New Program Proposal

Certificate of Achievement in Agripharmatech

Track 1: Plant Biotechnology
and
Track 2: Ethnopharmacognosy

Date of Proposal (2nd stage): September 2011
Proposed Date of Program Implementation: Spring 2012

USDA United States Department of Agriculture
National Institute of Food and Agriculture

Contents

1. Program Objectives

Plant biotechnology in the broadest sense deals with developing and improving plant production in order to supply the world's need for healthier (decreased use of pesticides) and more nutritious (higher vitamin and protein content) food crops, as well as biofuels, and plant-derived pharmaceuticals. The proposed Certificate of Achievement in Agripharmatech has two tracks of disciplines: Plant Biotechnology, and Ethnopharmacognosy. Agripharmatech is a combination of the two disciplines. The new 24 credit hour CA is proposed to replace the existing Academic Subject Certificate in BioResources and Technology: Plant Biotechnology (ASC BRT-PB).

In 1998, after prompting from the United States Congress, the National Institute of General Medical Sciences (National Institute of Health) initiated funding for biotechnology training. Under this program, universities nationwide received funds to establish biotechnology training programs. University of Hawaii - Windward Community College received Millennium Workforce Development Initiative (MWDI) grants to provide Plant Biotechnology – Tissue and Cell Culture Training Courses in Summer 2000 and 2001. The success of these training courses led to the establishment of four plant biotechnology program facilities, and to the offering of the ASC BRT-PB.

The four plant biotechnology program facilities include the Tissue Culture and Plant Biotech Laboratory, the Bioprocessing Medicinal Garden Complex, the Climate-Controlled Greenhouse, and the Kuhi La'au – Tropical Plant and Orchid Identification Facility (see Appendix 1). The facilities (including the equipment) and the program were developed and supported through grants from the USDA-NIFA*, USDA-SPEC*, HI-BRIN*, EPSCoR*, and PCATT*. The ASC BRT-PB has been offered and fully supported through grants from USDA-NIFA since 2002 (see Appendix 2).

The Plant Biotechnology program has generated a total of forty-five ASC BRT-PB graduates (29% are Native Hawaiians, 31% Caucasians, 24% Asians, 13% Mixed, 2% Pacific Islander). 40% of the graduates have entered the agribiotech workforce, 78% have transferred and received higher degrees, and 22 % have become agribioprocessing entrepreneurs (the total percentage exceeds 100% because different categories overlap. See Appendix 3).

The CA in Agripharmatech: Plant Biotechnology (track 1) focuses on plant molecular genetics and its applications. See research track 1 posters on virus free transgenic orchids, and the phylogenetic study of Epidendrums in Appendix 4. The CA in Agripharmatech: Ethnopharmacognosy (track 2) focuses on plant pharmacognostical study and its application. See research track 2 publications on Ethnopharmacognosy Series I, II and III in Appendix 5.

* USDA-NIFA (United States Department of Agriculture-National Institute of Food and Agriculture), USDA-SPEC (Secondary and Two-Year Postsecondary Agriculture Education Challenge), HI-BRIN (Hawaii-Biomedical Research Infrastructure Network), EPSCoR (Office of Experimental Program to Stimulate Competitive Research), and PCATT (Pacific Center for Advanced Technology Training)

Major Objectives for Agripharmatech Program (see Appendix 6a, 6b, 7a, 7b for Program Reviews and Program Maps):

A. Provide a skilled workforce

- **Track 1: CA in Agripharmatech - Plant Biotechnology (CA A-PB):**
  Through education, research and training, CA A-PB graduates will be skilled in the areas of plant biotechnology, microbial biotechnology. tissue culture, teaching/research in plant biological sciences, orchid molecular phylogenetic/taxonomy/breeding, plant nursery management, plant identification, plant conservation, plant quarantine inspection.

- **Track 2: CA in Agripharmatech - Ethnopharmacognosy (CA A-EP):**
  Through education, research and training, CA A-EP graduates will be skilled in the areas of plant bioproduct manufacturing, pharmaceutical/nutraceutical research, green pharmacy, teaching/research in ethnobotany, microbiology and plant ecology, plant nursery management, organic farming, plant conservation, plant quarantine inspection, dietary/health-food product management/inspection.

B. Facilitate student transfer to higher degree institutions

- **Track 1: CA in Agripharmatech - Plant Biotechnology (CA A-PB):**
  CA A-PB graduates are more likely have taken all general education course requirements by the time they receive this certificate. They should be able to transfer their credits smoothly to any higher degree institutions, majoring in agribiosciences including plant/microbial/general biotechnology, plant molecular phylogenetic taxonomy, agricultural sciences, horticulture, bioinformatics, biology, and biomedical sciences.

- **Track 2: CA in Agripharmatech - Ethnopharmacognosy (CA A-EP):**
  CA A-EP graduates are more likely have taken all general education course requirements by the time they receive this certificate. They should be able to transfer their credits smoothly to any higher degree institutions, majoring in agribiosciences includes ethnobotany, agricultural sciences, pharmacy, horticulture, biology, and biomedical sciences.

  Note: The course alignment and the articulation agreement were finalized in Fall 2002 and Summer 2004 with the College of Tropical Agriculture and Human Resources at University of Hawaii, Manoa; the College of Agriculture, Forestry and Natural Resource Management at University of Hawaii, Hilo; and the Department of Botany at University of Hawaii, Hilo (see Appendix A and http://www.hawaii.edu/gened/articulation_wincc.htm). The course alignment was also created with the University of Alaska at Fairbanks in 2009 (see Appendix B). A chart showing WCC Plant Biotechnology student transfer and workforce pathways was developed by CTAHR at UHM (see Appendix C).

C. Promote agribusiness entrepreneurship

- **Track 1: CA in Agripharmatech - Plant Biotechnology (CA A-PB):**
  CA A-PB graduates are well equipped with knowledge and should be able to operate their own agribusiness enterprises such as tissue culture laboratory, plant/orchid nursery, agriculture farm.

- **Track 2: CA in Agripharmatech - Ethnopharmacognosy (CA A-EP):**
  CA A-EP graduates are well equipped with knowledge and should be able to operate their own agribusiness enterprises such as plant-based product manufacturing, green pharmacy laboratory, food pharmacy enterprise, organic health food product/store, organic hydroponic/farm.

Note: WCC Chancellor, Vice Chancellor, Dean Division II and CA Agripharmatech Program Coordinator became members of the National Association for Community College Entrepreneurship (NACCE) in August 2011. NACCE supports entrepreneurship education and entrepreneurial leadership at the community college level. NACCE members have access to NACCE National Conferences, Resource Library, Press Promotion Services, Online Networking, Monthly Webinars etc. to promote the program and entrepreneurship careers nationwide.

2. Relationship of Objectives to WCC Mission and Strategic Plan

Windward Community College Mission

Windward Community College offers innovative programs in the arts and sciences and opportunities to gain knowledge and understanding of Hawai'i and its unique heritage. With a special commitment to support the access and educational needs of Native Hawaiians, we provide O'ahu's Ko'olau region and beyond with liberal arts, career and lifelong learning in a supportive and challenging environment - inspiring students to excellence.

The proposed Certificate of Achievement in Agripharmatech: Track 1 - Plant Biotechnology and Track 2 - Ethnopharmacognosy will fulfill the following goals outlined in the WCC Mission Statement and Strategic Plan (Action Outcomes listed in parentheses):

- Contribute to the development of a highly skilled, high-wage workforce through the establishment of career-focused certificates that lead to employment in emerging fields (4.1)
- Establish partnerships with employers to create internships and job placement (4.2)
- Expand the curriculum to prepare students for critical workforce shortage areas (4.3)
- Create internships and service learning opportunities in the community (4.4)
- Promote the knowledge, skills, and opportunities that support current and emerging STEM fields and careers (4.5)
- Increase the number of transfers to the UH baccalaureate programs that lead to related occupations (4.6)
- Increase the number of certificates awarded in STEM fields (4.8)

3. Program Justification

A. Local and National Need

According to the USDA - NASS (United States Department of Agriculture – National Agricultural Statistics Service), there are 2296 farms on Oahu; 250 of which are certified plant/orchid nurseries, including tissue culture labs (http://hawaii.gov/hdoa/pi/pq/nema_cert/nurseries-in-hawaii). Over 45 highly commercial biotechnology companies are operating in the Islands of Hawaii, and employ 1,700 Hawaii residents (http://www.iowabiotech.com/econ_dev_reports/Hawaiibiotech99.pdf). Plant biotechnology has become a source of skilled jobs that pay higher than average wages. It is estimated that agricultural positions account for 70% of the State's biotechnology employment (http://www.ctahr.hawaii.edu/biotech/economic.html) (see Appendix D). An O NET OnLine Summary Report for Agripharmatech related occupations nationwide (including agribiotechnicians, microbiologists, bioprocessing, nutraceuticals, food pharmacy) in the United States projected a need of 41,000 additional employees by 2016 (http:// online.onetcenter.org/link/summary/19-4021.00). The following data for occupational employment and wage in Agripharmatech related fields in Hawaii (Oahu, Big Island, Maui, Kauai) are provided by the Bureau of Labor Statistics in May 2010 (http://www.bls.gov/oes/current/oes_HI.htm):

		Employment Estimates		Wage Estimates	
Occupation Code	Occupation Title	Employment *	Location quotient **	Mean Hourly	Mean Annual ***
19-1012	Food Scientists and Technologists	****	****	$48.52	$100,930
19-1013	Soil and Plant Scientists	120	2.171	$33.48	$69,640
19-1022	Microbiologists	70	0.901	$29.32	$60,980
19-1029	Biological Scientists, All Other	270	2.005	$30.85	$64,160
19-1031	Conservation Scientists	90	1.111	$31.54	$65,600
19-1099	Life Scientists, All Other	****	****	$38.35	$79,780
19-4011	Agricultural and Food Science Technicians	240	3.122	$17.87	$37,170
19-4021	Biological Technicians	570	1.739	$14.71	$30,600
19-4092	Forensic Science Technicians	70	1.303	$25.01	$52,030
19-4093	Forest and Conservation Technicians	120	0.842	$19.06	$39,640

* Estimates for detailed occupations do not sum to the totals because the totals include occupations not shown separately. Estimates do not include self-employed workers.
** The location quotient is the ratio of the area concentration of occupational employment to the national average concentration. A location quotient greater than one indicates the occupation has a higher share of employment than average, and a location quotient less than one indicates the occupation is less prevalent in the area than average.
*** Annual wages have been calculated by multiplying the hourly mean wage by a "year-round, full-time" hours figure of 2,080 hours; for those occupations where there is not an hourly mean wage published, the annual wage has been directly calculated from the reported survey data.
**** Estimates not released.

B. Program History

Windward Community College already has a well–established Plant Biotechnology program, which offers an Academic Subject Certificate in BioResources & Technology: Plant Biotechnology (ASC BRT-PB), and has graduated an average of 6 – 7 students per year since 2003 (see Appendix 3). The graduates are trained in basic/applied sciences and research in botany, microbiology, orchidology, chemistry, cell and molecular biology, plant tissue culture, phytobiotechnology and ethnopharmacognosy. This knowledge/skill allows them to enter those occupations mentioned above. Biotechnology is listed as one of the emerging technical fields supported in the University of Hawaii Community College FB 2011-2013 Program Change Request (PCR) #2.

The Certificate of Achievement in Agripharmatech - Track 1: Plant Biotechnology (CA A-PB), and Track 2: Ethnopharmacognosy (CA A-EP) will replace the ASC BRT-PB. These two tracks are developed and proposed to provide more focused hands-on learning in specific fields, preparing students for immediate employment in the occupations mentioned above. The CA A-PB focuses on the study of plant/orchid tissue culture, plant molecular phylogenetic and genetic engineering. The CA A-EP focuses on study of plant-based pharmaceutical/nutraceutical product manufacturing.

C. Program Learning Outcomes

CA A-PB Learning Outcomes (students should be able to):

1. Cultivate and maintain plant growth
2. Identify plants (tropical plants and orchid species)
3. Demonstrate fluency in aseptic culture technique (microbial pure culture and plant tissue culture)
4. Operate laboratory equipment (using autoclave, gel electrophoresis, PCR machine, Particle Delivery/1000 Helium System, spectrophotometer, fluorescent microscopy, Gel Doc System)
5. Perform genetic engineering techniques/research (DNA/RNA extraction, electrophoresis, PCR reaction, DNA sequencing, gene transformation via bacteria and particle bombardment)
6. Perform alignment and analyze DNA sequence results (using Sequencher, PAUP, Finch TV software systems)
7. Follow standard ethics and regulations of biotech professionals, biosafety, chemical safety and intellectual property rights

CA A-EP Intended Outcomes (students should be able to):

1. Cultivate organically grown plants and maintain plant growth
2. Identify medicinal and nutritious plants
3. Conduct pharmaceutical and nutraceutical research
4. Operate laboratory equipment (autoclave, spectrophotometer, stereo microscope, anaerobic transfer chamber, rotary evaporator, distiller, Biacore Q system, HPLC)
5. Apply technology, management and marketing skills to become bioprocessing entrepreneurs
7. Follow standard ethics and regulations of biosafety, chemical safety and intellectual property rights

D. Curriculum

Track 1: Plant Biotechnology (total 24 credits)

A. One capstone class: 4 credits
BOT 210 Phytobiotechnology (4)
or BIOL 275/L Cell & Molecular Biology (4)

B. Four required classes: 12 – 14 credits
BOT 101 General Botany (4)
or BIOL 172/L General Biology II/L (4)
AG 152 Orchid Culture (3)
or BOT 130 Plants in the Hawaiian Environment (4)
MICRO 130 General Microbiology (3)
or BIOL 171/L General Biology I/L (4)
MICRO 140 General Microbiology Lab (2)

C. Select two or three elective classes: 6 – 8 credits
AG 149 Plant Propagation (3)
BOT 160 Identification of Tropical Plants (3)
BOT 199/299 Independent Study (1 – 4, with approval)
CHEM 161/L General Chemistry I/L (4)
or CHEM 151/L Elem Survey of Chemistry/L (4)
CHEM 162/L General Chemistry II/L (4)
or CHEM 152/L Survey of Organic/Bioorganic Chemistry (4)
CHEM 199 Independent Study (1 - 4, with approval)
CHEM 272/L Organic Chemistry/L (5)
BIOL 275/L Cell & Molecular Biology (4)

Track 2: Ethnopharmacognosy (total 24 credits)

A. One capstone class: 4 credits
BOT 205 Ethnobotanical Pharmacognosy (4)

B. Four required classes: 12 – 14 credits
BOT 160 Identification of Tropical Plants (3)
or BOT 101 General Botany (4)
or BIOL 172/L General Biology II/L (4)
CHEM 161/L General Chemistry I/L (4)
or CHEM 151/L Elem Survey of Chemistry/L (4)
MICRO 130 General Microbiology (3)
or BIOL 171/L General Biology I/L (4)
MICRO 140 General Microbiology Lab (2)

C. Select two or three elective classes: 6 – 8 credits
AG 152 Orchid Culture (3)
BOT 101 General Botany (4)
BOT 105 Ethnobotany (3)
BOT 130 Plants in the Hawaiian Environment (4)
BOT 199/299 Independent Study (1 – 4, with approval)
BIOL 171/L General Biology I/L (4)
CHEM 162/L General Chemistry II/L (4)
or CHEM 152/L Survey of Organic/Bioorganic Chemistry (4)
CHEM 199 Independent Study (1 - 4, with approval)
FSHN 185 Human Nutrition (3)

4. Description of Resources and Resources Required

In the existing ASC BRT-PB, there is 1 Botany/Microbiology professor, who is also the Coordinator of the Plant Biotechnology Program (.6 FTE), 1 Botany lecturer (.6 FTE), and 1 Microbiology lecturer (.6 FTE). The program coordinator's assigned time, student research internships and supplies needed to operate all plant biotech facilities have been supported through USDA-NIFA grants. Some lab equipment/supplies and undergraduate lab assistants have been funded through campus general funds.

