Government of Canada | Gouvernement du Canada

35405 SUB

Opened: 1998/05/01 Closed: 1999-06

Biotechnology - Issues Management

~~Issues~~ - Socieconomics - Biotechnology

Vol. 1 N

FOLDER ID: 19651

Date	Referred to Remis à	Remarks Remarques	PA Date	Date à classer	User's Initials Initiales de l'usager	BF Date	Date à rappeler

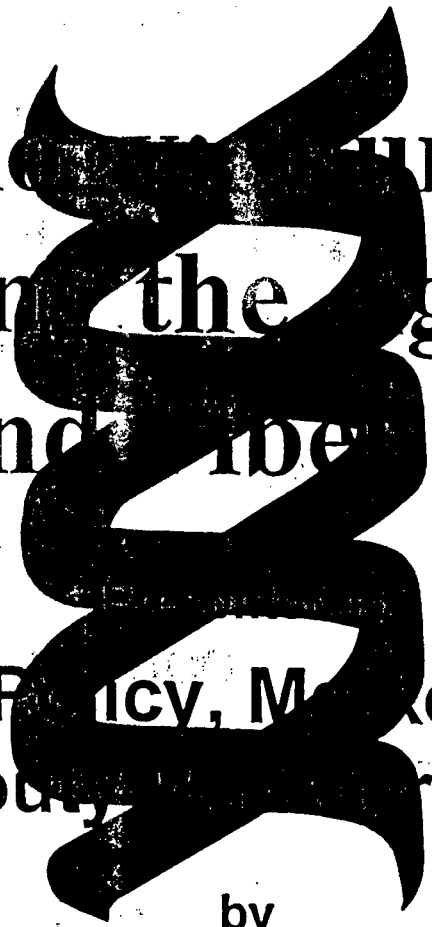
GC 39.1 (91/10) 7540-21-904-5775

Vol. 1 N

35405 Folder ID: 19651

EABrMg
June 9/99

Sparks Companies, Inc.



Biotechnology Fundamentally Reshaping the Agriculture, Food and Fiber Industry

A Meeting of Policy, Marketing and Trade Assistant Deputy Ministers of Agriculture

by

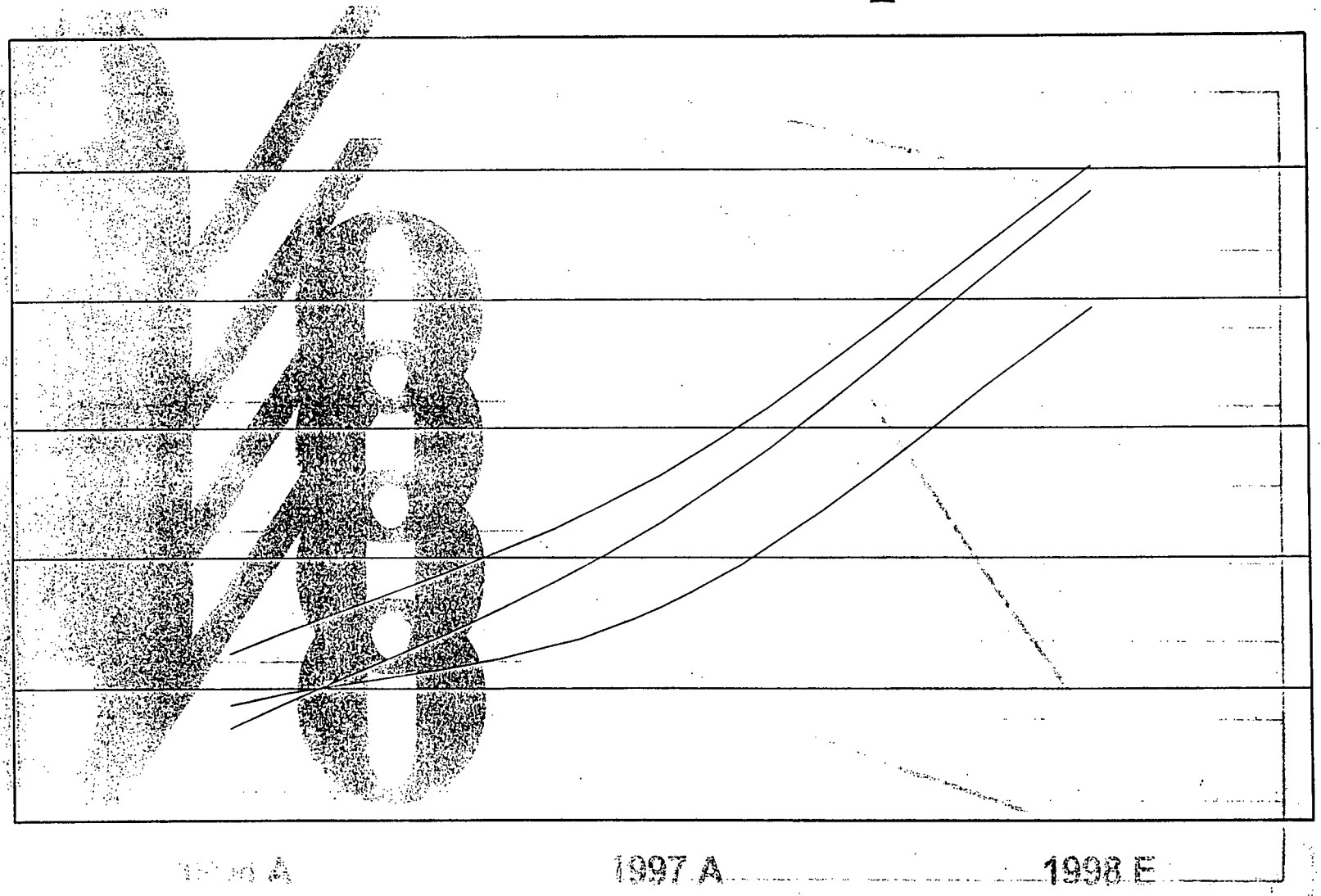
Beth Brechbill

June 9, 1999

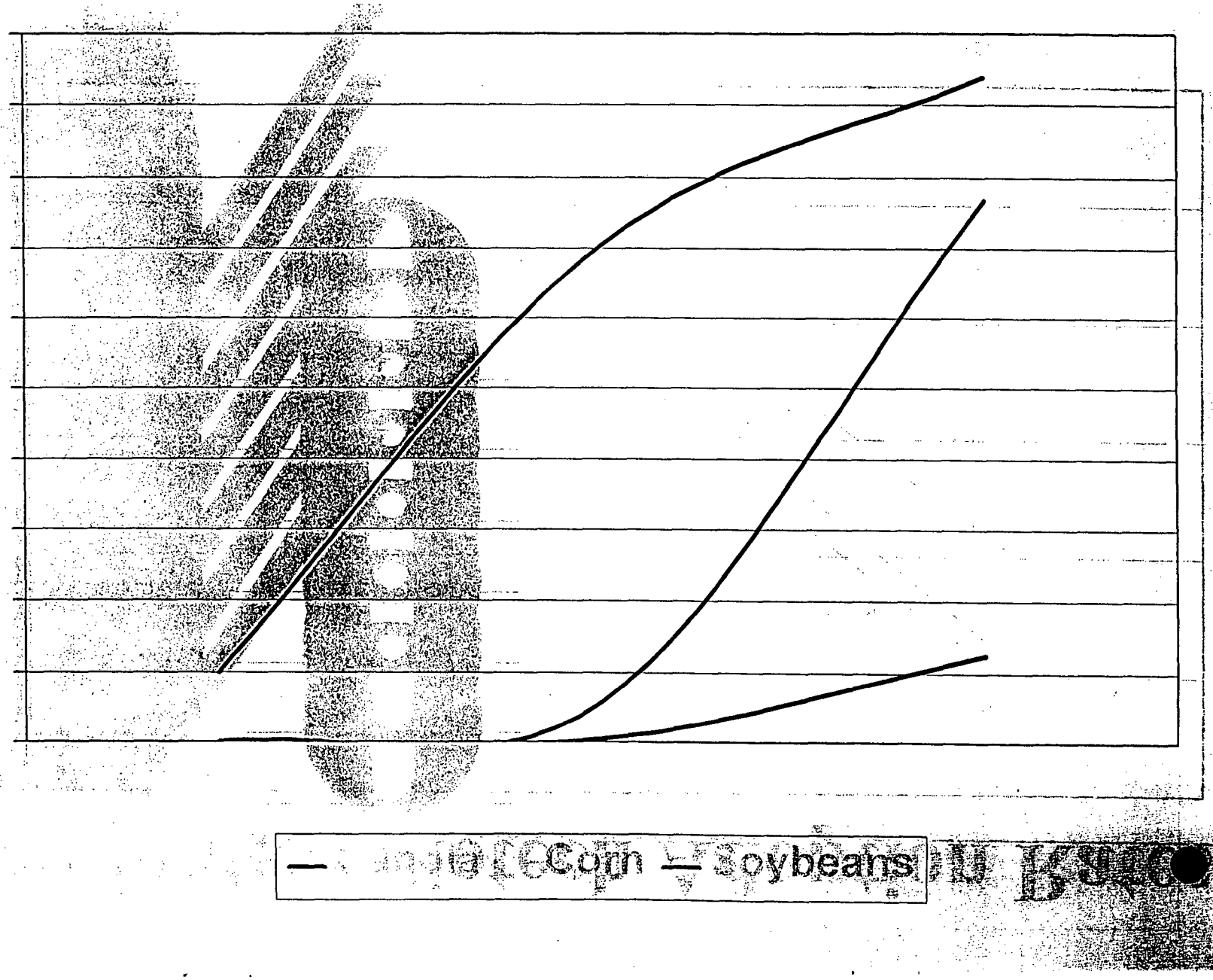
Biotechnology

- "First Wave" products
  - Cost reducing/yield enhancing
    - Herbicide tolerance
    - Insect/disease resistance
    - Drought/cold/heat tolerance
- "Second Wave" products
  - Value enhanced products
    - High oil corn
    - High oleic soybeans
    - Increased solids tomatoes
    - High methionine soybean

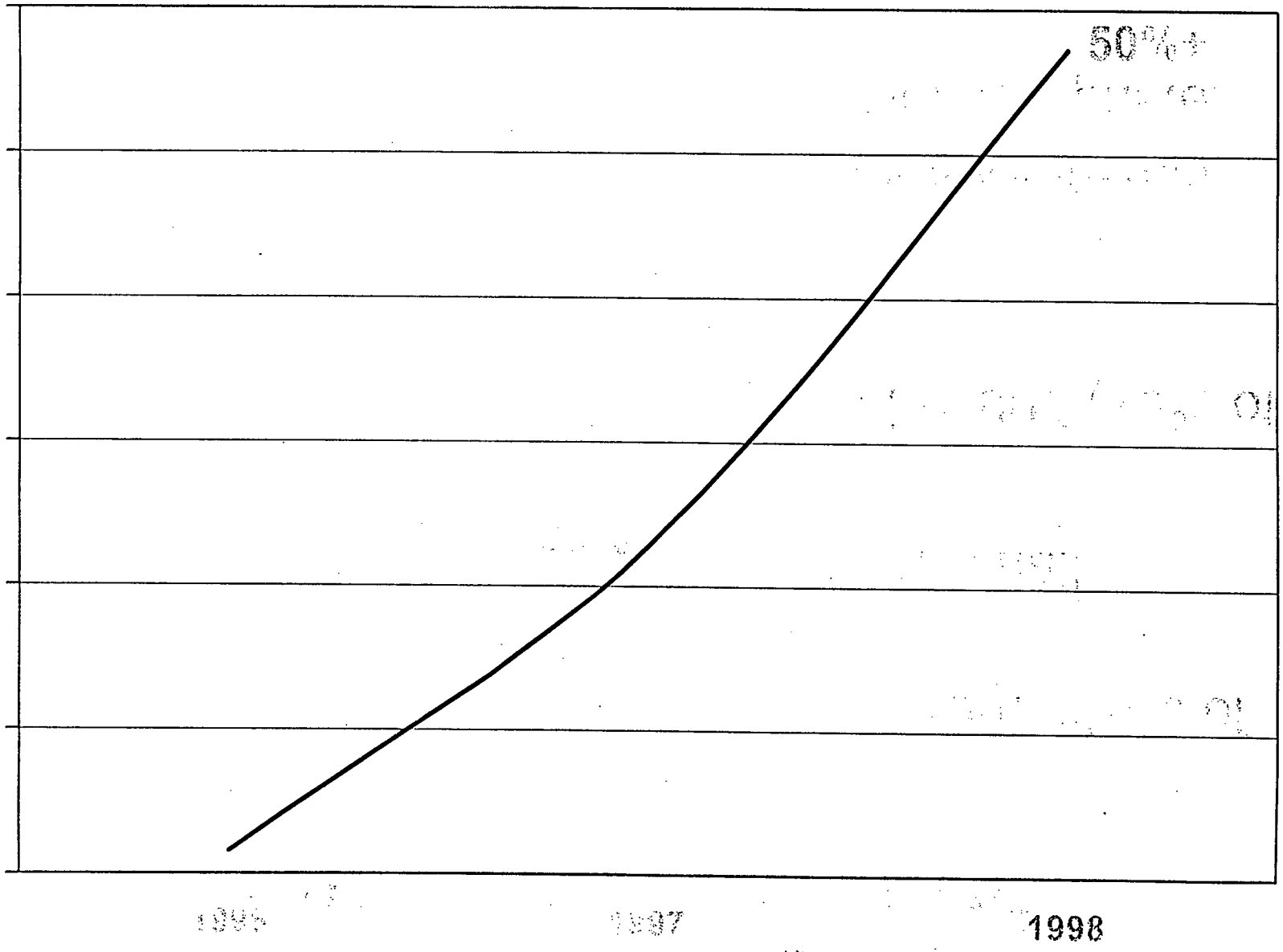
United States: Biotech Adoption Rates



Car a la: Biotecl Adoption Rates



Argentina: Roundup Ready Soybeans



Biotech Crops Worldwide

Mexico

- Bollgard (Bt) cotton: 50,000 acres in 1997 (10% of planted acres). Doubled in '98.
- Roundup Ready cotton: Still relatively small.

Australia

- Bollgard (Bt) cotton: 150,000 acres in 1997 (15% of planted acres). Doubled in '98.

Europe

- Minimal acreage due to current consumer issues
- Increased Pectin Tomato: Used for tomato paste.

Brazil

- Roundup Ready soybeans: Nearing approval, but delays continue. Likely planting next season.

Biotech Crops Worldwide

- Mexico
  - Bollgard (Bt) cotton: 50,000 acres in 1997 (10% of planted acres). Doubled in '98.
  - Roundup Ready cotton: Still relatively small.
- Australia
  - Bollgard (Bt) cotton: 150,000 acres in 1997 (15% of planted acres). Doubled in '98.
- Europe
  - Minimal acreage due to current consumer issues
  - Increased Pectin Tomato: Used for tomato paste.
- Brazil
  - Roundup Ready soybeans: Nearing approval, but delays continue. Likely planting next season.

Biotech - The Crops Pipeline

The Plant Pipeline - Next 5 Years

- Continued focus on input traits - herbicide/insect/disease resistance
- Extending current traits to other crops
- Major progress made in value enhanced product area - new oil, protein, starch compositions

The Plant Pipeline - Next 5 Years

- Continued focus on input traits - herbicide/insect/disease resistance
- Extending current traits to other crops
- Major progress made in value enhanced product area - new oil, protein, starch compositions

Insect Resistance

- European corn borer
- Corn rootworm
- Boll weevil
- Second generation bollworm
- Colorado potato beetle
- Cottonwood leaf beetle
- Mexican rice borer
- Other lepidoptera

Disease Resistance

- Significant losses of all crops from various diseases
- New crops control many diseases
  - Viruses: mostly minor crops; potential for "stacked" resistance
  - Fungi: Fusarium rot and wilt resistance in corn, wheat, soybeans, tomatoes; focus on fruits/vegetables
  - Bacteria: dominated by public research; minor crop focus

Agronomic Property Developments

- Increased yield
  - Corn
  - Canola
  - Rice
  - Wheat
- Other properties include:
  - Corn: Increased growth rate, fertility altered, stress tolerant, increased stalk strength
  - Cotton: Altered maturing, oxidative stress tolerant
  - Creeping bentgrass: Aluminum tolerant, drought tolerant, salt tolerance increased

Value Enhanced Products

- DuPont/Pioneer - Optimum Quality Grains - a leader in this "wave"
  - High lysine soybeans (2000)
  - High oil corn + high lysine, methionine (2001)
  - High lysine + high oleic soybeans (2001)
  - High lysine + high methionine soybeans (2001)
- Other products:
  - Low phytate corn
  - Colored cotton - (Monsanto 2002+)
  - Improved fiber cotton - (Monsanto 2002+)

Livestock Pipeline Developments

- Cloning
  - Extensive use unlikely in near term - high technology costs - public acceptance an unknown

  Vaccines
  - Improve animal health - therapeutics
  - Genetic resistance to diseases
- Pharmaceutical Product Production
  - Transforming animals into bio-factories to produce medicines, nutrients

  Product Improvement
  - Promote efficient muscle growth and identify genetic potential for reduced fat and muscle proteins

Microbes and Enzymes: The Pipeline

- Broad range of applications for food and feed industries
  - Ethanol production
  - Transformation of starch into glucose and fructose
  - Improve brewing efficiency and reduce filtration needs - allows reduced use of malt
  - Baking applications - flour supplementation, increased crust color, longer shelf life, strengthened gluten
  - Edible oils - degum oil or produce lyso-lecithin

The Biotech Revolution: What's At Stake?

The Potential "Stakes"

More valuable inputs	$ billions
◆ Farmer cost savings	$ billions
Increases in output	$ billions
◆ More valuable products	$ billions
◆ Expanded uses	$ billions
◆ New food products	$ billions
TOTAL	$ BILLIONS

The Potential "Stakes"

"Dirt" → ... *→ "Dinner"*

Inputs	Farm	Processing/Distribution/Retail

"Farmgate" → ... *→ "Dinner Plate"*

- Potential stakes are enormous - across the entire system
- Readily explains "Dirt to Dinner" strategy
- Capture more of the added value created in the farm inputs sector

The Implications

Food System Components

Implications: Ag Chemicals

Overall usage of system herbicides is higher on biotech acres - other herbicide use much reduced

Total herbicide usage reduced

Insect resistance through insertion of gene from *Bacillus thuringiensis* (Bt)

Use of specific insecticides greatly reduced

- Total insecticide use reduced

Implications: Fertilizer

Findings:

- Very modest impact on fertilizer industry over next 5 years
- Low-Phytate Corn and phytase enzyme - slightly positive for fertilizer sales
- Longer term - may succeed with crops that have reduced nutrient needs
- Blockbuster products like nitrogen-fixing corn still far off

Implications: Ag Equipment

- Small impact on the industry
  - Longer machine life from conservation tillage and reduced spraying applications
  - Shifts from cotton pickers to less expensive strippers for harvesting
  - Increased use of new equipment - for testing and monitoring

Implications: The Seed Sector

- Very significant concentration already occurred
- Will biotech companies expand across the marketing chain?
- Will require:
  - Significant acreage of value enhanced crops with compelling demand
  - Processing to derive products
  - Identity preserved handing and processing

Implications: The Seed Sector

Very significant concentration already occurred

Will biotech companies expand across the marketing chain?

Will require:

- Significant acreage of value enhanced crops with compelling demand
- Processing to derive products
- Identity preserved handing and processing

Implications: The Farm Sector

100k threshold	Number (thousands)	% of Total	Sales (billions)	% of Total
Commercial	346	18.1	159.1	80.8
Non-Commercial	1,566	81.9	37.8	19.2

- New Choices/Decisions
- New Risks
- New Marketing Channels
- New Relationships
- New Management Skills

Implications: The Farm Sector

- **Traditional producers** - produce biotech commodity products - focus continues to be on commodity markets - maintain characteristics of today's commercial farms
- **Value enhanced product producers** - continue focus on being low-cost producers but seek to enhance revenues, widen marketing by adopting "new" biotech products - management focus become broader, to product selection, market coordination, contracting, negotiation - focus is on margins
- Negotiators/contractors may emerge - a new "go-between" linking farmers and processors - coops may play this role, too.

Implications: The Processing Sector

- Commodity Handling and Marketing
- Bulk Commodity Processors
- Food Manufacturers
- Feed Manufacturers

Segregation / IP Continuum

At one end, high volume commodities, relatively low value, relatively low risk

- examples: wheat, canola, corn

- At the other end, low volume, high value, risky biotech products
  - examples: inedible industrial oils
- IP requirements increase as commercial risk and value increase

Implications: The Consumer/Retail Sector

- Little action evident to date
- Retail - likely greater future focus
  - This is where innovators can expand the sector's "total stakes" may expand the most
  - Question is allocation of biotech benefits
  - Likely focus on nutraceuticals/other 'special foods'
    - Products for elderly nutrition
    - Health focus - lower, better fats/oils
    - Nutrient fortification
    - Other
  - Special issues may emerge

Implications: The Consumer

- Consumers generally accepting of biotech products - Europe the exception
- Early experience with labeling mixed - still to be resolved - may be unnecessary
- Consumer opposition confined to few organizations with narrow concerns
- Price and value still the major drivers
- Niche markets to continue to thrive - organics, natural, non-biotech
- Consumers likely inclined for more value-added products

The Implications

Overarching

The Biotech Revolution: Overarching Implications

- Business restructuring
- Markets and marketing
- International trade policy
- Consumer acceptance

Business Restructuring

- Biotech comes amidst rapid, ongoing business restructuring
  - Production sector (pork, dairy and beef)
  - Cooperative sector (farm supply/marketing, dairy)
  - Agribusiness companies (Cargill/Continental acquisition)
  - Retail sector (Kroger/Fred Meyer merger and Safeway/Dominicks acquisition)
- Biotech-related restructuring becomes an overlay

Monsanto

just bought	DeKalb
owns	Holden's Foundation Seeds
owns	Asgrow
purchased	AgriPro Seeds Wheat Business
owns part of	Calgene
just bought	Delta and Pine Land
has a joint venture with	Cargill, bought Intl Seed Div.

In addition, Monsanto owns Hartz Seed and has licensing agreements with about 200 other companies.

7.7 B. 11's spent since 97

If Delta + Pine Land bought through would 85% of cotton seed industry

DuPont's "Dirt to Dinner" Strategy

Tech	Seed	Chem	Contract Farming	Marketing Value Enhanced	Processing	Consumer
Dupont	Pioneer	Dupont	Optimum Quality Grains LLC Alliana	Opt. Quality Grains/LLC Continental Alliance	Protein Technologies Incorporated	Nutritious Foods, Inc.

