A Few Thoughts on the Future of Plant Breeding

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There are about 2,200 plant breeders in the USA. Most of them are working on food or feed crops.

A ratio of 150k:1 is pretty efficient…..
not bad for a few farm kids.


ALLIED

The Conundrum of Breeding

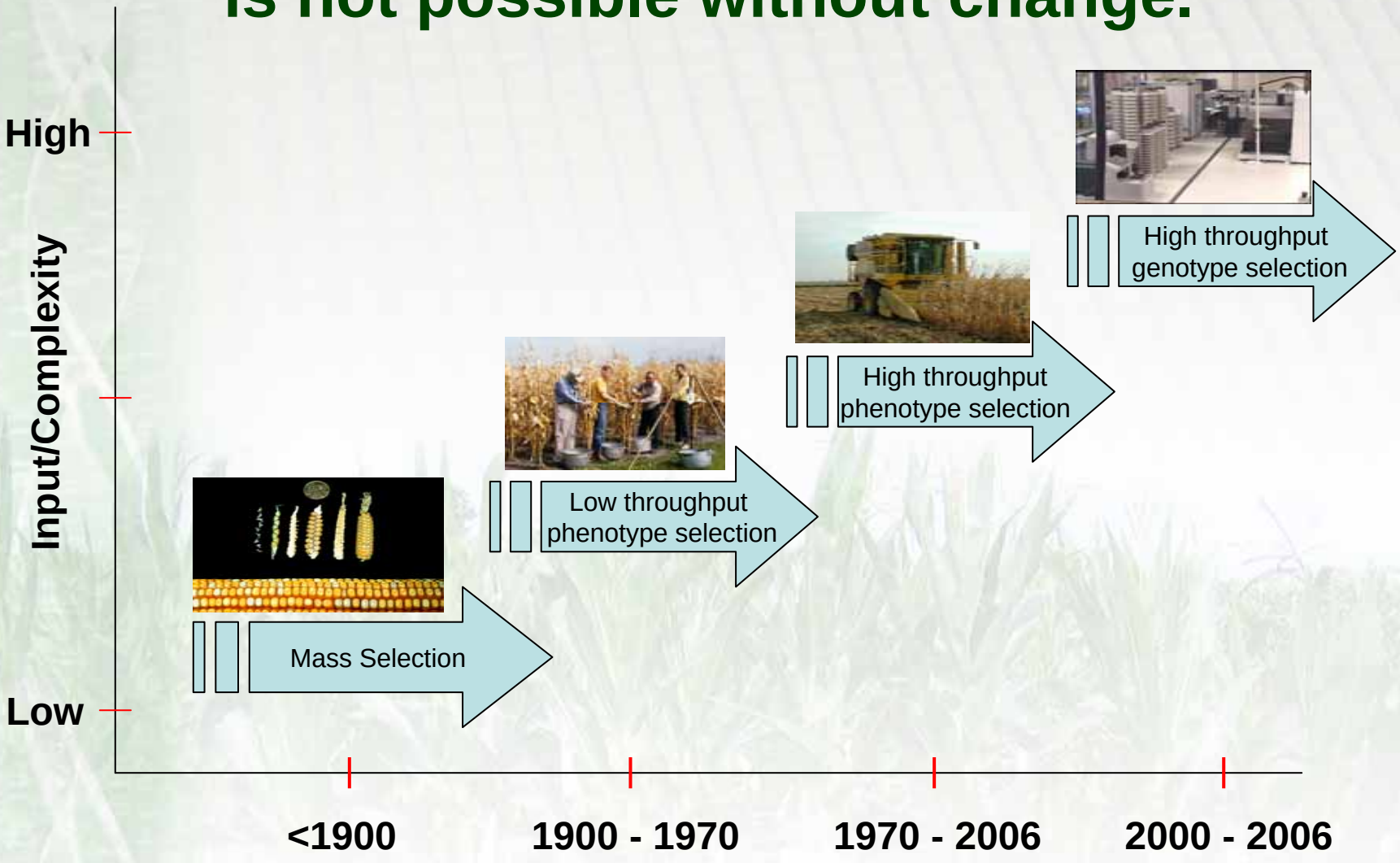
this year’s answers to last year’s questions

