

The Economic Status and Performance of Plant Biotechnology in 2003: Adoption, Research and Development in the United States



Barry Ryan
University of Minnesota
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Key findings

- Plant biotechnology has resulted in substantial benefits to producers in profitability and management efficiencies
- Plant biotechnology is also creating value beyond the farm gate through research and development investment and creation of high-value jobs
- Those states that rapidly adopt the technology behind the farm gate are reaping some of the greatest benefits beyond the farm gate
- The technology will deliver more value both behind and beyond the farm gate in the future



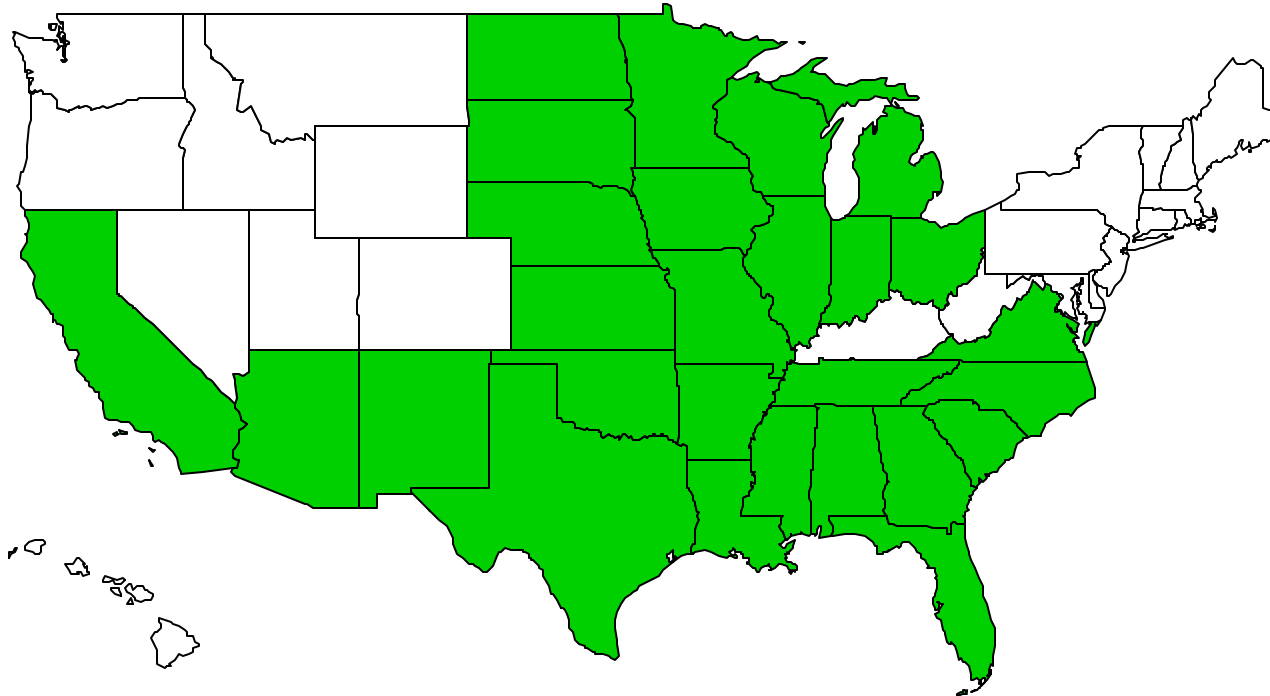
Study development

- An integrated view of the economic value of plant biotechnology both at the farm level and beyond the farm gate
- Focused on eight crops: corn, soybeans, cotton, rapeseed/canola, wheat, potatoes, rice and sugar beets
- Based on USDA and industry data and interviews with scientists, researchers and commodity groups
- Supported by Council for Biotechnology Information
- Views are those of the authors and not the University of Minnesota



