CAN HIGH-TECH CROPS BENEFIT LOW-TECH FARMERS?

SMALL-HOLDER BENEFITS OF BT COTTON IN WEST AFRICA

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What is Bt cotton?

Bt cotton is cotton that is engineered to express an insecticidal protein(s) isolated from a soil bacterium *Bacillus thuringiensis*.

Highly specific to narrow groups of insects

Very safe to non-targeted organisms (other insects, mammals, etc.)

Bt formulations have enjoyed a long history of safe use in agriculture, forestry, and public health

Photo: Dan Pitts

- Bt Cotton In Burkina Faso
  - Burkina Faso: Background
  - Capacity building and Bt cotton testing in BF
  - First 3 Years of Broad Commercial Release
    - Grower Survey: Yield; Profits; Health

Burkina Faso

formerly Upper Volta

- Land-locked Sub-Saharan West Africa
- 17 million people
- Heavily reliant on subsistence agriculture
- 61% live on less than $1 per day
- Life expectancy at birth ~ 48
- Males: prob of reaching 65 – 30%

Burkina Faso

ENVIRONMENTAL, HEALTH, GEOPOLITICAL BARRIERS TO DEVELOPMENT

- Locusts
- Drought
- Soil degradation/depletion
- Desertification
- Floods
- Malaria
- Regional Wars
- Contaminated Water
- Elephantiasis
- Meningitis
- Yellow Fever
- Illiteracy (~ 70%)

Cotton in Burkina Faso

- 400,000 - 550,000 ha
- ~ 450 Kg lint per ha
- ~ 240,000 MT lint
- Virtually 100% of lint exported
- Accounts for 60-70% of Burkina's export earnings

Photo: J. Greenplate

Cotton in Burkina Faso

- 2-5 hectare family farms
- All animal/manual labor
- 3 million people involved in cotton production
- Significant numbers involved in collateral industries

Photo: J. Greenplate

Photo: J. Vitale

COTTON COMPANIES
PROVIDE SEED, INPUTS, GINNING, ETC.