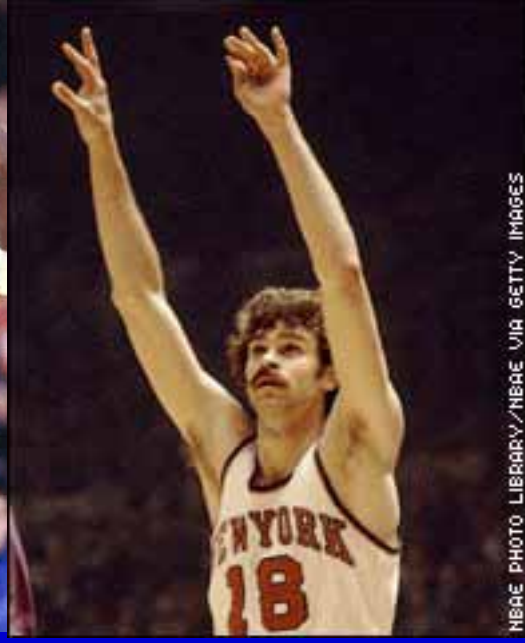
There is no data on the future…

Germplasm
Technology
People

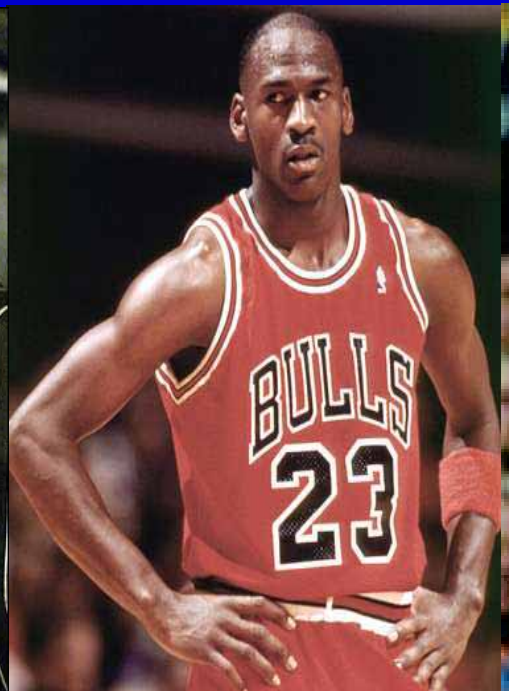
To be successful in Breeding one must be at least trilingual

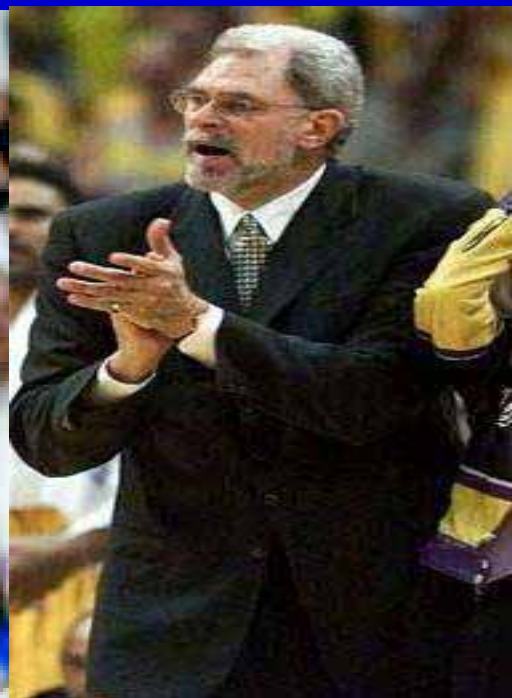
The uncomfortable fact is that progress is not possible without change.





Multiple career tracks are essential in plant breeding



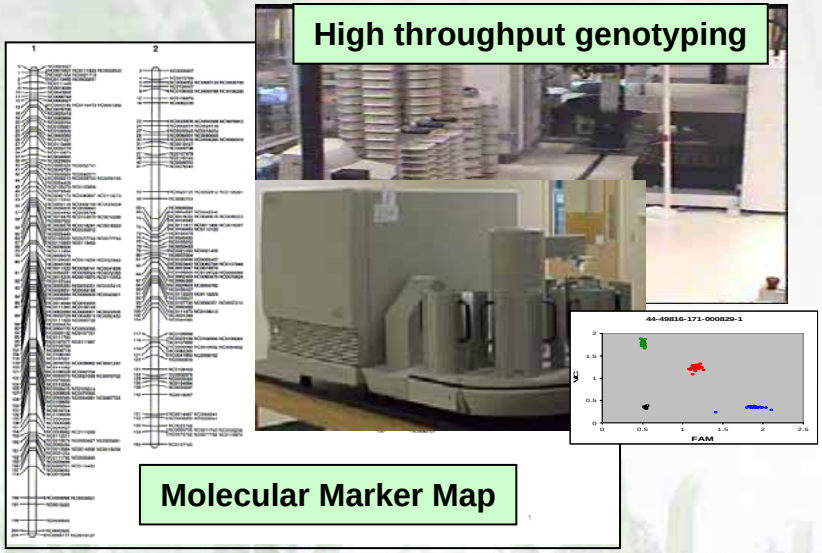


Teaching is not……just do it like I do….

Back-flip

This Ski Trick is a backward somersault in the air.
As you take off, shift your weight backwards by leaning back.
This will make your spin.

