Presented by Mycogen Seeds

- **February 8-10, 2011 Tulare CA, USA**
- This competition challenges farmers and ranchers to enter the bounty of their labor to see who produces the highest-quality forages in the West. This contest is an excellent chance to **WIN CASH PRIZES**!
- **THREE CATEGORIES TO ENTER:**
  - Alfalfa hay
  - Standard (non BMR) corn silage
  - Brown mid-rib (BMR) corn silage
- **PRIZES INCLUDE:**
  - $3,000 for first place in each of the three categories
  - $18,000 total cash and prizes
  - Plaque and Global recognition
- **Entries due December 10, 2010!**
- **For an entry form and instructions go to <http://www.worldagexpo.com/foragechallenge>**
  UP to $18,000 in Cash and Prizes Awarded, Sponsored by Lallemand Animal Nutrition, North America.

Current and Future Genetics in Corn Silage

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Abstract

- Attaining high quality corn silage
- Biotechnology
- Breeding Tools
- Genetic Advancements

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Introduction

- Corn Silage is a popular feed
  - Corn plants can provide large volumes of digestible palatable feed and requires harvesting once a year.
- Today's corn silage seed is a whole package with a trait pipeline to include insect and herbicide tolerance, agronomic & nutritional advances through breeding and biotechnology.

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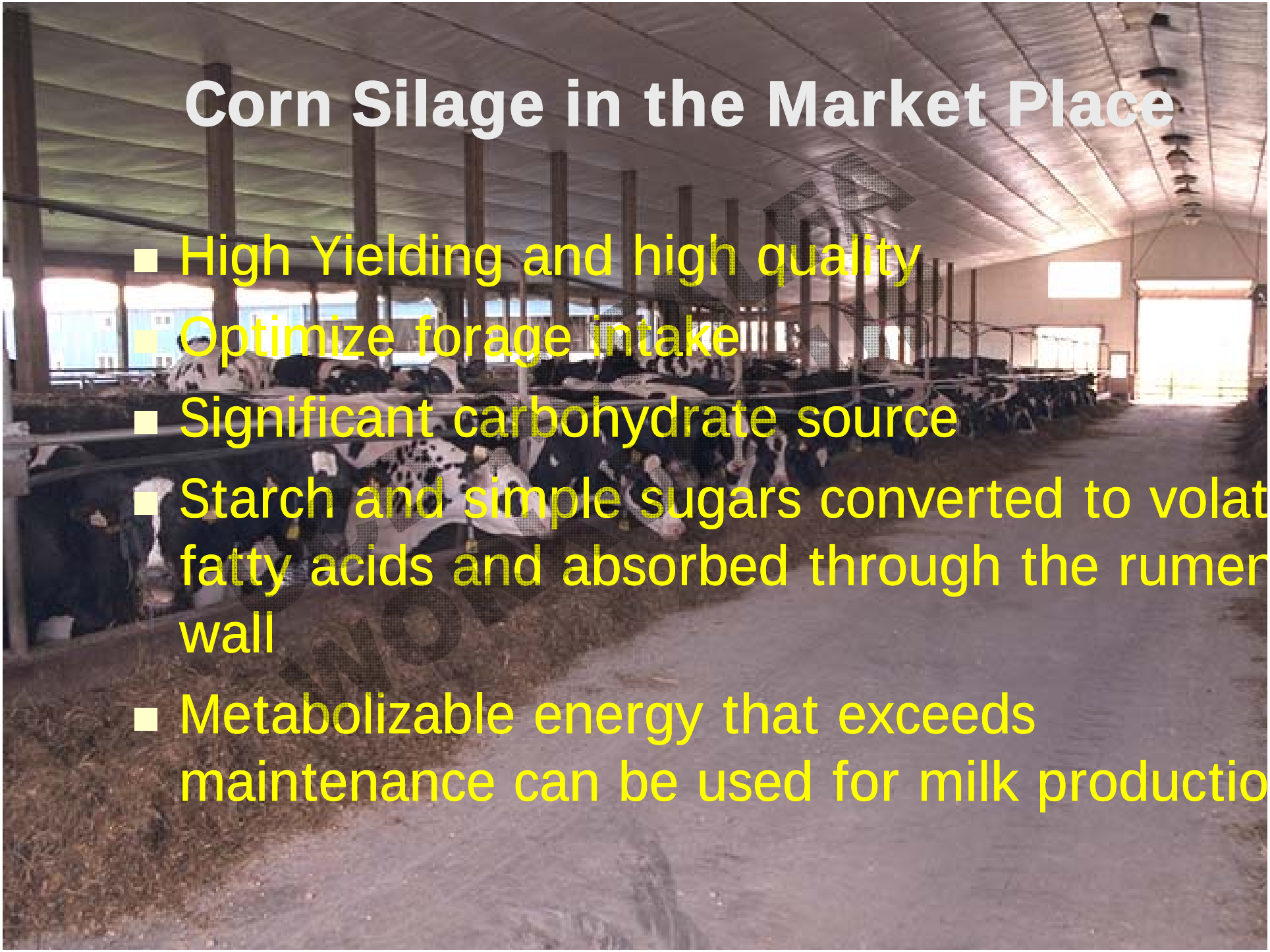

Corn Silage in the Market Place

- High Yielding and high quality
- Optimize forage intake
- Significant carbohydrate source
- Starch and simple sugars converted to volat fatty acids and absorbed through the rumen wall
- Metabolizable energy that exceeds maintenance can be used for milk productio