SOFITEX – 80%
SOCOMA – 15%
Faso Coton – 5%

Ownership:
BF Govt
Private investors
UNPCB

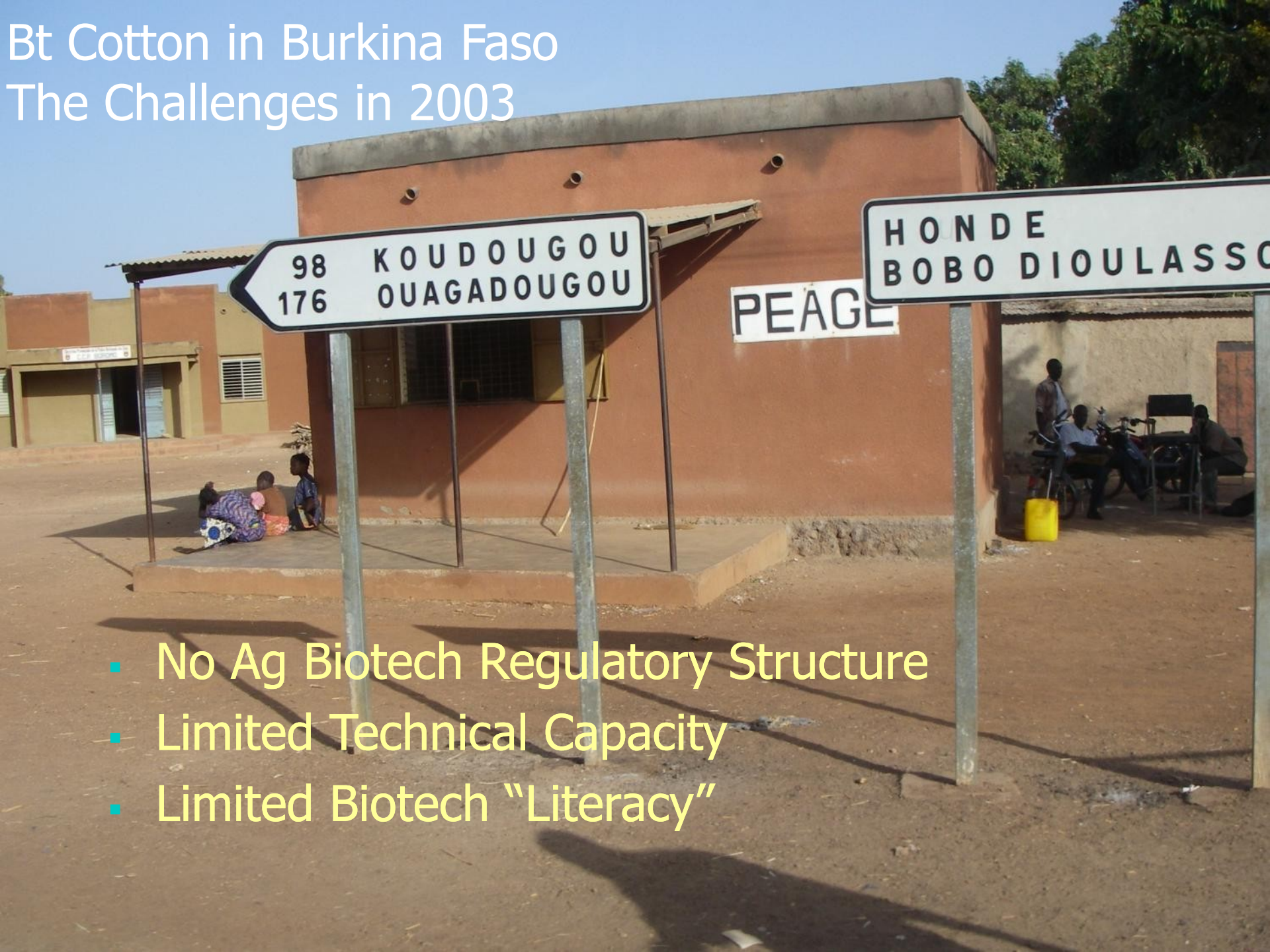
Photo: J. Greenplate

How did Monsanto become involved in Burkina Faso?

They asked us in 2003

Photo: J. Greenplate

Bt Cotton in Burkina Faso
The Challenges in 2003



- No Ag Biotech Regulatory Structure
- Limited Technical Capacity
- Limited Biotech "Literacy"

Stakeholders Contributing to Capacity Building

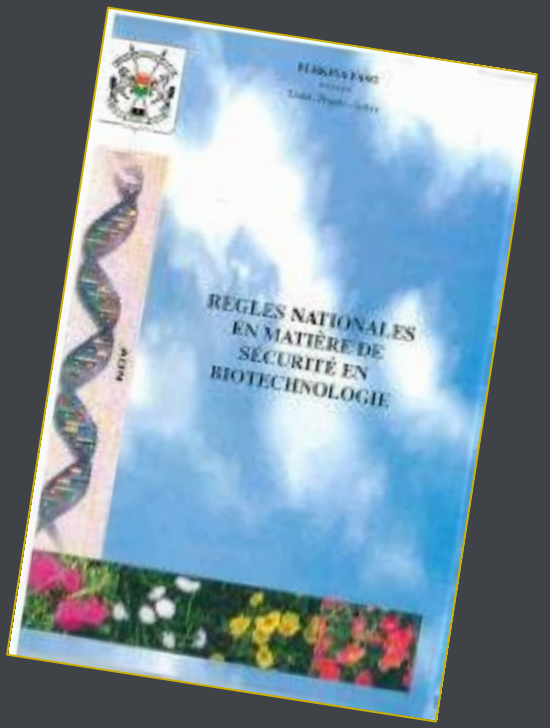
- Monsanto
- AfricaBio – Research and Regulatory Capacity Building – Africa Focus
- AgBios – Public Policy, Regulatory, Risk Assessment Expertise
- BBA – Burkina Biotech Assoc – Education/Communications
- CIRAD – French Parastatal Research Org. focusing on Africa
- Danforth Plant Sciences Center – Technical/Regulatory Capacity Building
- ICAC – International Cotton Advisory Committee
- ISAAA – International Service for Acquisition of Ag-Biotech Applications
- NCC – National Cotton Council US
- PBS – Program for Biosafety Systems – Regulatory Capacity Building
- Tuskegee University – Technical/Research Capacity Building
- University of Arkansas – Technical Capacity Building – Cotton Breeding
- New Mexico State University – Technical Capacity Building – Cotton Breeding
- USAID – US Agency for International Development
- USDA-FAS – USDA – Foreign Agriculture Service
- WACIP – West African Cotton Improvement Programme
- World Bank – Funding for Development of Regional Regulatory Capacity

Regulatory Capacity Building 2003

- Provisional Biosafety Committee
  - Minister of Agriculture
  - Minister of Research & Higher Ed.
  - Minister of Environment
  - Advisors
- Formal Research Agreement
  - Monsanto and INERA

