Segregated Handling Practices and Facility Design Needs for Identity Preservation of Grains & Oilseeds

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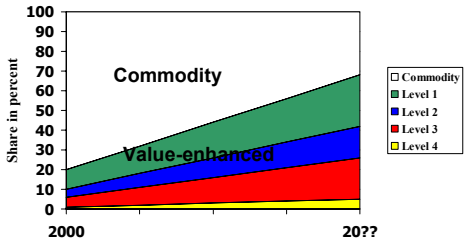
Differentiated Products



Current Quality Grain Dilemma

Avoidance
of transgenic characteristics

vs.

Promotion
of special end use characteristics

The New EU Labeling and Traceability Law

- ***All foods produced from GM-grains & oilseeds whether or not there is DNA or protein of GM origin in the final product***
  - Current labeling requirements will be extended to cover food containing soya or corn oil produced from GM-soya or GM-maize, and food ingredients produced from GM-grains
    - biscuits with corn oil produced from GM-maize
- ***All feeds produced from GM-grains & oilseeds*** will be required to be labeled.

The New EU Labeling and Traceability Law

- The labeling threshold for the presence of GM material in conventional food is 0.9%
  - currently 1%
  - must be adventitious and technically unavoidable
- The tolerance threshold for the adventitious presence of GM material in food and feed not yet authorized will be 0.5%
  - currently 0%
  - must have received favorable EU scientific risk assessment
  - must be technically unavoidable

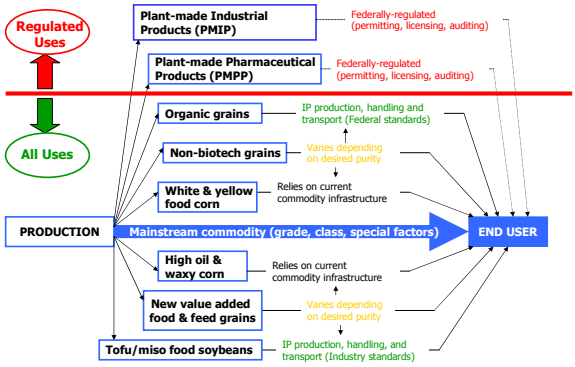
Future Quality Grain Challenge

Assure
Quality

and retain

Economies of Scale

Efficiencies of Operation



Zero Tolerance Dilemma

Regulation will specify:
Zero residue of certain transgenic traits in grains designated for certain markets

Market Place will operate:
No detectable residues above the zero limit based on sensitivity of available tests

Technology will provide:
Evermore sensitive measurement technology will drive detectable residues closer and closer to zero limit

➔ Zero Tolerance is a moving target!

Definition of Grain Quality

- Physical quality
  - outward visible appearance or measurement of kernel
    - size, shape, color, moisture, damage, density
- Sanitary quality
  - cleanliness and purity of the grain
    - foreign material, dust, broken grain, other grain or genetic material, rodent excreta, insects, residues, fungal infection
- Intrinsic quality
  - critical characteristics for grain end use that are non-visual and can only be determined by analytical tests
    - protein, starch, oil

Definition of Purity

Crop *purity* refers to the amount of grain as a percent of the total lot that is of the same genetic material.

Quality Grains Definition

Grains & oilseeds that meet *end user specifications* with respect to a range of pre-determined quality characteristics that are confirmed for final end use at the first point of sale with a *product verification* approach to quality management.

Quality Assured Grain

Purity and Quality of Grain are affected by:

- Seed selection
- Agronomic practices
- Environment during growth
- Timing and system of harvesting
- Post-harvest handling and drying treatment
- Storage structures and practices
- Transportation system and procedures

Quality Determination

Product Verification
at the first point of sale

vs.

Process Verification
from field to end use

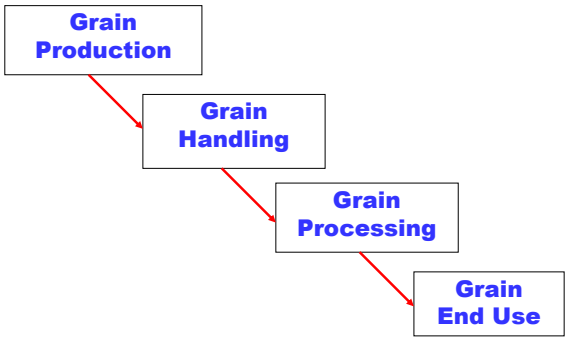
Quality Assured Grains Definition

Grains & oilseeds that meet *end user specifications* with respect to a range of production and handling practices and pre-determined quality characteristics that are confirmed and documented from seed to final end use with a *process verification* approach to quality management.