Corn Silage Breeding

Breeding Process

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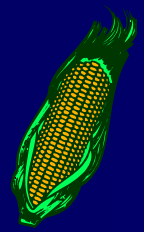
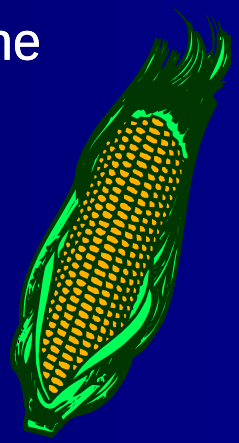
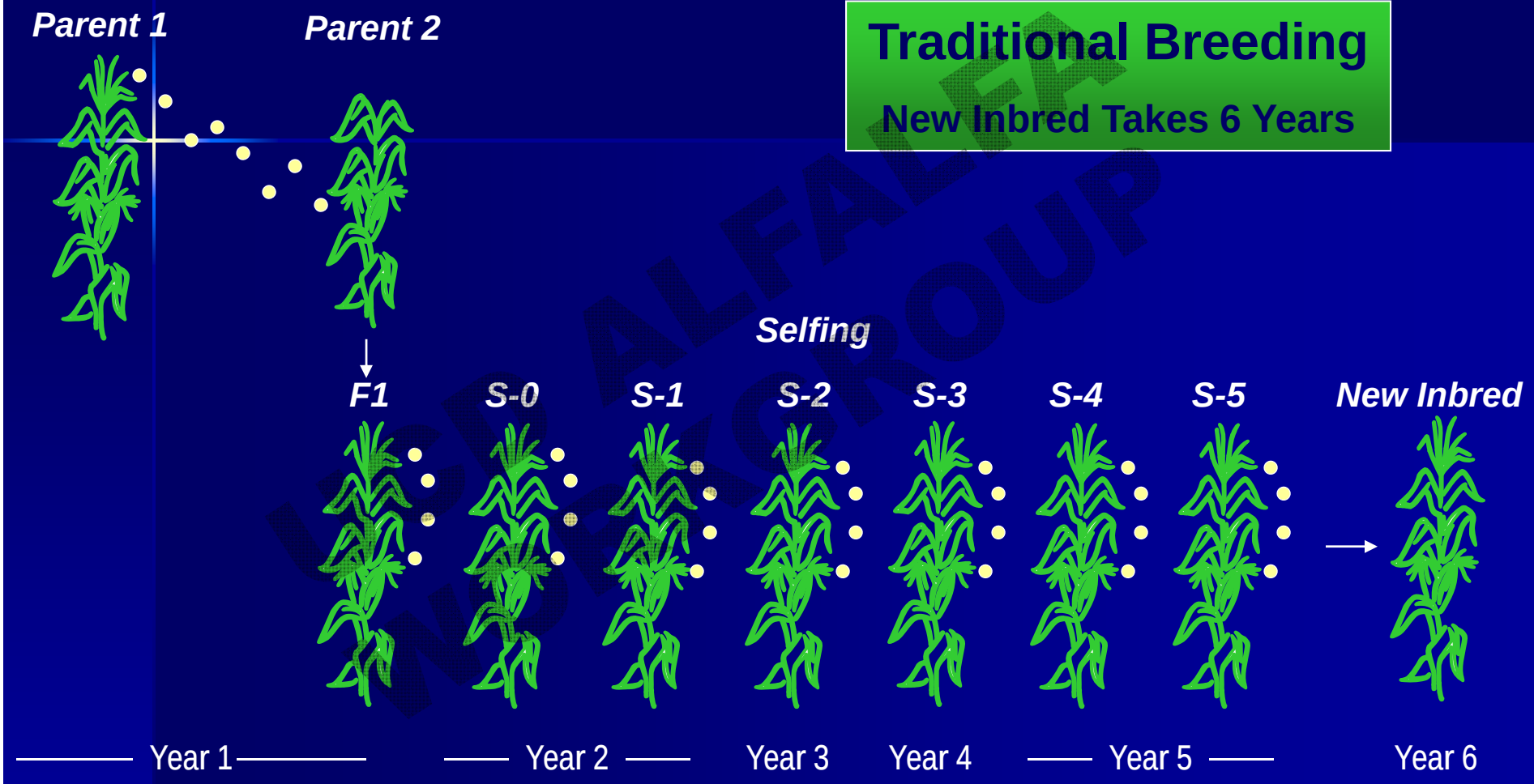
Inbred Development	Hybrid Development
Make breeding cross	
Self pollinate and select	Testcross to make test hybrids
Select finished inbred line	Grow yield trials
Increase line	Select and advance
	Commercial products





Traditional Breeding

New Inbred Takes 6 Years



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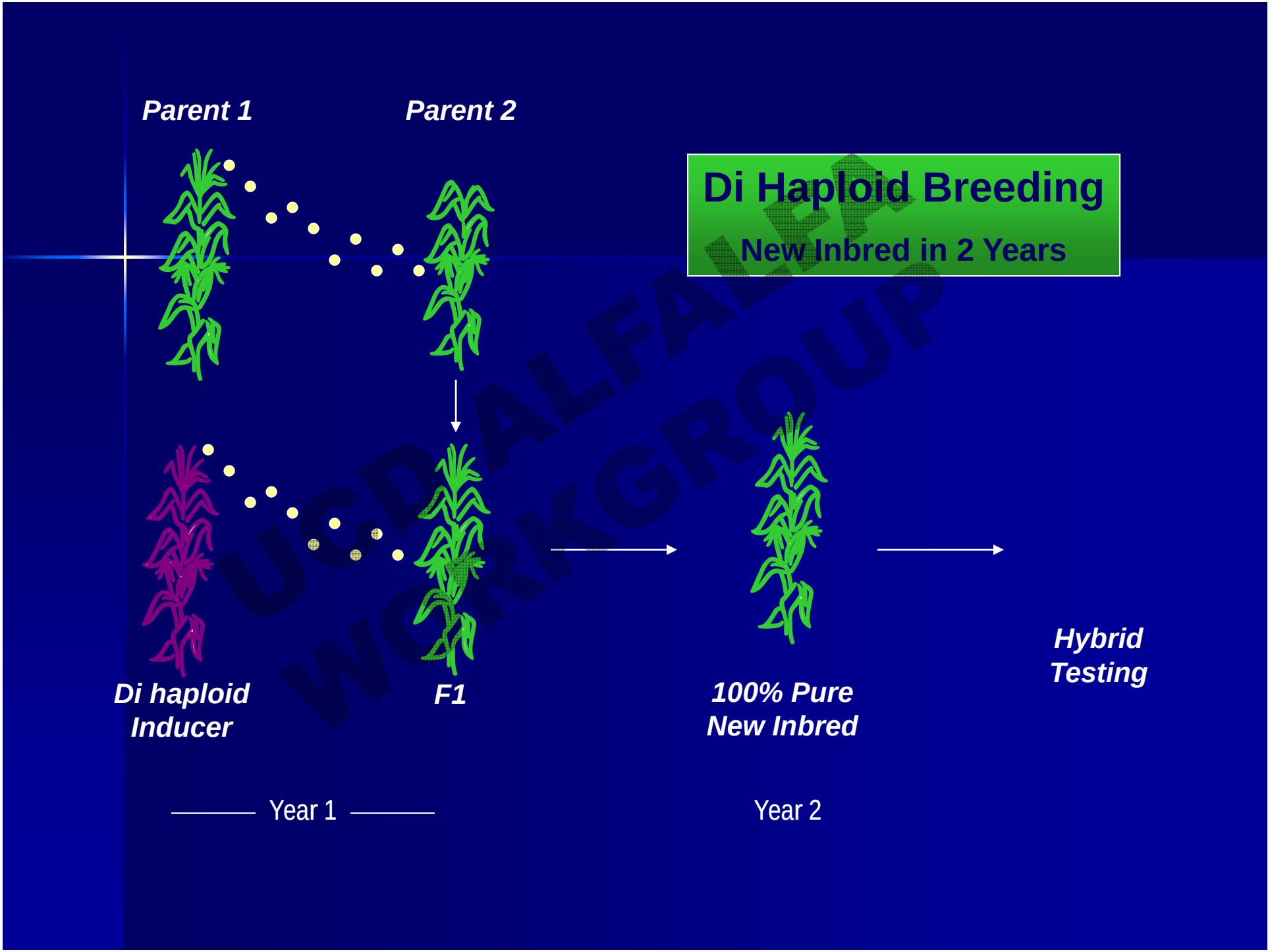
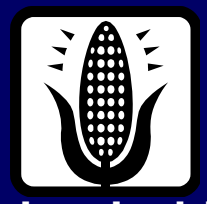

