2015 SPRING NOSB MEETING

April 30, 2015
LaLollla, CA

SEED PURITY – Solution in the Realm of Possible

Charles Brown

President

Brownseed Genetics, LLC.

Company History

Third Generation.

Family owned and operated.
Began in 1911.

Brownseed Genetics is Independent corn breeding program. Focus early maturity, value-added.

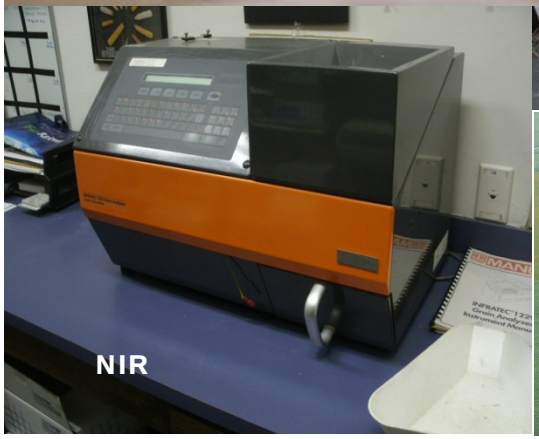
CBSeed™ retail brand focused on Northern US corn belt – GMO, non-GMO and Organic seed.

Brownseed
SINCE 1911

Brownseed
SINCE 1911


A/P


MAS
DOUBLE-HAPLOID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REP, MINI

SPRING 2015 NOSB MEETING

1. **CONTEXT: Seed Flow: from nursery to commercial seed field.**
2. **CONTEXT: View Seed Purity Reality. Venn Diagram.**
3. **Question 2 Response: 2000 BSG Pollen Study Data Summary.**
4. **2014 OV/GroAlliance Study.**
5. **Question 3 Response: Purity Plus® Production Standards**
6. **Current Efforts ASTA.**
7. **Possible Solution.**

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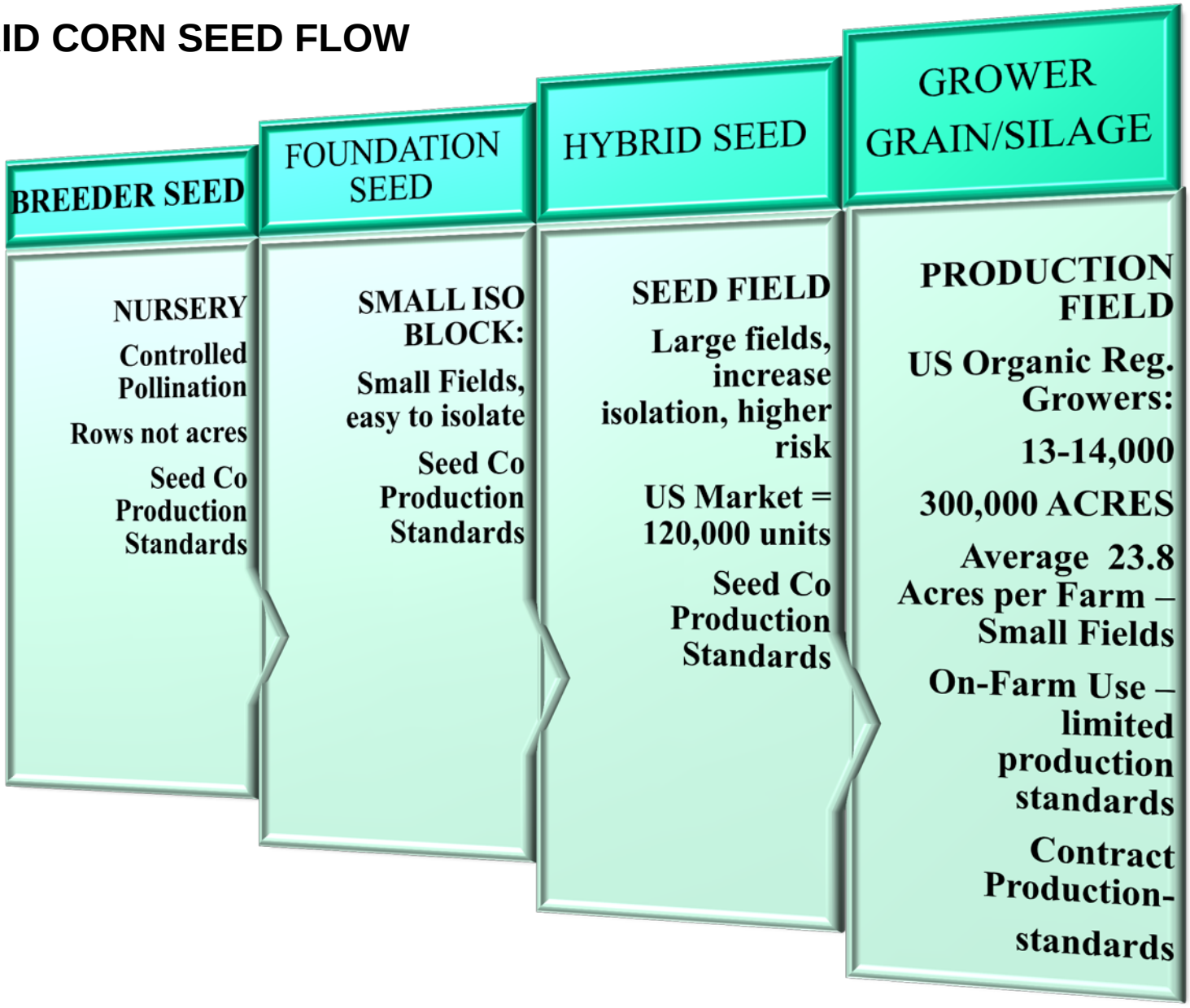
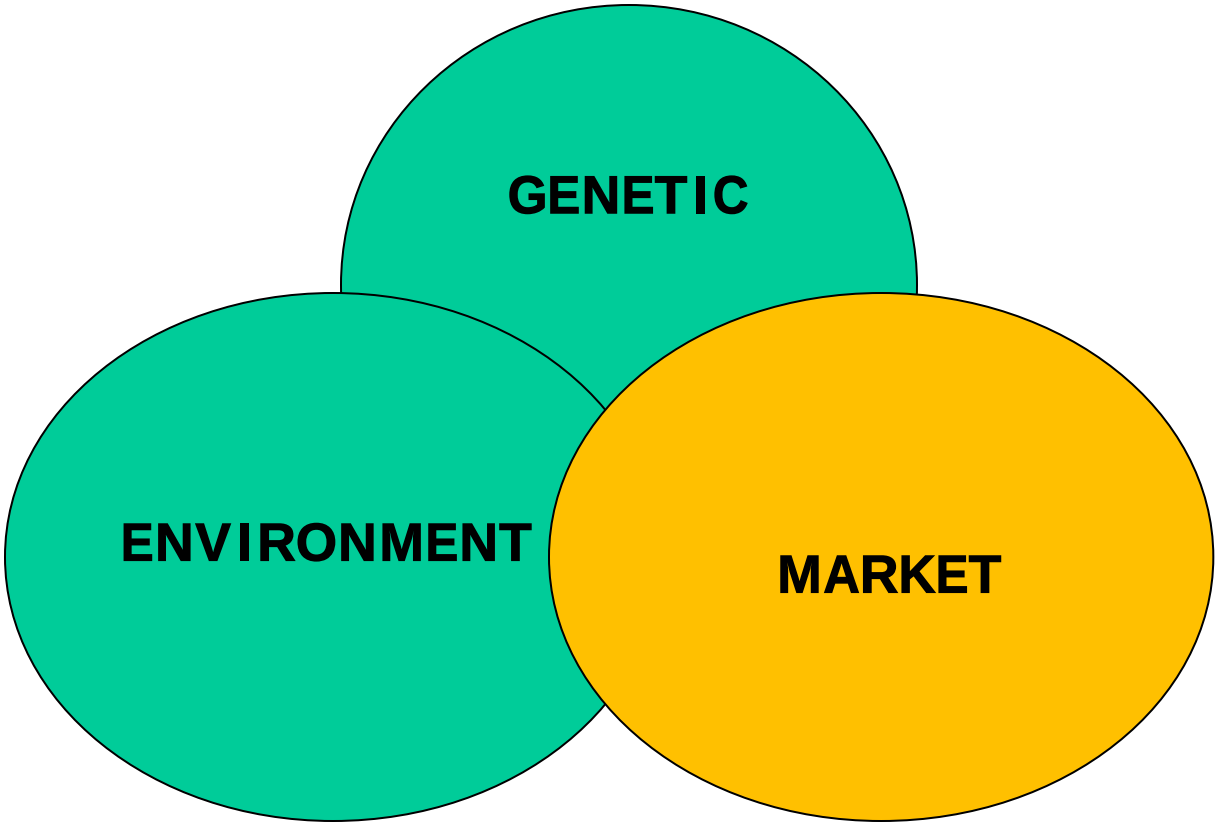
HYBRID CORN SEED FLOW