Farm value

States with major biotech crop value 2002



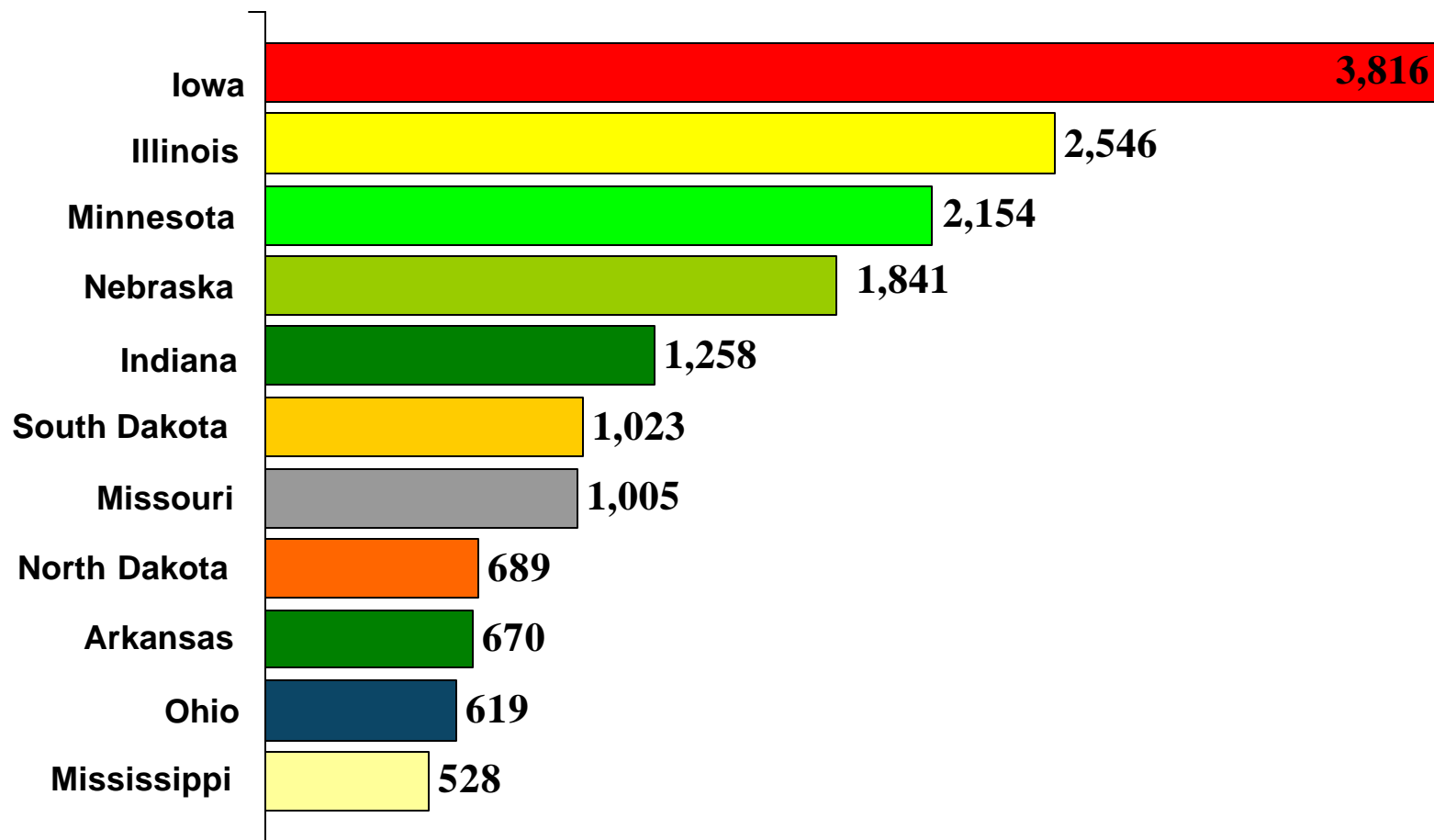
Total biotech crop value more than \$20 billion in 2002, half the total \$40 billion value of U.S. corn, soybeans, cotton and canola.

Source: USDA



Biotech Crop Value: 2002

(in millions of dollars)



Iowa had \$3.8 billion in biotech crop value in 2002



On-farm impact

Adoption of biotech varieties increased management efficiencies as well as farm profits

- Bt corn increased profits as much as \$60 per acre
- Herbicide tolerant soybeans improved profits nearly \$15 per acre
- Herbicide tolerant and Bt cotton increased profitability, ranging from \$15 to several hundred dollars per acre depending on severity of pest pressure



More value in the pipeline

- New biotech varieties will increase the value of biotech crops in size and scope
- For example:
 - **Agronomic traits:** yield improvement, stalk strength, cold and drought tolerant
 - **Environment traits:** Low phytate biotech corn and soybeans will reduce phosphorus in livestock waste, reducing pollution loads
 - **Product quality traits:** improved digestibility in wheat, increased beta carotene in potatoes, reduction of transfatty acids