Parent 1
Parent 2
Di Haploid Breeding
New Inbred in 2 Years
Di haploid Inducer
F1
100% Pure New Inbred
Hybrid Testing
Year 1
Year 2

Critical Success Factors

Elite Inbred

X



Inbred with desired trait

Offspring (2n)

X

Purple crown on kernel

(2n, haploid inducer)

Purple crown, white embryo

HAPLOID (1n , not fertile)

DIPLOIDS (2n, fertile, not useful)

Purple crown, purple embryo

Treat with Colchicine

Chromosome doubling

Completely homozygous 2n, fertile, DH inbred line with desired trait

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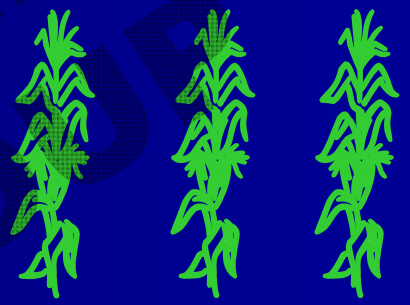
Traditional Breeding

# of inbreds in 6 years

- Fewer new inbreds developed
- Consumes more breeding time and assets
- Inbred never 100% pure

Di Haploid Breeding

# of inbreds in 6 years



- Accelerates genetic gain
  - Develop 3 inbreds in the time it took to develop 1
  - Begin yield testing earlier
  - Eliminate poor performers quickly
- Reduces time to bring new genetics to the market
- 100% homozygous lines

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Germplasm Definitions

- **Germplasm**: All the genetic material that provides the base of a breeding program

  - **Exotic (or Unadapted) Germplasm:** Germplasm which is typically not grown in the target environment and is mostly unadapted to the target environment. An example would be taking a Brazilian line and crossing it with a US line.

  - **Related Species:** Species which are cross fertile with target crop and can be used as sources of unique genes

  - **Transgenic**: Gene or set of Genes that come from another species.

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Genomics

- Is the study of the DNA sequence.
- The genome of the corn plant have been sequenced.

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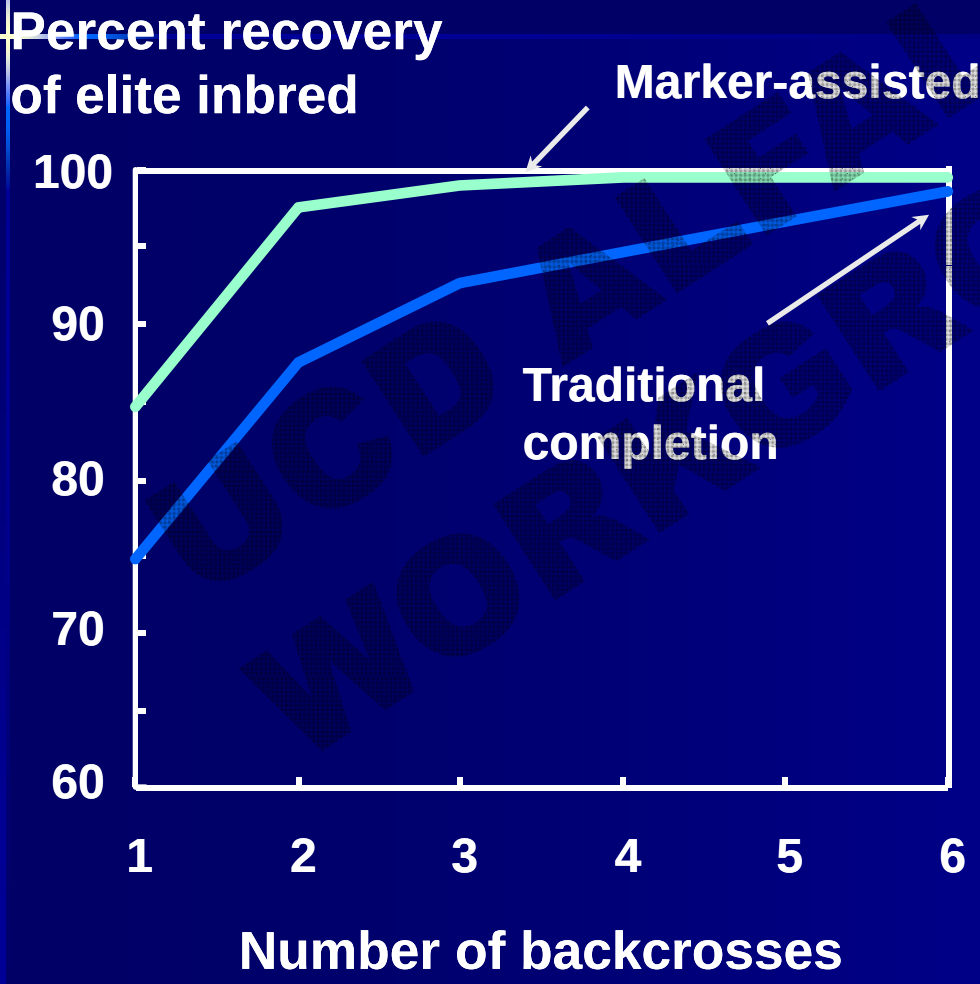
Tools to decrease Cycle time