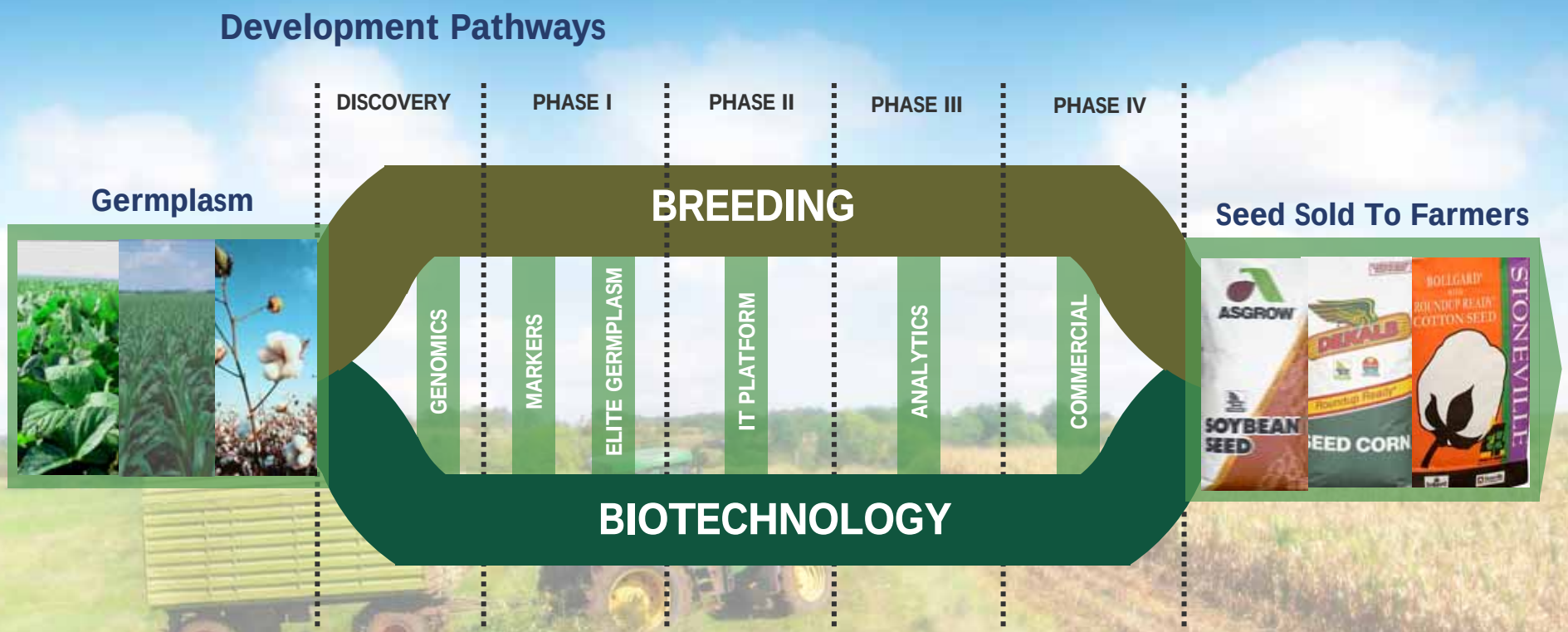
New breeders will find themselves working in a highly technical environment



<u>Analysis System</u>: Integrate and analyze phenotypic and genotypic data

New Products

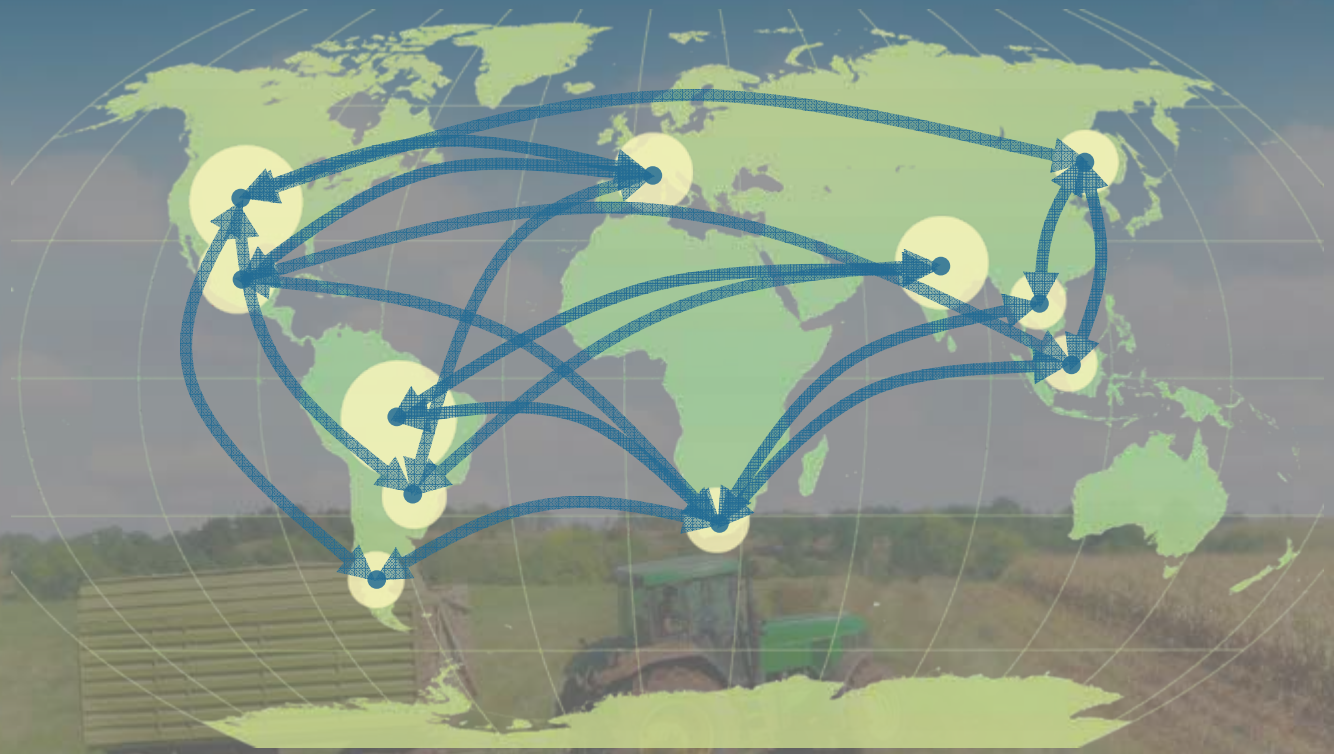
Breeding and Biotech Provide Integrated R&D Paths to Commercial Products



