



Breeding and biotechnology increase the productivity and efficiency of maize

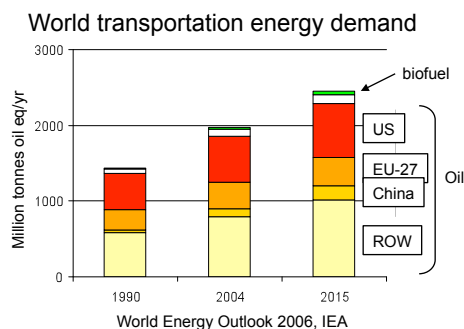
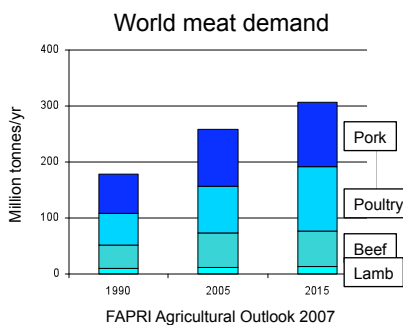
Mike Edgerton

Biomass 2008: Fueling Our Future  
17 April 2008

Global Stewardship: Proactively Addressing Environmental Sustainability



Feed and fuel demand are increasing

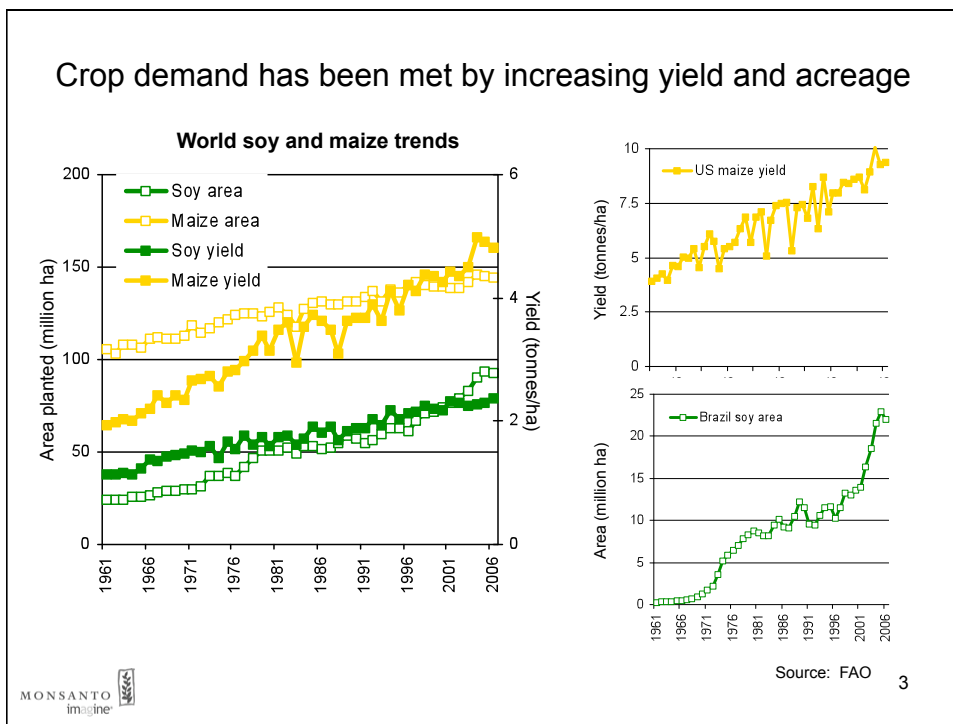


World demand for agricultural products is strong and growing

- Meat demand is driven by increases in GDP (developing countries) and population (developed countries)
- Biofuel demand is driven above, plus concerns about energy security, local economic factors and the environment