An FB 11 – 13 Operating Budget Adjustment Request to the UH BOR for staffing and equipment for the new CA in Agripharmatech has been approved for funding the following (see Appendix 8):

1). A Plant Molecular Biology Instructor ($55,344)
A request of 1 FTE Plant Molecular Biology Instructor to teach capstone classes such as BIOL 275/275L (Cell & Molecular Biology/Lab), BOT 210 (Phytobiotechnology), BOT 199/299 (Plant molecular phylogenetic research), as well as courses (BOT 101, MICRO 130, MICRO 140) required to fulfill the CA in Plant Biotechnology. These classes are transferable to UHM and other higher degree institutions, fulfilling biological requirements for Plant Biotechnology, General Biotechnology, Microbial Biotechnology, Molecular Biosciences and Bioengineering, Plant Molecular Phylogenetics, Horticulture, Biology and Pre-med.

2). A full time Lab Technician ($45,000)
Highly complex lab preparations and tremendous time are required to prepare laboratories for courses such as BIOL 275L, BOT 210, BOT 205, MICRO 140, and AG 152. A lab technician with molecular biology, chemistry, plant tissue culture and microbiology work experience/training background is needed to help prepare those lab courses.

3). A full time Garden Technician to maintain the Bioprocessing Medicinal Garden Complex (BMGC) ($35,000).
Currently the BMGC is maintained by a casual/overload hired Agriculture Technician (6 hours/week/8 months) and one student intern (3 hours/week/regular semester) paid through USDA-NIFA. The BMGC consists of 3 sub-facilities (the medicinal garden, the aquaponic system, and the bioprocessing facility), which require maintenance by a special BMGC technician. The medicinal garden must be weeded (by hand), mulched, tilled, and watered regularly to keep up with fast growing weeds and to maintain healthy growth of plants in an organic growth environment. Medicinal and nutritious plants are studied by botany and agriculture students. Organically grown plants are utilized in nutraceutical research for the BOT199/299 and BOT 205 lab practicum.

The organic hydroponic system requires cleaning and maintenance. Lab equipment in the bioprocessing facility needs to be serviced and maintained in working order.

4). Recruitment Specialist
A recruitment specialist is necessary to recruit/introduce high school and freshman college students to CA programs and encourage them to take classes listed in the programs and to receive certificates. This program offers excellent career pathways,

promising high paying jobs and transferable credits to higher institutions. Marketing tools including newspaper advertisements, TV, *Windward Malamalama, Ka 'Ohana*, websites, flyers, posters, PowerPoint presentations, special student activities and exhibits and class/school visitations are also part of the recruitment efforts that have to be integrated more actively and effectively.

This person (Counselor and Agripharmatech Student Intern) might be assigned by the Vice Chancellor of Student Affairs.

5). Lab equipment
Request to purchase CO_2 anaerobic chamber, cellometer, RT-PCR, DNA profile imaging system, DNA sequencher software system and warranty/maintenance fees (total $150,000). $20,000 per year has been approved by the BOR for FY 12 – 17.

The Agripharmatech program will continue utilizing the existing 4 plant biotech facilities: the Kuhi La'au – Tropical Plant and Orchid Identification Facility (Imiloa room 112-A), the Tissue Culture and Plant Biotechnology Laboratory (Imiloa room 101-A), the Climate-controlled Greenhouse (rear side of Imiloa), the Bioprocessing Medicinal Garden Complex (across from Imiloa); and lecture/lab rooms (Hale Imiloa rooms 101 and 106). These are facilities presently used for the ASC Plant Biotechnology program.

5. Five-Year Business Plan

The proposed Certificate of Achievement in Agripharmatech (2 tracks: Plant Biotechnology, and Ethnopharmacognosy) will fulfill the goal outlined in the WCC Mission Statement and Strategic Plan: to promote the knowledge, skills, and opportunities that support current and emerging STEM fields and careers. It is planned that WCC will produce at least 186 STEM graduates per year by 2015. The college projects that within three years each of the CA tracks will have an annual enrollment of 11 students, with a total of 22 graduates annually. These programs concentrate on workforce development and student transfer to higher degrees, providing STEM education in targeted fields, which have high job placement.

The Plant Biotechnology Program (including facilities, student internships, and reassigned time for the Program Coordinator) has been supported through USDA-NIFA grants since 2000. This Alaskan Native/Native Hawaiian (AN/NH) consortium grants will most probably continue for another five years. Lab supplies and the undergraduate lab assistant will continue to be funded by the college.

See the following narrative and table of Academic Cost and Revenue for provisional years 2012 – 2013 and 2013 – 2014 (see also Appendix E):

B. Annual SSH:
Includes Fall and Spring total head counts in classes listed in CA Agripharmatech (Track 1: Plant Biotechnology, and Track 2: Ethnopharmacognosy)

C. Instructional cost w/o fringe:
It is projected that a maximum of 70 credits/year are associated with the two CA Agripharmatech tracks: 54 credits will be taught by two FT faculty (= 2.0 FTE);

and 16 credits will be taught by lecturers (= 0.6)

D. Other personnel cost (total $53,858):
One Lab Technician: 1.0 FTE = $45,000
One Student Lab Assistant: 28 hours/year = $1,358
One Garden Technician: $4,000 (this cost is offset by the USDA-NIFA grant)
Student helpers and interns: $2,000 (this cost is offset by the USDA-NIFA grant)
Two persons assisting in the publication of the Ethnopharmacognosy Series at $750 each (this cost is offset by the USDA-NIFA grant)

E. Unique program cost (total $39,000):
$20,000 (lab supply), $9,000 equipment maintenance fees, $10,000 travel cost to attend scientific conferences (the total cost is partially offset by the USDA-NIFA grant)

H. Other sources of revenue:
It is based on $108,579 from the USDA-NIFA Consortium grant FY 11 – 12

K1. Total salary FT faculty/lecturers:
It is based on two (rank 4 @ $66,576 in FY 2011) FT faculty members' average annual salaries, plus 4% salary increase per year

K3. Total salary PT lecturers:
It is based on Step 2 Instructor's credit/hour salary ($1,518 per credit hour in FY 2011) x 16 credits, plus 4% salary increase per year

L. Non-instructional expenditure/SSH:
$277

		Provisional	Years
ENTER ACADEMIC YEAR (i.e., 2011-2012)		Year 1 (2012-2013)	Year 2 (2013-2014)
Students & SSH	A. Headcount enrollment (Fall)	18	20
	B. Annual SSH	2,287	2,300
Direct and Incremental Program	C. Instructional Cost **without** Fringe	$163,738	$170,287
Costs W/O Fringe	C1. Number (FTE) of FT Faculty/Lecturers	2.00	2.00
	C2. Number (FTE) of PT Lecturers	0.60	0.60
	D. Other Personnel Costs	$53,858	$53,858
	E. Unique Program Costs	$39,000	$39,000
	F. Total Direct and Incremental Costs	$256,596	$263,145
Revenue	G. Tuition	$230,987	$243,800
	Tuition rate per credit	$101	$106
	H. Other	$108,000	$108,000
	I. Total Revenue	$338,987	$351,800
J. Net Cost (Revenue)		-82,391	-88,655
Program Cost per SSH W/ Fringe	K. Instructional Cost **with** Fringe/SSH	$93	$97
	K1. Total Salary FT Faculty/Lecturers	$138,478	$144,017
	K2. Cost Including Fringe of K1	$186,945	$194,423
	K3. Total Salary PT Lecturers	$25,260	$26,270
	K4. Cost Including fringe of K3	$26,523	$27,584
	L. Support Cost/SSH	$318	$318
	Non-Instructional Exp/SSH	$277	$277
	System-wide Support/SSH	$41	$41
	Organized Research/SSH		
	M. Total Program Cost/SSH	$411	$415
	N. Total Campus Expenditure/SSH	$457	$457
Instruction Cost with Fringe per SSH	K. Instructional Cost/SSH	$93	$97
	O. Comparable Cost/SSH	$551	$551
Program used for comparison:	KCC Health Service Tech		

6. Impact on Current Courses or Programs

Courses that are already listed and offered in the ASC BRT-PB (26 credits) have been reselected and readjusted appropriately to emphasize the major focus of each of the new CA tracks (24 credits). This course adjustment will provide directed career/educational pathways with more in-depth hands-on learning, and fewer credit requirements, thus, allowing for faster graduation, immediate employment and seamless credit transfer to higher degree institutions.

It is projected that the head count enrollment for majors in both CA tracks will continue to increase from 16 in FY 11 – 12, 18 in FY 12 – 13, 20 in FY 13 – 14 to 22 in FY 14 – 15 due to aggressive marketing and recruiting efforts by the Recruitment Specialist and/or student interns. The SSH in classes listed in both tracks will also increase annually by approximately 2% (2,287 in FY12 –13; 2,300 in FY 13 – 14; 2,350 in FY 14 – 15). The American School Search reported that the graduation rate (AA in Liberal Arts) at Windward Community College is 10% and "transfer out" rate is 31% (http://www.american-school-search.com/review/windward-community-college). Based on this calculation, approximately 230 AA graduates and 710 "transfer out" students would have taken at least one or two science classes listed in the program tracks in 2012 – 2013. See the list of courses for CA A-PB and CA A-EP in Appendix 9, and course descriptions in Appendix 10.

A continuous increase in student enrollment will not impact other science programs, but will impact the natural science lecture and laboratory space, particularly Hale Imiloa 106. Currently the room is shared among MICRO 140, BOT 205, BOT 210, BIOL 275/275L, BIOL 171L and BIOL 172L. Funding will be sought to renovate Hale Imiloa 123 from an existing lecture/semi-lab room into a full wet lab to be used for BIOL 171L and BIOL 172L. This high priority budget request will be proposed for FY 11 – 12.

Note: Hale Imiloa 123 already has plumbing (3 sinks, a shower and an eyewash) and electrical systems (a fume hood and electrical outlets along stations on both sides of the wall) in place.

7. Evidence of Commitment/Support

The main courses, including capstone courses listed in both tracks of the CA in Agripharmatech, are botany and microbiology courses that have been developed and offered since 2002 by the ASC – PB Program Coordinator, who is a Professor of Botany and Microbiology and also a Co-Project Director of the USDA-NIFA Consortium grant. This individual will continue to be responsible for both CA tracks. Eventually, there will be a full time faculty member in charge of each track. The CA Agripharmatech program is supported by WCC administrators, the Department Chair, as well as botany, microbiology, chemistry, agriculture, biology and human nutrition instructors in the WCC Department of Natural Sciences.

Student transfer and research collaboration across the UH system has been established with the Department of Molecular Biosciences and Bioengineering, the Department of Tropical Plant and Soil Sciences, the Botany Department, the Department of Cell and Molecular Biology, and the Department of Biology at UHM. This

collaboration also exists with the College of Agriculture, Forestry and Natural Resource Management at UHH. Research partnerships/internships have also been developed with biotech companies including the Hawaii Agriculture Research Center, the Pioneer Hi-Bred International Inc., Monsanto Inc., Cardax Pharmaceuticals and many other plant/orchid nurseries/farms. See letters of support in Appendix 11.

8. Measure of Program Efficiency

Program efficiency will be measured using the following indicators. Goals for each indicator are listed in parenthesis:

- Number of students registering for the certificates (22)
- Course fill rate (85%)
- Number of core courses (capstone and required classes for both tracks) taught per year (13)
- Percent of students entering workforce (50%)
- Percent of students transferring to higher degrees (50%)
- Percent of students becoming agribusiness and agribioprocessing entrepreneurs (20%)
- Number of students meeting certificate requirements within 18 months (10)

9. Measure of Program Effectiveness

Program effectiveness will be measured by the following indicators. Goals for each indicator are listed in parenthesis:

- Placement of certificate-holders into industry related positions (80% within 12 months of certificate completion) or
- Increase in mean wage for those already working in the field (mean wage > 20% within 12 months of program completion) or
- Performance and retention of certificate-holders in industry related fields or
- Satisfactory rating of certificate-holders, and employers with the quality of the program (80% satisfied with the program) or
- Transfer retention in higher degree institutions in program related field (50%)

Program outcomes will be measured by:

- Student learning outcomes assessment
- Program (review) outcome assessment
- Student evaluations
- Course completion rates
- Follow-up surveys of students and employers

Appendix 1. Four plant biotechnology facilities and lab equipment

Tissue Culture and Plant Biotechnology Facility

Bioprocessing Medicinal Garden Complex

Climate-controlled greenhouse

Kuhi La'au – Tropical Plant and Orchid Identification Facility

Appendix 2. Academic Subject Certificate in Bio-Resource & Technology: Plant Biotechnology (ASC BRT-PB)

Bio-Resources & Technology

Academic Subject Certificate

Pursue careers in plant biotechnology, botany, horticulture, biology, pharmacy & medicine

University of Hawai'i®
Windward Community College

Plant Biotechnology

The Bio-Resources and Technology–Plant Biotechnology Academic Subject Certificate prepares students for careers in biotechnology and qualifies them to transfer to bachelor of science degree programs. Knowledge in plant biotechnology will be an asset in bioproduct manufacturing, assuring safe food and medicinal production.