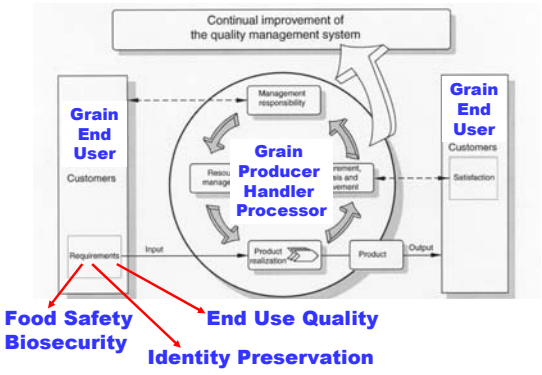
Process Definition

Grain handling at a commercial elevator represents a process that uses…
resources (labor, equipment, facilities, …)
that are managed to transform
inputs (individual truck loads of grain with range of quality characteristics)
into
outputs (110-car unit trains of grain with relatively uniform quality characteristics)

System of Processes



Process-based Quality Management System Approach for Agricultural Grain Production



Quality Management Systems Approach

- International Organization for Standardization (ISO) develops International Standards through ISO technical committees
- ISO 9001:2000 provides framework that defines requirements for quality management systems
  - quality management system documentation
  - management responsibility
  - resource management
  - product realization
  - measurement, analysis & improvement
- Require discipline, reproducibility & documentation of the process
- Universally understood to facilitate movement of goods & services across international borders

Quality Management Systems Approach

ISO standards promote the adoption of a *process approach* when developing, implementing and improving the effectiveness of a quality management system in order to enhance customer satisfaction by meeting (or exceeding) customer requirements.

Quality Management Systems Approach

The basic principle is:

"Say what you do,
do what you say,
and prove it!"

Quality Assurance Programs

- ISO 9000 series activities
  - ISO tracking system using Iowa Crop Management Database for Innovative Growers LLC
  - Grain Industry ISO Projects
    - CGB, Farmland, ConAgra, ADM, Farmers Cooperative…
  - Ag9000 Working Group
    - AG9000 Quality Management System Standard
    - similar to ISO 15161 "Guidelines on the Application of ISO9001:2000 for the Food and Drink Industry"
    - American Society of Agricultural Engineers (ASAE)

Quality Assurance Programs

- Association of Official Seed Certifying Agencies (AOSCA)
  - Identity Preservation (IP) Certification
  - Indiana Crop Improvement Association
- American Institute of Baking
  - AIB Gold Standard Certification Program
  - Quality Evaluation System
- American Feed Industry Association
  - AFIA Feed Quality Institute
- USDA Federal Grain Inspection Service
  - Process Verification Program (PVP)

AIB QSE Example: Iowa Grain Firm

- Training
  - Job descriptions; work procedures
- Documentation
  - Assure systematic follow through of all functions
- Statistical Performance Evaluation
  - Monitor performance of in-house grading vs. official FGIS grades
- Programmed Corrective Action
  - Employees expected & authorized to respond to situations
- Inventory Information
  - Tracking of inbound grain through storage and to shipping
- Employee Confidence & Professionalism
  - Improved job performance & satisfaction
- Food Grade Mindset
  - Handling grain & oilseeds as food ingredients

Benefit-Cost Summary for QMS at an Iowa Grain Firm (Hurburgh 2003)

Operation	*Cost Savings*
Grading	$1085
Inventory Control	$10675
Operational Efficiency	$2180
Regulatory Compliance	$5300
Employee Development	$3400
Total Benefits	**$22640**
Cost of QMS	$11250
Benefit-Cost Ratio	**2:1**

Critical Control Points (CCP) for Successful QA Program

- Land Requirements
  - know whether a GM/E crop that produces seed was grown on the field the previous season(s)
  - maintain maps with field identities and locations
- Original Seed Purity
  - only buy seed from a known source
  - keep invoice with hybrid/variety name and lot numbers
  - only buy certified seed that has been GM/E-tested
    - 0.375 % of seed samples tested positive for GM traits
      - IN Seed Commissioner, Larry Nees: "3 out of 800 samples"