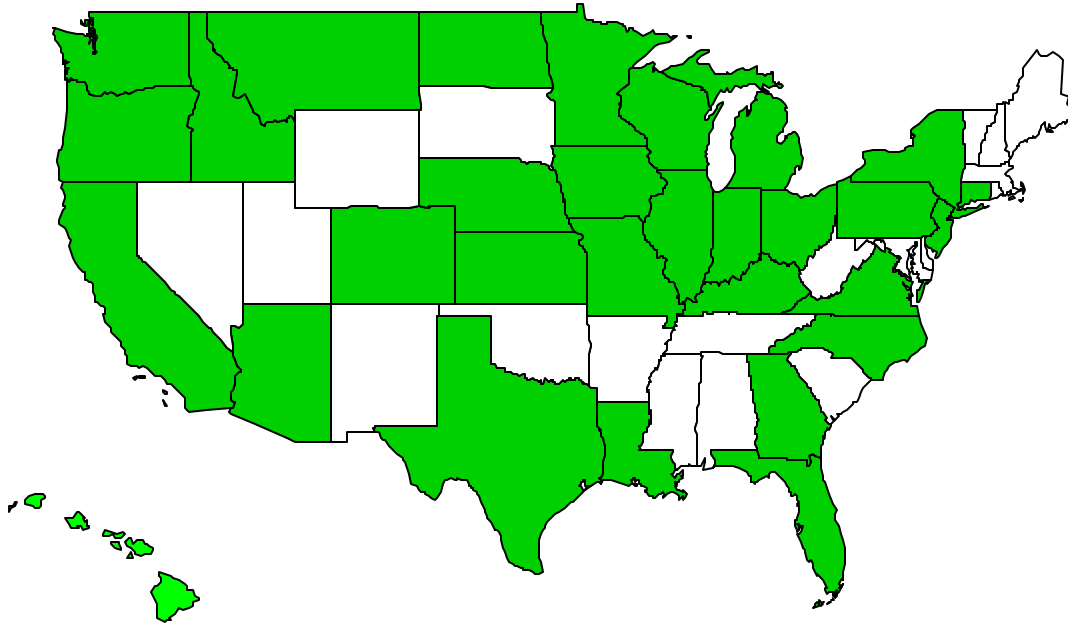
Beyond the farm gate

- R&D spending on genomics and plant biotechnology is growing at the federal and state level
- Benefits extend well beyond the farm states
- These investments are creating and will create new knowledge-based jobs
- Keeping these benefits alive and growing requires sustained private and public investments



R&D widespread

Public research institutions conducting biotech field trials 2001–2003



Eight crops
(corn,
soybeans,
cotton,
canola, wheat,
potato, rice,
sugar beets)

Since 2001, 100 new traits have undergone testing at 40 universities and by 35 private sector companies.

Even public research institutions in traditionally non-farm states are conducting field trials for potential biotech crop traits.

Source: USDA, APHIS

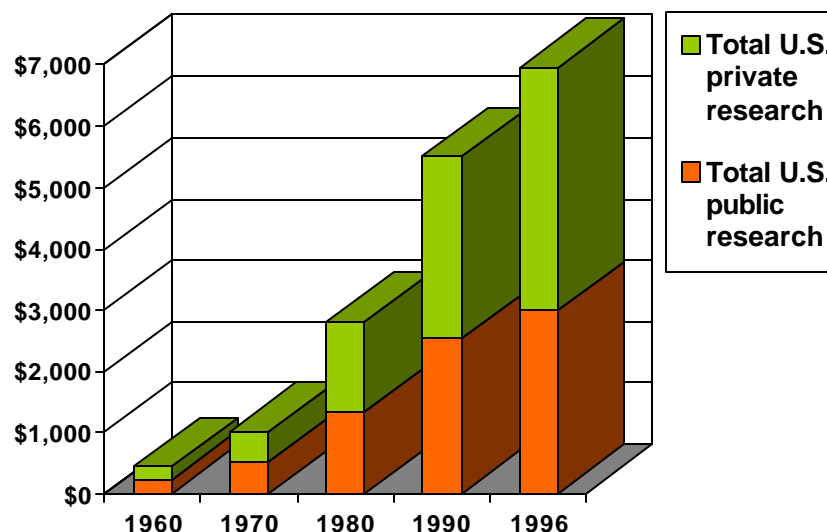




Public and private R&D

- Private sector R&D has grown 42% in four decades
- NSF funding for biological sciences research — most of it to universities — increased 70% between 1996 and 2002
- Private investment was 32% higher than public investment in 1996

