susceptible to 2kg/ha of MCPA with an acidifying surfactant. Dicamba was also effective at 2 kg/ha, but at greater cost. *Rhodomyrtus tomentosa*, tolerant to most brush herbicide, was susceptible to dicamba at 2 kg/ha. *Senna obtusifolia*, long known in Kona, suddenly became invasive in pastures. It was susceptible to dicamba and triclopyr, each at 1 kg/ha, but tolerant to MCPA. Very-low-volume basal bark applications of triclopyr ester in oil were effective in killing *Casuarina equisetifolia*, *Corynocarpus laevigatus*, and *Psidium cattleianum* at an herbicide cost of 8 to 12 cents per tree. *Olea europaeus* was virtually immune to this treatment.
- c. Sources of Federal Funding. Hatch.
- d. Scope of Impact. State, National, and Worldwide.

Key Theme – Plant Production Efficiency

- a. Description of activity. The goal of this project is to import, evaluate, and release exotic parasitoids of tephritid fruit flies in Hawai'i. (904H)
- b. Impact/Accomplishment. Eleven new natural tephritid fruit fly enemies were identified and

introduced to Hawai‘i. Parasitoid species were: *Fopius ceratitivorus* (05/23/02), *Psytalia concolor* (05/28/02), *Psytalia phaeostigma* (05/28/02), *Psytalia phaeostigma* (06/22/02), *Psytalia concolor* (07/12/02), *Psytalia phaeostigma* (07/12/02), *Fopius ceratitivorus* (08/22/02), *Psytalia lounsburyi* (09/03/02), *Fopius ceratitivorus* (11/15/02), *Fopius ceratitivorus* (11/29/02), and *Fopius caudatus* (12/11/02). Importation, release, and establishment of additional natural enemies of tephritid flies will incrementally add to the mortality of a critical complex of direct horticultural pests. This can help local farmers achieve better yields at lower costs, through reduced rates of infestation (especially in less-preferred host fruits), decreased use of toxic pesticides, and increased possibilities for area-wide control and/or eradication.

- c. Sources of Federal Funding. Hatch.
- d. Scope of Impact. State, National, and Worldwide.

Key Theme – Plant Production Efficiency

- a. Description of Activity. The goal of this project is to identify and register any needed insecticides that are target-specific, more environmentally acceptable, and that can be utilized in an integrated pest management systems approach. (733H)
- b. Impacts/Accomplishments. The EPA has granted a Special Local Need (SLN) label for Amdro in bait stations in some tropical fruit and nut crops without additional residue or tolerance data using information from work in pineapple. This outcome allows even more growers to use less toxic pesticides to control ants.
- c. Sources of Federal Funding. Hatch.
- d. Scope of Impact. State and National.

Key Theme – Plant Production Efficiency

- a. Description of Activity. The goal of this project is to study the watercress yellows disease. Specifically, the objectives are (1) to determine the etiology of watercress yellows, and (2) to study the epidemiology of watercress yellows, including host range and vector transmission. (903H)
- b. Impacts/Accomplishments. Watercress (*Nasturtium microphyllum* Boen. ex Rcbh.) in Hawai‘i has recently been afflicted with a yellows disease with symptoms that include reduced leaf size and leaf yellowing, and occasionally witches' brooms. These symptoms are followed by the rapid collapse of affected plants. Watercress yellows disease has led to an 80-90% loss for one of the largest watercress farms on O‘ahu. Watercress plants that displayed either early yellowing or advanced symptoms of disease were analyzed with phytoplasma-specific PCR primer-pairs P1/Tint and P1/P7. Normal, healthy-looking watercress plants were negative in these tests, but all samples that had symptoms of this disease produced amplicons of the expected sizes using each primer-pair. The known host range of the aster yellows phytoplasma is very large and includes monocot and dicot species from at least 40 plant families, many of which are important components of diversified agriculture in Hawai‘i. This pathogen may also be a threat to many of the plants that are found in our unique ecosystem.
- c. Sources of Federal Funding. Hatch and Integrated.

- d. Scope of Impact. State and National.

Key Theme – Plant Production Efficiency

- a. Description of activity. The goals of this project are to develop and apply sustainable production technology to both corporate and family farm throughout the State. Specific objectives include mechanized pruning for coffee. (18-816)
- b. Impact/Accomplishment. A four-year on-farm project for mechanized pruning for sustainable coffee production was concluded. Pruning coffee by hand costs over \$1,000 per acre per year. Because pruning is a time-sensitive activity, large-scale production of Hawaiian coffee will remain limited unless it can be mechanized. Today over half the coffee acreage in Hawai‘i (i.e., more than 4,000 acres) is pruned using the mechanized pruning methods developed by this project. Annual costs are 10 to 15% that of hand-pruning coffee. Total annual savings to the \$23 million coffee industry are about \$3.5 million.
- c. Source of Funding. Smith-Lever
- d. Scope of Impact. Statewide

Key Theme – Plant Production Efficiency

- a. Description of activity. The goal of this project is to apply arbuscular mycorrhizal technology. Specific objectives include (1) preparation of a training manual on the application of the arbuscular mycorrhizal technology to forestry and tree-based natural and agricultural ecosystems, (2) establishment of a field plot to demonstrate the response of trees to arbuscular mycorrhizal colonization, and (3) organization of a training workshop on the nature of the arbuscular mycorrhizal technology and its application to forestry and tree-based ecosystems. (13-131)
- b. Impact/Accomplishment. A manual titled *Arbuscular Mycorrhizas: Producing and Applying Arbuscular Mycorrhizal Inoculum* was published in 2001. An excerpt of a segment of the manual dealing with inoculum production and application was posted on the Internet. As a result, the manual received attention not only locally but from California, New York (Cornell University), West Virginia (University of West Virginia), Massachusetts (M.I.T.), and Indonesia. A training workshop was attended by 20 individuals who learned about the nature of the arbuscular mycorrhizal technology. At the end of the workshop, many of the participants indicated that the experiences they gained by participating in the workshop were very valuable. One of the participants indicated that he was ready to raise 65,000 mycorrhizal ginger seedlings, and has asked that the project supply him with inoculum until he starts producing his own. Post-workshop contacts with at least two of the participants indicate that they intend to put into practice what they learned during the workshop. One of these individuals is determined to produce 20,000 mycorrhizal seedlings per year for outplanting on the island of Kaho‘olawe.
- c. Source of Funding. Smith-Lever
- d. Scope of Impact. Statewide

Key Theme – Rangeland/Pasture Management

- a. Description of activity. The goal of this project was to plan, coordinate and implement promotional activities at two events per year with established industry associations and related interagency department. (20-049)
- b. Impact/Accomplishment. “A Taste of the Hawaiian Range” Food Show and the Mealani Forage Field Day programs increased consumer awareness of the high quality forage-based beef being produced in Hawai‘i. Retail supermarket and restaurant businesses are marketing this product more, thereby increasing consumer demand and raising the prices paid to ranchers. The food show celebrates the best of local agriculture and is a forum to educate the culinary industry, food service buyers, and the general public about the diversity of quality products produced in Hawai‘i. Local media that attend the event rated this food show as one of Hawai‘i’s best. Thirty chefs participated in this 7th annual event, along with 20 food service vendors, vegetable and ranch industry promotional booths. Nearly 1,100 total people attended the evening event. The project assisted the Hawai‘i County 4-H livestock programs’ annual Livestock Roundup and Sale and facilitated the show’s incorporation into the Mealani Forage Field Day and “A Taste of the Hawaiian Range” Food Show events. By combining these activities, the 4-H program increased its exposure to the public nearly five-fold, enhancing recruitment and educational efforts. Also, animal consignments, and promotional and educational activities were planned and coordinated at the Big Island Farm Fair, which showcased the livestock industries. Over 27,000 people attend this annual event.
- c. Source of Funding. Smith-Lever
- d. Scope of Impact. County

Key Theme – Rangeland/Pasture Management

- a. Description of activity. The goal of this project is to train individuals (cooperators) or groups (eg. 4-H Youth) in livestock, pasture, and range management improvement. (21-060)
- b. Impact/Accomplishment. Fireweed is poisonous to animals. Animals that are forced to eat the weed or fed contaminated hay can die from liver damage. Uncontrolled fireweed infestation has rendered large tracts of Big Island pasture unusable. A fireweed task force has contacted 66 clients that represent over 1500 infested acres and has sprayed 800 acres. Because fireweed produces over 30,000 seeds per plant, killing fireweed on 800 acres has the potential to curtail this invasive weed on many more than 800 acres during the ensuing rainy season. Herbicide trials on fireweed reduced the cost of treatment and stretched the money available to cover 25% more infested area. The results of these trials have been reported in a paper prepared for the Western Society of Weed Science meeting. The knowledge gained during this invasion creates a blue print for assisting other regions and fighting other invasions. Volunteers contributed approximately 175 hours and an estimated \$50,000 in in-kind and \$50,000 in monetary donations were received. Gorse (*Ulex europeans*) was also an active target. Sixteen individuals were trained in safe and effective herbicide application. Helicopter application was shown to be the most cost effective. This analysis resulted in the first application of 1000 gal. crop oil/herbicide spray on 100 acres in a 3-hr. period, cutting the cost of man/backpack application by more than half. Follow-up with ground applications and a six-month evaluation will dictate follow-up aerial work. The Maui 4-H Livestock Association has 106 members from 33 families. Three main events make up the 4-H livestock year: the Maui County Fair, with the Cloverbud show; the Upcountry Fair, our 4-H show and auction; and the State Farm

Fair. The 4-Hers showed 47 projects at Upcountry Fair, including market lamb, market barrow, market steer and dairy heifer. The auction generated \$57,000, most of which goes back to the 4-Her, with a small percentage financing next years' show. Seventeen projects and a livestock judging team were taken to the State Farm Fair. The judging team won the right to go to the American Royal Livestock Show in Kansas City to compete against the best from the other 49 states. The impact of the Maui 4-H Livestock Program is far-reaching and deep. Troubled youth from The Maui Farm, a temporary home for special youth that need some structured time away from their families, have made enormous gains when charged with full responsibility for an animal project.

- c. Source of Funding. Smith-Lever
- d. Scope of Impact. County

Key Theme - Tropical Agriculture

- a. Description of Activity. The goal of this project is to enhance the propagation of native Hawaiian plants using various agronomic approaches, including developing a protocol for managing arbuscular mycorrhizal fungi for propagation under nursery conditions. (825H)
- b. Impacts/Accomplishments. Work on this project includes propagation of native Ho'awa (*Pittosporum* species), which showed that recently matured leafy terminals could be rooted with 3,000 to 4,500 ppm dips in indolebutyric acid. The cutting source was critical. Coupling a pre-treatment of 10^{-3} M chlororesorcinol with 3,750 ppm of a commercial rooting agent (Dip N' Grow) produced better rooting response than was achieved by Dip N' Grow alone or in combination with 10^{-3} M chlorogenic acid or 10^{-3} M caffeic acid. Use of isozyme analysis on Nanu (*Gardenia brighamii*) and other native and introduced *Gardenia* species and cultivars demonstrated that the technique could quickly and inexpensively distinguish among different species and clones.
- c. Sources of Federal Funding. Hatch and Grants.
- d. Scope of Impact. State, National, and Worldwide.

Key Theme – Urban Gardening

- a. Description of activity. The goals of this project are (1) to provide practical research and demonstration activities relating to urban horticulture concerns, and (2) to develop new gardens and maintain extant gardens and demonstration plots for urban food production and plant selection using environmentally sound practices. (22-040)
- b. Impact/Accomplishment. New cultivars of vegetable soybean with higher yield, better flavor and faster maturity were selected. A red radish cultivar from Japan with less pithiness was selected for home planting. The Sensory Garden for the physically challenged, which features paved pathways, hand railings, and a raised garden, was completed. The Sun Dial Garden also became operational. New plants were added to other gardens, including the fruit orchard, plumeria collection, turf plots, ground covers, and the Hawaiian ecosystem. Gardens developed or renovated after 01 July 2001 can accommodate the physically challenged. Wider paths, wheel chair-accessible paths, and rest areas were included in the renovations. A website for the Urban Garden Center was created. More than 14,000 contacts (phone consultations, garden visits, garden clinics, internships, demonstrations, classes, correspondence, etc.) were made during the year. Additionally the Urban Garden Center

garden volunteers assisted 133 gardeners who were unable to be helped by Master Gardeners or who wanted practical, hands-on information on the subject of food production. The 107 volunteers provided 12,790.5 hours to plan, develop, maintain and participate in other gardening activities sponsored by the Urban Garden Center. The in-kind value of this contribution is estimated to be \$66,150. Garden enthusiasts from California, Arizona, and Texas furthered their interest after viewing the above-mentioned ornamentals by joining their local plumeria and hibiscus societies. Plant materials including native plants, turf, ornamentals, fruit, and vegetables were distributed to neighbor island educational centers, schools and other governmental and non-profit agencies.

- c. Source of Funding. Smith-Lever
- d. Scope of Impact. County

Key Theme – Other (Ants)

- a. Description of Activity. The goal of the project is to study the biology and management of ants. (952H)
- b. Impacts/Accomplishments. Ants are extremely hard to control in Hawai‘i, where 40 species have become established. Initial isolations of bacteria found in the gut of white-footed and Hawaiian carpenter ants were obtained. Bacteria found in the gut of these social insects may be turned into self-replicating pest control agents, using methods described in the patent application submitted in February 2002, “Recombinant Bacteria for Insect Control” (C. Hussender, J.K. Grace, D. Oishi, inventors).
- c. Sources of Federal Funding. Hatch.
- d. Scope of Impact. State-Specific.

GOAL 2: A SAFE AND SECURE FOOD AND FIBER SYSTEM

Overview:

A report for Goal 2 will not be provided. The Hawai‘i POW for Goal 2 contains the following statement: “Hawai‘i’s program under Goal 2 will be the Smith-Lever 3d Targeted program in Food Quality and Safety.”

GOAL 3: A HEALTHY, WELL-NOURISHED POPULATION

Overview:

Human health was promoted through diabetes education. Twenty educational seminars recruited 137 adults with diabetes. These individuals completed questionnaires and received important tests that measure effects of diabetes and associated factors, including assessment of hemoglobin A1c levels. Ninety-five percent of participants completed a three-months’ follow-up questionnaire, three-quarters had their hemoglobin A1c levels rechecked, and more than half attended nutrition classes. Hemoglobin A1c results generally showed improvement among participants.

Human nutrition efforts encouraged more than 1,000 children to eat five servings of vegetables and fruits per day, and taught 100 parents how to make better food choices for their children.