Advice to New Corn Breeders

- Good breeders are most successful in one heterotic pool than in others
- Better breeders understand 1 ½ heterotic pools..i.e., choose better testers
- Rare breeders master both sides of the pedigree and have walked miles looking for new and useful genetic variation. Their plants talk to them.
- Most new lines do not achieve their greatest commercial success with the original tester

Plant Breeding is a Complex Global Business

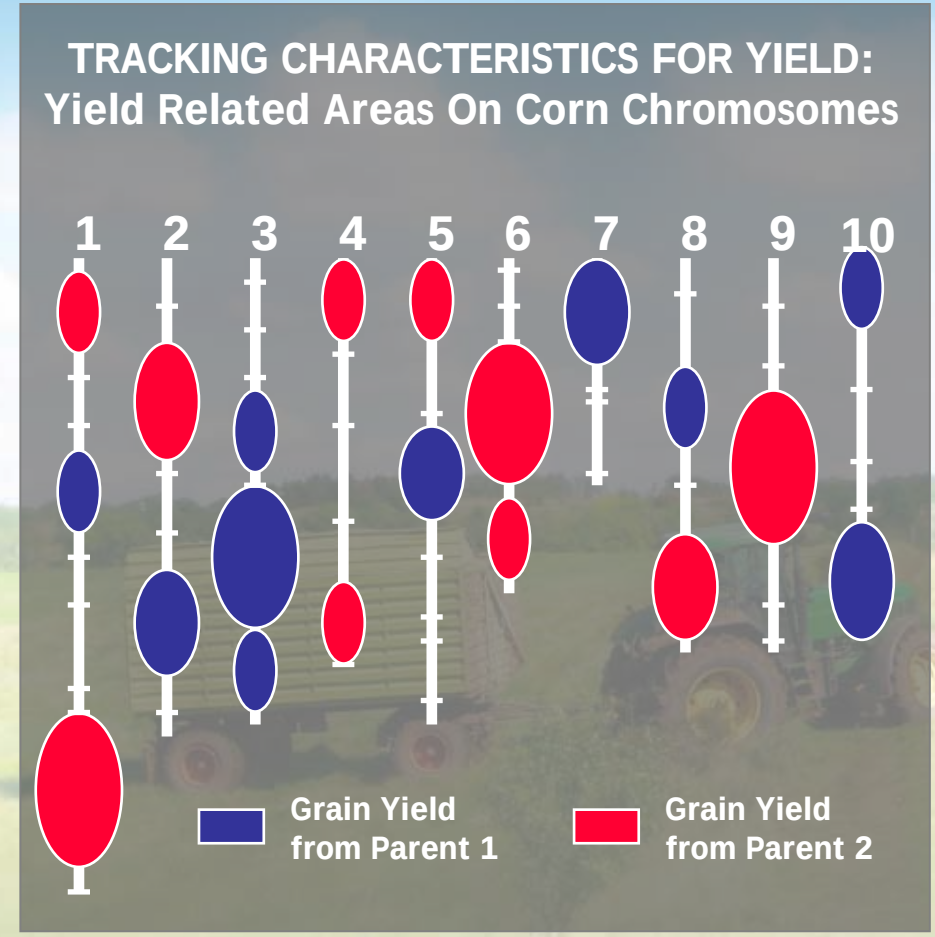


- Increased Yield
- Disease Resistance
- Stress Tolerance
- Grain Quality / Added Value
- Build on strength of current germplasm as well as Molecular Breeding and Crop Analytics Capabilities

Magnetic Resonance (MRI) and Near Infrared (NIR) Hyperspectral Imaging for Composition analysis

Markers Allow Breeders to Get Best Combinations of Germplasm Faster With Greater Predictability

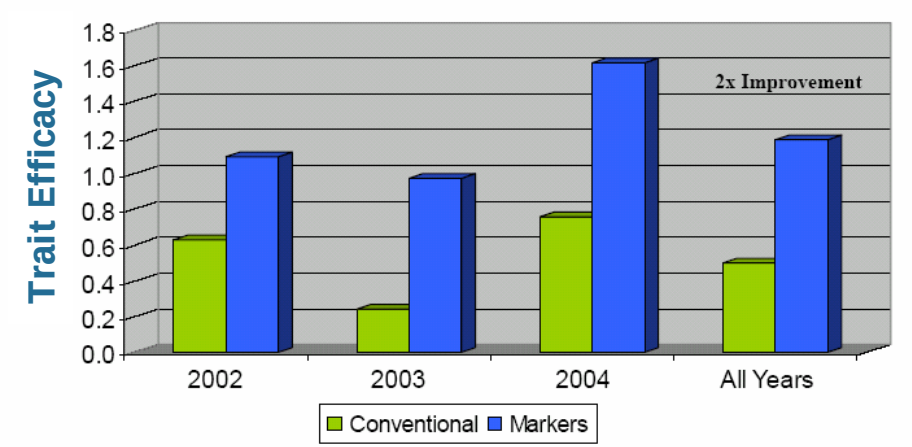
Marker-Assisted Breeding Rate of Gain is a 2X to 3X Improvement vs. Conventional