Critical Success Factors

Marker-assisted Backcrossing Can Reduce Launch Time



1-2 year development time savings

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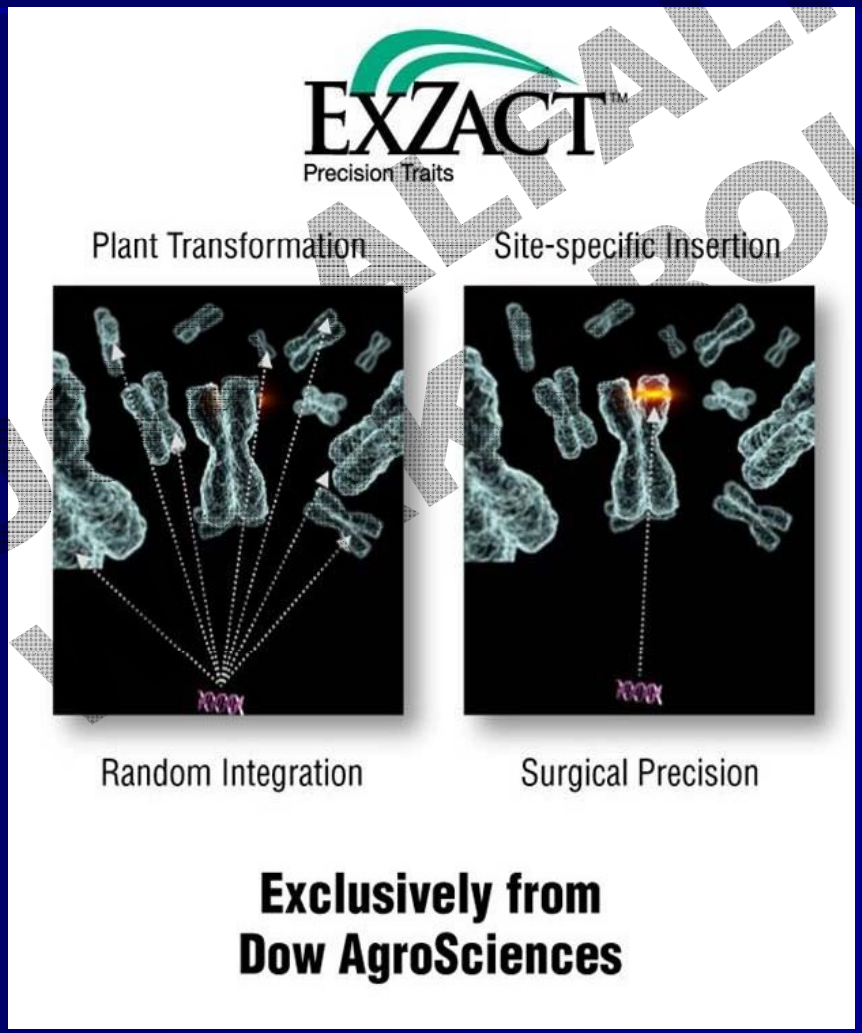
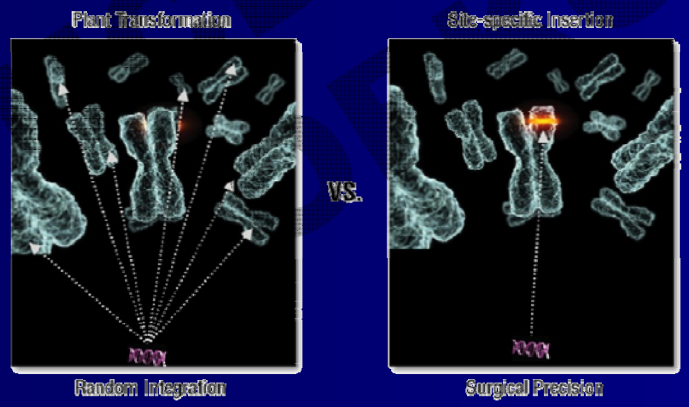
FASTER TECHNOLOGIES



EXZACT™ Precision Traits

- **Gene Regulation** – the ability to **Fine-tune** native gene expression
- **Gene Targeting** – the ability to precisely **Edit** native genes
- **Trait Stacking** – the ability to **Add** traits precisely where we want them



EXZACT™ is the only technology capable of specifically targeting any DNA sequence, allowing Dow AgroSciences to bring unique products to market.

Genotype by Environment Interaction

- Hybrids respond differentially to different environments
- GxE can confound testing results
- Hybrids showing little GxE are very stable
- Understanding GxE can help effectively position hybrids
- The only way to estimate GxE is by testing at many and diverse locations

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Importance of Exotic Germplasm in a Breeding Program

- Essential to enable long term genetic improvements
- Provides diversity in product offerings
- Adds unique appearance to products
- Source of new genes
- Adds new sources of variation