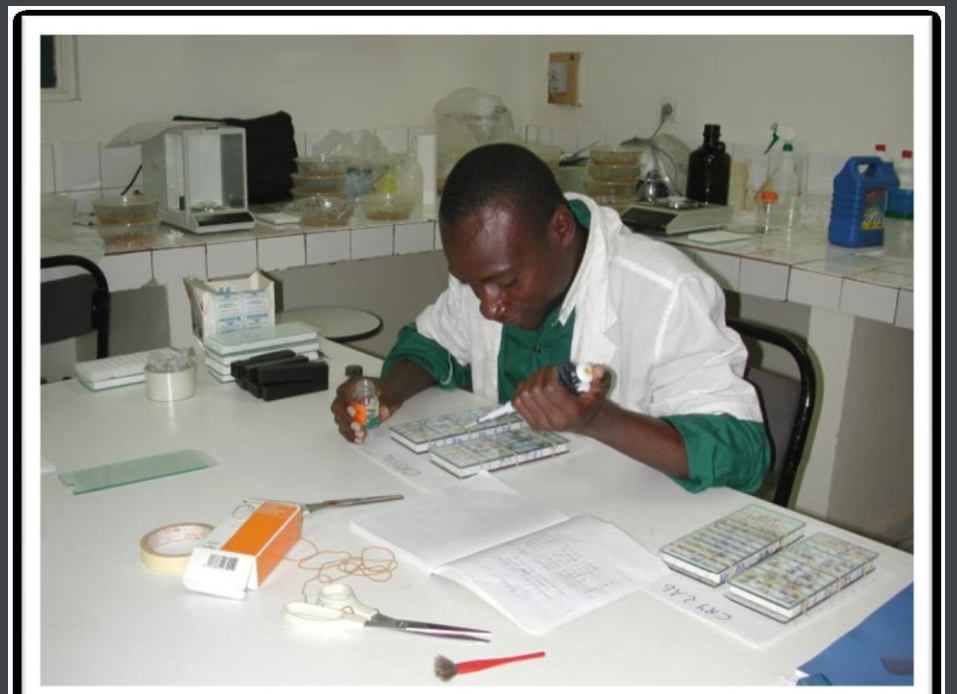
Regulatory Capacity Building 2004-2006

- Biosafety Law drafted and reviewed
- Regulatory Agencies established and their responsibilities identified
- Biosafety Law completed, ratified by legislature, signed by President
- Instruments in place for application for commercial release



Technical Capacity Building

- Training for working scientists and extension personnel on Biotech
- Efficacy, stewardship, environmental safety, and economic studies, and subsequent publications



Technical Capacity Building

INERA cotton breeders assisted in Bt cotton family selection

Biotech literacy capacity building: "Seeing is believing" seminars

Annual data reviews/field days for all stakeholders
Media training events

- Growers
- Scientists/Academics
- Regulators/Politicos
- Cotton Companies
- Media
- NGOs
- Faith Community

Bt Cotton in Burkina Faso

What were the potential benefits?

- The Bt proteins specifically target certain **caterpillars** (Lepidoptera larvae)
  - They are the key economic pests in BF cotton
  - They are responsible for most of the insecticides used
- Large portion of population could benefit if this important industry is improved

Helicoverpa armigera

Photo: J. Greenplate


Helicoverpa armigera
Photo: J. Greenplate

Photo: J. Greenplate

Anomis flava

Photo: J. Greenplate


Haritalodes derogata
Photo: J. Greenplate

Second Generation Bt Cotton Technology

- Cotton expressing 2 proteins which effectively control caterpillar insect pests

2003-2005 confined field trials on govt. stations

Bt genes in US germplasm

2006-2007 systems trials on commercial cotton plots

Bt genes in Local germplasm

Burkina Faso Field Research

- **Efficacy studies**
  - **Insect control**
  - **Plant damage ratings**
- **Economics**
  - **Input savings**
  - **Effects on yield**
  - **Value created?**
- **Environmental**
  - **Gene flow / isolation distance**
  - **Non-target/beneficials surveys**

