Application of Biotechnology to Traditional Crops for Biofuels

Alex Fink

Pioneer Hi-Bred

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DuPont Biofuel Opportunity Initiatives

Ag Inputs
Seed & Crop Protection

Seed & Crop Protection Solutions

Advanced Fuels
Butanol

Biobutanol, advanced biofuels

Biofuels From Biomass

Cellulosic Fuels

Current biofuel solutions are challenged to meet global needs

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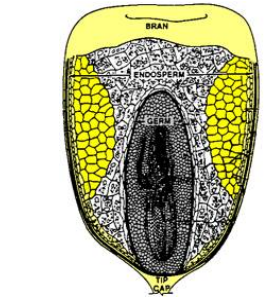
Corn: Bright Future as a Biofuels Feedstock

Long-Term Goal: 1,000 Gallons Per Acre of Corn

- More efficient conversion technologies
- Higher crop yields per acre
- More diverse feedstocks beyond grain

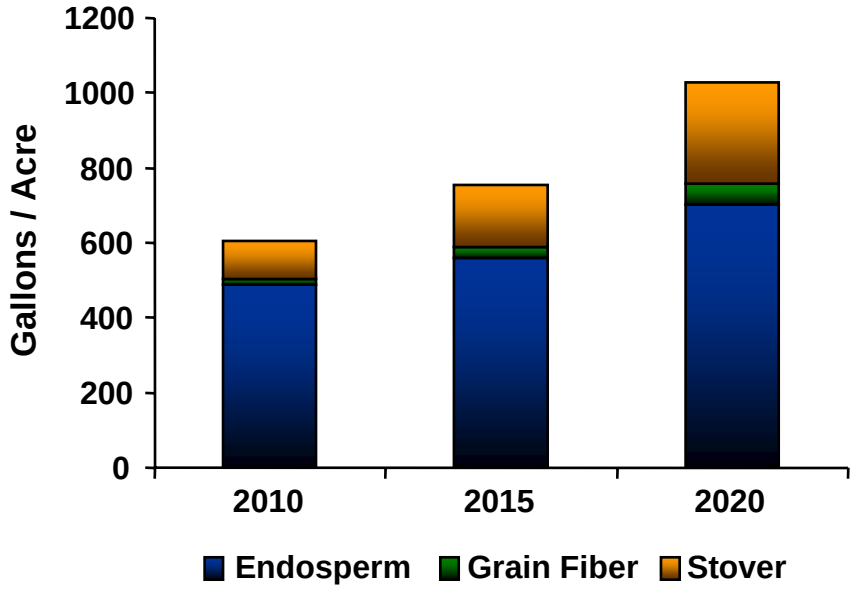


Ethanol Productivity

Endosperm → 500 gallon/acre (2010)

Pericarp → 18 gallon/acre (2010)

Stover → 100 gallon/acre (2010)