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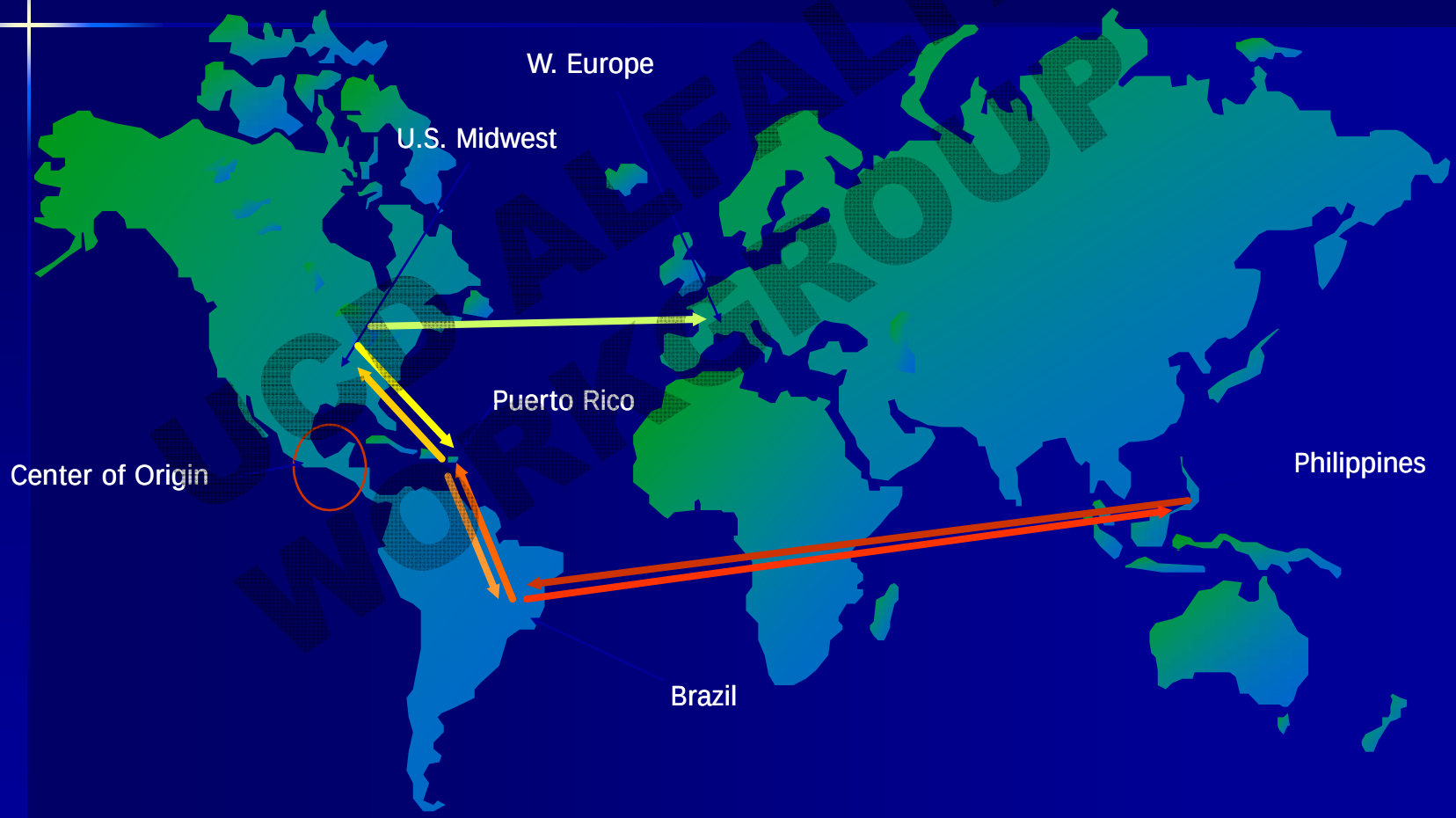
Flow of Maize Germplasm



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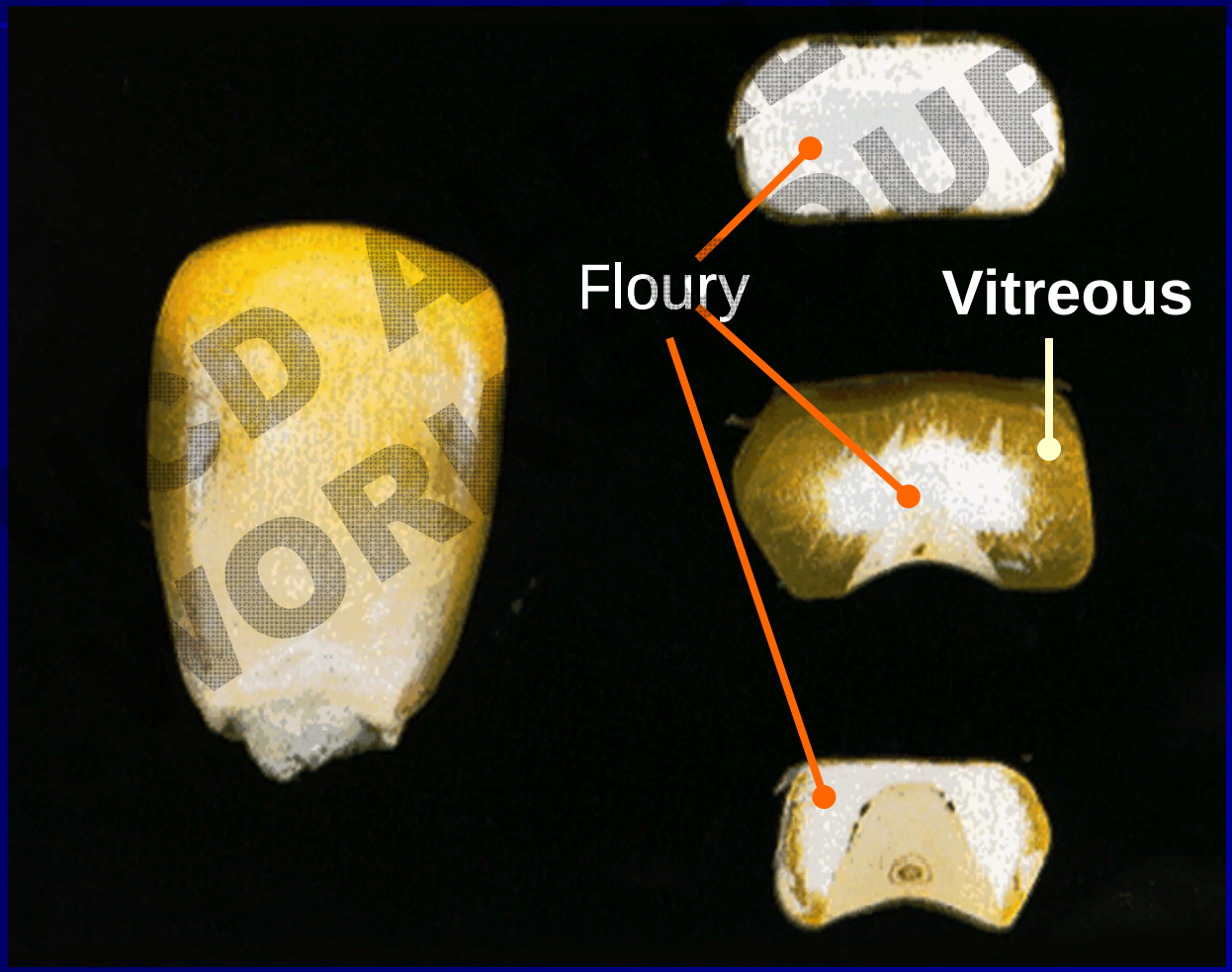
Endosperm



