

# Yield Can Fuel Ethanol Expansion

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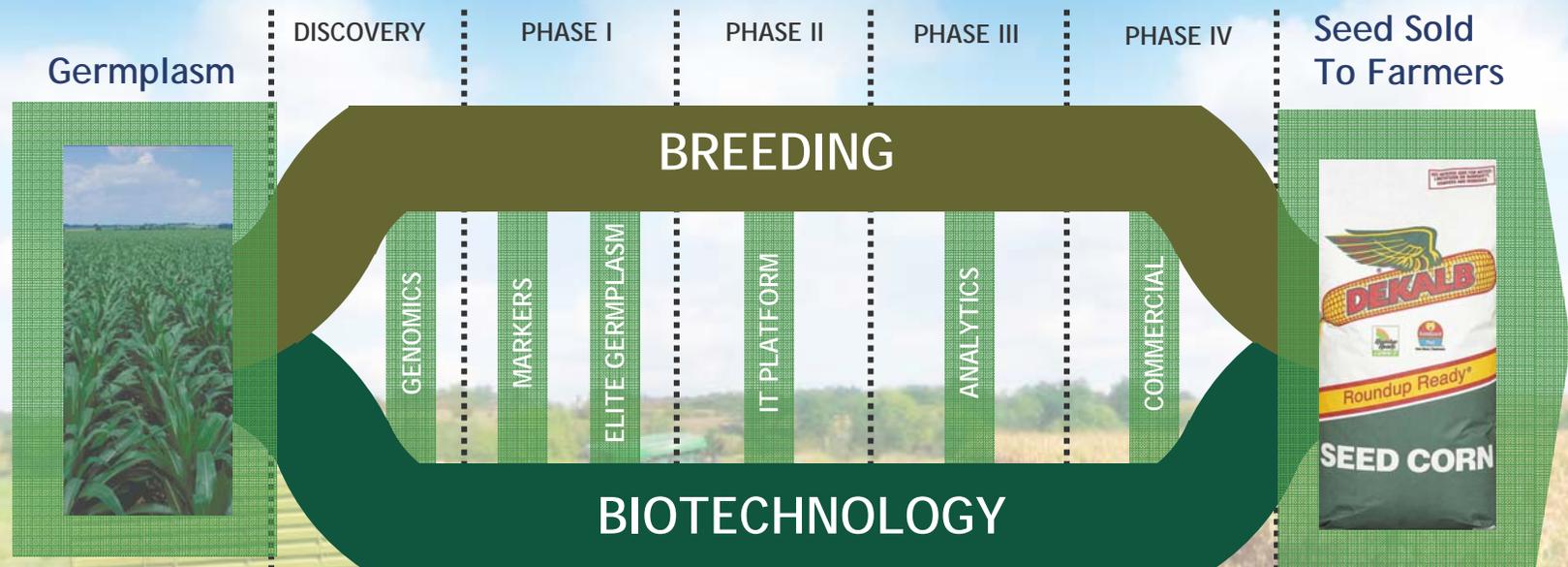
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RR = Roundup Ready; YGCB = YieldGard Corn Borer; RR2 = Roundup Ready Corn 2; HVC = High Value Corn; YGVT = YieldGard VT; YGRW = YieldGard Rootworm; YGPL = YieldGard Plus; RR2Y = Roundup RReady2Yield; RRF = Roundup Ready Flex; BG = Bollgard

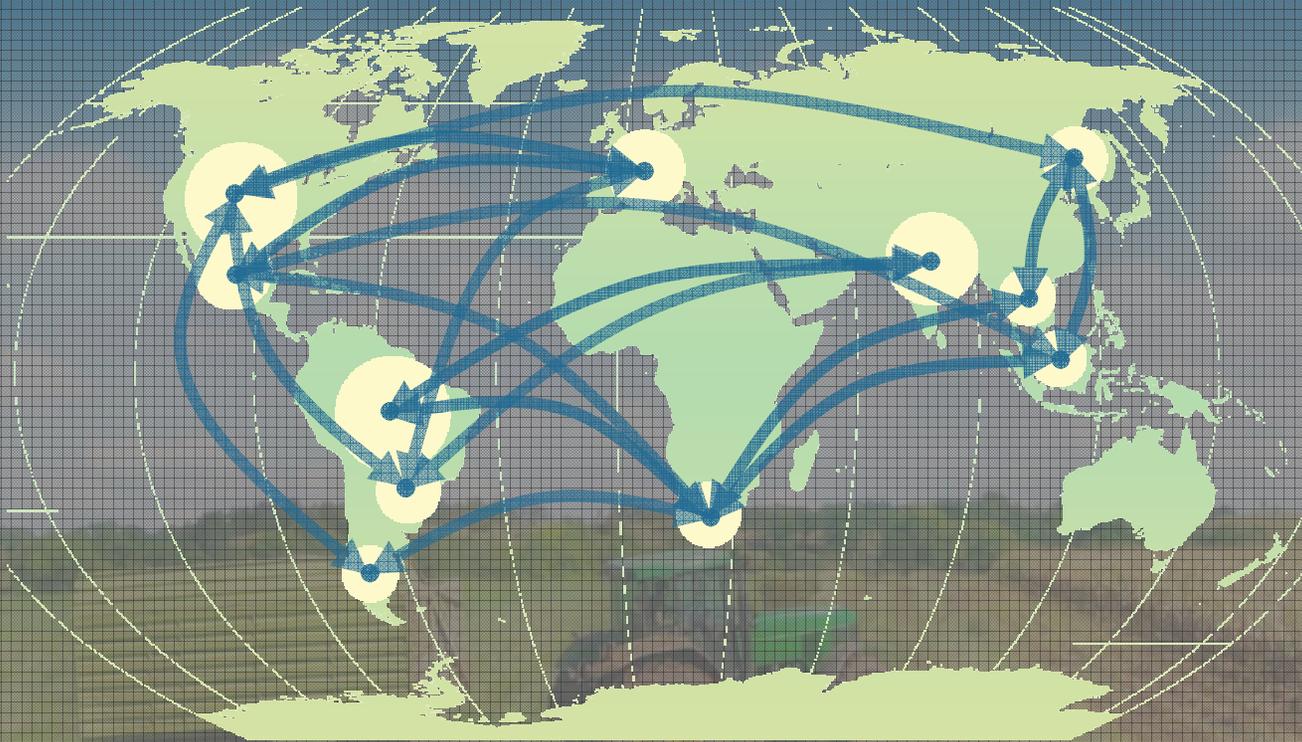
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# Breeding and Biotech Provide Parallel R&D Paths to Commercial Products