Business Restructuring

- Eventual restructuring - how may it occur?
  - Biotech companies expand activity across entire food system?
    - Broad-based across food groups and products?
    - Specialization in one or few commodities/products?
  - Biotech companies expand selectively into food system?
  - Consumer food companies become more active - initiate activity "backward" toward technology companies

Implications: Markets

- Evolution - from commodities to components markets
- Price determinants change - from food/feed fundamentals to component fundamentals
- Farm marketing - price takers to negotiators
- Transparency reduced - contracting expands
- Increased complexity - thinness - reference value
- Information collection/dissemination - value - control

International Trade Policy - Implications

- Much of world commercial agriculture based on trade
- Sanitary and phytosanitary standards (SPS) - must have scientific basis for any food safety standards

  The "Millennium Round" - what more is needed? What clarifications?
- Bans, labeling, novel foods
- Multiplicity of national approval processes (e.g., GMO crop approvals) - a trade hindrance - how to resolve?
- Biosafety Protocol - contradictory with WTO - looming problem?

Consumer Acceptance - Implications

- Widespread consumer acceptance critical to the future of biotech industry
- Acceptance rapid, largely noncontroversial- except in Europe
- Consumer awareness widely varies from country to country - low awareness might suggest support fragile - increases likely harm from any incidents?
- European consumer acceptance - area to watch

Key Considerations - What to Watch?

- Pace of farmer adoption
  Progress in consumer acceptance
  Emergence of pipeline products
  Continued business restructuring
  Role/actions of governments/international bodies

Producers holding the bag.

Sparks Companies, Inc.

Biotechnology: Fundamentally Reshaping the Agriculture, Food and Fiber Industry

Presented to

A Meeting of Policy, Marketing and Trade Assistant Deputy Ministers of Agriculture

by

Beth Brechbill

June 9, 1999

9/MARCH/99

Sparks Companies, Inc.

Biotechnology: Fundamentally Reshaping the Agriculture, Food and Fiber Industry

Final Seminar

November 18, 1998
Washington, D.C.

The Study - Background

Biotechnology-- Why This Study?

- Biotech burst onto commercial scene in 1996
  - Very rapid adoption rate
  - Tremendous potential - much discussed
  - Promises to fundamentally alter food system
- Precipitated rash of business activity

Biotechnology-- Why This Study?

- Key dimensions of change --
  - ✦Reduced production costs
  - ✦Changed product -- increased values
  - ✦New investment requirements
  - ✦New competitive relationships
  - ✦New/different risks and risk management challenges
  - ✦New focus on regulations/policies
- Few products/processes left untouched

Introduction

- Purposes of the study
  - Due diligence--perhaps greatest force affecting the industry in the century. How widespread? What to watch? How to position?
  - Stimulate client thinking--assist assessments, determine relative importance

Study Approach

Major Tasks

- Identify existing biotech products, their characteristics, and applications
- Ascertain products in the pipeline, characteristics and applications (five-year horizon)
- Identify/evaluate implications -- systematically across food system components -- and more broadly.
- Develop composite view (one) of the food industry of the future

Study Tools

- Conventional techniques not applicable
- Not another set of ten-year projections
- Will utilize several tools and techniques as appropriate
  - Personal interviews
  - Telephone surveys
  - Secondary surveys
  - Statistical analyses

Information Sources

- Biotech and agribusiness companies
  - Officials/scientists
  - Investor relations departments
  - 10k, 10q filings
  - Annual report
- Government and university scientists
- Food companies
- Public officials
- Secondary sources

Deliverables

- **Pre-study conference** – reviewed plans for study, identified special areas and issues
- **Comprehensive study report**
- **Post-study seminar** – concluding seminar to review findings and implications
- **Final report presentation** at clients' offices. SCI staff travel to client offices, if requested, to present report and conduct in-house seminars.

Today's Presentation

9:30 am	Welcome and Introductions	
9:45 am	The Study – Background	J. B. Penn
10:00 am	Existing Products and Services Crops Livestock Microbes/Enzymes Nutraceuticals	Scott Richman Beth Brechbill
12:00 pm	Lunch	
1:00 pm	The Implications:	
	Social Issues Group: NGOs	John Baltzer Scott Richman Beth Brechbill
	Commercializing	Beth Brechbill J. B. Penn
3:00 pm	Food System of the future	J. B. Penn
3:15 pm	What's Ahead – What to Watch / Synthesis	Group
4:00 pm	Adjourn	

What Is Biotechnology?

Biotechnology

- The science of shifting DNA in living organisms to modify the genetic make-up for the purpose of creating specific desirable traits.
- The implementation of specific genetic information in an organism to enhance desirable traits that can be passed on to progeny.
- Transgenic - transplantation of a gene from one organism to another - the result is GMOs, LMOs, etc.

Biotechnology

- Commercial development facilitated by the US Plant Variety Protection Act of 1970 - permitted genetic traits and transformation methods to be patented creating private value for intellectual property.
- Subsequent legislation and judicial rulings.

Biotechnology: Early Developments

- **FlavrSavr tomato - introduced 1994 - Calgene**
- **Bovine somatotropin - BST - introduced 1994 - Monsanto**

Biotechnology

- Categories used in report
  - Crops
    - Field crops
    - Vegetables
    - Fruits
  - Livestock
  - Microbes/Enzymes
  - Nutraceuticals (Functional foods)

Biotechnology

- Classification used in report
  - Cost reducing/ yield enhancing
    - Herbicide tolerance
    - Insect/disease resistance
    - Drought/cold/heat tolerance
  - Special product attributes
    - Delayed ripening
    - Reduced bruising
    - Improved shippability
    - Longer shelf life
    - Enhanced flavor/appearance

Biotechnology

- Classification used in report
  - Value enhanced products
    - High oil corn
    - High oleic soybeans
    - Increased solids tomatoes
    - High methionine soybeans

Existing Products

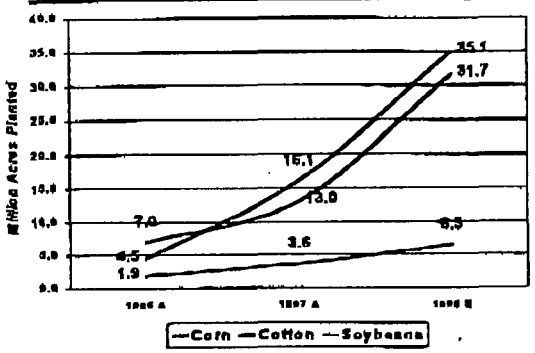
Ag Biotech: A Definition

- Biotech ***broadly*** defined:
  - Defined by characteristics:
    For example, herbicide tolerant crops
  - ***Not*** limited to transgenics:
    Not only genetically modified products

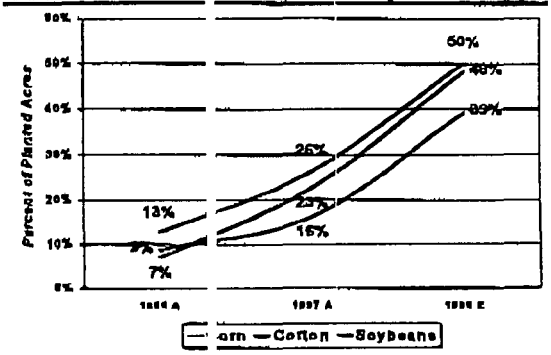
Biotech The First Wave

- IMI Corn comme 'cialized in early 1990s.
- Start of the Biote ch Revolution seen as 1996,
  with commercial zation of major (GMO) crops:
  - Monsanto Roun lup Ready soybeans &
    Bollgard (Bt) cot on
  - Novartis Bt corn

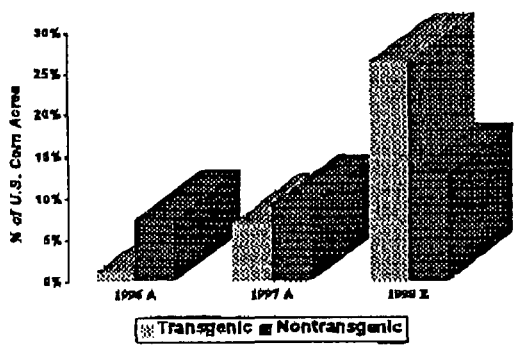
United States: Biotech Acreage



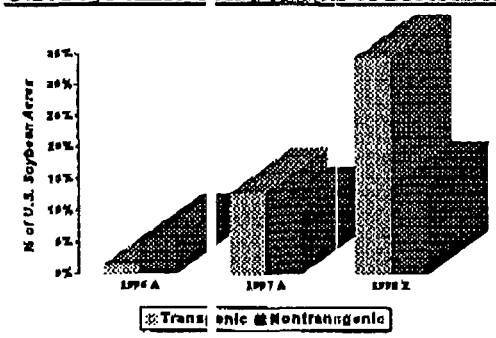
United States: Biotech Adoption Rates



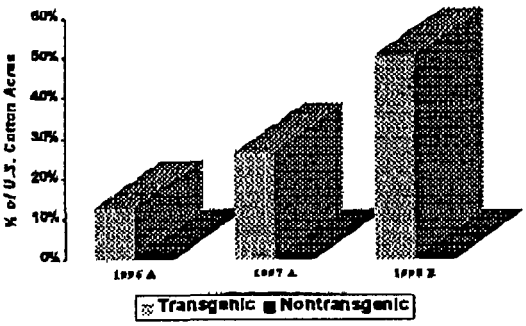
U.S. Corn: Composition of Biotech Acres



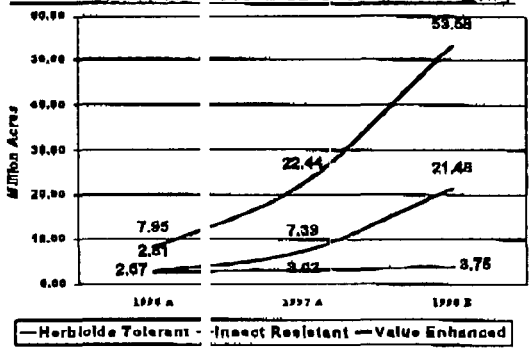
U.S. Soybeans: Composition of Biotech Acres



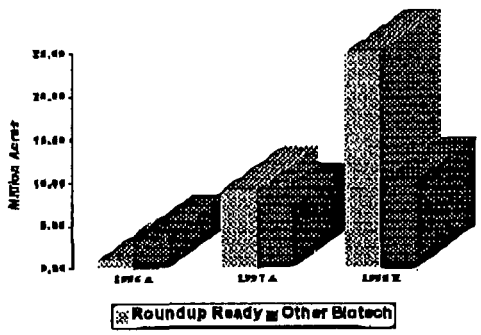
U.S. Cotton: Composition of Biotech Acres



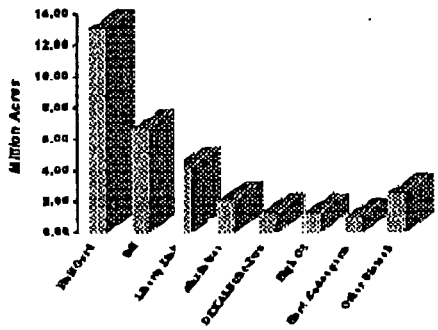
United States: Biotech Acres by Category



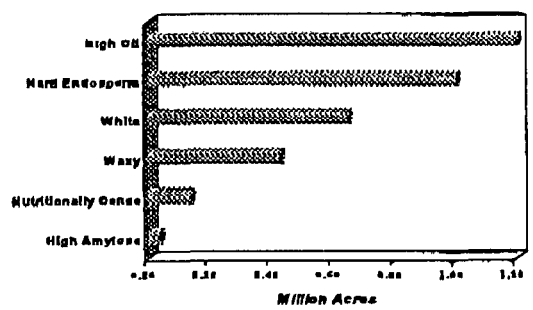
U.S. Soybeans: Key Biotech Products



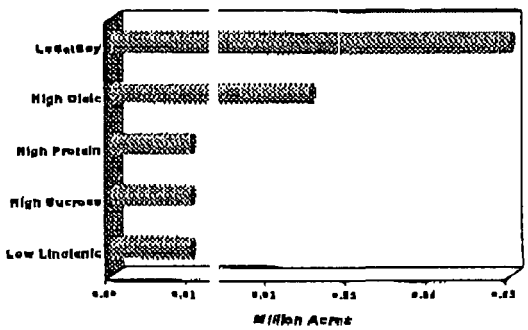
U.S. Corn: Key Biotech Products



U.S. Corn: Value Enhanced Products



U.S. Soybeans: Value Enhanced Products



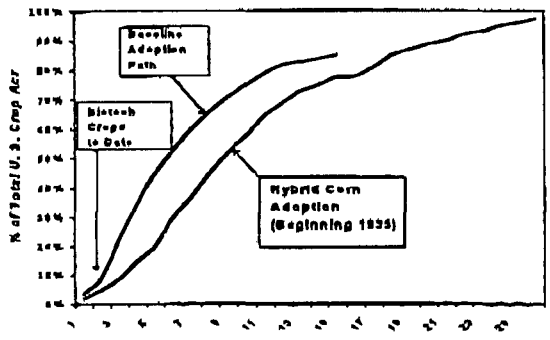
Other Value-Added Non-Biotech Crops

- Optimum Low Saturate Soybeans (DuPont/Pioneer) - marketed under LoSatSoy brand
- Optimum High Sucrose Soybeans - improved flavor
- Optimum High Protein Soybeans - used in tofu, soymilk
- Optimum Low Linolenic Soybeans
- Laurical Canola (Monsanto)
- Waxy corn, high amylase corn, white corn

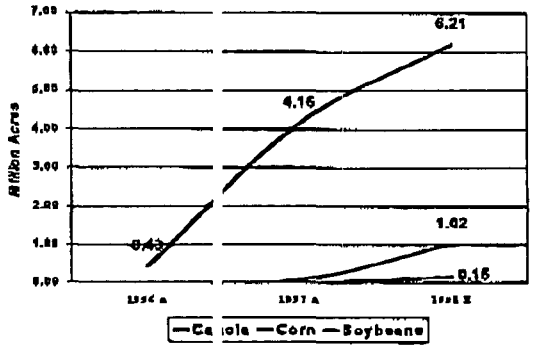
Value-Added Non-Biotech Crops: Acreage > 1 Million Acres

- High-Oil Corn (DuPont)
- STS Herbicide Tolerant Soybeans (DuPont)
- IMI Herbicide Tolerant Corn (AHP/American Cyanamid)

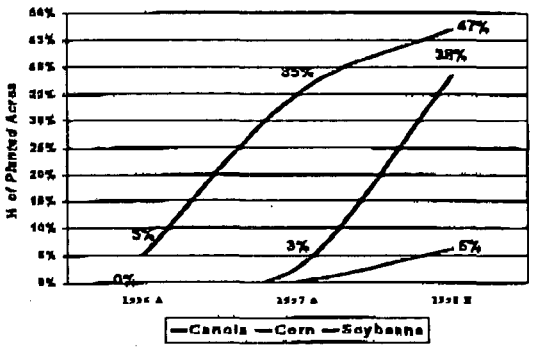
U.S. Biotech Adoption: Where to from Here?



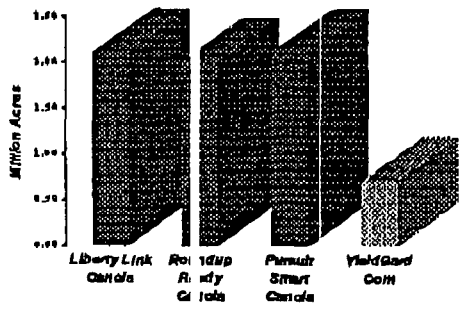
Canada: Biotech Acreage



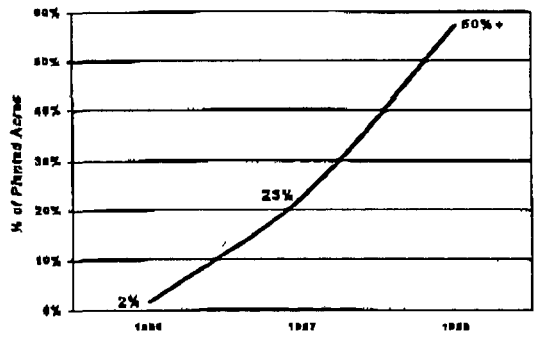
Canada: Biotech Adoption Rates



Canada: Major Biotech Crops



Argentina: Roundup Ready Soybeans



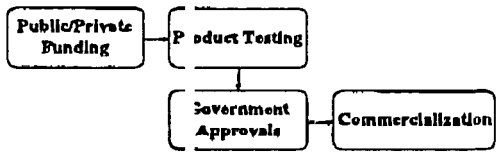
Biotech Crops Worldwide

- Mexico
  - Bollgard (Bt) cotton: 50,000 acres in 1997 (10% of planted acres). May have doubled in '98.
  - Roundup Ready cotton: Still relatively small.
- Australia
  - Bollgard (Bt) cotton: 150,000 acres in 1997 (15% of planted acres). May have doubled in '98.
- Europe
  - Minimal acreage due to current consumer issues
  - Increased Pectin Tomato: Used for tomato paste.
- Brazil
  - Roundup Ready soybeans: Nearing approval, but court challenge. Likely planting 1999 or 2000.

Biotech - The Crops Pipeline

The Pipeline

- A "flow" concept - a continuum



- Returns built on ongoing sequence of products - not one successful trait

Our Analysis of the Pipeline

- Compiled from a variety of sources
  - Company contacts, news releases
  - Publicly available databases - APHIS and OECD
  - Annual reports and SEC filings
  - Other reports, seminars, conferences

Pipeline Research Funding

- Public spending has been declining
  - USDA research budget 1985 $1.6 bil 1998 $1.48 bil
- Private spending on the rise - meeting needs of profitable markets
- Research focus shift - public sector focused on "basic" research
  - USDA/ARS 15% of $711 mil research budget is biotech
  - CGIAR 10% of $355 mil research budget

Research in the Public Sector

- Combination of "basic" infrastructure research and product development work in association with private sector
  - Gene mapping/gene expression/functionality
- Currently 290 active joint projects (CRADAs) between ARS and private companies - about 60% biotech related

Some Current ARS Projects

- Heat tolerance in plants
- Disease resistance/cold tolerance for fruit
- Sucrose accumulation in sugar beets
- Increased essential amino acids in plants
- Improve flavor and composition of soybean for tofu
- Hessian fly resistance in soft winter wheat
- Modification of vegetable oils as raw materials for industrial uses
- Development of carbohydrate polymers for food and non-food (e.g. plastics) products

Plant/Crop Developments - The Next 5 Years - Pipeline Reveals

- Continued focus on input traits - herbicide/insect/disease resistance
- Current biotech traits extended to other products
- Major progress made in value enhanced products - new oil, protein, starch compositions

Herbicide Tolerance

- Continues to be a trait of many pipeline products - companies extend current systems to other crops
- Significant work continues in high-value, high-volume crops - many minor crops in pipeline
- Universities involved - product areas not yet commercialized

Herbicide Tolerance

- Glyphosate tolerant crops

– Alfalfa	Monsanto
– Corn	Several
– Lettuce	Seminis
– Poplar trees	Monsanto, OSU
– Potatoes	Monsanto (2001)
– Canola	Several
– Rice	Monsanto (2002+)
– Sugarbeets	Monsanto (2000)/Novartis
– Tomato	Seminis
– Wheat	Monsanto (2002+)

Herbicide Tolerance

- Glufosinate tolerant crops

– Cotton	AgrEvo
– Canola	Western Ag Research
– Rice	AgrEvo, ARS
– Soybeans	AgrEvo, Asgrow
– Sugarbeets	AgrEvo, Betaseed

- Imidazolinone tolerant crops

– Corn	Pioneer
– Cotton	Boswell
– Rice	Cyanamid
– Sugarbeets	Cyanamid
– Wheat	Cyanamid

Insect Resistance

- European corn borer
- Corn rootworm
- Boll weevil
- Second generation bollworm
- Colorado potato beetle
- Cottonwood leaf beetle
- Mexican rice borer
- Other lepidoptera

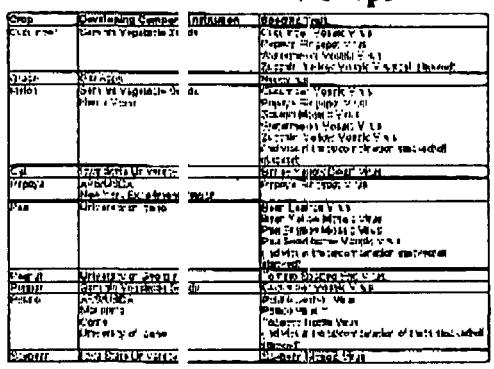
Insect Resistance

- Monsanto plans commercial introduction of rootworm resistant corn (2000/2001), boll weevil resistant cotton (2002)
- Second generation insect control - cotton (2001)
- Less work in soybeans, rice and wheat
- Universities working on eggplants, peanuts, potatoes, poplar trees, soybeans and sugarcane
- Bt toxins specific to insects - must understand genetic makeup of crop and Bt

Disease Resistance

- Significant amounts of damage to all crops from various diseases
- New crops control viruses, fungi and bacteria
- Relies heavily on transfection to create resistance

Virus Resistant Crops



Virus Resistant Crops

- Focus on minor crops - primarily fruits and vegetables
- "Stacked" virus resistant traits - resists several different viruses

Fungus Resistant Crops

- Corn
- Northern leaf blight
- Ear mold
- Gray leaf spot
- Fusarium ear rot
- Mycotoxin
- Smut
- Potato
- Phytophthora
- Verticillium

Fungus Resistant Crops

- Fusarium rot and wilt resistance in corn, wheat, soybeans, tomatoes
- Fruits and vegetables - apples, carrots, eggplants, grapes, raspberries, strawberries
- Strong presence of both private and university research

Bacteri: Resistant Crops

Crop	Developing Cor	any/Institution	Specific Trait
Apple	Cornell Universit		Fire blight resistant
Poplar	Iowa State Univ	ity	Crown gall resistant
Potato	ARS/USDA		Erwinia carotovora resistant
Rice	University of Cal	rnia/Davis	Bacterial leaf blight resistant
Sugarcane	Texas A&M Univ United States Su	sity ar Corp.	Clavibacter resistant
Tomato	Ohio State Unive Purdue Universit	ity	Bacterial speck resistant
Walnut	University of Cal	rnia/Davis	Bacterial leaf blight resistant

Agronomic Property Developments

- Increased yield
  - Corn
  - Canola
  - Rice
  - Wheat
- Other properties include:
  - Corn: Increased growth rate, fertility altered, stress tolerant, increased stalk strength
  - Cotton: Altered maturing, stress tolerant
  - Creeping bentgrass: Aluminum tolerant, drought tolerant, salt tolerance increased

Agronomic I roperty Developments

- Many of the d escriptions are vague, non-descripti e for proprietary reasons - in many insta ices
- Many traits h: ve direct impact on yields
- Examples:
  - More reliable pollination control system - eliminates ne id for detasseling (AgrEvo)
  - Higher yieldir g corn - developed to increase crop yields - (Monsanto 2002•)

Value-Enhanced Products

- Significant potential in the medium and long-term
- Innovations include:
  - Corn with increased amino acid content
  - Cotton with increased fiber quality
  - Canola, soybeans with altered oil profiles
  - Fruits, vegetables with improved shipping and ripening attributes
- Value created for animal feeders, food companies, personal care companies, etc.