- Corn plant has 40,000 genes spanning 10 chromosomes.
- Characteristics (traits) are built from different pieces on different chromosomes. Markers indicate where particular genes are located
- Using markers to make better selections, breeders can improve the probability of success:

Probability of finding 1 trait that is controlled by 20 genes	
"Random" crosses:	1 per trillion
After application of markers and breeding technology	
1 in 5	

The technology is changing rapidly even within "molecular breeding"



Marker-Assisted Breeding Rate of Gain is a 2X Improvement vs. Conventional Methods

CYCLE 1:
INTEGRATION OF GLOBAL GERMPLASM

- ASSEMBLED 36 MAJOR CORN BREEDING PROGRAMS IN 12 COUNTRIES
- FIRST INTRA-COMPANY CROSSES; BY CYCLE 3, >50% OF HYBRIDS IN THE U.S. PORTFOLIO MADE THROUGH INTRA-COMPANY CROSSES

CYCLE 2:
APPLICATION OF MOLECULAR BREEDING TO SELECTION

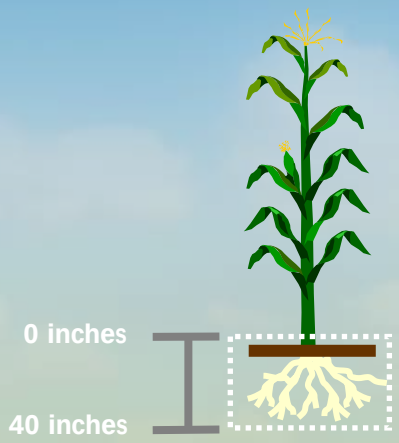
- PREDICTIVE COMBINATIONS ALLOW MORE EFFICIENT BREEDING
- MOLECULAR BREEDING ACCELERATES TRAIT INTEGRATION BY SHORTENING 'BACKCROSSING' CYCLES

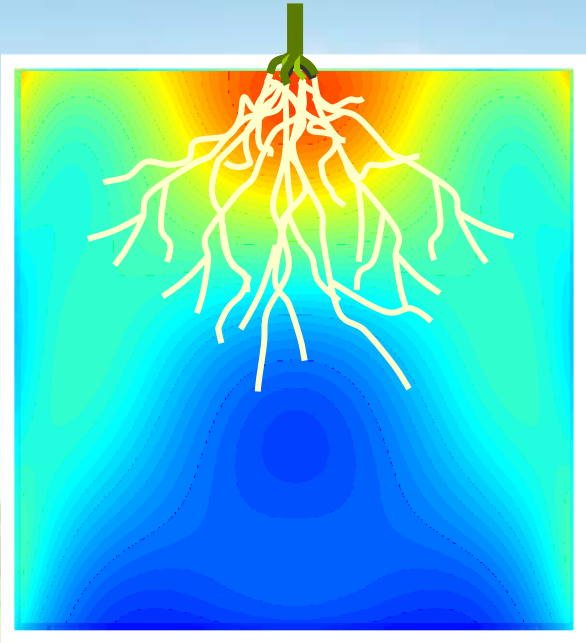
CYCLE 3:
SELECTION POWER OF MOLECULAR BREEDING

- MOLECULAR BREEDING IMPROVES GENETIC RATE OF GAIN BY 2X VERSUS CONVENTIONAL BREEDING
- LAST YEAR, FIRST MOLECULAR BREEDING HYBRIDS ENTERED COMMERCIAL PORTFOLIO