ALLOCATED RESOURCES -- GOAL 3

Fiscal Year	Research Hatch Funds (\$)	Research State Funds (\$)	Research Other Fed & Non Fed Funds (\$)	Research Total Funds (\$)	Research Scientist Years (SY)
2002	41,958	65,763	31,408	139,129	0.7

Fiscal Year	Extension Smith-Lever Funds (\$)	Extension State Funds (\$)	Extension Other Funds (\$)	Extension Total Funds (\$)	Extension Faculty Years (FY)
2002	1,874	138,435	0	140,309	2.6

Key Theme – Human Health

- a. Description of activity. It is estimated that over 80,000 people in Hawai'i have diabetes, and that the Big Island has the highest rate of diabetes in the State. The goals of this project are to help people understand five medical tests that measure indicators of diabetes, and to provide educational opportunities for people to learn to manage diabetes. Efforts to increase awareness about diabetes will continue through this project's screening and educational offerings. (20-072)
- b. Impact/Accomplishment. The project conducted 20 screening and educational sessions to recruit 137 adults with diabetes. Each participant completed an initial questionnaire and screening for hemoglobin A1c, LDL cholesterol, microalbumin and blood pressure, and attended a class to learn about the five important and recommended medical tests for persons with diabetes and how to lower elevated numbers. About 95% of participants completed a follow-up questionnaire 3 months after their initial enrollment, with about three-fourths also having their A1c rechecked. Eleven classes on nutrition were also attended by about 60% of the participants. Efforts to expand the project were initiated to other islands as well as with other community partners. Data collected from project participants are being compiled and measured by project partners at the Joslin Diabetes Center in Boston. Preliminary results show that most participants have learned about the five medical tests and have made efforts to better manage their diabetes (through medical check-ups, medication, and modifications to their eating and physical activity). Follow-up measurements for A1c generally have shown improvements among the participants.
- c. Source of Funding. Smith-Lever
- d. Scope of Impact. County

Key Theme – Human Nutrition

- a. Description of activity. The goal of this project is to promote the consumption of fruits and vegetables by young children. (20-071)
- b. Impact/Accomplishment. “Auntie Akamai and the Good Food Tree” is an educational program for

young children that complements nutrition lessons taught in school. A child's attitude toward eating fruits and vegetables can be changed more easily at an early age. "Auntie Akamai and the Good Food Tree" program presents the importance of proper nutrition, the food guide pyramid, food safety, and eating locally grown fruits and vegetables in a fun and interactive way for children. This program reached more than 300 students and parents have commented that their children now ask more often for a fruit or vegetable as a snack or at mealtime. A poster contest, focusing on the importance of eating fruits and vegetables, reached more than 1000 students with the 5-A-Day message. Teachers indicated that the students increased their awareness of the value of eating fruits and vegetables. "Nutrition for Keiki" can enhance parents' knowledge of good eating habits and strengthen their ability to make healthy food choices. "Nutrition for Keiki" helped 100 eager, anxious parents overcome their fears about what to feed their children and assist the transition to kindergarten to be a positive and enjoyable one.

c. Source of Funding. Smith-Lever

d. Scope of Impact. County

GOAL 4: GREATER HARMONY BETWEEN AGRICULTURE AND THE ENVIRONMENT

Overview:

To manage soil resources more effectively, computer simulations were employed to determine which diversified agricultural activity—annual crop, orchard, or pasture—could conserve topsoil as effectively as did sugar cane and pineapple, Hawaiian industries that are currently shrinking.

Analysis of water by visitor industries such as hotels, resorts, and golf courses indicate that managers of water resources in Hawai'i can increase water conservation through pricing, voluntary measures, and the substitution of non-potable water when appropriate. In another water management project, more than 50 acres of sweet potatoes were converted from sprinkler to drip irrigation, reducing water consumption by more than 50% without reducing yield.

Integrated pest management (IPM) made several important impacts. Replacing mechanical weed control with low volume application of selective herbicides yielded cost savings of 90% in maintaining forest trails and 75% in maintaining pasture and range land. Using IPM techniques that include sanitation, bait spray, and male annihilation, melon fly infestations were reduced from 40%-50% to less than 5%, while direct insecticide applications were cut by about 75%. IPM is now applied to 75% of Hawai'i's banana acreage, reducing pesticide use by 10%.

In the area of pesticide application, chemical residue data were obtained for four pesticides used on five crop plants. The pesticides were subsequently registered by the U.S. Environmental Protection Agency for the uses tested. Also, data obtained for one of the four pesticides defining its teratogenicity in chicken embryos indicated that the residual levels of the pesticide encountered in human or animal diets are not expected to cause prenatal harm. A sensitive immunoassay was developed to quantify traces of a fifth pesticide. Two hundred fifty-one individuals received pesticide safety instruction through a self-study packet or a training program. Of the 110 individuals who received in-person instruction, 67 were commercial pesticide applicators.

Water quality research examined the efficiency with which an experimental bioreactor could treat manure-contaminated dairy wastewater. Results indicate that the bioreactor approach provides a simple

treatment alternative to the existing lagoon system used to treat manures. Additional work focused on nutrient management seeks to employ this bioreactor in a pilot study at a dairy, with the eventual goal of converting bovine waste into a valuable commodity, fertilizer.

Bioremediation offers hope of a cheaper, less disruptive way to clean contaminated media, including surface and subsurface soils, sediments, and compost. Work to remediate hazardous materials in soil centered on correlating measures of microbial metabolism with the size of the microbial population to create inexpensive, relatively rapid tests for assessing bio-treatability and optimizing bioremediation. Other investigations of hazardous materials included the isolation and identification of Hawaiian soil bacteria able to degrade the polycyclic aromatic hydrocarbon, pyrene. Discovery of these bacteria is particularly beneficial because such native strains do not require importation and quarantine restrictions. Another project focused on developing extraction methods that minimize the use of solvents for analysis of environmental contaminants. The new extraction technique could diminish by more than a factor of ten the amount of solvent waste generated by an environmental testing laboratory.

ALLOCATED RESOURCES -- GOAL 4

Fiscal Year	Research Hatch Funds (\$)	Research State Funds (\$)	Research Other Fed & Non Fed Funds (\$)	Research Total Funds (\$)	Research Scientist Years (SY)
2002	168,404	842,638	574,741	1,585,783	8.0

Fiscal Year	Extension Smith-Lever Funds (\$)	Extension State Funds (\$)	Extension Other Funds (\$)	Extension Total Funds (\$)	Extension Faculty Years (FY)
2002	182,438	481,134	0	663,572	8.8

Key Theme – Forest Crops

- a. Description of activity. The goals of this project are to increase the number of native plant nurseries on homestead lands and to use native plant materials to reforest Hawaiian homelands. (21-026)
- b. Impact/Accomplishment. The Pu‘u Ka‘ana Reforestation project is a multi-organization effort to educate school children about native plants and their relation to Hawaiian culture. This 10-year project has reached thousands of school children and adult volunteers in native plant education, the Hawaiian cultural aspects, and planting of the native plants. Through this project, the youth are learning to become good land stewards and gaining experience in planting and in how native plants relate to Hawaiian culture.
- c. Source of Funding. Smith-Lever and Grant - HHL
- d. Scope of Impact. County

Key Theme – Hazardous Materials

- a. Description of Activity. The goal of the project is to evaluate the role of bacteria in degradation of polycyclic aromatic hydrocarbons (PAHs) in tropical soils. Specifically, the objectives are (1) to

determine which bacterial species are capable of biodegrading PAHs in Hawaiian soils, and (2) to determine the PAH degradation rates and associate the DNA profiles of specific bacterial populations with respective degradation curves. (905H)

- b. Impacts/Accomplishments. Bacterial candidates (180 strains) were isolated from local samples of Wahiawa soils and the roots of a perennial grass, *Paspalum* sp., which is a major candidate for phytoremediation of PAHs in tropical soils. All candidates were screened for use in bioremediation. Four bacterial species capable of pyrene degradation in laboratory and greenhouse studies were identified. Pyrene degradation rates were quantified and degradation products were analyzed. The discovery of local strains of bacteria for bioremediation is valuable because such strains will not require State Import Permits for bioremediation of Hawaiian soils. As so little is known about the ecology of these organisms and the mechanisms of degradation, this project is providing a solid basis upon which to develop model systems for bioremediation and reclamation of contaminated tropical soils.
- c. Sources of Federal Funding. Hatch.
- d. Scope of Impact. State and wider Asia-Pacific region.

Key Theme – Hazardous Materials

- a. Description of Activity. The focus of this project has been the development of fast "solvent-free" analytical methods for environmental contaminants. This is an essential activity because of the impact in cost of disposal and environmental pollution, and of organic solvent use by analytical laboratories. The development of a fast testing procedure is also essential for rapid emergency response. (617H)
- b. Impacts/Accomplishments. The project has developed extraction methods using supercritical fluid extraction and pressurized fluid extraction that use between 10 and 25 mL of such solvent per extract. This represents, for a laboratory doing 1,000 sample extractions per year, a solvent consumption reduced from 20-40 L/year, down to 1-2.5 L/year. With the methods developed, the analysis of some samples take less than one hour from beginning of the sample preparation to the end of analysis. This is ideal for identifying spills in emergency response situations. They also are efficient, and considerably reduce the consumption of organic solvents by analytical laboratories, thus reducing the total disposal volume of organic chemicals by the University.
- c. Sources of Federal Funding. Hatch.
- d. Scope of Impact. State, National, and Worldwide.

Key Theme – Integrated Pest Management

- a. Description of activity. The goal of this project is to conduct herbicide efficacy trials on various weeds emphasizing low volume application methods. (23-020)
- b. Impact/Accomplishment. Low volume application of selective herbicides in the maintenance of forestry trails has reduced costs by 90%. The savings are determined by comparing mechanical weed control/man hour to low-volume herbicide application/man hour. Low volume application of selected herbicides for pasture/range weed control has also reduced costs by 75% by increasing the

productive spray time and decreasing the down time spent refilling and traveling between the mixing and spray target areas.

- c. Source of Funding. Smith-Lever
- d. Scope of Impact. County

Key Theme – Integrated Pest Management

- a. Description of activity. The goal of this project is to develop a pest management program that includes monitoring, and cultural and chemical controls to address a phytoplasma, vectored by the aster leafhopper, that severely crippled the watercress industry. (22-034)
- b. Impact/Accomplishment. An Aster Yellows Task Force kept watercress growers aware of the plant host range and geographic distribution of the phytoplasma and the aster leafhopper associated with watercress yellows. Watercress growers became skilled in cultural and chemical disease management practices. Watercress production has returned to near normal production levels at most farms. However, control of Aster Yellows in watercress increases production costs.
- c. Source of Funding. Smith-Lever
- d. Scope of Impact. County

Key Theme – Integrated Pest Management

- a. Description of activity. The goals of the project are to develop, transfer and promote the adoption of integrated pest management practices for key insect pests that, if not controlled, will limit the viability of Hawaiian crops. (16-903)
- b. Impact/Accomplishment. Implementation of the regionally focused resistance management program continued. The two thrusts were to manage the susceptibility of diamondback moth (DBM) populations to emamectin benzoate (Proclaim) and indoxacarb (Avaunt) and to mitigate DBM resistance to spinosad (Success). Susceptibility to emamectin benzoate and indoxacarb has been preserved. Resistance to spinosad has been mitigated. Population resistance was reversed from extremely resistant to susceptible. Grower knowledge about resistance management tactics has grown immensely.
- c. Source of Funding. Smith-Lever 3d
- d. Scope of Impact. Statewide

Key Theme – Integrated Pest Management

- a. Description of activity. Conduct a comprehensive outreach education program that will lead to the adoption of the area-wide fruit fly management technologies by commercial and non-commercial growers. (16-924)
- b. Impact/Accomplishment. The Hawai'i Fruit Fly Integrated Pest Management Program employed (1) in-field crop sanitation to limit breeding of flies; (2) a newly developed protein-based bait spray that

uses an environmentally acceptable toxicant; (3) fruit fly attractants to entice the insects to annihilation traps; (4) release of sexually sterile flies; and (5) release of natural enemies of fruit flies. The program has demonstrated to the agricultural community that collaborative efforts can be used to develop diversified agriculture in Hawai'i to its fullest potential. Melon fly infestations in zucchini and cucumber at Kula, Maui were reduced from 40-50% (at program onset) to less than 5% for all but a few growers. Melon fly infestations in cucurbits and melons at Waimea, Hawai'i were reduced to near nil. Populations of wild melon flies at Puukapu, Hawai'i were practically eliminated when sterile male releases were made at weekly intervals. Melon fly infestations in cantaloupe, honeydew, watermelon, and zucchini were reduced to less than 5% within two months after sanitation, bait spray, and male annihilation tactics were begun. Direct insecticide sprays to the crops were reduced by about 75%. Medfly infestations to persimmon and peaches were greatly reduced (>90%).

c. Source of Funding. Smith-Lever

d. Scope of Impact. Statewide

Key Theme – Integrated Pest Management

a. Description of activity. The goal of this project is to promote adoption of IPM on 75% of total banana crop acres. (16-918)

b. Impact/Accomplishment. Over 75% of the banana acreage in Hawai'i is verified to comply with the IPM program. IPM practices for banana have resulted in at least a 10% reduction in pesticide applications at participating farms in Hawai'i. This reduction in pesticide use has positive implications for human and environmental health issues, and makes banana farming a more profitable enterprise in Hawai'i by reducing costs associated with pesticide applications.

c. Source of Funding. Smith-Lever 3d

d. Scope of Impact. Statewide

Key Theme – Integrated Pest Management

a. Description of activity. The goal of this project is to conduct ginger wilt management trials to develop alternatives to methyl bromide for Big Island growers. (20-026)

b. Impact/Accomplishment. Methyl bromide offers excellent control of soil diseases, rootknot nematodes, and weeds. Four cover crops were evaluated for control of rootknot nematodes in ginger field trials. Although methyl bromide resulted in the highest total marketable yield, sunnhemp (*Crotalaria juncea*), in addition to a fallow system, exhibited the greatest potential among the cover crops tested. Growers view a cover crop system as additional time and expense.

c. Source of Funding. Smith-Lever

d. Scope of Impact. County

Key Theme – Integrated Pest Management

- a. Description of activity. The goal of this project is to train ranchers, conservationists and other workers in methods and strategies for managing pasture and environmental weeds efficiently, effectively and safely. (13-120)
- b. Impact/Accomplishment. Very-low-volume herbicide application training was conducted in Hilo for State foresters, federal invasive species staff, and *Miconia* task force personnel. Guidance was provided to the State Division of Forestry and Wildlife (DOFAW) on invasive species management with very-low-volume techniques. The Nature Conservancy, and four ranches on Hawai‘i and Maui were advised on aerial application of herbicides. Very-low-volume methods have been adopted by all four of the DOFAW districts. On Kaua‘i, these methods are used for almost all trail maintenance and invasive plant control. On Maui, these methods have been incorporated into the DOFAW *Miconia* control program and in the reclamation of Kanahā Pond Bird Sanctuary, where an acre can reportedly be treated in 20 minutes. It is expected that very-low-volume applications will cut the cost of invasive plant management by over 90%.
- c. Source of Funding. Smith-Lever
- d. Scope of Impact. Statewide

Key Theme – Natural Resource Management

- a. Description of Activity. The goal of this project is to study whether “diversified” crops have a different impact on the natural resource base and environmental quality. Using the C-factor information reported earlier, and the revised universal soil loss equation (RUSLE), a number of scenarios were used to answer this question. The scenarios used were to replace plantation crops by annuals, orchards/forests, or pastures. Two important model-based elements were prominent in these comparisons, namely (1) the frequency, timing, and extent of soil exposure during various stages of the cropping cycle, and (2) the frequency, timing, and extent of soil “disturbance” by field preparation and crop harvest operations. (135H)
- b. Impacts/Accomplishments. The quantitative predictions, using RUSLE, showed that annuals grown with “conventional” practices would be considerably less protective than either sugar cane or pineapple. Orchards and short rotation bio-energy (fuel tree) plantings were also vulnerable, particularly during the highly exposed early stages of tree growth, after full canopy development shades out ground cover or “understory” vegetation, and during or following harvest operations. Well-managed pastures represent the most “protective” alternative. Similar arguments were made for agrochemical loading and subsequent contamination of surface and groundwater supplies. This is because alternative land uses differ in their requirements and application frequencies of fertilizers and pesticides.
- c. Sources of Federal Funding. Hatch.
- d. Scope of Impact. State Specific.