Value-Enh: nced Corn Products

DeKalb	Altered amino acid composition Lysine level increased Methionine level increased Tryptophan level increased
DuPont	Carbohydrate metabolism altered Increased phosphorus Protein quality altered Oil profile altered and lysine and methionine levels increased
Monsanto	Carbohydrate metabolism altered Nitrogen metabolism altered
Pioneer	Carbohydrate metabolism altered Increased phosphorus Lysine level increased Methionine level increased Mycotoxin production inhibited Protein lysine level increased
University of Arizona	Nutritional quality altered Anthocyanin produced in seed
University of Minnesota	Oil profile altered Lysine level increased
Rutgers University	Methionine level increased

Value-Enhanced Soybean Products

DeKalb	Protein quality altered Lysine level increased
DuPont	Protein quality altered Carbohydrate metabolism altered Lysine level increased Oil profile altered/Seed composition altered Lysine and methionine levels increased Oil quality altered/Protein altered
Monsanto	Protein altered Seed composition altered Nitrogen metabolism altered
Pioneer	Methionine level increased Seed methionine storage increased
University of Illinois	Protein altered

Value-Enhanced Potato Products

ARS/USDA	Blackspot bruise resistant Nutritional quality altered Steroidal glycoalkoids reduced
Frito Lay	Carbohydrate metabolism altered
Monsanto	Bruising reduced/Carbohydrate metabolism altered Carbohydrate metabolism altered Solids increased
North Dakota State University	Carbohydrate metabolism altered
Rutgers University	Bruising reduced

Value Enhanced Products

- *DuPont/Pioneer* - Optimum Quality Grains - a leader in this "wave"
  - High lysine soybeans (2000)
  - High oil corn + high lysine, methionine (2001)
  - High lysine + high oleic soybeans (2001)
  - High lysine + high methionine soybeans (2001)
- Other products:
  - Low phytate corn - reduces need for phosphorous supplements or phytase enzymes in animal feed - may reduce phosphorous concentration in animal waste

Value Enhanced Products

- *Other products:*
  - Colored cotton - produces colors reducing the need for chemical dyeing - (Monsanto 2002+)
  - Improved fiber cotton - used to make sturdier, better quality cotton fabrics - (Monsanto 2002+)
  - Improved quality potatoes - improved commercial storage properties, less discoloration caused by bruising (Monsanto 2002+)

Biotechnology and the Consumer Food Industry

- Progress slow on consumer-oriented biotech foods
  - Most investment on agronomic traits
  - Researchers know cost-reductions sell
  - Food products appearing slowly
- Next five years
  - Expect significant number of new developments in this area
  - Especially for fruits & vegetables and edible oils

Biotech Food Products Currently on the Market

- FreshWorld Farms Endless Summer Tomato by DNAP - superior color, taste, texture, extended shelf life
- Increased Pectin Tomato by Zeneca - remains firm longer and retains pectin during processing into tomato paste

Other Biotech Food Products Currently on the Market

- FreshWorld Farms Sweet Mini-Peppers by DNAP - sweet taste, deep color, nearly seedless
- Low Linolenic Soybean Oil by Optimum Quality Grains - this oil requires less hydrogenation, thus lowering trans fatty acids in the diet

Biotech Food Products Approved... but Not Yet on the Market

- Quantum Tube s Seed Potatoes by American Ag-te c International are higher-yielding seed p tato varieties
- Squash from S minis Seeds - resistant to several strains of the mosaic virus
- Papaya from C rnell and U. Hawaii - resistant to ring spot virus

Biotech Food Products Expected on the Market in the Next Five Years

Fruits & Vegetables

- Ripening controlled fruits (bananas, pineapples, and cherry tomatoes) by DNA Plant Technology
- High Solids Potato by Monsanto - with increased starch, it absorbs less fat during cooking
- Firmer and sweeter peppers by DNA Plant Tech.
- Fungus resistant bananas by Zeneca
- FreshMarket Tomato by Zeneca - enhanced flavor, color, and antioxidant vitamin content

Biotech Food Products Expected on the Market in the Next Five Years

Edible Oils

- High monounsat rated fats & low saturated fats canola oils by Ca gill/Intermountain Canola
- High stearate & l w saturated fats canola oils by Calgene - will re uce fat, help lower cholesterol
- High stearate so oil by Monsanto - requires no hydrogenation - l ealthier properties for margarine, short nings (2000)
- High oleic corn b Optimum Quality Grains - will make better oil f r cooking applications

Major Breakthrough Products May Be Several Years Away

- Food companies waiting to see what develops, still deciding how they will use biotech
- Biotech companies waiting for signals from food industry
- Longer regulatory process and stronger consumer attitudes for new foods adds another hurdle

Existing Products and a Review of the Pipeline

Livestock

Biotech Today: Livestock & Poultry Benefits

- Bovine somatotropin (BST)
- Cloning: "Dolly" and her successors
- Cloning calves - PPL Therapeutics and ABS Global

Livestock Pipeline Developments

- Embryo Transfer/In-vitro Fertilization
  - More predictable traits and offspring
  - But slow adoption – cost concerns
- Basic Research - Markers
  - Genetic Markers and Market Assisted Selection
  - Ability to determine qualitative traits (coat color) and advances being made on quantitative (growth traits)
  - Lagged due to funding
  - Mapping more developed than determining functionality

Livestock Pipeline Developments

- Cloning
  - New approach developed - nuclei transfer from genetically modified cell cultures
  - Offers potential to improve animal quality and consistency
  - Extensive use unlikely in near term - high technology costs - public acceptance an unknown
- Vaccines
  - Improve animal health - therapeutics
  - Genetic resistance to specific diseases - IBDV, IBV, CAV in chickens; Salmonella in pigs; OvLV in sheep

Livestock Pipeline Developments

- Pharmaceutical Product Production
  - Transforming animals into bio-factories to produce medicines, nutrients
  - Advantages: Relatively low operating costs, unlimited ability to multiply
  - Protein products expressed in milk or eggs
  - Canada's first transgenic dairy animal - goat contains human gene to produce therapeutic protein in milk - Nexia Biotechnologies

Livestock Pipeline Developments

- Product Improvement
  - Promote efficient muscle growth and identify genetic potential for reduced fat and muscle proteins
  - Examples include:
    - Genetically engineered pigs - 30% more efficient and brought to market seven weeks earlier
    - Limit brooding instinct in hens to increase egg production
    - Development of new sheep strain with excellent production traits of one breed and hardiness of another

Existing Products and a Review of the Pipeline

Microbes and Enzymes

Today's Microbes and Enzymes

- Targeted at ag/food processing and animal feed
- Transgenic enzymes
  - Chymosin: biotech version imitates that found in calves used to curdle milk for cheese production
  - Alpha amylase/beta glucanase: used in conversion of grain to ethanol, beverage alcohol and sweeteners
  - Phytase: added to feed to help digestion of phosphorous
  - Rhizobia - alfalfa seed inoculant - increases nitrogen fixation and yields

Microbes and Enzymes: The Pipeline

- Broad range of applications for food and feed industries
  - Ethanol production
  - Transformation of starch into glucose and fructose
  - Improve brewing efficiency and reduce filtration needs - allows reduced use of malt
  - Baking applications - flour supplementation, increased crust color, longer shelf life, strengthened gluten
  - Edible oils - degum oil or produce lyso-lecithin

Existing Products and a Review of the Pipeline

Nutraceuticals

Nutraceuticals Farther Down the Road

- Considered major product innovation of next decade
- Key to development is finding ways to alter products with cost effective biotech methods
- Industry still in formative stages
- Next five years - very few products - but potential is enormous
  - Tailored for specific health benefits
  - Modified to contain vaccines
  - Plant derived pharmaceuticals

Nutraceuticals in Development

- Boyce Thompson Institute developing potatoes, bananas with Hepatitis B, Cholera vaccines
- High Beta Carotene Canola Oil by Monsanto will contain enhanced beta-carotene levels to combat vitamin A deficiency conditions such as night blindness (2002+)
- ARS developing carrots and cucumbers with enhanced beta carotene
- Approval and commercialization several years away

Industrial Products Coming

- Expansion of agriculture to entirely new forms of production
- Industrial chemical production from genetically modified plants is likely in the future
- Possibilities are endless
  - Components of detergents, nylon, glue, paints, lubricants and plastics
  - Biodegradable plastic polymers - Monsanto developing plant varieties designed to produce biodegradable plastics (2002+)
- Plants become "mini-factories"

Global Pipeline Developments

- Canada
  - Input characteristics still dominate research agenda
  - Research heavily focused on canola and mustard
  - Developments in oilseeds, wheat, barley and alfalfa coming
- European Union
  - Development centered in France, UK and Italy
  - Centered on feed crops and oilseeds - some high-value (potatoes, sugarbeets, tobacco) as well
  - Continued development could accelerate product acceptance

Global Pipeline Developments

- South America
  - Most research underway in corn and soybeans
  - Input traits are major focus - herbicide tolerance, insect resistance
- Japan
  - New initiative to support biotech research - especially rice, fruits/vegetables
- Elsewhere
  - Australia - livestock
  - China - field trials underway

The Biotech Revolution: What's At Stake?

The US Food and Agricultural System

Inputs	Farm	Processing/Distribution/Retail			
		Processing	*Transport*	*Wholesale/Retail*	*Food Service*
$337.6b	$60.6b	$1[illegible].5	$36.2b	$302.5b	$139.4b
33.2%	5.6%	16.1%	3.4%	28.1%	12.8%

What's At Stake

- Farmers purchase $72.5 bil of INPUTS
  - Seed $6.3 bil
  - Pesticides $8.8 bil
  - Fertilizer $10.9 bil
  - Livestock $13.2 bil
- Farmers sell $201 bil of PRODUCTS
  - Crops $106 bil
  - Livestock $95 bil

What's At Stake

- Consumers purchase $678 billion of FOOD annually
  - At home $380 bil (56%)
  - Away from home $298 bil (44%)

The Potential "Stakes"

- More valuable production inputs
- Savings to farmers
- Increases in output
- More valuable farm products
- More valuable food products
- Expanded uses - Industrial products

The Potential "Stakes"

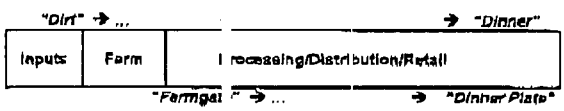
- More valuable inputs — $ billions
  - Technology fees
- Farmer cost savings — $ billions
  - Nematode infestation — $100 bil
  - European corn borer — $1-2 bil
  - Corn rootworm — $1 bil
  - Cotton pests — $720 mil
  - Livestock disease, parasites — $ bil
- Increases in output — $ billions
  - Yield boosts - better pest control
  - Reduced crop/livestock losses
  - Yield increases

The Potential "Stakes"

- More valuable products — $ billions
  - Value enhanced crops/livestock (commodities to components)
- Expanded uses — $ billions
  - More industrial applications
- New food products — $ billions
  - Nutraceuticals
  -

TOTAL — $ BILLIONS

The Potential "Stakes"



- Potential stakes are enormous - across the entire system
- Readily explains "Dirt to Dinner" strategy
- Capture more of the added value created in the farm inputs sector

The Implications

Food System Components

Implications: The Inputs Sector

- Most acreage to date is for herbicide tolerant and/or insect resistant crops.

Implications: Agricultural Chemicals

- Herbicide Tolerance:
  - Roundup Ready
  - Liberty Link
  - IMI/Pursuit Smart (imidazolinone)
  - STS (sulfonylurea)

Implications Ag Chemicals (Cont.)

Soybeans: Herbicide Usage per Treated Acre in the U.S.

	Glyphosate (Roundup)	General Herbicides
1996	↑ 13.1%	↑ 9.3%
1997	↑ 17.4%	↓ 0.7%

Implications: Ag Chemicals (Cont.)

Cotton: Herbicide Usage per Treated Acre in the U.S.

	Glyphosate (Roundup)	General Herbicides
1997	↑ 22.7%	↑ 5.8%

Implications Ag Chemicals (Cont.)

- Insect resistance through insertion of gene from *Bacillus thuringiensis* (Bt)
  - Corn:
    Protects against European corn borer
  - Cotton:
    Protects against tobacco budworms, cotton bollworms and pink bollworms

Implications: Ag Chemicals (Cont.)

Cotton: Insecticide Usage per Treated Acre in the U.S.

	Insecticides Ex. Malathion	General Insecticides
1996	↓ 46.4%	↓ 31.6%
1997	↓ 5.6%	↑ 12.2%

Implications Ag Chemicals (Cont.)

- Findings:
  - Biotech Revolution causing shifts among herbicides
  - Facilitating price cuts and lower herbicide costs to the farmer
  - Permitting a reduction in insecticide usage (mainly cotton) and improved yields (mainly corn)
  - Impacts will continue with commercialization of:
    - More herbicide tolerant brands
    - Second-generation insect resistant crops (e.g., fight rootworm)

Implications: Fertilizer

- Very little impact to date on fertilizer

Implications: Fertilizer (Cont.)

- Future developments that could affect fertilizer usage:
  - Crops modified to require less fertilizer
  - Microorganisms modified to fix more nitrogen or improve nutrient uptake
  - Crops and microorganisms affecting livestock and poultry waste composition

Implications: Fertilizer (Cont.)

- Crops modified to require less fertilizer:
  - Monsanto corn with "altered nitrogen metabolism." Reported to enhance nitrogen uptake by 10%. Recently announced similar work on wheat
  - Purdue researchers have cloned phosphate transporter genes, but only in *Arabidopsis*. Would improve phosphate uptake from soil
  - USDA-ARS identified gene regulating hypernodulation of soybean roots. Would leave more nitrogen for crops grown in rotation

Implications: Fertilizer (Cont.)

- Microorganisms – the other half of the nutrient equation:
  - Research Seeds, Inc. commercialized transgenic rhizobia as alfalfa seed inoculant to increase nitrogen fixation and yields
  - Rutgers & Iowa State research on azospirilla that increase root development in corn to promote nutrient uptake
  - Field trials in 1998 on rhizobia to boost nitrogen fixation in soybeans

Implications: Fertilizer (Cont.)

- Crops/microorganisms affecting livestock/ poultry waste:
  - Low-Phytate Corn improves phosphorous absorption by monogastrics. ExSeed Genetics may commercialize in 1999; Pioneer soon after
  - Adding phytase enzyme to feed achieves similar result. BASF has commercialized. Researching heat tolerant enzyme or coding genes into soybeans
  - Researching grains/oilseeds to reduce fecal nitrogen and odor

Implications: Fertilizer (Cont.)

- Findings:
  - Biotech Revolution will continue to have very modest impact on fertilizer over next 5 years.
  - Low-Phytate Corn and phytase enzyme may be slightly positive for fertilizer sales.
  - However, over the longer term, biotech companies may succeed with crops that have reduced nutrient needs.
  - Potential for blockbuster products like nitrogen-fixing corn appears to be far off.

Implications: Agricultural Equipment

- Very little impact to date on agricultural equipment

Implications Ag Equipment (Cont.)

- Main effect to date: Need to clean equipment when planting and harvesting
  - Issue of varieties that are not approved by importing countries
  - Prevent mixing standard and herbicide tolerant seed
  - In future, maintaining purity and food safety related to value enhanced crops

Implications: Ag Equipment (Cont.)

- Over time, effects on planting and tillage practices:
  - Herbicide tolerant crops enable no-till and other conservation tillage practices
  - Starting to encourage ultra-narrow-row cotton

Implications: Ag Equipment (Cont.)

- Biotech Revolution implications to the agricultural equipment industry are expected to continue to be moderate
  - Reduced machinery wear from conservation tillage and reduction in spraying applications on crops with input traits.
  - Over time, some shift from cotton pickers to less expensive strippers for harvesting.

Implications: The Seed Sector

- Seed industry has been the most dramatically affected by the Biotech Revolution.

Implications: The Seed Sector

- Step 1: Licensing agreements between biotech companies and seed companies
  - At first, "gene providers" and seed companies were separate
  - Biotech companies needed access to seed to sell their technologies to the farmer

Implications: The Seed Sector

- Step 2: Wave of mergers, acquisitions and alliances began in 1996.
  - Commercialization of biotech crops made seed access a necessity
  - Biotech crops met with strong demand from farmers, and early results were positive
  - Race to control the "choke point" of seed supplied to the farmer

The Need for Seed: Activity in 1996

1/96	DowElan o (Dow AgroSciences) purchases 45% of M /cogen; Mycogen receives additiona seed brands
3/96	Monsanto and DEKALB Genetics enter into a strategic illiance, with Monsanto taking an equity int rest
9/96	Monsanto acquires Asgrow from the Seminis subsidiar of Empresas La Moderna
12/96	DowElan o increases its stake in Mycogen, in order t have a controlling interest

Implications: The Seed Sector

- Step 3: Movement to ensure access to seed internationally.
  - South America potentially a large market.
- Step 4: Start to secure access to grain handling and processing capacity that will be needed for value enhanced crops.

Expansion Inte nationally and Along the Ma keting Chain

10/96	Mycogen pu chases Morgan Seeds (Argentina).
8/97	DuPont buys Protein Technologies International from Ralston Purina
11/97	Monsanto ac quires Agroceres (Brazil).
5/98	Mycogen ac uires Dinamilho (Brazil).
5/98	Monsanto, C argill form joint venture to develop and process value enhanced crops.
6/98	Monsanto ac quires Cargill's international seed operations
9/98	AgrEvo buys Cargill's North American seed operations (t ay be reconsidering)

Implications: The Seed Sector

- Will biotech companies vertically integrate into the rest of the marketing chain rapidly?
- Arguments against:
  - Biotech companies have little experience in handling, merchandising and hedging grain.
  - Large grain companies are competitive in a high-volume, low-margin business.
  - It would take considerable financial resources to acquire a large grain company
  - Given the relatively small acreage on which value enhanced crops are currently grown, buying a large grain company would be overkill.

Implicati ns: The Seed Sector

- What about vertic al integration over the longer term?
- Requirements:
  - Value enhanced rop with compelling demand
  - Crop has to be p ocessed to derive products
  - Economics are s fficient to support identity preserved handli g and processing
- Once there is sig ificant acreage of such crops, integration may m ake sense
- For the next 5 yea rs, biotech companies can get benefits of integra ion through alliances.

Implications: The Farm Sector - Markets & Marketing

- Farm Sector
- Grain Handling and Transportation
- Market Structure
- Marketing and Risk Management

General Features

- New Choices Decisions
- New Risks
- New Marketing Channels
- New Relationships
- New Management

The Farm Sector

	Number (thousands)	% of Total	Sales (billions)	% of Total
Commercial	339	16.4	175.6	79.6
Non-Commercial	1,725	83.6	44.9	20.4

The Farm Sector

- Successful farmers have focused on business management
  - Reducing costs, marketing, asset allocation
- Biotech provides:
  - Further reduction of costs
  - New crops (products) with higher revenue/margins
  - Need for new management skills
  - Possible new relationships

Projected Evolution

- Traditional Producers
- Value-Enhanced Producers
- Negotiators/Contractors

Implications: The Farm Sector

- Biotech could precipitate evolution of commercial farmers into two groups:
  - **Traditional producers** - produce biotech commodity products - focus continues to be on commodity markets - maintain characteristics of today's commercial farms

Implications: The Farm Sector

- **Value enhanced product producers** - continue focus on being low-cost producers but seek to enhance revenues, widen marketing by adopting "new" biotech products - management focus become broader, to product selection, market coordination, contracting, negotiation - focus is on margins
- Negotiators/contractors may emerge - a new "go-between" linking farmers and processors - coops may play this role, too.

Implications: Operations

- Biotech will affect all farm types
- Management
  - Skills
  - Asset utilization (capital, labor, resources)
  - Information
- Transactions
  - Contracting / Negotiating
  - Risk Management
  - Strategic alliances / JVs

Implications: Structure

- Farm consolidation
  - Advantage to early adopters
  - Relentless cost pressure
- Biotech benefits - capitalized in land values
- More stringent IP and segregation requirements
- Vertical integration
  - Closer ties - coops and companies
  - Increased requirements

Implications: The Farm Sector

- Outstanding concerns/issues
  - Concentration/consolidation - family farm structure
  - "Independence" of the farmer - contract producers
  - The farm land investment - Who makes it? Why?

Cultural Issue

- Crops that cross pollinate may be impossible to segregate in the field
- Example: Standard canola (with low erucic acid content) and high erucic acid canola (being developed)
- Growing these in close proximity to each other runs the risk of contaminating one or the other or both

Resistance Factors

- Education / Skills
- Risks
- Farmer Independence - Family Farm / Rural Fabric
- Farm Enterprise Financing

Grain Handling and Marketing

- Scientific Viability vs Economic Viability
- Segregation and Identity Preserved Requirements
- Marketing
- Grain Flows
- Risk Management
- Role of the Grain (elevator) Company

Agronomic Traits

- Economically Viable
- Limited Segregation and/or IP Requirements
- Grain Flows Not Significantly Altered
- Minimal Marketing Issues
- Typical Risk Management Approaches
- Typical Role for Grain Company

Value Enhanced Traits

- Scientific Viability vs Economic Viability
- Continuum of increasingly onerous implications:
  - Segregation / IP
  - Grain flows
  - Marketing approaches
  - Risk / risk management
  - Role of the grain company
  - Costs

Segregation / IP

- Transgenics and Transgenics
- Transgenics and Non-Transgenics
- Import Restrictions
- Valuable Traits
- Risky Traits

Segregation / IP Continuum

- At one end, high volume commodities, relatively low value, relatively low risk
  - examples: wheat, canola, corn
- At the other end, low volume, high value, risky biotech products
  - examples: high value, high risk
- As commercial risk and value goes up, IP requirements also increase

Grain Flows

- As risk and value increases, there is an incentive to withdraw from the bulk handling system
- Examples:
  - Containerization
  - Production of a biotech crop contracted in close proximity to the processor - the product does not enter the bulk grain handling system at all

Role of the Grain Company

Commodity Merchandiser	*IP Handler / Manager*
Typical Approach	Atypical Approach
– Simple segregation requirements	– Strict IP requirements
– Hedging price risk	– No price risk
– Merchandising opportunities	– No merchandising opportunities
– Manages system to earn a positive margin	– Handling for a fee or "toll"

Handling Margins

- Typical grain merchandising is multifaceted
  - Hedging; arbitrage; blending
- IP Programs could lead to handling for a fixed fee
  - Cover IP costs; no price risk; no merchandising opportunities

Gross Handling Margin for a VE Grain Under an IP Program

M_{ve} =
Margin for standard commodity;
- minus price risk factor;
- plus IP risk factor;
- plus blending opportunity factor;
- plus futures trading/hedging factor;
- plus arbitrage factor;
- plus transportation and logistics factor;
- plus IP program cost factor;

weighted by the proportion of the facility used by the IP program;
PLUS

Gross Handling Margin for a VE Grain Under an IP Program

- plus IP risk factor;
- plus blending opportunity factor;

weighted by the proportion of the facility not used by the IP program;

divided by the proportion of the facility used by the IP program.