### Crop demand has been met by increasing yield and acreage



### Large increases in production possible by improving yield outside of the US

- Brazil (12.7 M Ha), Eastern Europe (9.8 M Ha), China (24 M Ha) and Mexico (7.6 M Ha) all have large corn acreage and yields significantly below US averages
- Increasing productivity of lower yielding regions could yield another 150 million tonnes/yr of corn without bringing new land into production

Exporters	Corn area (M Ha)	Production (M tonnes)	Yield (tonnes/Ha)	% US yield	Growth potential (M tonnes)
Argentina	2.3	15.1	6	69	1.4
Brazil	12.7	45.1	4	38	44.3
<b>Total</b>	<b>15.0</b>	<b>60.2</b>			
EtOH producers					
China	24.8	123.3	5	53	51.4
South Africa	3.4	9.9	3	31	14.3
Western Europe	3.4	28.7	8	90	
Eastern Europe	9.8	40.9	4	44	28.3
Canada	1.1	9.2	8	86	
Mexico	7.6	21.2	3	30	32.4
<b>Total</b>	<b>50.2</b>	<b>233.3</b>			<b>172.0</b>

**Color code**

- Light Green: Yield >75% of US
- Light Yellow: Yield 50-75% of US
- Light Orange: Yield <50% of US

Growth potential – Yield increase (million tonnes/yr) if yield is raised to 75% of US average



### Breeding and Biotechnology are both needed to provide the highest yields

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imagine

5

### Marker-assisted breeding has double the breeding rate of gain

Improvement in MTI for conventional and marker-assisted breeding

Year	# pops	Conventional Trait efficacy	Markers Trait efficacy
2002	79	~0.65	~1.15
2003	97	~0.35	~1.05
2004	72	~0.75	~1.65
All Years	248	~0.55	~1.25

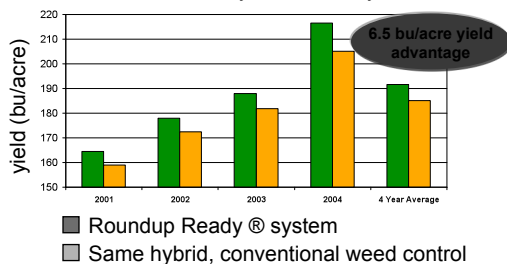
Eathington et al (2007) Crop Sci

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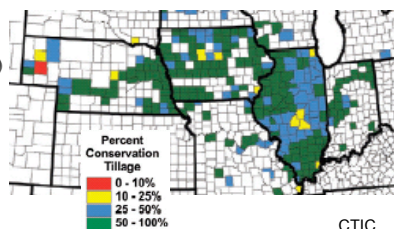
6

## Roundup Ready® corn system can improve yield and facilitates conservation tillage

Roundup Ready® corn system vs. conventional hybrids over 4 years



Conservation Tillage (2006)



CTIC

### Conservation tillage improves the environmental profile of farming

- Reduced soil erosion
- Improved water quality
- Lower farmer fuel usage

Source: 282 field trial comparisons, same Roundup Ready® Hybrid.Grower on-farm, university and Monsanto trials, 2001-2004.

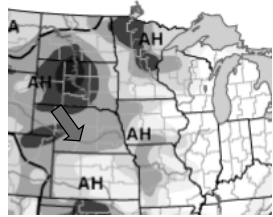
• 2008 Acreage estimate for Roundup Ready® Corn – 65 to 67 million acres



7

## “Triple stacked” hybrid showing superior performance under drought conditions in NE

Drought index at time of photo



Competitor +  
Poncho 1250

Crow's 4290 T  
(RR/CRW/CB)

- Crop insurance discounts offered in 2008 to growers using Monsanto's "triple stack" technology
- 2008 acreage estimate for "triple stacks" – 26 to 28 million acres