Photos: J. Greenplate

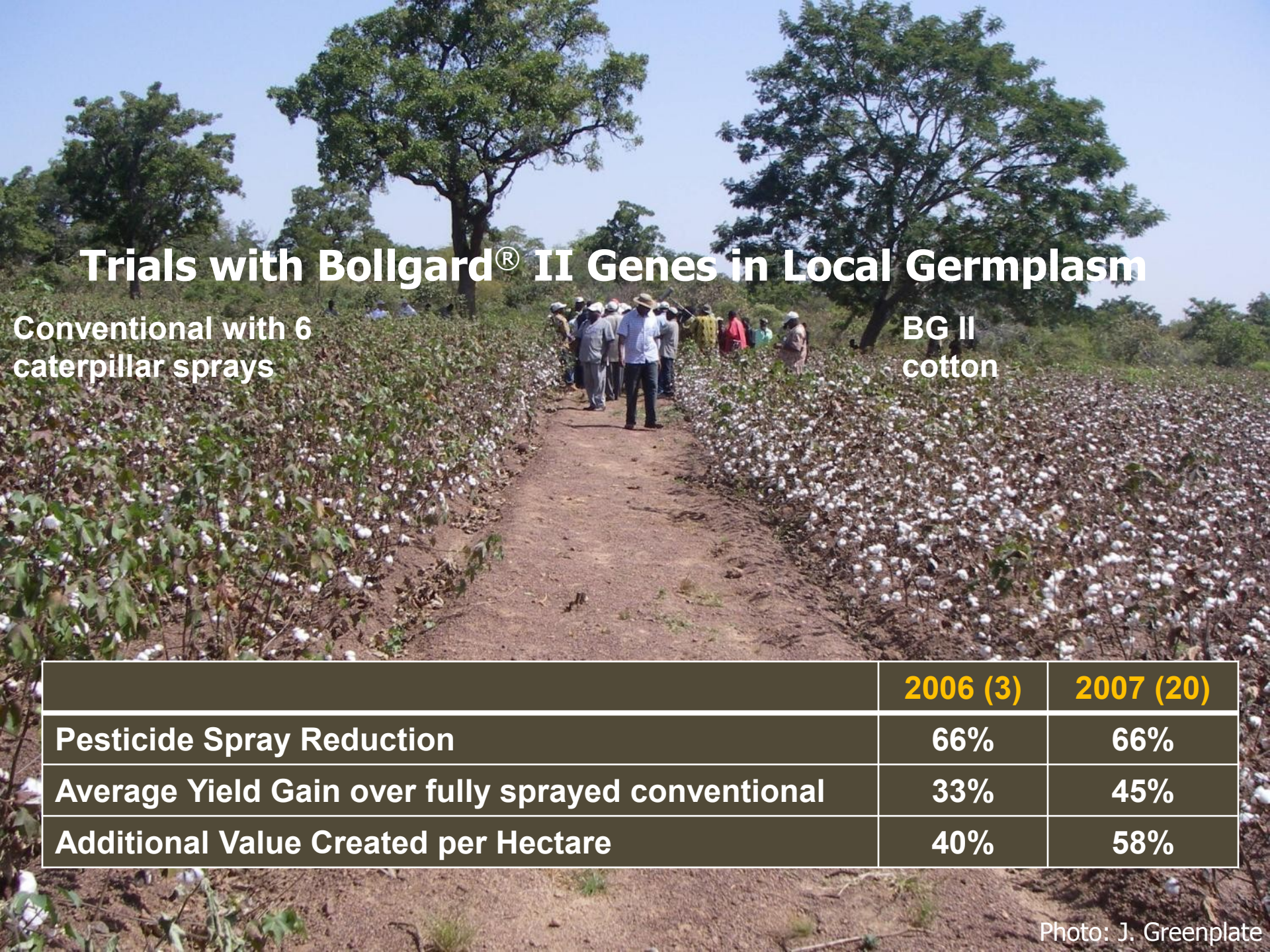
2003 – 2005 Field Trials at Govt Research Farms

(Bollgard® II genes in US germplasm)

2003-2005 data summarized	
Caterpillar control	92-100%
Reduction in damaged fruit	88-90%
Reduction of pesticide sprays	66%
Average Yield Gain over fully sprayed conventional	15%
Additional Value Created per hectare (value of extra yield + savings on insecticide)	30%

