Refuge in a Bag

by James Shearl

ASTA 2010
The Situation

- GMO traits introduced in 1997
- Refuge requirement
- Yield advantage
  - Refuge non-compliance?
- Solution – Refuge in a Bag (RIB)
- Seeking EPA approval from 20% to 5% refuge

Refuge in a Bag
Considerations of RIB

• Mechanics of achieving seed blend
• Coordination with EPA & seed regulatory personnel
  – Environmental & labeling requirements
• Seed product & facilities audits
• Handling carry-over RIB seed during re-bag
Current/Proposed RIB Products

- **DuPont/Pioneer** – 90/10 blend rootworm only for 2011
  - Still requires refuge for aboveground pests
  - Full RIB products offered in future

- **Monsanto** – 95/5 blend of Bt protected corn with multimode action + non-insect protected corn in refuge
  - 2012 approval expected


**Current/Proposed RIB Products**

- **Dow** – 95/5 blend – multimode of action Bt protected corn + herbicide tolerant refuge
  - Approval expected 2012

- **Syngenta** – 95/5 blend of multiple modes of Bt protected corn & non-Bt protected corn
  - Approval expected 2012 or 2013

*Refuge in a Bag*
Mechanics of Seed Blending

- Seed facility modifications
  - Computerized equipment & highly accurate scales
- Goals:
  - To meet label claims
  - Complete bagging on time
- Cost of systems
Seed Regulatory Requirements

• Get EPA approval
  – Will determine if RIB can replace along-side refuge planting, and at what %
Labeling

• 3 options
  – Label as a blend or mixture of 2 varieties
  – Label as Varieties Not Stated
    • Not allowed in some states
  – Label as “Other Crop”
Label as Blend
(example from L. Nees)

Labeling a “RIB” Seed Product
Option # 1

Adam's RIB Brand Hybrid Corn Mixture

94.50% Hybrid ABC Corn Gem: 95% Test Date: 01/10
5.00% Hybrid DEF Corn (refuge) Gem: 95% Test Date: 01/10
0.00% Other Crop Seed
0.50% Insert Matter
0.00% Weed Seed

Refuge in a Bag
Label Refuge in a Bag as “Variety Not Stated”
(example from L. Nees)
Label as “Other Crop” if ≤5%  
(example from L. Nees)
Seed Colorants

• One vs. two

Courtesy of AASCO
Regulatory Process

- Quality Manual
- Seed Stewardship
- Facility audits/Reporting compliance
- Seed sampling
Farmer Audits

• Current requirements

• Should diminish with RIB
**Carry-over Seed**

- Receiving seed back from the customer
- Re-tested, then re-bagged
- Sample retained for new lot
- Similar to current practices
Farmer Benefits of RIB

(Monsanto study 2009)

• Automatic refuge compliance
• Don’t have to keep seed separate or buy separate seed
• Saves time
• Greater whole farm yield
• No changing the seed planter
• Easier to understand and manage
• Less recordkeeping

Responses received from 478 farmers
Farmer Benefits of RIB
(Syngenta study 2010)

- Increased simplicity
- Automatic refuge compliance
- Saves time/increased speed
- Simplified record keeping & planting
- Decreased labor

Responses received from 308 farmers
End results of RIB will be satisfied corn farmers with higher yields and more profits and successfully accomplished stewardship goals resulting in a protected ecosystem.
Seed Production Technology
Next Generation Seed Production

- Seed Production Technology (SPT process) is an innovative, proprietary seed production process that is expected to dramatically increase the efficiency of hybrid seed production. This advancement will build on Pioneer’s industry-leading ability to respond to customer demands for reliable supplies of high quality hybrid seed corn.

- The SPT process is an efficient production process that works with all Pioneer elite corn genetics and will allow Pioneer to meet customer demand with a reliable supply of superior hybrid seed corn products containing the high performance traits and technologies our customers expect.

- This unique approach to hybrid seed production uses proprietary technology to produce female inbred parents that do not shed pollen. This eliminates the need for detasseling in fields where the SPT process is used, and dramatically reduces the risk of female parents pollinating themselves, ultimately improving the overall quality of the hybrid seed.