3 FORCES IMPACT GENETIC PURITY

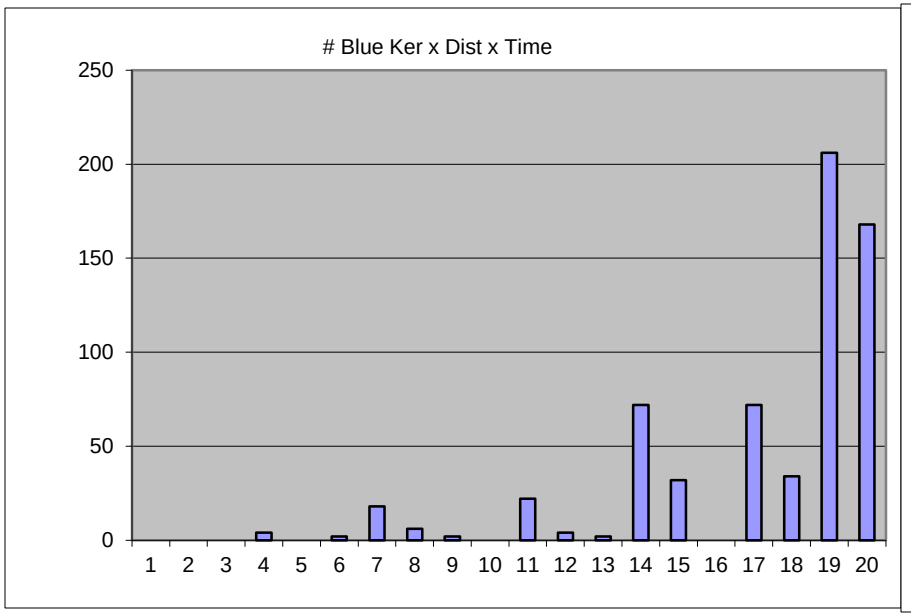


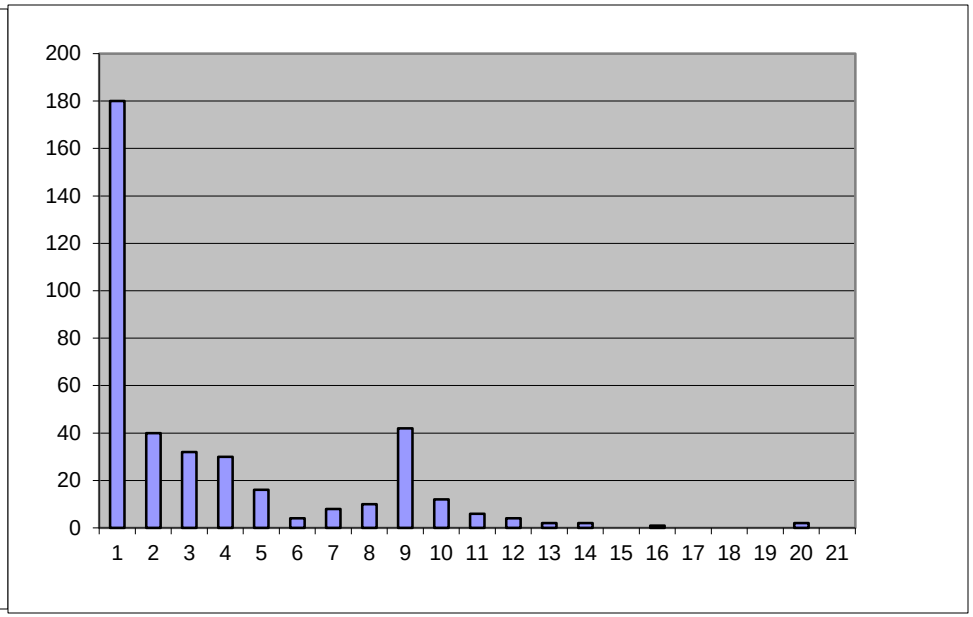
Let the Market sort out the SQ issues.

Q.2 Farmer plants seed of at-risk crops surrounded by the same conv. GE crop, follows all prevention strategies for organic producers, what level of contamination might be expected on the average? Is this level different when starting with tested conv. seed than untested conv. or organic seed?