Photo: M. Abdennadher

Trials with Bollgard® II Genes in Local Germplasm

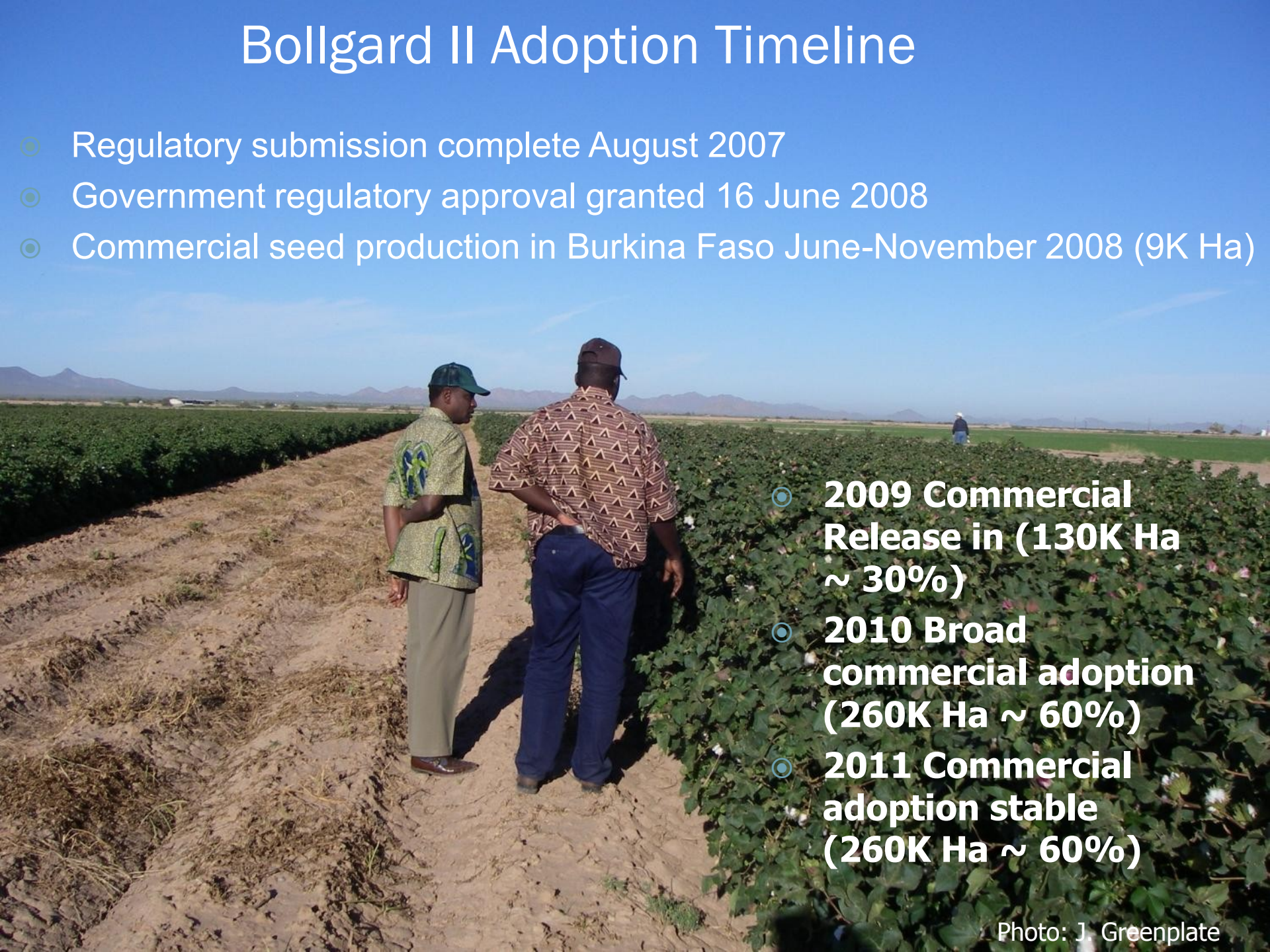


	2006 (3)	2007 (20)
Pesticide Spray Reduction	66%	66%
Average Yield Gain over fully sprayed conventional	33%	45%
Additional Value Created per Hectare	40%	58%

Photo: J. Greenplate

Bollgard II Adoption Timeline

- Regulatory submission complete August 2007
- Government regulatory approval granted 16 June 2008
- Commercial seed production in Burkina Faso June-November 2008 (9K Ha)



- **2009 Commercial Release in (130K Ha ~ 30%)**
- **2010 Broad commercial adoption (260K Ha ~ 60%)**
- **2011 Commercial adoption stable (260K Ha ~ 60%)**

Photo: J. Greenplate

2009 - 2011: three years of broad commercial production

So, what happened?
Have benefits been realized?