Gross Handling Margin for a VE Grain Under an IP Program

$$M_{ve} = \frac{[(S_{ve})(M_{comm}-R_{bc}+R_{ip}+O_p+O_f+O_{arb}+O_d+C_{ip})]+[(1-S_{ve})(R_{ic}+O_h)]}{S_{ve}}$$

Grain Handling

- Commodity merchandising and biotech grain handling under IP programs can (and do) co-exist
- Little evidence to suggest that the grain handling system will be reconfigured to handle value enhanced grains
- Some isolated examples of companies selecting elevators to be dedicated to a program
- On balance, biotechnology will increase the amount of grain handled in the commercial system

The Birth of a New Market

- Phase One - The Introduction:
  - Market Pioneer provides the seed and takes the production
  - Very few farmers get involved - early adapters
  - Farmers grow crop with priced production contract
  - Market Pioneer provides a great deal of agronomic assistance
  - Risk of moral hazard is very low; low price volatility
  - Relevant information available only from the Market Pioneer

The Birth of a New Market

- Phase Two - The Evolving Market:
  - Additional buyers - competition
  - More farmers as well
  - Farmers will contract some production, but will leave some "open" - unpriced and uncommitted
  - Increased risk of moral hazard; increased price volatility
  - Relevant information now available from more sources

The Birth of a New Market

- Phase Three - The Mature Market:
  - Many buyers; many producers
  - Farmers will not use production contracts at all - will use price contracts if available (flat price or basis)
  - Many will leave an increasing amount of production "open"
  - Risk of moral hazard reduced (but not eliminated)
  - Easy access to relevant information

Risk Management and Price Discovery

- Most novel trait crops will be priced relative to their "standard" parent
  - End-use value will be related to the standard commodity
  - Biotech product must compete for acreage base
- Use of standard hedging tools (futures and options) will be applicable
  - With a premium over standard commodity to cover additional risks and possibly higher production costs

Implications: The Processing Sector

- Three segments of the processing sector:
  - Bulk Commodity Processors
  - Food Manufacturers
  - Feed Manufacturers

Implications: Bulk Commodity Processors

- Yield enhancing/cost reducing crops:
  - Little effect on bulk commodity processors
  - Effects are mostly on marketing chain segments from inputs through the farm gate
  - Directly affect processing only if the grain is not approved for import into other countries
  - Indirectly, these crops reduce farmers' production costs, and may reinforce the trend toward high throughput among many bulk processors

Implications: Bulk Processors (Cont.)

- Value Enhanced Crops:
  - Over the long term, value enhanced crops with the economics to support identity preservation will be able to carve out markets.
  - A segment of US processing capacity will handle such crops, while the rest focus on commodities.
  - Where value enhanced crops are processed, heightened, managerial, operational, marketing and risk management skills will be necessary.

Implications: Bulk Processors (Cont.)

- Will the process ng of value enhanced crops take place at "de dicated" facilities?
  - Difficulty in conc ucting runs of standard and value enhanced grain sequentially at one facility.
  - Also, ignoring tr ditional customers
  - Only after suffici nt acreage and economics will anyone be willin to dedicate a facility.
  - First facility ded cated to value enhanced crops will have "first m over" advantages/disadvantages.
  - Potential for "mi li-mills"

Implications: Food Manufacturers

- Very little effect from yield enhancing and cost reducing crops
- Will make clear-cut decisions about using ingredients from value enhanced crops.
  - Use small number of suppliers that can meet specifications and practice quality management.
  - Likely to have long-term contracts with suppliers, though price may be tied to the market.
  - Hesitant to change labels except for marketing reasons, including health claims.
  - Ingredient must add value for the processor and must be accepted by consumers.

Implication : Feed Manufacturers

- Very little effect f om yield enhancing and cost reducing crops
- Value enhanced grain and other ingredients will compete bas d on nutrient content and cost against star dard commodities.
  - Least cost form lations
  - Will want to see results of feeding trials with biotech ingredie nts.
  - No issue of acc ptance from initial consumer, but if backlash at gr cery or restaurant, integrators will be most affe ted.

Implications: The Consumer

- Consumers generally accepting of biotech products - Europe the exception
- Early experience with labeling mixed - still to be resolved - may be unnecessary
- Consumer opposition confined to few organizations with narrow concerns
- Price and value still the major drivers
- Niche markets to continue to thrive - organics, natural, non-biotech
- Consumers likely inclined for next wave - nutraceuticals

The mplications

O verarching

The Biotech Revolution: Overarching Implications

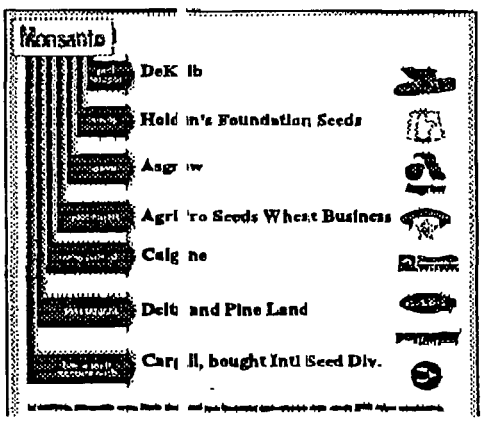
- Business restructuring
- Markets and marketing
- International trade policy
- Consumer acceptance
- Agriculture research and extension
- Developing countries
- The environment
- Financial services

Business Restructuring

- Biotech comes amidst rapid, ongoing business restructuring
  - Production sector - pork, dairy and beef
  - Cooperative sector (farm supply/marketing, dairy)
  - Agribusiness companies (Cargill/Continental acquisition)
- Biotech-related restructuring becomes an overlay

Business Restructuring

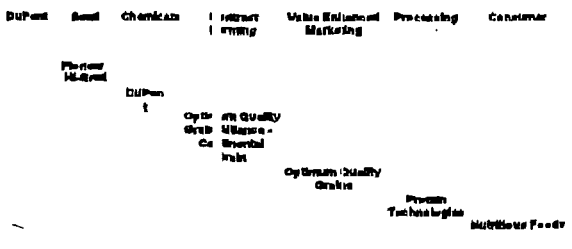
- Largely confined to inputs sector - agricultural chemical (biotech) and seed companies
- Actively focused on biotech companies:
  - Broadening IP base
  - Gaining distribution system (seed companies) for new technology to farmers
  - Pesticide companies reinvented as "life sciences" companies



Business Restructuring

- What's ahead - the potential "stakes" become the drivers
- Potential "stakes" suggest opportunity extends beyond inputs and farm sectors - all across the food system
- Two long-term strategies revealed
  - DuPont "Dirt to Dinner"
  - Monsanto "Farmgate to Dinnerplate"

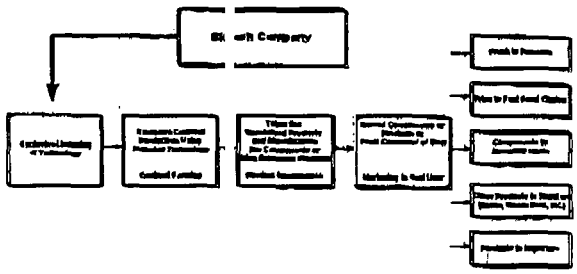
DuPont's "Dirt to Dinner" Strategy



Business Restructuring

- Eventual restructuring - how may it occur?
  - Biotech companies expand activity across entire food system?
    - Broad-based across food groups and products?
    - Specialization in one or few commodities/products?
  - Biotech companies expand selectively into food system?
  - Consumer food companies become more active - initiate activity "backward" toward technology companies

A New Stru :ture for the Food and Agricultu al System (Potatoes)



International Trade Policy - Implications

- Much of world commercial agriculture based on trade
- Sanitary and phytosanitary standards (SPS) - must have scientific basis for any food safety standards
- The "Millennium Round" - what more is needed? What clarifications?
- Bans, labeling, novel foods
- Multiplicity of national approval processes (e.g., GMO crop approvals) - a trade hindrance - how to resolve?
- Biosafety Protocol - contradictory with WTO - looming problem?

Consumer Ac(eptance - Implications

- Widespread cor sumer acceptance critical to the future of bio ech industry
- Acceptance rap d, largely noncontroversial- except in Europ :
- Consumer awai eness widely varies from country to coun y - low awareness might suggest suppor fragile - increases likely harm from any i icidents?
- European cons mer acceptance - area to watch

Agricultural Research and Extension - Implications

- Public/private shift in research spending
  - Reflects chronic budget pressures and philosophy
  - Advent of PVPA of 1970 - patenting IP
- Increased public/private collaboration - CRADAs, other
  - Increased future sharing of commercial returns to bolster budgets
- Increased public/private partnering (e.g., UCB/Novartis)

Agricult ıral Research and Extensi)n - Implications

- Concentration in arming and biotech likely change role of e: ension services
  - Fewer opportun ies in large-scale commercial farming
    - Role as technic il advisors declining
    - Role as market advisors declining
  - Continued oppc tunities in niche areas - organics, non-b otech, natural farming systems

Agricultural Research and Extension - Implications

- Intellectual property rights
  - US - "Hand of Man" 20 years patent
  - International - likely looming issue
  - Lawyers dream -- disputes more prevalent
    - The stakes - huge R&D investment
    - Relative ease of "copying" new innovations
  - Numerous cases pending

Agricult ıral Research and Extensi ɔn - Implications

- Other implicatior ɜ
  - Will biotech foc ıs siphon support from other agricultural disc plines?
  - Can universitie: maintain integrity and creative independence ı ıith increased partnering?
  - What does this mply for basic research?
  - How are public rivate returns shared?

The Developing World - Implications

- Potentially controversial area
- Offers tremendous potential benefits
  - Greater quantities of cheaper food - reduced hunger and malnutrition
  - Reduced environmental degradation - less pressure on resources, fragile areas, reduced pesticide use, reduced water pollution

The Developi ıg World - Implications

- Raises concern ɜ for some
  - Benefits go to (eveloped world farmers - widens the income dis| arity
  - Little biotech d| velopment yet for developing country crops
  - IPR could slow transfer of improvements to developing cou ıtries unable to afford them
  - Use of the "ter ıinator gene" - CGIAR excludes it
  - Loss of indiger ɔus crops as biotech crops become wides| read

The Environment- Implications

- Offers tremendous potential benefits
  - Reduced pesticide use - reduced water pollution
  - Higher output - reduces strain on land resources (rainforest, fragile economies, etc.)
  - Reduced energy use - fewer field passes
  - Reduced soil erosion - encourages conservation tillage
  - Reduced chemical fertilizer use - nitrogen fixation
- Gives rise to some concerns
  - Superbugs and superweeds - may develop resistance
  - Gene flow ("jumping") and biological pollution - creating unwanted plants

Financial Sɛ rvices - Implications

- Financing farming ɜ nd the food industry - structural shifts make this inc easingly unclear - biotech further complicates
- Small number of la ge, sophisticated farms have specialized needs
- Future role of ...
  - Conventional len ers - shifting market shares
  - Biotech compan| s as "integrators/financiers"?
  - Coops as "franch sees"?
- Closely tied to shift ıg incidence of risk (old and new)
  - Who bears it?

Food System of the Future - One View (2003)

- Widespread adoption of biotech crops
  - US-Canada/Latin America/Japan/Australia - Europe too
  - "First wave" crops broadly adopted - "Second wave" growing rapidly
  - Biotech commodities continue to predominate, but components markets grow
  - Increasing activity in livestock products

Food System of the Future - One View (2003)

- Commercial farm sector moving quickly into two distinct groups
  - Traditional commodity producers - focus on costs/efficiency, continue utilizing commodity markets
  - Value enhanced product producers - focus on both costs and on premium products for higher revenues, wider margins - contracting prevalent, new sources/methods of financing, new risk management strategies emerge
  - Activity in livestock sector expands
  - Niche markets continue - for organics, natural foods, and even non-biotech crops

Food System of the Future - One View (2003)

- Business restructuring continues
  - Further consolidation occurs among biotech/seed companies - farm machinery/fertilizer players remain little affected
  - Biotech companies pursue strategy of capturing added value - expand operations across food system segments - through mergers, acquisitions, alliances become broad-based food companies
  - Specialization tends to occur - early leaders in a crop area tend to become predominant in the crop and its components/products

Food System of the Future - One View (2003)

- Food system structure slowly evolves
  - Distinction between components begins to blur for some crops/products
  - Overall system expands as more value added throughout
- Consumer acceptance continues - becomes firmer - more and newer products accepted

Key Considerations - What to Watch?

- Pace of farmer adoption
- Progress in consumer acceptance
- Actions of regulatory bodies
- Emergence of value enhanced products
- Episodes and events - backlash
- Activity in consumer end of food system
- Research activity/product approvals/introduction
- Nutraceutical and industrial product emergence
- Role/actions of governments/international bodies
- Developing country adoption and reaction

Synthesis: Striking Factors

- Biotechnology is unlike any technological advancement seen thus far in agriculture
- The acceptance of biotech in North America has come early and with little protest
- The fast pace of adoption of existing products
- The industry's response
- The enormity of the pipeline
- The rapid extension of the successes
- Disparity between crop and livestock products

Synthesis: Striking Factors

- The potential of nutraceuticals
- The long reach of the implications
- What's at stake
- Where everyone will fit
- Restructuring yet to come
- The farm inputs sector
- Environmental impacts
- Public/private sector research
- More international harmonization logical

Sparks Companies, Inc.

Biotechnology: Fundamentally Reshaping the Agriculture, Food and Fiber Industry

Final Seminar

November 18, 1998
Washington, D.C.

CFIA ACIA
CANADIAN FOOD INSPECTION AGENCY
AGENCE CANADIENNE D'INSPECTION DES ALIMENTS

OFFICE OF BIOTECHNOLOGY
59 Camelot Drive
NEPEAN, ONTARIO
CANADA
K1A 0Y9

BUREAU DE LA DE LA BIOTECHNOLOGIE
59 rue Camelot
NEPEAN (ONTARIO)
CANADA
K1A 0Y9

DATE: January 12, 1999

DISTRIBUTION TO: Plant Biotech Office (also circ to PHRA, Feeds, Fertilizers)
Keith Robinson, International Affairs
Gerry Reasbeck, Consumer Protection & Food Policy Coord.
Veterinary Biologics and Biotechnology Section

Also sent AAFC Dalia Billy Harold Gary Jan

FROM: Nora Nishikawa

RE: SPARKS REPORT AND PROPOSED SEMINAR

The AAFC Economic Policy and Analysis Directorate was the client of a SPARKS Co. Inc. syndicated study on biotech, agriculture and future trends. On their behalf, we have distributed one full copy of the SPARKS final report to you for internal use within your group. If you have any questions about the report or the study process, Jamie Oxley, tel: 759-7428 was the EPAD representative to the study client group.

For your info, Jamie Oxley is coordinating with SPARKS for a presentation on the report. The seminar including a Q&A session will likely be held the first week of February at AAFC-Sir John Carling. EPAD will post a seminar announcement shortly. Colleagues from DFAIT, Industry Canada and Health Canada will also be invited to this seminar.

Finally, you will note some intermittent symbols "B"s and "= 's" in the report text. Unfortunately, these are the result of the report conversion to a hard copy. If you require additional copies, the electronic version of the document is available.

From: Jamie Oxley
To: Nishikawa, Nora
Date: 1/5/99 9:56am
Subject: Re: Sparks Biotech report -Reply

Tanks Nora... I've provided answers to your question below in bold letters.

>>> Nora Nishikawa 01/05 8:34 am >>>
Thank you for the Sparks report. It looks huge. I will add the files to our weekly biotech report which we distribute on Thursdays. At the same time, we will ask about interest in a presentation by Sparks and I will get back to you the next week as to the level of interest. I suspect that we will find at least 15-20 people who would be interested to attend.

I do have a few questions.

1) As this is a syndicated study, I want to check with you that the report files are okay to forward to external interdepartmental biotech contacts. Your email indicates that such contacts could have the report and would be welcome at the presentation. If the whole report is limited to internal distribution, I would like to pass them at least the synopsis to give an indication of the presentation content.

This was a multi-client funded study, where paying clients implicitly have first rights to the information within the report. Thus to respect this right, the report should be treated as an internal Gov't of Canada document, not for immediate distribution to private sector.

2) When were you thinking of asking Sparks to present? If it depends on interest from our biotech network, I would suggest the end of the month. If you have a specific date in mind - I could add it to Thursday's email
Sparks would be prepared to come the end of this month or early next month. Have you a preferred date(s)?

3) Would the format be a presentation and then Q&A? How long would the seminar be ? About 2 hours?

I think so...

If you decide to go ahead with the presentation, I would suggest that you do up a quick little seminar poster and send to us electronically. We could make sure are biotech network were distributed the info. This was done by Marie Biron for the Designer Genes presentation by Angus-Reid and it worked quite well to attract an audience.

Nora

>>> Jamie Oxley 01/04/99 01:03pm >>>
Nora:

As per my voice-mail message, here's the Spark's report (in Microsoft Word 7.0) on Biotechnology. Could you please forward to committee members and other interested gov't officials.

As I mentioned, we would like to invite Spark's representatives up to give a seminar. Could you please survey the committee to see if there would be interest?

Thanks,

Jamie Oxley

Sparks Companies, Inc.

Memphis, Tennessee

Washington Office
6708 Whittier Avenue
McLean, Virginia 22101

(703) 734-8787
Fax: (703) 893-1065

July 28, 1998

Memorandum

To: **Biotechnology: Fundamentally Reshaping the Agriculture, Food and Fiber Industry Multi-Client Study Participants**

Regarding: **Inaugural Meeting Materials**

We certainly enjoyed meeting those of you who attended our July 15 inaugural seminar for the Biotechnology study and are sorry that we did not have the opportunity to meet those of you who could not attend. The meeting provided a good forum to learn more about the participating clients, their companies and specific interests. We especially value the input we get from each of you – what you expect to take away from the project and how it can be more useful to your business.

As promised, we have compiled the comments from that meeting and will focus on these throughout the study. These are enclosed along with the presentation materials from the meeting, a general study outline and a list of participants to date.

We will keep you abreast of our progress with the study over the next few months and look forward to working with you throughout this process. If you have questions or need assistance, please do not hesitate to contact me.

Sincerely,

J. B. Penn
Senior Vice President

Nora,
As per our telephone conversation, here's a copy of materials from the 1st meeting to Sparks. Please forward to Margret Kenny & other members of the CBS working group

Thanx
Jane.

Sparks Companies, Inc.

Biotechnology: Fundamentally Reshaping the Food and Agriculture Industry

Inaugural Meeting
July 15, 1998

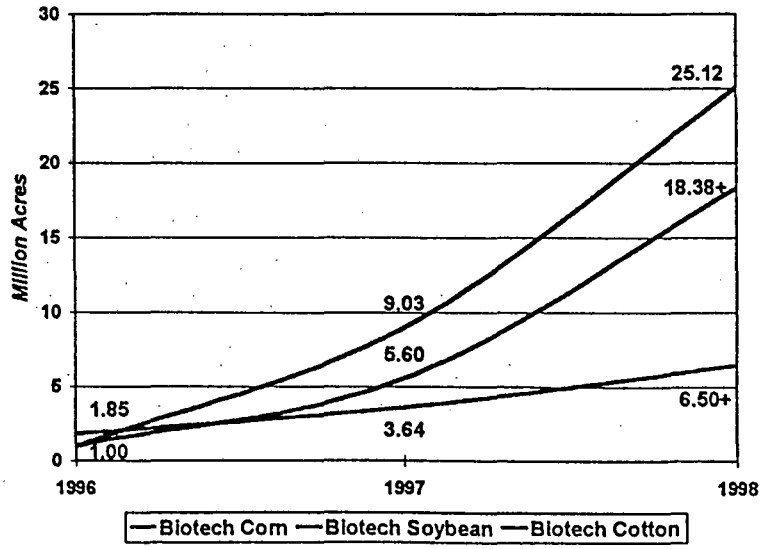
Welcome/Introductions

- Introduce SCI staff
- Client introductions
- Agenda for the day
  - Multi-client study format
  - Identify major issues/problems of broad concern
  - Develop prospectus--enroll participants
  - Study products:
    - Initial seminar--solicit client input
    - Comprehensive study report
    - Final seminar--present study findings
    - Individual client seminar (if requested)

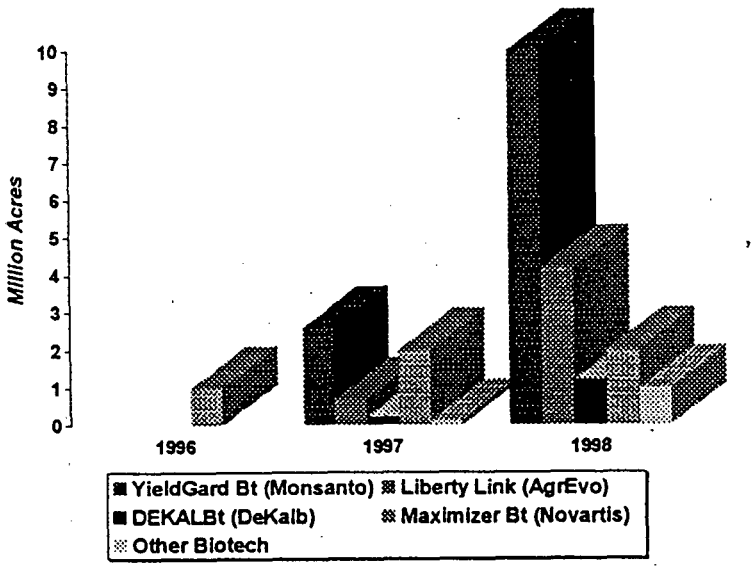
Biotech: The First Wave

- Biotech narrowly defined as genetically modified.
- First commercializations for major crops in 1996:
  - Monsanto Roundup Ready soybeans & BollGard Bt cotton
  - Novartis Bt corn

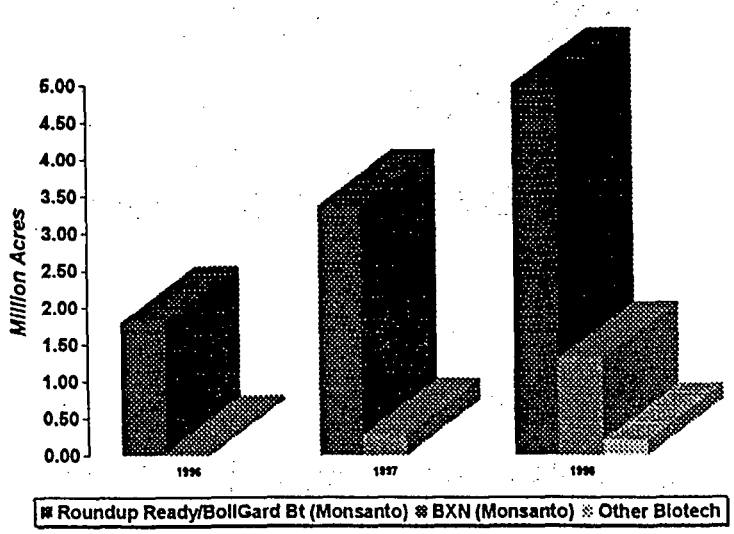
Biotech: The Acreage Take-Off



Corn: Key Biotech Products



Cotton: Key Biotech Products



Other Value-Added Non-Biotech Crops

- Optimum Low Saturate Soybeans (DuPont/Pioneer)
- Optimum High Sucrose Soybeans (DuPont/Pioneer)
- Optimum High Protein Soybeans (DuPont/Pioneer)
- Optimum Low Linolenic Soybeans (DuPont/Pioneer)

Biotech: Livestock & Poultry Benefits

- **Bovine somatotropin (BST)**
- **Cloning: "Dolly" and her successors**

Business Restructuring - Changing the Face of US Agribusiness

- Step 1: Seed, chemical companies vie for position
  - Increase market share
  - Gain access to technology
- Step 2: Linkages of biotech firms to processors, marketers
- Step 3: Food companies demand improved, value-added food products

Merger Mania in the Industry

1/97	Monsanto buys Holden's Foundation Seeds
8/97	DuPont, Pioneer agree to research alliance, joint venture company (Optimum Quality Grains)
8/97	DuPont buys Ralston Purina's Protein Technologies International
5/98	Monsanto acquires DeKalb & Delta and Pine Land
5/98	Monsanto, Cargill announce grain processing joint venture
6/98	Monsanto, American Home Products merge
6/98	Monsanto buys Cargill Intl. Seed Operations

Intellectual Property Rights

- Patent challenges - lawsuits, countersuits abound
- Example: US Patent Office granted over 200 patents for Bt use
  - Nearly 40 groups have legal right to one piece of overall process
- Sterile seed patent debate emerges
- Some 20 outstanding disputes today among seed, chemical, technology companies
- Large legal expenses
- New precedents set

Consumer Acceptance

- Surveys reveal biotech not major issue with US consumers
  - Favorable response to products with better flavors, reduced use of pesticides, no insect damage
- Public awareness in US remains low
- Worldwide - cultural, economic differences make acceptance slower
- Education seen as key to public acceptance
  - Monsanto ad campaign in Europe

Trade Relations Strained

- Despite labeling action, EU members still deciding positions
  - Swiss referendum favored biotech research - reaction to Europe's lagging in the industry
  - French "citizen's conference" offered lukewarm support for two corn varieties - GOF issued same cautious approval - final decision to come this month
  - US claims $200 million in lost corn sales - lost tender in Spain, Portugal

International Acceptance

- Approval process for products country-by-country -- a cumbersome process
  - Canada, Japan, Mexico, Argentina, Australia planting significant acreage to biotech
- Convention on Biological Diversity - from 1992 UN Rio Summit
  - Access to genetic resources by developing nations
  - Safe transfer, handling and use of GMOs
- Harmonized international standards - WTO/SPS

How to Focus Issues?