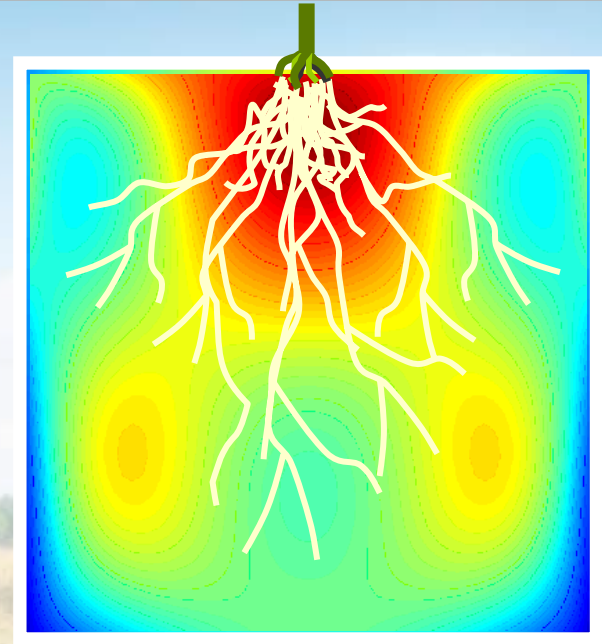
New traits raise old questions

Soil Probe Analysis of Water Use by Similar Genetics in Colorado





Soil Insecticide
DKC 61-72 with Force®



YieldGard® Rootworm
DKC 61-68

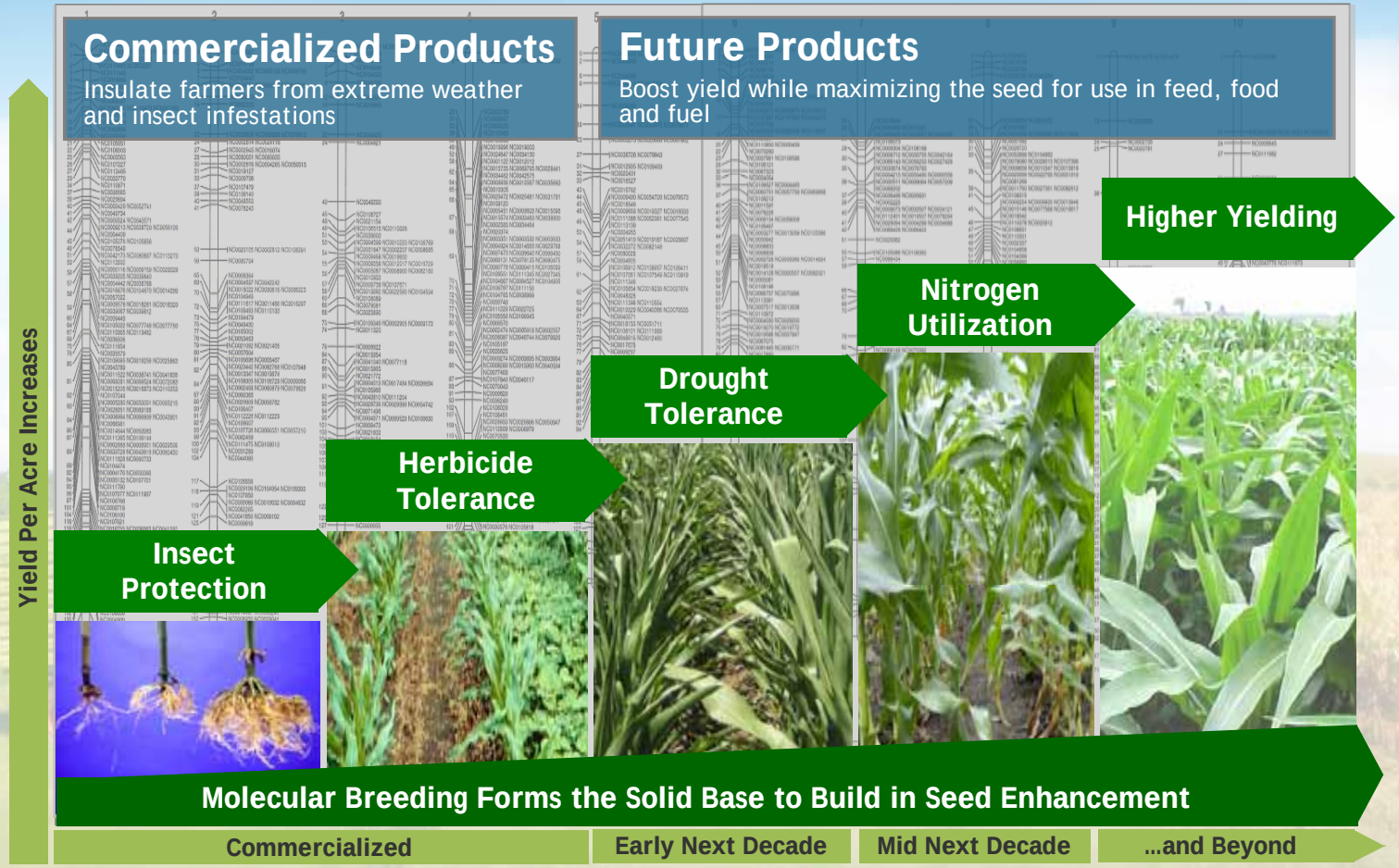
Water Use Key

- Low Water Absorption
- Moderate Water Absorption
- High Water Absorption

August 25, 2006

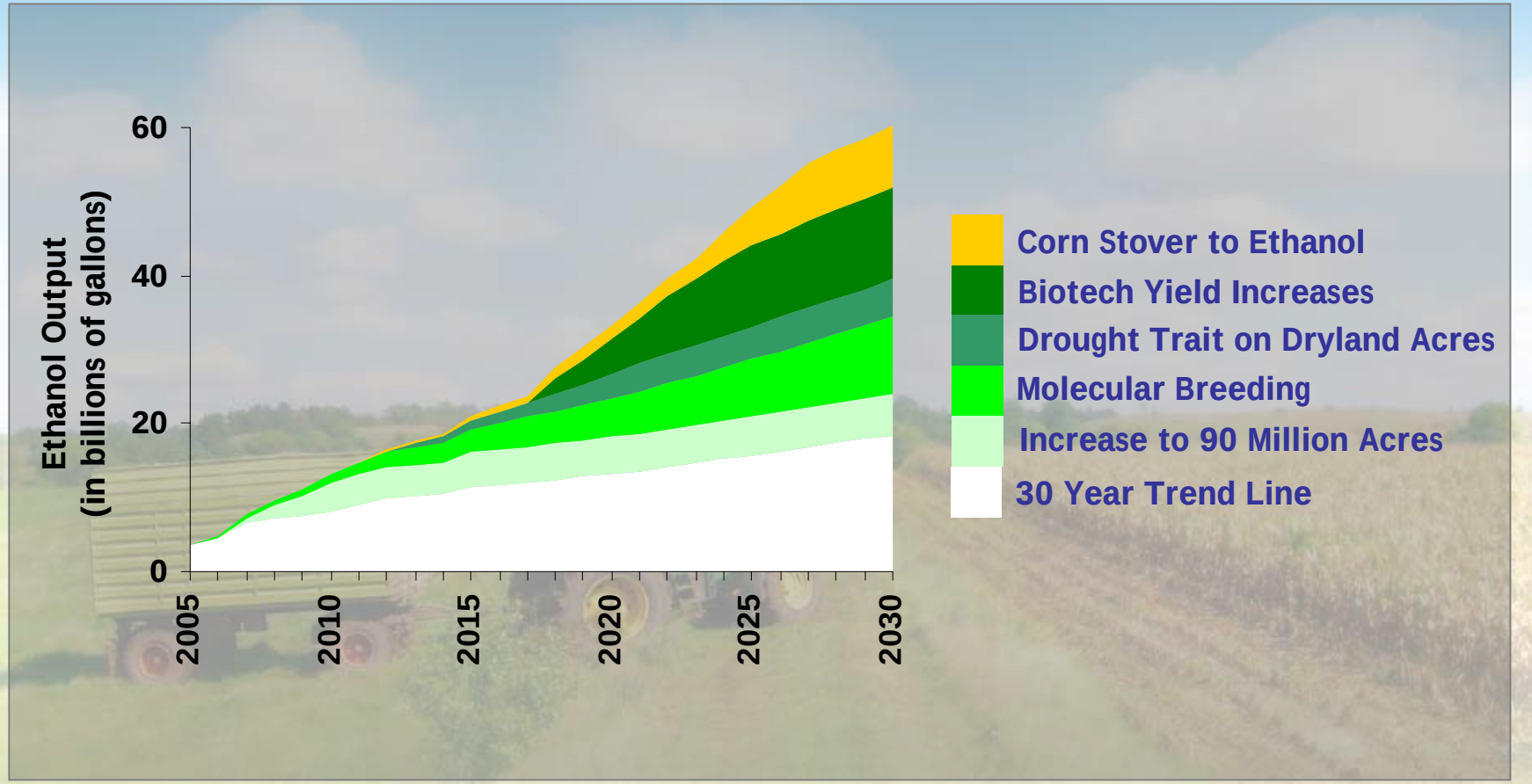
Our world of plant breeding has changed

Advances Assisting in Protecting and Boosting Yields



We will need a bunch of smart, hot, sweaty breeders to do this!

Step-Changes in Grain Potential