Plant biotechnology can lead to developing better food supplies, saving endangered plant species, fighting disease and strengthening strains of native plants.

Students have the rare opportunity to do hands-on research early in their college careers through WCC's Tissue Culture and Plant Biotechnology Lab, Plant and Orchid Identification Facillity, climate-controlled greenhouse and the Bioprocessing Medicinal Complex Garden.

Students can qualify for work as plant biotechnologists in this growing field or transfer to a bachelor of science degree program with majors in biotechnology, agriculture, horticulture, botany, aquaculture, pharmacy or pre-medicine.

This certificate consists of 26 credits. See course descriptions for prerequisites.

Required Courses (16 credits)

BOT 101	General Botany (4) **OR**
BIOL 171/171L	General Biology I and Lab (4)
BOT 160	Identification of Tropical Plants (3) **OR**
BOT 130	Plants in the Hawaiian Environment (4)
BOT 210	Phytobiotechnology (4) **OR**
BIOL 275/275L	Cell and Molecular Biology and Lab (4) **OR**
BOT 205	Ethnobotanical Pharmacognosy (3)
MICRO 130	General Microbiology (3)
MICRO 140	General Microbiology Lab (2)

Electives (10 credits)

AG 149	Plant Propagation (3)
AG 152	Orchid Culture (3)
BIOL 275	Cell and Molecular Biology (3)
BIOL 275L	Cell and Molecular Biology Laboratory (1)
BOT 105	Ethnobotany (3)
BOT 130	Plants in the Hawaiian Environment (4)
BOT 199/299	Independent Study or Summer Field Study Abroad (1-4)
BOT 205	Ethnobotanical Pharmacognosy (4)
CHEM 151 or CHEM 161	
CHEM 152 or CHEM 162	
CHEM 151L or CHEM 161L	
CHEM 152L or CHEM 162L	
FSHN 185	Human Nutrition (3)
GIS 150	Introduction to GIS/GPS (3)

For more information, contact Dr. Inge White at 808-236-9102 or ingelia@hawaii.edu.

Visit us at windward.hawaii.edu

Appendix 3. Academic Subject Certificate – Plant Biotechnology graduates, Spring 2002 – Summer 2011

Number	Name	4-Year Degrees	Occupations
1	Erin Yafuso	Received M.Sc MBBE - UHM	Workforce: WCC lecturer
2	Natallie Kong	Received MSc MBBE & Medical Doctor - UHM	
3	Anolani Badua	Received Doctor of Pharmacy-Loma Linda Univ.	Workforce: Pharmacy
4	Gregory Osterman	Received B.Sc Biology - UHH	Workforce
5	William Gray	Received M.D.	Entrepreneur
6	Brandon Pualoa		Entrepreneur
7	Marcia Diver		Entrepreneur
8	Jamie Iwamoto	Pursuing B.Sc Botany - UHM	Entrepreneur
9	Waiete Williams	Pursuing B.Sc TPSS - UHM	Entrepreneur
10	Tracy Peters	Pursuing B.Sc Biology - UHM	
11	Kristin Takaba	Pursuing B.Sc Bioinformatics - UHM	
12	Cheyne Somera		Entrepreneur
13	Shane Chambers	Pursuing B.Sc Forensic Science - Chaminade U.	
14	Pamela Gribbins		Workforce: Nursery Manager
15	Brian Freed	Pursuing B.Sc Horticulture - California	Workforce
16	Monica Young		Workforce: Syngenta Co.
17	Jessica Curry	Received B.Sc Microbial Biotech - UHM	Workforce: Pioneer HI-Bred Int.
18	Darin Chung	Pursuing B.Sc Nursing	Workforce: Nurse
19	Micole Sakaida	Pursuing B.Sc Dental Hygiene - UHM	
20	Kimberley Chinen	Received B.Sc Biology - UHM	Workforce
21	Cassandra Brandt		Workforce: School teacher, FL
22	Kimberly Ching	Pursuing B.Sc Botany - UHM	
23	Amber Tateno	Received B.Sc TPSS - UHM	Workforce: Research intern
24	Helen Shaudy	Received B.Sc Art & Education - UHM	Entrepreneur
25	Alisa Sheriff	Received B.Sc Biochemistry - HPU	
26	Brianne Christiansen	Pursuing B.Sc TPSS- UHM	Workforce
27	Kawaii Pali		Workforce: WCC
28	Payten Purdy		Entrepreneur
29	Barbara Davis	Received B.A. Accounting	Workforce: Nurse
30	Jaridan Choy	Pursuing B.Sc Ethnobotany & Nursing, UHM	
31	Justin Long	Pursuing B.Sc, TPSS, UHM	Workforce
32	Jamie Yee	Pursuing B.Sc. TPSS, UHM	
33	Javier Estrada	Pursuing B.Sc. MBBE, UHM	Entrepreneur
34	Jon Shimabukuro	Pursuing B.Sc. MBBE, UHM	Workforce: USDA – AG Inspector
35	Ikaika Dilliner	Pursuing B.Sc in Pharmacy, UHH	
36	Mark Rosskopf	Pursuing pre-med, UHM	Workforce: Kaiser Medical Center
37	Carmen Jimenez	Pursuing Horticulture, TPSS - UHM	Entrepreneur
38	John Murry	Pursuing Microbiology, MBBE - UHM	
39	Adrienne Ziegler	Pursuing AG Business/Social Science, UHM	
40	Michael Cervantez *	Pursuing Horticulture degree, UHH	
41	Kevin Mason	Pursuing Biotechnology, Oregon	
42	Abby Kualapai		Ko'olau Farmers
43	Nyan Stillwell	Pursuing TPSS degree, UHM	
44	Carden Vincent	Pursuing Ethnobotany & Hawaiian Studies, UHM	
45	Lorna Uehara-Tilton *		Workforce

* Delayed graduation

Appendix 4. Plant Biotechnology research posters

Morphological and DNA analysis of a wild-collected and a cultivated Epidendrum O'brienianum on Oahu, Hawaii: preliminary study

Ingelia White (*1), Kimberley Chinen (1), Clifford Norden (2)

Abstract

Naturalized *Epidendrum* O'brienianum are found on a rocky hillside in Nuuanu Pali, Oahu, Hawaii. A preliminary study was conducted from Summer 2006 to Spring 2007 to look for polymorphism between a wild-collected and a cultivated *Epi.* O'brienianum cultivar. Distinctive morphological differences between the pollinia, petals, leaves, and root tips of the two specimens were observed with a scanning electron microscope. DNA from fresh leaf tissue was extracted using Wizard Genomic DNA Purification Kit protocol from Promega. ITS and TrnTL primers were used for DNA amplification. PCR products were digested with restriction enzymes Sau 3AI, Dar III, and Taq I in preparation for gel electrophoresis. PCR products were detected at 1000 bp (primed with ITS1 and 700 bp (primed with ITS). Restriction fragments were generated. Differences in morphological and DNA molecular weights suggest that polymorphism does occur between the two cultivars, indicating that they might have genetically divergent origins.

Introduction

Epidendrums are native to the tropical Americas. They are found in various natural habitats from sea level to 10,000 feet elevation, growing as terrestrials, epiphytes or lithophytes. The reed-stem *Epidendrum ibaguense* (syn. *Epi. radicans*) bears raceme inflorescence in many shapes and shades of color, such as red, orange, purple, or white. Some are marked with yellow at the center base lip (Phillips and Hill, 1998).

Luer (1975) mentioned that *Epi. O'brienianum* (*Epi. ibaguense* x *Epi. oxyanthum*) made by Veitch in 1888 in England was brought to Hawaii and subsequently naturalized there. Self pollination very likely occurred. Jan Goo made many hybrids in the 1940s in Hawaii using *Epi. ibaguense, Epi. elliptican, Epi. arachnoglossum, Epi. cinnabarinum*, and backcrosses were also made using their primary hybrids including *Epi. O'brienianum* (Sanders and Wreford, 1961). Unfortunately, many of his hybrids today that are commonly grown as garden plants or in greenhouses have lost their registered names (Rose and Rose, 2005).

This study was done at Windward Community College, Oahu, Hawaii from Summer 2006 to Spring 2007 to determine the morphological and molecular phylogenetic relationship between the wild-collected *Epi. O'brienianum* from Nuuanu, Pali (Fig. 1) and its cultivated cultivar commonly grown in the greenhouse.

Materials and Methods

Epidendrum O'brienianum were collected from a rocky hillside in Nuuanu Pali, Oahu (WCC voucher # 934) and from the greenhouse-grown cultivar at Windward Community College (WCC voucher # 931) in Summer 2006 (Fig. 2). They were used for morphological analysis using a scanning electron microscope, and molecular phylogenetic study (DNA extraction for PCR amplification and restriction digest analysis).

Scanning electron microscopy

Pollinia, x-sections of 2mm-wide petals and leaves, and x-sections of 5 mm long root tips from wild-collected and cultivated *Epi. O'brienianum* were fixed in 4% glutaraldehyde in 0.1 M sodium cacodylate, pH 7.4 for 2 hours at 23° C. The tissues were washed twice in 0.1 M cacodylate buffer for 10 minutes each. Postfixed with 1% osmium tetroxide in 0.1 M cacodylate buffer for 1 hour. Dehydrated in a graded ethanol series as follow: 30% (2x for 5 minutes each), 50% (2x for 5 minutes each), 70% (3x for 5 minutes each), 85% (3x for 5 minutes each), 95% in 5 minutes, 98% in 10 minutes and 100% to be kept at refrigerator overnight.

Tissues were then critical-point dried in a SAMDRI-795 machine. Dried tissues were each mounted on carbon conductive tapes that were secured on metal stubs, ready for gold palladium coating in Hummer 6.2 Sputter Coater machine. Transmission electron micrographs were taken with a Hitachi S-4800 field emission SEM.

DNA extraction

Fresh leaf tissues (100 mg) each of the wild-collected and cultivated *Epi. O'brienianum* were ground with a mortar and pestle in 1 mL Nuclei Lysis Solution buffer to extract total DNA. The following modified Promega Wizard Genomic DNA Purification Kit protocol was used: 600 µL of the cell lysate was put in an Eppendorf tube to be incubated at 65° C for 15 minutes. 3 µL RNase solution was added and mixed by inverting the tube 3 – 4 times. It was then incubated at 37° C for 15 minutes and cooled to room temperature. Protein Precipitation Solution (200 µL) was added and vortexed at high speed for 20 seconds, followed by centrifuge for 3 minutes at 14,000 rpm to pellet the proteins. Supernatant was removed to a new tube containing 600 µL of room temperature isopropanol. The tube was inverted gently several times to precipitate the DNA, then it was centrifuged at 14,000 rpm for 1 minute. Supernatant was carefully discarded. 600 µL of room temperature 70% ethanol was added to the tube, and the tube was gently inverted several times to wash the DNA from any isopropanol residue. Centrifuged at 14,000 rpm for 1 minute. The ethanol was carefully pipetted out and the pellet was air dried for 15 minutes by leaving the tube open and inverted on a paper towel. 100 µL DNA Rehydration Solution was added to rehydrate the DNA and incubated at 65° C for 1 hour. Periodically the solution was mixed by gently tapping the tube. The DNA quality was visualized in 1% agarose gel, run in 1x TAE buffer and dyed in methylene blue.

PCR amplification and restriction analysis

Two reaction mixtures containing each ITS and TrnTL primers were prepared. One reaction mixture contained of 19 µL autoclaved distilled water, 10 µL of 1x PCR buffer (diluted from 10x buffer of Invitrogen: 200 mM Tris-HCl, pH 8.4, 500 mM KCl), 4 µL of 25 mM $MgCl_2$, 5 µL of 1% Bovine Serum Albumin (BSA), 0.5 µL of each 100 µM forward and reverse primers, 8 µL of dNTPs (1.25 mM each dNTP) and 0.35 µL (4 u/uL) of Taq DNA Polymerase (Invitrogen, Carlsbad, CA).

Each 47 µL reaction mixture was pipetted into a tube containing 3 µL DNA extract from each wild-collected and cultivated *Epi. O'brienianum*. Negative controls were prepared containing only 47 µL reaction mixtures each without DNA. PCR was programmed for 1 cycle of 2 minutes at 95° C, 35 cycle of 1 minute at 92° C, 1 minute at 52° C, 2 minutes at 72° C and 1 cycle of 3 minutes at 72° C. PCR products were loaded in 2% agarose gel containing 0.5 µg/mL ethidium bromide, and electrophoresis was run in 1x TAE buffer.

Digestion of PCR products was done with 3 restriction enzymes: Sau 3A1, Hae III, and TaqI (Promega, Madison, WI). A restriction enzyme reaction mixture (per reaction) was prepared as follows: 12.5 µL of autoclaved distilled water, 2 µL of 10x Multicore buffer of Promega, 0.2 µL of BSA, and 0.1 µL of the corresponding restriction enzyme. A total of 15 µL of each restriction enzyme reaction mixture was added to 5 µL of each corresponding PCR product. The Sau 3A1 and the Hae III – digested products were incubated for 1 hour at 37° C. The Taq I – digested products were incubated for 1 hour at 65° C. Approximately 10 µL of each fragmented PCR product per well was loaded on 2% agarose gel containing 0.5 µg/mL ethidium bromide. Electrophoresis was run in 1x TAE buffer.