Corn will be competitive with other feedstocks

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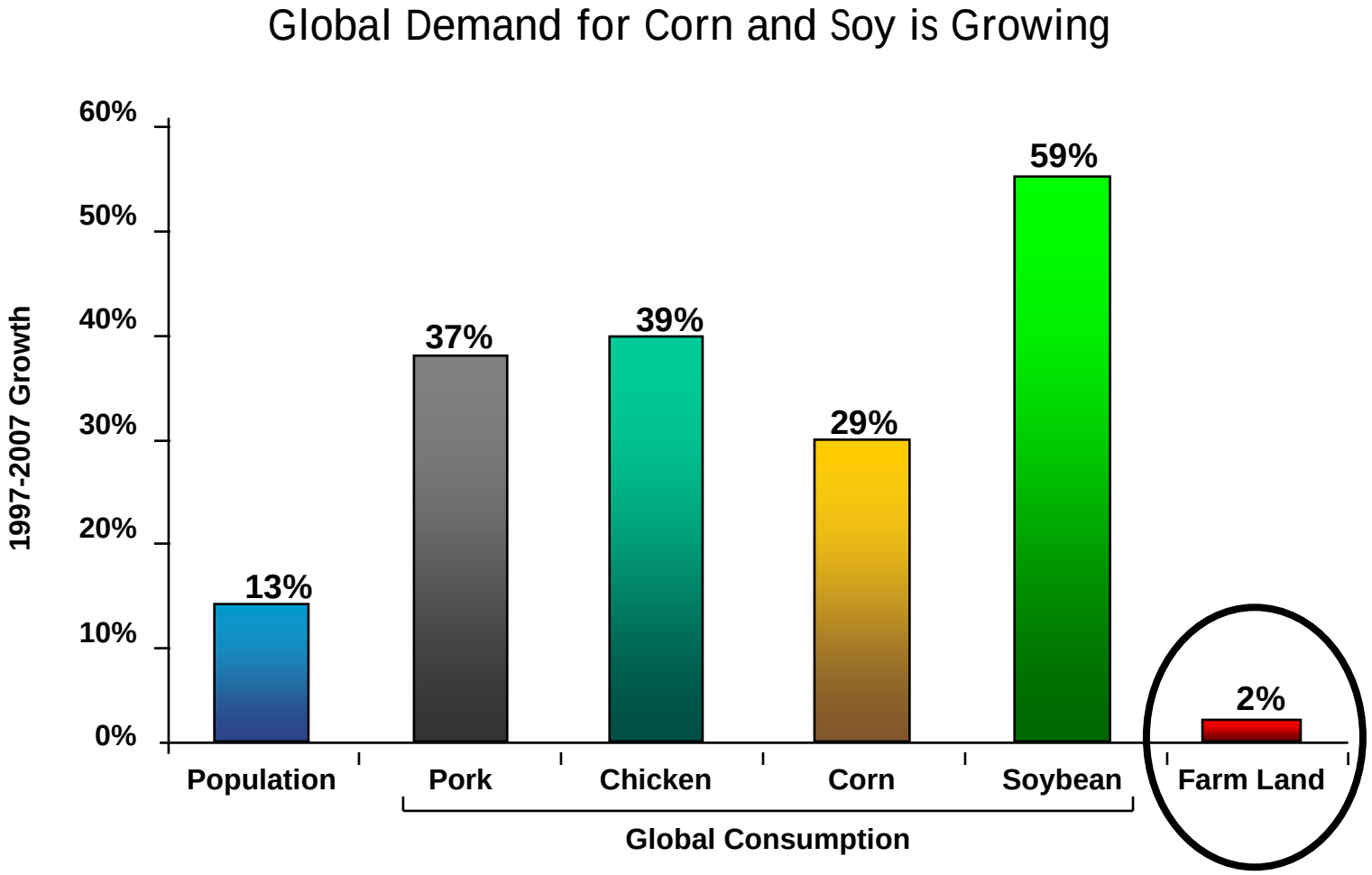
The Challenge: Increasing Crop Productivity