Key Theme – Natural Resource Management

- a. Description of Activity. The goals of this project are to evaluate various policy, technology, and institutional changes regarding water resources for irrigated agriculture, and for resolving competing agricultural and environmental water demands. (425R)
- b. Impacts/Accomplishments. Water consumption in hotels and golf courses that cater to the needs of the visitor industry was examined. Results showed that size and price were important determinants of water use by golf courses. The number of units, swimming pools, and golf courses were found to be statistically significant determinants in water consumption by the hotels. This year, a comprehensive analysis, discussion, and critique of the State Water Commission's allocation of Waiahole water among competing water uses and users was completed. Based on this research, a policy analysis framework was developed, using seven specific criteria to assess the efficacy of water allocation among multiple stakeholders. A paper based on this research was accepted for presentation at the UNESCO Conference on "Conflict to Cooperation: Challenges and Opportunities in Water Resource Management" that was held in the Delft in November 2002. The visitor industry is the mainstay of Hawai'i's economy, accounting for 30% of the gross state product (GSP). Resorts and hotels, and golf courses, the two key sectors of the visitor industry, are both heavy water users. In 2000, hotels and golf courses together made up 20% of the water consumed by the top 100 water users on O'ahu—5.7 million gallons per day. The visitor industry's water consumption is expected to go up in the future, with a projected 50% increase in golf courses, and further additions to hotels and resorts. This increase could come at the expense of other sectors, especially agricultural and in-stream water uses. Our analysis showed that pricing and substitution of non-potable water for potable water could effectively reduce fresh water consumption by the golf courses. Pricing was found to have little impact on water consumption by hotels and resorts, suggesting that the focus should be on voluntary water conservation measures. Effective implementation of the pricing policy by the Honolulu Board of Water Supply and other measures by the parties involved could lead to a 15-20% reduction in visitor industry water demand annually, making more water available for agricultural and in-stream uses. From a multi-state perspective, the Hawai'i situation closely parallels the increase in non-agricultural water demand that much of the western United States has been experiencing in recent years, e.g., in Nevada (visitor industry), California (municipal and industrial), and Oregon and Colorado (environmental/in-stream).
- c. Sources of Federal Funding. Hatch and MRF.
- d. Scope of Impact. State, Nevada, California, Oregon, and Colorado.

Key Theme – Natural Resource Management

- a. Description of activity. The goal of this project is to convert sweet potato irrigation practice from sprinkler to drip irrigation in three years, thereby reducing water requirements. (21-031)
- b. Impact/Accomplishment. More than 50 acres of sweet potato production are now grown by drip irrigation. Farmers that switched from sprinkler to drip irrigation reduced their water requirement by more than 50%, without reducing yield. In the drought water-rationing situation that Moloka'i farmers face, the drip system is a positive irrigation alternative for sweet potato production.
- c. Source of Funding. Smith-Lever

d. Scope of Impact. County

Key Theme – Nutrient Management

- a. Description of Activity. The goal of this project is to integrate a simple two-stage anaerobic reactor for the stabilization of milk parlor wastewater for reuse as liquid fertilizer as the primary objective of this study. Specific objectives include (1) characterization of wastewater, design, and operation criteria for the proposed bioreactors, (2) establishment of potential application criteria for the reuse of liquid fertilizer and irrigation of crop practice, and (3) dissemination of results generated from this research to the public through the implementation of field application. (550H)
- b. Impacts/Accomplishments. A two-stage anaerobic pre-treatment process has been investigated in three phases of study. Phase 1 includes two completely mixed reactors with sludge recycle (30°C), Phase 2 includes one completely mixed and one without completely mixed with sludge recycle (30°C), and Phase 3 includes two bio-nest reactors (a once-through system operated at 25°C). Among the three phases of study, Phase 3 demonstrates that it is simple to install and operate, effective, and inexpensive, and that it eliminates odors, produces bioenergy, and provides long SRT (sludge retention time). The dairy producer is able to plan an integrated wastewater management system for protecting the groundwater, soil, and air quality, and also to increase the competitiveness of the agricultural production system.
- c. Sources of Federal Funding. Hatch.
- d. Scope of Impact. State, National, and Worldwide.

Key Theme – Nutrient Management

- a. Description of activity. The goal of this project is to develop, demonstrate, and disseminate livestock waste management information and practices. (14-210)
- b. Impact/Accomplishment. Eight farms in Hawai‘i participated in the On Farm Assessment and Environmental Review (OFAER) workshops. Ninety days after the workshop, farms were found to have implemented 73% of best management practice recommendations and 53% of structural change recommendations for high risk challenges. At six-month follow-up, farms were found to have implemented 80% of the best management practice recommendations and 60% of the structural change recommendations. Of the recommendations requiring continued maintenance, 97% are reported as being maintained. Of the low risk challenges, about 96% involved management practices and 4% involved structural problems. At 6-month follow-up, 47% of the best management practice and 40% of structural recommendations had been implemented. Of the recommendations requiring continued maintenance, 93% were reported as being maintained.
- c. Source of Funding. Smith-Lever
- d. Scope of Impact. Statewide

Key Theme – Pesticide Application

- a. Description of Activity. The goal of this project is to determine adverse impacts from agrochemical exposure to cells, organisms, and ecosystems. (609R)

- b. Impacts/Accomplishments. Imidacloprid, a neonicotinoid insecticide, was examined for teratogenicity in chicken embryos. It caused mild to moderate arthrogryposis in 72% of the tested chicken embryos and a 10% reduction in leg and wing length when administered at 1 mg per egg. No malformations were caused by 0.5 mg of imidacloprid. Nicotine that was used as a standard teratogen caused arthrogryposis in all treated embryos at the dose of 1 mg/kg. Arthrogryposis induced by this dose was extremely severe in 47% of the treated embryos. A threshold dose for inducing arthrogryposis in chicken embryos by nicotine was 0.1 mg per egg. Considering the size of the imidacloprid dose that was needed for the induction of malformations in chicken embryos, and the route of imidacloprid administration, the residual levels of imidacloprid in human diet and in animal feed are not expected to be teratogenic to mammals and avians.
- c. Sources of Federal Funding. Hatch and MRF.
- d. Scope of Impact. State, National, and Worldwide.

Key Theme – Pesticide Application

- a. Description of activity. The goal of this project was to provide pesticide safety training for farmers, turfgrass specialists, pest control operators, nurserymen and others who apply pesticides and to write and distribute electronically a pesticide safety newsletter that can be used to provide re-certification credits to certified applicators. (10-600C)
- b. Impact/Accomplishment. Nearly 110 individuals attended a 16.5-hour training program. The majority (67) were commercial applicators. An additional 131 individuals used a self-study packet. Fifty seven of the trainees who attended classroom training adopted at least one pesticide risk management practice and 32 planned to adopt one or more pesticide risk management practices. Most of the trainees adopted two or more practices. Thirty-one of the individuals who received study packets adopted one or more (average 3.7) pesticide risk management practices. Staff developed or revised/updated 13 training and educational publications.
- c. Source of Funding. Smith-Lever
- d. Scope of Impact. Statewide

Key Theme – Soil Quality

- a. Description of Activity. The goal of this project is to develop inexpensive and quick biotreatability tests for effective bioremediation. Specifically, the objectives for the past years have been (1) to determine the correlation between CO₂ production, O₂ consumption and plate counts, and thus, determine the validity of CO₂ and O₂ analyses as a measure of microorganism activity, and (2) to replace the plate count analyses with the less time-consuming and continuous CO₂- and O₂- monitoring in a bio-treatability protocol. (512H)
- b. Impacts/Accomplishments. Data from several bio-treatability experiments show good correlation between CO₂ production, O₂ consumption (as measured by gas analyzers), and plate count analyses. The project demonstrated that CO₂ and O₂ levels are good general indicators of microbial activity in our bio-treatability testing protocol. These experiments, which were performed on various types of contaminated media (e.g., surface and deep soils, sediments, and compost), also demonstrated that

this bio-treatability testing protocol can be applied to various contaminated media in which biological activities occur. Bio-treatability tests that determine the potential of success, and the optimal conditions for bioremediation, at a specific site will allow companies who are involved in environmental remediation to design a bioremediation project more effectively. The companies require that the tests be inexpensive and provide answers relatively quickly (< two months).

- c. Sources of Federal Funding. Hatch.
- d. Scope of Impact. State and National Specific

Key Theme – Water Quality

- a. Description of Activity. The goal of this project is to use an EMMC (entrapped mixed microbial cell) technology (biological treatment) to effectively remove NO₃-N and provide economic ways to clean NO₃-N-contaminated groundwater. (511H)
- b. Impacts/Accomplishments. Biological denitrification (nitrate-nitrogen removal) from simulated contaminated groundwater using ethanol as an external carbon source was investigated with an EMMC technology. It proves that the EMMC technology can provide an effective and stable removal of nitrate-contaminated groundwater with fast start-up behavior. It simplifies the design and operation of biological removal of nitrate-nitrogen. It holds potential to be applied in rural areas for a clean water supply.
- c. Sources of Federal Funding. Hatch.
- d. Scope of Impact. State and National.

Key Theme – Water Quality

- a. Description of Activity. The goal of this project is to develop, evaluate, and refine physical, chemical, and biological treatment processes in engineered and natural systems for management of manures and other wastes. (513R)
- b. Impacts/Accomplishments. A laboratory experimental set-up for bio-nest reactors was installed for the treatment of milk parlor wastewater at an ambient temperature of 25±2°C, and these bio-nest reactors were filled with a certain media for retaining the biomass to be washed out from the bioreactor. It proves that the bioreactor can effectively remove the organic pollutant (about 80%) and produce the biogas (75% methane) at the rate of 1.5 L/L/d with the loading rate of 3-5 g total COD/L/d. Based on the finding of this study, the existing wastewater management systems can be improved by integrating the bio-nest reactors in order to achieve odor reduction, prevent groundwater contamination, eliminate clean-out of lagoon content, reuse treated wastewater and recover bioenergy. This may provide an effective and simple treatment alternative to improve the existing lagoon system for land-limited conditions and tropical environments, such as in the State of Hawai‘i.
- c. Sources of Federal Funding. Hatch and MRF.
- d. Scope of Impact. State and other Pacific-region areas

Key Theme – Water Quality

- a. Description of activity. The goal of this project is to educate community members, agency personnel, and teachers in assessment of non-point-source pollution risks and identification of risk-reducing activities using a localized version of Farm*A*Syst / Home *A*Syst (FAS/HAS). (13-107)
- b. Impact/Accomplishment. A total of 20 workshops reached 825 participants (521 through the workshop series and another 304 through 10 outreach activities). Follow-up surveys indicated that the program was successful in educating individual workshop participants about major water pollutants in Hawai'i, how their actions affect water quality, and the availability of resources to help them minimize the impact of their activities.
- c. Source of Funding. Smith-Lever
- d. Scope of Impact. Statewide

Key Theme – Other (Harmony Between Agriculture and the Environment)

- a. Description of Activity. The goal of this project was to obtain minor use and specialty-use pesticide clearances, and to assist in the maintenance of current registrations. (615R)
- b. Impacts/Accomplishments. A number of uses were labeled as a direct result of work under this project: oxyfluorfen (Goal) in banana, imidacloprid (Provado) in taro (leaf production only), diazinon in watercress, mefenoxam + copper (Ridomil Gold Copper) in papaya, azoxystrobin (Quadris) in watercress, mefenoxam (Ridomil Gold) in basil, glyphosate (Roundup WeatherMax) in 'awa and peach palm, hydramethylnon (Amdro Pro, Siege Pro) in various tropical fruit and nut orchard crops, and azoxystrobin (Abound) in various tropical fruit crops. Growers of crops that have new pest control chemicals available to them can improve their productivity and strengthen their viability.
- c. Sources of Federal Funding. Hatch, MRF, and Grants.
- d. Scope of Impact. State-Specific.

Key Theme – Other (Harmony Between Agriculture and the Environment)

- a. Description of Activity. The project's goal is to identify, develop, and/or validate trace residual analytical methods, immunological procedures, and biomarkers. (634R)
- b. Impacts/Accomplishments. An enzyme-linked immunosorbent assay (ELISA) was developed for the neonicotinoid insecticide thiamethoxam. Three polyclonal antisera were raised from rabbits immunized with the hapten-KLH conjugate. Based on the computational analysis of hapten candidates, the hapten with a spacer arm on the thiazolyl ring of thiamethoxam was synthesized to elicit thiamethoxam-specific antisera. The hapten was 3-(2-(2-carboxyethylthio)-5-ylmethyl)-5-methyl-4-nitroimino-1,3,5-oxadiazinane. Antisera were characterized with indirect competitive ELISA (icELISA). Cross-reactivity and effects of organic solvents, pH, and ionic strengths were evaluated. The antisera was specific to thiamethoxam and tolerant of up to 20% acetonitrile and 40% acetone, respectively. Ionic strengths and pH values in the tested ranges had negligible effect on the

assay performance. Under the optimized conditions, the half-maximal inhibition concentration (I_{50}) and the limit of detection were approximately 9.0 and 0.1 $\mu\text{g/L}$ of thiamethoxam, respectively. The ELISA analysis of water samples fortified with thiamethoxam showed an excellent correlation between the concentrations fortified and determined. This new immunoassay is an excellent analytical tool for measurement of the insecticide thiamethoxam in environmental and biological matrices. Thiamethoxam is a new systematic and effective insecticide to control sucking insects.

- c. Sources of Federal Funding. Hatch and MRF.
- d. Scope of Impact. State, National, and Worldwide.

GOAL 5: ENHANCED ECONOMIC OPPORTUNITY AND QUALITY OF LIFE FOR AMERICANS

Overview:

Volunteer activities were utilized to pursue community development goals. A distressed property owned by Maui Community College, which had once been an eyesore and a site of criminal and anti-social activities, has been converted into an educational garden, largely through volunteer labor and donated supplies. More than 200 Family and Community Education members and their families contributed more than 8,000 hours of community service, accomplishing community improvements such donations to benefit needy newborns, promotion of family reading night, and area cleanup.

Youth development and 4-H projects also tapped veins of volunteer spirit. Ten teenagers designed and produced cloth animals that they donated to children that had suffered as a result of the 9/11 terror events. The hundreds of hours of volunteer labor that 4-H participants and leaders donated to rehabilitation of Waimea Nature Park replaced overgrown exotic weeds with native plants, and encouraged more than 60% of participants to garden and compost at home. One 4-H participant donated half the proceeds from the sale of his project animals to teachers at a local elementary/middle school to fund the purchase of school supplies.