- Impacts will be systemwide --
  - Inputs/services
  - Farms
  - Processing -- Marketing -- Distribution -- Other Services
  - Consumers
  - World -- e.g. Food Security for Developing Countries
- Overarching Issues
  - Policy
    - Farm/Food/Trade
    - Regulatory/Environmental
  - Institutions/organizations
  - Anti-monopolistic

Food Sector Overview

- It is enormous -- nearly $983 billion GDP
  - Nearly 23 million jobs;
  - $55 billion exports;
  - More than $27 billion balance of trade (1996).
    - Farming is central, but only 6% of total:
    - Upstream (inputs) is 33%
    - Downstream (processing) is 61%.

Farm Sector Overview (Numbers and Size), 1980-95

	1980	*1985*	*1990*	*1995*	*Annual change: 1990-85*	*1995-90*
Farm numbers	*1,000 units*				*percent*	
Commercial	271	326	321	341	-0.3	1.0
Other	2169	1966	1819	1729	-1.3	-0.8
Total	2440	2292	2140	2070	-1.1	-0.6
Land in farms (mil acres)	1042	1012	987	972	-0.4	-0.3
Average farm (acres)	426	441	461	469	0.7	0.3
Commercial farm (acres)	1549	1575	1550	1564	-0.3	0.1

Marketing Bill -- Domestically Produced Foods

Year	*Farm Value*	*Marketing*	*Total*
	bil $		
1950	18	26	44
1960	22.3	44.6	66.9
1970	35.5	75.1	110.6
1980	81.7	182.7	264.4
1990	106.2	343.6	449.8
1994	109.6	401	510.6

Farm Value -- 41% in 1950
-- 31% in 1980
-- 21% by mid-1990s

"The biotech revolution means another rural revolution -- the virtual end of today's service structure."

- "Big-ticket items -- machinery, bulk chemicals, seeds -- will be sold regionally or nationally."
- "Local dealers must compete with increasingly efficient farmers for the market for services."
- "Cooperatives must focus on non-commercial producers in many areas, or see their markets dwindle."
  - Will non-commercial producers become increasingly dependent on off-farm services to have access to new technologies?

"The future inputs distribution chain will be much shorter. Which stage will disappear?"

- Will the four-stage system (national, regional, district, local) be reduced to three -- or fewer?

- Will the **district wholesaler** --who has less opportunity to develop ways to add value for large producers -- likely disappear?

- What other changes in the chain can we expect?

"Commercial farm financing will become a key area of competition for the future."

- New technologies cost more, more financial support needed?
  - Costs per farm will grow?
- Conventional lenders will face greater demand for credit, and demands for greater flexibility
- Credit terms increasingly important?
  - Credit always a competitive tool
  - Credit terms/broader support increasingly important tool

"The biotech revolution will largely by-pass the small farm, and will mean the demise of many."

- Most farms are small. They--
  - Depend on non-farm income
  - Frequently have a loss from farming
  - Are heavily livestock oriented (85% of livestock operations 92% of cattle operation)
  - Are heavily family owned
- Are these units prepared to invest in new technology?
- Are there new institutions that will help them accommodate to new markets, new competition?

"Consumer demand -- the search for new niche markets -- will really drive the system after 2000. By today's standard, markets will be much more volatile."

- What will drive consumer markets in the future? Concerns about --
  - ✦ Health?
  - ✦ Product appearance/freshness/color?
  - ✦ Services/pre-prepared?
  - ✦ Organic preparation?
  - ✦ Ethnic preferences?
  - ✦ Relative cost?

◆ How will processors reduce risk of filling these market needs?

"Consumer acceptance of biotech is shallow -- few understand it, most mistrust it. A major challenge is likely in the next few years."

- Could new "Delaney-like" restrictions arise?
  - ✦ Would they matter?
- Could test requirements become more stringent, especially difficult for small firms?
- Could rules arise that outlaw some biotech on moral or ethical grounds?
  - ✦ Animal rights activists efforts continue? Focus on biotech?

"Trade policy concerning biotech products will continue to be a severe problem. Where 'Green' groups are important, they will never quit opposing GMO products."

- Will local overseas groups' needs for biotech to be competitive provide the support needed to open key markets?
- Will foreign opposition to biotech find a foothold in the US?
- How vulnerable does the rapid acceptance of biotech make US producers in world export markets?

"The biotech revolution will increase the direct cost of technology. Will it make small farmers in developing countries who cannot afford it less competitive, more dependent on imports and less secure?"

- How important will "gene fees" become as a production cost element?
- Will productivity increases for "low technology" producers offset technology costs as for "high technology" farmers?
- Will the long-term impact of biotechnology on developing countries be positive or negative?

Study Approach

Major Tasks

- Identify the existing biotech products, their characteristics, and applications
- Ascertain products in the pipeline, characteristics and applications (five-year horizon)
- Identify/evaluate implications -- systematically across food system components -- and more broadly. Use appropriate measures of impact.
- Develop composite view (one) of the food industry of the future

Study Tools

- Conventional techniques not applicable
- Not another set of ten-year projections
- Will utilize several tools and techniques as appropriate
  - Personal interviews
  - Telephone surveys
  - Focus groups
  - Models/statistical analyses

Major Tasks

- **Ascertain products in the pipeline - characteristics and applications (five year horizon)**
  - Crops sector
  - Livestock sector
  - Food products
  - Expected breadth/pace of adoption and acceptance

- **Identify/evaluate implications**

  (of the economic and social changes likely to result from introduction of new biotech products)

- Systematic by food system component:
  - Inputs/Services
  - Farm
  - Processing/Distribution
  - Consumer
  - Other (cross-component)
    - Transportation
    - Finance
    - Research/extension

Sparks Companies, Inc.

BIOTECHNOLOGY: FUNDAMENTALLY RESHAPING THE AGRICULTURE, FOOD AND FIBER INDUSTRY

Comments from 7/15/98 Inaugural Meeting

CoBank – Steve Lauck

CoBank is financing coops that have no direct relation with food consumers and have no patents on the technology, but have strong relations with producers. These include some 1,000 "farm supply/marketing" coops providing inputs to farmers and helping market their products. The expected changes in production agriculture resulting from biotechnology will affect these and other coops.

- What will be the role of the coop (especially farm input coop)?
- What will be the impacts on their capital structure?
- How do you ensure the placement of technology to producers?
- What kind of knowledge base and other services will producers require?

Clemson University – Jim Fischer, Dan Smith

In light of all of the LGU revitalization and self-imaging that has been done in the past and is still underway:

- What are agribusinesses' expectations for LGUs? For research? For extension?
- What type of graduates are needed in the industry now?
- Will biotechnology hasten the decline of the public agriculture research budget?
- How will public-private partnerships develop? What will be the role of the LGU with the private sector (especially related to intellectual property rights) and especially with the "conglomerates" now being formed?
- How will biotechnology affect the family/small farm? What are the companies' expectations for small farms?
- How are companies formulating their research agenda?
- What are the respective roles of business and the LGU to get information to both farmers and consumers? The private sector may not fulfill this function as well as government and universities have in the past. If this is the case, how can LGUs work with the private sector to fill the gaps?

Riceland Foods – Bert Greenwalt, Terry Richardson

- What will be the farmer's and the coop role in this new "relationship driven" environment created by biotech?
- How will implications differ for input trait and output trait products? For example, with input traits, the CBOT would remain, but with output traits, market and contract arrangements will be very different and reduce its importance. Likewise, the university's role may be greater in dealing with input trait crops (i.e., yield information, planting practices, farming practices, etc.).
- Look at price discovery related to IP crops.
- How will coops build relationships with producers? Will coops play a role in the "second wave"?
- What type of biotech development is underway for lesser crops (rice, peanuts, etc.)? Will a niche market develop for these crops?

Rabobank – Joyce Cacho

- What is the linkage between plant biotechnology and animal feeding? What are animal, feed industry related innovations? How do livestock process and digest GMO crops – could it be different than with traditional varieties?
- How does the rebundling of components (fat, protein, etc.) separate from grain affect feed costs and relationships?
- How are cost shares affected – for feed and chemical inputs?
- How does the power of consumer groups affect this? Why is there more acceptance in the US than in Europe, elsewhere? Alternatively, why do consumer groups in the US seem to lack any power? How would consumer rejection affect the pace of adoption?
- What are the factors or assumptions underlying the dominance of demand in the value chain?
- What if retail groups (e.g., WalMart, McDonalds) opted not to accept biotech products? How would that affect overall adoption? Could this occur here, in other countries?
- Will biotech developments be replicated in other countries?
- What about shares versus definite value – the changing risk profile?

Bunge – Gwen Meyer, Phillipe de Laperouse

- What is the perceived demand for IP food products? Will IP products succeed in niche markets? How will this be related to the time for development of new food products (18 months) and the new product life cycle (24 months)? Will developments continue to be scientist driven, with the consumer not having much of a role?
- How will biotech affect non-differentiated commodity operations? Should Bunge be investing in more IP operations and facilities?
- What will be the demand for specifically designed products for all uses? Animal products? Nutraceuticals?

- How will the farmers' risk management options change? How narrow will contract arrangements be? Who controls the contract? What's the model? Will farmers lose their independence?
- How can one address and alleviate farmers' concerns about losing control of their production, particularly in an era of contract production?
- What will be new opportunities for cooperatives?

Australian Bureau of Agricultural and Resource Economics – Paul Morris

- Wants some quantification around all this – quantify things such as adoption rates of these commodities.
- Consumer acceptance and demand side issues are of interest.
- What's the research, promotion, education aspect of all of this?
- The scope for trade arrangements under the WTO to facilitate the diffusion of biotechnology throughout the world. How likely is it that we could develop an international harmonized acceptance system for new products to reduce dubious trade barriers?
- Intellectual property rights (patents) and the related issue of market power. Most patents thus far are US – what about use in other countries? What about enforceability? The role of WTO? Will the US model for intellectual property rights be imposed on the rest of the world?
- How could the Biosafety Protocol restrict trade?

Equipment Manufacturers Institute – Emmett Barker

- May need to take off the "agriculture hat" in viewing the impact of a new technology on the industry – happens often in other industries (e.g., computers) – can learn from how other industries and segments have reacted.
- Resolution of some of the market related questions (i.e., pricing structure) may come more quickly and easily than expected.
- Transition costs – what will they be? Who pays? May need to be borne by somebody (maybe government/taxpayers) – who will bear them and how will this be done?
- Who and where will new managers be trained to handle new technologies? In the LGUs?
- Where will farmers be located – geographically? What equipment do they want? When do they want it?

ConAgra – Dick Gady, Bill Lapp, Pat Koley, and Warren Hammerbeck

- Where will the real revolutionary biotech changes occur? In the seed industry? Processing? What role will biotech have in processing?
- Who will control the food chain – genetics companies or grocers/retailers? Input suppliers going forward? Or, branded processors going backward? Will one supply chain become dominant?

"wrong-sizing"? Who will correct this and how? Same for storage facilities. Transportation (unit trains).

- How will product tracking work in guaranteeing IP all the way back to the farm? Where's the liability? On the farm, with the chemical supplier?
- What if "big" business moves keep coming in the next year or two? How will that affect the industry? Need to consider that a few more major moves will again greatly challenge the industry.

Embrex – Rick Ryan

- What developments have there been with transgenic animals and cloning?
- What traits will develop in livestock? What are the implications for the livestock sector? (We can make better feed for livestock or make animals do better with existing feed.) Especially interested in the intersection of animal/plant biotechnology.
- Watch for technologies as well as products – technologies may not yet be products.
- Time perspective – when could things actually come about?
- The biotech landscape now is fashioned in the US – will take longer to occur in Europe – what levers might change the current consumer acceptance landscape? What might shake the consumers' confidence in the US? What big factors could derail the revolution?

Agribrands International – Nick Eicher

- How will IP develop throughout the food chain? How will by-product production be affected?
- Where is biotech going? Contracts – must have a hedging medium.
- Hybridization heightened the susceptibility of crops to microtoxins. Will we weaken the strains to make this a much bigger problem? What assurances are there?
- Can biotech reverse (or will it accelerate) this process? What are the requirements for production of new seeds (i.e., climate, fertility) to control mycotoxins?

American Farm Bureau Federation – Terry Francl

Areas of interest include:

- Contracts, contract farming
- Integration
- Market segmentation (related to IP crops)
- Information – price transparency (related to IP crops)
- Concentration, monopolistic issues
- Regulation – what costs are involved?

# # #

S : a ks Comr anies, Inc.

BIOTECHNOLOGY: FUNDAMENTALLY RESHAPING THE AGRICULTURE, FOOD AND FIBER INDUSTRY

Contents

- Issues affecting consumer acceptance
- Consumer education – new products, their properties and benefits

➢ **System-wide segments**
- Transportation
- Finance
- Research/dissemination

➢ **System-wide overarching areas/issues**
- Public policies/regulatory
  - Farm/commodity
  - International trade
  - Food security
  - Environmental
  - Regulatory issues
  - Competition/concentration
- Role of institutions, organizations
- The developing world
- Other

V. THE FOOD INDUSTRY OF THE FUTURE

- What the findings might imply
- One view of the industry

VI. IMPLICATIONS FOR FOOD AND AGRIBUSINESS

VII. SUMMARY/CONCLUSIONS

- Emerging issues
- Actions to watch in the future
- Opportunities/threats to the industry

BIBLIOGRAPHY

APPENDIX

Sparks Companies, Inc.

Participants in the Biotechnology Multi-Client Study -

Agribank
Dave Reinders

Agribrands International, Inc.
Nick Eicher

Agriculture & Agrifood Canada
James Oxley

American Farm Bureau Federation
Terry Francl

Australian Bureau of Agricultural and Resource Economics (ABARE)
Brian Fisher
Paul Morris

Babson Bros. Company
Nick Babson

BIOTECanada
Rick Walter

Bunge Corporation
Philippe de Laperouse

Cargill
Carolyn Fritz

Clemson University
James R. Fischer

CoBank ACB
Steve Lauck

ConAgra
Bill Lapp
Dick Gady

Deere & Company Technical Center
Richard R. Johnson

DuPont Company
Gail F. Santoro

Embrex
Rick Ryan

Equipment Manufacturers Institute
Emmett Barker

European Union Commission
Tassos Haniotis

Farm Credit Corporation
Louise Neveu

George Weston Ltd.
David Farnfield

Growmark, Inc.
Jim Charlesworth

John Hancock Mutual Life Insurance Company
Phillip J. Peters

Kal Kan Inc.
David Abdoo

Kraft Foods, Inc.
Marcia Glenn

Maple Leaf Foods (Canada Bread)
William Oakley

Monsanto
Molly Cline

New Holland North America Inc.
Robert Bledsoe

Sparks Companies, Inc.

Memphis, Tennessee

Washington Office
6708 Whittier Avenue
McLean, Virginia 22101

(703) 734-8787
Fax: (703) 893-1065

July 28, 1998

Memorandum

To: **Biotechnology: Fundamentally Reshaping the Agriculture, Food and Fiber Industry Multi-Client Study Participants**

Regarding: **Inaugural Meeting Materials**

We certainly enjoyed meeting those of you who attended our July 15 inaugural seminar for the Biotechnology study and are sorry that we did not have the opportunity to meet those of you who could not attend. The meeting provided a good forum to learn more about the participating clients, their companies and specific interests. We especially value the input we get from each of you – what you expect to take away from the project and how it can be more useful to your business.

As promised, we have compiled the comments from that meeting and will focus on these throughout the study. These are enclosed along with the presentation materials from the meeting, a general study outline and a list of participants to date.

We will keep you abreast of our progress with the study over the next few months and look forward to working with you throughout this process. If you have questions or need assistance, please do not hesitate to contact me.

Sincerely,

J. B. Penn
Senior Vice President

Sparks Companies, Inc.

Biotechnology: Fundamentally Reshaping the Food and Agriculture Industry

Inaugural Meeting
July 15, 1998

Welcome/Introductions

- Introduce SCI staff
- Client introductions
- Agenda for the day
  - Multi-client study format
  - Identify major issues/problems of broad concern
  - Develop prospectus--enroll participants
  - Study products:
    - Initial seminar--solicit client input
    - Comprehensive study report
    - Final seminar--present study findings
    - Individual client seminar (if requested)

Introductions

- Purpose of the study
- Due diligence--perhaps greatest force affecting the industry in the country. How widespread? What to watch? How to position?
- Stimulate client thinking--assist assessments, determine relative importance

THE BIOTECH REVOLUTION

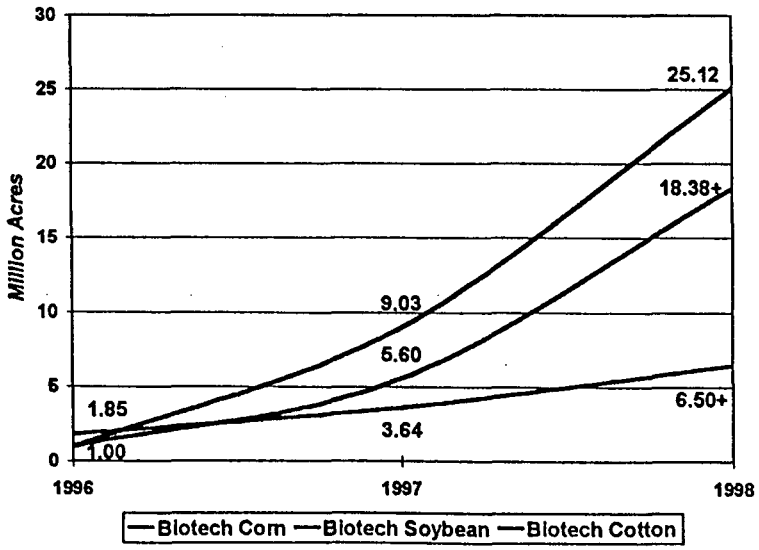
THE FIRST WAVE

Tidal

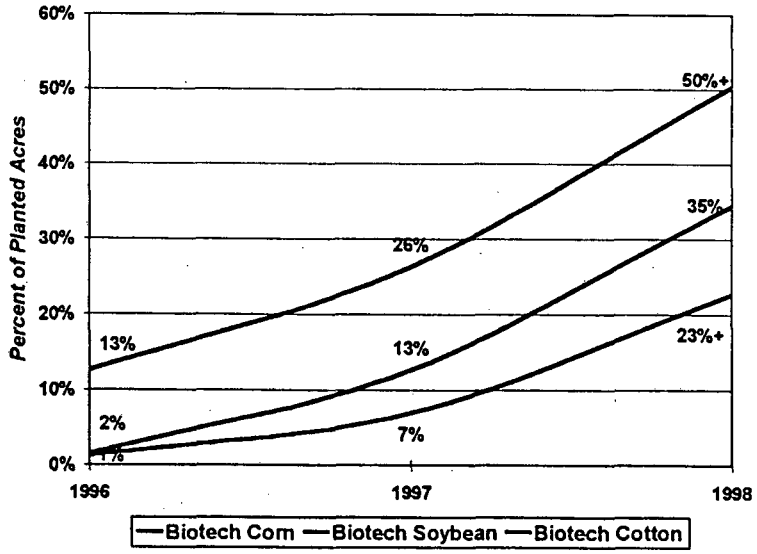
Biotech: The First Wave

- Biotech narrowly defined as genetically modified.
- First commercializations for major crops in 1996:
  - Monsanto Roundup Ready soybeans & BollGard Bt cotton
  - Novartis Bt corn