Critical Control Points (CCP) for Successful QA Program

- Planters
  - plant non-GM/E crop ahead of GM/E crop
  - run planter boxes empty and vacuum if necessary
  - thoroughly clean out seed metering mechanism
  - calibrate seed metering mechanism
- Cross-Pollination in Corn
  - plant non-GM/E and GM/E crop at different dates
  - follow field isolation recommendations to minimize cross-pollination potential
  - conduct field inspections during and after pollination period to determine possible isolation problems

Equipment Management Alternatives

1. A strict *cleanout* program for each piece of equipment that handles or processes seed or grain
2. Field *operation planning* to prevent contamination during planting, harvesting and handling
3. Use of *dedicated equipment* for planting, harvesting and handling a particular crop

Equipment Management Essentials

If the ***cleanout*** *strategy* is selected:

- strive for absolute cleanliness
- remove any potential contaminants from each piece of seed and grain handling equipment prior to handling any grain, and when switching crops
  - Clean+Flush Strategy

Equipment Management Essentials

If the ***operation planning*** strategy is selected:

- **all** of one crop must be planted, harvested and handled before the next crop
  - FIF-FOF Strategy
- **in-season** cleanout can be avoided

Equipment Management Essentials

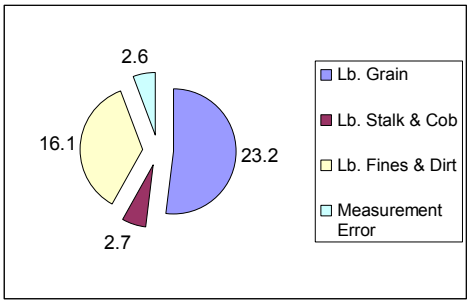
If the ***dedicated equipment*** strategy is selected:

- a **clean** machine must plant, harvest and handle only one type of crop throughout an entire season
- **in-season** cleanout can be avoided

Harvest & Transport




Initial Cleaning Dump (44.6 pounds total)



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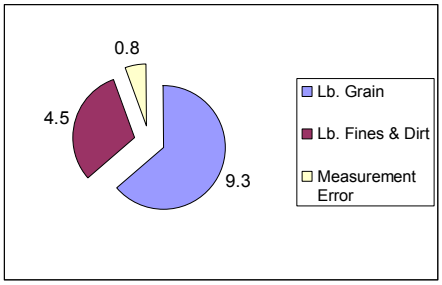
Final Vacuum Cleaning (14.6 pounds total)



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Critical Control Points (CCP) for Successful QA Program

- Combine Harvester
  - typically ~1-3 bu remain
  - harvest non-GM/E varieties ahead of GM/E ones
  - run combine empty & blow out carry-over material
  - run tank empty & clean-out with compressed air
  - use compressed air to blow out kernels on any ledges throughout threshing and cleaning units
  - open inspection door on bottom of clean grain auger & clean-out hung-up kernels
  - flush combine with initial half tank (100-150 bu) from non-GM/E field & discard grain into separate wagon
  - modify combine for easier clean-out

Unsorted and sorted red corn contamination after 15 seconds into first unloaded batch of yellow corn

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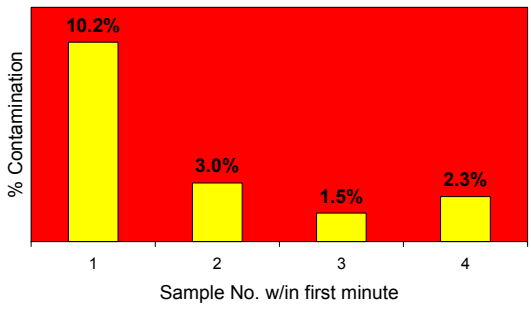
Yellow Kernels in Red Corn



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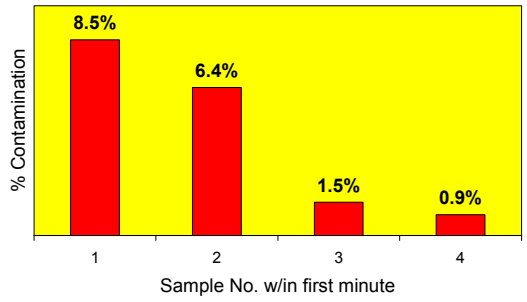
Red Kernels in Yellow Corn