A survey of family businesses in Hawai'i provided a unique data set that focused on both family and business spheres at two points in time, 1997 and 2000. The survey was used to develop a socioeconomic vulnerability scale applicable to family businesses. Business success was found to promote family success and *vice versa*. Being in excellent health was found to increase the household/business manager's sense of family success. Between 1997 and 2000, perceptions of family success increased, while perceptions of business success declined. In comparison to 1997, families in 2000 had fewer teenagers, but more children under the age of five.³

The CTAHR Hawaiian Costume and Textiles Collection was organized and photographed in its entirety. A new book, published on the history of textile design in aloha shirts, has become a useful resource for apparel industry workers and is required reading for the sales forces of the two dominant apparel firms in Hawai'i.

ALLOCATED RESOURCES -- GOAL 5

Fiscal Year	Research Hatch Funds (\$)	Research State Funds (\$)	Research Other Fed & Non Fed Funds (\$)	Research Total Funds (\$)	Research Scientist Years (SY)
2002	52,056	119,219	81,820	253,095	1.0

Fiscal Year	Extension Smith-Lever Funds (\$)	Extension State Funds (\$)	Extension Other Funds (\$)	Extension Total Funds (\$)	Extension Faculty Years (FY)
2002	158,185	830,270	0	988,455	16.0

Key Theme – Child Care/Dependent Care

- a. Description of activity. The goal of this project is to provide kindergartners and their parents opportunities to feel comfortable in their “new” school environment and provide parents with knowledge on the development of their child. (20-240)
- b. Impact/Accomplishment. Completed written evaluations (222) were received from 75% of the adult Kindergartners Are Most Precious (KAMP) participants; 95% said working with their children on the educational experiences helped them see how they can help their children in learning. Evaluations received from the participating kindergarten teachers a month after KAMP was held indicated that having KAMP made the first week of school run smoothly. There was less crying when parents dropped off their kindergartner at school. This positive feedback encouraged continuation of this with this educational experience.
- c. Source of Funding. Smith-Lever
- d. Scope of Impact. County

Key Theme – Community Development

- a. Description of activity. The goal of this project is to develop an educational garden. (21-020)
- b. Impact/Accomplishment. A thirteen-week Master Gardener program increased student knowledge of horticulture, soil science, plant nutrition, plant pests and diseases, and pesticide usage by twenty-five percent. The Cooperative Extension Service office and staff rely greatly on volunteers to help maintain the high level of service for its residents. The Master Gardeners program’s 20 volunteers contributed more than 3,563 hours of service during this past year. Volunteers did most of the manual work required to develop and maintain the Maui Educational Garden (MEG). This 3-acre site includes a mixed fruit orchard; a banana collection; a culinary herb/spice garden; vegetable beds; a lei flower garden; displays of various ornamental shrubs, groundcovers, and hedges; a bougainvillea collection; a tree arboretum; a native/Polynesian introduced plant display; and a composting/recycling area. The value of these volunteer contributions to MEG was estimated to be \$21,830. The site is highly visible and has attracted attention and compliments from the public, bringing greenery and color to a once-desolate area. MCC instructors have begun to utilize parts of the garden for their educational programs. Our culinary/herb/spice and vegetable produce are used

in MCC's food service program and MCC's agricultural department is using various plant materials for their classes. Other agricultural curricula (high schools and alternative educational programs) and the public have also visited the garden to see our plant displays and to observe various agricultural techniques. A composting and recycling area has been developed to bring awareness about Maui's refuse problem.

- c. Source of Funding. Smith-Lever
- d. Scope of Impact. County

Key Theme – Community Development; Leadership Training and Development

- a. Description of activity. The goal of the project was to increase the capacity of communities, families, and individuals to improve their own quality of life. (20-071)
- b. Impact/Accomplishment. Family and Community Education (FCE), Family Community Leadership (FCL) and the 4-H Youth Development programs work to build the capacity of individuals, families, and communities through continuing informal education, leadership, action and community service. More than 200 FCE members and their families planned and implemented various community service projects. These volunteers contributed more than 8,000 hours of service for countless causes in projects that include, but not limited to, Books and Blankets for Newborns, Get a Drift and Bag It (area cleanup), Family Reading Night, and Family Choice-TV (for positive television programming). The volunteer efforts equate to four full-time employees and increase the capacity of Extension's outreach.
- c. Source of Funding. Smith-Lever
- d. Scope of Impact. County

Key Theme – Consumer Science/Management

- a. Description of activity. The goal of this project is to increase the accessibility and impact of consumer-oriented, high-quality financial information, education, and counseling. (06-358)
- b. Impact/Accomplishment. Factors that indicate the goal was met include the local and national demand for our publications, the availability and accessibility of those publications to a local and national audience via the Internet, the assessment of the publications' high quality (as evidenced by the comments and requests of locally and nationally recognized institutions), and the impact of such publications in concert with other efforts to address the emotional and financial needs of the newly unemployed following 9/11. Donors provided approximate \$612,000 in in-kind materials and services.
- c. Source of Funding. Smith-Lever
- d. Scope of Impact. Statewide

Key Theme – Family Resource Management

- a. Description of activity. The goals of this project are to provide training and develop resources related to family economics and resource management. (22-083)
- b. Impact/Accomplishment. Technical assistance was provided to all Expanded Food and Nutrition Education Program (EFNEP) families. Families participated in at least four sessions of “Food & Money Basics...Choices & Decisions.” EFNEP generally reaches approximately 650 limited-income families with young children, of which 50%-60% complete the program. Consistently, nearly 80% of those completing the series make at least one improvement in dietary intake as well as in food resources management.
- c. Source of Funding. Smith-Lever
- d. Scope of Impact. Statewide

Key Theme – Home Safety

- a. Description of activity. The goal of this project is to address water quality and water quality issues associated with the use of rainwater catchment systems. (13-124)
- b. Impact/Accomplishment. Twice as many people attended seminars during the first two years of this project than originally were projected for the entire project. Ten times as many guideline booklets were printed and distributed. Ninety-three percent of survey respondents who have read *Guidelines on Rainwater Catchment Systems for Hawai‘i* report that they will alter the way they maintain their water system as a result of reading the document, making changes such as adding chlorine more regularly or more often, changing their filters more often, checking the water quality more often, cleaning the tank more often, checking the tank and liner more often, cutting back trees and plants from around the catchment area and tank, and cleaning the roof and gutters more often. Seventy-nine percent of survey respondents said they would change their rainwater catchment system in some manner, e.g., adding a filter, treatment or purification system, adjusting the gutter slope, adding a first flush system, clearing a path for fire trucks, keeping their mesh cover out of the water, or getting a food-grade liner. With the cooperation of the Hach Co. and technical advice from microbiologists, an inexpensive homeowner test kit and guide was designed. Since the project began, 1077 test kits have been sold either at cost (for educational purposes) or for a slight profit so the program could be continued. While the sale of the test kits is an outcome indicator in itself, post-test surveys add more weight to the success of this project. People were asked to fill out and mail back surveys handed out with the test kits. Of the 71 responses, 46% of the respondents’ water systems tested positive for fecal contamination. That fact alone demonstrates the value of this project.
- c. Source of Funding. Smith-Lever and RREA
- d. Scope of Impact. County

Key Theme – Youth Development/4-H

- a. Description of activity. The goal of this project is to provide subject matter support to 4-H leaders and youth livestock programs. (20-318)

- b. Impact/Accomplishment. A report that addressed the concerns of 4-H livestock leaders was sent to CTAHR administrators for review, with the goal of revamping the program to satisfy clients' needs. Implementation of the report's recommendations could solve recruitment problems in future years. A 16-year-old male who has been a 4-H member for 6 years responded to a survey of what 4-H means to him with the following comment: "Being in 4-H has helped me become a leader. I've learned that 4-H is not just an animal project but it is also a people and community project." For the third year, this 4-Her donated 50% of the profit from the sale of his project animals to the teachers at Waimea Elementary & Intermediate School to help them purchase supplies needed for their classroom.
- c. Source of Funding. Smith-Lever
- d. Scope of Impact. County

Key Theme – Youth Development/4-H

- a. Description of activity. The goal of this project is to expand 4-H enrollment in traditional organized clubs, special interest, and school enrichment programs in rural and urban communities. (20-038)
- b. Impact/Accomplishment. A "New 4-H Leaders Handbook" to assist new leaders in organizing a 4-H club was developed. In partnership with Army and Air Force installations on O'ahu, 4-H clubs have been organized at each base. Hawai'i received the national award from the National Association of Extension 4-H Agents for "Excellence In 4-H Club Programming" for efforts in expanding the Cloverbuds 4-H Program. Successful marketing and promotional efforts have resulted in the recruitment of 79 adult and 52 teen volunteers.
- c. Source of Funding. Smith-Lever 3d
- d. Scope of Impact. Statewide

Key Theme – Youth Development/4-H

- a. Description of activity. The goal of this project is, through 4-H leadership programs and experiences, to help 4-H youth develop and practice leadership skills to enhance their quality of life and to improve their communities. (20-043)
- b. Impact/Accomplishment. More than 200 youth and adults planned and implemented community service projects, contributing more than 3,000 hours of service for the betterment of the community. Ten teens undertook a Make-a-Difference Day project to do something for the children affected by the 9/11 terrorist attack. The teens planned, cut, sewed and created 150 little puppy and kitty "Aloha Animals" and sent them to the fire stations in New York and Pennsylvania for distribution. These teens were honored by their local newspaper and received an award from the American Red Cross as Everyday Heroes in the Youth Organization category.
- c. Source of Funding. Smith-Lever
- d. Scope of Impact. Statewide

Key Theme – Youth Development/4-H

- a. Description of activity. The goal of this project is to implement collaborative youth development education programs with the U.S. Army and U.S. Air Force. (22-021)
- b. Impact/Accomplishment. Worked with the 4-H Army Partnership to implement 4-H clubwork at their sites. The fifteen 4-H clubs organized at the Army installations involved 160 youth, 40 of which completed 4-H recordbooks. Formed an Army 4-H Marketing team that will promote the 4-H program on base and recruit volunteers for their program. Compiled a club leader manual for Army staff, redid the Cloverbud recordbook and recordbook for junior members. Collaborated with Air Force Youth Programs (Air Force School Age Services and Teen Directors) to implement 4-H clubwork as part of their after-school programs.
- c. Source of Funding. Smith-Lever
- d. Scope of Impact. County

Key Theme – Youth Development/4-H

- a. Description of activity. The goal of this project is to use research-based curricula focused on natural resource/ environmental science to train 4-H volunteers and youth educators. (13-126)
- b. Impact/Accomplishment. Teachers, Girl Scout Leaders, and 4-H leaders learned to use the Liholiho Garden to teach students about native Hawaiian plants used for landscaping in an urban setting. Teachers and Soil and Water Conservation Directors learned to utilize Cooperative Extension Service (CES) curricula in Conservation Awareness to teach skills in judging soil, suitability of land for agriculture, and conservation practices to protect land from erosion. Teachers of preschool Head Start programs learned to teach children skills in recycling, composting and insect identification. Extension personnel from Saipan were trained in the use of CES publications to increase public awareness about water catchment safety and composting techniques to reduce the green waste stream in Saipan. 4-H members who learned about Hawaiian forests decided to plan service learning weekends to collect koa seeds, harvest and process them, and then return to plant out the seedlings. As a result of several years of intensive volunteer contributions, hundreds of acres of former pasture land has been planted with koa seedlings, and the ten-year-old trees are now serving as habitat for nesting, endangered species of tropical forest birds. Hundreds of hours of volunteer labor, including those of 4-H members and leaders, transformed Waimea Nature Park from a weedy jungle of alien vines to a garden of native plants for the community to enjoy. As a result of growing a garden at school, over 60% of the children returning to school the following year reported that they grew a garden during the summer, made a compost pile, and returned the compost to the garden.
- c. Source of Funding. Smith-Lever
- d. Scope of Impact. County

Key Theme – Youth Development/4-H

- a. Description of activity. The goal of this project is to incorporate “Mini-Society” into existing youth programs. (06-361)

- b. Impact/Accomplishment. Three hundred ninety-one youth (185 males and 206 females) received Mini Society training. This is a 24-hour course completed during school intersessions. One group established a sewing business, doing minor repairs and sewing arts and craft items. This group sewed garments for a 4-H fashion show for their parents at an open house.
- c. Source of Funding. Smith-Lever
- d. Scope of Impact. Statewide

Key Theme – Other (Family Business)

- a. Description of Activity. The goal of this project is to compare the interaction of family and business systems in economically vulnerable and non-vulnerable communities. (378R)
- b. Impact/Accomplishment. Results from this study for the single manager households--1997 are: (1) being in excellent health increases the household/business manager's perception of family success, (2) family success positively affects business success and, (3) increased profits are associated with increased perception of business success. Results for the single manager households--2000 are: (1) being in excellent health increases the household/business manager's perception of family success and, (2) business success positively affects family success. Difference between 1997 and 2000 means test results show: single-manager households: (1) perceptions of family success have increased, (2) perceptions of business success have decreased, (3) number of teenagers has declined and, (4) number of children under age 5 have increased. As factors associated with business success and family success is determined, this information can be used by family business owners to assist with business and family resource allocation decisions.
- c. Source of Federal Fund. Hatch and MRF.
- d. Scope of Impact. State and National.

Key Theme – Other (Fiber-Related Products and Businesses for Protection, Social, and Economic Enhancement)

- a. Description of Activity. The focus of this project is the historic development of Hawaiian textiles and Hawaiian garments. (367H)
- b. Impacts/Accomplishments. The entire CTAHR Hawaiian Costume Collection was photographed. A book was published on the history of textile designs in aloha shirts. A greater understanding of the role of textile design in the Hawaiian apparel industry has been achieved both for scholars and textile and apparel industry workers in the Hawaiian garment industries. The earlier book, Aloha Attire: Hawaiian Dress in the Twentieth Century, and the new book, The Art of the Aloha Shirt, are highly valued by the two dominant apparel firms in Hawai'i; their vice-presidents have made these books required reading for their entire sales force.
- c. Sources of Federal Funding. Hatch and Grants.
- d. Scope of Impact. State-Specific.

STAKEHOLDER INPUT PROCESS

Because of fiscal constraints, it has not been possible to fully implement the Industry Analysis process described in the POW to seek Stakeholder Input. Over the past few years, Hawai'i experimented with an alternative process that is less resource intensive to seek stakeholder input. The process was designed to ensure participation from a wide range of stakeholders. Because of the success of this alternative process, a decision was recently made to abandon the Industry Analysis Stakeholder Input Process described in the POW. The revised Stakeholder Input process is described below.

The revised Stakeholder Input Process has five key elements to insure participation from a wide range of stakeholders. The five key elements are: (1) a CTAHR Board of Advisors; (2) active participation of CTAHR administrators in various stakeholder organizations; (3) use of public opinion surveys; (4) active participation of faculty in stakeholder organizations; and (5) direct faculty interaction with stakeholders.

The CTAHR Board of Advisors consists of 20 members that are selected to insure participation from all of the major Hawaiian Islands. Members bring stakeholder input from the following perspectives: (1) business; (2) children and family; (3) corporate agriculture; (4) small companies involved in farming, processing and marketing; (5) food retailing; (6) native Hawaiian issues and rural development; (7) small farmer involved in production and direct marketing; (8) management of large land holdings; (9) general retail sales and merchandising; (10) export of fresh tropical fruits; (11) production only farmer; (12) livestock and milk production; (13) ornamental crops; (14) new diversified agriculture enterprises in large land areas released from sugar production; (15) adding value to products through new product development and manufacturing; (16) marketing of value added products; and (17) research consulting. Member of the Board bring stakeholder needs to the attention of CTAHR during regular meetings of the Board.