## Development Pathways



# Most Diverse Genetic Pool Increases Depth and Breadth of Germplasm



- 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

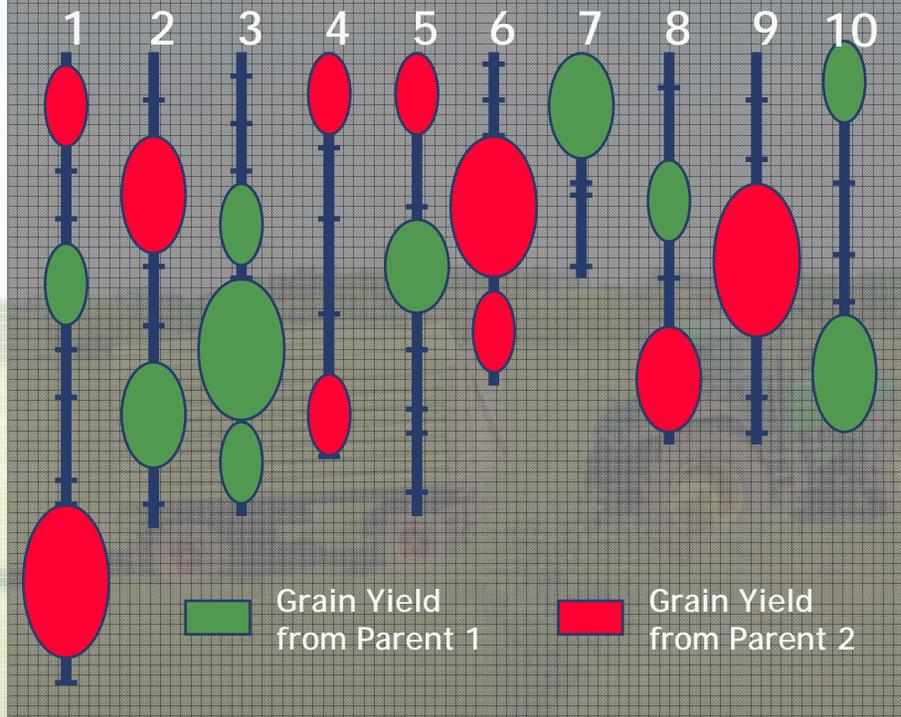


Magnetic Resonance (MRI) and Near Infrared (NIR) Hyperspectral Imaging for Composition analysis

# 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

TRACKING CHARACTERISTICS FOR YIELD:  
Yield Related Areas On Corn Chromosomes



- 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"