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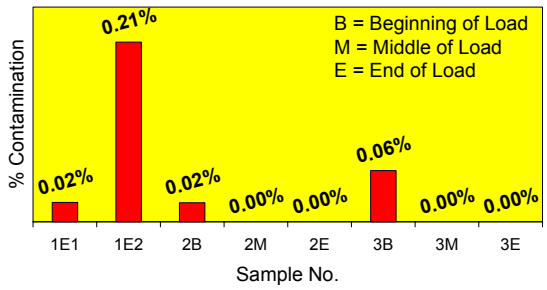
Red Kernels in Yellow Corn
(Subsequent Samples)



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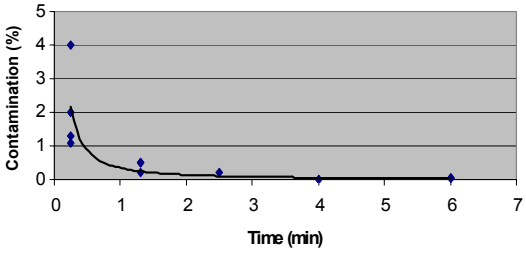
Handling

Handling Equipment

- Pits and leg boots
  - 0.25 – 1.5% of handling capacity can easily remain
    - 2-15 bu in a 1,000 bph leg
    - 20-150 bu in 10,000 bph leg
  - dedicated pits; self-cleaning elevator boot; clean-out cycles
- Distributors and downspouts
  - watch out for leakage and overflow possibilities
- Augers and conveyors
  - run completely empty before switching grain type
- Flush handling system with initial 75-100 bu from first non-GM/E truck load & discard grain
  - 0.1 – 0.5% commingling effect may remain
- Modify equipment for easier clean-out

Does Flushing of Handling Equipment Work?



Data for a 3000 bph leg; white in yellow corn; Source: GMPRC

Storage

Dedicated Handling, Drying and Storage Equipment

Optimistic estimate of the potential contamination in IP corn if the cleanout and/or operational management strategies were used with a typical grain handling system.	
Seed	0.50%
Planting	0.01%
Pollination	0.50%
Combine harvester	0.02%
Grain cart	0.01%
Truck	0.01%
Receiving pit	0.1%
Elevator leg (wet)	0.1%
Wet holding hopper bin	0.01%
Dryer	0.1%
Elevator leg (dry)	0.1%
Cleaner & distributor	0.1%
Downspout & cushion box	0.01%
Storage bin	0.01%
Underfloor unload auger	0.1%
Take-away unload auger	0.1%
Elevator leg (dry)	0.1%
Cleaner & distributor	0.1%
Downspout & cushion box	0.01%
Load-out hopper bin	0.01%
Truck	0.01%
Accumulated varietal mixture	2.01%

Optimistic estimate of the potential contamination in IP corn if the dedicated post-harvest handling equipment strategy were used with a multiple bin set-up.	
Seed	0.50%
Planting	0.01%
Pollination	0.50%
Combine harvester	0.02%
Grain cart	0.01%
Truck	0.01%
Portable belt conveyor	0.01%
In-bin dryer & storage bin	0.01%
Underfloor unload auger	0.1%
Portable belt conveyor	0.01%
Truck	0.01%
Accumulated varietal mixture	1.19%

Potential reduction in contamination with dedicated handling, drying and storage equipment = 2.01 - 1.19 = 0.82, or 41%

Probing, Sampling, Grading & Testing

Critical Control Points (CCP) for Successful QA Program

- Probing and Grading of Bulk Grain
  - make sure probe is empty and clean before probing a truck
  - make sure grading equipment is clean
    - consider second station equipment dedicated for non-GMO
  - to prevent accidental mixing avoid dumping sample from previous truck back into following truck
    - watch out for mixed samples in discard barrel
  - follow consistent probing pattern to get representative sample

Critical Control Points (CCP) for Successful QA Program

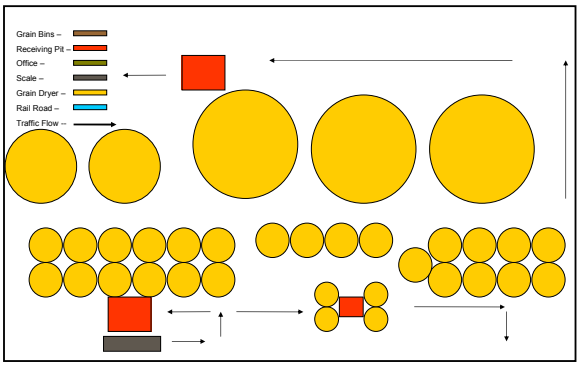
- Sampling and Testing of Bulk Grain
  - large & representative sample absolutely critical
    - 5-10 lb sample
    - rough grind and divide
    - only a *few grams* are analyzed
  - sampling error potential for biotech traits similar to mycotoxins
    - aflatoxin, fumonison, vomitoxin
  - follow test kit instructions
    - 2-3 tests/sample
  - understand result interpretation
    - 25-50% false positives due to single kernel event

