Biotechnology for California: Science, Policy and Marketing

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Crop Biotechnology in California

- Current status of agricultural biotechnology.
- What about specialty crops?
- Regulatory issues with agricultural biotechnology.
- Political issues with biotechnology in California.
Current Status of Ag Biotechnology

- Market status of biotech field crops

  - Field crops with GM traits already in the market continue to expand (corn, cotton, soybean, canola).

  - In California, herbicide-tolerant cotton is the major biotech crop.

Global Acreage of Biotech Crops

- USA 59%
- Argentina 20%
- Canada 6%
- Brazil 6%
- China 5%
- Paraguay 2%
- India 1%
- S. Africa 1%

- Soybean 56%
- Cotton 28%
- Canola 19%
- Corn 14%

Benefits of Biotech Crops

A study released in October 2004 by the National Center for Food and Agricultural Policy found the following impacts in the US for 11 biotech traits in six crops (soybeans, corn, cotton, papaya, squash and canola):

![Table 1: Overall impact on U.S. agriculture of biotechnology-derived crops](image)

Current Status of Ag Biotechnology

- Market status of biotech field crops
  - Additional input traits are being introduced (e.g., rootworm-resistant corn)
  - Some new crops are being introduced (e.g., Roundup Ready alfalfa in 2005)
  - Output traits are coming (e.g., modified oils)
What About Specialty Crops?

- 85% of California’s crop production is in vegetables, fruits, nuts, nursery and flower crops.

Specialty Crops Account for 47% of US Crop Value

<table>
<thead>
<tr>
<th>Crop</th>
<th>Farm cash receipts ($ Billions)</th>
<th>Share (Percent)</th>
<th>Crop Area (Million Acres)</th>
<th>Share (Percent)</th>
</tr>
</thead>
<tbody>
<tr>
<td>All crops</td>
<td>106.2</td>
<td>100.0</td>
<td>409.2</td>
<td>100.0</td>
</tr>
<tr>
<td>Horticultural crops</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vegetables</td>
<td>16.0</td>
<td>15.1</td>
<td>10.6</td>
<td>2.6</td>
</tr>
<tr>
<td>Nursery and greenhouse</td>
<td>15.2</td>
<td>14.3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fruits and melons</td>
<td>11.5</td>
<td>10.8</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tree nuts</td>
<td>2.4</td>
<td>2.3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other (mushrooms, seeds)</td>
<td>4.9</td>
<td>4.6</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Field crops</td>
<td>56.1</td>
<td>52.9</td>
<td>398.6</td>
<td>97.4</td>
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<tr>
<td>Oil crops (incl. soybeans)</td>
<td>17.3</td>
<td>16.3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Feed crops (incl. corn)</td>
<td>24.3</td>
<td>22.9</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Food grains (wheat, rice)</td>
<td>8.0</td>
<td>7.5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cotton</td>
<td>5.0</td>
<td>4.7</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tobacco</td>
<td>1.6</td>
<td>1.5</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Biotech Crops Formerly in the Market

- Flavr Savr tomato – long shelf life
  - Initial marketing success
  - Poor varieties
  - Business failure
  - Led to seed and genetics consolidations

- Potatoes – insect and virus resistant
  - 4% of national acreage in 1999
  - Withdrawn due to marketing issues

Horticultural Biotech Crops in the Market

- Papaya – virus resistant
- Squash – virus resistant
- Sweet corn – insect resistant
- Blue carnations - color
Biotech Crops Potentially in the Market

- Herbicide resistance
  - Lettuce
  - Tomato
  - Strawberries
  - Sugar beets
  - Rice
  - Wheat

- Insect resistance
  - Broccoli
  - Alfalfa
  - Apples
  - Walnut

Interplanting Bt-apples with walnuts controls codling moth without insecticides.