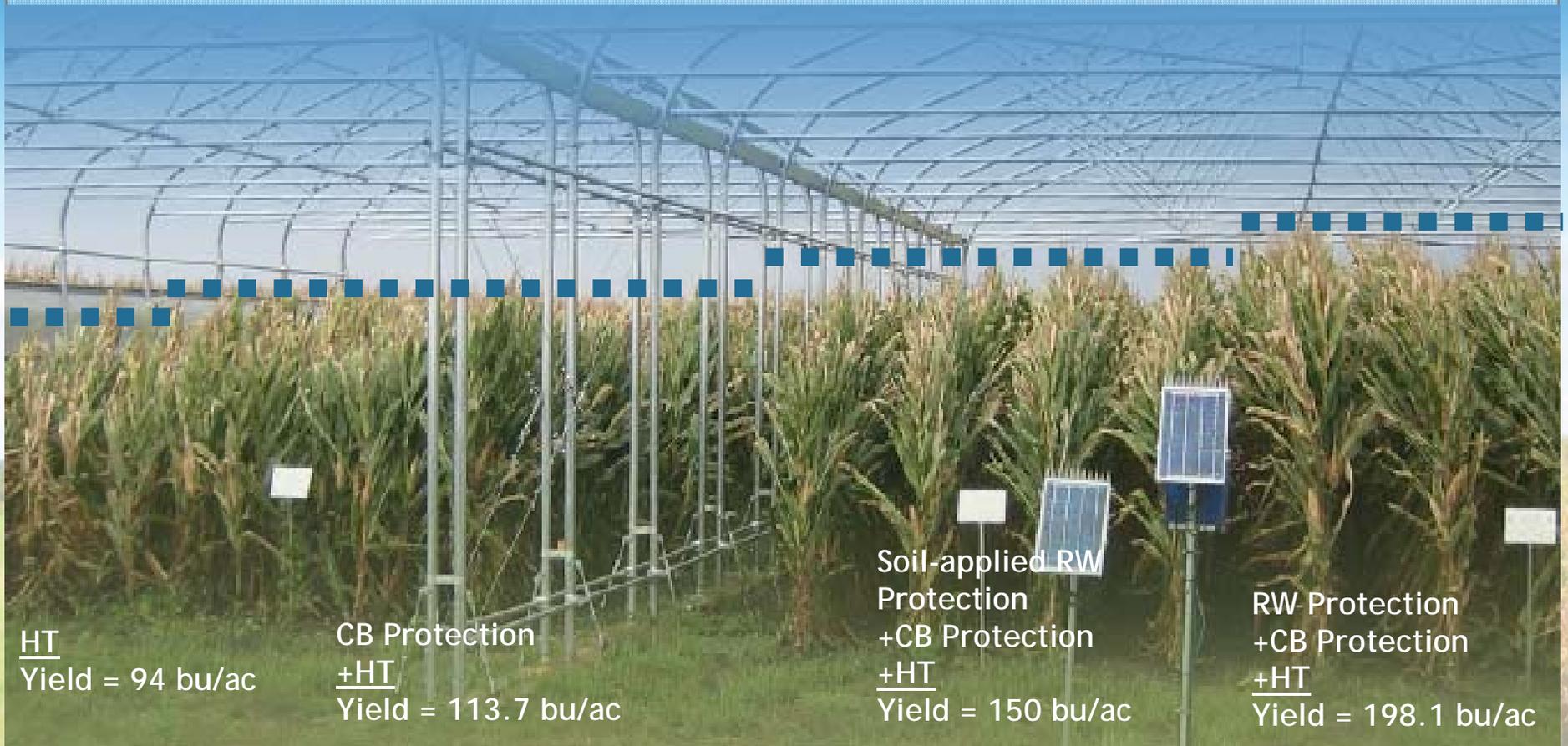
1 per trillion

After application of markers and breeding technology

1 in 5

# Positive Effects of Stress Mitigation Are Compounded by the Power of Trait Stacking

Rain Shelter Trial Corn Plot at A Monsanto Research Site



HT  
Yield = 94 bu/ac

CB Protection  
+HT  
Yield = 113.7 bu/ac

Soil-applied RW  
Protection  
+CB Protection  
+HT  
Yield = 150 bu/ac

RW Protection  
+CB Protection  
+HT  
Yield = 198.1 bu/ac

Roundup Ready®  
Corn 2

YieldGard® Corn Borer  
with Roundup Ready  
Corn 2

YieldGard Corn Borer with  
Roundup Ready Corn 2  
+ Force® insecticide

YieldGard Plus with  
Roundup Ready  
Corn 2

\*Yields representative of similar trial. All yield corrected to No. 2 yellow corn.

# Biotechnology R&D Portfolio Will Continue to Grow, Providing Benefits in Five Key Areas

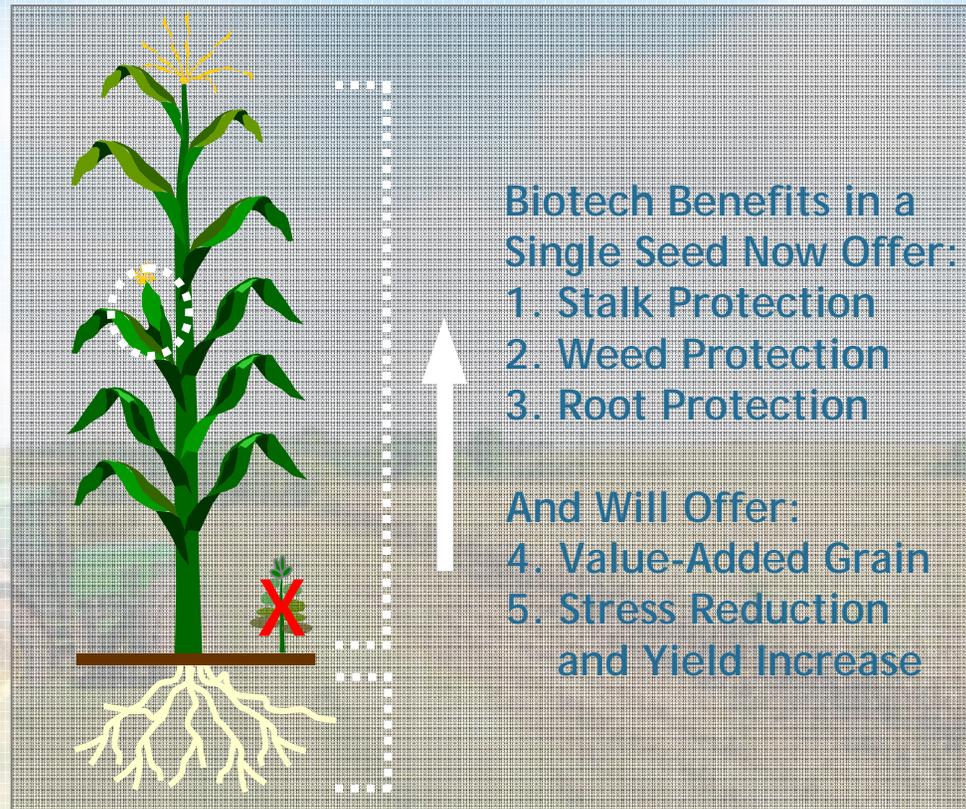
Protection Above and Below the Ground Today, Boosting Yield and Grain Value Tomorrow

## TODAY'S TRAITS

YieldGard® Corn Borer  
Roundup Ready® Corn 2  
YieldGard Rootworm

## TOMORROW'S TRAITS

YieldGard VT™ Stacks  
Mavera™ high-value corn with lysine  
YieldGard VT PRO™ Stacks  
Drought Tolerance I  
2nd Gen. high-value corn with lysine  
Corn Rootworm III  
Yield I  
Nitrogen Utilization  
Drought Tolerance II  
Cold Tolerance



Today's traits will be supplemented by tomorrow's, delivering a "total package."