Impact of Inaccurate & Imprecise Biotech Traits Testing

Contract Specs (%)	Biotech (%)	Mean (%)	Actual Range (%)	Tests <1.0%
1.0	0.9	0.7	0 – 1.9	77
1.0	1.1	0.9	0 – 2.3	66
1.0	0.5	0.4	0 – 1.3	95
1.0	1.5	1.2	0 – 3.2	52
*Range based on mean +/- 2 s.d.				

Source: GIPSA

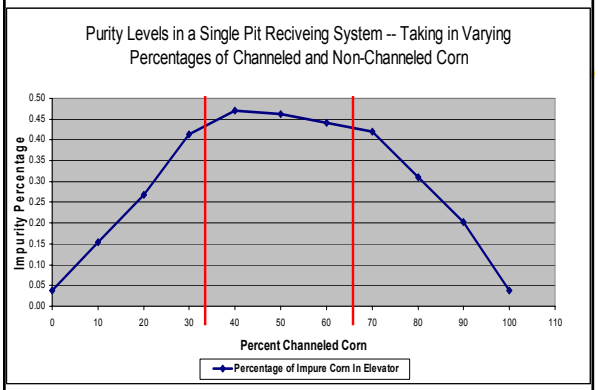
Typical Elevator – Central Illinois



Evaluating Contamination Scenarios

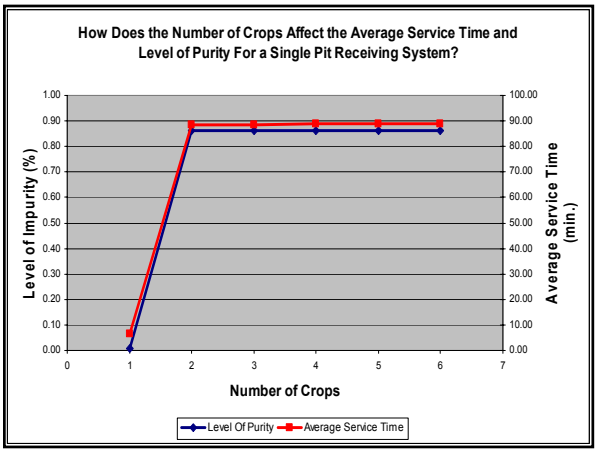
Worst Case

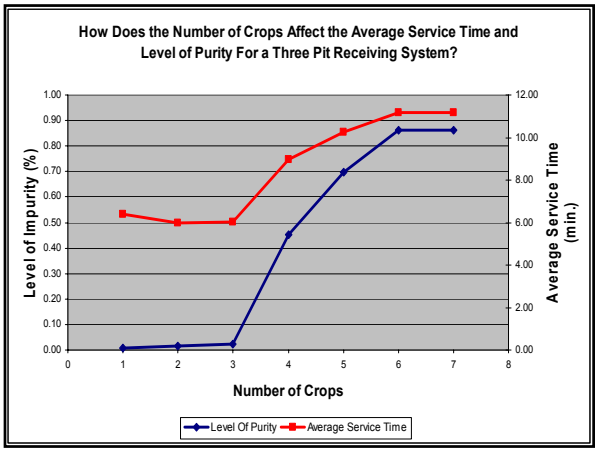
Not The Worst Case



Receiving Pits vs. Crop Types

Contamination risk is directly related to the number of grain types delivered and the receiving pits available.





The Cleanout Process

- Important Questions
  - What is the real cost of contamination?
  - What is the real cost of prevention?
  - What strategies are most reasonable?

Realistic Strategies for Maintaining Crop Quality & Purity

- Harvest, Transport and Handling Planning
  - Implement an all-in, all-out harvest, transport & handling management program (FIF-FOF)
- Handling Equipment Cleaning & Flushing
  - Implement a cleaning & flushing program
- Dedicated Handling Equipment
  - Dedicate a particular piece of handling equipment (or system) to a particular category of crop

Our Goal:

A quality grain management system must be based on *least cost* and *most efficient best agricultural practices* that result in *consistent quantities* of *quality-assured* grains and oilseeds to *maximize the margins* of producers, handlers and processors.