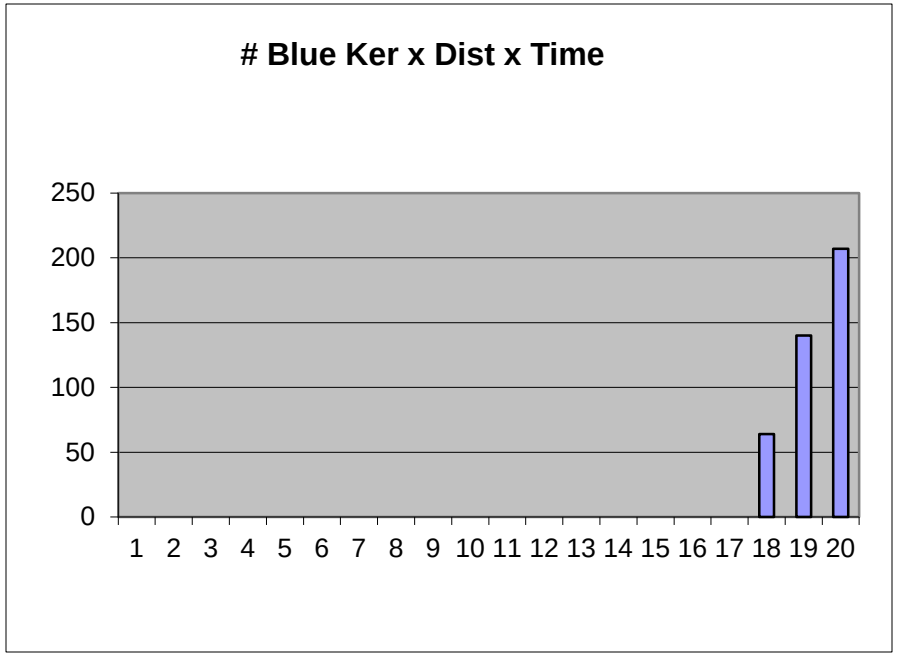
RF Plot: 2000 Pollen Study

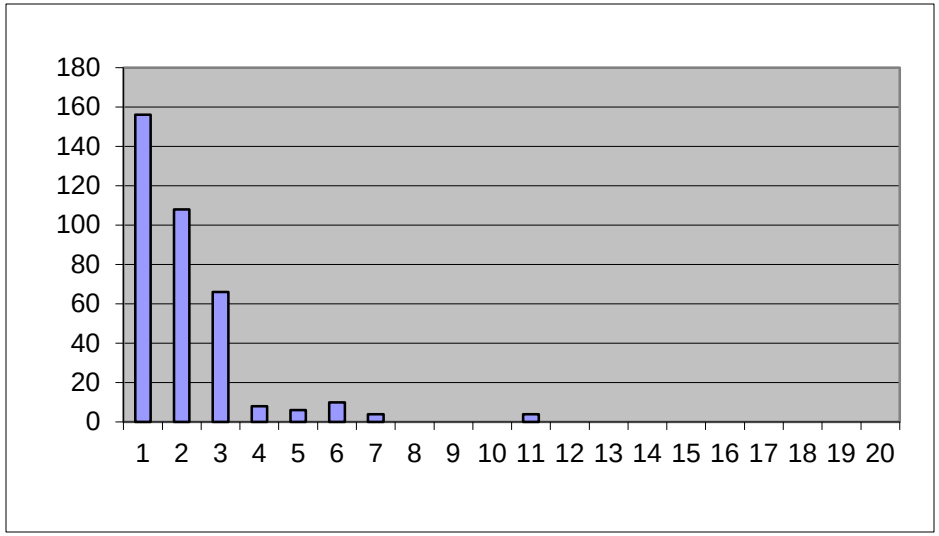
2000 Pollen Study – Range 1 Early





2000 Pollen Study – Range 2 Late





Range 1 - EARLY					# Rows	# Days Silk
HYBRID	TASSEL DAT	SILK DAT	# BLUE KER	% AP**	DISTANCE	BAD***
1688	J29	J29	0	0.00%	39	-2
1M06	J31	A2	0	0.00%	37	3
1M07	J31	A2	0	0.00%	35	3
1M03	J31	J31	4	1.78%	33	0
1967	A3	A3	0	0.00%	31	4
1M01	J30	J30	2	0.89%	29	-1
1M04	J29	J29	18	8.00%	27	-2
2000	J26	J28	6	2.67%	25	-3
2M15	A2	A2	2	0.89%	23	3
2M10Bt	A3	A3	0	0.00%	21	4
2041	A2	J31	22	9.78%	19	0
2M11	A2	A2	4	1.78%	17	3
2080	J31	A2	2	0.89%	15	3
2M12	A3	A3	72	32.00%	13	4
2M13	J31	J31	32	14.22%	11	0
3M27	J31	J31	0	0.00%	9	0
3277	A2	A2	72	32.00%	7	3
3M29	A1	A2	34	15.11%	5	3
3M33	A3	A3	206	91.56%	3	4
3M32	A5	A5	168	74.67%	1	6
BLUE	J31	J31				0
BLUE	J31	J31				0
3M31LP	A1	A1	180	80.00%	1	2
3M28	A3	A3	40	17.78%	3	4
3680	A5	A5	32	14.22%	5	6
3M30	A6	A6	30	13.33%	7	7
4300	J30	J30	16	7.11%	9	-1
4590RR	A3	A3	4	1.78%	11	4
4641	A2	A2	8	3.56%	13	3
4M50	A2	J31	10	4.44%	15	0
4555RR	A2	A2	42	18.67%	17	3
4700	A2	A2	12	5.33%	19	3
4680	A3	A3	6	2.67%	21	4
4M54	A2	A2	4	1.78%	23	3
4M60ND	A3	A3	2	0.89%	25	4
4M49	J31	J31	2	0.89%	27	0
4M52	A3	A3	0	0.00%	29	4
5000	A3	A3	1	0.44%	31	4
5M66	A3	A3	0	0.00%	33	4
5180	A6	A6	0	0.00%	35	7
5341	A2	A2	0	0.00%	37	3
5M80RR	A3	A3	2	0.89%	39	4
5M67	A3	A3	0	0.00%	41	4
LOW	**J26**	**J28**	**0**	**0.00%**	**1**	**-3**
HIGH	**A6**	**A6**	**206**	**91.56%**	**41**	**7**

Range 2 - LATE					# Rows	# Days Silk
HYBRID	TASSEL DATE	SILK DATE	# BLUE KER*	% AP	DISTANCE **	BAD
7050	A7	A7	0	0.00%	39	10
7041	A7	A7	0	0.00%	37	10
7M95	A7	A7	0	0.00%	35	10
9M95HAP	A7	A7	0	0.00%	33	10
7M92	A7	A7	0	0.00%	31	10
7M93	A7	A7	0	0.00%	29	10
7M91	A3	A7	0	0.00%	27	10
6950	A5	A3	0	0.00%	25	6
6990ND	A6	A6	0	0.00%	23	9
6M84RR	A4	A4	0	0.00%	21	7
6M85	A3	A3	0	0.00%	19	6
6M90A	A6	A6	0	0.00%	17	9
6895	A6	A6	0	0.00%	15	9
6341	A3	A3	0	0.00%	13	6
6M83RR	A6	A6	0	0.00%	11	9
6850	A6	A6	0	0.00%	9	9
6640	A6	A6	0	0.00%	7	9
6M82	A3	A3	64	28.44%	5	6
6M89	A6	A6	140	62.22%	3	9
6M88	A6	A6	207	92.00%	1	9
BLUE	J29	J29				0
BLUE	J31	J31				0
6M90B	A6	A6	156	69.33%	1	7
6070	A4	A4	108	48.00%	3	5
6574	A5	A5	66	29.33%	5	6
5M77	A6	A6	8	3.56%	7	7
5225	A5	A5	6	2.67%	9	6
5M70	A5	A5	10	4.44%	11	6
5541Bt	A2	A2	4	1.78%	13	3
5M71	A3	A3	0	0.00%	15	4
5M68	A6	A6	0	0.00%	17	7
5M69RR	A6	A6	0	0.00%	19	7
5M80A	A3	A6	4	1.78%	21	7
5M76	A3	A3	0	0.00%	23	4
5M75	A6	A6	0	0.00%	25	7
5M63	A6	A6	0	0.00%	27	7
5060	A6	A6	0	0.00%	29	7
5M79	A5	A3	0	0.00%	31	4
5M74	A3	A3	0	0.00%	33	4
5M73	A3	A5	0	0.00%	35	6
5290wx	A5	A3	0	0.00%	37	4
5941RR	A6	A6	0	0.00%	39	7
LOW	**A2**	**A2**	**0**	**0.00%**	**1**	**3**
HIGH	**A7**	**A7**	**207**	**92.00%**	**39**	**10**

All Hybrid Filter by Distance

HYBRI	ASSEL D	SILK DA	BLUE K	% AP*	# Rows DISTANC	# Days Silk DBA**	Feet DISTANC
4680	A3	A3	6	3%	21	4	52.5
6M84RR	A4	A4	0	0%	21	7	52.5
5M80A	A3	A6	4	2%	21	7	52.5
2M15	A2	A2	2	1%	23	3	57.5
4M54	A2	A2	4	2%	23	3	57.5
6990ND	A6	A6	0	0%	23	9	57.5
5M76	A3	A3	0	0%	23	4	57.5
2000	J26	J28	6	3%	25	-3	62.5
4M60ND	A3	A3	2	1%	25	4	62.5
6950	A5	A3	0	0%	25	6	62.5
5M75	A6	A6	0	0%	25	7	62.5
1M04	J29	J29	18	8%	27	-2	67.5
4M49	J31	J31	2	1%	27	0	67.5
7M91	A3	A7	0	0%	27	10	67.5
5M63	A6	A6	0	0%	27	7	67.5
1M01	J30	J30	2	1%	29	-1	72.5
4M52	A3	A3	0	0%	29	4	72.5
7M93	A7	A7	0	0%	29	10	72.5
5060	A6	A6	0	0%	29	7	72.5
1967	A3	A3	0	0%	31	4	77.5
5000	A3	A3	1	0%	31	4	77.5
7M92	A7	A7	0	0%	31	10	77.5
5M79	A5	A3	0	0%	31	4	77.5
1M03	J31	J31	4	2%	33	0	82.5
5M66	A3	A3	0	0%	33	4	82.5
9M95HAP	A7	A7	0	0%	33	10	82.5
5M74	A3	A3	0	0%	33	4	82.5
1M07	J31	A2	0	0%	35	3	87.5
5180	A6	A6	0	0%	35	7	87.5
7M95	A7	A7	0	0%	35	10	87.5
5M73	A3	A5	0	0%	35	6	87.5
1M06	J31	A2	0	0%	37	3	92.5
5341	A2	A2	0	0%	37	3	92.5
7041	A7	A7	0	0%	37	10	92.5
5290wx	A5	A3	0	0%	37	4	92.5
1688	J29	J29	0	0%	39	-2	97.5
5M80RR	A3	A3	2	1%	39	4	97.5
7050	A7	A7	0	0%	39	10	97.5
5941RR	A6	A6	0	0%	39	7	97.5
5M67	A3	A3	0	0%	41	4	102.5

Q.2 This data would suggest >100' isolation with 7 day silk delay from foreign pollen would result in high probability of success to achieve .1 AP threshold or none found in 3000 seeds.