Germplasm Enhancement

- Programs focused on transferring valuable traits from unadapted germplasm to elite adapted germplasm
- Primary focus on introgression of ***Elite*** tropical material into elite North American lines to expand germplasm pool and identify useful genetic segments
- This brings greater genetic diversity to silage breeding programs

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Plant Modifications in Corn Silage

High quality corn silage hybrids have been obtained through genetic selection for improved stover digestibility (stalk, leaves, husk and cob) and grain yield.

Examples: waxy, Opaque 2 (high lysine), brown midrib (BMR), high oil, multi leaf (leafy), and high ndf.

BMR Hybrid

- BMR = Brown Mid-Rib
- It is a genetic mutation (not genetically engineered)
- Mutation that results in less lignin
  - 25 to 35% reduction
- BMR feeding recommendations make the ration a high corn silage ration

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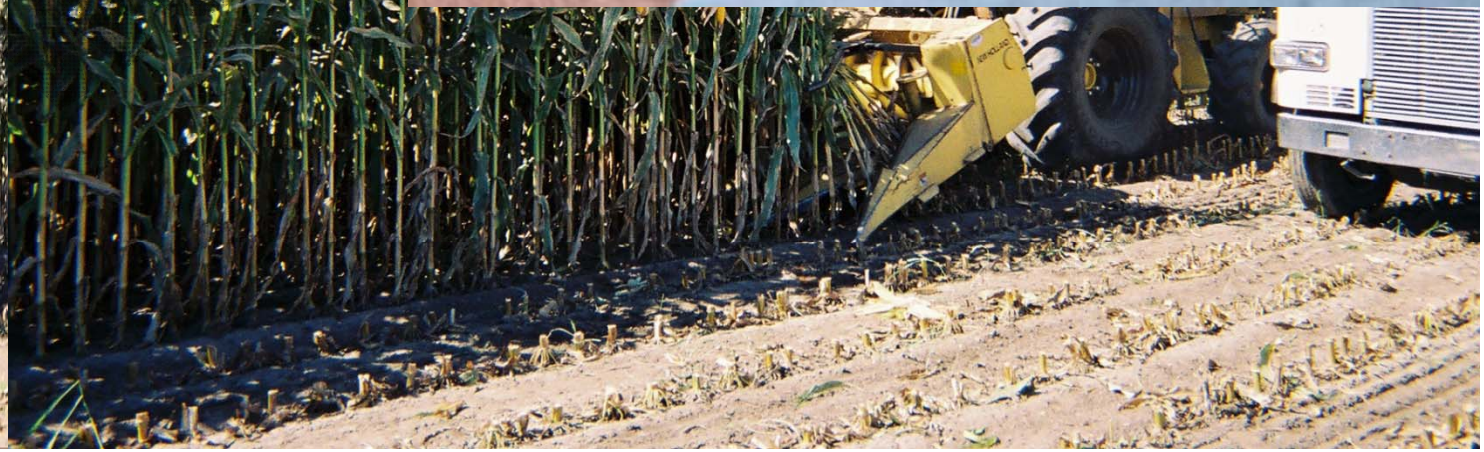

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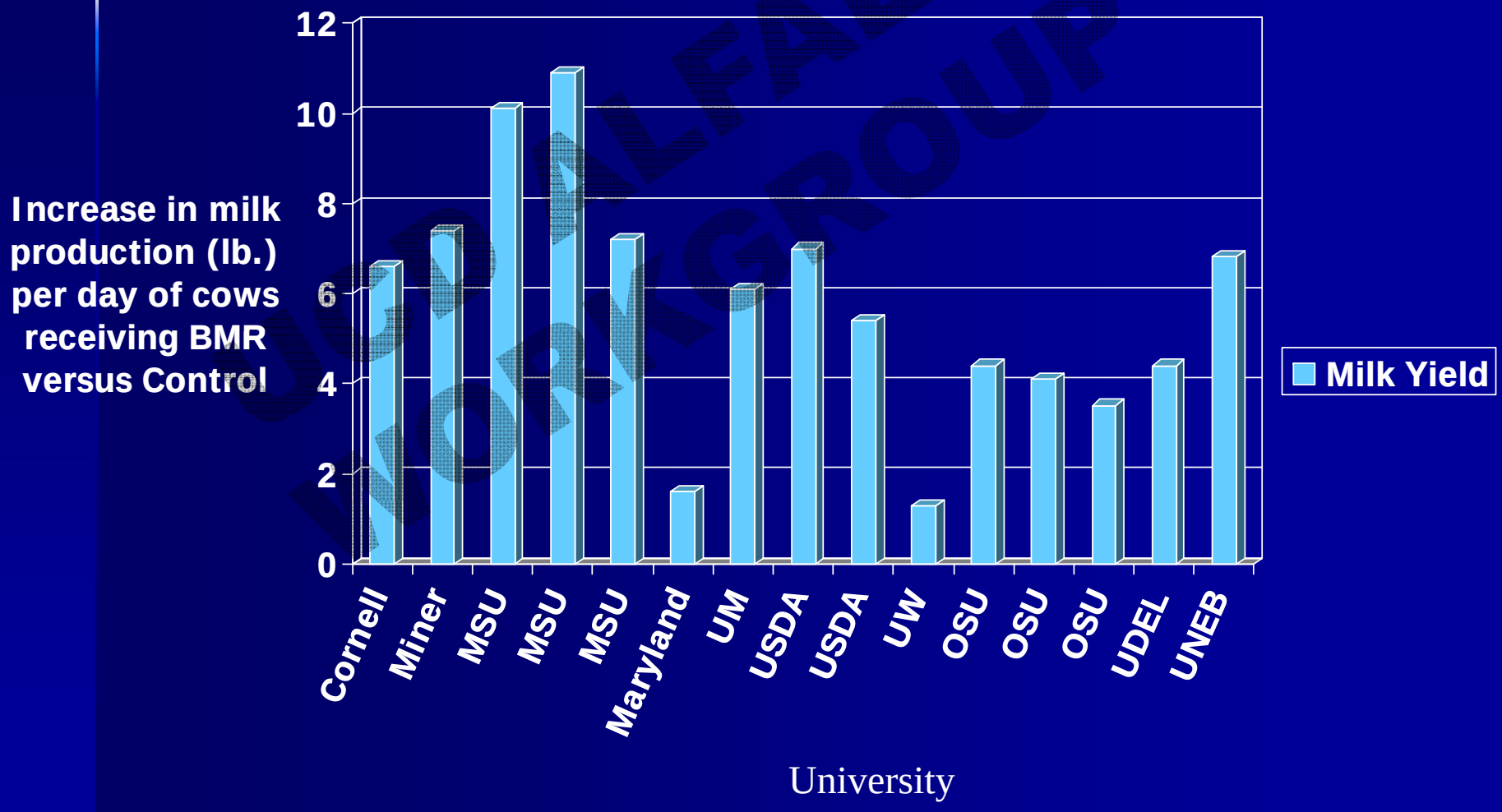
Modern BMR Milk Production Research