CTAHR administrators participate in various stakeholder organizations to seek stakeholder input. The organizations that the CTAHR administrators currently participate in are: (1) Agricultural Leadership Foundation of Hawai'i Board; (2) Agricultural Coalition; (3) Academy of the Pacific Board of Trustee; (4) Commodity Advisory Group; (5) Hawai'i Farm Bureau Federation; (6) Hawai'i 4-H Foundation Board; (7) Hawai'i 4-H Alumni Association Board; (8) Japan-America Society of Hawai'i Board of Trustees; (9) Kamehameha School CEO Board of Advisors; (10) Mānoa Budget Advisory Committee; (11) National Agricultural Biotechnology Council; (12) State of Hawai'i Board of Agriculture; and (13) University Connections Advisory Board.

As needed, public opinion surveys are conducted using focus groups and/or telephone surveys to seek stakeholder input. The participants are randomly selected from the major Hawaiian Islands to represent the general population of Hawai'i. Through these public opinion surveys, CTAHR will be able to gain a better understanding of stakeholder concerns. Faculty are asked to apply survey results to prioritize their research and extension activities.

The report from the last public opinion survey conducted by CTAHR is posted on the CTAHR Web Site: <http://www.ctahr.hawaii.edu/ctahr2001/Research/pdfs/QMarkReport.pdf>

CTAHR faculty actively participate in stakeholder organizations to seek stakeholder input. CTAHR faculty actively participate in the following stakeholder organizations: (1) O'ahu Banana Growers Association; (2) Kaua'i Cattlemen's Association; (3) East Kaua'i Water Users Cooperative; (4) Hawai'i

Cattle Producer's Association; (5) Hawai'i Cattlemen's Association; (6) Hawai'i Cattlemen's Council; (7) Hawai'i Egg Producers Association; (8) Hawai'i Association of Conservation Districts; (9) Hawai'i Pest Control Association; (10) Hawai'i Pork Industry Association; (11) Hawai'i State Livestock Residual Management Education Advisory Committee; (12) State and County Farm Bureau; (13) Local Water Conservation Districts; (14) Maui Onion Growers Association; (15) Hawai'i Tropical Flower Council; (16) Hawai'i 4-H Foundation; (17) Hamakua Family Community Education; (18) Hilo Family Community Education; (19) Kona Family Community Education; (20) Hawai'i Coffee Growers Association; (21) Hawai'i Coffee Association; (22) Hawai'i 'Awa Council; (23) Landscape Industry Council of Hawai'i; (24) Hawai'i Food Manufacturers Association; (25) Kaua'i Anthurium Association; (26) Kaua'i Bonsai Club; (27) Garden Island Orchid Association; (28) Hawai'i Tropical Foliage and Flowers Association; and (29) Dendrobium Orchid Growers Association.

(1) Ala Wai Watershed Association; (2) Big Island Association of Nurserymen; (3) Dendrobium Orchid Growers Association; (4) East Kaua'i Water Users Cooperative; (5) Garden Island Orchid Association; (6) Hamakua Family Community Education; (7) Hawai'i 4-H Foundation; (8) Hawai'i Association of Conservation Districts; (9) Hawai'i 'Awa Council; (10) Hawai'i 'Awa Council; (11) Hawai'i Banana Industry Association; (12) Hawai'i Cattlemen's Association; (13) Hawai'i Cattlemen's Council; (14) Hawai'i Cattle Producer's Association; (15) Hawai'i Coffee Association; (16) Hawai'i Coffee Growers Association; (17) Hawai'i Export Nursery Association; (18) Hawai'i Florists and Shippers Association; (19) Hawai'i Food Manufacturers Association; (20) Hawai'i Orchid Growers Association; (21) Hawai'i Pest Control Association; (22) Hawai'i Pork Industry Association; (23) Hawai'i State Livestock Residual Management Education Advisory Committee; (24) Hawai'i Tropical Foliage and Flowers Association; (25) Hawai'i Tropical Flower Council; (26) Hilo Family Community Education; (27) Kailua Bay Advisory Council; (28) Kaua'i Anthurium Association; (29) Kaua'i Bonsai Club; (30) Kaua'i Cattlemen's Association; (31) Kona Family Community Education; (32) Landscape Industry Council of Hawai'i; (33) Local Water Conservation Districts; (34) Maui Onion Growers Association; (35) National Water Quality Coordinators Association; (36) Natural Resources Conservation Service; (37) Nawiliwili Bay Watershed Association; (38) O'ahu Banana Growers Association; and (39) State and County Farm Bureau.

In requests for Hatch and Smith-Lever project proposals issued by CTAHR Administration, faculty are required to include a section on stakeholder input. Faculty are expected to seek stakeholder input on a regular basis in various way such as one-on-one contacts, meeting with commodity leaders and representatives, and opinion surveys.

The Stakeholder Input Process described above should be taken as the revised Stakeholder Input Process for the Hawai'i POW.

Provided below are specific examples of recent activities related to seeking Stakeholder Input using the revised Process for Hawai'i:

- a. **Maui Vegetable Growers.** The needs and concerns of stakeholders and their industries were identified through the 1994 vegetable and melon industry analysis, industry meetings, mail surveys and individual consultations. Control of Tomato Spotted Wilt Tospovirus (TSWV) was the major concern of the tomato growers. In 1997, a needs assessment was conducted for the Maui sweet onion industry. The Maui Onion Growers Association identified pink root and fusarium basal plate rot as the major bottlenecks facing their industry. The crucifer industry on Maui identified the diamondback moth as the most serious pest limiting production. Extension educational programs were developed to address those needs and assist clientele in the transfer and adoption of research based information.

- b. **Cattle Industry**. Stakeholder input was obtained through executive committee meeting, annual industry meetings, facilitated scheduled meetings, strategic planning meetings, one-on-one producer interaction, and feedback from workshops and field days. The priorities identified are marketing of local beef, transportation cost (i.e. control and/or reduce shipping costs), animal welfare during shipment, and manure spillage during transportation. A Hatch project was initiated entitled “The Situation and Outlook for Hawai`i’s Beef Industry.”
- c. **Foliage Plant Industry**. An assessment of the foliage plant industry that was updated in February 2000 served as a basis for setting preliminary priorities for extension programs. The top three priorities identified are plant culture research (i.e. new cultivars and species), insect control, and marketing and promotion. An effort is being made to develop proposals on new cultivar development. An association of foliage plant producers will attempt to prioritize type of plant features and plant species that the proposal should address.
- d. **Public and Agency Input to Extension Water Quality Projects**. The extension faculty involved in this program seeks stakeholder input through interaction with the following: (1) the Natural Resources Conservation Service; (2) the Hawai`i Association of Conservation Districts; (3) the National Water Quality Coordinators Association; and (4) various community watershed groups such as the Ala Wai Watershed Association, the Nawiliwili Bay Watershed Association and the Kailua Bay Advisory Council.
- e. **Banana Industry**. Extension faculty is working with the Hawai`i Banana Industry Association to update the banana crop profile and to develop a Pest Management Strategic Plan (PMSP). Input was received from the Banana Industry Association Board of Directors. CTAHR will receive additional input through upcoming workshops. The PMSP workshop for bananas will be held in FY 2003 to identify research priorities.
- e. **Protea, Foliage, and Orchid Industries**. To obtain stakeholder input related to Protea research and extension programs, an annual Protea field day is held at the Maui Agricultural Research Center. The field day is also open to all Protea growers and the public. To obtain stakeholder input related to foliage plant cultivar development, CTAHR faculty requested a meeting with representatives of the Big Island Association of Nurserymen and the Hawai`i Export Nursery. To obtain stakeholder input related to crop improvement research for orchids, CTAHR faculty attended a general membership meeting of the Hawai`i Orchid Growers Association in Hilo and the Dendrobium Orchid Growers Association of Hawai`i on O`ahu. To obtain stakeholder input related to floriculture crops, CTAHR faculty interact with an industry advisory committee made up of commercial producers. This committee reviews progress reports and funding proposals and makes recommendations to CTAHR.
- f. **Floriculture Industry**. CTAHR faculty facilitated industry retreats in the past year. The statewide industry groups involved in the various retreats were the Hawai`i Tropical Flower Council, Hawai`i Florists and Shippers Association, and Hawai`i Export Nursery Association. One of the outcomes of the various retreats is a prioritized list of research and extension needs of the industry. In addition, surveys were conducted to gather Hawai`i County data on pesticide usage and insect problems. This survey allowed CTAHR to develop projects that are focused on the highest priority pests.

- g. **Aster Yellows Disease**. Aster yellows disease was first identified in watercress farms in late 2001. Researchers identified the causative agent as a phytoplasma. The watercress industry supplies 99 percent of the watercress consumed in Hawai'i. Growers agreed unanimously that this devastating pest threatened the existence of the entire industry. A task force including specialists, researchers, county agents, and regulatory agencies met with watercress growers to develop a strategy to manage the disease.

PROGRAM REVIEW PROCESS

There are no significant changes in the "Program Review Process."

EVALUATION OF THE SUCCESS OF MULTI- AND JOINT ACTIVITIES

Existing multi- and joint activities were continued in FY 2002. These activities include: (1) research and extension integrated projects; (2) the Hatch Multi-State Regional Projects; (3) the Agricultural Development in the American Pacific (ADAP) project that involves American Samoa Community College, the University of Guam, the College of Micronesia, Northern Marianas Community College, and the University of Hawai'i; (4) the Tropical and Subtropical Agriculture Research Program that involves the University of Hawai'i, the University of Guam, the University of Florida, the University of Puerto Rico, and the University of the Virgin Islands; and (5) nine new externally reviewed integrated projects were approved in 2002.

Examples of current research and extension multi- and joint activities for 2002 are provided below:

1. Stress Factors of Farm Animals and Their Effects on Performance (257R, W-173). Studies were conducted jointly with Cornell University and the University of Arizona on the effect of radiation on sweating rate, rectal temperatures, and respiration rates in cows in the new environmental chambers at the University of Arizona. Work on new sensors for cooling cows in freestalls was conducted at Michigan State University with Cornell University collaborating. The Hobo watertemp probe with the modified holder to acquire accurate body temperature of cows was tested. With this system, it will be possible to monitor cows' homeostasis without interfering in their routine or behavior. With this approach, it will be possible to perform a whole range of studies including comparing micro-environments between herds and within a herd. It may be possible to use this technology to develop improved methods to minimize animal stress during transportation to feedlots. If transit related stress can be minimized, animal performance in feedlots will be enhanced. This multi-state project capitalized on the different expertise and facilities of the various state partners resulting in shared knowledge and project efficiency.
2. Plant Genetic Resources Conservation and Utilization (820R, S-009). This project is conducted via the National Plant Germplasm System (NPGS), which is a coordinated national acquisition and management program for plant germplasm valuable for agricultural, environmental, medical, and industrial uses. In Hawai'i, this project evaluates flowering of longan (*Dimocarpus longan* [Lour. Steud.]), which can be inconsistent and is a major constraint to sustain commercial production. The findings of this project will enable growers from different parts of the U.S. and Asia-Pacific region to stimulate flowering of longan trees and obtain consistent seasonal and off-season production. Longan is a potential fruit for domestic consumption especially for the Asian population.

3. Genetic Manipulation of Sweet Corn Quality and Stress Resistance (864R, NE-124). Major conversions of inbred parents of commercial hybrid #10 were completed. The improved #10 hybrids have green inner silks and generally have improved tenderness. The multi-state project enables our researcher to obtain knowledge and test various tropical and temperate cultivars and breed the best hybrids for our State. For Hawai'i's food security goal, multi-state project such as this greatly enhances the efficiency of our breeding programs to achieve the productivity needed for self-reliance.
4. Agricultural Water Management Technologies, Institutions, and Policies Affecting Economic Viability and Environmental Quality (425R, W-190). Water consumption in hotels and golf courses that cater to the needs of the visitor industry was examined. Results showed that size and price were important determinants of water use by golf courses. Based on this research, a policy analysis framework was developed, using seven specific criteria to assess the efficacy of water allocation among multiple stakeholders. It also showed that pricing and substitution of non-potable water for potable water could effectively reduce fresh water consumption by the golf courses. Pricing was found to have little impact on water consumption by hotels and resorts, suggesting that the focus should be on voluntary water conservation measures. Effective implementation of the pricing policy by the Honolulu Board of Water Supply and other measures by the parties involved could lead to a 15-20% reduction in visitor industry water demand annually, making more water available for agricultural and in-stream uses. From a multi-state perspective, the Hawai'i situation closely parallels the increase in non-agricultural water demand that much of the western United States has been experiencing in recent years, e.g., in Nevada (visitor industry), California (municipal and industrial), and Oregon and Colorado (environmental/in-stream).
5. A National Agricultural Program to Clear Pest Control Agents for Minor Crops (615R, NRSP-004). Several pesticide uses are the direct result of work done by this project: oxyfluorfen (Goal) in banana, imidacloprid (Provado) in taro (leaf production only), diazinon in watercress, mefenoxam + copper (Ridomil Gold Copper) in papaya, azoxystrobin (Quadris) in watercress, mefenoxam (Ridomil Gold) in basil, glyphosate (Roundup WeatherMax) in 'awa and peach palm, hydramethylnon (Amdro Pro, Siege Pro) in various tropical fruit and nut orchard crops, and azoxystrobin (Abound) in various tropical fruit crops. The impact is that growers of crops from Hawai'i and elsewhere now have new pest control chemicals available to them that can improve their productivity and strengthen their viability.
6. Edible Crops of Maui (21-030). Tomato spotted wilt tospovirus (TSWV) reduced tomato production by over 25% since the mid-1980s. In response, plant pathologists developed multiple disease resistant (resistance to TSWV, tomato mosaic virus and root knot nematode) parental tomato lines that produce tomato hybrids with high quality fresh market fruits and high yields. Work continued with solarization, fumigation and cover crops to control Fusarium basal plant rot on onions. A collaborative effort with growers, chemical industry representatives, extension specialists and agents led to the development of a successful insecticide resistance management program for diamondback moth. As long as crucifer growers follow the program, they've been able to control diamondback moth. The success of these programs demonstrated the value of bringing horticulturists, entomologists, and plant pathologists together to develop multi-pronged disease and pesticide management strategies.

7. Aster Yellows Disease: A New Threat to Many Crops in Hawai'i (22-034). An Aster Yellows Task Force kept watercress growers aware of the plant host range and geographic distribution of the phytoplasma and the aster leafhopper associated with watercress yellows. Task Force members included researchers, extension agents, and State Department of Agriculture inspectors. Watercress growers became skilled in cultural and chemical disease management practices. Extension Agents on neighbor islands were trained to identify and manage Aster Yellows and the watercress leafhopper. Extension conducted monitoring of the vector using sticky traps and net sweeps and disease at the farms of cooperating growers. Watercress production has returned to near normal production levels at most farms. However, without constant grower vigilance Aster Yellows could again threaten the existence of the watercress industry. This effort could not have been successful without the cooperative efforts between growers, plant pathologists, entomologists, horticulturists and the department of agriculture.