# Overcoming Insufficient Fresh Water for Crop Usage

## Drought Tolerant Corn

- Yield enhancement demonstrated again in 2006 under water-stress conditions in U.S.
- Lead gene chosen
- 2007 trials expected to demonstrate yield enhancement in multiple hybrids under dryland conditions

2006 Testing  
Yield Improvement of Lead Event Under Drought Stress



In third year field testing in U.S., drought-tolerant leads are consistently achieving higher yields with gene with controls under drought-stressed conditions

Reduced Leaf Rolling

Discovery

Phase 1

Proof of Concept

Phase 2

Early Development

Phase 3

Adv. Development

Phase 4

Pre-Launch

Launch

# Providing Tailored Seed Offerings Necessary to Fuel Ethanol Markets

## Maximizing Co-Product Value

### Ethanol Draw Area

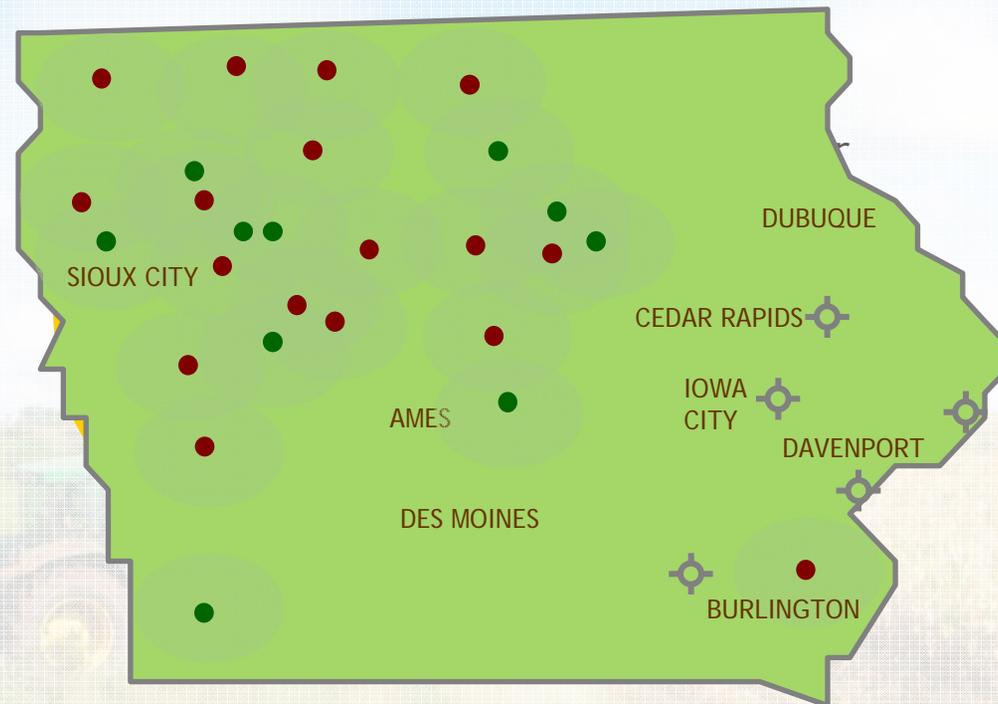
290K corn acres required to supply a 100M gallon dry mill

### Opportunity

Ethanol draw acres are likely to be highly "technified" with elite Processor Preferred® germplasm combined in a future stack

Monsanto's molecular breeding increases the rate of genetic gain versus conventional breeding

### Example: Iowa Ethanol Refineries



DRAW AREA FOR ETHANOL DRY MILL



ETHANOL PLANTS IN PRODUCTION



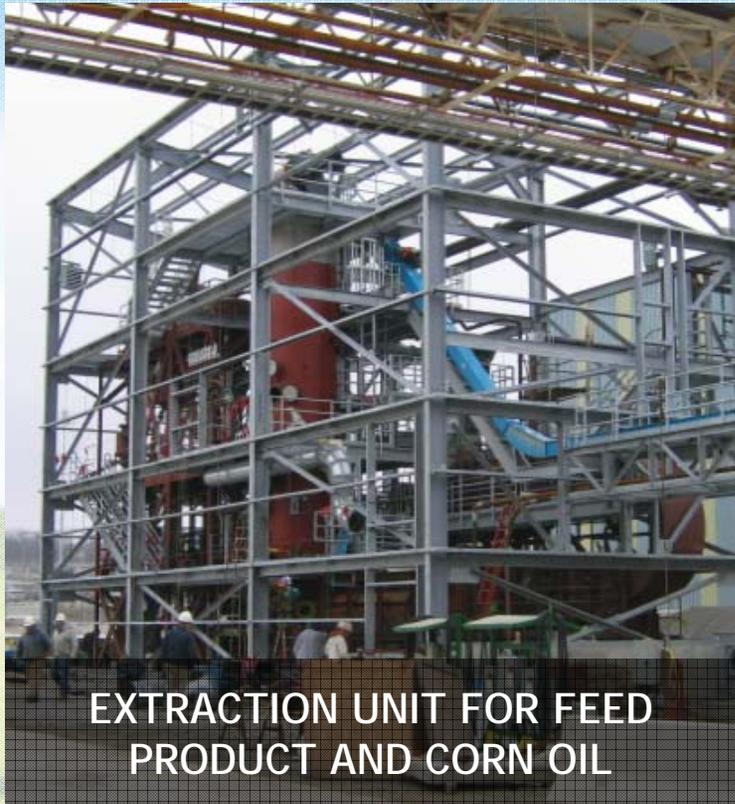
ETHANOL PLANTS UNDER CONSTRUCTION



WET MILL

# Corn Processing Technology Increases Yield and Product Bundle Value

Renessen's Extrax™ Process Bolts on to a Conventional Dry Mill Process



1

Start with a nutritionally dense corn developed through biotech and advanced breeding technologies.