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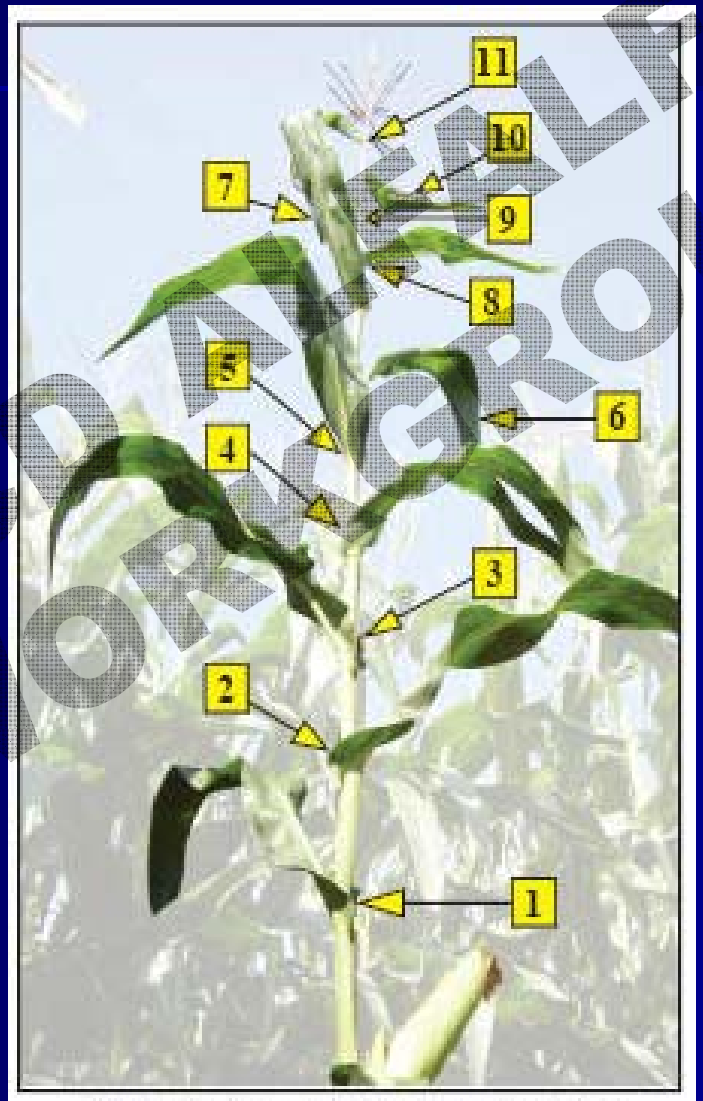
Leafy Corn Hybrids



A plant of Leafy corn with eleven leaves above the ear.

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Biotech – Agronomic traits

Insect protection

Herbicide tolerance

- higher yields - increased tonnage
- reduced chemical use
- more environmentally friendly production system
- reduced grower costs

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Biotech – Forage Enhanced Traits

- Reduce or alter lignin
- Alter carbohydrates
- Increase protein
- Rate limiting digestive enzymes
- Fermentation adjuvants in the plant