8

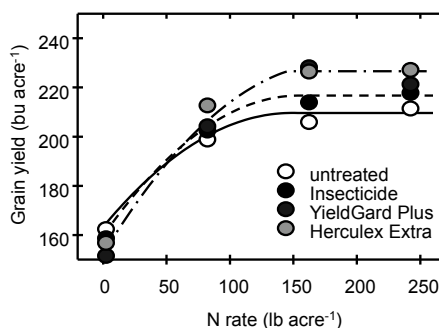
## Rootworm control can improve nitrogen use efficiency

Plants grown under low N treated with insecticide (Force® 3G) or YieldGard® rootworm



DKC63-81 (RR2/ YGCB) Force® 3G 4.4 #/A  
 DKC63-74 (RR2/ YGPL)

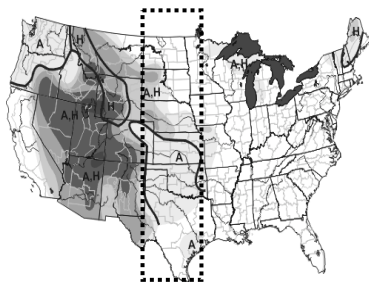
Grain yield vs. applied nitrogen



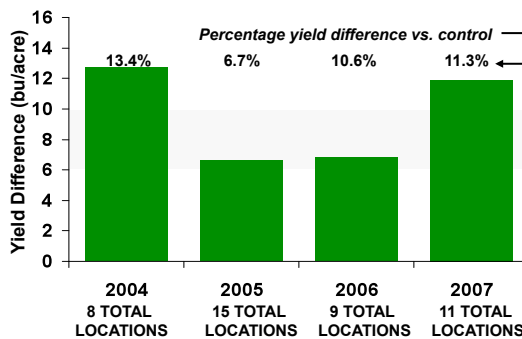
Data from Fred Below 2007



## 4 years of solid results with drought tolerance lead



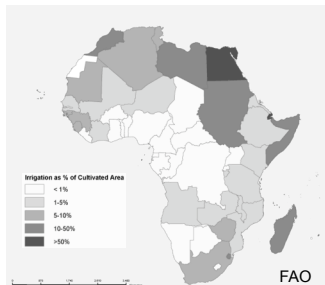
Average Yield Improvement of Lead Event



## Water-Efficient Maize for Africa (WEMA)

- Multi-party effort to develop drought tolerant maize to Africa
- Begins with adapted germplasm, includes both marker-assisted breeding and Monsanto's drought tolerance trait

Irrigation as % of cultivated area



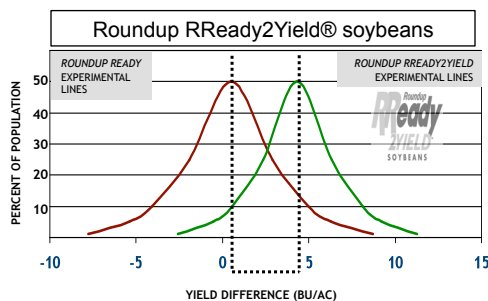
<http://www.aatf-africa.org/>



11

## Soybean yields are also being improved through application of markers and biotechnology

- 37.6 kg/ha (0.5 bu/ac) yield advantage observed across 43 soybean populations put through marker-assisted selection vs. conventional breeding (Eathington et al., (2007) Crop Science)
- Roundup RReady2Yield® soybeans provide enhanced yield, with a target of 7%-11% yield increase compared with Roundup Ready soybeans
- Transgenic high yielding soybeans show 3-5 bu/ac yield improvement



Transgenic higher yielding soy



12

## Improvements in productivity and efficiency will continue to reduce agriculture's impact on the environment

- Global demand for meat and biofuel has increased demand for grain and oilseeds
- Yield improvements can help reduce agricultural land requirements
- Biotech traits can improve yield stability, water use efficiency and nitrogen use efficiency
- Efficiency gains in terms of fuel use, fertilizer use and water use all improve the per bushel impact of farming
- A combination of technologies including breeding, biotechnology and agronomy are needed