2

Separate it through a novel process technology developed by Cargill and Renessen

3

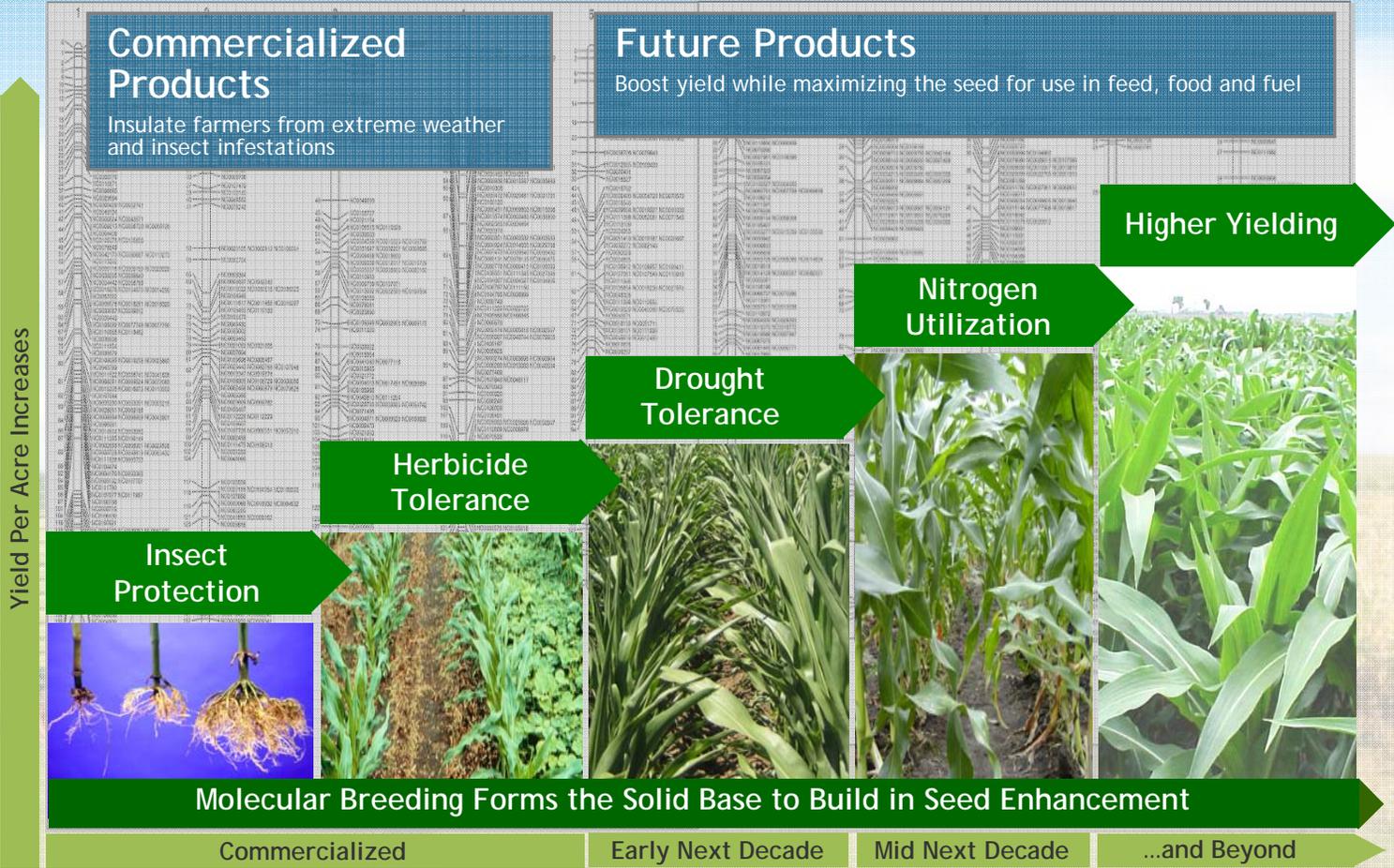
Deliver four high value revenue streams:

- A. Corn oil and / or biodiesel
- B. High value swine & poultry feed
- C. Highly fermentable starch
- D. High protein, low oil DDGs

THE PILOT PLANT IN EDDYVILLE, IOWA, IS IN OPERATION, CO-PRODUCTS BEGINNING FEEDING TRIALS WITH PORK PRODUCERS.

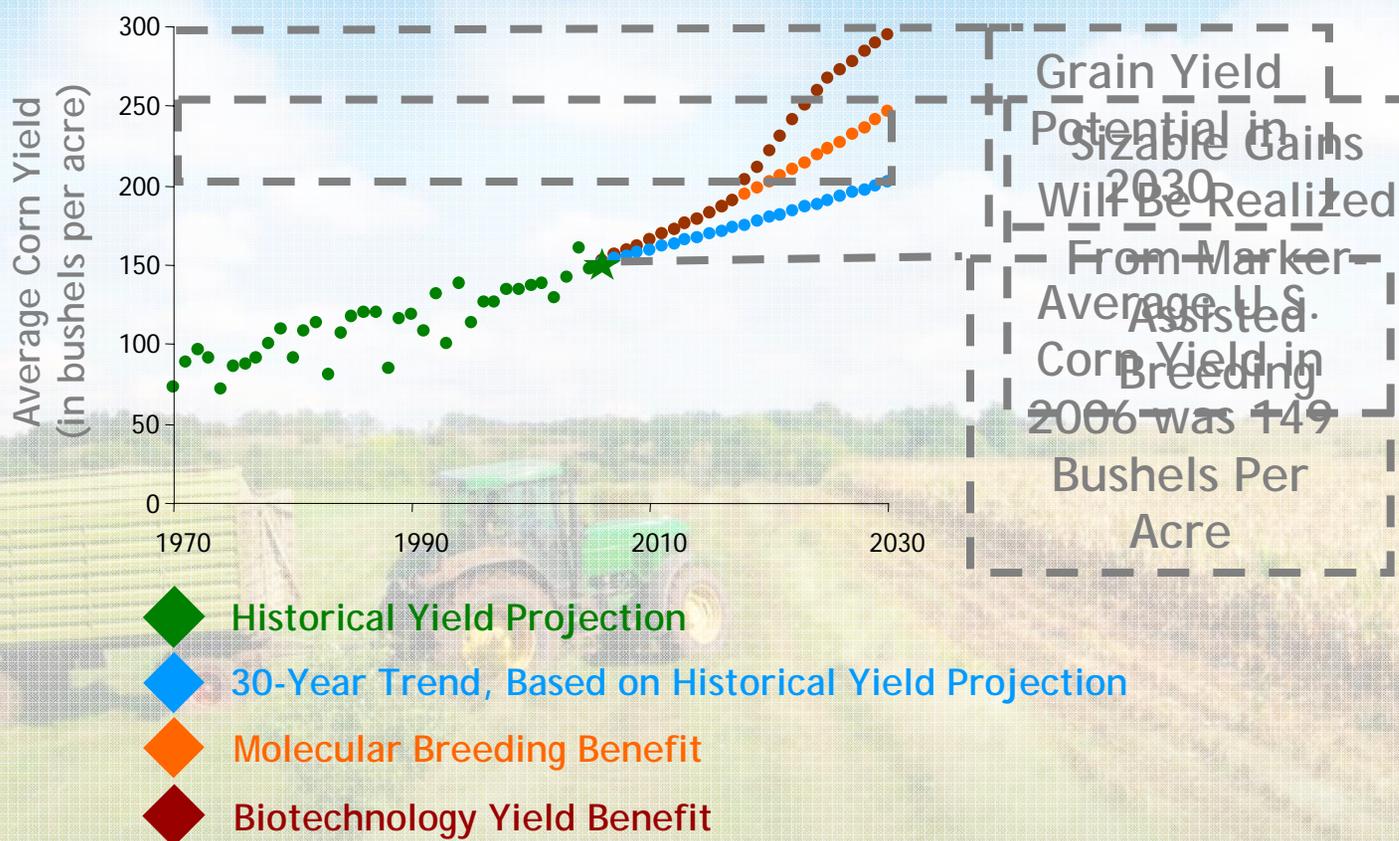
# Scientific Advancement Resulting in Current and Future Yield Enhancement