Q.3 Several possible testing standards for seed have been suggested to us, 1)No-Detect for GMOs in a 3000 seed sample, 2) .1% threshold, and 3) .9% threshold as is required in other countries. What is your experience and opinion with these options with regard to practicality, cost and integrity?

Gro Alliance

ORGANIC VALLEY

ORGANIC PRAIRIE
FARMER-OWNED

CROPP COOPERATIVE
organic and farmer-owned since 1988

ZONE HARVEST TRIALS

Goal: Assess the feasibility and cost of producing organic, hybrid seed corn to a "none found in a 3,000 seed" standard for genetic purity with regard to GMO, simply by doing it.

Note: Tested using Semi-quantitative, real-time PCR and 10,000 seed samples. (NOS and 35s)
"1" in 1 found… refers to a positive testing well of 250 seeds

In-field Purity promoting techniques:

- Nearest corn was located over **1,300ft** from the field.
- Planting was delayed to insure a **2 week off-set in pollen shed** from surrounding fields.
- An **8-row male border** was planted around the field perimeter to promote pollen flooding.
- **Male parent rows contained two plantings** of the same inbred, spread several days apart to extend the pollen shed window beyond the typical 12 days.

Gro Alliance

ORGANIC VALLEY

ORGANIC PRAIRIE
FARMER-OWNED

CROPP COOPERATIVE
organic and farmer-owned since 1988

Parent line seed purity:

Parent Line	"none found" language	Estimated total GMO presence
Male	1 found in 10,000	0.01%
Female	None found in 10,000	Non-detect

Note: Tested using Semi-quantitative, real-time PCR and 10,000 seed samples. (NOS and 35s)
"1" in 1 found… refers to a positive testing well of 250 seeds

Results:

Description	"none found" language	Estimated total GMO presence
Proposed standard	None found in 3,000	0.1%
Zone 1	5 found in 3,000	0.22%
Zone 2	3 found in 3,000	0.12%
Note: Tested using Semi-quantitative, real-time PCR and 3,000 seed samples. (NOS and 35s) "1" in 1 found… refers to a positive testing well of 300 seeds		

Conclusions:

- **"None found in 3,000 seeds" standard for GM purity (and any 0.1% threshold) is not feasible for seed corn** given the current predominance of GM corn in the US.
- Further investigation, and a more complete accounting of the level of GM presence in organic, IP, and non-GMO seed supplies (for various crops) is essential to the on-going rule-making discussion.
- Without a more factual basis for discussing the feasibility of seed purity standards, we run the risk of substantially damaging the companies that have built this fledgling segment of the seed industry.
- Data on GM presence in these sensitive sectors should be mediated/aggregated by a qualified governmental department to prevent damage to early adopters and those willing to confront the issue.

Q.3. Also, the data showing 100' isolation and 7 day minimum delay would not have worked at GroAlliance OV Zone Test.
My opinion is the contamination resulted from the male parent having .1% AP, not from AP pollen flow.
Another explanation would be sampling error. Another explanation would be environment conducive to pollen viability, and/or late plants.

Q.3. However the lesson learned is that with rising sensitivity of testing and dynamic production environment, there is risk in establishing a threshold without enough data and input from stakeholders.

Field production is not a precise world.

Economics of 40 acre seed field.

Seed acre Fixed + Variable Cost	**$3500 - $4000**
Opportunity cost, other not incl.	**x 40**
	$144,000 - $160,000

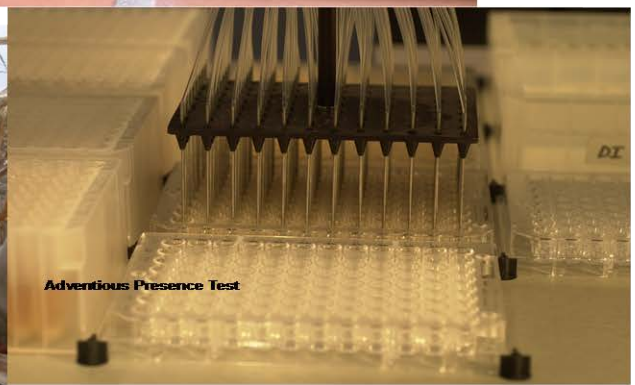
Variables: Bad wind at pollination, viable pollen environment, comingling, dust on seed from post-harvest handling, inter-field crew and machinery movement .

Q3. Several possible testing standards for seed have been suggested to us: 1) No-detect for GMOs in a 3000 seed sample, 2) 0.1% threshold and 3) .9% threshold as is required by other countries. What is your experience and opinion with these options with regard to practicality, cost and integrity.

2008 FAFO GRANT
ENSURING NON-TRANSGENIC SOURCE OF PARENT SEED FOR ORGANIC CORN PRODUCTION

FINAL REPORT January 10, 2009

Brownseed GENETICS™



1. 49 GMO-PURE INBRED LINES. The biggest "home run" of the Grant were the purity results on 50 inbred lines of our permanent culture. When we started, we did not think any, or perhaps a few, were 0.00 % presence of GMO proteins. We tested 50 lines for this and 49 of the lines tested (98%) came back 0.00 % pure of GMO proteins. This exceeded our goal significantly. Many of these lines are in an active hybrid testing program, and are to be released within the next two years, as soon as we can do the increase. We would not have been able to test for A/P under our normal program due to the risk of return.

Brownseed Genetics
Seed Purity Program – Operating Procedures

1. **Purity Plus™ Production Standard for high probability of success in non-GMO seed production**

    Isolation requirements
    Phenotype requirements
    Seed quality requirements
    Seed purity requirements

2. **Require 3rd Party validation at every step.**

    AOSCA certification
    Seed tag
    MCIA initial coordinator

Brownseed
SINCE 1911

PURITY PLUS™
NO DETECTABLE GMO'S

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Certifier Login >

Purity Plus™ The Gold Standard for Genetic Purity

FOOD COMPANIES
SEED COMPANIES/BREEDERS
GRAIN BUYERS
CONSUMERS
FARMERS

Purity Plus is a new standard created to ensure very low, if any, adventitious presence of genetically modified organism (GMO) proteins in foundation and hybrid seed corn.

Seed corn labeled with the Purity Plus logo has been certified to have no detectable presence of GMOs. When this seed is grown according to an approved production and testing protocol, it will yield grain that is absent any GMO traits.

The Purity Plus standards have been verified by AOSCA (Association of Official Seed Certification Agencies), and each state's seed certification agency where Purity Plus products. are grown.

When non-GMO seed is essential, Purity Plus is the answer!

"We have a lot of customers requesting that our product is non-GMO across the board, from our grains to our colors to our nutraceuticals. We see that as a significant trend within the industry, and Purity Plus allows us a major point of differentiation. We want to be on the cutting edge, and we view Brownseed Genetics as taking us to that spot."
SUNTAVA • Bill Petrich, CEO

Marketing Support

2012 Launch

PURITY PLUS™ INBRED SEED

ISOLATION STANDARDS

1. Minimum isolation from corn: 1320 feet*
2. Minimum isolation from biotech-trait corn: 2640 feet*
3. The previous crop on a parent seed increase field should be any crop other than corn

*Isolation can be modified by use of border rows – 1 row=30', maximum 20 border rows.