Public and private funding of agricultural research (in millions)



Source: Philip Pardey, University of Minnesota, 1996.
Compiled from unpublished USDA data

Ag research returns

- Estimates of return on ag research since 1958 average 81% annually
- By the mid-90's, for every \$100 of ag output there was \$1000 in stock of plant breeding knowledge to draw on
- Maintaining these stocks of knowledge through biotech R&D critical to future returns



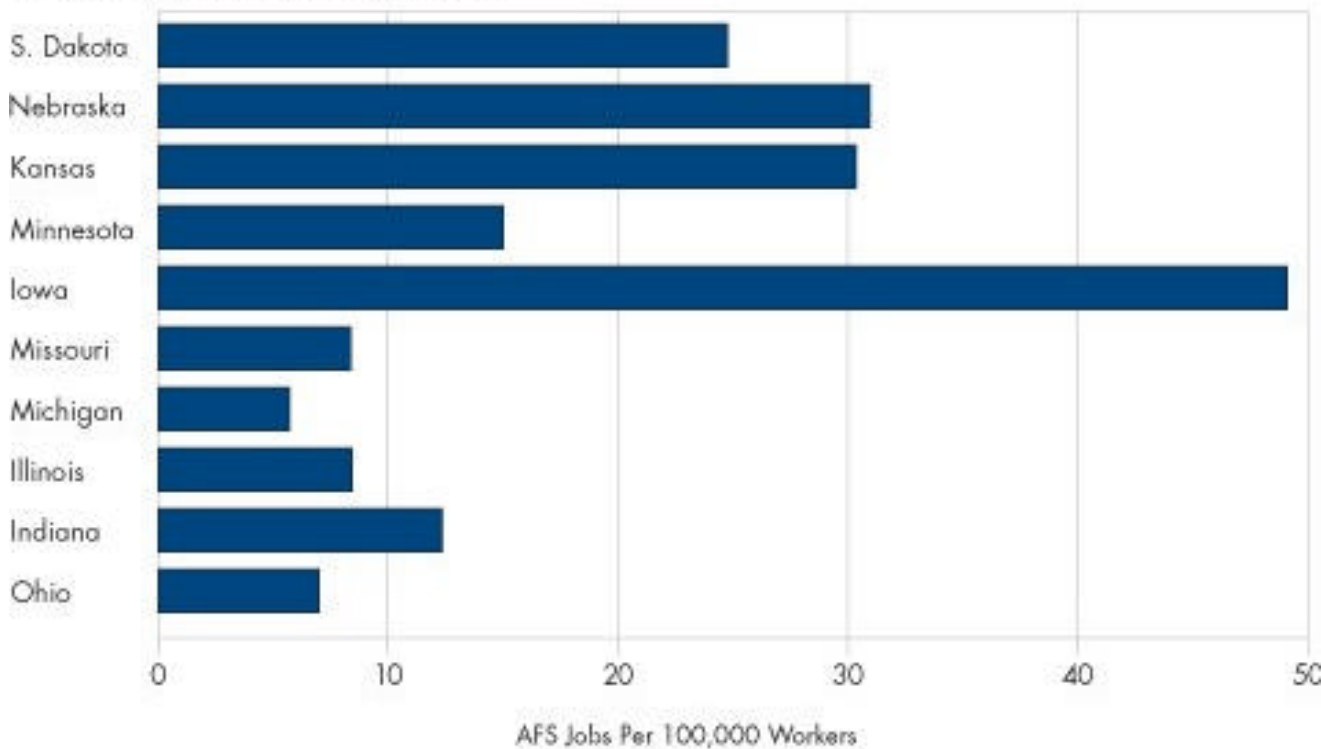
Growing good jobs

- Biotech industry touches multiple job and employment categories: e.g., microbiologists, molecular biologists, computer scientists
- These jobs pay 1.5 to 2 times typical wage of workers in these states
- For example, Iowa is one of the top five biotech states in adoption and employs 50 ag and food science jobs per 100,000, more than lower adoption states



Ag and food scientist jobs per 100,000 workers

Highest Ranking Plant (Corn and Soybean) Biotech Adopting States and Agricultural and Food Scientists (AFS) per 100,000 – 2003



States with rapid adoption also have greatest demand for ag and food science jobs.