## Advances Assisting in Protecting and Boosting Yields



# The Combination of Biotechnology and Breeding Can Maximize Gains

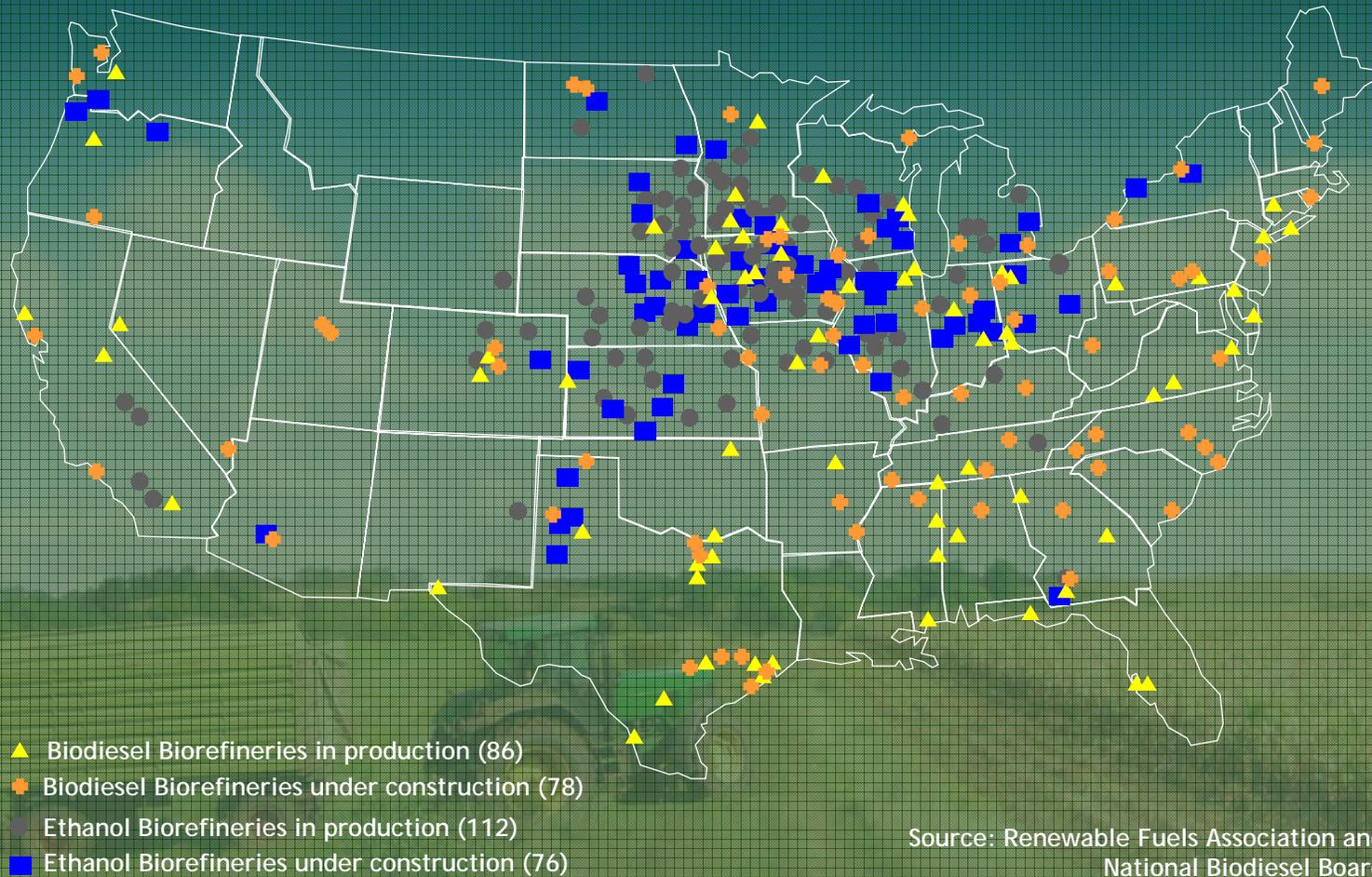
## Step-Changes in Grain Potential





# Biofuel Production Provides Local Economic Boost

## U.S. Biorefinery Locations



By 2030, ethanol and biodiesel production and sales could account for hundreds of thousands of jobs in local communities.