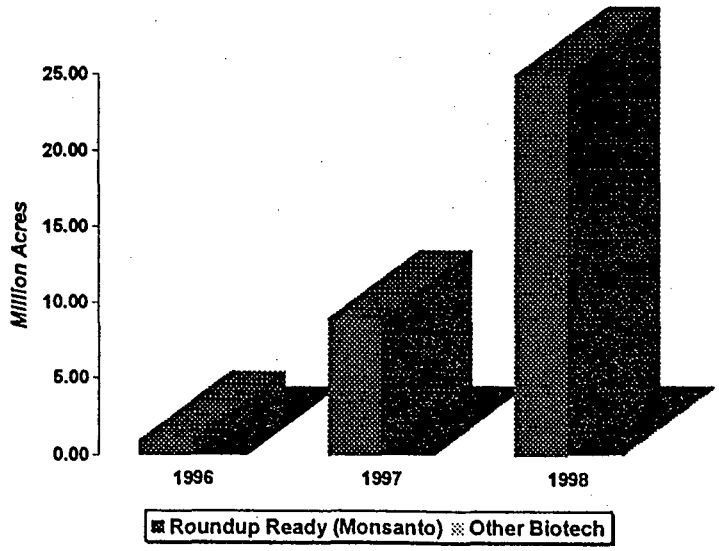
Biotech: The Acreage Take-Off



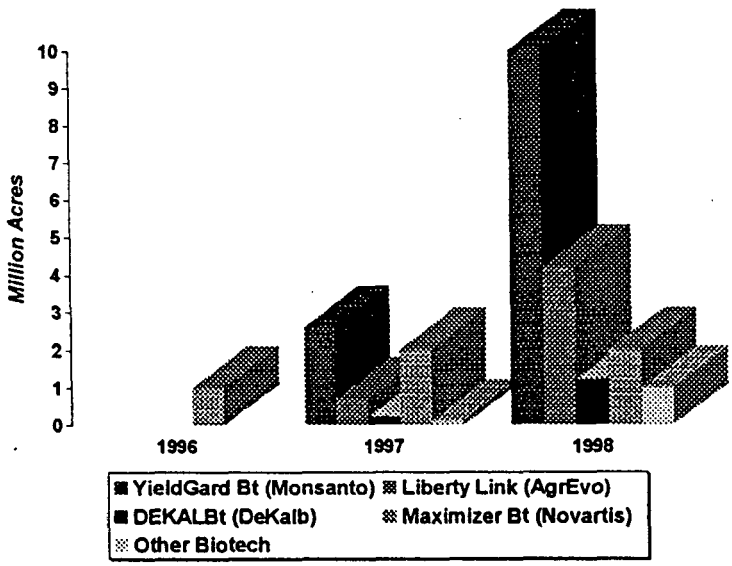
Biotech Adoption Rates



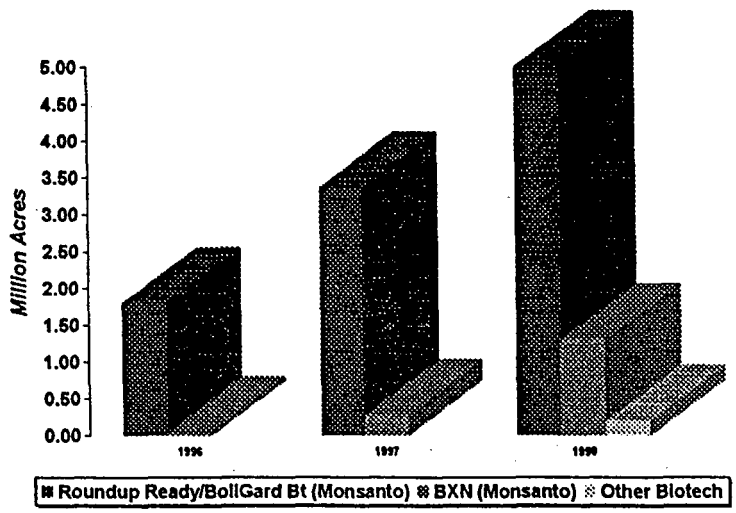
Soybeans: Key Biotech Products



Corn: Key Biotech Products

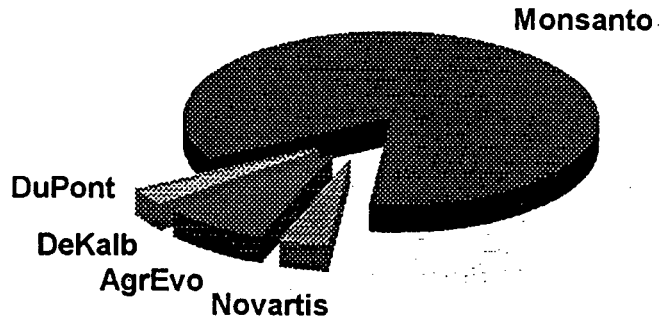


Cotton: Key Biotech Products



Market Shares of "Gene Providers"

(Biotech Defined as Genetically Modified)



Value-Added Non-Biotech Crops: Acreage > 1 Million Acres

- High-Oil Corn (DuPont)
- STS Herbicide Tolerant Soybeans (DuPont)
- IMI Herbicide Tolerant Corn (AHP/American Cyanamid)

Other Value-Added Non-Biotech Crops

- Optimum Low Saturate Soybeans (DuPont/Pioneer)
- Optimum High Sucrose Soybeans (DuPont/Pioneer)
- Optimum High Protein Soybeans (DuPont/Pioneer)
- Optimum Low Linolenic Soybeans (DuPont/Pioneer)

Biotech: Livestock & Poultry Benefits

- **Bovine somatotropin (BST)**
- **Cloning: "Dolly" and her successors**

Biotech: The Next Wave

- **Crops:**
  - More Quality-Enhanced Crops
  - Nutraceuticals
  - Continued Expansion Overseas
- **Livestock:**
  - Correcting current problems
  - Enhancing specific traits

THE BIOTECH REVOLUTION

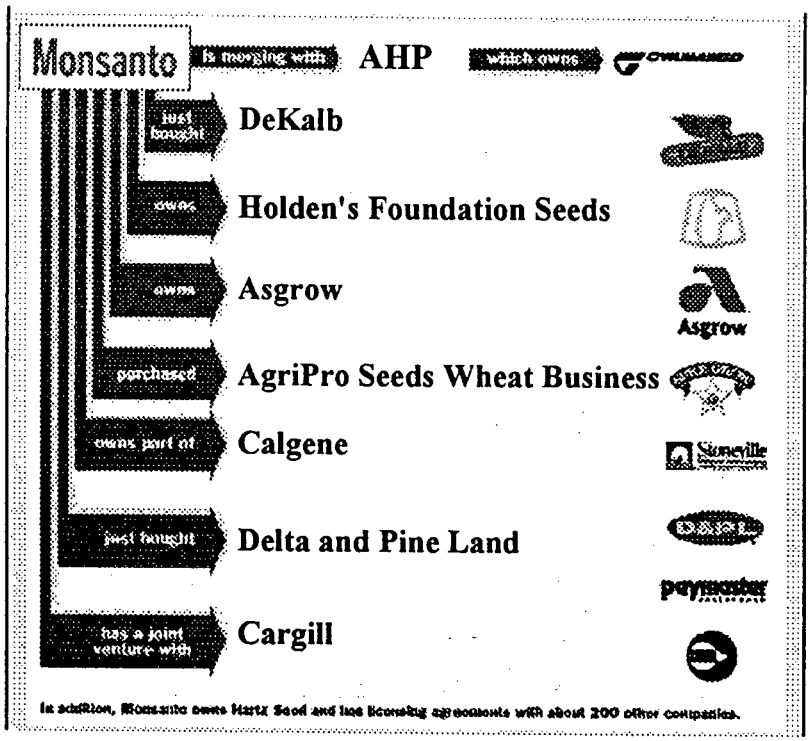
Issues and Implications to Date

Business Restructuring - Changing the Face of US Agribusiness

- Step 1: Seed, chemical companies vie for position
  - Increase market share
  - Gain access to technology
- Step 2: Linkages of biotech firms to processors, marketers
- Step 3: Food companies demand improved, value-added food products

Merger Mania in the Industry

1/97	Monsanto buys Holden's Foundation Seeds
8/97	DuPont, Pioneer agree to research alliance, joint venture company (Optimum Quality Grains)
8/97	DuPont buys Ralston Purina's Protein Technologies International
5/98	Monsanto acquires DeKalb & Delta and Pine Land
5/98	Monsanto, Cargill announce grain processing joint venture
6/98	Monsanto, American Home Products merge
6/98	Monsanto buys Cargill Intl. Seed Operations



After the Dust Settles....Who is Left?

- ✓ AHP/Monsanto - global leader in ag biotech and chemicals and #3 in pharmaceuticals
- ✓ DuPont/Pioneer
- ✓ Novartis
- ✓ All others (AgrEvo, Dow AgroSciences)

Intellectual Property Rights

- Patent challenges - lawsuits, countersuits abound
- Example: US Patent Office granted over 200 patents for Bt use
  - Nearly 40 groups have legal right to one piece of overall process
- Sterile seed patent debate emerges
- Some 20 outstanding disputes today among seed, chemical, technology companies
- Large legal expenses
- New precedents set

Consumer Acceptance

- Surveys reveal biotech not major issue with US consumers
  - Favorable response to products with better flavors, reduced use of pesticides, no insect damage
- Public awareness in US remains low
- Worldwide - cultural, economic differences make acceptance slower
- Education seen as key to public acceptance
  - Monsanto ad campaign in Europe

Consumer Concerns in Europe

- Consumer awareness higher in Europe (Germany, Austria, Denmark) and Japan
- Consumer concerns higher in Germany, Austria -- less likely to buy biotech products
- "Mad cow" scare and activist opposition groups (Greenpeace, "green" movements) slow acceptance
- Labeling and segregation proposals emerge

Trade Relations Strained

- Corn, soybean varieties given scientific approvals (late 1996)
- Several national governments dissented, banned production/import of crops
  - Austria, Luxembourg, France, Italy
- Regulatory process for product approval still evolving
- Law enacted (5/98) obligating companies to label foods containing GMOs

Trade Relations Strained

- Despite labeling action, EU members still deciding positions
  - Swiss referendum favored biotech research - reaction to Europe's lagging in the industry
  - French "citizen's conference" offered lukewarm support for two corn varieties - GOF issued same cautious approval - final decision to come this month
  - US claims $200 million in lost corn sales - lost tender in Spain, Portugal

International Acceptance

- Approval process for products country-by-country -- a cumbersome process
  - Canada, Japan, Mexico, Argentina, Australia planting significant acreage to biotech
- Convention on Biological Diversity - from 1992 UN Rio Summit
  - Access to genetic resources by developing nations
  - Safe transfer, handling and use of GMOs
- Harmonized international standards - WTO/SPS

Issues Giving Rise to the Study

Biotechnology-- Why This Study?

- The sector will be fundamentally different in the future
  - How can the key differences be described?
  - How anticipated and evaluated?
- Key dimensions of change --
  - Reduced production costs
  - Changed products -- increased values
  - New investment requirements
  - New competitive relationships
  - New/different risks and risk management challenges
  - New focus on regulations/policies
- Few products/processes left untouched

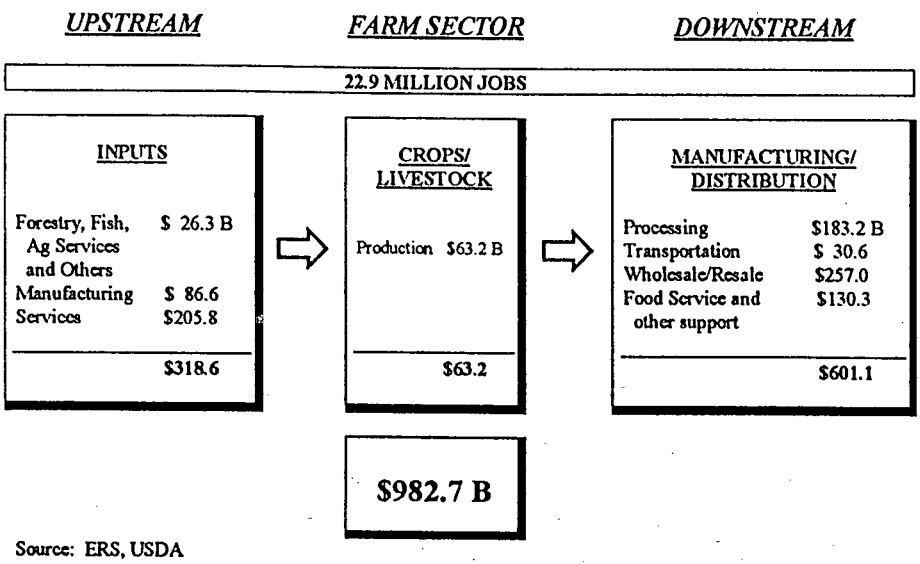
How to Focus Issues?

- Impacts will be systemwide --
  - Inputs/services
  - Farms
  - Processing -- Marketing -- Distribution -- Other Services
  - Consumers
  - World -- e.g. Food Security for Developing Countries
- Overarching Issues
  - Policy
    - Farm/Food/Trade
    - Regulatory/Environmental
  - Institutions/organizations
  - Anti-monopolistic

Food Sector Overview

- It is enormous -- nearly $983 billion GDP
  - Nearly 23 million jobs;
  - $55 billion exports;
  - More than $27 billion balance of trade (1996).
    - Farming is central, but only 6% of total:
    - Upstream (inputs) is 33%
    - Downstream (processing) is 61%.

US Food System GDP Contribution, 1995



Source: ERS, USDA

Input Side -- Farmers Buy:

	1998 f	Share
	bil $	%
Feed Purchased	24.3	13
Livestock & Poultry Purchased	13.3	7
Seed Purchased	6.3	3
Subtotal	43.9	24
Manufactured Inputs		
Fertilizer and Lime	10.9	6
Fuels & Oil	5.6	3
Electricity	3.1	2
Pesticides	8.7	5
Subtotal	28.3	15
Interest Charges	13.6	7
Other Operating Expenses	59.4	32
Overhead -- Capital, Rent Taxes	39.9	22
Total Production Expenses	185.2	100

Farm Sector Overview (Numbers and Size), 1980-95

	1980	1985	1990	1995	Annual change: 1990-85	1995-90
Farm numbers		1,000 units			percent	
Commercial	271	326	321	341	-0.3	1.0
Other	2169	1966	1819	1729	-1.3	-0.8
Total	2440	2292	2140	2070	-1.1	-0.6
Land in farms (mil acres)	1042	1012	987	972	-0.4	-0.3
Average farm (acres)	426	441	461	469	0.7	0.3
Commercial farm (acres)	1549	1575	1550	1564	-0.3	0.1

Marketing Bill -- Domestically Produced Foods

Year	Farm Value	Marketing	Total
	bil $		
1950	18	26	44
1960	22.3	44.6	66.9
1970	35.5	75.1	110.6
1980	81.7	182.7	264.4
1990	106.2	343.6	449.8
1994	109.6	401	510.6

Farm Value -- 41% in 1950
-- 31% in 1980
-- 21% by mid-1990s

Processing Side: Domestically Produced Foods

	bil $	%
Farm cost	109.6	21
Labor	188.7	37
Packaging	42.1	8
Intercity transportation	21.8	4
Depreciation	17.4	3
Advertising	18.9	4
Fuels/electricity	17.9	4
Before-tax profits	16	3
Rent	17.8	3
Interest - net	13.5	3
Repairs	7.1	1
Business taxes	18.3	4
Other	21.3	4
Total	510.6	100

"In five years, a handful of firms will own the major genetic products, control the bulk of the investment, determine product emphasis and needs for other inputs, as well."

- What will be the key genetic changes in crops and livestock?
- What will be the structure of the genetics providers?
- What links will develop between seed and chemical companies?
- How much will chemical/fertilizer/information/other inputs be "bundled?"
- How much will biotech affect :
  - credit needs?
  - production, food safety, other risk?

"The biotech revolution means another rural revolution -- the virtual end of today's service structure."

- "Big-ticket items -- machinery, bulk chemicals, seeds -- will be sold regionally or nationally."
- "Local dealers must compete with increasingly efficient farmers for the market for services."
- "Cooperatives must focus on non-commercial producers in many areas, or see their markets dwindle."
  - Will non-commercial producers become increasingly dependent on off-farm services to have access to new technologies?

"The future inputs distribution chain will be much shorter. Which stage will disappear?"

- Will the four-stage system (national, regional, district, local) be reduced to three -- or fewer?

- Will the **district wholesaler** --who has less opportunity to develop ways to add value for large producers -- likely disappear?

- What other changes in the chain can we expect?

"Biotechnology, precision farming and new management techniques will make today's farm structure completely obsolete in five years."

These mean:

- ✦ Better management control, better decisions?
- ✦ Lower costs/higher yields, greater returns?
- ✦ Greater potential returns on investment?
- ✦ Greater risk -- greater need for information?

– Much larger, more powerful commercial farms?
  – How will these be organized? How many will survive?

– Different needs for credit, marketing support, other services?

"Current commercial farm organizational schemes are under pressure and will not survive the next few years."

– Key problem of future -- finding and /developing markets

– Dealing with new problems -- more competitive environment
  – Consumer safety
  – Finding information about premium markets
  – Dealing with government regulations
  – Find/develop better environmental approaches, products, etc. that protect soil and water

– What new organizational forms will evolve?

"Commercial farm financing will become a key area of competition for the future."

- New technologies cost more, more financial support needed?
  - Costs per farm will grow?
- Conventional lenders will face greater demand for credit, and demands for greater flexibility
- Credit terms increasingly important?
  - Credit always a competitive tool
  - Credit terms/broader support increasingly important tool

"The biotech revolution will largely by-pass the small farm, and will mean the demise of many."

- Most farms are small. They--
  - Depend on non-farm income
  - Frequently have a loss from farming
  - Are heavily livestock oriented (85% of livestock operations 92% of cattle operation)
  - Are heavily family owned
- Are these units prepared to invest in new technology?
- Are there new institutions that will help them accommodate to new markets, new competition?

"In less than five years, the commodity markets as we know them will be a thing of the past."

- Markets for components only?
- How many markets? For which components?
- How will prices be discovered?
  - How transparent, how liquid?
  - How will buyers/sellers be informed?
- Will markets be narrow -- individual contracts?
  - Or, will a few large components provide leadership for the system?
- Risk management will be much more difficult?
  - And, risks will multiply (price, quantity, safety, performance, etc.)?
- Where will information come from?

"Information -- especially market information will become a much more valuable competitive tool."

- Conventional information sources (universities, magazines, company mailings, etc.) less important?

- More important?
  - Crop/livestock-specific technical publications
  - Local dealers
  - Technical reports from private companies
  - Own consultants, and own experiments

"Consumer demand -- the search for new niche markets -- will really drive the system after 2000. By today's standard, markets will be much more volatile."

- What will drive consumer markets in the future? Concerns about --
  - ✦ Health?
  - ✦ Product appearance/freshness/color?
  - ✦ Services/pre-prepared?
  - ✦ Organic preparation?
  - ✦ Ethnic preferences?
  - ✦ Relative cost?

◆ How will processors reduce risk of filling these market needs?

"Consumer acceptance of biotech is shallow -- few understand it, most mistrust it. A major challenge is likely in the next few years."

- Could new "Delaney-like" restrictions arise?
  - ✦ Would they matter?
- Could test requirements become more stringent, especially difficult for small firms?
- Could rules arise that outlaw some biotech on moral or ethical grounds?
  - ✦ Animal rights activists efforts continue? Focus on biotech?

"Designer food products will boost demand for agricultural products significantly-- as they target nutrition, health and taste requirements ever more specifically."

- What is the magnitude of this impact?
- How will it be managed? Who will benefit?
- What will be its impacts on:
  - ✦ Consumer prices?
  - ✦ Spending?
  - ✦ Product development?
  - ✦

"Biotech regulation is a patchwork, and will become a major public policy battleground in the near future."

- Is a super agency needed?
  - ✦ Food and Drug Administration
    - Food Safety (food additives) except meat and poultry
    - Drug Safety and Efficacy. e.g. BST and PST approved by FDA.
      - Key focus on residues, proper labeling, changes in character.
  - ✦ Environmental Protection Agency
    - Measuring environmental impact of "new" plants, animals, pesticides
    - Environmental Assessments of impacts of specific products on consumers, economy, environment
  - ✦ US Department of Agriculture/APHIS (focus on field crops)
    - Environmental assessments made for release of plants tested

"Trade policy concerning biotech products will continue to be a severe problem. Where 'Green' groups are important, they will never quit opposing GMO products."

- Will local overseas groups' needs for biotech to be competitive provide the support needed to open key markets?
- Will foreign opposition to biotech find a foothold in the US?
- How vulnerable does the rapid acceptance of biotech make US producers in world export markets?

"The biotech revolution will increase the direct cost of technology. Will it make small farmers in developing countries who cannot afford it less competitive, more dependent on imports and less secure?"

- How important will "gene fees" become as a production cost element?
- Will productivity increases for "low technology" producers offset technology costs as for "high technology" farmers?
- Will the long-term impact of biotechnology on developing countries be positive or negative?

"***The biotech revolution, by increasing the importance of private research and investment, and boosting the scale of commercial farms, will make USDA and the Land Grant Institutions obsolete within five years.***"

- Increasing shares of technology research will be private, as the public investment share declines. What will be the role of the future USDA?
-
- Can the Extension Service, or the Land Grant Universities find a new role as the agriculture and food system changes?

The Tentative Study Approach

Study Approach

Major Tasks

- Identify the existing biotech products, their characteristics, and applications
- Ascertain products in the pipeline, characteristics and applications (five-year horizon)
- Identify/evaluate implications -- systematically across food system components -- and more broadly. Use appropriate measures of impact.
- Develop composite view (one) of the food industry of the future

Study Tools

- Conventional techniques not applicable
- Not another set of ten-year projections
- Will utilize several tools and techniques as appropriate
  - Personal interviews
  - Telephone surveys
  - Focus groups
  - Models/statistical analyses

Information Sources

- Biotech and agribusiness companies
  - Officials/scientists
  - Investor relations departments
  - 10k, 10q filings
  - Annual reports
- Government and university scientists
- Companies in the food system
- Public officials
- Secondary sources

Major Tasks

- **Identify existing biotech products, their characteristics and applications**
  - Extent of use
  - Pace of adoption
  - Economic effects
  - Other consequences

Major Tasks

- **Ascertain products in the pipeline - characteristics and applications (five year horizon)**
  - Crops sector
  - Livestock sector
  - Food products
  - Expected breadth/pace of adoption and acceptance

- **Identify/evaluate implications**

  (of the economic and social changes likely to result from introduction of new biotech products)

- Systematic by food system component:
  - Inputs/Services
  - Farm
  - Processing/Distribution
  - Consumer
  - Other (cross-component)
    - Transportation
    - Finance
    - Research/extension

- **Identify/evaluate implications**

  (of the economic and social changes likely to result from introduction of new biotech products)

- System wide--overarching
  - Policy: Farm/Food/Trade/Environment/Regulatory Process/Competition/Resources
  - Institutions/Organizations
  - Developing Country
  - Other

- **Develop view of Food Industry of the Future (2003)**

- One composite view--by system component--An overall sketch of the food industry of the future, pulling together implications developed in (III)
- Other views are possible - objective is to stimulate *thinking*
- Key Determinants: What to watch? What factors may accelerate or slow pace?

