# Politics and Agricultural Biotechnology in Hawaii: Teaching Teachers about Biotechnology

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## Abstract

To ensure sustainability of agriculture in Hawaii, research is needed to improve resistance to pests and diseases using biotechnology. However, recent legislation in Hawaii has been passed to restrict research on genetic engineering of certain crops. In November 2008, the Hawaii County Council passed Bill 361 that makes it unlawful for any person to test, propagate, cultivate, raise, plant, grow, introduce or release genetically engineered (transgenic) or recombinant DNA taro (kalo) or recombinant DNA coffee. The purpose of the bill was to protect the taro (kalo) and coffee industry from genetic engineering and preserve agriculturally-based practices and cultural traditions associated with taro (kalo) and coffee within the County of Hawai`i. The language of the bill is very broad and could be interpreted to prohibit molecular biological techniques for purposes other than genetic engineering. Many oral and written testimonies presented before the Hawaii County Council were emotional and without scientific basis. Clearly, the current controversy provides a teachable moment when there is both interest and need to educate the public about genetic engineering. To address this problem through education, a place-based based course on Agricultural Biotechnology was offered for middle school and high school science and agriculture teachers during June 2009, using the context of genetic engineering of papayas (*Carica papaya*) for resistance to papaya ringspot virus. This course was team-taught by instructors from the University of Hawaii Manoa, University of Hawaii Hilo, and Kamehameha Schools. Information gained from the legislative experience and from teaching this class will be presented.

'SunUp' Papaya genetically engineered for papaya ringspot resistance.

### AG 494 Agricultural Biotechnology

**Teacher composition**:

Seven middle and high school teachers enrolled in this course. They were diverse in their scientific background, laboratory techniques, and knowledge of biotechnology. This diversity affected the pacing of the course, but provided alternative perspectives on biotechnology that were an essential part of this course.

### Lab Exercises – AG 494

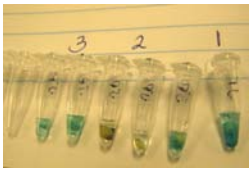
Transformation of *E. coli* with pGlo plasmid
Extraction and purification of pGlo from *E. coli*
Restriction enzyme analysis of pGlo
Polymerase chain reaction Agarose gel electrophoresis
X-gluc staining of papaya seeds for GUS detection

Mike Shintaku demonstrating proper laboratory techniques to middle and high school teachers in AG 494.

High school and middle school teachers performing pGLO (Bio-Rad) transformation of bacterial cells.

pGLO (Bio-Rad) transformed bacterial cells.

Ania Wieczorek demonstrating staining of papaya seeds with x-gluc for presence of β-glucuronidase gene.




Deposition of blue pigment from x-gluc indicates β-glucuronidase activity in transgenic papaya seeds.

### Field Trips – AG 494

Rusty Perry's papaya farm
Tropical Hawaiian Products papaya packing plant
Pacific Basin Agricultural Research Center
Kamehameha Schools Hawai`i campus

Papaya farmer 'Rusty' Perry talking about the challenges of growing papayas in the face of an epidemic of papaya ringspot disease.

Loren Mochida from Tropical Hawaiian Products talking to AG 494 class.

Tracie Matsumoto from Pacific Basin Agricultural Research Center (PBARC) showing tissue cultured plants.

### Student feedback:

**What was the most valuable part of this class?**

"I enjoyed the hands-on lab experiments and seeing the results immediately."
"The contacts I made with University and High School educators will continue to pay off for years to come."
"Field trips were great."

**What kinds of materials did you obtain from this class that will be useful to you in your teaching?**

"The binder from Ania has a lot of user-friendly classroom activities."
"The contacts with working scientists … will be useful."
"I would use all labs, all content, and pedagogy."
"All the knowledge I received from the experts in the field."
"All the discussions on gene transformation, the issues related to GE."

## Conclusions:

The original objective of teaching AG 494 was to provide middle school and high school science and agriculture teachers with materials that they could use to educate their students on agricultural biotechnology. Based on the course evaluations, the teachers indicated that the most valuable components were laboratory exercises, field trips, and networking with other teachers and scientists. Dr. Wieczorek provided each student with a collection of protocols and reading materials that was especially useful for their classrooms.

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