# Stacking Beneficial Traits in Soybeans Has the Potential to Make Each Acre More Productive and Valuable

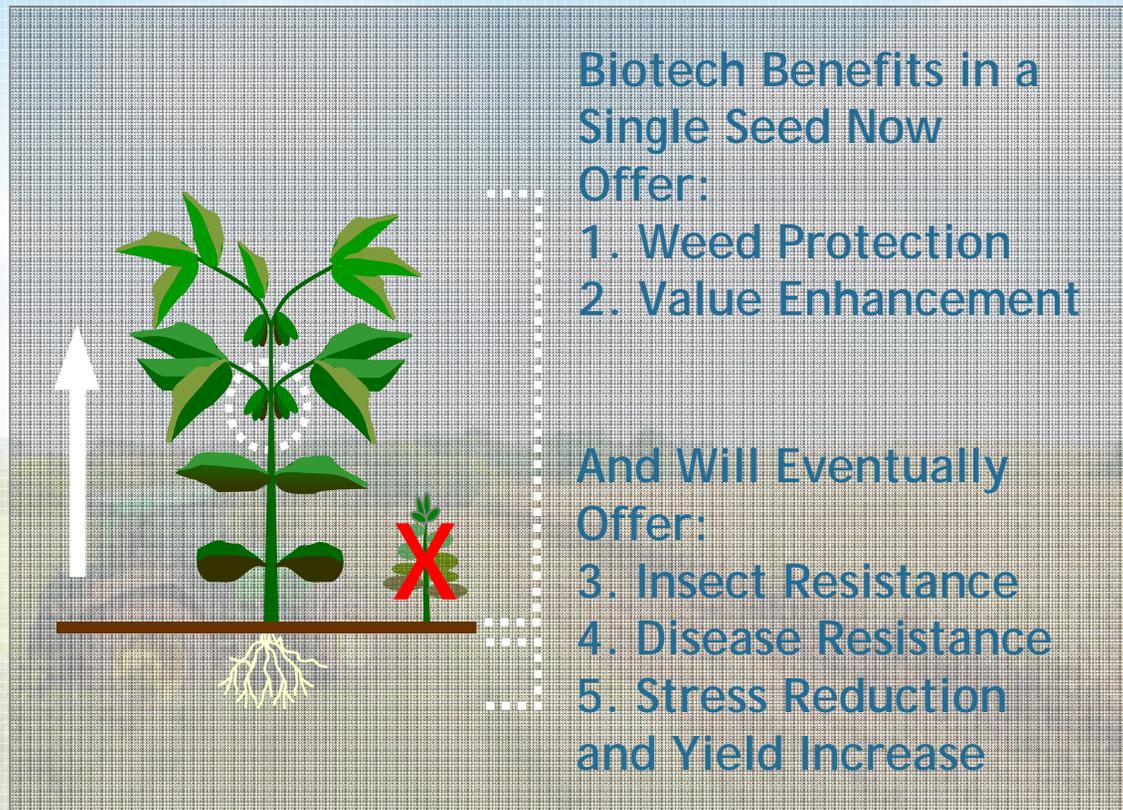
Weed Protection and Value Enhancement Today, Boosting Yield and Generational Improvements Tomorrow

## TODAY'S TRAITS

Roundup Ready®  
Vistive™ low-linolenic

## TOMORROW'S POTENTIAL TRAITS

Roundup RReady2Yield™  
Dicamba Tolerance  
Vistive III  
Omega-3  
Soybean Cyst Nematode  
Higher Yielding  
Insect Control



Biotech Benefits in a  
Single Seed Now  
Offer:

1. Weed Protection
2. Value Enhancement

And Will Eventually  
Offer:

3. Insect Resistance
4. Disease Resistance
5. Stress Reduction  
and Yield Increase

Today's traits will be supplemented by tomorrow's, delivering a "total package."

# Delivering Increased Yield in Soybeans

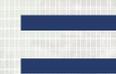
Two Pipeline Traits That May Deliver a Powerful One-Two Yield Punch



2006 trials averaged 3 to 5 bushels more than experimental lines of Roundup Ready® soybeans in same developmental phase



**Monsanto's Higher Yielding Soybeans**  
In multiple seasons of field testing, Monsanto's Higher-Yielding Soybeans averaged more than four bushels an acre more than the control, in head-to-head tests of similar varieties.

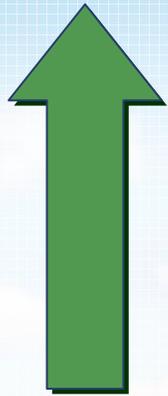


COMBINED,  
THESE TRAITS  
**FIELD A**  
MAY ADD A  
1000 acres  
POTENTIAL 15%  
~42,700 bu.  
TO 20% YIELD  
ADVANTAGE IN  
SOME AREAS,  
WHICH CAN  
ALLOW MORE  
**FIELD B**  
SOYBEAN  
800 acres  
PRODUCTION  
~40,500-  
ON FEWER  
42,700 bu.  
ACRES

BIOTECHNOLOGY CAN DELIVER MORE PRODUCTIVITY PER ACRE

# Biotech Crops Bringing Benefits to Agriculture, Growers and the Environment

## The Global Impact of Biotechnology 1996 - 2006



### Productivity

- Increased by 30M acres in the U.S. from 2005 to 2006
- \$6.2B global value of biotech crops in 2006



### Economic Return

- Global accumulated impact of biotech crops since 1996 is estimated at \$35.5 billion

Biofuels: Research indicates biofuels initiatives could result in a net savings of 65% in energy resource depletion.