PHENOTYPIC STANDARDS

1. An inbred seed increase field shall have no more than 0.1% (1 per 1000) off-type plants
2. Conditioned inbred seed shall have no more than 0.2% (2 per 1000) of off-color or off-textured kernels

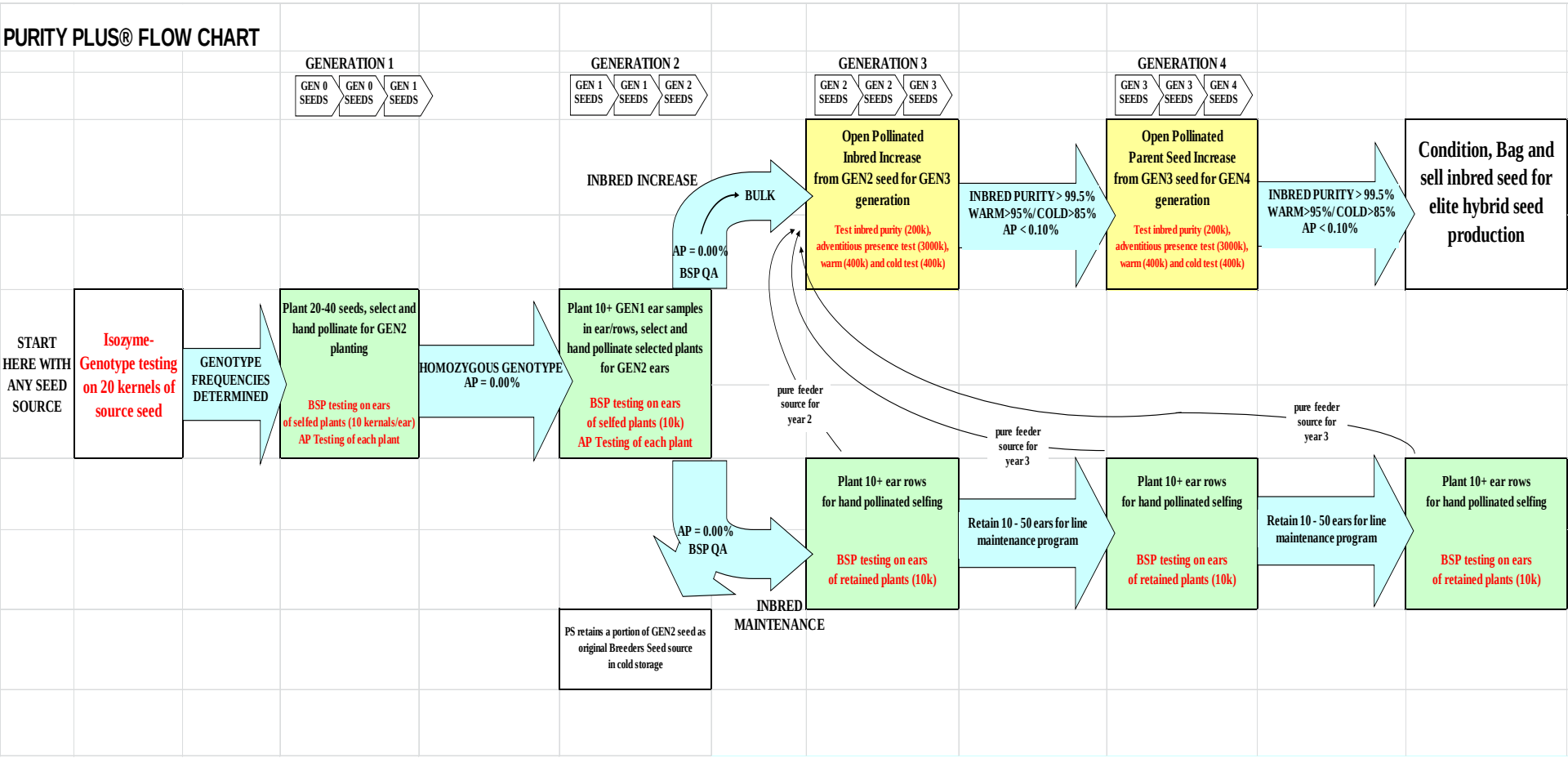
SEED QUALITY STANDARDS

1. Pure Seed (minimum)	99.50%
2. Inert Matter (maximum)	0.50%
3. Other crop seed (maximum)	0.00%
4. Weed seed (maximum)	0.00%
5. Standard Germ	95.00%
6. Cold Germ	85.00%

GENETIC PURITY STANDARDS

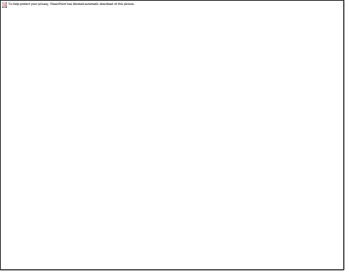
1. Two and three loci off types:	Maximum of 0.5% (1 per 200 plants)
2. Variants:	Maximum of 0.5% (1 per 200 plants)
3. Adventitious presence:	Maximum of 0.1% at 95% Confidence **(None Found in 3,000 k)**

PURITY PLUS® FLOW CHART



Purity Plus™ Testing Process	
Step	Test
1-Program Entry Evaluation	Isozyme Pre-evaluation
2-Inbred Purification	AP Test Nursery Plants
2-Inbred Purification	Breeders Seed Purification
3-Breeders Seed Increase	Bulk AP
3-Breeders Seed Increase	Breeders Seed Purification
3-Breeders Seed Increase	SNP Marker Genotype
4-Parent Seed Increase	Inbred Purity
4-Parent Seed Increase	AP Test
4-Parent Seed Increase	Warm Test
4-Parent Seed Increase	Cold Test
4-Parent Seed Increase	Purity Analysis
5-Commercial Inbred Seed Production	Inbred Purity
5-Commercial Inbred Seed Production	AP Test
5-Commercial Inbred Seed Production	Warm Test
5-Commercial Inbred Seed Production	Cold Test
5-Commercial Inbred Seed Production	Super Cold Test
5-Commercial Inbred Seed Production	Purity Analysis
6-Commercial Hybrid Seed Production	Hybrid Purity
6-Commercial Hybrid Seed Production	AP Test
6-Commercial Hybrid Seed Production	Warm Test
6-Commercial Hybrid Seed Production	Cold Test
6-Commercial Hybrid Seed Production	Super Cold Test
6-Commercial Hybrid Seed Production	Purity Analysis

From single ear to Commercial hybrid seed Six generations



ASTA CURRENT ACTIVITIES:

ASTA CURRENT ACTIVITIES:

‘MADISON GROUP’ MEMBER SURVEY FOR ORGANIC AND NON-GMO SEED AVAILABLE FOR ORGANIC MARKET. AVAILABLE JUNE 2015

ACCESSING NEW GERMPLASM FROM LARGE BREEDING COMPANY DISTRIBUTED THROUGH FOUDATION HOUSE. AVAILABLE SOON.

SEED PURITY – Solutions in the Realm of Possible

Seed Companies all have production standards

For Isolation, Phenotye,

Genetic Purity.

SEED PURITY – Solutions in the Realm of Possible

Solution:

NOSB recommend to NOP to support production standards of seed companies made public on sister website AOSCA Organic Seed Finder.

SEED PURITY – Solutions in the Realm of Possible

Solution:

AOSCA websites would become ‘clearing house’ of production information for the industry.

Including: QC standards, yield trial data USTN, product availability

SEED PURITY – Solutions in the Realm of Possible

This would:

Educate seed companies, certifiers, growers, buyers what is possible in seed quality.

SEED PURITY – Solutions in the Realm of Possible

This would:

Through competition seed companies would drive AP to lowest level at economical cost.

SEED PURITY – Solutions in the Realm of Possible

QUESTIONS?

SEED PURITY – Solutions in the Realm of Possible

THANK YOU

ALBERT LEA SEED ORGANICS

GMO Contamination and Avoidance in Organic Field Seed Production

Mac Ehrhardt
Albert Lea Seed
Albert Lea, MN

What I am going to cover today.