Results and Discussion

SEM photograph of the pollen from the wild-collected *Epi. O'brienianum* shows a length of 830.31 µm and a width of 462.58 µm (Fig. 3A). The length of thepollen from the cultivated cultivar, by comparison, is 724.60 µm and the width is 78.17 µm (Fig. 3B). A more deeply folded and rugose stipe belongs to the wild-collected *Epi. O'brienianum* (Fig. 3C). Its width is also greater (178.01 µm), compared to 64.15 µm in the cultivated cultivar (Fig. 3D). The larger pollinia and stipe present in the wild cultivar might have been a result of an adaptation to the windy environment on Pali.

Similar bulbous-cell structures are found on the upper layer of petals from both cultivars (Fig. 4A & 4B). Differing cell structures are seen on the lower surface of the petals. Pulvinded concave cells with numerous dimples belong to *Epi. O'brienianum* from Pali (Fig. 4C), while elongated flattened cells are seen on the cultivated cultivar (Fig. 4D).

The two cultivars showed no detectable differences in leaf and/or root tip cell structures other than a much thinner x-section of leaf tissue (546.33 µm) from the wild-collected *Epi. O'brienianum* (Fig. 5A), compared to a 1305.83 µm thickness in the cultivated cultivar (Fig. 5B). Differences in the thickness of leaf tissues were determined by differences in the size of the cells as seen in each of their vascular bundles (Fig. 5C & 5D). A thinner root tip (1094.19 µm) is also seen in the wild-collected *Epi. O'brienianum*, as opposed to the thicker root tip (1638.34 µm) of the cultivated cultivar (Fig. 6A & 6B). The greater thickness of leaf and root tissues of the cultivated cultivar was due to abundant and constant water received during its growth in the climate-controlled greenhouse equipped with sprinkler systems.

DNA bandings with molecular weight slightly higher than 1 Kb were detected in 1% agarose gel stained with methylene blue. PCR products ran in 2% agarose gel containing 0.5 µg/mL ethidium bromide show bandings at 1000 bp (primed with TrnTL) and 700 bp (primed with ITS).

All four base – recognizing enzymes: Sau 3A1, Hae III, and Taq 1 produce restriction fragments (Fig. 7 & 8). Gel results, however, were inconclusive due to the presence of smears. It is suggested for the next experiment to load only 5 µL digested PCR product per well, and to use 3.5% Meta Phor TM (FMC Bio Products, Rockland, ME) agarose gels to resolve restriction fragments smaller than 200 bp in size that were not visualized clearly on conventional 2% agarose gels.

Morphological differences in cell structures found on the stipes and lower surfaces of petals, as well as different restriction sites generated by the 3 enzymes indicate that the wild-collected and the cultivated *Epi. O'brienianum* might have genetically divergent origins.

Acknowledgements

This research was supported through a grant from the USDA – Cooperative State Research, Education and Extension Service (CSREES) FY 05. The corresponding author wishes to thank the USDA-CSREES for travel funding to present this poster at the Second Scientific Conference on Andean Orchids in Loja, Ecuador, November 14 – 17, 2007. We also thank Tina Carvalho from the Biological EM Facility, the Research Corporation of the University of Hawaii, Manoa for assisting in the preparation of specimens for SEM photography.

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Prepared by I. White

Agrobacterium-Mediated Transformation of *Brassolaeliocattleya* Raye Holmes 'Mendenhall' Protocorm-Like Bodies to Confer Resistance to Cymbidium Mosaic Virus

Alisa Sheriff[1], Kimberley Chinen[1], Heather McCafferty[2], Yun J. Zhu[2], Fengyong Zhou[2], and Ingelia White[*1]

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[2] Hawaii Agriculture Research Center

Abstract

Orchids are infected by more than 50 different viruses. Infected plants bloom less efficiently, lack vigor, and produce lower quality flowers than healthy plants. One of the most important viruses, with worldwide distribution, is Cymbidium Mosaic Virus (CymV). It is a single-stranded RNA virus belonging to the group of rod-shaped potexviruses. In this study a *Brassolaeliocattleya* orchid was transformed with the coat protein gene from Cymbidium Mosaic Virus using an *Agrobacterium*-mediated method. The aim is to improve resistance of the orchid to the CymV virus. RNA was extracted from diseased orchid leaves (*Bl. Waikiki Gold* x *C. Harrisoniana*) and used for RT-PCR. A full-length coat protein gene of CymV was cloned into the vector CHF3 to create transformation vector, pCymV CHF3. This construct also contained Kanamycin resistance for the selection of transformants. The coat protein was inserted under control of a CaMV 35S promoter in either a sense or anti-sense orientation. The construct pCNL65 was used as a control, which includes GUS with an intron as well as Kanamycin resistance, both under a CaMV 35S promoter. The *Agrobacterium tumefaciens* strains EHA 105 and LBA4404 were used at two different inoculum levels with vacuum infiltration. Protocorm-like bodies (plbs) of *Brassolaeliocattleya* Raye Holmes 'Mendenhall' were used. Putative transformants were selected for four months on media containing 25 µg/mL Geneticin Disulfate (G418). Molecular characterization of transformants is ongoing. Future work will investigate the resistance of these lines to the Cymbidium Mosaic Virus.

Introduction

Cut and potted orchid sales in Hawaii in 2007 reached a record high of $21.8 million, 1 percent more than the previous year (Anonymous, 2008). Viral infections, particularly those caused by Cymbidium Mosaic Potexvirus (CymV) have widely infected the *Cattleya* alliance in Hawaii.

An effective gene transformation system to help reduce the loss of orchid plants due to viral infections is needed. Transgenic Dendrobiums resistant to CymV resulting from the particle bombardment technique have been reported (Chang, et al., 2005).

An experiment using the *Agrobacterium*-mediated transformation method for *Bl.* Raye Holmes 'Mendenhall' protocorm-like-bodies (plbs) was conducted at the Hawaii Agriculture Research Center and University of Hawaii – Windward Community College from Spring 2007 to Fall 2008.

Virus-infected leaves of *Bl.* Waikiki Gold x *C. Harrisoniana*

Virus-infected sepals of *Bl.* Waikiki Gold x *C. Harrisoniana*

Materials and Methods

I. *A. tumefaciens* Transformation

Three constructs were used for transformation of plbs of the orchid *Bl.* Raye Holmes 'Mendenhall'. Two constructs were designed with a full-length coat protein in either a sense or antisense orientation, pCymV CHF3 S and pCymV CHF3 AS, respectively. The construct pCNL65 was used as a control as it has the marker gene ß-Glucuronidase (GUS) under control of a 35S promoter. Vacuum infiltration with *Agrobacterium tumefaciens* strains LBA4404 and EHA105 was used. After a 2-week recovery period the plbs were maintained for four months on selective media containing 25µg/mL Geneticin Disulfate (G418).

II. Molecular Analysis of Transformants

PCR Analysis

Eight putative lines which regenerated in the presence of G418 were selected for molecular analysis. DNA was extracted from tissue culture plants using the Puregene kit (Gentra Systems). DNA was then used in PCR to test for the presence of the transgenes. Standard PCR conditions were used with gene-specific primers for GUS, NPTII and the viral coat protein. Primers designed specifically to an orchid actin sequence were used to check for inhibition in the PCR reaction.

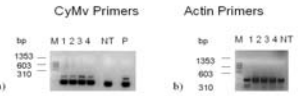
Southern Analysis

Southern blotting was carried out using a 491 bp PCR product from the NPTII gene or a 669 bp fragment of the viral coat protein. A Roddprime kit (Amersham) was used to radiolabel the PCR product and all steps were carried out as per manufacturer's instructions.

Results and Discussion

PCR analysis of transformed orchids

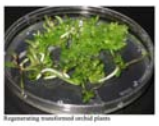
DNA was extracted from regenerating tissue culture plants using the Puregene kit (Gentra Systems). Primers for GUS, NPTII and the viral coat protein were used. Actin primers were used to ensure there were no false negatives due to PCR inhibition.



Agarose gel electrophoresis of PCR product from orchid lines. a). CyMv primer set with product of ~ 218 bp. Lanes: *M* molecular weight marker (pkl-x174 DNA-Hae III digest, New England Biolabs), *1-4* transgenic lines, *P* plasmid, *NT* non-transformed control. b). Actin primer set with product of ~ 217 bp. Lanes: *M* molecular weight marker, *1-4* transgenic lines, *NT* non-transformed control.

- Putative transformants were selected according to PCR results
- Southern blotting is currently underway
- Plants are being regenerated and will be potted in preparation for a laboratory assay to examine virus resistance
- Any individual lines showing improved resistance to CyMV would be candidates for a field trial

Protocorm-like-bodies of *Bl.* Raye Holmes 'Mendenhall' used for transformation



Regenerating transformed orchid plants

Acknowledgements

This research was supported through a grant from the USDA-CSREES (Cooperative State Research, Education and Extension Service). The corresponding author and her student wish to thank USDA-CSREES for travel funding to present this poster at the Third Scientific Conference on Andean Orchids in Quito, Ecuador. Special thanks to Professor Joanne Chory at the Salk Institute for the plasmid pCHF3; Professor Stanton B. Gelvin of Purdue University for pCNL65; Scott Mitamura of Foster Gardens of Honolulu for virus-infected *Bl.* Waikiki Gold x *C. Harrisoniana*, and Tom Kosaki of Kosaki Nursery, Kailua, Hawaii for *Bl.* Raye Holmes 'Mendenhall' protocorm-like-bodies.

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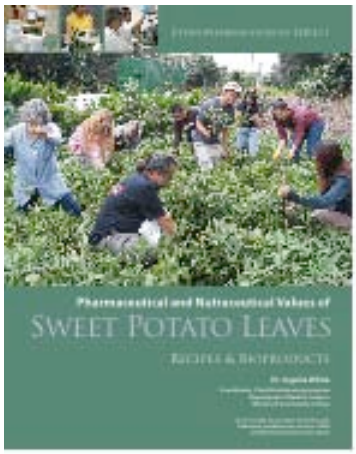
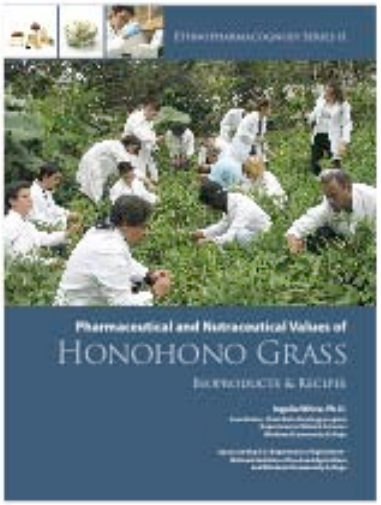
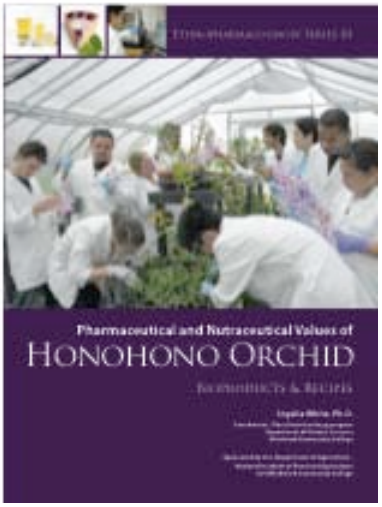
Appendix 5. Ethnopharmacognosy research publications