8. New and Immigrant Farmers – Underserved Population. (A) Most of Hawai'i's new or recent immigrant farmers live on O'ahu, work on less than 4.5 acres, and earn less than \$50,000 annually in total sales. Immigrant farmers operate approximately one in every five vegetable, melon or fruit farms on O'ahu. Displaced sugarcane workers constitute another population of high-risk farmers. Many of them have never operated a farm and lack the skills to succeed without strong mentoring. Because new and unskilled farmers often view pesticides as a panacea for a wide variety of pest problems, they may use pesticides unnecessarily or in ways that result in overuse. This lack of knowledge of pest management practices has resulted in an inordinately high percentage (10.9% in 1997) of their crops being recalled by the Hawai'i Department of Health for volatile residues. Non-English proficiency and/or the lack of training are major causes of the problem. Without an effective pesticide safety education program, these farmers can put themselves, their families and the environment at risk from the misuse of pesticides. (B) Training was conducted on the farms in small groups of 3 to 4 farmers. Highly graphic training materials were translated into Laotian, Tagalog, and Ilokano. A total of 117 farmers were trained in pesticide safety and pest management. Another 101 were trained to meet the Worker Protection Standard (WPS) required by EPA. Forty-six videos (English and Laotian versions) of Pesticide Safety for Small Farms were distributed. Field Identification Guides to Common Pests were written and distributed to growers. PSA and radio programs were used to reach Ilokano speaking growers. Forty-five of the targeted farmers were revisited at least once to check their records, review problems, and evaluate training. (C) Twenty five percent of the farmers completed an evaluation to determine impacts of training. As a result of training, 71% will now calibrate application equipment, 59% will store pesticides according to label instructions, 80% will manage pesticide spills according to federal/state regulations, 61% will scout for pests before applying pesticides, 68% will dispose of pesticides according to label directions, 59% will adopt pesticide drift management practices, 58% will abide by the WPS requirements, 57% will use and maintain their personal protective equipment, 50% will look for signal words to determine product toxicity, 61% can now recognize signs and symptoms of pesticide poisoning, 56% can treat pesticide poisoning in accordance with label directions, 52% can recognize and manage heat stress, and 18-48% will adopt six other pesticide and pest management practices as the result of training. As a result of training, farmers are now aware of techniques to reduce their exposure to pesticides, able to integrate non-chemical alternatives into their pest management practices, and increase their self-esteem within their immigrant communities.

9. Hawaiian Homesteaders Farmers – Underserved Population. (A) The objective of the Hawaiian Home Lands program is to provide educational and training programs to improve the Hawaiian Homestead Farmers’ knowledge of farm management practices, upgrade their agricultural skills and techniques, and develop and promote community and leadership development. Market development assistance was provided to the Makuu Farmers Association who were able to open a two acre farmers market in October 2001. Six homestead farmers participated at the market bringing in a total of more than \$1,000 per week. Since opening, agricultural products have diversified and now include vegetables, nursery products, and handmade craft items. A portion of the revenues generated by the farmers’ market will be utilized for construction of a community center for the Makuu homesteaders. (B) A project to commercialize ulu was initiated. The project received an initial grant of \$5,000 from the County of Hawai`i for additional product development and market studies. A pre-cooked, microwaveable product was developed for market acceptance trials. The product was well received and market pricing information was developed. A 3-year projection estimates that 10 acres could potentially produce 150,000 lbs. of processed ulu. Homesteaders benefit from this program by increasing their land utilization which in turn results in additional farm related income. (C) Water is a scarce commodity on Molokai. Therefore, a project to encourage farmers to switch from sprinkler to drip irrigation was initiated. More than 50 acres of sweet potato are now being grown by drip irrigation. These 50 acres represent nearly 75% of the total sweet potato acreage on Molokai. Farmers that switched from sprinkler to drip irrigation reduced their water requirement by more than 50% without reducing yield. In the drought water-rationing situation Molokai farmers face, the drip system is a positive irrigation alternative for sweet potato production. Previous to this project all sweet potato acres were irrigated with sprinklers.

MULTISTATE EXTENSION ACTIVITIES

Form CSREES-REPT (2/00), Page 57.

INTEGRATED RESEARCH AND EXTENSION ACTIVITIES

Form CSREES-REPT (2/00), Pages 58 to 74.

U.S. Department of Agriculture
 Cooperative State Research, Education, and Extension Service
 Supplement to the Annual Report of Accomplishments and Results – FY 2002
 Multistate Extension Activities and Integrated Activities
 (Attach Brief Summaries)

Institution College of Tropical Agriculture and Human Resources
 State Hawai'i

Check one: Multistate Extension Activities
 Integrated Activities (Hatch Act Funds)
 Integrated Activities (Smith-Lever Act Funds)

Title of Planned Program/Activity	Actual Expenditures FY 2000	Actual Expenditures FY 2001	Actual Cost FY 2002	Estimated Cost FY 2003	Estimated Cost FY 2004
HAWAII DOES NOT HAVE MULTISTATE EXTENSION ACTIVITIES. THERE ARE NO EXPENDITURES. A PRE-WAIVER WAS REQUESTED.					
TOTAL					

_____ Director

_____ Date

U.S. Department of Agriculture
 Cooperative State Research, Education, and Extension Service
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Institution College of Tropical Agriculture and Human Resources
 State Hawai'i

Check one: Multistate Extension Activities
 Integrated Activities (Hatch Act Funds) : **Actual Expenditure and Estimated Cost -- Page 1 of 3**
 Integrated Activities (Smith-Lever Act Funds)

Title of Planned Program/Activity	Actual Expenditure FY 2000	Actual Expenditure FY 2001	Actual Expenditure FY 2002	Estimated Cost FY 2003	Estimated Cost FY 2004
103H The Relationship Between Oxidation-Reduction Potential of Flooded Soil and Taro Yield	250	5,344	4,238	4,238	4,238
130H Effective and Labor-Efficient Management of Weeds in Pastures and Native Forests of Hawai'i	6,747	15,736	20,500	20,500	20,500
162H Designing & Implementing Improved Nutrient Management Decision-Making for Natural Resource Management	4,800	0			
211H Improving Bone Health in Adolescence Through Targeted Behavioral Intervention			19,840	19,840	19,840
217H Needs Assessment and Resource Inventory Related to a Food Innovation Center			3,883	3,883	3,883
220R Factors Influencing the Intake of Calcium-Rich Foods Among Adolescents (Formerly 327R)			22,118	22,118	22,118
327R Factors Influencing the Intake of Calcium-Rich Foods Among Adolescents (W191)		54,347			
369H Measuring Success	5,048	0	0	0	0
372H Incarcerated Parents: Adjustment of their Children and Families			32,292	32,292	32,292
378R Family Businesses in Economically Vulnerable Communities		25,206	10,328	10,328	10,328

Integrated Activities (Hatch Act Funds) : **Actual Expenditure and Estimated Cost -- Page 2 of 3**

Title of Planned Program/Activity	Actual Expenditure FY 2000	Actual Expenditure FY 2001	Actual Expenditure FY 2002	Estimated Cost FY 2003	Estimated Cost FY 2004
380H The State of Hawai'i's Families	335	20,018			
513R Animal Manure and Waste Utilization, Treatment, and Nuisance Avoidance for a Sustainable Agriculture (Formerly 518R)			9,636	9,636	9,636
518R Animal Manure and Waste Utilization, Treatment, and Nuisance Avoidance for a Sustainable Agriculture	13,929	14,764			
520R Microirrigation Technologies for Protection of Natural Resources and Optimum Production	18,879	0	0	0	0
550H A Simple Two Stage Bioreactor for Milk Parlor Wastewater Treatment and Reuse in the Tropics			13,764	13,764	13,764
602G Hawai'i Pesticide Impact Assessment Program	0	0	0	0	0
615R A National Agricultural Program to Clear Pest Control Agents for Minor Crops	393	0	0	0	0
618H Acquisition of Pesticide Residue Data on Specialty (MINOR) Crops to Support Registration Requirement	1,200	2,700			
726H Etiology and Control of Fungal Diseases of the Tropics	18,169	28,290			
735H Control of Papaya Diseases	40,538	43,589			
798H Disease Management Strategies for Vegetable Crops in the Tropics	30,110	32,104			
853H Designing and Implementing Improved Nutrient Management Decision-Making for Natural Resource Management (Formerly 162H)			9,226	9,226	9,226
854H Cultivar Evaluation for Container Production in Hawai'i	2,858				
855H A New Material for Amending Metal Toxicities in Acid Soils		15,626	8,636	8,636	8,636
873H Developing Weed Control Components for Best Management Practices in Hawai'i	26,419	36,475	38,544	38,544	38,544
905H Bioremediation of Hawaiian Soils Contaminated with Polycyclic Hydrocarbons			905	905	905

Integrated Activities (Hatch Act Funds) : **Actual Expenditure and Estimated Cost -- Page 3 of 3**

Title of Planned Program/Activity	Actual Expenditure FY 2000	Actual Expenditure FY 2001	Actual Expenditure FY 2002	Estimated Cost FY 2003	Estimated Cost FY 2004
915R A National Agricultural Program to Clear Pest Control Agents for Minor Crops (Formerly 615R)					
944H Flower and Nursery Crops: Pest Management & Quarantine Treatments	15,722	30,953	33,855	33,855	33,855
967H Disease Control of Diversified Crops using Etiology, Low Risk Chemicals, Biological, and Cultural Methods (Formerly 726H)			32,802	32,802	32,802
977H Control of Papaya Fungal Diseases (Formerly 735H)			56,622	56,622	56,622
TOTAL	185,397	325,152	316,644	316,644	316,644

Director

Date

Note: A Pre-Waiver was requested. The Target amount is \$221,000. The Reduced Target amount was \$144,591. However, since the actual expenditures exceeded the Target of \$221,000, the Pre-Waiver is not needed.

U.S. Department of Agriculture
 Cooperative State Research, Education, and Extension Service
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 Multistate Extension Activities and Integrated Activities
 (Attach Brief Summaries)

Institution College of Tropical Agriculture and Human Resources
 State Hawai`i

Check one: Multistate Extension Activities
 Integrated Activities (Hatch Act Funds)
 Integrated Activities (Smith-Lever Act Funds) : **Actual Expenditure and Estimated Cost -- Page 1 of 2**

Title of Planned Program/Activity	Actual Expenditures FY 2000	Actual Expenditures FY 2001	Actual Expenditure FY 2002	Estimated Cost FY 2003	Estimated Cost FY 2004
02-005 CTAHR Video Production Facility	38,919	0	0	0	0
06-353 The State of Hawai`i's Families	7,056	17,043	0	0	0
06-355 Measuring Success: Measuring Effectiveness of FCE and 4-H Programs	2,975	0	0	0	0
10-600B Pesticide Impact Assessment Program		0	0	0	0
10-606 Supporting Pesticide Registration for Use in Hawai`i's Crops	12,740	0	0	0	0
12-505 Evaluation of Animal Waste Management Alternatives for the State of Hawai`i		0	0	0	0
12-506 Improved Irrigation System and Scheduling in Hawai`i		0	0	0	0
13-106 Weed Control Workshop: Noxious Alien Plants	100	0	0	0	0
13-108 Cooperative Vegetation Management Case Studies in Pastures and Forests	3,100	0	0	0	0
13-120 Management of Pasture and Environmental Weeds			33,447	33,447	33,447
14-205 Porcine Reproductive and Respiratory Syndrome (PRRS) in Hawai`i			2,768	2,768	2,768
16-908 Hot Water Treatment for Cut Flowers and Propagative Materials	250	0	0	0	0
16-912 Educational Programs to Transfer Pest Management Technology To The Cut Flower Industry		0	0	0	0

Integrated Activities (Smith-Lever Act Funds) : **Actual Expenditure and Estimated Cost -- Page 2 of 2**

Title of Planned Program/Activity	Actual Expenditures FY 2000	Actual Expenditures FY 2001	Actual Expenditure FY 2002	Estimated Cost FY 2003	Estimated Cost FY 2004
16-920 Supporting Pesticide Registration for Use in Hawai'i's Crops		49,690	47,702	47,702	47,702
16-921 Fungal Disease Control and Educational Program in Hawai'i			15,089	15,089	15,089
16-925 Nematode Control for Tropical Crops in Hawai'i			8,136	8,136	8,136
18-806 Technology Transfer to Support Sustainable Farming Systems in Hawai'i	671	6,388	16,714	16,714	16,714
18-809 Development and Expansion of the Floriculture Industry in Hawai'i	12,941	58,360	35,821	35,821	35,821
19-705 Fungal Disease Control and Educational Program in Hawai'i	237	0	0	0	0
20-080 Weed Management in Hawai'i Pastures	6,000	0	0	0	0
21-029 Demonstration on Technologies to Produce Value-Added Taro Products			4,236	4,236	4,236
21-030 Edible Crops of Maui			22,044	22,044	22,044
22-016 O'ahu-Kaua'i Food Crops Extension Project			15,200	15,200	15,200
22-034 Aster Yellows Disease: A New Threat to Many Crops in Hawai'i			1,921	1,921	1,921
23-040 Improved Cultural Management of Ornamental, Nursery, Landscape and Turf Commodities	4,500	18,800	20,150	20,150	20,150
103H The Relationship Between Oxidation-Reduction Potential of Flooded Soil and Taro Yield	250	11,799	6,600	6,600	6,600
TOTAL	89,489	162,080	229,828	229,828	229,828

Director

Date

Note: A Pre-Waiver was requested from the Target amount of \$85,000. However, since the actual expenditures exceeded the Target of \$85,000, the Pre-Waiver is not needed.

U.S. Department of Agriculture
Cooperative State Research, Education, and Extension Service
Supplement to the Annual Report of Accomplishments and Results – FY 2002
Multistate Extension Activities and Integrated Activities
Brief Summaries

Institution College of Tropical Agriculture and Human Resources
State Hawai'i

Check one: Multistate Extension Activities
 Integrated Activities (Hatch Act Funds) : **Brief Summaries -- Page 1 of 7**
 Integrated Activities (Smith-Lever Act Funds)

103H The Relationship Between Oxidation-Reduction Potential of Flooded Soil and Taro Yield (Goal 1).

Progress/Accomplishments: Results of surveys at farms to test the redox potential in taro paddies showed that taro growth was related to redox potential and oxygen content in the water. In areas where taro grew well, the redox potential averaged 585 mV and oxygen content averaged 7.0 mg/L. In contrast, the redox potential averaged 339 mV and oxygen content averaged 2.5 mg/L in places where taro grew poorly. Taro growth did not seem to be related to other measured characteristics. The survey results suggested that nitrogen (N) was being lost to denitrification and nitrogen-use efficiency was probably low. Toxicity was not likely, except under unusually stagnant conditions. Results of the project demonstration showed that nitrogen-use efficiency was highest with polycoated urea, intermediate with calcium peroxide/urea, and lowest with regular urea. The project also found that organic matter, such as compost applied to wetland conditions, could provide a sustained release of N over a period of many months. Analyzing the soil for total N prior to planting a wetland taro crop may be useful for estimating the existing level of N from crop residue and previously applied compost. A significant finding was that N fertilization appeared to have delayed the physiological maturity of the taro crop, and increased the incidence of taro pocket rot disease. This has important implications on the management of N fertilization and the timing of harvest for taro. These findings will lead to improved N management in taro grown under wetland conditions, reducing production cost, improving taro quality, and benefiting the environment. It is envisioned that farmers will be able to greatly increase their nitrogen-use efficiency through such practices as applying organic matter, using slow-release fertilizer, and making smaller but more frequent fertilizer applications, and improving nitrogen redox potential and taro performance budgeting based on soil analyses.