191 Surveys of Commercial BGII Growers Countrywide

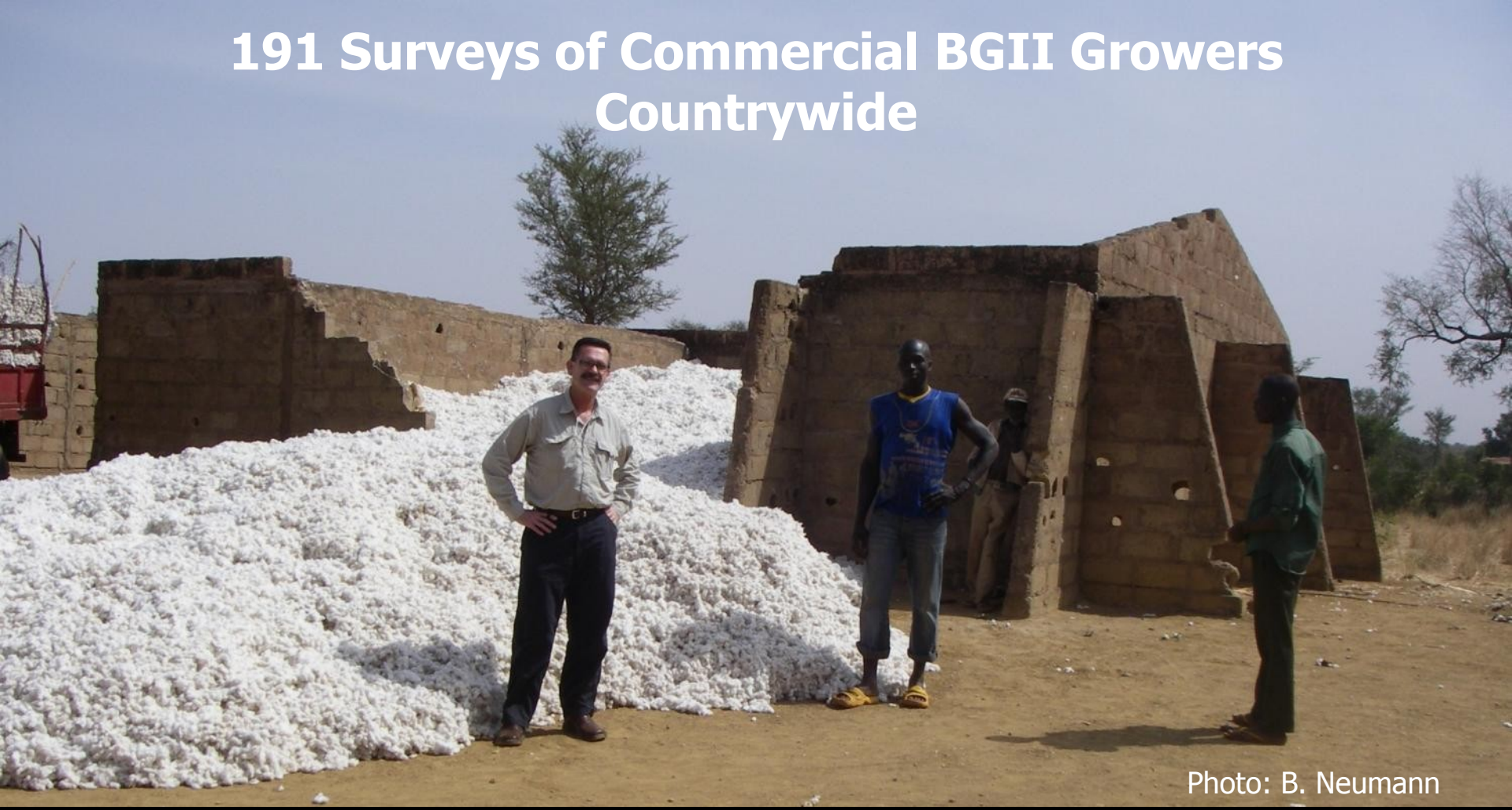


Photo: B. Neumann

2009 First Broad Commercial Release: ~ 30% of cotton acreage

Reduction in pesticide applications	66 – 100%
Average Yield Gain over fully sprayed conventional	20%
Grower increase in net profit per hectare	$87