ALBERT LEA SEED ORGANICS

Questions posed by the NOSB

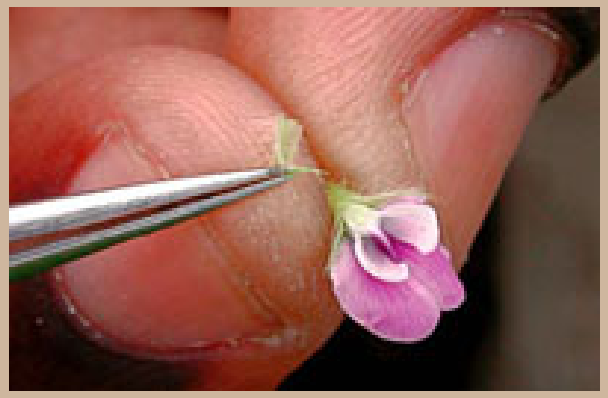
"3. Several possible testing standards for seed have been suggested to us: 1.) No-detect for GMOs in a 3000 seed sample, 2.) 0.01% threshold (because seed must be more stringent than crop testing) and 3). 0.09% threshold as is required in other countries. What is your experience and opinion with these options with regard to practicality, cost, and integrity?

4. Would a testing program for at-risk conventionally grown seed used on organic farms impact the genetic diversity of those crops available to farmers, and if so, to what extent?"

Practical outlook (from field seedsman's perspective) on the establishment of a GMO contamination threshold for seed. (Seed Corn, Soybean, Oats, Wheat, Barley)

- All species are not the same (from a contamination & prevention strategy standpoint)
- Current state of contamination in organic and non-organic corn & soybean seed
- My opinion on threshold and next steps

State of GMO Contamination in **Soybean Seed**



ALBERT LEA SEED ORGANICS

1. Possible to meet a very tight non-gmo standard or threshold
2. Soybeans are self-pollinating, non-hybrid, and true-breeding (not commonly cross-pollinated by neighboring fields)
3. Start with genetically pure seed (achievable)
4. Do all the things you would normally do in seed production:
    a. Not that much isolation required for soybeans
    b. Dedicated non-gmo machinery: (planter, combine, wagons, augers, truck, bin)
    c. Dedicated cleaning facility (Belt conveyors, Elevators, Cleaning machinery, packaging machinery)

Non-GMO Conventional and Organic Soybean Seed 2013 & 2014. GMO % of finished lots.

ALBERT LEA SEED ORGANICS

	Conv. Non-GMO		Organic Soybean Seed
Total Number of Tested Lots	**30**		**31**
None Detected	24		28
>0.00% - <0.1%	0		0
0.1% - 0.5%	5		2
0.51% - 0.99%	1		1
>1.0%	0		0

- GMO Tests initially done with a 750 seed bio-assay. Positive tests were followed up with either a 1500 seed bio-assay or a Quantitative PCR Test.
- All soybean followed the "Best Mgmnt. Practices" outlined in the Guidance (grown in MI, WI, IL, IA) and produced under the MCIA's Non-GMO program.
- The seed tested above represents seed planted on 45-50,000 acres.

State of Contamination in Organic Hybrid Seed Corn

ALBERT LEA SEED ORGANICS

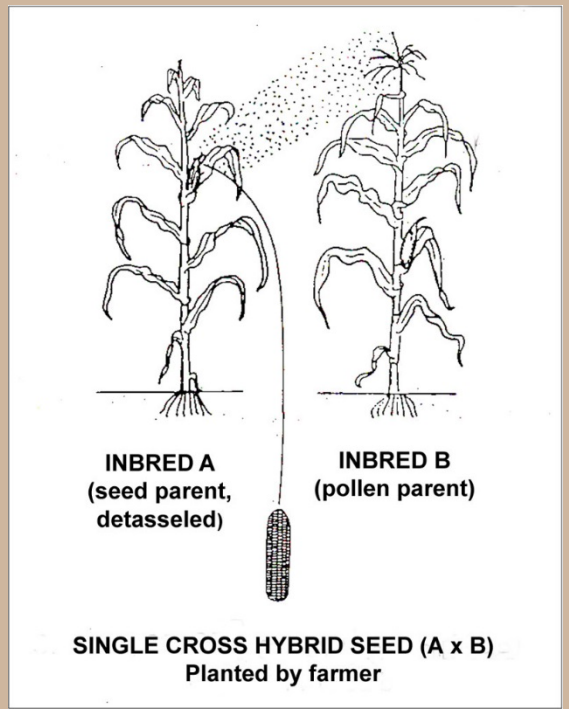
I. <u>Corn is Promiscuous</u>

"having or characterized by many transient sexual relationships"

II. In 2013 there were 96 Million Acres of Corn in the U.S. (90% GE)

III. All (99.9%) corn grain is produced from **<u>hybrid</u>** seed

1. Non-GE Hybrid seed production requires
   - 2 pure inbred parents (commonly contaminated at low levels)
   - Isolation (distance and/or timing) from GE Corn fields
   - Specialized production techniques (split planting, de-tasseling, rouging)
   - Dedicated Processing of seed



Issues in producing Non-GE Organic & Conventional Hybrid Seed Corn

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I. Nearly all corn inbred parent seed is developed and patented by: Syngenta, Monsanto, Dupont, Dow
II. Limited Availability of Non-GE Inbreds
    - Good news: there are non-GE inbreds that can produce hybrids that compete for yield/agronomics with GE inbreds
    - Bad news: Very few of these non-GE inbreds are available untreated (non from the big companies). Almost zero corn inbreds are available as true organic seed.
III. There are small, independent corn breeders who are developing non-GE inbreds, but it is slow (7 years on average for 1 inbred) with a low success rate.
IV. Any hybrid seed corn production field (or grain field) can easily by contaminated by pollen blowing in from neighboring fields
V. Producing Organic Hybrid Seed Corn requires the coordination of two very specialized sets of knowledge. Fewer than 20 growers with capability
VI. The tighter the GE standard we impose on Hybrid Seed Corn, the smaller the pool of available inbreds & hybrids