Sparks Companies, Inc.

BIOTECHNOLOGY: FUNDAMENTALLY RESHAPING THE AGRICULTURE, FOOD AND FIBER INDUSTRY

Comments from 7/15/98 Inaugural Meeting

CoBank – Steve Lauck

CoBank is financing coops that have no direct relation with food consumers and have no patents on the technology, but have strong relations with producers. These include some 1,000 "farm supply/marketing" coops providing inputs to farmers and helping market their products. The expected changes in production agriculture resulting from biotechnology will affect these and other coops.

- What will be the role of the coop (especially farm input coop)?
- What will be the impacts on their capital structure?
- How do you ensure the placement of technology to producers?
- What kind of knowledge base and other services will producers require?

Clemson University – Jim Fischer, Dan Smith

In light of all of the LGU revitalization and self-imaging that has been done in the past and is still underway:

- What are agribusinesses' expectations for LGUs? For research? For extension?
- What type of graduates are needed in the industry now?
- Will biotechnology hasten the decline of the public agriculture research budget?
- How will public-private partnerships develop? What will be the role of the LGU with the private sector (especially related to intellectual property rights) and especially with the "conglomerates" now being formed?
- How will biotechnology affect the family/small farm? What are the companies' expectations for small farms?
- How are companies formulating their research agenda?
- What are the respective roles of business and the LGU to get information to both farmers and consumers? The private sector may not fulfill this function as well as government and universities have in the past. If this is the case, how can LGUs work with the private sector to fill the gaps?

- Is there still a need for the LGU? If so, in what capacity? What ideas do people have?
- How will this technology affect agriculture geographically? Will agriculture become more concentrated in certain regions of the US?

Farm Credit Corporation – Louise Neveu

- What are the implications for producers? For value-added businesses?
- What will develop on the value-added side?
- What, generally, is happening in the industry?

Kal Kan – David Abdoo/Dan Beyer/Tom Novak

- What direction will commodities develop in? How will by-products evolve?
- What policies (trade, phytosanitary, etc.) will develop that interfere with international trade and impede business?
- What work is being done on commodities like rice, canola, etc.? What about by-products (meals)?
- What's in the pipeline for the next five years? Who are the global players in the industry? What do foreign biotech players have to offer? Their intellectual properties?
- Where are the university centers for biotech? Will the university system truly lose out to major private companies? How will these fare relative to the major players?
- Are the same types of linkages that have developed in the software industry (the Microsoft model) likely to happen in the agriculture industry as a result of this technology? Will agribusinesses eventually agglomerate into only a few huge companies? If so, what would that mean for the rest of the industry?
- What's happening with designer (characteristic specific) crops?
- What are the expected rates of adoption for these new products? Farmers are fairly conservative – will acceptance be slower in the future than it has been in the past three years? What are the acceptance cycles? Will they change? What could change them?

Agriculture and Agrifood Canada – James Oxley

- Very interested in the US perspective – would like to see the parallels drawn to both the Canadian and global perspectives.
- What are some of the major social issues (i.e., rural development, consumer acceptance) that may result?

Saskatchewan Wheat Pool – Paul Bonnet

- What are the implications across the food chain – the relationships among input suppliers, processors, purchasers? How will they change?
- What biotechnology development is being done with canola, flax, and barley varieties?
- What are some of the major Canadian implications? Will biotech develop differently in Canada than in the Untied States?

Riceland Foods – Bert Greenwalt, Terry Richardson

- What will be the farmer's and the coop role in this new "relationship driven" environment created by biotech?
- How will implications differ for input trait and output trait products? For example, with input traits, the CBOT would remain, but with output traits, market and contract arrangements will be very different and reduce its importance. Likewise, the university's role may be greater in dealing with input trait crops (i.e., yield information, planting practices, farming practices, etc.).
- Look at price discovery related to IP crops.
- How will coops build relationships with producers? Will coops play a role in the "second wave"?
- What type of biotech development is underway for lesser crops (rice, peanuts, etc.)? Will a niche market develop for these crops?

Rabobank – Joyce Cacho

- What is the linkage between plant biotechnology and animal feeding? What are animal, feed industry related innovations? How do livestock process and digest GMO crops – could it be different than with traditional varieties?
- How does the rebundling of components (fat, protein, etc.) separate from grain affect feed costs and relationships?
- How are cost shares affected – for feed and chemical inputs?
- How does the power of consumer groups affect this? Why is there more acceptance in the US than in Europe, elsewhere? Alternatively, why do consumer groups in the US seem to lack any power? How would consumer rejection affect the pace of adoption?
- What are the factors or assumptions underlying the dominance of demand in the value chain?
- What if retail groups (e.g., WalMart, McDonalds) opted not to accept biotech products? How would that affect overall adoption? Could this occur here, in other countries?
- Will biotech developments be replicated in other countries?
- What about shares versus definite value – the changing risk profile?

Bunge – Gwen Meyer, Phillipe de Laperouse

- What is the perceived demand for IP food products? Will IP products succeed in niche markets? How will this be related to the time for development of new food products (18 months) and the new product life cycle (24 months)? Will developments continue to be scientist driven, with the consumer not having much of a role?
- How will biotech affect non-differentiated commodity operations? Should Bunge be investing in more IP operations and facilities?
- What will be the demand for specifically designed products for all uses? Animal products? Nutraceuticals?

- Price discovery is also a concern – how does one place a value on these products? How are increased values shared?
- What is international demand likely to be for IP products? How will that affect processing system design and resource investments? How much restructuring will be required? How much lead time will be available?
- What types of new markets may develop for by-products? How will the value of by-products change with the development of these new crops?
- Define what biotechnology is – distinguish among value-added, value-enhanced traits, hybrid, IP, etc. Can a product be both?
- What is happening in the "third wave" of products – industrial applications, plastics, etc.?
- Separate the issues and timelines for adoption, product development for each – corn, soybeans, wheat – they may be different.
- Try and look a little past the five year timeline to give some general ideas of where the industry is headed.
- How will relationship building work? What will the core business look like? What types of relationships will develop? How will collaboration evolve?

MapleLeaf – Bill Oakley

- Make sure the study is global in nature – not just US in scope. What are the impacts of consumer acceptance, labeling requirements – internationally?
- What will be government policies regarding trade, labeling, production, etc.?
- How will the overall production of commodities change?
- Provide a strong inventory of products already developed and in the pipeline. Also, provide some focus on more exotic issues (microbial GMOs, antibodies in livestock).

J.R. Simplot Company – Doug Brede

- A concern is that the big players dictate to the rest of industry – wants a role in how new products are decided and developed?
- How can big agriculture biotech firms be prevented from dominating the industry? And, how can smaller companies keep from being dominated by them?
- Focus on product development.

Growmark – Merlin Anderson, Rod Woelfel

- How will intellectual property rights affect learning about pipeline developments? How fast will this occur? Need to assess the pace at which new products will be emerging. Does this cause an overreaction?
- How will information distribution change? Who will originate that information? How will the transfer of the information work?
- What's in all of this for the farmer?

- How will the farmers' risk management options change? How narrow will contract arrangements be? Who controls the contract? What's the model? Will farmers lose their independence?
- How can one address and alleviate farmers' concerns about losing control of their production, particularly in an era of contract production?
- What will be new opportunities for cooperatives?

Australian Bureau of Agricultural and Resource Economics – Paul Morris

- Wants some quantification around all this – quantify things such as adoption rates of these commodities.
- Consumer acceptance and demand side issues are of interest.
- What's the research, promotion, education aspect of all of this?
- The scope for trade arrangements under the WTO to facilitate the diffusion of biotechnology throughout the world. How likely is it that we could develop an international harmonized acceptance system for new products to reduce dubious trade barriers?
- Intellectual property rights (patents) and the related issue of market power. Most patents thus far are US – what about use in other countries? What about enforceability? The role of WTO? Will the US model for intellectual property rights be imposed on the rest of the world?
- How could the Biosafety Protocol restrict trade?

Equipment Manufacturers Institute – Emmett Barker

- May need to take off the "agriculture hat" in viewing the impact of a new technology on the industry – happens often in other industries (e.g., computers) – can learn from how other industries and segments have reacted.
- Resolution of some of the market related questions (i.e., pricing structure) may come more quickly and easily than expected.
- Transition costs – what will they be? Who pays? May need to be borne by somebody (maybe government/taxpayers) – who will bear them and how will this be done?
- Who and where will new managers be trained to handle new technologies? In the LGUs?
- Where will farmers be located – geographically? What equipment do they want? When do they want it?

ConAgra – Dick Gady, Bill Lapp, Pat Koley, and Warren Hammerbeck

- Where will the real revolutionary biotech changes occur? In the seed industry? Processing? What role will biotech have in processing?
- Who will control the food chain – genetics companies or grocers/retailers? Input suppliers going forward? Or, branded processors going backward? Will one supply chain become dominant?

- Which crop will prevail as being the dominating commodity? Corn? Soybeans? Wheat? Which will win out?
- Will we replace animals with some soy-based protein?
- What's happening with the retailers, grocers and the branded-food industry? How will they react to biotechnology? Be sure to look at the top end of the food chain.
- What products are in the pipeline? What benefits (price, quality, nutritional) from each product will be available to consumers?
- How are all of the business deals of the last few months affecting the industry? What would happen if AHP/Monsanto bought a food processor and controlled the entire chain?
- How will precision agriculture relate to biotech? Research needs are rapidly changing – universities are slow to adapt and become helpful.
- How will contracts work? What types of incentives will be included?
- What are the various components of the quality trait products, and how are they being developed? How are they being valued? The "factoryization" of farming is occurring (car bumper from corn components).

AgriBank – Neil Accola

- Special interest in farmer/producer interests.
- For output trait products, who will have access to markets, genetics, product services, contracts, etc.? How will this "bundling" occur? Contracting issues are of concern.
- What's happening in the livestock industry, not only from a crop and feed perspective, but from food and veterinary perspectives, as well?

Babson Brothers – Bob Dixon

- What are the big changes occurring in biotechnology? How will they come to dairying?
- What's happening in the livestock (especially dairy) industry? Will dairy farms be able to survive in Wisconsin? Or, will they be forced to move to remain competitive? What are the geographic impacts? Location of production? Size of farms?

DuPont – Gail Santoro and Jeff Jury

- What are the drivers of consumer acceptance? What makes something acceptable to a consumer? How will public policy change because of consumer concerns related to biotechnology?
- What traits will be most marketable? Who will determine the output traits? These ultimately will be the traits that succeed.
- How can biotech create value at the consumer level? Agriculture increasingly is a consumer-driven business.
- Can we better communicate with consumers? (Terms like "killer" and "terminator" genes aren't helpful.) How does public perception affect trade policy?
- How will IP affect processing, handling facilities? Facilities that now are expanding may need in the future to handle smaller volumes of many different types of product? Are we

"wrong-sizing"? Who will correct this and how? Same for storage facilities. Transportation (unit trains).

- How will product tracking work in guaranteeing IP all the way back to the farm? Where's the liability? On the farm, with the chemical supplier?
- What if "big" business moves keep coming in the next year or two? How will that affect the industry? Need to consider that a few more major moves will again greatly challenge the industry.

Embrex – Rick Ryan

- What developments have there been with transgenic animals and cloning?
- What traits will develop in livestock? What are the implications for the livestock sector? (We can make better feed for livestock or make animals do better with existing feed.) Especially interested in the intersection of animal/plant biotechnology.
- Watch for technologies as well as products – technologies may not yet be products.
- Time perspective – when could things actually come about?
- The biotech landscape now is fashioned in the US – will take longer to occur in Europe – what levers might change the current consumer acceptance landscape? What might shake the consumers' confidence in the US? What big factors could derail the revolution?

Agribrands International – Nick Eicher

- How will IP develop throughout the food chain? How will by-product production be affected?
- Where is biotech going? Contracts – must have a hedging medium.
- Hybridization heightened the susceptibility of crops to microtoxins. Will we weaken the strains to make this a much bigger problem? What assurances are there?
- Can biotech reverse (or will it accelerate) this process? What are the requirements for production of new seeds (i.e., climate, fertility) to control mycotoxins?

American Farm Bureau Federation – Terry Francl

Areas of interest include:

- Contracts, contract farming
- Integration
- Market segmentation (related to IP crops)
- Information – price transparency (related to IP crops)
- Concentration, monopolistic issues
- Regulation – what costs are involved?

# # #

Sr arks Companies, Inc.

BIOTECHNOLOGY: FUNDAMENTALLY RESHAPING THE AGRICULTURE, FOOD AND FIBER INDUSTRY

Contents

- Livestock products
  - Characteristics, attributes
  - Uses, benefits
  - Pace of adoption
- Other (food products, by-products, non GMOs, etc.)
  - Characteristics, attributes
  - Uses, benefits
  - Pace of adoption

Profile biotech's extensiveness in the food and agriculture industry

IV. IMPLICATIONS OF THE BIOTECH REVOLUTION

Introduction of new biotech products – thorough step-by-step evaluation of the likely impacts on each segment of the food system

- **Input and service industry structure**
  - Industry restructuring
  - Strategies of the major players
  - Business relationship changes

- **Farm structure**
  - Producers' response to technology
  - Impact on farm sector structure
  - Management/operation of farms
  - Contract arrangements
  - Role of information
  - Biotechnology and precision farming

- **Markets**
  - Shifts in market structure/fragmentation
  - Market efficiency
  - Contract arrangements
  - Marketing channels
  - Market information

- **Processing/distribution structure**
  - Alliances and mergers – processors, producers, and input suppliers
  - Identify preservation – restructuring and investments required
  - Contracting arrangements
  - Product pricing

- **Consumers**
  - Benefits of new products/processes to consumers
  - Expected pace of consumer acceptance in the United States, worldwide

- Issues affecting consumer acceptance
- Consumer education – new products, their properties and benefits

➢ **System-wide segments**
- Transportation
- Finance
- Research/dissemination

➢ **System-wide overarching areas/issues**
- Public policies/regulatory
  - Farm/commodity
  - International trade
  - Food security
  - Environmental
  - Regulatory issues
  - Competition/concentration
- Role of institutions, organizations
- The developing world
- Other

V. THE FOOD INDUSTRY OF THE FUTURE

- What the findings might imply
- One view of the industry

VI. IMPLICATIONS FOR FOOD AND AGRIBUSINESS

VII. SUMMARY/CONCLUSIONS

- Emerging issues
- Actions to watch in the future
- Opportunities/threats to the industry

BIBLIOGRAPHY

APPENDIX

Sparks Companies, Inc.

Participants in the Biotechnology Multi-Client Study

Agribank
Dave Reinders

Agribrands International, Inc.
Nick Eicher

Agriculture & Agrifood Canada
James Oxley

American Farm Bureau Federation
Terry Francl

Australian Bureau of Agricultural and Resource Economics (ABARE)
Brian Fisher
Paul Morris

Babson Bros. Company
Nick Babson

BIOTECanada
Rick Walter

Bunge Corporation
Philippe de Laperouse

Cargill
Carolyn Fritz

Clemson University
James R. Fischer

CoBank ACB
Steve Lauck

ConAgra
Bill Lapp
Dick Gady

Deere & Company Technical Center
Richard R. Johnson

DuPont Company
Gail F. Santoro

Embrex
Rick Ryan

Equipment Manufacturers Institute
Emmett Barker

European Union Commission
Tassos Haniotis

Farm Credit Corporation
Louise Neveu

George Weston Ltd.
David Farnfield

Growmark, Inc.
Jim Charlesworth

John Hancock Mutual Life Insurance Company
Phillip J. Peters

Kal Kan Inc.
David Abdoo

Kraft Foods, Inc.
Marcia Glenn

Maple Leaf Foods (Canada Bread)
William Oakley

Monsanto
Molly Cline

New Holland North America Inc.
Robert Bledsoe

National Cotton Council
Gaylon B. Booker

Pioneer Hi-Bred International Inc.
Tom Dougherty

Rabobank International
Joyce Cacho

Rhone Poulenc
Spencer Cohen

Riceland Foods, Inc.
Richard E. Bell

Sara Lee Trading
Randall Chambers

Saskatchewan Agriculture and Food
Ken Perlich

Saskatchewan Wheat Pool
Paul Bonnet

J.R. Simplot Company
Raymond V. Sasso, Jr.

July 24, 1998

BIOTECanada

Facsimile Transmittal Slip

To: BART BILMER.

Fax: 228-6604.

From: ANDREW.

RE: AGRI-FOOD STUDY PROPOSAL

Biotecda involved in Cda for SCI work MK analysis

No.of pages: 11 (including this one)

As PROMISED.

Jamie Oxley x7428

① Who went AAFC?
② What did we seek as input / key areas
③ Is there any info / outcome summaries from July 15th that you can share w/us
④ Next Steps?

- Summary of July 15th.
- MK Added to Distr. list

420-130 RUE ALBERT STREET, OTTAWA ON CANADA K1P 5G4 TEL: (613) 230-5585 FAX: (613) 563-8850
E-MAIL: info@biotech.ca WEB SITE: http://www.biotech.ca

SPARKS COMPANIES, INC.

BIOTECHNOLOGY: FUNDAMENTALLY RESHAPING THE AGRICULTURE AND FOOD INDUSTRY

A Special SCI Multi-Client Study

June 1998

Taking Advantage of Opportunities
From the Next New Wave of Technology

BIOTECHNOLOGY: FUNDAMENTALLY RESHAPING THE AGRICULTURE AND FOOD INDUSTRY

Background

Technological progress in agriculture traditionally has been incremental, as evidenced by the generally slow but persistent expansion in crop yields and animal output. Periodically, however, there is an eruption of growth. This was the case early in this century with the invention of the internal combustion engine which led to the massive shift from animal power to mechanization. Another technology explosion occurred before mid-century with corn hybridization, followed by widespread use of chemical fertilizers and pesticides after World War II.

Another such eruption is occurring today with the advent of biotechnology and precision farming. Products are already in commercial use that lower costs and increase yields (e.g., insect and herbicide resistant) and that provide custom user traits (e.g., specific qualities for particular uses), reducing processing and final product costs. Many more are in the near-term pipeline and these are but the tip of the iceberg. These technologies together promise to alter fundamentally virtually every aspect of today's farming and food structure, and *in a relatively short period of time!*

Although still in the early stages, this change is occurring so rapidly and with such breadth that it is prompting numerous questions about its likely impacts all across the agriculture and food industry. The implications could prove enormous:

- **Industry structure and business relationships** – What will be the result of the fast-paced restructuring now underway – on numbers and sizes of key players? On traditional sales and service relationships? On marketing channels and products flows? Will there be a further blurring of once-distinct lines all across the farm supply, production and processing and distribution sectors?

- **Agricultural processors** – How extensive will "decommoditization" become? How will the emergence of many new products affect processing and distribution? Storage and handling methods? Investment requirements? Operating costs and margins? Marketing relationships? Who specifies new product requirements?

- **Nature and character of traditional commodity markets** – How will pricing occur for more, highly specific component and niche products? How transparent will it be? Will new contract relationships emerge? Risks easier or harder to manage? What new informational needs will arise?

- **Farm sector structure** – How will the number, sizes and location of farms be affected? How will their cost structure be changed? Competitiveness? Will farm consolidation accelerate and sizes increase? How will these farms be managed, financed? How will traditional relationships with input providers, product purchasers, cooperatives, etc. be altered?

- **Identity and composition of products** – Are entirely new products with improved functionality in the offing? How will existing products be altered? Will new production management, handling and storage services be required? How will contract specifications, food safety and quality standards, etc. be ensured?

- **Consumer responses and acceptance** – Will consumers continue to eagerly accept new products? Will new product designs aim specifically at improving healthfulness, meeting medicinal needs? Will there be an overall impact on food demand, food prices, on consumer spending?

- **Business information requirements and availability** – Will traditional sources and content fast prove inadequate? Will market information become highly fragmented, highly specialized? What will new information requirements be? From what sources? At what cost? How credible?

- **The public policy agenda** – Will a new policy agenda largely unfamiliar to the industry emerge? Will issues never before encountered emerge? Will the government assume new roles in regulating markets and products, insuring transparency and equitable marketing systems, monitoring concentration, etc.?

- **International trade conflicts** – Will the US food system – as the early adopter – gain significant competitive advantage? Will the global competitiveness picture subsequently change as technology spreads? Will new trade tensions be created? Will disputes linger over consumer acceptance or be quickly resolved? Will new handling, processing, labeling, etc. requirements emerge? Will the next WTO negotiating round resolve the biotechnology issues?

It is the vast scope of this just-beginning revolution and the breadth of its implications that prompt this special multi-client study. While no crystal ball can foretell the future perfectly, a systematic analysis and evaluation will make it possible to discern major trends and directions, identify key developments, and identify and anticipate some of the myriad changes that biotechnology will bring to our industry. That is the purpose of this study, ***Biotechnology: Fundamentally Reshaping the Agriculture and Food Industry.***

About the Study

The **purpose of the study** is to systematically identify the likely impacts, challenges and opportunities from biotechnology and precision farming on the agriculture and food industry. It

will evaluate developments now underway and being planned, and identify likely impacts, enabling clients to better position their businesses for such outcomes. It will not be a statistical or quantitative forecasting study, but will focus on implications and issues, bringing forth ideas, developments and implications that might otherwise might not be anticipated. Notions of magnitude and relative importance of trends and impacts will be developed where possible.

The **study approach** will involve first establishing and projecting the likely broad advances in new products and techniques that biotechnology and precision farming will bring in the next few years. Then, the potential impacts and implications will be explored systematically, tracing across each segment of the food system (input supply, farming, processing, transporting, retailing). Particular attention will be paid to the business restructuring aspects, production sector implications, international trade policy issues (especially in view of the upcoming WTO "Millennium Round"), consumer concerns, and global food security matters.

Clients will be asked to participate actively, especially at the start of the study, in charting its exact course and identifying the specific aspects to be emphasized. Client concerns and special interests will be accorded more attention. A preliminary outline of the study follows.

Who Will Be Affected/Who Should Participate?

The answer is ***EVERYBODY***. Biotechnology promises to have such widespread impacts that no part or participant in the food system will remain unaffected.

Understanding the development and future implications of this technological revolution is of tremendous importance to virtually every component of the global food and agriculture structure, beginning with those who develop the technologies and on to the consumers in both domestic and international markets who purchase the new food products. It will affect structure, markets, institutions, and the entire business process.