--Dry Creek Laboratories
**Biotech Crops Potentially in the Market**

- Virus resistance
  - Pumpkin, watermelon, tomato, pepper
  - Stone fruits – plum pox virus
  - Raspberries – bushy dwarf virus
  - Citrus – tristeza virus
- Bacteria resistance
  - Grapes – Pierce’s disease
  - Citrus – Bacterial canker
  - Apples – Fire blight
  - Walnut - Crown gall
- Fungi, nematodes
  - Various crops


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**Potential Impact of Biotech Crops**

A study on pest control released by the National Center for Food and Agricultural Policy in June 2002 found that:

- Case studies of 32 biotech crops “in the pipeline” could reduce grower costs by $400 million and reduce pesticide use by 117 million lbs/year.
- California would potentially benefit the most, with estimated economic benefits of $206 million and 66 million fewer lbs of pesticides applied per year.

www.ncfap.org
**Biotech Crops Potentially in the Market**

- Stress resistance
  - Salt tolerance
  - Drought tolerance
  - Cold tolerance

Transgenic tomato plants expressing the Na⁺/H⁺ antiporter grow well at 200 mM NaCl.


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**US Field Trials of Biotech Specialty Crops**

- Vegetables
- Fruits
- Ornamentals

http://www.nbiap.vt.edu/cfdocs/fieldtests1.cfm
Why Aren’t Biotech Crops in the Market?

- Market resistance
  - US consumers relatively unconcerned
  - Marketers/retailers very concerned
  - Why risk being picketed?
  - Brand name protection
  - Regardless of production benefits, they don’t outweigh the potential negatives in the market
  - Waiting for “consumer traits” to pull products through the market
    - More difficult to engineer
    - Value uncertain in the market
    - Foregoes benefits from input traits
Why Aren’t Biotech Crops in the Market?

- Access to intellectual property

Agricultural biotechnology

- Monsanto 14%
- Du Pont 13%
- Syngenta 7%
- Bayer 4%
- Dow 3%
- Rest of private sector 33%
- Public sector 24%
- Unknown 2%

Public Intellectual Property Initiatives

- Housed at UC Davis
- 25 Member institutions
- www.pipra.org

- Center for the Application of Molecular Biology to International Agriculture
- www.cambia.org
**Why Aren’t Biotech Crops in the Market?**

- **Market size**
  - Many minor crops serve niche markets and require multiple varieties to match production and marketing needs.
  - Individual varieties can only command a small fraction of the total market.
  - Small markets cannot recoup development and registration costs on seed sales alone.
  - Similar to the situation for maintaining registrations for agricultural chemicals for small market applications or drugs for minor uses.
    - IR-4 program - USDA
    - Orphan drug program - FDA

- **Regulatory issues**
  - Current regulatory data requirements are not economical for small market crops.
  - Regulatory hurdles are a key factor limiting commercialization of biotech small market crops, particularly for public institutions and smaller private companies.
  - Efforts are underway to establish a program analogous to the IR-4 program to assist with regulatory approvals for small market crops.
Papers from the Workshop were published as a special issue of *California Agriculture* in April 2004. It is available online at http://californiaagriculture.ucop.edu.

### Local Regulatory and Policy Issues

- **Rice Certification Act -- 2002**
  - Established a procedure for evaluation of new varieties having "market impact."
  - Rice engineered to produce two human proteins for use in hydration fluids for infants was evaluated under this act.
  - Was approved, but with restrictions that it not be grown near existing rice production.
  - Company has moved to Missouri.
Local ordinances are being circulated or enacted to ban the production of GM crops.

Current Status of Anti-GM Ordinances in California

- Anti-GMO Ordinances Passed
- Anti-GMO Ordinance Voted On and Rejected, November 2004
- Anti-GMO Ordinances Proposed
- Pro-GMO Resolution Passed

Green outline denotes major GE-crop growing areas

Courtesy of Dr. Peggy Lemaux  
As of 12/14/04
International Development of Biotech Crops

- At least 15 developing countries are supporting public research on biotech traits in 45 species, most of which are specialty crops.
- China is second only to the US in expenditures on crop biotechnology.
- Some countries are moving forward, while our industry is stymied by regulatory and market constraints.
- Just as European biotech companies moved operations to the US, some US specialty crop breeding companies are opening research and production facilities in China.


Summary

- Some biotech crops are expanding in acreage while others are excluded from the market.

- Market acceptance and regulatory issues, not science, are limiting what products are in the market.

- Many types of agriculture can co-exist in California.

- California’s ability to compete in local and global markets will be hampered if our agricultural industry is not able to use the most efficient production methods.