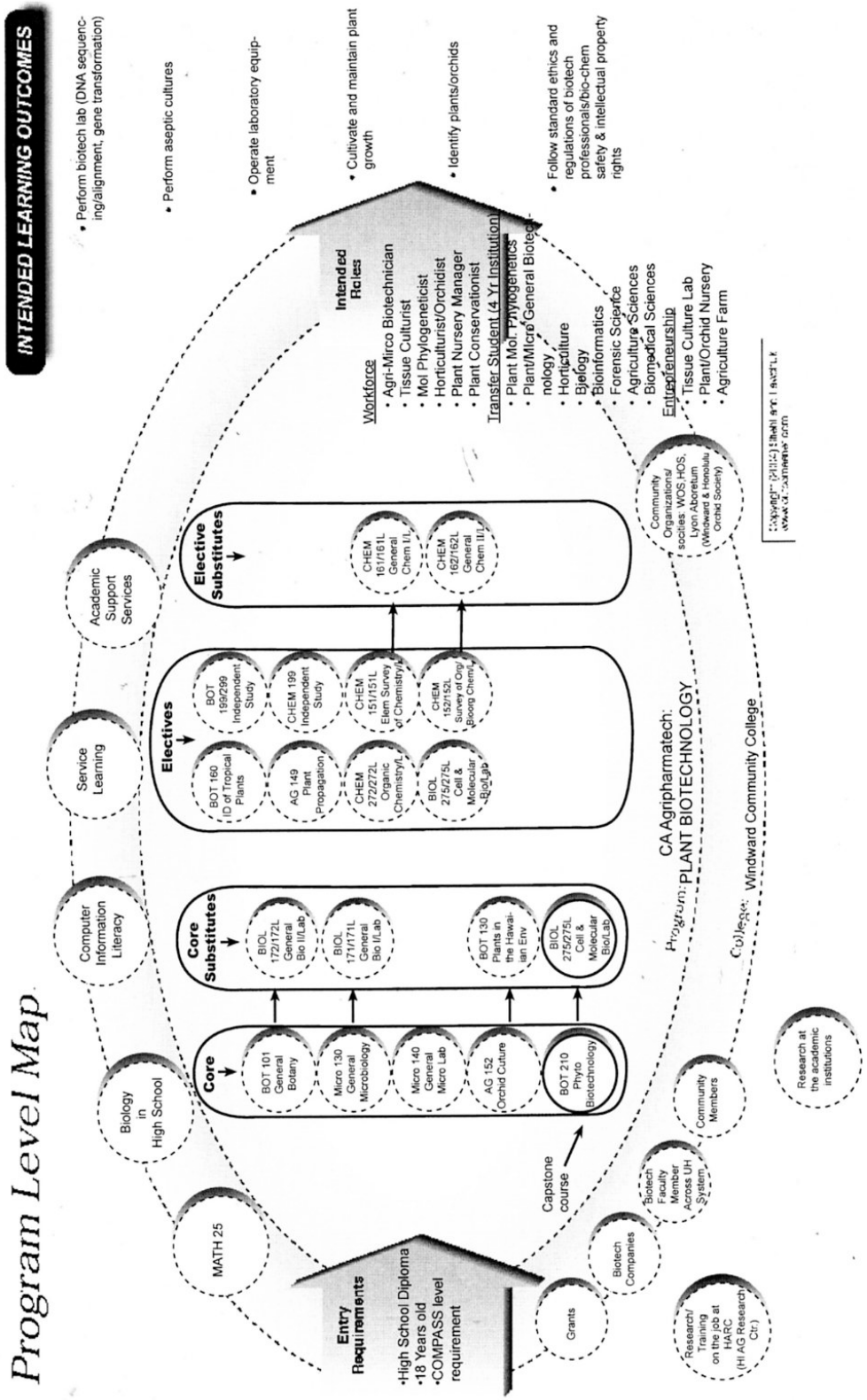




Appendix 6a. Agripharmatech: Plant Biotechnology program review

Institutional Mission Statement	Intended Roles
Windward Community College offers innovative programs in the arts and sciences and opportunities to gain knowledge and understanding of Hawai'i and its unique heritage. With a special commitment to support the access and educational needs of Native Hawaiians, we provide O'ahu's Ko'olau region and beyond with liberal arts, career and lifelong learning in a supportive and challenging environment - inspiring students to excellence.	Plant biotechnologist, microbial biotechnologist. tissue culturist, assistant researcher in plant biological sciences, orchid molecular phylogeneticist/taxonomist/hybridizer, plant biology teacher, plant nursery manager, plant identification specialist, plant conservationist, horticulturist, botanist, agriculture inspector.
Institutional Action Outcomes	**Intended Outcomes**
1. Increase diversity of programs offered to underserved regions 2. Contribute to the development of a highly-skilled, and highly-wage workforce 3. Establish partnerships with employers to create internships 4. Promote knowledge/skills and certificates in STEM fields 5. Increase transfer to UH baccalaureate programs	1. Cultivate and maintain plant growth 2. Identify plants (tropical plants and orchid species) 3. Demonstrate fluency in aseptic culture technique (microbial pure culture and plant tissue culture) 4. Operate laboratory equipment (using autoclave, gel electrophoresis, PCR machine, Particle Delivery/1000 Helium System, spectrophotometer, fluorescent microscopy, Gel Doc System) 5. Perform genetic engineering techniques/research (DNA/RNA extraction, electrophoresis, PCR reaction, DNA sequencing, gene transformation via bacteria and particle bombardment) 6. Perform alignment and analyze DNA sequence results (using Sequencher, PAUP, Finch TV software systems) 7. Follow standard ethics and regulations of biotech professionals, biosafety, chemical safety and intellectual property rights
Program Mission	
To prepare students for careers in plant biotechnology and to qualify them for transfer to BS degree programs in biosciences	

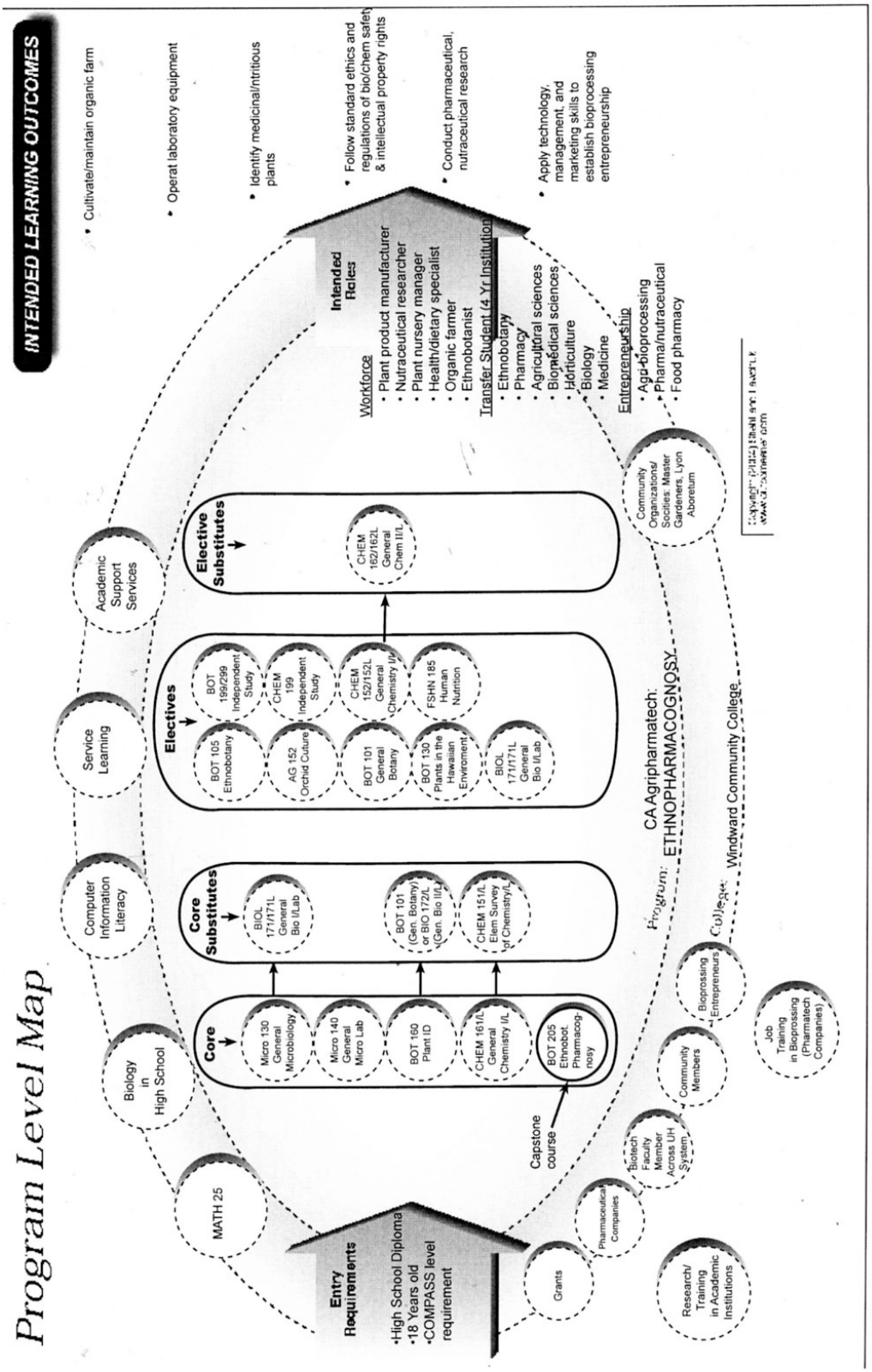
Appendix 6b. Agripharmatech: Plant Biotechnology program map



Appendix 7a. Agripharmatech: Ethnopharmacognosy program review

Institutional Mission Statement	Intended Roles
Windward Community College offers innovative programs in the arts and sciences and opportunities to gain knowledge and understanding of Hawai'i and its unique heritage. With a special commitment to support the access and educational needs of Native Hawaiians, we provide O'ahu's Ko'olau region and beyond with liberal arts, career and lifelong learning in a supportive and challenging environment - inspiring students to excellence.	Plant bioproduct manufacturer, pharmacognosy researcher, nutraceutical specialist, green pharmacist, herbalist, plant biology teacher, plant nursery manager, organic farmer, plant identification specialist, plant conservationist, industrial ecologist, ethnobotanist, microbiologist, agriculture inspector, food product manager/inspector, dietician/health food specialist.
Institutional Action Outcomes	
1. Increase diversity of programs offered to underserved regions 2. Contribute to the development of a highly-skilled, and highly-wage workforce 3. Establish partnerships with employers to create internships 4. Promote knowledge/skills and certificates in STEM fields 5. Increase transfer to UH baccalaureate programs	**Intended Outcomes** 1. Cultivate organically grown plants and maintain plant growth 2. Identify medicinal and nutritious plants 3. Conduct pharmaceutical and nutraceutical research 4. Operate laboratory equipment (autoclave, spectrophotometer, stereo microscope, anaerobic transfer chamber, rotary evaporator, distiller, Biacore Q system, HPLC) 5. Apply technology, management and marketing skills to become bioprocessing entrepreneurs 7. Follow standard ethics and regulations of biosafety, chemical safety and intellectual property rights
Program Mission	
To prepare students for careers in ethnopharmacognosy and bioproduct manufacturing and to qualify them for transfer to BS degree programs in ethnobotany, pharmacognosy, and herbal medicine	

Appendix 7b. Agripharmatech: Ethnopharmacognosy program map



Appendix 8. FB 11 -13 Operating budget adjustment request

FORM A

Date Prepared: **6/3/2010**

FB 11-13 BUDGET
OPERATING BUDGET ADJUSTMENT REQUEST
UNIVERSITY OF HAWAII

Program ID/Org. Code: Community Colleges - UOH 800/DD
Program Title: Windward Community College Instruction - UOH 331

Department Contact: Clifford Togo   Phone: 235-7403

Department Priority ________

Request Category:
Fixed Cost/Entitlement ________
Health, Safety, Court Mandates ________
Trade-Off/Transfer (+) (-)
Governor's Program Initiatives (+) (-)
Recurring Costs X
Other ________

I. **TITLE OF REQUEST:** **CA in Plant Biotechnology; CA in Ethnopharmacognosy; Certificate of Completion (CoC) in Plant-Food Production and Technology (70%)**

Description of Request:

II. **OPERATING COST SUMMARY**

	FY 12 Request			FY 13 Request			FY 14	FY 15	FY 16	FY 17
	FTE (P)	FTE (T)	($)	FTE (P)	FTE (T)	($)	($ thous)	($ thous)	($ thous)	($ thous)
A. Personal Services	- 2.00	0.00	100,068	2.00	0.00	100,068	100	100	100	100
B. Other Current Expenses			20,000			20,000	20	20	20	20
C. Equipment			0			0	0	0	0	0
L. Current Lease Payments			0			0	0	0	0	0
M. Motor Vehicles			0			0	0	0	0	0
TOTAL REQUEST	2.00	0.00	120,068	2.00	0.00	120,068	120	120	120	120
By MOF: A	2.00	-	120,068	2.00	-	120,068	120	120	120	120
B	-	-	-	-	-	-	-	-	-	-
N	-	-	-	-	-	-	-	-	-	-
R										
S										
T										
U										
W	-	-	-	-	-	-	-	-	-	-
X										

III. **OPERATING COST DETAILS**

	MOF	FY 12 Request			FY 13 Request			FY 14	FY 15	FY 16	FY 17
		FTE (P)	FTE (T)	($)	FTE (P)	FTE (T)	($)	($ thous)	($ thous)	($ thous)	($ thous)
A. Personal Services (List all positions)											
Plant Molecular Biology Faculty (C2-5 (9 mo.)	A	1.00		55,344	1.00		55,344	55	55	55	55
Lab Tech (APT), PBB-1 (11 mo.)	A	1.00		44,724	1.00		44,724	45	45	45	45
	A										

		A							-	-	-	-
		A							-	-	-	-
		A							-	-	-	-
									-	-	-	-
									-	-	-	-
									-	-	-	-
	Subtotal Personal Service Costs		2.00	0.00	100,068	2.00	0.00	100,068	100	100	100	100
	By MOF	A	2.00	-	100,068	2.00	-	100,068	100	100	100	100
		B	-	-	-	-	-	-	-	-	-	-
		N	-	-	-	-	-	-	-	-	-	-
		W	-	-	-	-	-	-	-	-	-	-
B. Other Current Expenses (List by line item)												
Educational Supplies		A			20,000			20,000	20	20	20	20
		A							-	-	-	-
		A							-	-	-	-
		A							-	-	-	-
	Subtotal Other Current Expenses				20,000			20,000	20	20	20	20
	By MOF	A			20,000			20,000	20	20	20	20
		B			-			-	-	-	-	-
		N			-			-	-	-	-	-
		W			-			-	-	-	-	-
C. Equipment (List by line item)												
		A							-	-	-	-
		A							-	-	-	-
	Subtotal Equipment				0			0	0	0	0	0
	By MOF	A			-			-	-	-	-	-
		B			-			-	-	-	-	-
		N			-			-	-	-	-	-
		W			-			-	-	-	-	-
L. Current Lease Payments (Note each lease)												
		A							-	-	-	-
									-	-	-	-
	Subtotal Current Lease Payments				0			0	0	0	0	0
	By MOF	A			-			-	-	-	-	-
		B			-			-	-	-	-	-
		N			-			-	-	-	-	-
		W			-			-	-	-	-	-
M. Motor Vehicles (List Vehicles)												
									-	-	-	-
									-	-	-	-
	Subtotal Motor Vehicles				0			0	0	0	0	0
	By MOF	A			-			-	-	-	-	-
		B			-			-	-	-	-	-
		N			-			-	-	-	-	-
		W			-			-	-	-	-	-
	TOTAL REQUEST		2.00	0.00	120,068	2.00	0.00	120,068	120	120	120	120