North / South America have 14% of global population and 26% of arable land

Source: DuPont Worldwide Agriculture Forecast

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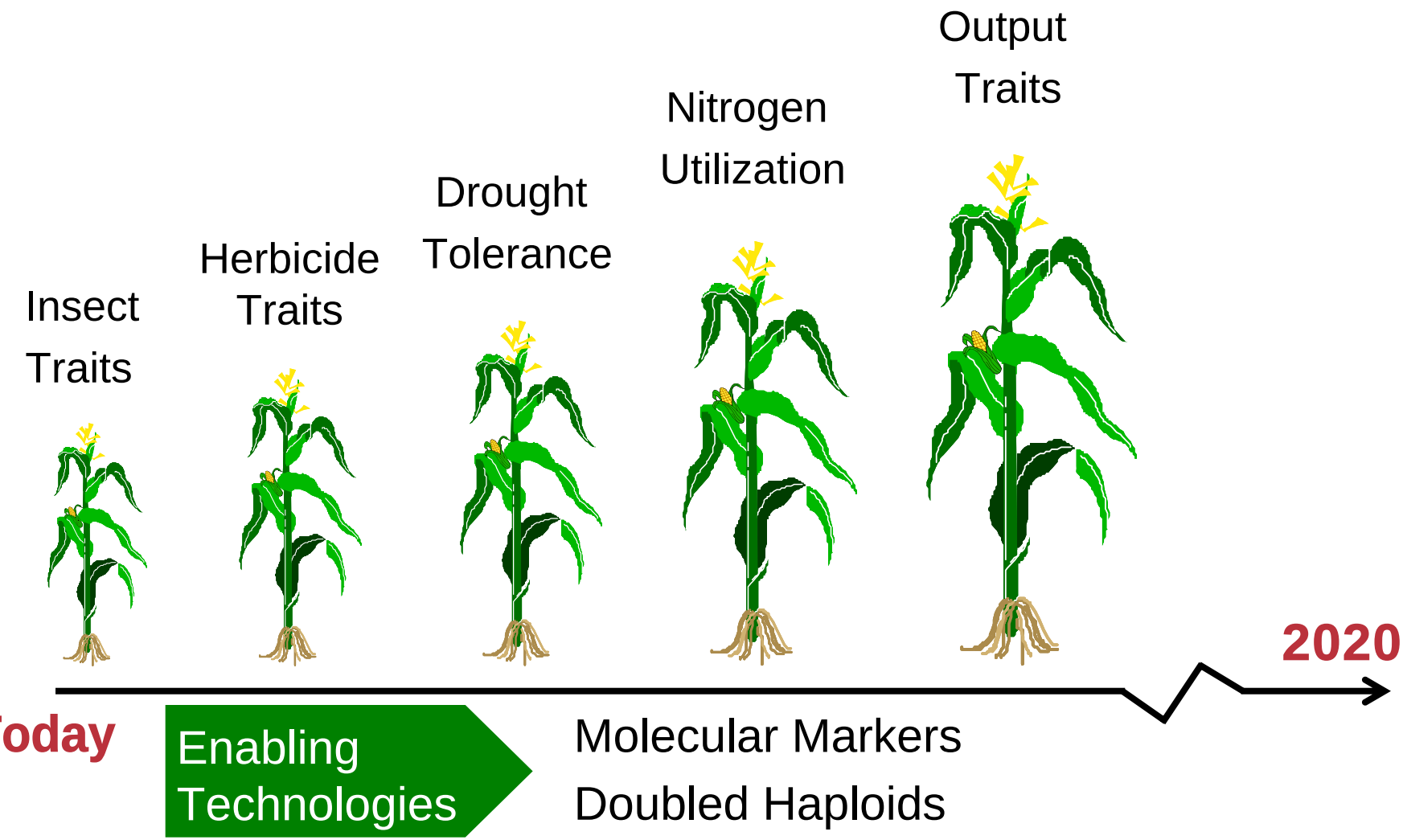
Meeting the Increased Productivity Challenge



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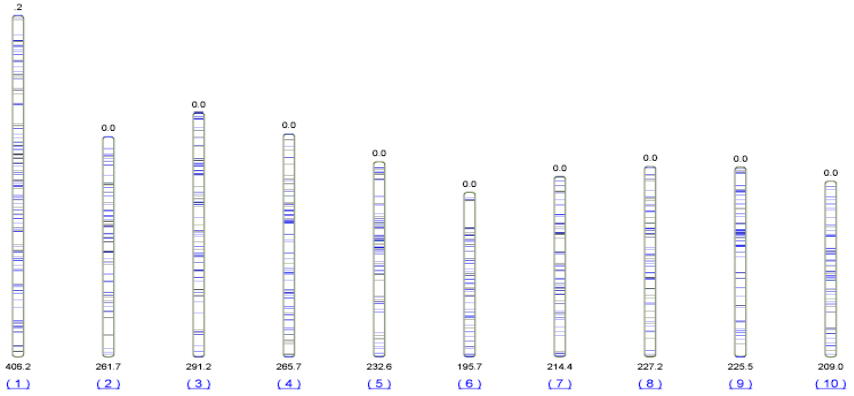
Molecular Markers: More Efficient Corn Breeding