Organic Seed Corn Production 2014
GMO % at Planting and Post-Harvest

ALBERT LEA SEED ORGANICS

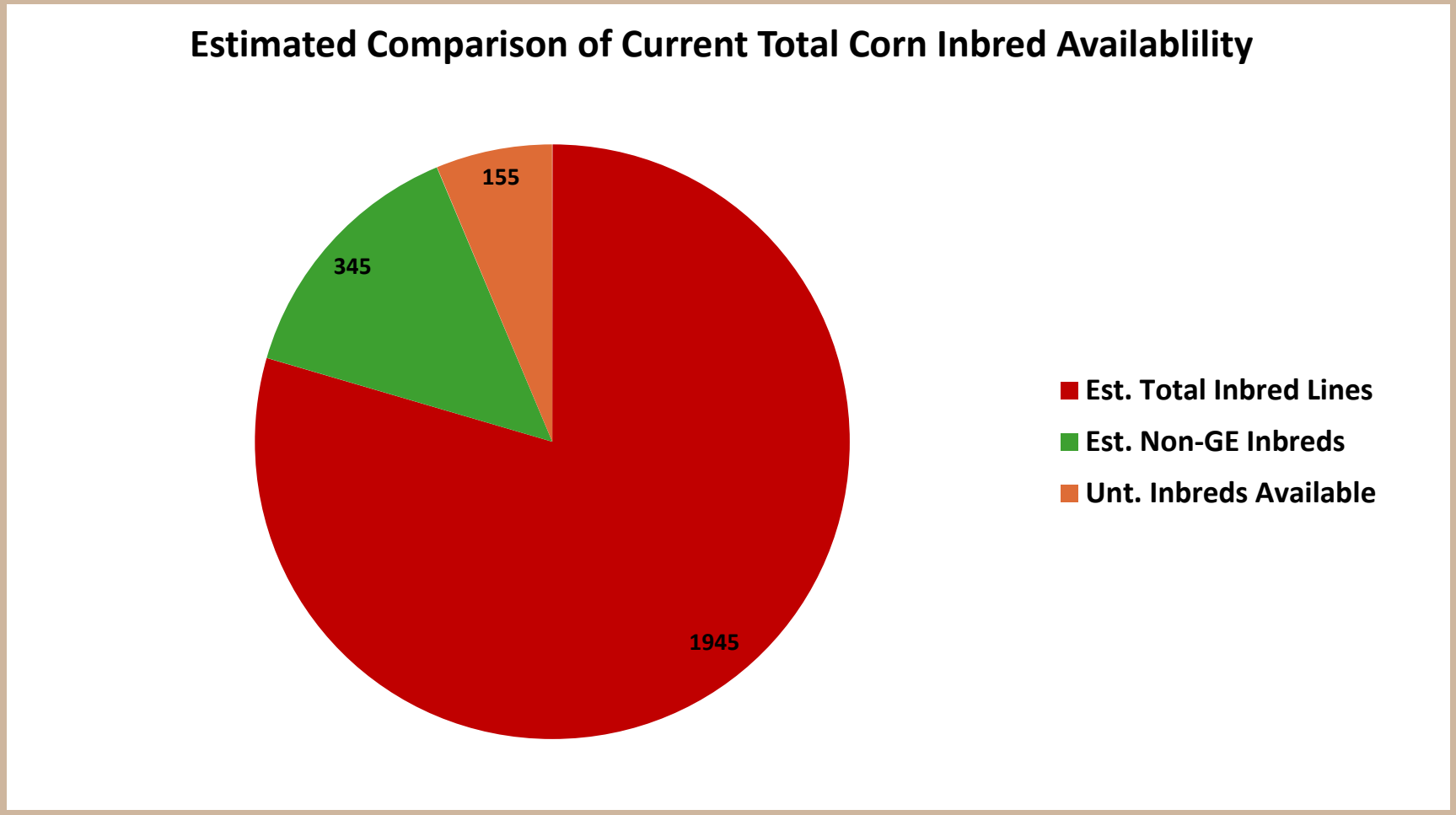
	Inbred Parent Seed		Resulting Hybrid Seed
	Female	Male	
Total Number of Tested Lots	**23**	**22**	**110**
None Detected	2	1	? (1-74)?
>0.01% - <0.1%	6	11	? (1-74)?
0.1% - 0.5%	7	10	? (1-74)?
0.51% - 0.99%	4	0	24
>1.0%	4	0	12

- Parent seed tested at Genetic ID using Real-Time PCR Quantitative
- Hybrid seed tested with semi-quantitative strip test (no accuracy below 0.5%)
- All hybrid seed followed the “Best Mgmnt. Practices” outlined in the Guidance (grown in MI, WI, IL, IA)
- The seed tested above will be planted on 30-40% of the organic corn acres in the U.S. in 2015

State of Contamination in Organic Hybrid Seed Corn

A. Corn

1. Availability of Non-GE inbreds



What is PuraMaize?

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- PuraMaize is a natural gene blocking system that impedes fertilization from “foreign” pollen.

PURAMAIZE WORKS!

ALBERT LEA SEED ORGANICS

PuraMaize gene system prevents pollination from GMO corn and blue corn by strongly preferring its own pollen.

On the left a PuraMaize hybrid, on the right a regular hybrid.

Both pollinated with Hopi Blue Corn pollen and their own pollen.

Concluding Thoughts

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"3. Several possible testing standards for seed have been suggested to us: 1.) No-detect for GMOs in a 3000 seed sample, 2.) 0.01% threshold (because seed must be more stringent than crop testing) and 3). 0.09% threshold as is required in other countries. What is your experience and opinion with these options with regard to practicality, cost, and integrity?

1. Please involve stakeholders from across the seed industry in the development of a GMO threshold for seed.
   - Breeders, Growers, Sellers, Farmers. (Vegetable, Field, and other seeds)
2. A single threshold or standard for all seed may not work because of the different challenges facing different species.
   - 0.99% in Hybrid Seed corn would require discarding 5-8% of inventory each year
3. The tighter the standard (and the shorter the implementation time) the more you will limit the genetic diversity available to organic farmers.
   - Again, different for different species
4. Consider who is going to pay for seed that does not meet the standard and how that "hidden" cost may affect the price and diversity of seed available to organic farmers.

Thank You!

ALBERT LEA SEED
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Different types of GE Testing

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I. Strip Testing & “Comb” Testing (Lateral Flow Strips)
   - Cheap & Fast (within the hour)
   - “Quantitative” approach is somewhat crude. Difficult to interpret “stacked” GE traits
   - Usually protein-based, but newer tests have DNA capabilities

II. Bio-Assay (Grow & Spray) sprout in a chemical solution
   - No false positives. Slow (10 days). Take a lot of space. Only works for HT Traits.

III. Elisa Testing (Protein Level Testing)
   - More expensive (depending on number of pools tested)
   - Somewhat slow (days)
   - Good accuracy for stacked GE traits, but expensive
   - Fairly accurate, especially when used with pooled statistical methods

IV. PCR Testing (DNA Testing, tests for promoter sequences)
   - Very expensive
   - High degree of quantitative accuracy (esp. when combined with statistical methods)
   - Possibility of false positives due to contaminated grain dust or handling equipment

State of Contamination in Organic Hybrid Seed Corn

ALBERT LEA SEED ORGANICS

Risks for Organic Seed Company (Organic Hybrid Seed corn):

1. Purity of Non-GE Inbreds (0.05-0.25 on avg.)
2. Ability to test Non-GE Inbred Seed
3. Even starting with pure inbred seed, hybrid seed production can be cross-pollinated by GMOs.
4. Contaminated hybrid seed (who bears cost?)

    Real-world example:

    600 Bags of Org. 80 Day Hybrid Corn = $81,000

    a. GE content is too high (over 1%)

        * If we can sell as conventional treated corn (may not be able to, 2nd class hybrid) (lose $39,000)
        * If we sell as organic feed corn = $6,300 (lose $74,700)

State of Contamination in major Organic grain & forage seeds

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Hay (Alfalfa & Grass): 786,000 Organic Acres in 2011 (U.S.)

- •RR Alfalfa (seed contamination & pollination contamination)
- •Testing on Hay? “Almost no GMO testing of organic hay.”

Wheat: 344,000 Organic Acres in 2011 (U.S.)

- •No commercialized Transgenic Wheat, although contamination last year found in Oregon

Corn: 234,000 Organic Acres in 2011 (U.S.) (300,000 in 2013?)

- •Widespread GE contamination in seed & grain, very difficult to control

Soybeans: 132,000 Organic Acres in 2011 (U.S)

- •Widespread contamination, much easier to control at low levels

Barley & Oats: 125,000 Organic Acres in 2011 (U.S.)

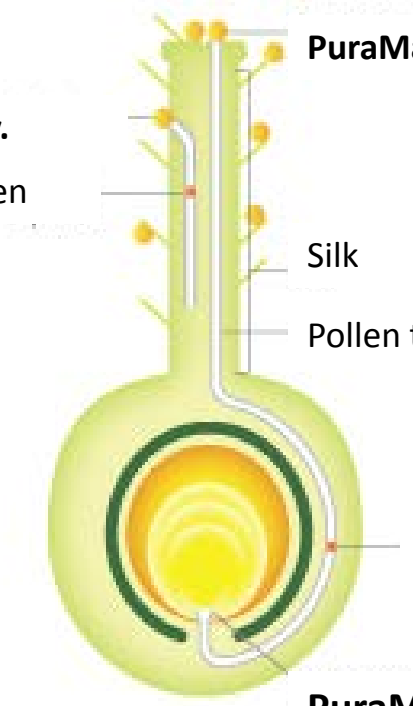
- •No commercialized transgenic barley or oats

ALBERT LEA SEED ORGANICS

- Pollen from surrounding fields may drift onto PuraMaize silk.

PuraMaize pollen tubes grow at a normal rate.

"Foreign" pollen tubes grow slowly.