Thus, agribusiness and food industry firms wishing to become more aware of coming developments and be better able to position themselves to take advantage of this rapid change can benefit especially from the study. More specifically, those affected throughout the system include:

- Seed companies
- Pesticide and fertilizer companies
- Equipment manufacturers
- Investors/bankers
- Commodity processors
- Grain merchandising and trading companies
- Cooperatives
- Food ingredient suppliers
- Food retailers
- Food processors
- Feed manufacturers
- Meat and poultry processors
- Trade associations
- Transporters
- Exporters
- World market participants (Australia, Canada, European Union, Japan, etc.)
- Government agencies
- International organizations

BIOTECHNOLOGY: FUNDAMENTALLY RESHAPING THE AGRICULTURE AND FOOD INDUSTRY

Preliminary Study Outline

I. *Introduction: Why the Study and Why Now?*

This introductory section reviews the past role of technological progress in the agriculture and food industry, and the factors that importantly determine its growth. It then looks ahead to future global food requirements and the contribution that technology must make to improve crop yields and animal offtakes. Next, it reviews the advent of biotechnology, its broad promise, the issues it raises, and the critical need for specialized information to improve understanding of its likely far-reaching implications.

- Past technology growth in crop and animal agriculture – its relative importance, historical growth rates, recent trends, expected growth rates, before the advent of biotechnology.
- Factors that importantly determine technological progress.
- Future food needs for the global population – technology's expected contribution.
- The advent of biotechnology – what it is, its promise, factors determining its acceptance, the products, extent of adoption today.

II. *Biotechnology: The Near-Term Pipeline*

This section first reviews the biotech products now in commercial use, their characteristics, and the extent of their adoption. It then looks ahead to the range of products now in the pipeline and likely to be introduced over the next five years. The nature and characteristics of these products and their expected benefits and advantages will be examined. It will attempt to develop an overall profile of the extensiveness of biotechnology in the food and agriculture industry in the next five years.

- Biotech products now in commercial use, their characteristics, extent of adoption, and future role.
- Types of products to emerge from the pipeline over the next five years – their likely characteristics, attributes, uses, and pace of adoption. Based on interviews with experts in universities, biotech firms and leading-edge producers and processors.
- What new crop, animal and food products are likely to emerge – how extensive can "gene stacking" be? What other characteristics will they possess? What problem do they overcome, benefits offered, etc.

III. *Systematic Evaluation of Impacts*

- There obviously is no statistical method that can precisely forecast the tremendous impacts that biotechnology will have on the global food and agriculture system. It is clear, however, that the new technologies will affect nearly everyone at some degree. This approach then involves a thorough step-by-step evaluation of the likely impacts on each segment of the food system.

- This section will focus on key impacts for:

  - ***Input industry structure*** – How much further will the current pace of rapid restructuring proceed? What is the strategy of the major players? How will business relationships be changed?

  - ***Farm structure*** – How will producers respond to the rapidly changing technologies? Will they hasten further consolidation in the farm sector? Will this accelerate growth of large farms? How will the farms of the future be structured? Managed? Operated? How does precision farming fit with the advent of biotechnology? What tangible benefits does it offer? What synergies are gained from biotech/precision farming in tandem?

  - ***Markets*** – How will markets react to a shift from producing commodities to components - to characteristic – specific crops and animals? How will the markets evolve? Will new contracting arrangements develop? How will new products be priced? Will new marketing channels be created, and at what cost? How will market information be gathered and provided? By whom?

  - ***Processing structure*** – What types of alliances and mergers can be expected between processors, producers, and input suppliers? What new investments may be required to ensure identity preservation of characteristic specific products?

  - ***Consumers*** – How will new products/processes benefit consumers? Will consumer acceptance continue at pace in the United States? What will happen in Europe? Japan? What could diminish consumer acceptance in these markets? Who is educating consumers on new products, their properties and benefits? What is the role of government in education? In regulations?

  - ***International markets*** – Will these technologies be embraced by these markets? Will new products require labeling, segregation? Role of multinationals in bringing new products to global markets?

  - ***Policy and trade issues*** – Will biotechnology prove to be a contentious and enduring – or short-lived – trade issue? Will disputes disrupt trade flows?

Will new trade conventions accelerate acceptance of new products? Will harmonized biotechnology standards by quickly adopted?

- ***Overarching issues*** – How will environmental considerations affect acceptance of the new technologies? Will biotechnology play a major role in future global food security?

IV. *Implications for Study Participants*

This section will develop implications of the biotechnology revolution over the next decade for major participants in the agribusiness industry. It will develop specific information to help participating clients better position their business to take advantage of the opportunities and adapt quickly to the challenges that may be presented.

How will my industry and business be affected by the advent of biotech? What are the strategic implications for my business?

VII. *Summary/Conclusions*

This section will identify and assess the issues and actions that should be closely watched in the future to determine the opportunities and problems that could emerge as biotechnology and precision farming development continues at a rapid pace.

Study Products

The project will involve several specific products for participating clients including:

- **Pre-study conference.** A day-long meeting of all participating clients and the SCI study staff will be held in Washington, DC to review the detailed plans for the study and to identify particular areas and issues that clients want to receive special attention.

- **Comprehensive study report.** All participating clients will receive ***Biotechnology: Fundamentally Reshaping the Agriculture and Food Industry***, the fully documented study report containing all description, background statistics, analysis and evaluations, empirical projections and supporting detail developed during the course of the study. (All materials will be available both electronically and in hard copy.)

- **Post-study seminar.** A concluding seminar will be held for all clients as a group to participate with study staff and consultants in reviewing the findings and implications.

- **Final report presentation** at clients' offices. SCI staff will travel to client offices, if requested, to present the final report and conduct in-house seminars.

Study Staff and Review Team

The overall project will be coordinated by Dr. J. B. Penn, Senior Vice President and head of SCI's Washington, DC office. Other SCI staff with directly relevant experience will actively participate in the analysis including Ms. Beth Brechbill, Dr. William C. Motes, Mr. Tom Scott, Mr. Scott Richman and others. In addition, consultants with extensive experience evaluating various aspects of the industry will serve as special advisors to the study team. Brief notes on the lead analysts follow.

Dr. J.B. Penn, Senior Vice President and head of the Washington Office – extensive experience in evaluating emerging industry trends, conducting regional market and sector studies, and in analysis of national and international policy impacts – formerly Deputy Administrator for Economics of USDA's Economics and Statistics Service and Senior Staff Economist with the President's Council of Economic Advisers – 17 years of private sector consulting experience closely following industry trends and policies.

Ms. Beth Brechbill, Senior Consultant – responsible for analyzing agricultural and food policies, industry trends, and international trade prospects – recent studies include examination of the future US farm structure, implications of biotechnology, and the economic impacts of the global warming treaty – experience in international trade and marketing as consultant to the American Soybean Association in Moscow – holds a BS in international law and relations from Georgetown University, MS in agricultural economics from Purdue University.

Dr. William C. Motes, Senior Vice President – extensive experience evaluating agricultural markets, policies, and emerging industry trends in many countries – formerly head of USDA's policy analysis in the Office of the Secretary and Senior Staff Member of the Senate Committee on Agriculture and Forestry – graduate degrees from Kansas State and Iowa State Universities.

Mr. Tom Scott, Senior Vice President – heads project consulting group, focuses on the grain industry and international markets, specialist in long-term asset demand in transportation industry – previously held management, trading logistics, and merchandising positions with Continental Grain Company – a BS in agricultural economics from Cornell University, MBA from Dartmouth College.

Mr. Scott Richman, Vice President – responsibilities include consulting with a broad range of clients, including grain milling, oilseed and other crop biotechnology, and the livestock/meats areas. Projects often involve estimating the market position and financial attractiveness of business ventures – holds BS in economics from Vanderbilt University and MS in international affairs/business from Columbia University.

John De Pape, Vice President – Mr. De Pape joined SCI in 1996, opening the Winnipeg office, where his main focus is working with Canadian clients in the area of risk management, logistics and asset development (site selection and analysis). Mr. De Pape has an extensive background in the Canadian grain industry including grain merchandising and transportation, risk management, and exchange administration. Mr. De Pape holds a Bachelor's Degree in Agriculture and a

Master's of Business Administration specializing in agribusiness, both from the University of Manitoba.

Ron Gibson, Vice President – Mr. Gibson's major areas of focus include project consulting for international and domestic clients, as well as price risk management in the cereal grain sector. Ron has traveled to more than 40 countries and worked extensively on the development of cash and futures markets for agricultural products. Gibson previously worked for the Canadian Wheat Board (CWB) holding senior positions in the areas of policy, pricing, risk management and transportation. He holds a Master's of Science degree in Agricultural Economics from the University of Manitoba and a Bachelor of Commerce degree from the University of Saskatchewan.

Project Schedule

June - July 1998	Pre-study conference and study begins
July - September	Study completed and draft report sent to clients for review
September	Group seminar to review report
September-October	Individual presentations at client offices

Study Fees

The fees for participating in the study are US $14,500 for SCI clients and US $17,500 for non-clients. The fee includes attendance at the pre-study conference, the group review seminar, and a presentation at client's offices by SCI staff. Cost of company representatives' travel to the conference and seminar, and expenses for SCI staff travel to companies' offices for the presentation are not included.

Sparks Companies, Inc.

ENROLLMENT FORM

☐ Yes, I want to participate in the special ***Biotechnology: Fundamentally Reshaping The Agriculture And Food Industry*** multi-client study. The cost of the study for current SCI clients will be US $14,500 and US $17,500 for non-clients. One-half will be billed upon initiation of the study and the remaining one-half upon my acceptance of the final report.

FAX to 204-925-7074

☐ Please have someone contact me to provide further information.

Name: _____

Title: _____

Company: _____

Address: _____

City, State, Zip: _____

Telephone: _____ Fax: _____

Mail or fax the form to:

Dr. J.B. Penn
SCI/Washington
6708 Whittier Ave.
McLean, VA 22101

Phone: 703-734-8787
Fax: 703-893-1065

- or -

John DePape/Ron Gibson
Sparks Companies, Inc.
Suite 1200 – 191 Lombard Ave.
Winnipeg, Manitoba R3B 0X1

Phone: 204-925-7070
Fax: 204-925-7074

National Cotton Council
Gaylon B. Booker

Pioneer Hi-Bred International Inc.
Tom Dougherty

Rabobank International
Joyce Cacho

Rhone Poulenc
Spencer Cohen

Riceland Foods, Inc.
Richard E. Bell

Sara Lee Trading
Randall Chambers

Saskatchewan Agriculture and Food
Ken Perlich

Saskatchewan Wheat Pool
Paul Bonnet

J.R. Simplot Company
Raymond V. Sasso, Jr.

July 24, 1998

Sparks Companies, Inc

Participants in the Biotechnology Multi-Client Study

Agribank
Dave Reinders

Agribrands International, Inc.
Nick Eicher

Agriculture & Agrifood Canada
James Oxley

American Farm Bureau Federation
Terry Francl

Australian Bureau of Agricultural and Resource Economics (ABARE)
Brian Fisher
Paul Morris

Babson Bros. Company
Nick Babson

BIOTECanada
Rick Walter

Bunge Corporation
Philippe de Laperouse

Cargill
Carolyn Fritz

Clemson University
James R. Fischer

CoBank ACB
Steve Lauck

ConAgra
Bill Lapp
Dick Gady

Deere & Company Technical Center
Richard R. Johnson

DuPont Company
Gail F. Santoro

Embrex
Rick Ryan

Equipment Manufacturers Institute
Emmett Barker

European Union Commission
Tassos Haniotis

Farm Credit Corporation
Louise Neveu

George Weston Ltd.
David Farnfield

Growmark, Inc.
Jim Charlesworth

John Hancock Mutual Life Insurance Company
Phillip J. Peters

Kal Kan Inc.
David Abdoo

Kraft Foods, Inc.
Marcia Glenn

Maple Leaf Foods (Canada Bread)
William Oakley

Monsanto
Molly Cline

New Holland North America Inc.
Robert Bledsoe

NTF/Action/Meeting	Nora Nishikawa/BSCO-CFIA	DATE: June 8/98
SUBJECT: SCI Proposed Study		
ACTION ITEM:		

- Spoke w/ Harold
- John de Papp, SCI Cdn office in Winnipeg (204) 925-7071
- Speak w/ Garry - Done he will check into it

FBC Network
- request for $
- French Bilingual
- ~~need~~ recommendations

Ann Penner -
for your info.
PD

Sparks Companies, Inc.

May 11, 1998

FYI -
Margaret Kenny - CFIA
Ray McAlpine - MISB
Dalia Kudirka - Research
Lynne Stewart - MISB
Gary Hewston - Policy

Dear Colleague:

I want to draw your attention to a development now in its infancy that could change our industry more than any other since World War II — the growing availability and application of biotechnology. *Never before has the sector had the capacity to restructure its production processes, fundamentally remake its commodities and realign its markets as it now will be able to do. In only a few years, our current systems will be not only outmoded, but could become unrecognizable.*

Such sweeping changes will mean large numbers of winners and losers — and will shift investment ground rules for the future. Few in agribusiness can afford to stand on the sidelines secure in the assumption that they will be little, or only positively, affected. The new developments will mean huge opportunities for firms that are correctly positioned, but could imply major threats for others. How well is your firm prepared to answer these questions about the industry in the next five years?

- What will your competitive position be when the impact of new biotech processes is fully felt? What about your competitive position in your region, and in national and world markets?
- What new markets will develop, and what will it take to compete there? What can be expected of those markets? What new competitors can you expect in your major markets? How will the markets change to accommodate the new products/processes?
- What new market development and client service strategies should you consider? Which products? Which markets?
- How will you deal with the increased supply and demand volatility likely for the new products? Which risk management strategies likely will be most effective?
- How should you focus your financial planning? How can you position your firm strategically for the next decade, and beyond?

SCI is organizing a study to evaluate the changes that biotechnology could imply for our industry over the next decade. We will develop a systematic view of the current and approaching new products and processes, estimate what's in store in the "next wave" and from those still in various stages of development. And, we will estimate what the impacts could mean for the system and its participants. We invite you to become a part of the evaluation so that you can be sure your special questions and interests are covered.

889 Ridge Lake Boulevard • Suite 300 • Memphis, Tennessee 38120-9493 • Telephone (901) 766-4600

The attached prospectus describes the study in more detail. We welcome your consideration of our proposal, and look forward to working with you on this project.

Sincerely,

Bruce A. Scherr
President
Chief Executive Officer

BAS/ebm

Attachment

SPARKS COMPANIES, INC.

BIOTECHNOLOGY: FUNDAMENTALLY RESHAPING THE AGRICULTURE AND FOOD INDUSTRY

A Special SCI Multi-Client Study

May 1998

Taking Advantage of Opportunities
From the Next New Wave of Technology

BIOTECHNOLOGY: FUNDAMENTALLY RESHAPING THE AGRICULTURE AND FOOD INDUSTRY

Background

Technological progress in agriculture traditionally has been incremental, as evidenced by the generally slow but persistent expansion in crop yields and animal output. Periodically, however, there is an eruption of growth. This was the case early in this century with the invention of the internal combustion engine which led to the massive shift from animal power to mechanization. Another technology explosion occurred before mid-century with corn hybridization, followed by widespread use of chemical fertilizers and pesticides after World War II.

Another such eruption is occurring today with the advent of biotechnology and precision farming. Products are already in commercial use that lower costs and increase yields (e.g., insect and herbicide resistant) and that provide custom user traits (e.g., specific qualities for particular uses), reducing processing and final product costs. Many more are in the near-term pipeline and these are but the tip of the iceberg. These technologies together promise to alter fundamentally virtually every aspect of today's farming and food structure, and *in a relatively short period of time!*

Although still in the early stages, this change is occurring so rapidly and with such breadth that it is prompting numerous questions about its likely impacts all across the agriculture and food industry. The implications could prove enormous:

- **Industry structure and business relationships** – What will be the result of the fast-paced restructuring now underway – on numbers and sizes of key players? On traditional sales and service relationships? On marketing channels and products flows? Will there be a further blurring of once-distinct lines all across the farm supply, production and processing and distribution sectors?

- **Agricultural processors** – How extensive will "decommoditization" become? How will the emergence of many new products affect processing and distribution? Storage and handling methods? Investment requirements? Operating costs and margins? Marketing relationships? Who specifies new product requirements?

- **Nature and character of traditional commodity markets** – How will pricing occur for more, highly specific component and niche products? How transparent will it be? Will new contract relationships emerge? Risks easier or harder to manage? What new informational needs will arise?

'll evaluate developments now underway and being planned, and identify likely impacts, enabling clients to better position their businesses for such outcomes. It will not be a statistical or quantitative forecasting study, but will focus on implications and issues, bringing forth ideas, developments and implications that might otherwise might not be anticipated. Notions of magnitude and relative importance of trends and impacts will be developed where possible.

The **study approach** will involve first establishing and projecting the likely broad advances in new products and techniques that biotechnology and precision farming will bring in the next few years. Then, the potential impacts and implications will be explored systematically, tracing across each segment of the food system (input supply, farming, processing, transporting, retailing). Particular attention will be paid to the business restructuring aspects, production sector implications, international trade policy issues (especially in view of the upcoming WTO "Millennium Round"), consumer concerns, and global food security matters.

Clients will be asked to participate actively, especially at the start of the study, in charting its exact course and identifying the specific aspects to be emphasized. Client concerns and special interests will be accorded more attention. A preliminary outline of the study follows.

Who Will Be Affected/Who Should Participate?

The answer is ***EVERYBODY***. Biotechnology promises to have such widespread impacts that no part or participant in the food system will remain unaffected.

Understanding the development and future implications of this technological revolution is of tremendous importance to virtually every component of the global food and agriculture structure, beginning with those who develop the technologies and on to the consumers in both domestic and international markets who purchase the new food products. It will affect structure, markets, institutions, and the entire business process.

Thus, agribusiness and food industry firms wishing to become more aware of coming developments and be better able to position themselves to take advantage of this rapid change can benefit especially from the study. More specifically, those affected throughout the system include:

- Seed companies
- Pesticide and fertilizer companies
- Equipment manufacturers
- Investors/bankers
- Commodity processors
- Grain merchandising and trading companies
- Cooperatives
- Food ingredient suppliers
- Food retailers
- Food processors
- Feed manufacturers
- Meat and poultry processors
- Trade associations
- Transporters
- Exporters
- World market participants (Australia, Canada, European Union, Japan, etc.)
- Government agencies
- International organizations

- What new crop, animal and food products are likely to emerge – how extensive can "gene stacking" be? What other characteristics will they possess? What problem do they overcome, benefits offered, etc.

III. *Systematic Evaluation of Impacts*

- There obviously is no statistical method that can precisely forecast the tremendous impacts that biotechnology will have on the global food and agriculture system. It is clear, however, that the new technologies will affect nearly everyone at some degree. This approach then involves a thorough step-by-step evaluation of the likely impacts on each segment of the food system.

- This section will focus on key impacts for:

  - ***Input industry structure*** – How much further will the current pace of rapid restructuring proceed? What is the strategy of the major players? How will business relationships be changed?

  - ***Farm structure*** – How will producers respond to the rapidly changing technologies? Will they hasten further consolidation in the farm sector? Will this accelerate growth of large farms? How will the farms of the future be structured? Managed? Operated? How does precision farming fit with the advent of biotechnology? What tangible benefits does it offer? What synergies are gained from biotech/precision farming in tandem?

  - ***Markets*** – How will markets react to a shift from producing commodities to components - to characteristic – specific crops and animals? How will the markets evolve? Will new contracting arrangements develop? How will new products be priced? Will new marketing channels be created, and at what cost? How will market information be gathered and provided? By whom?

  - ***Processing structure*** – What types of alliances and mergers can be expected between processors, producers, and input suppliers? What new investments may be required to ensure identity preservation of characteristic specific products?

  - ***Consumers*** – How will new products/processes benefit consumers? Will consumer acceptance continue at pace in the United States? What will happen in Europe? Japan? What could diminish consumer acceptance in these markets? Who is educating consumers on new products, their properties and benefits? What is the role of government in education? In regulations?

  - ***International markets*** – Will these technologies be embraced by these markets? Will new products require labeling, segregation? Role of multinationals in bringing new products to global markets?

Study Staff and Review Team

The overall project will be coordinated by Dr. J. B. Penn, Senior Vice President and head of SCI's Washington, DC office. Other SCI staff with directly relevant experience will actively participate in the analysis including Ms. Beth Brechbill, Dr. William C. Motes, Mr. Tom Scott, Mr. Scott Richman and others. In addition, consultants with extensive experience evaluating various aspects of the industry will serve as special advisors to the study team. Brief notes on the lead analysts follow.

Dr. J.B. Penn, Senior Vice President and head of the Washington Office – extensive experience in evaluating emerging industry trends, conducting regional market and sector studies, and in analysis of national and international policy impacts – formerly Deputy Administrator for Economics of USDA's Economics and Statistics Service and Senior Staff Economist with the President's Council of Economic Advisers – 17 years of private sector consulting experience closely following industry trends and policies.

Ms. Beth Brechbill, Senior Consultant – responsible for analyzing agricultural and food policies, industry trends, and international trade prospects – recent studies include examination of the future US farm structure, implications of biotechnology, and the economic impacts of the global warming treaty – experience in international trade and marketing as consultant to the American Soybean Association in Moscow – holds a BS in international law and relations from Georgetown University, MS in agricultural economics from Purdue University.

Dr. William C. Motes, Senior Vice President – extensive experience evaluating agricultural markets, policies, and emerging industry trends in many countries – formerly head of USDA's policy analysis in the Office of the Secretary and Senior Staff Member of the Senate Committee on Agriculture and Forestry – graduate degrees from Kansas State and Iowa State Universities.

Mr. Tom Scott, Senior Vice President – heads project consulting group, focuses on the grain industry and international markets, specialist in long-term asset demand in transportation industry – previously held management, trading logistics, and merchandising positions with Continental Grain Company – a BS in agricultural economics from Cornell University, MBA from Dartmouth College.

Mr. Scott Richman, Vice President – responsibilities include consulting with a broad range of clients, including grain milling, oilseed and other crop biotechnology, and the livestock/meats areas. Projects often involve estimating the market position and financial attractiveness of business ventures – holds BS in economics from Vanderbilt University and MS in international affairs/business from Columbia University.

Sparks Companies, Inc.

ENROLLMENT FORM

Yes, I want to participate in the special ***Biotechnology: Fundamentally Reshaping The Agriculture And Food Industry*** multi-client study. The cost of the study for current SCI clients will be $14,500 and $17,500 for non-clients. One-half will be billed upon initiation of the study and the remaining one-half upon my acceptance of the final report.

① What will be the study products
② ~~who~~

FAX to 703-893-1065 or 901-766-4402

Please have someone contact me to provide further information.

Name: _____

Title: _____

Company: _____

Address: _____

City, State, Zip: _____

Telephone: _____ Fax: _____

Mail or fax the form to:

Dr. J.B. Penn
SCI/Washington
6708 Whittier Ave.
McLean, VA 22101

Phone: 703-734-8787
Fax: 703-893-1065

- or -

Dr. Bruce A. Scherr
Sparks Companies, Inc.
889 Ridge Lake Blvd.
Memphis, TN 38120

Phone: 901-766-4600
Fax: 901-766-4402