Plant Breeders Play a Central Role in Monsanto

The Art and Science of Breeding Contributes Greatly to Improving Plants



Today's plant breeders require:

- Several skills, significant knowledge and a variety of abilities to function in diverse scientific teams.
- A passion for working closely with plants in field environments.
- Understanding complex interactions of genotypes with environment.
- A strong ability to apply the sciences toward the directed goal of marketable products

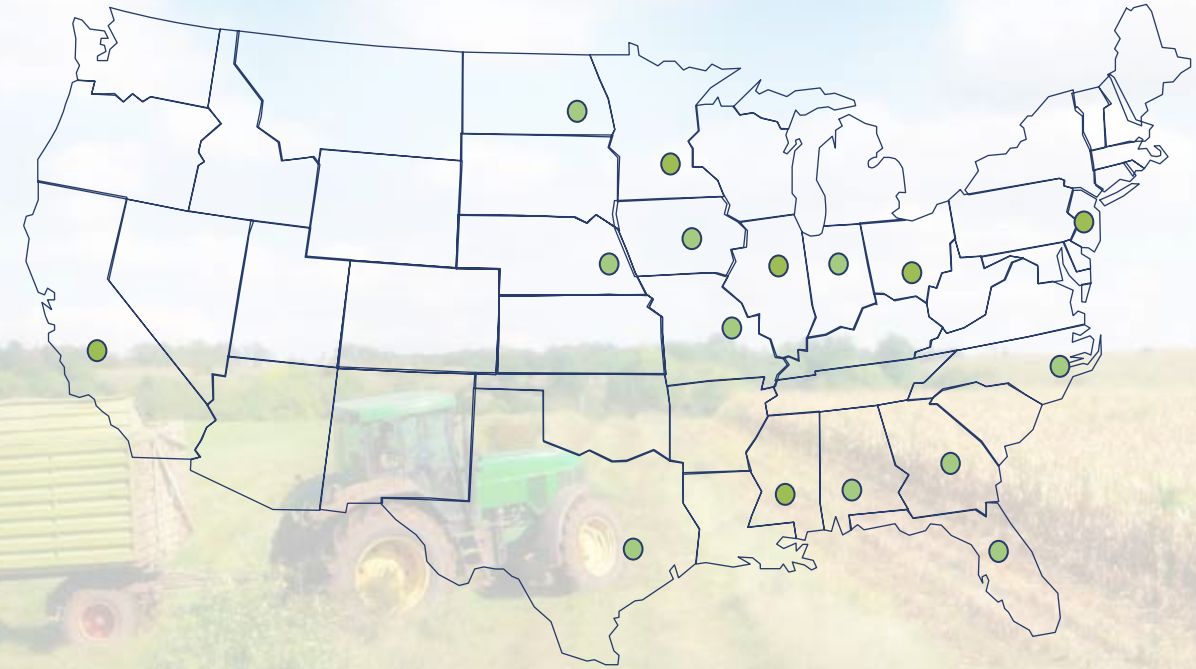
BREEDERS CONNECT SCIENCE AND PRODUCT DEVELOPMENT PROCESS TO BUSINESS CHANNELS.

