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

Dennis Craig
Product Development Agronomist
Dow AgroSciences / Mycogen Seeds
Corcoran, California
Abstract

- Attaining high quality corn silage
- Biotechnology
- Breeding Tools
- Genetic Advancements
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.
Corn Silage in the Market Place

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

Inbred Development

Make breeding cross
Self pollinate and select
Select finished inbred line
Increase line

Hybrid Development

Testcross to make test hybrids
Grow yield trials
Select and advance
Commercial products

Select finished inbred line
Increase line
Traditional Breeding
New Inbred Takes 6 Years
Di Haploid Breeding
New Inbred in 2 Years

Parent 1

Parent 2

Di haploid Inducer

F1

100% Pure New Inbred

Hybrid Testing

Year 1

Year 2
Critical Success Factors

Elite Inbred

Inbred with desired trait

Offspring (2n)

(2n, haploid inducer)

Purple crown on kernel

Purple crown, white embryo

HAPLOID (1n, not fertile)

Treat with Colchicine

Purple crown, purple embryo

DIPLOIDS (2n, fertile, not useful)

Chromosome doubling

Completely homozygous 2n, fertile, DH inbred line with desired trait
- Fewer new inbreds developed
- Consumes more breeding time and assets
- Inbred never 100% pure

- 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
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.
Genomics

- Is the study of the DNA sequence.
- The genome of the corn plant have been sequenced.
Tools to decrease Cycle time

Critical Success Factors

Marker-assisted Backcrossing Can Reduce Launch Time

Percent recovery of elite inbred

1-2 year development time savings

Number of backcrosses

1 2 3 4 5 6
FASTER TECHNOLOGIES

Exclusively from Dow AgroSciences
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
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
Flow of Maize Germplasm
Endosperm

Floury

Vitreous
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
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
Modern BMR Milk Production

Research

Increase in milk production (lb.) per day of cows receiving BMR versus Control.

University
Leafy Corn Hybrids

A plant of Leafy corn with eleven leaves above the ear.
Biotech – Agronomic traits

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

- Herbicide tolerance
Biotech - Forage Enhanced Traits

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

2009
- Genuity V1 Triple Pro
- Genuity V1 Double Pro

2010
- SmartStax
- Optimum AcreMax 1
- Agrisure Viptera broad lepidopteran

2011
- Water optimization—native trait
- Drought-tolerant hybrids—native trait

2012
- SmartStax refuge in the bag
- Genuity VT Double Pro refuge in the bag

2013
- Dual mode of action, lepidopteran only
- Dual mode of action, corn rootworm and lepidopteran
- Optimum AcreMax 2
- 2,4-D, glyphosate and FOP tolerance

2014
- Drought-tolerant corn
- Glyphosate tolerance

2015
- Nitrogen utilization
- Water optimization

Beyond
- Nitrogen-use efficiency
- Increased yield
- Dicamba & glufosinate tolerance
- 2nd-generation drought tolerance

Data Source: Pipelines of Promise. Farm Journal, Summer 2010, P. Smith
Thank You!
Questions?
BMR Mutants Contain Lower Lignin

s-adenosylmethionine → OMT → o-methyl transferase

Coumaric acid → ferulic acid → sinapic acid

coumaryl alcohol → coniferyl alcohol → sinapyl alcohol

LIGNIN