Appendix 9. Course list for CA A-PB and CA A-EP

CA program with 2 tracks	CA Agripharmatech (24 credits)			
	Plant Biotechnology		Ethnopharmacognosy	
1 capstone class (4 credits)	BOT 210	Phytobiotechnology (4)	BOT 205	Ethnobotanical Pharmacognosy (4)
	or BIOL 275/L	Cell & Molecular Biology (4)		
4 required classes (12 - 14 credits)			CHEM 161/L	General Chemistry I/L (4)
	BOT 101	General Botany (4)	or CHEM 151/L	Elem Survey of Chemistry/L (4)
	or BIOL 172/L	General Biology II/L (4)	BOT 160	Identification of Tropical Plants (3)
	AG 152	Orchid Culture (3)	or BOT 101	General Botany (4)
	or BOT 130	Plants in the Hawaiian Env (4)	or BIOL 172/L	General Biology II/L (4)
	MICRO 130	General Microbiology (3)	MICRO 130	General Microbiology (3)
	or BIOL 171/L	General Biology I/L (4)	or BIOL 171/L	General Biology I/L (4)
	MICRO 140	General Microbiology Lab (2)	MICRO 140	General Microbiology Lab (2)
2 - 3 elective classes (6 - 8 credits)	BOT 160	Identification of Tropical Plants (3)	BOT 105	Ethnobotany (3)
	BOT 199/299	Independent Study (1-4,w/ appr.) (Directed Research for track 1)	BOT 199/299	Independent Study (1 - 4,w/ appr) (Directed Research for track 2)
	CHEM 199	Independent Study (1 - 4)	CHEM 199	Independent Study (1 - 4)
	AG 149	Plant Propagation (3)	BOT 101	General Botany (4)
	CHEM 161/L	General Chemistry I/L (4)	BOT 130	Plants in the Hawaiian Env (4)
	or CHEM 151/L	Elem Survey of Chemistry/L (4)	AG 152	Orchid Culture (3)
	CHEM 162/L	General Chemistry II/L (4)	CHEM 162/L	General Chemistry II/L (4)
	or CHEM 152/L	Survey of Org/Bioorg Chemistry (4)	or CHEM 152/L	Survey of Org/Bioorg Chemistry (4)
	CHEM 272/L	Organic Chemistry/L (5)	FSHN 185	Human Nutrition (3)
	BIOL 275/L	Cell & Molecular Biology (4)	BIOL 171/L	General Biology I/L (4)

Appendix 10. Course descriptions for CA A-PB and CA A-EP

Course # and Title	Credits	Prerequisites	Course Description
BOT 101 - General Botany	4	High school biology	Introduction to plant structure, function, reproduction, and evolution; plants in relation to the environment and human activities. Lecture/laboratory/field trip course. DB/DY
BOT 105 - Ethnobotany	3	None	The scientific study of the interaction between human culture and plants, including the interrelationship of botany, socio-economics, belief systems and history that have shaped the cultural uses of plants in Hawaii, as well as Asia or the Pacific. Lecture/field trip course with service-learning option. DS
BOT 130 - Plants in Hawaiian Environment	4	None	Introduction to the evolution of plant communities and species of Hawaiian ecosystems; ecological interactions; observations, identification and systematics of native and introduced flora. Lecture/laboratory/field trip course. DB/DY
BOT 160 - ID of Tropical Plants	3	None	Nontechnical course in identification of common plants of tropics; includes native and introduced flora. DB
BOT 199/299V - Independent Study	1 - 4	Under supervising instructor's and/or co-advisor's expertise	An independent study project could take the form of directed reading, research, or fieldwork. It is designed to meet individual needs, and interests to continue an in-depth study of a particular topic that is appropriate to the student's program of study, or related to the existing college curriculum. DY
BOT 210 – Phytobiotechnology	4	BOT 101, or AG 152, or MICR 130 and MICR 140, or BIOL 171 and 171L	Introduction to practical aspects of Plant Biotechnology. Topics include micropropagation techniques, such as plant tissue, cell and protoplast cultures: DNA-based technologies, such as DNA extraction, DNA sequencing, PCR; and methods of plant genetic engineering. This course is designed to train students for careers in advanced agriculture technology and industry. DB/DY
AG 149 - Plant Propagation	3	None	Introduction to the principles and practices of propagation of fruit, vegetable, and ornamental crops by seed, cuttings, grafting, budding, layering and division.
AG 152 - Orchid Culture	3	None	An extensive study of orchid identification, breeding, growth, and culture. Students are required to write a 10 to 15 page research report.
MICR 130 - General Microbiology	3	None	Fundamentals of microbiology, growth, development, and classification of bacteria, viruses, protozoa, fungi and algae; roles of microorganisms in the environment and human affairs: medical microbiology, immunology, and applied microbiology for food sanitation and public health. DB
MICR 140 - General Microbiology Lab	2	MICR 130; placement into MATH 24 or higher	Laboratory course illustrating fundamental techniques and concepts of microbiology, such as microscopic observations, aseptic transfer, microorganism classification and identification, environmental factors

			influencing microbial growth, biochemistry of microorganisms, ecological microbiology, and medical microbiology. DB/DY
BIOL 171 - General Biology I	3	High school chemistry or college chemistry and registration in BIOL 171L	Introductory biology for all life science majors. Cell structure and chemistry, growth, reproduction, genetics, evolution, viruses, bacteria, and simple eukaryotes. DB
BIOL 171L - General Biology Lab I	1	Credit for or registration in BIOL 171	Laboratory to accompany BIOL 171. DY
BIOL 172 - General Biology II	3	Credit for BIOL 171 and 171L	Continuation of BIOL171. Anatomy, physiology, and systematics of plants and animals, behavior, ecosystems, populations, and communities. DB
BIOL 172L - General Biology Lab II	1	Credit for or registration in BIOL 172	Laboratory to accompany BIOL 172. DY
BIOL 275 - Cell & Molecular Biology	3	"C"/better in BIOL171/171L & CHEM 272/272L or consent of instructor	Integrated cell and molecular biology for life science majors. Modern advances in recombinant DNA technology. DB
BIOL 275L - Cell & Molecular Biol Lab	1	BIOL 275; or consent of the instructor.	Laboratory for cell and molecular biology. DY
CHEM 151 - Elementary Survey of Chemistry	3	MATH 24 or grade of "C"/better in ENG 21 or placement in ENG 22 or higher	Provides the student with an adequate background in the fundamentals of chemistry. Covers the basic language and quantitative relationships of chemistry, including atomic structure, chemical bonding, structure-property relationships, chemical reactions. Prerequisite to CHEM 152 for majors in medical technology and nursing and other allied health and science-related fields, or can be taken as a preparatory course for CHEM 161. DP
CHEM 151L - Elem Survey of Chemistry Lab	1	Credit for or registration in CHEM 151	Experiments introducing laboratory techniques and illustrating chemical principles; supplemented by films, demonstrations, and problem sessions. DY
CHEM 161 - General Chemistry I	3	Registration in CHEM 161	Basic principles of inorganic chemistry with an emphasis on problem solving. First course of a two-course sequence designed to meet the one-year General Chemistry requirement for pre-med, science and engineering majors. Topics include chemical calculations, electronic structure, chemical bonding, states of matter and solutions. DP
CHEM 161L - General Chemistry Lab I	1	Credit for or registration in CHEM 161	Laboratory experiments illustrating fundamental principles of chemistry. DY

CHEM 152 - Survey of Organic & Bio Chem	3	Credit for CHEM 151 or equivalent or consent of instructor	Structure, nomenclature, properties and reactions of organic compounds will be studied with emphasis on those compounds of practical importance in life science and related fields. DP
CHEM 152L - Survey of Organic & Bio Chem Lab	1	Credit for or registration in CHEM 152	Laboratory to accompany CHEM 152. DY
CHEM 162 - General Chemistry II	3	"C"/better in CHEM 161, credit for or registration in MATH 135, or consent of instructor	Second course of a two-course sequence designed to meet the one-year General Chemistry requirement for pre-med, science and engineering majors. Topics include thermochemistry, kinetics, acid-base equilibrium, solubility equilibrium and electrochemistry. Emphasis on problem solving. DP
CHEM 162L - General Chemistry Lab II	1	Credit for or registration in CHEM 162	Laboratory experiments illustrating fundamental principles of chemistry. DY
CHEM 272 – Organic Chemistry	3	"C"/better in CHEM 162 or instructor's consent	This is the first semester course in organic chemistry intended for science majors. Topics to be covered include structure, properties, nomenclature, reactions, reaction mechanisms, stereochemistry, and spectroscopy of alkanes, alkenes, alkynes, alkyl halides, alcohols, and their applications to biology. DP
CHEM 272L – Organic Chemistry Lab	2	"C"/better or registration in CHEM 272 or instructor's consent	Laboratory to accompany CHEM 272. DY
FSHN 185 - Human Nutrition	3	Placement into ENG 100 and MATH 25 or higher, or consent of instructor	An introductory level biological science course which integrates basic concepts of science with the study of human nutrition. Designed for students who want an introduction to nutrition, as well as those who later choose to major in it. DB

Appendix 11. Letters of support

University of Hawai'i

WINDWARD COMMUNITY COLLEGE

August 8, 2011

To whom it may concern,

I am writing this letter to express University of Hawaii Windward Community College's full support and commitment to the University of Hawaii Agribusiness Education, Training and Incubator (AETI) proposal to USDA-NIFA. The statement of work proposed by University of Hawaii Windward Community College Professor, Dr. Ingelia White, which appears in the AETI proposal, will contribute significantly toward attaining the common goals of the University of Hawaii team.

Since 2002, Dr. White has done an outstanding job in developing and offering the Academic Subject Certificate in BioResources and Technology: Plant Biotechnology (ASC BRT-PB) at Windward Community College. The success of the Plant Biotechnology Program can be attributed to the USDA Consortium grant support. Dr. White has also followed up with students who have completed the certificate, and she can document that they all have either found gainful employment or gone on to seek higher education in the field.

Because of the success and further expansion of our Plant Biotechnology Program, to include the plant-based pharmaceuticals, we are proposing a Board of Regents approved Certificate of Achievement (CA) in Agripharmatech in this USDA consortium project for Fiscal Year 2011 – 2012. The CA in Agripharmatech consists of 2 tracks: the Plant Biotechnology (CA A-PB), and the Ethnopharmacognosy (CA A-EP). The CA A-PB and the CA A-EP will replace the current ASC BRT-PB.

The main focus of the USDA consortium project for Fiscal Year 2011-2012 is to produce a highly trained and skilled workforce in agripharmacobiotechnology for Native Hawaiian students and other minorities, and to promote a nutraceutical diet and make Hawaii more self-sufficient in health food production (green pharmacy), as is stated in section # 4 (Justification) of the WCC Fiscal Year 2011 grant proposal. The other (ongoing) focus is to improve student enrollment and retention by engaging high school students with Windward students in collaborative projects that involve the cultivation of medicinal and nutritious plants, analysis of their medicinal properties and the use of plants in producing biopharmaceutical products. Community outreach projects have been launched to bring public attention to this program.

This proposal promises to be a timely and worthy project, and, without any hesitation whatsoever, we continue to fully support the work of Dr. White, and this proposal. We look forward to collaborating successfully with our University of Hawaii partners in this very important endeavor.

Sincerely,

Richard Fulton, PhD
Vice Chancellor, UH Windward Community College
45 – 720 Keaahala Road
Kaneohe, HI 96744
(808) 235 - 7443

45-720 Kea'ahala Road, Kāne'ohe, Hawai'i 96744-3528
Telephone: (808) 235-7400

Donna "Sweetie" Kuehu
4473 Likini St.
Honolulu, HI 96818
dkuehu@hawaii.edu

August 10, 2011

Ingelia White, PhD
Prof. Botany/Microbiology
Coordinator, Plant Biotechnology Program
Chair, Department of Natural Sciences
Windward Community College
45-712 Keaahala Road
Kaneohe, HI 96744

Re: Certificate of Achievement in Agripharmatech

Dear Dr. White,

I would like to express my gratitude for your strong support and commitment to providing education, research and training at Windward Community College offered through the Plant Biotechnology Program. The Certificate of Achievement in Agripharmatech curriculum provides valuable exposure to opportunities beyond the community college, whether it is in the workplace, the market place, or an advanced educational pursuit.

The scientific training acquired in plant molecular genetics, and plant pharmacognosy studies provides a competitive edge in the workforce, and are the same skills required to operate a successful agribusiness for anyone interested in the challenges and rewards of entrepreneurship. It also provides a firm foundation for an advanced degree program at the University of Hawaii at Manoa, or any other four year program.

The program has been found to meet a wide variety of interests as indicated by the diversity of the students enrolled in the courses. Each student that I have met including myself have a vision of where the Certificate of Achievement will lead them in their future, and I have enjoyed the quality of instruction and student participation in the program.

Thank you again for your devotion to providing a level of education that has a positive impact on peoples lives.

Sincerely,

Sweetie Kuehu

PIONEER.
A DuPont Company

Cindy Goldstein, Ph D
Pioneer Hi-Bred International
Pioneer Waialua Parent Seed
PO Box 520
Waialua, HI 96791

August 1, 2011

To Whom It May Concern,

It is my pleasure to provide this letter of support on behalf of Pioneer Hi-Bred International as an industry partner affirming the importance of these proposed Windward Community College programs. Pioneer Hi-Bred sees great long-term value for Hawaii's seed industry, agriculture and technology sectors in development of the Plant Biotechnology program.

The seed industry is one of the few growth areas of our economy in Hawaii. Pioneer Hi-Bred International has expanded our operations and number of employees on Oahu and Kauai over the past decade and especially in the past 3 years. We have experienced difficulty in identifying and hiring employees with the educational background we seek for our positions and are very interested in having Windward Community College offer program that provides training to fulfill our demand for future job candidates in the area of agriculture science and plant biotechnology. Pioneer currently employees approximately 325 employees in Hawaii, with approximately 120 positions added in the past 3 years. We expect to recruit in the range of 40 to 50 full time employees in the next 3 years. Pioneer Hi-Bred is a committed industry partner that supports Windward Community College's goals and strategies. We feel that training a highly qualified, "home grown" workforce is key to developing a strong, sustainable economy in Hawai`i. To demonstrate our support, Pioneer Hi-Bred International is prepared to provide science-based presentations to students in classes offered as part of these programs as well as information and presentations about career opportunities and preparation for becoming well qualified job candidates. Pioneer is prepared to help place trained and qualified workers into our work force, especially students with an educational background in plant science, technology, and biotechnology.

We look forward to seeing course programs offered by Windward Community College and the opportunity to be involved as a community business partner and future employer of program graduates.

Sincerely,

Cindy Goldstein

Cindy Goldstein, Ph. D
Business and Community Outreach Manager
Pioneer Hi-Bred International, Inc

Hawaii Agriculture Research Center
94-340 Kunia Road, Waipahu, HI 96797
Mailing address: P. O. Box 100, Kunia, HI 96759
Ph: 808-621-1266/Fax: 808-621-0399

August 11, 2011

Dear Dr. White:

This letter is to provide collaborative support for your continuing research project at Windward Community College (WCC).