Biotechnology impact on state economies

- Plant biotechnology attracts public and private R&D dollars to states
 - Benefits existing biotech companies in the state
 - Brings more R&D money to land grant universities
 - In 2000, total U.S. public agricultural research spending was \$3.5 billion
 - USDA R&D funding for plant biotechnology expected to be more than \$2.3 billion in 2004
 - R&D spending of major biotech companies totals an additional \$2.7 billion



State impacts: on-farm and beyond

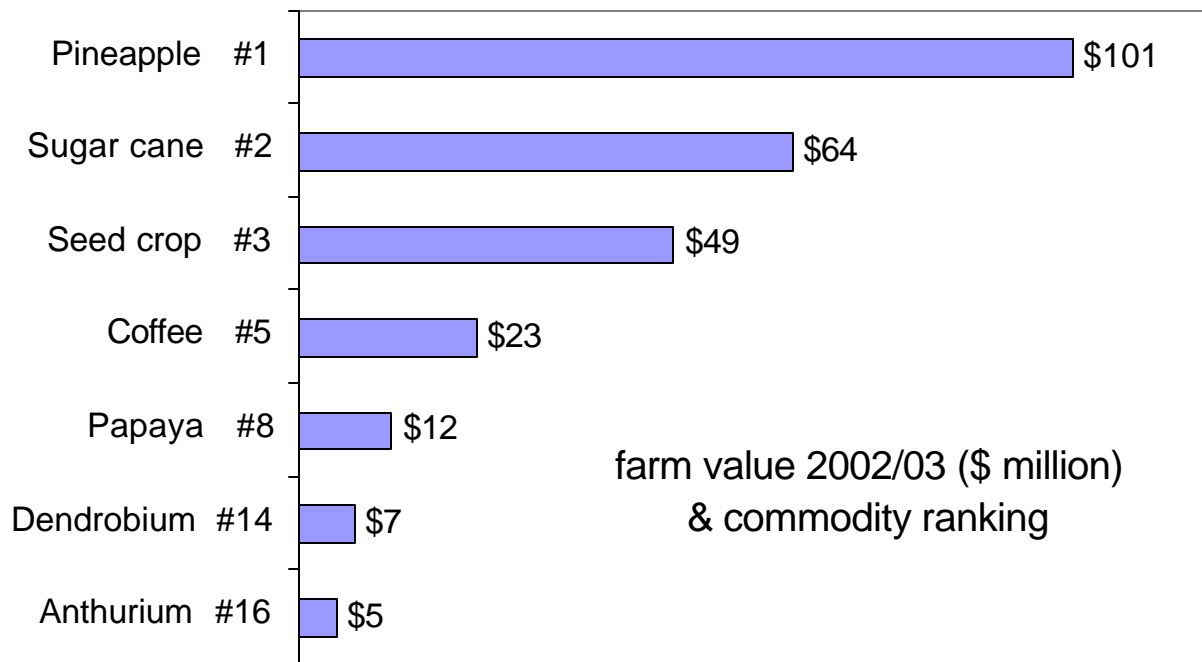
- Iowa witnessed the greatest on-farm economic gain (\$3.8 billion) of any state from biotech adoption
- Minnesota gained \$2.1 billion on-farm and has more than 170 firms involved in biotech R&D
- Wisconsin gained \$498 million on-farm benefits; 200 bioscience companies and universities employed 26,000 workers generating total industry activity (ag and non-ag) of \$5 billion