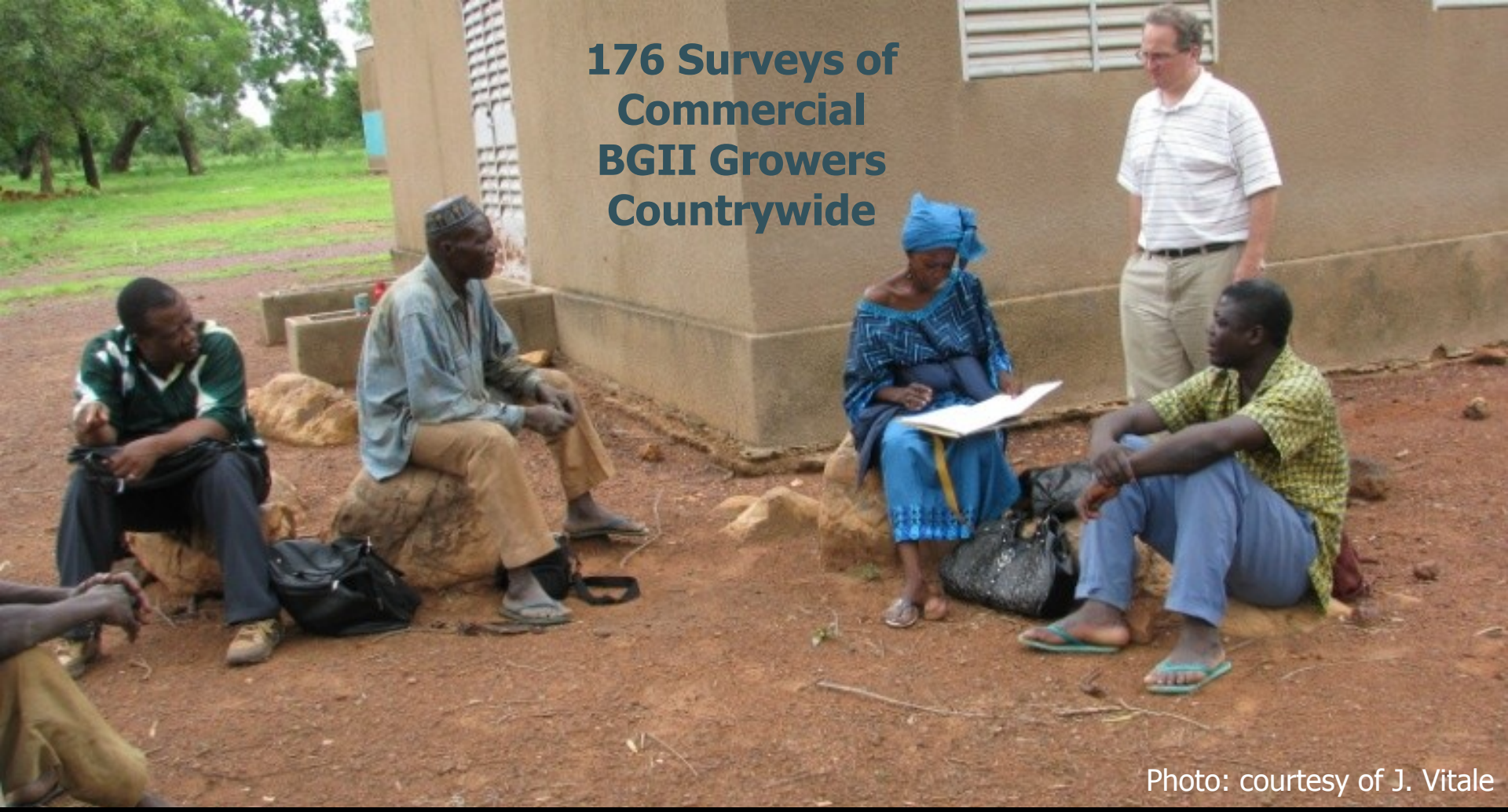


Photo: courtesy of J. Vitale

2010 Second year commercial adoption ~ about 60% of cotton acreage

Reduction in pesticide applications	66 – 100%
Average Yield Gain over fully sprayed conventional	29%
Grower increase in net profit per hectare	$88

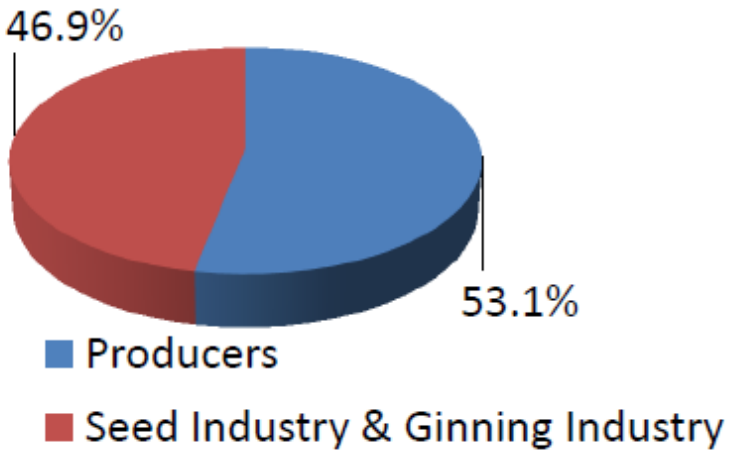
257 Surveys of Commercial BGII Growers Countrywide