I am a Research Scientist at Hawaii Agriculture Research Center (HARC) and my research interest at HARC is focused on the area of biochemical and molecular biology in tropical plant disease resistance and their interaction with microbes. Our lab is fully equipped to handle tissue culture, genetic transformation, pathogen isolation and culture, protein analysis, DNA/RNA isolation and characterization. My collaborations with Dr. White at WCC are: 1) to train and mentor students from WCC to learn new techniques, such as DNA/RNA isolation and characterization; 2) to develop tissue culture and genetic transformation system for orchids; 3) to evaluate the presence and expression of transgene transformed in the plant; 4) to develop bioassay for evaluation of transgenic orchid plants for virus resistance; and 5) to prepare the presentation of research findings in poster and/or paper for publication.

In the past few years, the collaboration between HARC and WCC has generated tremendous impact in several students from WCC in terms of their learning modern biotechnology, finding employment, and advancing to institutes offering high degrees. The following is the list of ASC in Plant Biotechnology graduates from WCC who have been trained in a number of research projects through this collaboration and have been employed by HARC:

1. Natalie Kong: Worked on the project entitled 'Transgenic orchids', Fall 2002 (received M.Sc in MBBE and Doctor of Medicine from UHM).
2. Greg Osterman: 2003. Biology major at UHH and worked for HARC and USDA ARS as a biology technician.
3. Erin Yafuso: 2003. She has received M.Sc in MBBE and worked at HARC. Currently a lecturer at Windward Community College.
4. Waiete Williams: Researched in 'Transgenic Orchids via Gene Bombardment', 2003-2004, and worked at HARC.
5. Anolani Badua: 2004-2005. Researched on 'CyMV Resistant Gene Transformation in Orchids via Agrobaterium tumefacience'. She has received B.Sc in Biology and B.Sc. in Pre-med from HPU, and Doctor of Pharmacy from Loma Linda University, San Diego.
6. Tracy Peters: 2004-2005. She is pursuing a B.Sc in Biology at UHM.
7. Kimberley Chinen: Researched on 'Agrobacterium-mediated Transformation of Blc. Raye Holmes Mendenhall Protocorm-Like Bodies to Confer Resistance to Orchid Cymbidium Mosaic Virus'. 2006-2007. She is pursuing Biology degree at UHM.
8. Alisa Sheriff: 2009. She presented a poster titled "Agrobacterium/-Mediated Transformation of Brassolaeliocattleya Raye Holmes 'Mendenhall' Protocorm-Like Bodies to Confer Resistance to Cymbidium Mosaic Virus" at the 3rd Scientific Conference on Andean Orchids, Quito, Ecuador, February 4-8, 2009. She received B.Sc in Biochemistry from HPU.

Best wishes!

Y. Judy Zhu

Appendix A. WCC Plant Biotech program course alignment with CTAHR-UHM, CAFNR-UHH, and Biology Department-UHH

Course title	PEB & MBBE UHM-CTAHR	CR	WCC-PBP	CR	UHH Biology	CR	UHH Agriculture	CR
General Botany	BIOL 102/102L	4	BOT 101	4	BOT 153			
General Microbiology	elective		MICRO 130	3	BIOL 275 (Fundamental of Microbiol)	3		
General Microbiology Lab	elective		MICRO 140	2	BIOL 275L Fundamental of Micro Lab	1		
Phytobiotechnology	MBBE 401 consent w/ advisor	3	BOT 210	4			AG 297 (Plant Biotechnology)	
Identification of Tropical Plants	elective		BOT 160	3				
Plant Propagation	TPSS 420 or consent with instructor	3	AG 149	3			HORT 264	3
Orchid Culture	TPSS 440 or consent with instructor	3	AG 152	3				
Ethnobotany	BOT 105 (HAP /Soc. Sc. Focus)	3	BOT 105 (HAP/Soc.Sc. Focus)	3				
Plants in the Hawaiian Environment	BOT 351/351L or elective	4	BOT 130	4				
Pharmacognosy	BOT 442 or discretion of the instructor	3	BOT 205(Ethnobotanical Pharmacognosy)	4				

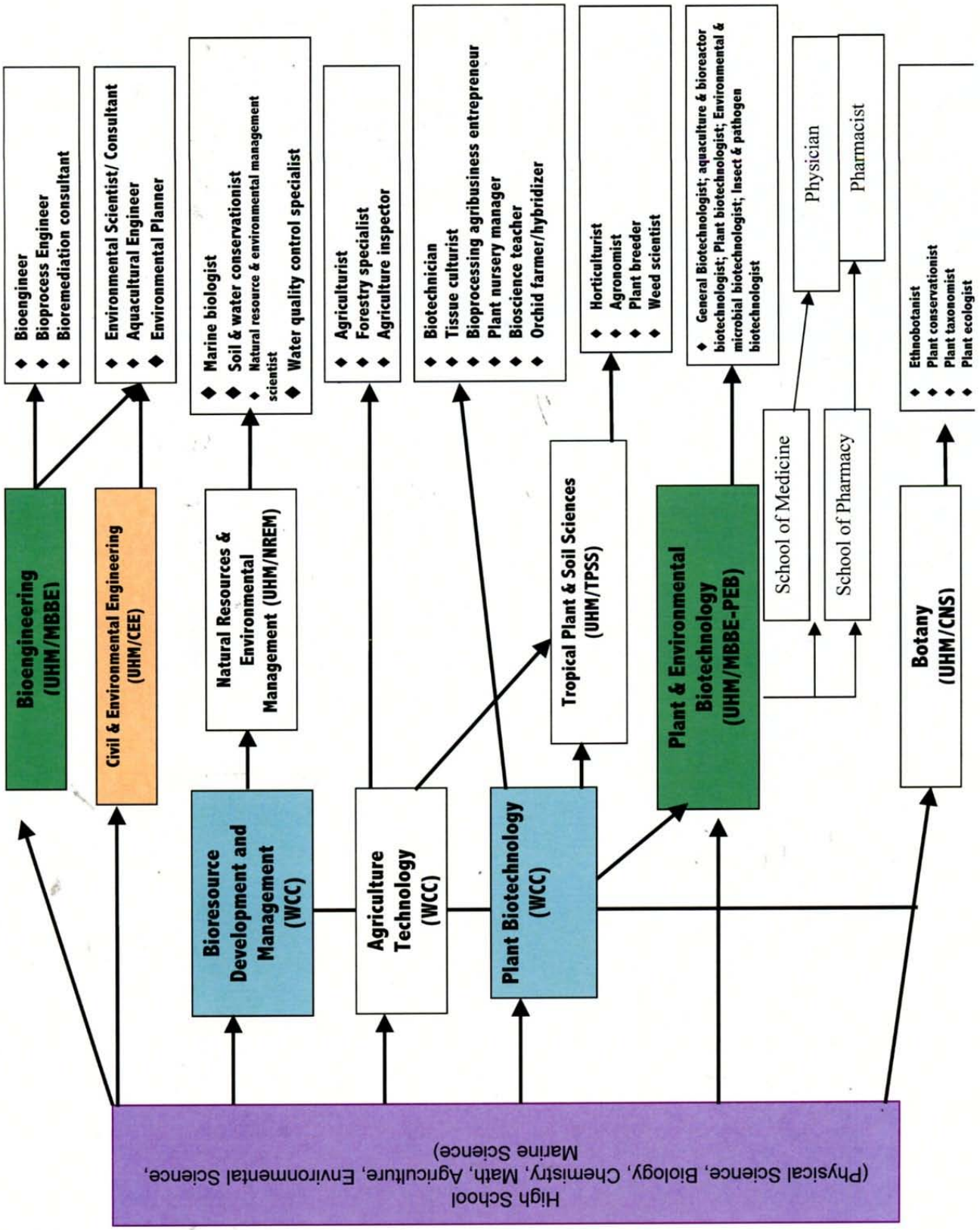
Course title	PEB & MBBE UHM-CTAHR	CR	WCC-PBP	CR	UHH Biology	CR	UHH Agriculture	CR
Plant Sea Life	BOT 480 or elective	4	BOT 181	4				
Independent Study	MBBE/PEPS/TPSS 499	1 - 4	BOT 199/299	1 - 4	BIOL299/399 (Directed Study)	1 - 3	AG 195/395/399	1 - 4
Cell & Molecular Biology	BIOL 275/275L	4	BIOL 275/275L	4	BIOL 270/270L	4		
Elementary Survey of Chem/Lab	CHEM 151/151L	4	CHEM 151/151L	4	CHEM 114/114L	4		
Survey of Organic & Bio-Organic Chem	CHEM 152/152L	4	CHEM 152/152L	4	CHEM 141/141L	4		
General Chemistry I	CHEM 161/161L	4	CHEM 161/161L	4	CHEM 124/124L	4		
General Chemistry II	CHEM 162/162L	4	CHEM 162/162L	4	CHEM 125/125L	4		
Human Nutrition	FSHN 185 or elective	3	FSHN 185	3				
Introduction to GIS/GPS	elective		GIS 150	3				
General Biology I/Lab	BIOL 171/171L	4	BIOL 171/171L	4	ZOOL 150/150L			

Appendix B. WCC Plant Biotech program course alignment with UAF

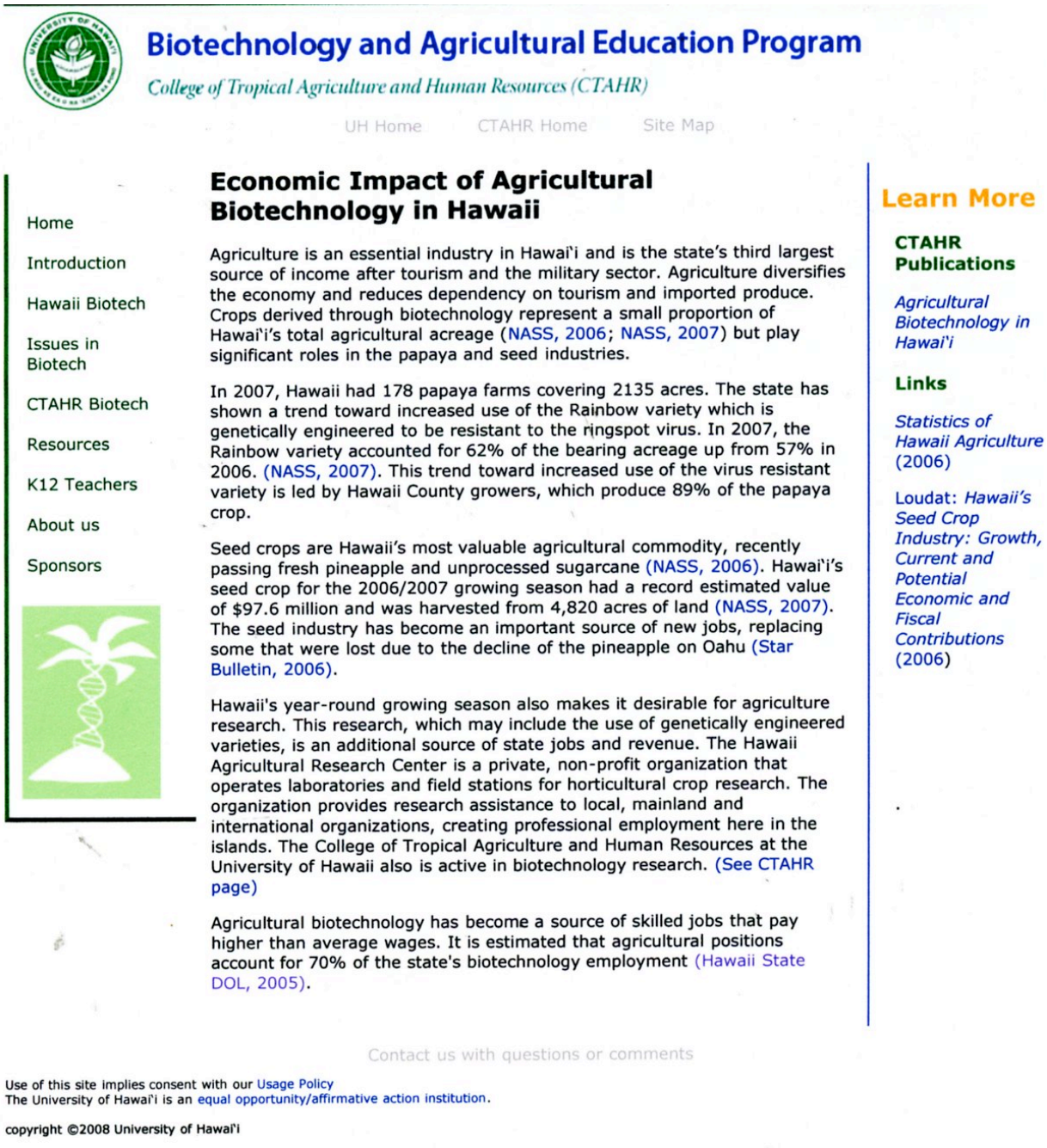
Course Alignment: ASC Plant Biotechnology (WCC) and AS Ethnobotany (UAF)