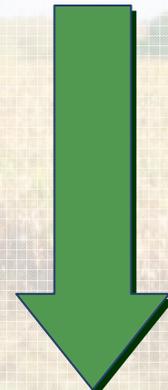
### Pesticide Reduction

224,000 Tons, 15% reduction



### Greenhouse Gas Emissions

Reduced >11B Kg Carbon Dioxide Emission  
Equal to removing 6 M cars from the road for a year



Source: Graham Brooks, 2006, [www.agbioforum.org](http://www.agbioforum.org) ; NCFAP report, 2006; Ford Runge & Barry Ryan 2005

Pesticides registered by the U.S. Environmental Protection Agency will not cause unreasonable adverse effects to man or the environment when used in accordance with label directions.

# Summary

## ■ Breeding

- Molecular breeding has increased the rate of genetic yield gain by a factor of between two and three.

## ■ Traits

- Innovative traits are helping to drive yield increases and yield stability.

## ■ Compositional Improvements

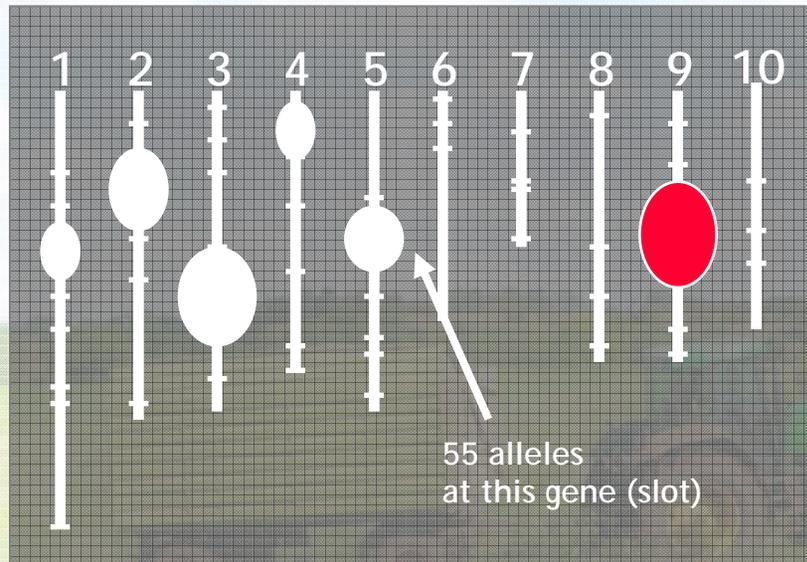
- Improvements to grain composition and processing can contribute to increased ethanol production and higher-value co-products.

**Technology Is Raising the Bar Significantly on  
Future Yield Potential**

# Getting the Best Genetic Combination is a Numbers Game

## Step-Changes in Grain Potential

### Ten Chromosomes of Corn



#### Lottery

- 5 white balls selected from a set numbered 1-55
- 1 red ball selected from a set numbered 1-42
- Probability of matching the 6 numbers is ~1 in 146 million

#### Genetic Combinations

- Slots (1 red and 5 white balls) equal genes
- The different numbers on the balls are different alleles (variant) at each gene
- Probability of getting the "best" (match) 6 numbers is ~1 in 146 million

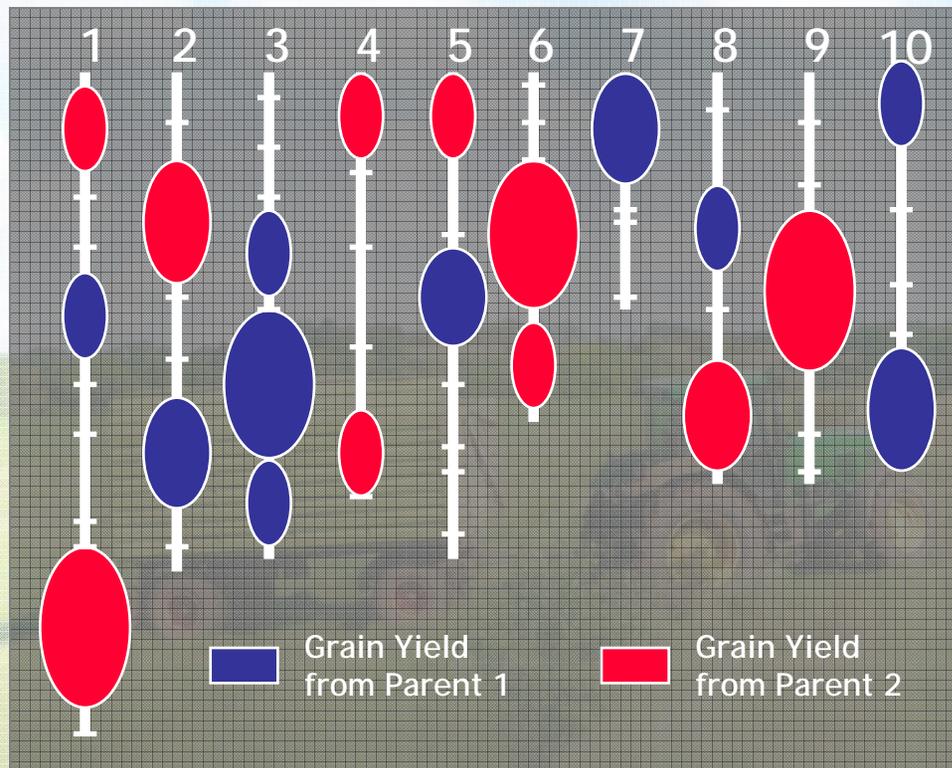
#### Getting the Best Plant Product is Much Harder

- Corn as tens of thousands of genes (slots)
- Monsanto's elite global germplasm pool has lots of genetic variation (alleles)
- With just 20 genes and 2 alleles, the probability is ~1 in 1 trillion of getting the "best" plant

# Monsanto is Changing the Numbers Game in Plant Breeding

## Step-Changes in Grain Potential

Use Molecular Markers to Identify Which "Ball" We Want to Pick



With a Few Selection Cycles, We Can Quickly Improve Probability of Success

Cycle	Frequency of Best Genotype
0	1 Per Trillion
1	5 Per Billion
2	1 Per 5,000
3	1 in 5