- Phenotype = Genotype + Environment + GxE
- Markers allow for selection of genomic sections (QTL) with known phenotypic effects in environments where the trait is not expressed
- Starting point of finding the underlying genes responsible for phenotype

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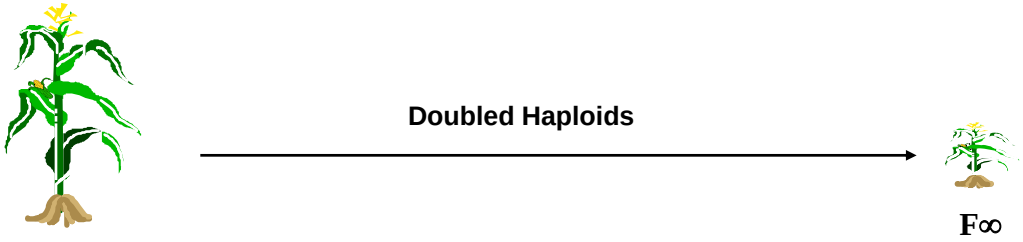
Doubled Haploids: Faster Corn Breeding

Traditional Inbreeding
7 years

Doubled Haploids
2 yrs



- Advantages:
  - Increases precision of molecular markers
  - Reduces hybrid development cycle time 1-2 years
  - Increases options for per se selection (parent traits, disease, maturity)
  - Breeding impact – more complex pedigree selection away from home nursery

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Herbicide and Insect Control Traits

- Herculex® insect protection provides the most efficacious, sustainable insect control solution today
- In 2010, we will introduce stacks of a dual mode of action lepidopteran control traits coupled with HXRW
- Refuge reduction strategies being executed

- On track for a 2010 commercial introduction in corn
- Triple-mode herbicide tolerance when stacked with Herculex®
  - Glyphosate, ALS, Liberty
  - Maximum grower flexibility
- New ALS herbicide mixtures with multiple modes of action

Critical Agronomic Traits

- **Drought Tolerance**
  - Four most advanced drought leads showing 5-14% yield increase in all stress locations (8) in the corn belt
    - No negative yield impact watered situation
    - All different modes of action
  - 50 new drought leads in phase one evaluation
- **Nitrogen Use Efficiency**
  - Greater than 20 NUE leads under evaluation in phase one
  - Top seven leads showing 10-25% yield increase in reduced nitrogen environments

Drought Tolerance

Nitrogen Use Efficiency

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Outstanding Performance in 2007 Field Trials

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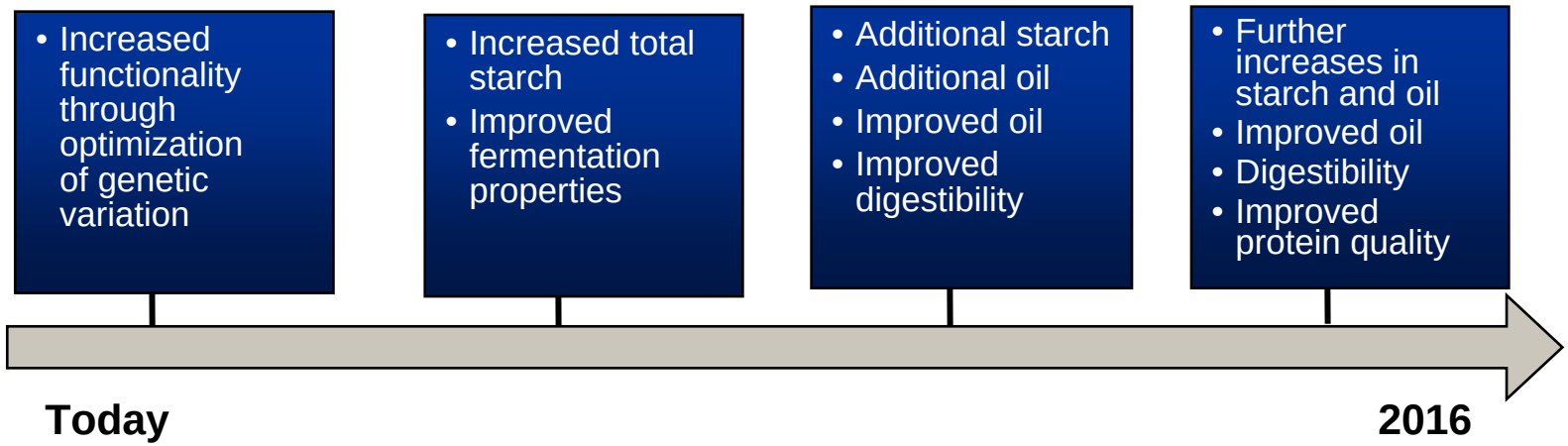
Pioneer's Pipeline of Grain Traits For Fuel and Feed