WCC Course Title	WCC ASC Plant Biotech	WCC Credits	UA Course Title	Universtiy of Alaska AS Ethnobotany	UAF Credits	Comments
General Botany	BOT 101	4	Introduction to Plant Biology	BIOL F239	4	10/13/08 email to Inge
General Microbiology	MICRO 130	3	Beginnings in Microbiology	BIOL F240	4	Lecture/ 1 credit Lab
General Micro Lab	MICRO 140	2		BIOL F240		WCC's Micro lab is 2 credits vs UAF is 1 credit
Phytobiotechnology	BOT 210	4				
Identification of Tropical Plants	BOT 160	3				
Plant Propagation	AG 149	3				
Orchid Culture	AG 152	3				
Ethnobotany	BOT 105	3	EBOT 193-Intro to Ethnobotany(3)/ EBOT 100-Intro to Ethnobotany(3)/EBOT 102 Ethnobotanical Chemistry(3)/EBOT 210 Ethical Wildcrafting (1)	EBOT 193,or 195, or 100, or 102, or 210	3	(HAP focus) Should we even list HAP because it is semester/instructor specific. The courses may fulfill the requirement, but are not equivalent because it does not discuss Hawaiian flora & fauna. Also, if a student takes more than one of these courses, can they apply it to the certificate?
Plants in the Hawaiian Environment	BOT 130	4	Natural History of Alaska BIOL F104	EBOT 104 (Nat. Hist. of Alaska) ? BIOL F104	4	1/28/09 email asked if EBOT 210 was similar to BOT 130. Do you mean BIOL F 104?
Ethnobotanical Pharmacognosy	BOT 205	4	EBOT 102 Ethnobotanical Chemistry/ EBOT 210 Ethical Wildcrafting	EBOT 102 and EBOT 210	6	(In my notes, I have noted that EBOT 210 is going to be similar to BOT 199, Independent Study. So perhaps we should not list it here. Has it changed?) 4.24.09 Mtg with Inge. EBOT 102 (Chemistry) is 3 credits & EBOT 210 (Wildcrafting) is 1 credit. Good match for BOT 205 4 credits.
Independent Study or any elective courses	BOT 199/299	1 to 4	EBOT 201 Ethical Wildcrafting/ ANTH 293 Seminar in Ethnobotany	EBOT 201, or ANTH 293		4.24.09 Mtg w/ Inge. BOT 205 can be either fulfilling a requiement or if one of the other classes is taken, then it can be used as an elective credit. Note: the credit cannot be used twice - fulfilling requirement and elective.
Cell and Molecular Biology	BIOL 275/275L	4	Introduction to Cell and Molecular Biology	BIOL F261	4	description, not cover the material in BIOL 275/L. Inge may contact Rose for a syllabus. BIOL F261 (Introduction to Cell and Molecular Biology) Found the syllabus after Inge left.
Elementary Survey of Chem/Lab	CHEM 151/151L	4	Basic General Chemistry	CHEM F103X	4	4.24.09 2:35 email from Inge OK equivalency
Survey Organic & Bio-Org Chem/Lab	CHEM 152/152L	4	A Survey of Organic Chemistry and Biochemistry	CHEM 104X		CHEM 151/L
General Chem I/Lab	CHEM 161/161L	4	General Chemistry I	CHEM F105X	4	CHEM 161/L
General Chem II/Lab	CHEM 162/162L	4	General Chemistry II	CHEM F106X	4	CHEM 162/L
Human Nutrition	FSHN 185	3				
Introduction to GIS/GPS	GIS 150	3				
General Biology I/Lab	BIOL 171/171L	4	Fundamentals of Biology I	BIOL 105 changed to BIOL F115X		BIOL 171/L 4.24.09 Mtg w/ Inge. Alaska changed course number and topics. In the BIOL 115X syllabus, it indicates that BIOL 105 became 116X and BIOL 106 became 115. Since 116 has the prerequisite of 115, Inge would like to leave BIOL 115 as equivalent to WCC's BIOL 171/L. 4.24.09 2:14 email from Inge OK equivalency
Elective Credits						
Human Nutrition	FSHN 185	3	Science of Nutrition	HLTH F 203	3	Found after Inge left. 4.24.09 2:20 email from Inge OK equivalency
Using University of Alaska Fairbanks Catalog 2007-08 Mtg w/ Inge 4.24.09 Updated w/ Inge's email appproval 4.24.09	4.2.09					

Appendix C. WCC Plant Biotechnology student transfer and workforce pathways



Appendix D. CTAHR – Biotechnology and Agricultural Education Program



Biotechnology and Agricultural Education Program

College of Tropical Agriculture and Human Resources (CTAHR)

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Economic Impact of Agricultural Biotechnology in Hawaii

Agriculture is an essential industry in Hawai'i and is the state's third largest source of income after tourism and the military sector. Agriculture diversifies the economy and reduces dependency on tourism and imported produce. Crops derived through biotechnology represent a small proportion of Hawai'i's total agricultural acreage (NASS, 2006; NASS, 2007) but play significant roles in the papaya and seed industries.

In 2007, Hawaii had 178 papaya farms covering 2135 acres. The state has shown a trend toward increased use of the Rainbow variety which is genetically engineered to be resistant to the ringspot virus. In 2007, the Rainbow variety accounted for 62% of the bearing acreage up from 57% in 2006. (NASS, 2007). This trend toward increased use of the virus resistant variety is led by Hawaii County growers, which produce 89% of the papaya crop.

Seed crops are Hawaii's most valuable agricultural commodity, recently passing fresh pineapple and unprocessed sugarcane (NASS, 2006). Hawai'i's seed crop for the 2006/2007 growing season had a record estimated value of $97.6 million and was harvested from 4,820 acres of land (NASS, 2007). The seed industry has become an important source of new jobs, replacing some that were lost due to the decline of the pineapple on Oahu (Star Bulletin, 2006).

Hawaii's year-round growing season also makes it desirable for agriculture research. This research, which may include the use of genetically engineered varieties, is an additional source of state jobs and revenue. The Hawaii Agricultural Research Center is a private, non-profit organization that operates laboratories and field stations for horticultural crop research. The organization provides research assistance to local, mainland and international organizations, creating professional employment here in the islands. The College of Tropical Agriculture and Human Resources at the University of Hawaii also is active in biotechnology research. (See CTAHR page)

Agricultural biotechnology has become a source of skilled jobs that pay higher than average wages. It is estimated that agricultural positions account for 70% of the state's biotechnology employment (Hawaii State DOL, 2005).

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CTAHR Publications

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Statistics of Hawaii Agriculture (2006)

Loudat: *Hawaii's Seed Crop Industry: Growth, Current and Potential Economic and Fiscal Contributions* (2006)

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Appendix E. Academic Cost and Revenue 2012 - 2014

	A	B	C	D	E	F	G	H	I	J	K
1	**Academic Cost and Revenue Template - New Program (adjust template for appropriate number of years) (Updated 09/06/11)**										
2											
3	**ENTER VALUES IN YELLOW CELLS ONLY**										
4		**CAMPUS/Program**		WCC/CA in Agripharmatech							
5				**Provisional Years (2 yrs for Certificate, 3 yrs for Associate Degree, 6 yrs for Bachelor's Degree, 3 yrs for Masters Degree, 5 yrs for Docto**							
6				Year 1	Year 2	Year 3	Year 4	Year 5	Year 6		
7		**ENTER ACADEMIC YEAR (i.e., 2011-2012)**		2012-2013	2013-2014						
8		**Students & SSH**									
9			A. Headcount enrollment (Fall)	18	20						
10			B. Annual SSH	2,287	2,300						
11											
12		**Direct and Incremental Program Costs Without Fringe**									
13			C. Instructional Cost **without** Fringe	$ 163,738	$ 170,287						
14			C1. Number (FTE) of FT Faculty/Lecturers	2.00	2.00						
15			C2. Number (FTE) of PT Lecturers	0.60	0.60						
16			D. Other Personnel Costs	$ 53,858	$ 53,858						
17			E. Unique Program Costs	$ 39,000	$ 39,000						
18			F. Total Direct and Incremental Costs	$ 256,596	$ 263,145						
19											
20		**Revenue**									
21			G. Tuition	$ 230,987	$ 243,800						
22			Tuition rate per credit	$ 101	$ 106						
23			H. Other	$ 108,000	$ 108,000						
24			I. Total Revenue	$ 338,987	$ 351,800						
25											
26		**J. Net Cost (Revenue)**		-82,391	-88,655						
27											
28											
29											
30		**Program Cost per SSH With Fringe**									
31			K. Instructional Cost **with** Fringe/SSH	$ 93	$ 97						
32			K1. Total Salary FT Faculty/Lecturers	$ 138,478	$ 144,017						
33			K2. Cost Including Fringe of K1	$ 186,945	$ 194,423						
34			K3. Total Salary PT Lecturers	$ 25,260	$ 26,270						
35			K4. Cost Including fringe of K3	$ 26,523	$ 27,584						
36			L. Support Cost/SSH	$ 318	$ 318						
37			Non-Instructional Exp/SSH	$ 277	$ 277						
38			System-wide Support/SSH	$ 41	$ 41						
39			Organized Research/SSH								
40			M. Total Program Cost/SSH	$ 411	$ 415						
41			N. Total Campus Expenditure/SSH	$ 457	$ 457						
42											
43		**Instruction Cost with Fringe per SSH**									
44			K. Instructional Cost/SSH	$ 93	$ 97						
45			O. Comparable Cost/SSH	$ 551	$ 551						
46			Program used for comparison:	KCC Health Service Tech							
47											
48		**Reviewed by campus VC for Administrative Affairs:**		**(signature and date)**		C. Rojo	9/9/11				
49		**Instructions**									
50		Please include an explanation of this template in your narrative.									
51	A.	Headcount Enrollment: Headcount enrollment of **majors** each Fall semester. Located at url: http://www.hawaii.edu/iro/maps.php? Category = Enrollment. Campus data may be used when majors are a subset of enrollment reported in IRO reports.									
52	B.	Annual SSH: Course Registration Report located at http://www.hawaii.edu/iro/maps.php? Title = Course Registration Report. Add the SSH for the Fall and Spring reports to obtain the annual SSH. This is all SSH taught by the program, including to non-majors. Adjust if majors are shh set of SSH reported.									
53	C.	Instructional Cost **without** Fringe (automated calculation): Direct salary cost for all faculty and lecturers teaching in the program. *Formula for column D: =IF(OR(D32<>"",D32+D34,"")									
54		**C1**. Number of full time faculty and lecturers who are ≥.5 FTE.									
55		**C2.** Number of part time lecturers who are <.5 FTE.									
56	D.	Other Personnel Cost: Salary cost (part or full time) for personnel supporting the program (APT, clerical lab support, advisor, etc.) This includes personnel providing necessary support for the program who may not be directly employed by the program and may include partial FTEs. Add negotiated collective bargaining increases and 4% per year for inflation thereafter.									
57	E.	Unique Program Cost: Costs specific to the program for equipment, supplies, insurance, etc. For provisional years, this would be actual cost. For established years, this would be projected costs using amortization for equipment and add 4% per year for inflation thereafter.									
58	F.	Total Direct and Incremental Cost: C + D + E *Formula for column D: =IF(OR(D13<>"",D16<>0,D17<>0),SUM(D13,D16,D17),"")									
59	G.	Tuition : Annual SSH X resident tuition rate/credit *Formula for column D: =IF(D10>0,D10*D22,"")									
60	H.	Other: Other sources of revenue including grants, program fees, etc. This should not include in-kind contributions unless the services or goods contributed are recorded in the financial records of the campus and included in Direct and Incremental Costs in this template.									
61	I.	Total Revenue: G + H *Formula for column D: =IF(OR(D21<>"",D23<>0),SUM(D21,D23),"")									
62	J.	Net Cost: F - I This is the net incremental cost of the program to the campus. A negative number here represents net revenue (i.e., revenue in excess of cost.) If there is a net cost, please explain how this cost will be funded. *Formula for column D: =IF(AND(D18<>"",D24<>""),D18-D24,"")									
63	K.	Instructional Costs **with** Fringe/SSH: (K2 + K4) / B *Formula for column D: =IF(D10<>"",(SUM(D33,D35)/D10),"")									
64		**K1.** Salaries **without** Fringe of Full Time Faculty and Lecturers who are ≥ .5 FTE based on FTE directly related to the program. Add negotiated collective bargaining increases and 4% per year for inflation thereafter.									
65		**K2.** K1 X 1.35 Formula for column D: =IF(D32="","",D32*1.35)									
66		**K3.** Salaries **without** Fringe for Lecturers who are < .5 FTE based on FTE directly related to the program. Add negotiated collective bargaining increases and 4% per year for inflation thereafter.									
67		**K4.** K3 X 1.05 Formula for column D: =IF(D34="","",D34*1.05)									
68	L.	Support Cost/SSH:The **campus'** non instructional expenditure/ssh + systemwide support – organized research (UHM only) as provided by UH Expenditure Report (http://www.hawaii.edu/budget/expend.html) *Formula for column D: =IF(OR(D37>0,D38>0,D39>0),D37+D38-D39,"")									
69											
70		For example, from the 2009-10 UH Expenditure Report, the support expenditure/ssh per campus is:									
71											
72		UHM	$450.00 + $56 - $131 for organized research = $375								
73		UHH	$369.00 + $42 = $411								
74		UHWO	$210.00 + $31 = $241								
75		Haw CC	$164.00 + $37 = $201								
76		Hon CC	$233.00 + $46 = $279								
77		Kap CC	$119.00 + $29 = $148								
78		Kau CC	$359.00 + $64 = $423								
79		Lee CC	$123.00 + $27 = $150								
80		Maui CC	$163.00 + $36 = $199								
81		Win CC	$277.00 + $41 = $318								
82											
83	M.	Total Program Cost/SSH: K + L *Formula for column D: =IF(OR(D31<>"",D36<>""),D31+D36,"")									
84	N.	Total Campus Expenditure/SSH: Taken from UH Expenditures Report For example, for 2009-2010: UHM = $923-131 (organized research) = $792, UHH = $682, UHWO = $501, HawCC = $408, HonCC = $505, KapCC = $316, KauCC = $703, LeeCC=$300, Maui CC= $396, WinCC=$457									
85	O.	Comparable Program/Division Instructional Cost/SSH: Taken from UH Expenditures Report (http://www.hawaii.edu/budget/expend.html) or campus data, as available. Please note in the space provided, the program used for the comparison.									
86											
87	Rev. 09/06/11										

Review of ATP Proposals at Windward Community College

New Program Proposal:

New Program Proposal levels of review done prior to or concurrent with the ATP submission for off-campus review.

		Signatures	Dates
1.	Proposer	INGELIA WHITE	8/25/11
2.	Department Area (more than one departmental instructor's signature required)		9/9/11
			9/9/11
			9/9/11
3.	Department Chairperson		9/9/11 Date
4.	Dean of Instruction		9/9/11 Date

5. Curriculum Committee Review

_____ Approved _____Disapproved

Reason:_____

_____ _____

Curriculum Committee Chairperson Date

6. Faculty Senate Review

_____ Approved _____Disapproved

Reason:_____

_____ _____

Faculty Senate Chairperson Date

7. Vice Chancellor for Instruction

_____ Approved _____Disapproved

Reason:_____

_____ _____

Vice Chancellor for Instruction Date

8. Chancellor

_____ Approved _____Disapproved

Reason:_____

_____ _____

Chancellor Date