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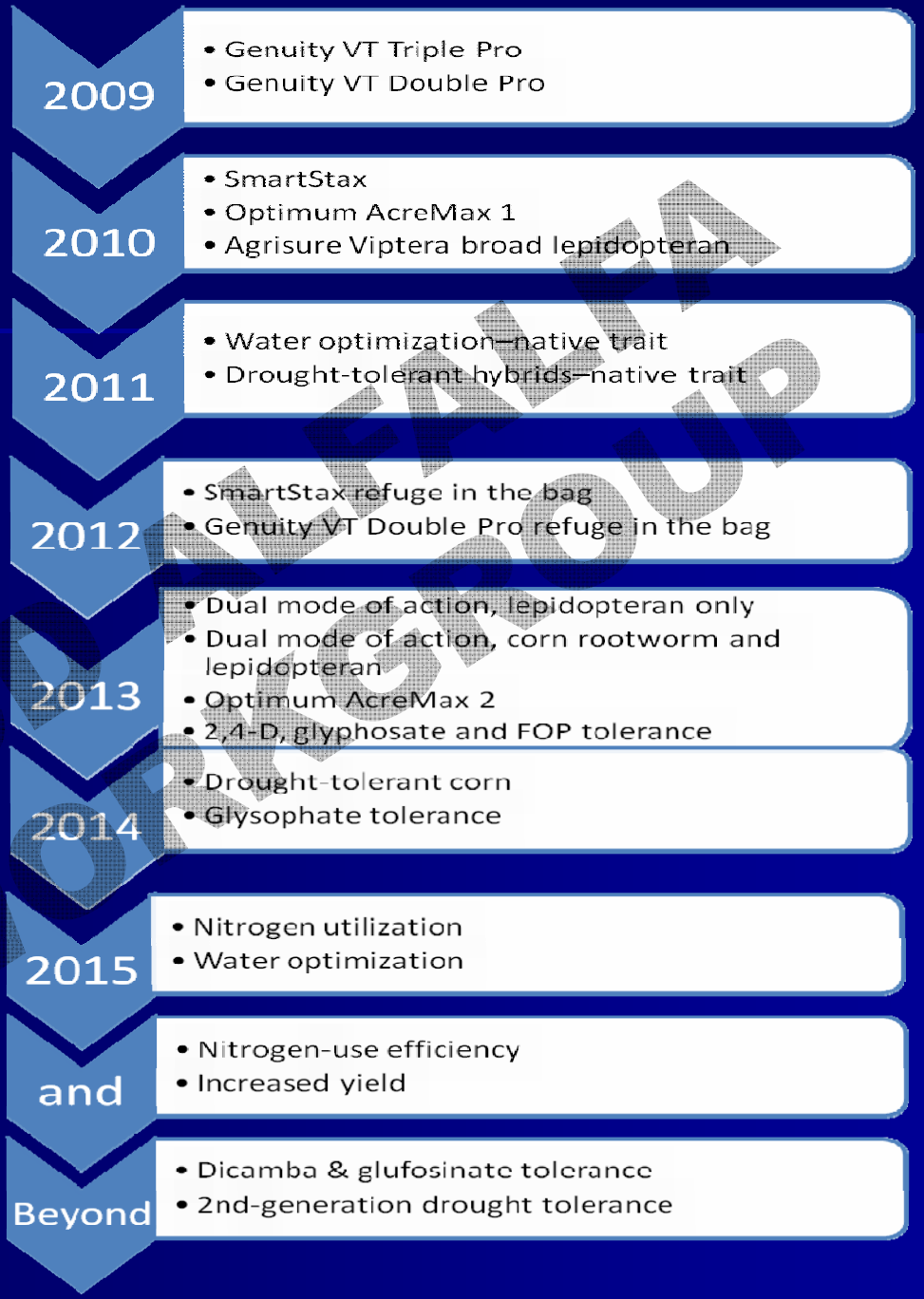
Pipeline of Traits



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Data Source: Pipelines of Promise. Farm Journal, Summer 2010, P. Smith

Thank You!

Questions?

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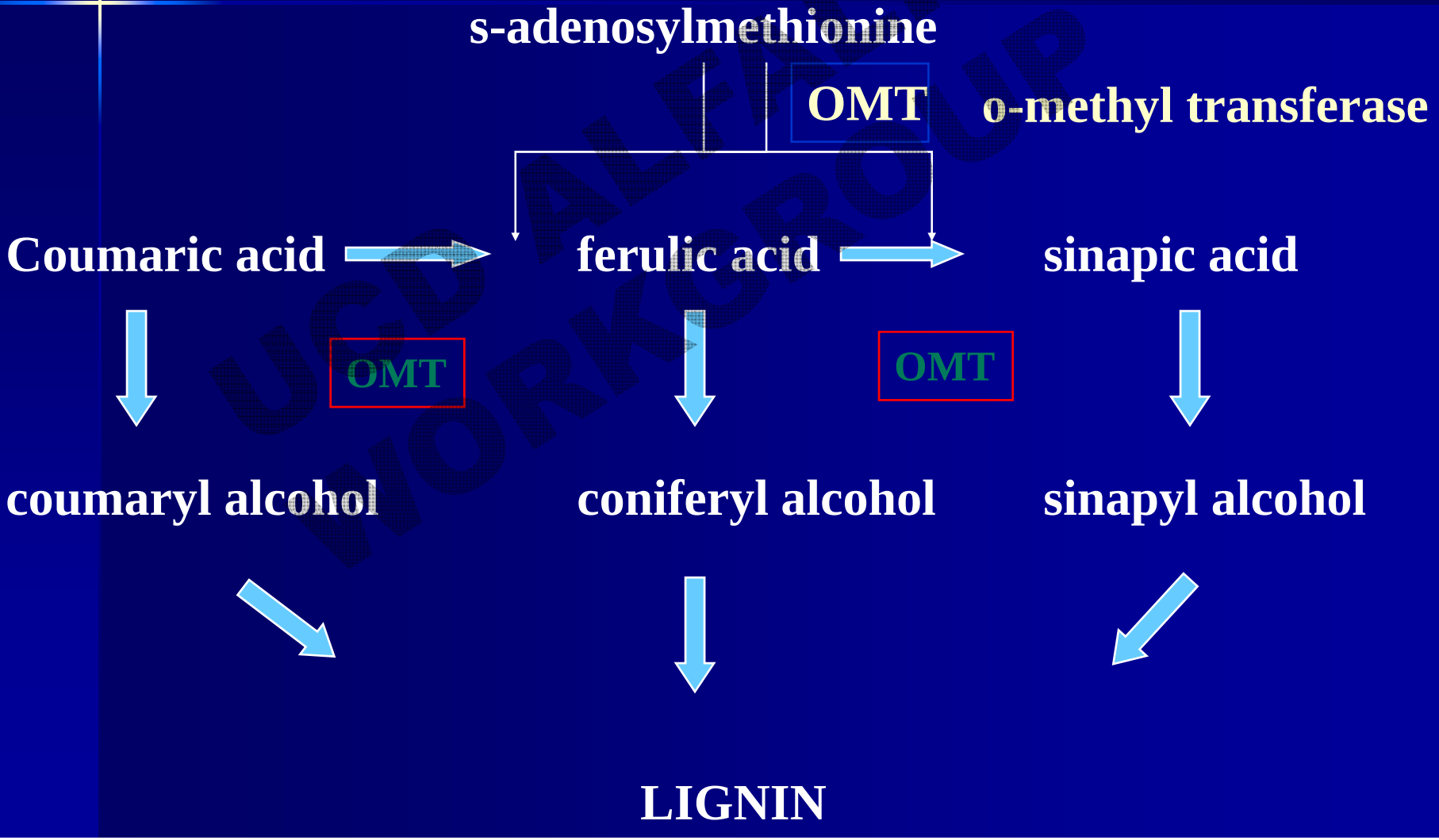
BMR Mutants Contain Lower Lignin



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