The Future of Alfalfa: Understanding GMO Traits and Their Impact on Production and Marketing

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Changing Climate

- Farmers are impacted by climate change in many ways:
  - Water availability issues
  - Increasingly unpredictable weather
  - Insect range expansion
  - Weed pressure changes
  - Crop yield increases
  - Planting zone shifts

Solutions for Sustainable Agriculture

- Precision Agriculture
- Plant Breeding
- Biotechnology
- Microbes
- Crop Protection
- Stewardship

A Broad Range of Solutions

- Alfalfa Breeding Advancements
Breeding for Improved Persistence

Seedlings that survive sequential screening to key diseases are used to establish spaced plant breeding nurseries. All breeding nurseries are cut on an aggressive schedule to increase stress and encourage stand decline. Persistent selections are made after the fourth or fifth winter after check varieties have thinned significantly.

Major Pests in Alfalfa

- Bacterial Wilt
- Fusarium Wilt
- Verticillium Wilt
- Phytophthora Root Rot
- Anthracnose
- Aphanomyces Root Rot

Major Pests in Alfalfa

- Spotted Alfalfa Aphid
- Pea Aphid
- Blue Alfalfa Aphid
- Cow Pea Aphid
- Potato Leafhopper
- Stem Nematode
- Root Knot Nematode
- Spotted Alfalfa Aphid
- Pea Aphid
- Blue Alfalfa Aphid
- Cow Pea Aphid
- Potato Leafhopper
- Stem Nematode
- Root Knot Nematode
Breeding for Salt Tolerance

- Soil salinity currently limits crop production potential
- Saline soil conditions are often accompanied by two other soil problems
  - High sodium content (sodic soils)
  - High soil pH (alkaline soils)

Current Industry Practices

1. A one week salt germination test (photo below) measures alfalfa seed germination under moderately high salt conditions

Tolerant

Non-tolerant
Breeding for Salt Tolerance

- We have identified field testing to better understand the tolerance of alfalfa grown and
  - to validate the efficiency of the greenhouse salt tests
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After two years in this nursery, >90% of the plants were dead or dying.

2013 Salt Forage Trial
Rocky Ford, CO

FGI Salt Testing Locations

1. Taunton, WA
2. Nampa, ID
3. White Lake, ID
4. Blue Valley, ID
5. Rocky Ford, CO
6. West Side, CA
7. Malibu, AZ
Option 1: Improved Quality
Farmers can maintain a normal harvest schedule and achieve higher quality.

Option 2: Delay Harvest
Or choose to delay harvest for up to 7 days for higher yield potential without sacrificing quality.
2011 HarvXtra® Alfalfa Cutting Management Trial
Tucumcari, NM

1st cut 5/8 = 3.60 T/acre
1st cut 5/19 = 4.35 T/acre

Six Harvests
Source - NM State University Research Site

HarvXtra® Alfalfa vs Conventional Alfalfa Varieties
University Trials

- Field trials were established in six states (CA, KS, MI, OH, PA, WI) in spring 2015
- Three alfalfa varieties
  - HarvXtra-008 with the reduced lignin trait
  - 54R02 with high yield
  - WL-355RR selected for high forage quality

Forage Genetics

Multiple trials conducted at the University of Wisconsin (UW) have shown a 15-20% forage yield advantage for a three cut versus four cut management system over a four year rotation.
Source - UW - Extension. Dan Undersander 2009
Future of Alfalfa Improvement

- Alfalfa genome sequencing fully enabling use of molecular markers and whole genome selection for enhancing traits
- A combination of breeding gene-editing and CRISPR techniques will be used to create a more productive alfalfa variety
- Improved abiotic and biotic stress tolerance
- Improved feeding quality

The Results: AD & NDFd

The figure shows a comparison of AD (Apparent Digestibility) and NDFd (Neutral Detergent Fiber digestion) rates for different alfalfa varieties in different locations. The data is represented graphically with lines indicating the changes over time and space.
Summary
• Significant advancements withintraited and conventional alfalfa
• Each introduction of a variety brings significant improvement over older genetics
• Growers have choices