2011 Third year commercial adoption ~ about 60% of cotton acreage

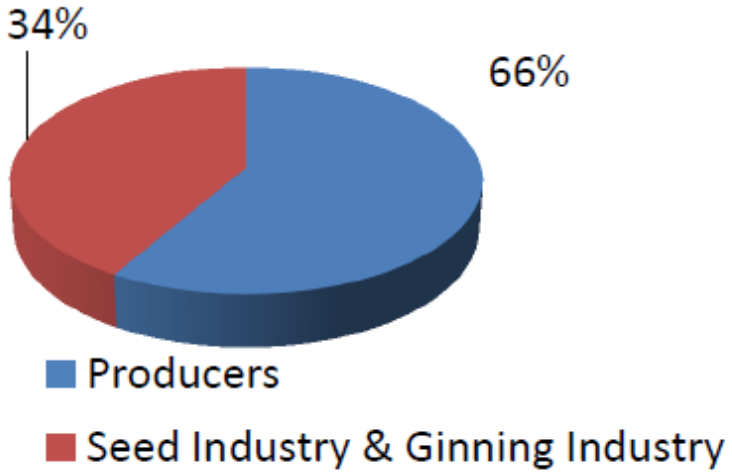
Reduction in pesticide applications	66 – 100%
Average Yield Gain over fully sprayed conventional	20%
Grower increase in net profit per hectare	$95

Distribution of Benefits

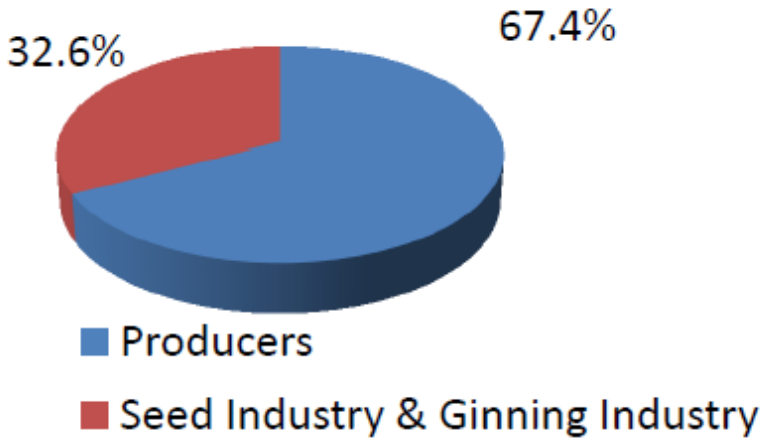
2009



2010



2011



2012-13 RECORD HARVEST

Preliminary socio-economic data indicate outcomes similar to 2009-11 results

Burkina Faso cotton output soars 57.5 pct due to GMOs -producers

OUAGADOUGOU | Thu Jan 31, 2013 12:00pm EST

Jan 31 (Reuters) - Cotton production in Burkina Faso, one of the first countries in Africa to approve genetically modified cotton, jumped 57.5 percent in 2012-2013 due to an increase in GMO crops, the producers' association said.

Output for the year to end-January 2013 rose to 630,000 tonnes from 400,000 tonnes in 2011/2012 and exceeded the association's expectations for 532,000 tonnes, the Burkina National Cotton Producers' Union (UNPCB) said on Thursday.

Burkina Faso, which relies on cotton as one of its major exports, approved the planting of Monsanto's Bt cotton GMO variety in 2008.

"Genetically modified cotton production is experiencing growth every year," said Karim Traore, UNPCB president.

Burkina Faso's top cotton producer, SOFITEX, collected 500,000 tonnes, 55 percent of which came from genetically modified crops, while the Gourma Cotton company collected 100,000 tonnes, he said

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UPDATE 5-Mali Islamists capture strategic town.

Health-related responses from grower survey

~50% of households reported at least one pesticide poisoning incident over last 6 years

~81% of reported poisonings associated with lepidopteran sprays

Photo:
J. Vitale

Projecting survey findings, BGII could reduce poisoning cases by about 30,000 incidents annually, nationwide, adding close to $1 million in benefits from reduced medical expenses and recouped lost wages

BGII could reduce number of pesticide containers by close to 1 million

Photos: J. Vitale

Bollgard II benefits in BF

- Increase in yields and in-country profits
  - $22 million in income benefit for small farmers at 60% adoption
  - Additional money retained locally by seed companies, etc.
- Significant reduction in sprays/exposure
- Vehicle for local regulatory and scientific capacity building

Research team for first confined Bt Cotton Field Trial
in West Africa - 2003

Thank You

Photo: M. Abdennadher