- The SPT process is a greener technology that uses less equipment and labor in the fields than current production processes, resulting in a safer and more environmentally-friendly approach to hybrid seed production.

- Current detasseling practices can damage corn plant leaves during the process and create possible yield loss. For every leaf cut from a corn plant, approximately 3 to 5 percent of yield potential is lost from that plant. Seed Production Technology preserves the corn plant, as well as potential yield, in hybrid seed production.

Current detasseling practices are labor and machinery-intensive processes that involve removing the tops of the corn plant to prevent female self-pollination and reduce yield potential in hybrid seed production fields.

The SPT process is an innovative production process that leaves corn plants undamaged during hybrid seed production.
Roundup® Hybridization System

John Miklos—RHS Development Lead
December 9th, 2010
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Outline

• Brief history of hybrid seed production
• How RHS works
• Why is this technology beneficial
Large Scale Hybrid Pilot Production Utilizing RHS Technology

We’ve come a long way........
US Corn Yields over last 140 years

Breeding Plus Cultural Practice Gains

Start of Hybrid Production

Start of CMS Technology

Start of Mechanical Detasseling

No Significant Change over the last 30+ years

Technologies to Produce Hybrid Seed Corn

Mechanical Detasseling

- **Upsides**
  - Hybrid product is fertile
  - No need formaintainer lines

- **Downsides**
  - Very costly, manual detasseling
  - Labor & equipment intensive
  - Critical timing, 3-4 day for purity
  - Greater potential for recordable injuries

CMS/Fertile

- **Upsides**
  - Conventional breeding for inbred male sterility
  - Reduces detasseling on +/- 30% of surface

- **Downsides**
  - Inbred sterility variable in different GxE
  - Hybrid prodigy can be sterile requiring blending
  - Integration process delays availability
Roundup® Hybridization System (RHS)

Product concept: Male sterility system that utilizes a specific type of glyphosate tolerant corn and glyphosate to greatly reduce detasseling in hybrid corn seed production, and is cost effective and labor efficient.

Mode of Action

- High sensitivity to glyphosate in tassels
- High tolerance to glyphosate in vegetative and female tissues

Roundup® Ready® male (pollen donor)

*RHS female (male sterile)

* Patent pending
Time-lapse Photography Demonstrating the Inducible Nature of RHS
RHS Would Greatly Reduce Detasseling Activities

- **RHS (Remote Herbicide Sprayer)**
  - Sterility Sprays: Up to 2 times
  - Monitoring: Daily
  - Sterile tassel

- **Detasseling**
  - Cutting
  - Pulling: Up to 3 times Daily
  - Hand-detasseling: Up to 2 times Daily

**Timeline Example**
- Planting: May 15
- June 1
- June 15
- July 1
- July 15
- August 1

- Sterility Sprays

**Monitoring**
How is Fertility Measured?

Anther Extrusion (AE) is used to measure fertility

AE Magnitude used to quantify tassel fertility

Reproductive stage used to measure results across time

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<th>S50</th>
<th>S90</th>
<th>S90 + 3 Days</th>
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Lower AE is better!
Relative GDU Method Can Provide Consistent Levels of Male Sterility*

Sterility Performance

$n = 620$

Tassel development scale

Vg $T_0$ $T_1$ $T_2$ $T_3$ $T_4$ $T_5$ $T_6$ $T_7$

* Patent pending
Risk Mitigation Tool: Automated Spray Monitor System

Flow Sensors

GPS receiver

Ruggedized PC

Field Map
Benefits of RHS

- Less field exposure equal less risk for our employees
- Reliability in delivering high quality seed to our customers
- Hybrid fertility restored with Roundup Ready® trait from male
- CP4 has a long history of safe use
- Trait integration/parent seed process improved over CMS
- Early result suggest broad use possible in seed production
- Enables use of glyphosate for weed control in seed production
Detasseling Facts

Lancaster County, Nebraska, July 1943

Today - Typical morning in mid-July

http://www.flakmag.com
RHS “Real” Project Value
Society is changing…
Competitiveness requires better profitability…
Current system is not a sustainable long-term solution…
A step-change is required…

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