130H Effective and Labor-Efficient Management of Weeds in Pastures and Native Forests of Hawai'i (Goal 1).

Progress/Accomplishments: MCPA has become the standard treatment for *Senecio madagascariensis* by the Maui Fireweed Task Force, and is now recommended to ranchers who have reported good to excellent control. Current recommendations include the addition of the acidifying surfactant that should improve efficacy. Triclopyr ester with a crop oil adjuvant, cheaper than standard surfactants, is now recommended for *Clidemia hirta* control. Very-low-volume basal bark treatments have been utilized on trails on Kaua'i and Hawai'i to kill invasive plants and will be found to be a safer, much more economical way to do so. The addition of crop oil to 0.5% v/v of the spray mixture increased the efficacy of triclopyr on *Clidemia hirta* over that of a conventional and a silicone surfactant. MCPA and dicamba were ineffective. *Senecio madagascariensis*

was most susceptible to 2kg/ha of MCPA with an acidifying surfactant. Dicamba was also effective at 2 kg/ha, but at greater cost. *Rhodymyrtus tomentosa*, tolerant to most brush herbicide, was susceptible to dicamba at 2 kg/ha. *Senna obtusifolia*, long known in Kona, suddenly became invasive in pastures. It was susceptible to dicamba and triclopyr, each at 1 kg/ha, but tolerant to MCPA. Very-low-volume basal bark applications of triclopyr ester in oil were effective in killing *Casuarina equisetifolia*, *Corynocarpus laevigatus*, and *Psidium cattleianum* at an herbicide cost of 8 to 12 cents per tree. *Olea europaeus* was virtually immune to this treatment.

162H Designing and Implementing Improved Nutrient Management Decision-Making for Natural Resource Management (Goal 1).

Progress/Accomplishments: See Project 853H.

211H Improving Bone Health in Adolescence Through Targeted Behavioral Intervention (Goal 3).

Progress/Accomplishments: Four schools (Kamehameha School, St. Andrew's Priory, Maryknoll Grade School, Sacred Hearts Academy) have been successfully recruited for the ACT study. A full time staff has been hired and is actively recruiting 6th grade girls from these schools. Six participants have completed their first visit to the Kapiolani Clinical Research Center. Osteoporosis affects 35 million Americans for an annual cost of almost \$14 billion. Adequate intake of calcium during adolescence is important because by age 17 a woman has developed 95% of her bone mass. Greater bone mass reduces the chance of osteoporosis. However, today's adolescents are at increased risk of osteoporosis later in life because calcium intake has decreased as intake of soda drinks has increased. This research study will contribute to osteoporosis prevention by obtaining more information about: (1) the use of computer technology (DVD/CD ROM) as a school curriculum intervention which can be expanded to large-scale outreach programs, (2) the development of a school curriculum intervention to increase calcium intake and improve bone health in adolescents as compared with standard curriculum, (3) behavioral interventions to overcome lactose maldigestion resulting in increased calcium intake of maldigesters and, (4) a decision-making assessment tool to link specific interventions with predicted behavioral responses.

217H Needs Assessment and Resource Inventory Related to a Food Innovation Center (Goal 1).

Progress/Accomplishments: This project has been extended to accommodate still-evolving changes within CTAHR, including initiatives for a Business Development Partnership and agribusiness incubators, and the formation of Integrated Solutions (IS--formerly MEP). These changes are shifting the target clientele as well as the definition of a "comparable" center. The background information developed by this project will help meet broader goals of increasing and strengthening opportunities in diversified agriculture as well as the economic well-being and sustainability of agribusiness, associated families, and their communities.

220R Factors Influencing the Intake of Calcium-Rich Foods Among Adolescents (Goal 3)

Progress/Accomplishments: This study will examine the familial factors and how they relate to the child's calcium intake, knowledge, attitudes, and behaviors. A clearer understanding of familial factors and how they influence preadolescent calcium intake will enable intervention strategies to be more effective. Additionally, little information is available on the role of dietary supplements and fortified foods, which are new to the food supply, and the contribution of these items to the calcium intake of adolescents. This study examined these factors based on the child's gender and focus on the ethnic groups at highest risk for osteoporosis (Asians, Hispanics, and whites).

327R Factors Influencing the Intake of Calcium-Rich Foods Among Adolescents. (Goal 3)

Progress/Accomplishments: See Project 220R.

369H Measuring Success (Goal 5).

Progress/Accomplishments: Terminated.

372H Incarcerated Parents: Adjustment of their Children and Families (Goal 5)

Progress/Accomplishments: The literature relevant to incarceration of parents and effects/adjustment of children and families was reviewed. Variables were identified that will be important factors to be included or measured in the planned surveys. Two Community Correctional programs/locations (with incarcerated parents who might serve as subjects) were identified and contacted regarding possible participation in our survey. Confidentiality of prisoner data is a concern and potential problem.

378R Family Businesses in Economically Vulnerable Communities (Goal 5)

Progress/Accomplishments: Results from this study for the single manager households--1997 are: (1) being in excellent health increases the household/business manager's perception of family success, (2) family success positively affects business success and, (3) increased profits are associated with increased perception of business success. Results for the single manager households--2000 are: (1) being in excellent health increases the household/business manager's perception of family success and, (2) business success positively affects family success. Difference between 1997 and 2000 means test results show: single-manager households: (1) perceptions of family success have increased, (2) perceptions of business success have decreased, (3) number of teenagers has declined and, (4) number of children under age 5 have increased. As factors associated with business success and family success is determined, this information can be used by family business owners to assist with business and family resource allocation decisions.

380H The State of Hawai'i's Families (Goal 5).

Progress/Accomplishments: Terminated

513R Animal Manure and Waste Utilization, Treatment, and Nuisance Avoidance for a Sustainable Agriculture (Goal 4).

Progress/Accomplishments: A laboratory experimental set-up for bio-nest reactors was installed for the treatment of milk parlor wastewater at an ambient temperature of $25\pm 2^{\circ}\text{C}$, and these bio-nest reactors were filled with a certain media for retaining the biomass to be washed out from the bioreactor. It proves that the bioreactor can effectively remove the organic pollutant (about 80%) and produce the biogas (75% methane) at the rate of 1.5 L/L/d with the loading rate of 3-5 g total COD/L/d. Based on the finding of this study, the existing wastewater management systems can be improved by integrating the bio-nest reactors in order to achieve odor reduction, prevent groundwater contamination, eliminate clean-out lagoon content, reuse treated wastewater and recover bioenergy. This may provide an effective and simple treatment alternative to improve the existing lagoon system for land-limited conditions and tropical environments, such as in the State of Hawai'i.

518R Animal Manure and Waste Utilization, Treatment, and Nuisance Avoidance for A Sustainable Agriculture (Goal 4).

Progress/Accomplishments: See Project 513R.

520R Microirrigation Technologies for Protection of Natural Resources and Optimum Production (Goal 1).

Progress/Accomplishments: Terminated.

550H A Simple Two Stage Bioreactor for Milk Parlor Wastewater Treatment and Reuse in the Tropics (Goal 4)

Progress/Accomplishments: A two-stage anaerobic pre-treatment process has been investigated in three phases of study. Phase 1 includes two completely mixed reactors with sludge recycle (30°C), Phase 2 includes one completely mixed and one without completely mixed with sludge recycle (30°C), and Phase 3 includes two bio-nest reactors (a once-through system operated at 25°C). Among the three phases of study, Phase 3 demonstrates that it is simple to install and operate, effective, and inexpensive, and that it eliminates odors, produces bioenergy, and provides long SRT (sludge retention time). The dairy producer is able to plan an integrated wastewater management system for protecting the groundwater, soil, and air quality, and also to increase the competitiveness of the agricultural production system. A pilot plant study is now required for the investigation of the bio-nest reactor. This will encourage the dairy producers to adopt the proposed integrated wastewater management system with a more comfortable attitude.

602G Hawai'i Pesticide Impact Assessment Program (PIAP) (Goal 4).

Progress/Accomplishments: Terminated

615R A National Agricultural Program to Clear Pest Control Agents for Minor Crops (Goal 4).

Progress/Accomplishments: See Project 915R.

618H Acquisition of Pesticide Residue Data on Specialty (MINOR) Crops to Support Registration Requirement (Goal 4)

Progress/Accomplishments: Terminated.

726H Etiology and Control of Fungal Diseases of the Tropics (Goal 1).

Progress/Accomplishments: See Project 967H.

735H Control of Papaya Diseases (Goal 1).

Progress/Accomplishments: See Project 977H.

798H Disease Management Strategies for Vegetable Crops in the Tropics (Goal 1)

Progress/Accomplishments: Terminated.

853H Designing and Implementing Improved Nutrient Management Decision-Making for Natural Resource Management (Goal 1)

Progress/Accomplishments: This project provides important impacts because it is a direct link with clients and users of the ADSC services for soil and plant samples. Homeowners, gardeners and growers all use this service. Many of these people use this as the main contact with the University and with CTAHR. Thus the impact of the quality and promptness of the analysis and the reporting reflect directly on the College and University. A recently completed dissertation indicates that one of the sources of nitrogen that is contaminating the Pearl Harbor groundwater may be coming from excessively fertilized gardens and lawns. The soil tests provided by ADSC are one of the major diagnostic tools for identifying such situations and suggesting remedial action. By calling attention to such excessive fertilization, results from this project are sounding an alarm so that increased care and caution is needed in nutrient management in the islands.

854H Cultivar Evaluation for Container Production in Hawai'i (Goal 1).

Progress/Accomplishments: Terminated.

855H A New Material for Amending Metal Toxicities in Acid Soils

Progress/Accomplishments: Pineapple growers correct manganese-induced iron deficiency with foliar application of iron. In October of 2001, personnel from Dole Pineapple Company and the University of Hawai'i installed an experiment to investigate the effects of calcium source and rate of calcium application on two industry problems, namely (1) manganese-induced iron deficiency, and (2) fruit translucency. The calcium sources were gypsum, limestone, and basaltic dust. Gypsum was applied at a low and high rate, but basaltic dust and limestone were applied at a single rate adjusted to avoid root rot. A limestone-gypsum mixture was also included in the treatments. To study the effect of calcium on manganese-induced iron deficiency, the treatments were split to receive, or not receive, foliar application of iron. One year after installation, all treatments receiving iron are green and healthy, but those receiving no iron show iron deficiency to varying degrees. Of the three calcium sources, basaltic dust appears at this stage to produce greener plants than limestone or gypsum, and may help growers reduce the frequency of iron applications. Because basaltic dust is a waste product of rock quarries, it will be a cheap and readily available soil amendment. Basaltic dust, a waste product of rock quarrying on O'ahu, appears to be a possible inexpensive source of calcium to the pineapple industry. If proven to be true, the rock quarry industry may be able to dispose of their waste product to meet EPA standards while providing the agricultural sector with an inexpensive source of calcium. For the pineapple industry on O'ahu, this may provide improved fruit quality at lower input costs. The economic and environmental impacts to both industries and the State have great potential.

873H Developing Weed Control Components for Best Management Practices in Hawai'i (Goal 1).

Progress/Accomplishments: The living sod pineapple study will allow for world wide exposure of a new cropping system that can incorporate the use of plastic mulch and living mulches to greatly reduce polluted runoff. The work in export-potted palms will provide the industry with new and legal pesticides to control weeds in exported crops. The chemical weed control in native Hawaiian plants will allow for large-scale production of these important species needed for ecosystem restoration in Hawai'i.

905H Bioremediation of Hawaiian Soils Contaminated with Polycyclic Hydrocarbons (Goal 4)

Progress/Accomplishments: Bacterial candidates (180 strains) were isolated from local samples of Wahiawa soils and the roots of a perennial grass, *Paspalum* sp., which is a major candidate for phytoremediation of PAHs in tropical soils. All candidates were screened for use in bioremediation. Four bacterial species capable of pyrene degradation in laboratory and greenhouse studies were identified. Pyrene degradation rates were quantified and degradation products were analyzed. The discovery of local strains of bacteria for bioremediation is valuable because such strains will not require State Import Permits for bioremediation of Hawaiian soils. As so little is known about the ecology of these organisms and the mechanisms of degradation, this project is providing a solid basis upon which to develop model systems for bioremediation and reclamation of contaminated tropical soils.

915R A National Agricultural Program to Clear Pest Control Agents for Minor Crops (Goal 4)

Progress/Accomplishments: Field residue trials and field data notebooks were completed and submitted to IR-4 for the following projects: zoxamide in taro, methoxyfenozide in papaya, paraquat in ginger, imidacloprid in banana, spinosad in banana, and myclobutanil in papaya. These projects required a total of 18 field sites. Efficacy trials for metalaxyl in taro and kaolin in papaya were conducted. Metalaxyl, applied through drip irrigation, did not appear to effectively control corm rot. Kaolin effectively reduced the leaf edgeroller mite (eriophyid) population in papaya; however, it did not appear to be effective at controlling powdery mildew. Sulfur appears to continue to be the best overall treatment for powdery mildew and mite control in papaya, as long as good spray coverage is obtained. Hawai'i's IR-4 Residue Satellite Laboratory completed analyses and submitted Analytical Summary Reports for the following projects: MCPA in pea, imidacloprid in coffee and avocado, spinosad in coffee, banana, and nectarine, and dimethomorph in taro. The samples for these projects were from approximately 36 field sites. A number of uses were LABELED as a direct result of work previously conducted under this project: oxyfluorfen (Goal) in banana, imidacloprid (Provado) in taro (leaf production only), diazinon in watercress, mefenoxam + copper (Ridomil Gold Copper) in papaya, azoxystrobin (Quadris) in watercress, mefenoxam (Ridomil Gold) in basil, glyphosate (Roundup WeatherMax) in kava and peach palm, hydramethylnon (Amdro Pro, Siege Pro) in various tropical fruit and nut orchard crops, and azoxystrobin (Abound) in various tropical fruit crops. Growers of crops that have new pest control chemicals available to them can improve their productivity and strengthen their viability. Future registrations will keep these industries viable and provide for pesticide resistance management.