- Increase ethanol yield
- Increase feed energy value
- Maximize DDG co-product protein quality
- Reduce unwanted or low-value kernel components
- Accommodate new processing technologies such as fractionation

High Grain Yields, Strong Agronomics and Input Traits are Key

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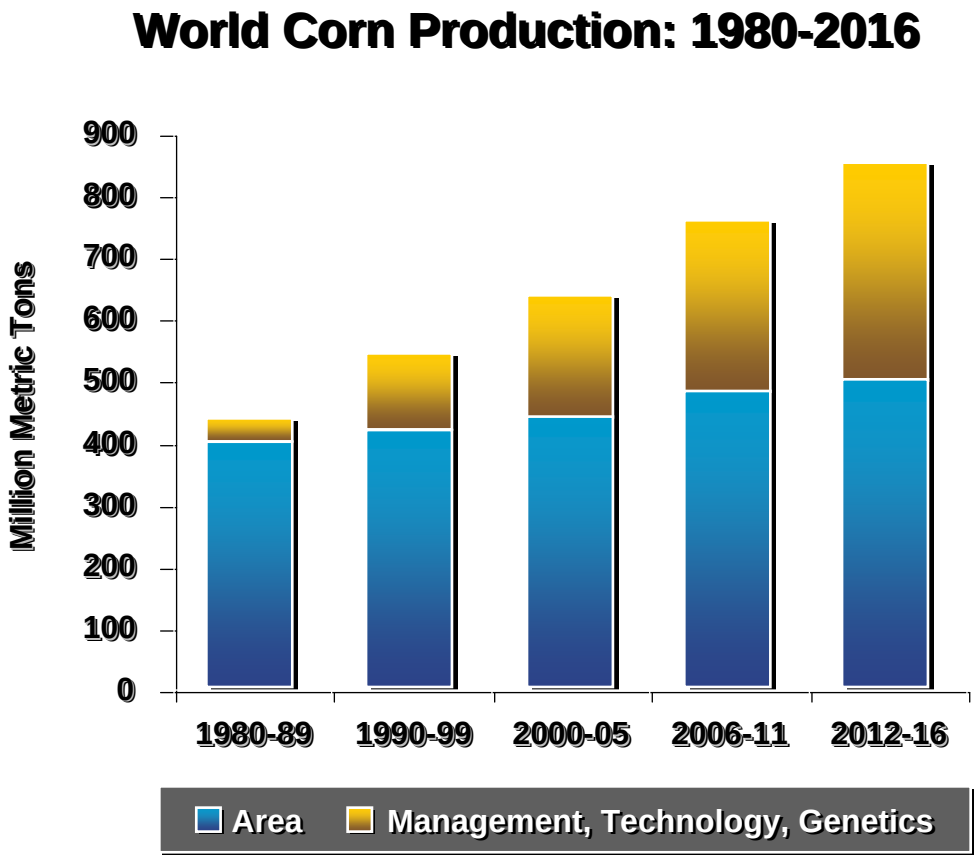
Corn Remains Critical for Biofuels

- Crop yields need to increase to keep pace with demand
  - Since 1980
    - Global corn area increased 11%
    - Production increased 68%
- Future production increases driven by management, technology, & genetics
  - Enabling technologies
  - Insect and herbicide traits
  - Agronomic traits
  - Output traits



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Thank You

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www2.dupont.com/Biotechnology/en_US/