We need more breeders….after all… some of us are going to “retire” in 10-20 years

- Our success in seeds and traits has created a need for more plant breeders at Monsanto
- Created a team to work toward partnering with universities in education, mentoring and development of new plant breeders
- Our hope is that greater involvement in the process of training new plant breeders will ensure a viable pipeline of top talent to supply future staffing needs

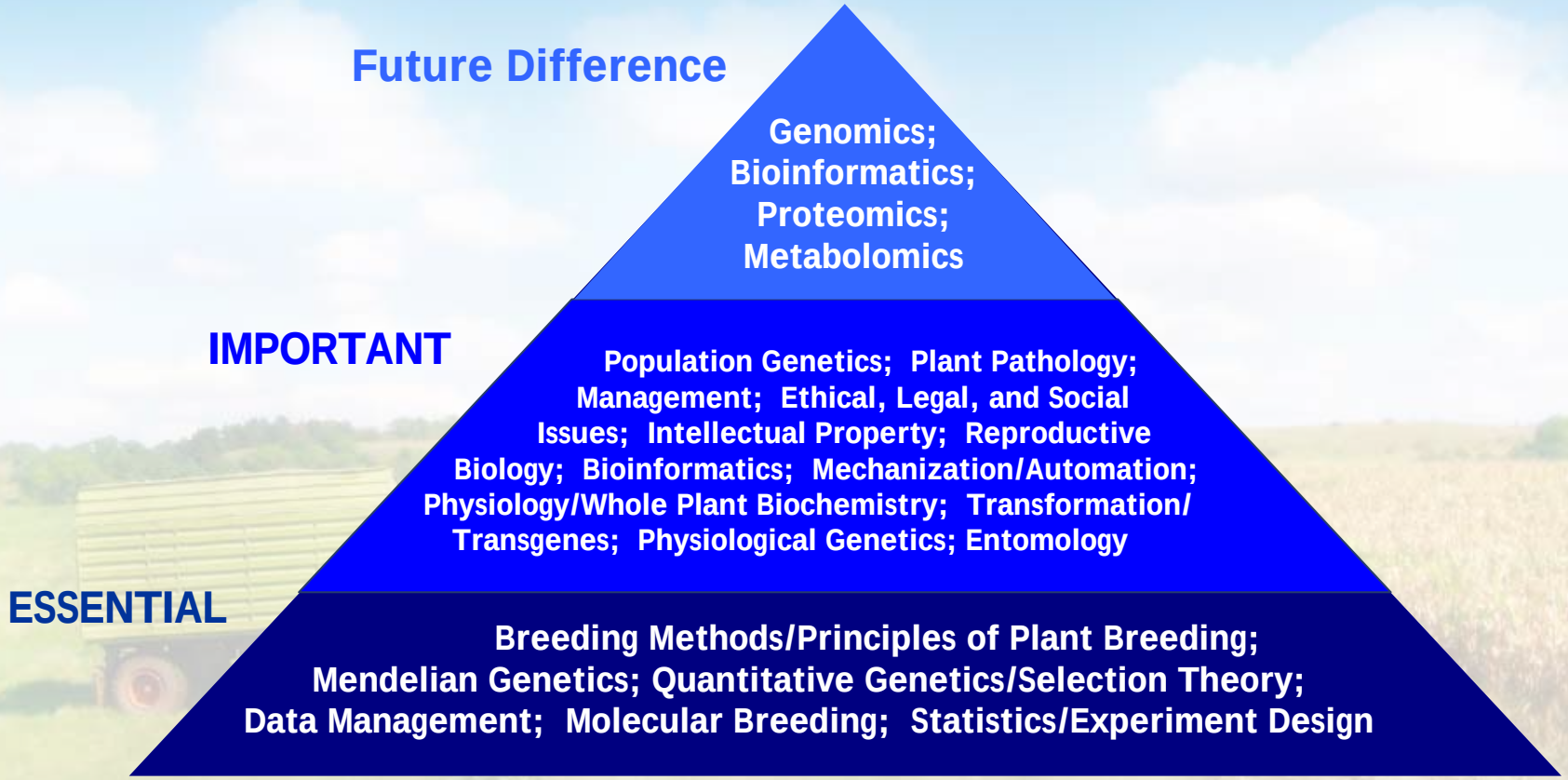
Who will educate the breeders in the future?

A WAY TO ENSURE CONTINUED BREEDING INTEREST IS TO CREATE PLANT BREEDING CENTERS



Survey of More Than 100 Monsanto Breeders on Plant Breeding Education

January 2007



THE RULES OF THE EDUCATION GAME ARE CHANGING IN BREEDING


Have you ever been really good as something you didn’t like?
Jack Nicholas

At a minimum we need….

- Professors who know how to teach
- Professors who conduct relevant research
- Inquisitive minds who don’t mind getting hot, sweaty, and dirty to find out the answer
- A graduate education that enables individual excellence on cross functional teams
- Breeders who understand theory and can implement it on an industrial scale.

Love what you do….do what you love

Successfully Delivering Better Products to Growers Requires:

- Cutting-Edge Scientific Innovation
- The collaboration of breeding, biotechnology and other disciplines to deliver tomorrow's improved plants
- Capitalizing on Breeding to Deliver What the Market Needs


Breeding for a better future