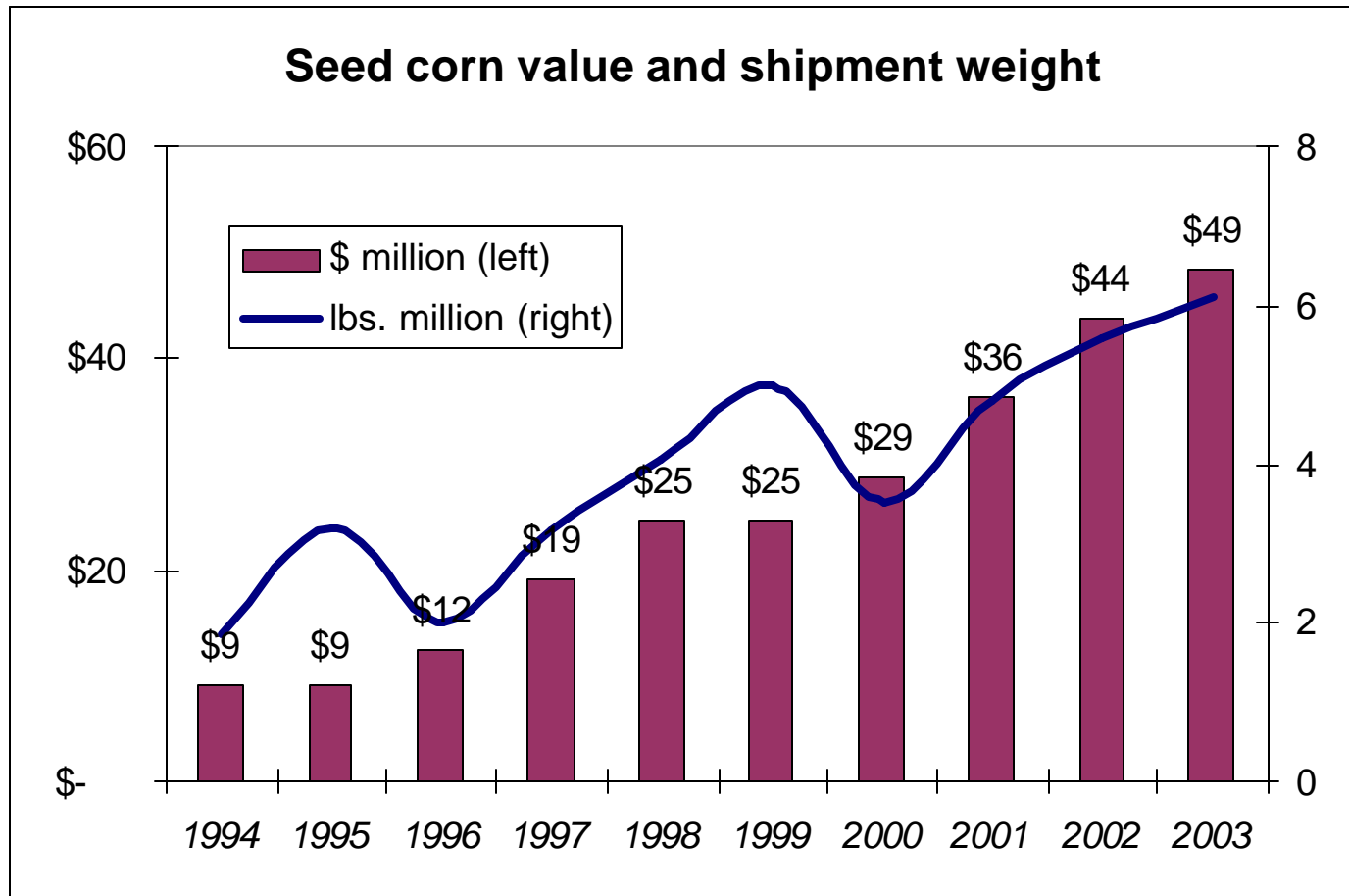
State impacts: Hawaii



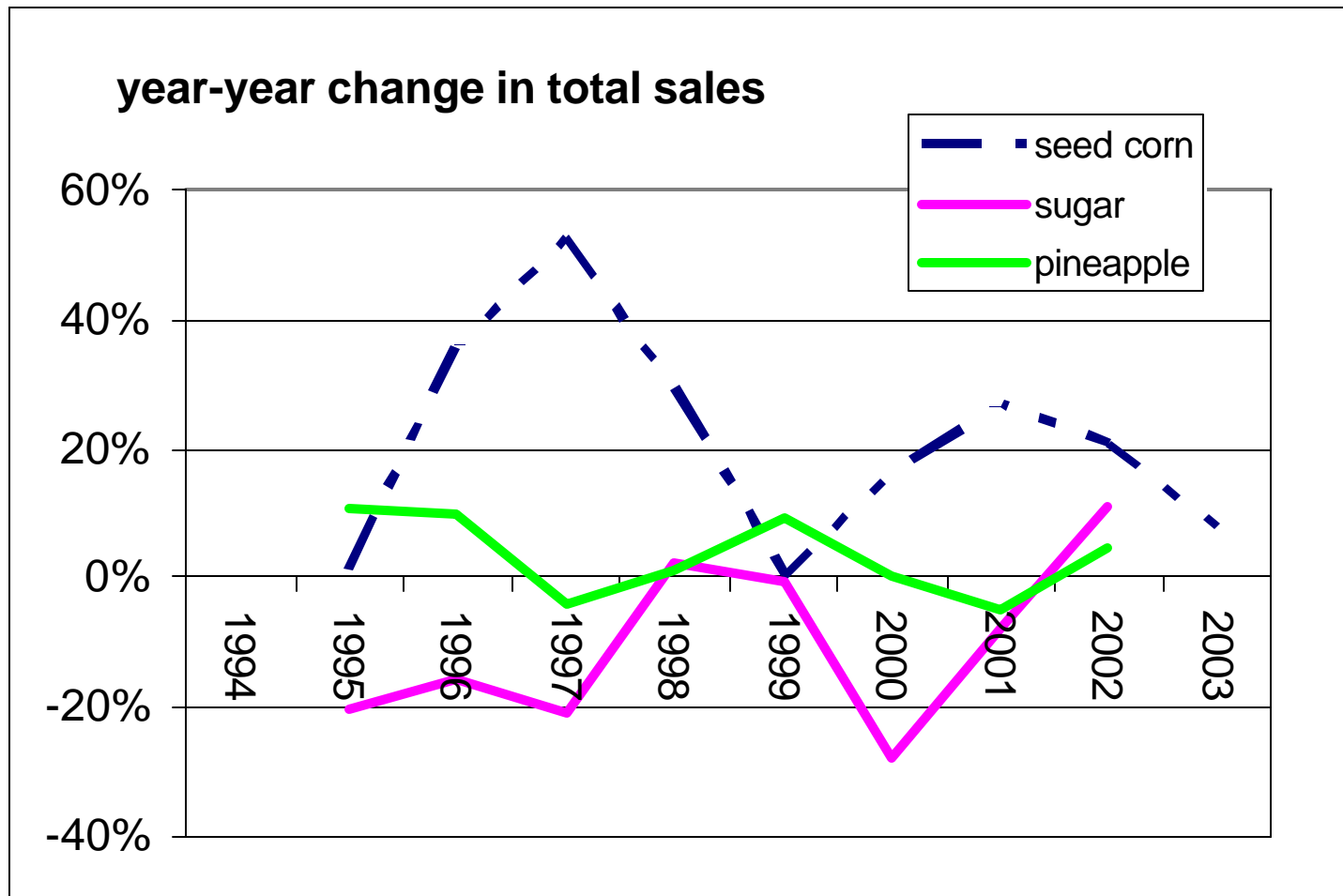
Value of Hawaiian crops of biotech research interest



State impacts: Hawaii



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<i>County</i>	<i>Seed operations</i>	<i>Full-time</i>	<i>Part-time</i>	<i>Seed crop</i>
Kauai	Dupont (Pioneer)	50	120	corn, soy, sunflower
	Syngenta (NK)	22	60	corn, soybeans
Oahu	Monsanto (Holden)	25	-	corn
	Garst	16	60	corn, soybeans
	Dupont (Pioneer)	13	24	corn, soybeans
Maui	Monsanto (Dekalb)	55	215	corn, soy, sunflower
Molokai	Dow AgroSciences	22	45	corn
	Monsanto (Holden)	5	-	corn





State impacts: Hawaii

Main points -

Agriculture helps diversify Hawaii's economy, supporting 50,000 jobs and \$1.1 billion in household income.

Seed corn industry contributes \$49 million in economic activity through local wages, taxes, and other direct operating costs.

Seed industry has returned positive economic growth for last 8 years.

Half the \$12 million in papaya crop value is biotech varieties.

Additional research interest in pineapple, sugarcane, coffee, floriculture focus on disease resistance and product quality traits.

Mainland university researchers - Iowa State, Stanford, Arizona, and others – have long history in Hawaii.

Conclusions

- Plant biotech represents enormous value to farmers, states and the nation
- This value extends well beyond the farm into private job creation and private and public R&D
- Both on farm and general economic benefits are producing new knowledge-based jobs
- As biotech activities and applications grow wider and deeper, value will increase in size and scope
- Maintaining and expanding biotech investment in both private and public sector is critical