944H Flower and Nursery Crops: Pest Management and Quarantine Treatments (Goal 1)

Progress/Accomplishments: Several strategies have been developed for both field and post-harvest disinfestations using various heat treatments. The bulk media sterilization unit was demonstrated to the public at CTAHR's Open House celebrating the 100-year anniversary of the Hawai'i Agricultural Research Stations (held at the Komohana Agricultural Complex in Hilo), and at the Nursery Pest Control Field Day (held at the California and Hawai'i Foliage Growers' farm in Kea'au). The California Department of Food and Agriculture is not currently enforcing the requirement that all plants, including epiphytic orchids, be planted in sterilized media, as listed in the new Master Permit for the Shipment of Nursery Stock from Hawai'i to California; however, larger growers of export plants are confident that when the CDFA requirement is instituted, the sterilization unit can serve as a prototype sufficient to treat the volume of media required. Use of preconditioning prior to exposure to hot air at target temperature greatly reduces phytotoxicity in certain *Protea* species, perhaps by increasing thermotolerance of the plant material. This finding holds potential for the use of heat treatment in post-harvest disinfestations of other heat-sensitive commodities. For propagative material that

cannot tolerate hot water dipping, such as *Aglaonema* top cuttings, a 10-minute basal dip that does not expose the leaves and meristem to hot water, prevented leaf loss associated with phytotoxicity. Initial studies indicate that irradiation provides another potential method for post-harvest disinfestation of cut flowers and foliage. Use of pots with inner surfaces impregnated with Spin Out alone or with bifenthrin showed tremendous potential for use as part of an IPM program in containerized nursery crops to manage root-infesting mealybugs. On *Anthurium*, a number of effective pesticides for anthurium thrips (*Chaetanaphothrips orchidii*) and banana rust thrips (*C. signipennis*) were identified, Tame 2.4 EC, Scimitar GC, and Marvik with and without the synergist Incite, which reduced the numbers of thrips-damaged flowers. On fishtail palms, Acetamiprid provided the greatest initial and residual efficacy against coconut mealybugs, (*Nipaecoccus nipae*), followed by Dursban 50 W.

967H Disease Control of Diversified Crops using Etiology, Low Risk Chemicals, Biological, and Cultural Methods (Goal 1)

Progress/Accomplishments: Greenhouse studies have demonstrated that the newly isolated Phytophthora from taro corm will reproduce pocket rot. This is the organism that is isolated from rare active rots and extremely difficult to grow and maintain. This new Phytophthora is homothallic and produced sexual spores surrounded by a thickened wall. This morphology allows the spore to survive in the paddy until the next crop is planted. By the time pocket rots are produced the cause of the initial rot is no longer present. Thus, many more tests are needed on hundreds of corms to re-isolate the Phytophthora before it dies. For the causal organism, *Asperisporium caricae*, it was cultured for the first time and spores produced in pure cultures were used to inoculate healthy papaya plants. The disease was reproduced in about 6 weeks and the fungus was re-isolated from diseased leaves, completing Kochs postulates for the first time. A *Fusarium* species has been isolated from the black roots. The *Fusarium* has been pure cultured and pathogenicity tests are needed. A basidiomycetes fungus tentatively named *Marasmius* was found for the first time on white ginger (*Hedychium coronarium*). Pure cultures have been planted in preparation for pathogenicity tests. The *Marasmius* is a serious pathogen on red ginger (*Alpinia purpurata*) and *Heliconia*. With causal agents identified or confirmed work on control measures is proceeding. Evidence that nitrogen levels can increase disease is accumulating and growers are being informed of these results. These results help to build the case for reductions in nitrogen application to the taro crop or better timing for N application. At this time many growers who were using 700 to 900 lbs of nitrogen per acre are now using 300 to 400 lbs per acre.

977H Control of Papaya Diseases (Goal 1)

Progress/Accomplishments: A field fungicide trial was completed for the control of the new black spot fungal disease caused by *Asperisporium caricae*. Results confirmed that mancozeb (already used by growers), when applied on a regular basis, will control *Asperisporium* black spot disease. A newer fungicide, azoxystrobin, also provided control, but was no better than mancozeb. Assurance was provided to papaya growers that the fungicide they currently use to control other fungal disease also controls this new disease, but must be applied on a regular basis. The fungicide has slowed the spread of PRSV in the Puna District on the Big Island of Hawai'i enough to make papaya growing profitable. Without this project, many papaya growers would not be able to grow papayas in the Puna District.

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02-005 CTAHR Video Production Facility (Goal 1).

Progress/Accomplishments: Terminated

06-353 The State of Hawai`i's Families (Goal 5).

Progress/Accomplishments: Terminated

06-355 Measuring Success: Measuring Effectiveness of FCE and 4-H Programs (Goal 5).

Progress/Accomplishments: Terminated

10-600B Pesticide Impact Assessment Program (Goal 4).

Progress/Accomplishments: Terminated

10-606 Supporting Pesticide Registration for Use in Hawai`i's Crops (Goal 4).

Progress/Accomplishments: Terminated

12-505 Evaluation of Animal Waste Management Alternatives for the State of Hawai`i (Goal 4).

Progress/Accomplishments: Terminated.

12-506 Improved Irrigation System and Scheduling in Hawai`i (Goal 1).

Progress/Accomplishments: Terminated

13-106 Weed Control Workshop: Noxious Alien Plants (Goal 1).

Progress/Accomplishments: Terminated

13-108 Cooperative Vegetation Management Case Studies in Pastures and Forests (Goal 1).

Progress/Accomplishments: Terminated

13-120 Management of Pasture and Environmental Weeds (Goal 1)

Progress/Accomplishments: Very-low-volume herbicide application training was conducted in Hilo for State foresters, federal invasive species staff, and *Miconia* task force personnel. Guidance was provided to the State Division of Forestry and Wildlife (DOFAW) on invasive species management with very-low-volume techniques. The Nature Conservancy, and four ranches on Hawai'i and Maui were advised on aerial application of herbicides. Very-low-volume methods have been adopted by all four of the DOFAW districts. On Kaua'i, these methods are used for almost all trail maintenance and invasive plant control. On Maui, these methods have been incorporated into the DOFAW *Miconia* control program and in the reclamation of Kanahā Pond Bird Sanctuary, where an acre can reportedly be treated in 20 minutes. It is expected that very-low-volume applications will cut the cost of invasive plant management by over 90%.

14-205 Porcine Reproductive and Respiratory Syndrome (PRRS) in Hawai'i (Goal 1)

Progress/Accomplishments: The survey of all swine farms in the state of Hawai'i has been completed. At least three strains of PRRS virus have been identified in Hawai'i: The testing schedule, the number of pigs to be tested, and the projected costs have been developed for the herd certification program. The costs of the program were found to be higher than the expected benefits from sales of breeding stock to participating producers. Serum from 30 cattle egrets and 2 pigeons has been tested for PRRS virus. The results do not strongly support a role for cattle egrets in the transmission of PRRS, but indicate that further investigation would be of value. The attempt to experimentally infect egrets and recover virus depends on collaboration with another university that has appropriate containment facilities. This is not a high priority with mainland labs, especially since recent attempts to duplicate work on recovering virus from ducks have not been successful.

16-908 Hot Water Treatment for Cut Flowers and Propagative Materials (Goal 1).

Progress/Accomplishments: Terminated

16-912 Educational Programs to Transfer Pest Management Technology To The Cut Flower (Goal 1).

Progress/Accomplishments: Terminated

16-920 Supporting Pesticide Registration for Use in Hawai'i's Crops (Goal 4).

Progress/Accomplishments: A number of uses were labeled as a direct result of work previously conducted under this project: oxyfluorfen (Goal) in banana, imidacloprid (Provado) in taro (leaf production only), diazinon in watercress, mefenoxam + copper (Ridomil Gold Copper) in papaya, azoxystrobin (Quadris) in watercress, mefenoxam (Ridomil Gold) in basil, glyphosate (Roundup WeatherMax) in 'awa and peach palm, hydramethylnon (Amdro Pro, Siege Pro) in various tropical fruit and nut orchard crops, and azoxystrobin (Abound) in various tropical fruit crops. As a result, growers of these crops now have new pest control chemicals available to them to improve their productivity and strengthen their viability.

16-921 Fungal Disease Control and Educational Program in Hawai`i (Goal 4)

Progress/Accomplishments: New disease agents were isolated from naupaka, taro, ginger, and papaya. Discovered that increased levels of nitrogen resulted in increased disease incidence in taro. Application of nitrogen after the sixth month may actually promote disease incidence. Using cover crops while allowing taro lo`i to remain fallow between plantings increased both taro survival (+86%) and total biomass (1090%). Fallowing also breaks the disease cycle, reducing future losses. Growers agreed this was an obvious benefit that had to be weighed against the cost of leaving the lo`i fallow.

16-925 Nematode Control for Tropical Crops in Hawai`i (Goal 1)

Progress/Accomplishments: A demonstration was conducted on a cooperator's farm showing how an intercycle cover crop of sunnhemp, *Crotalaria juncea*, is beneficial in controlling nematodes and fungi. Anthurium growers are now aware of which products can control burrowing nematodes. Papaya growers can make informed choices about planting intercycle cover crops such as sunnhemp, marigold, or rapeseed. These cover crops have the potential to reduce both soil erosion and losses to certain fungi and nematodes. Pineapple plantations are aware of the potential to use Actigard and DiTera as alternatives and replacements to Nematicur in their cropping system. Anthurium, papaya, and pineapple growers can use less toxic pesticides, thereby increasing worker safety and protecting the environment.

18-806 Technology Transfer to Support Sustainable Farming Systems in Hawai`i (Goal 4).

Progress/Accomplishments: Various field demonstrations were developed to demonstrate the usefulness of no-tillage systems in vegetable and orchard production. These demonstrations emphasized how to maximize the effectiveness of herbicides to reduce their use but increase their efficacy. Work with no-till farming and living mulches helped farmers design Best Management Practices to reduce erosion.

18-809 Development and Expansion of the Floriculture Industry in Hawai`i (Goal 1).

Progress/Accomplishments: Organized the program and presided over the 6th International Society for Horticulture Science Protea Research Symposium, which was held in conjunction with the 11th International Protea Association Conference. Local growers made new contacts for expanded sales of their flowers and related products. Protea producers from Israel, New Zealand, Australia, Zimbabwe, and Portugal have offered to pay royalties to be licensed to grow the new CTAHR cultivars. Forty new *Leucospermum* cultivars were introduced among 6,373 cuttings distributed to local growers. The project has introduced 61 new cultivars to the floral trade since 1999.

19-705 Fungal Disease Control and Educational Program in Hawai`i (Goal 1).

Progress/Accomplishments: Terminated.

20-080 Weed Management in Hawai`i Pastures (Goal 1).

Progress/Accomplishments: Terminated

21-029 Demonstration on Technologies to Produce Value-Added Taro Products (Goal 1)

Progress/Accomplishments: Conducted taro farmer interviews and assessments on their perspectives of vertically integrated production systems best suited for small farm operations. Conducted assessment of potential taro products for value-added production so that farmers will be able to (1) develop market driven business plans, and (2) match their management capability with their ability to produce raw materials. Planned for a workshop in January 2003 to increase clientele's knowledge of potential manufacturing opportunities.

21-030 Edible Crops of Maui (Goal 1)

Progress/Accomplishments: Head cabbage growers experienced yield losses due to diamondback moth (DBM) of 20 to 40%, and in some cases up to 100%. From 1990 to 1994, the head cabbage industry was in severe financial distress with losses up to \$1.8 million. In attempt to eliminate the resistant DBM populations in cole crop production areas, CTAHR worked with to develop and implement a DBM resistance management program. Growers were able to obtain very good control of DBM and to maximize their production to the 1999 levels. The success of CTAHR's Resistance Management Program for DBM in Hawai'i serves as the foundation for resistant management of DBM throughout the world.

The use of new and improved adapted varieties is among the most cost-efficient tools available to farmers to increase profit margins. The use of these new vegetable varieties often increases yields, improves production efficiency, and minimizes farm inputs, because these varieties often require less pesticide, fertilizer, and labor to reach optimum yields than do less adapted varieties. Tomato spotted wilt tospovirus (TSWV) reduced tomato production by over 25% since the mid-1980. In response, plant pathologists developed multiple disease-resistant parental tomato lines that produce tomato hybrids with high quality fresh market fruits and high yields. These fresh market hybrid tomatoes contain genes that confer resistance to TSWV, tomato mosaic virus and root knot nematode. Local chefs and produce buyers are also excited about obtaining new and exciting specialty produce for their niche and local markets.

Grower surveys conducted in 1992 anticipated changes affecting agriculture within the next 10 years and identified areas of high priority, marketing education, and financial management. A marketing committee was organized to help educate growers in the area of marketing and farm management. By organizing conferences and workshops growers were provided information to better manage their resources, run their business more efficiently and maintain an economic viable farming operation in Hawai'i.

22-016 O'ahu-Kaua'i Food Crops Extension Project (Goal 4)

Progress/Accomplishments: Promoted development and implementation of an Insecticide Resistance Management (IRM) program for Diamondback Moth (DBM). The continued use of the only effective insecticide (Success, an environmentally friendly product) was being threatened. As a result of very intensive grower education programs the resistance levels in certain areas dropped to normal levels. Growers in these areas were asked to use Success exclusively and always according to a well-planned rotation schedule. Growers obtained the appropriate rotation schedule for their area through their Extension Agent.

22-034 Aster Yellows Disease: A New Threat to Many Crops in Hawai'i (Goal 1)

Progress/Accomplishments: An Aster Yellows Task Force kept watercress growers aware of the plant host range and geographic distribution of the phytoplasma and the aster leafhopper associated with watercress yellows. Watercress growers became skilled in cultural and chemical disease management practices. Extension Agents on neighbor islands were trained to identify and manage Aster Yellows and the watercress leafhopper. Extension conducted monitoring of the vector using sticky traps, net sweeps, and disease at the farms of cooperating growers. Field tests are in progress for insecticide efficacy as well as for barrier nets and other non-chemical strategies. Watercress production has returned to near normal production levels at most farms. However, control of Aster Yellows in watercress increases production costs. The next steps are to help ensure against insecticide resistance and to develop other cultural control alternatives.

23-040 Improved Cultural Management of Ornamental, Nursery, Landscape and Turf (Goal 1).

Progress/Accomplishments: Two additional accession clones of *Heliconia* were released to eight grower-cooperators for release to the tropical flower industry in 2004. This will provide the tropical flower industry with greater variety, volume, and value. Growers are adopting soil/tissue sampling and IPM practices to improve their production and economics.

103H The Relationship Between Oxidation-Reduction Potential of Flooded Soil and Taro Yield (Goal 1).

Progress/Accomplishments: Results of surveys at farms to test the redox potential in taro paddies showed that taro growth was related to redox potential and oxygen content in the water. In areas where taro grew well, the redox potential averaged 585 mV and oxygen content averaged 7.0 mg/L. In contrast, the redox potential averaged 339 mV and oxygen content averaged 2.5 mg/L in places where taro grew poorly. Taro growth did not seem to be related to other measured characteristics. The survey results suggested that nitrogen (N) was being lost to denitrification and nitrogen-use efficiency was probably low. Toxicity was not likely, except under unusually stagnant conditions. Results of the project demonstration showed that nitrogen-use efficiency was highest with polycoated urea, intermediate with calcium peroxide/urea, and lowest with regular urea. The project also found that organic matter, such as compost applied to wetland conditions, could provide a sustained release of N over a period of many months. Analyzing the soil for total N prior to planting a wetland taro crop may be useful for estimating the existing level of N from crop residue and previously applied compost. A significant finding was that N fertilization appeared to have delayed the physiological maturity of the taro crop, and increased the incidence of taro pocket rot disease. This has important implications on the management of N fertilization and the timing of harvest for taro. These findings will lead to improved N management in taro grown under wetland conditions, reducing production cost, improving taro quality, and benefiting the environment. It is envisioned that farmers will be able to greatly increase their nitrogen-use efficiency through such practices as applying organic matter, using slow-release fertilizer, and making smaller but more frequent fertilizer applications, and improving nitrogen redox potential and taro performance budgeting based on soil analyses