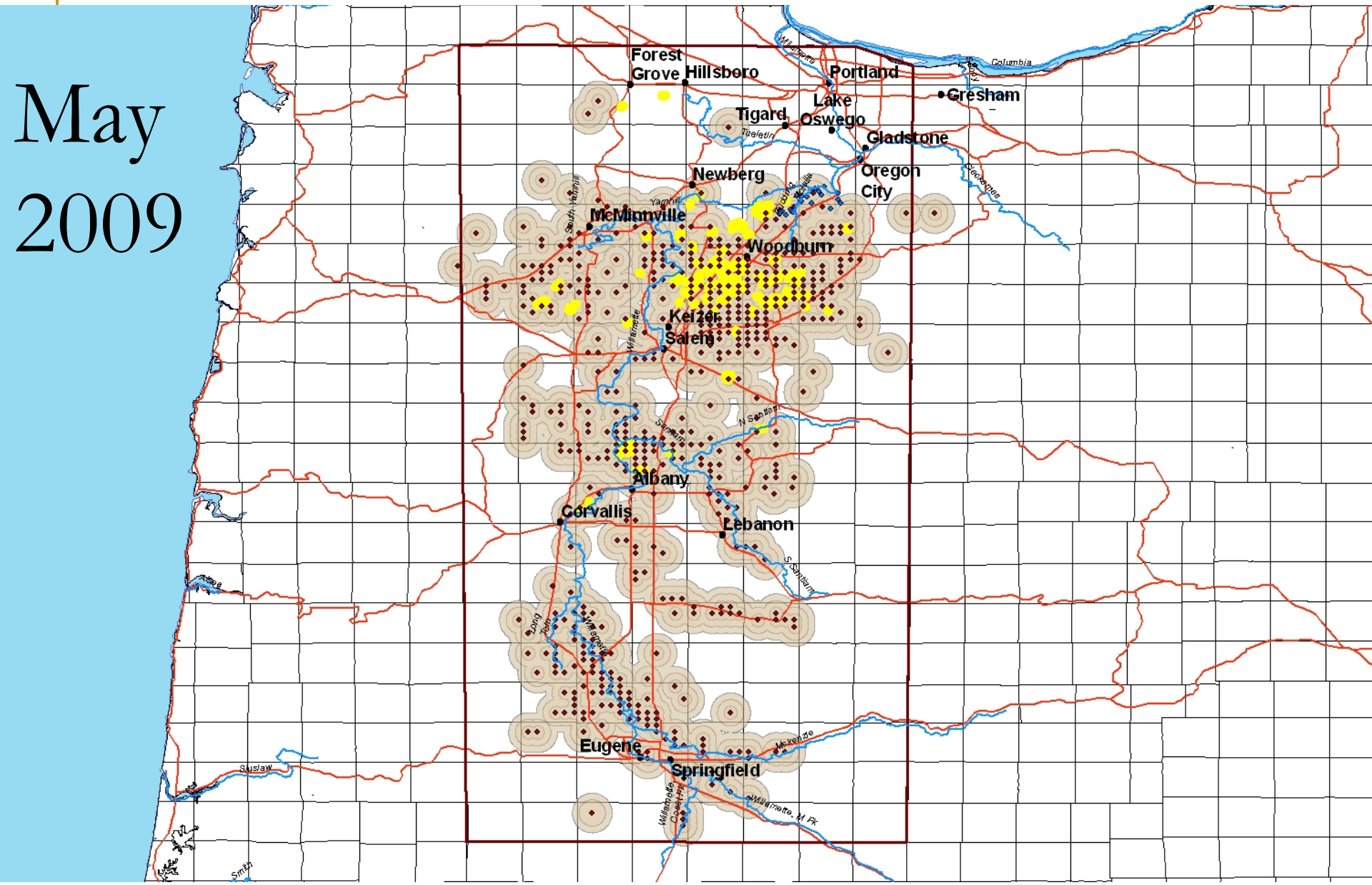


PuraMaize reaches the ovule (or future kernel) first.

Oregon perspective:

- Different mix of GMO crops compared to Midwest US.
- Seed production important, few commodity crops
  - Sugar beet seed production
  - Silage corn for dairies
  - Canola excluded from certain regions
  - Grass seed production
- Pinning maps, exclusion zones, isolation regulations

May 2009


Forest Grove
Hillsboro
Portland
Gresham
Tigard
Lake Oswego
Tualatin
Gladstone
Oregon City
Newberg
McMinnville
Woodburn
Keizer
Salem
Albany
Corvallis
Lebanon
Eugene
Springfield
Columbia
Clackamas
Willamette
Yamhill
South Yamhill
Santiam
N Santiam
S Santiam
Long Tom
Coast Fk
McKenzie
Willamette-M Fk
Siuslaw
Siletz
Alsea
Smith

Governor's Task Force on Genetically Engineered Seeds and Agricultural Products

- http://oregonconsensus.org/wp-content/uploads/2014/04/Final-GE-Task-Force-Report.pdf

Coexistence
- Cross - pollination and Gene Flow
- Practices
  - Mapping and Pinning
  - Control Areas
- Voluntary vs Mandatory Approaches
- Legal Liability, Compensation, Enforcement

Oregon seed production rules proposed as a model for coexistence

- With seed, relationship between GMO and non GMO parties is more equal since neither wants contamination
- Relationship in the case of food production is asymmetrical: GMO producing entity doesn't care; producer with stringent market requirements bears the burden

HB 2509 Relating to agriculture

- Summary: Requires State Department of Agriculture to provide mediation program services when person has reasonable belief that planting, growing or harvesting of agricultural or horticultural commodity on nearby land might interfere or is interfering with farming practices.

1. Source of contamination

- Will depend on the crop & environment
  - For seed crops, degree of outcrossing?
  - Clonal propagation?
  - Part of value reproductive or vegetative?
  - Mature or immature reproductive part?
- Environmental influence
  - Pollinator diversity
  - Pollen longevity

Pollen dispersion in *Brassicas*

- Most *Brassica* pollen disperses to within 10 meters (33 feet) of its source
- Transfer has been detected up to 4 km (2.4 miles)
- Pollen may be moved by wind as well as by insects
- Wind-transferred pollen has been detected up to 1.5 km (0.9 mile) from the source plant
- Pollen can live up to 4 or 5 days
- Warm temperatures and low humidity reduce survival time to 1 or 2 days

1. Source of contamination

- Selfers & clones = adventitious presence (soybean, potato, apple)
- Outcrossers
  - Seed crop = pollen drift & adventitious presence (corn, canola, summer squash, cotton)
  - Vegetative crop = adventitious presence (sugar beet, alfalfa)
- Less chance for certified organic seed to show adventitious presence

2. Level of contamination w/ mitigation

GMO Crop	At risk crop(s)	Organic	Conventional		Greatest risk
			Tested	Untested	
Corn	Field & sweet corn	low	low	moderate	Wind pollination, commingling grain
Soybean	Soybean, edamame	low	low	moderate	Commingling
Alfalfa	Alfalfa	low	low	moderate	Commingling, insect pollination
Canola	Canola, Siberian kale, rutabaga, Asian *B. rapa* vegetables, turnip	moderate	moderate	very high	Insect pollination (canola); residues for vegetables
Sugar beet	Sugar beet, table beet, chard	low	low	moderate	Commingling for sugar beet; residue for vegetables
Summer squash	C. pepo summer & winter squash	Moderate	Moderate	High	Insect pollination, commingling of fruit
Potato	Potato	Low	Low	Low	Commingling

Canola seed lot contamination with GMOs

- Some conventional canola seed lots are contaminated with GMO canola*
  - … three varieties of 14 tested exceeded the 0.25% maximum allowable contamination…
  - … level of herbicide resistance contamination in conventional seed lots exceeded the 0.25% limit in approximately half of the 27 samples tested…
- Transgenes detected in aborted seed from *B. rapa* but not *B. oleracea* cross (Quinn, 2010)

*Hall et al., 2003

3. Testing standards for seeds - practicality, cost, and integrity?

- Type of test
  - Grow out - visual inspection or spray
  - ELISA
  - PCR (divide into lots; rtPCR)
- In testing for presence of seedborne diseases (beans, lettuce) threshold of 10,000 to 30,000 used.

4. Testing program impact genetic diversity?

- Allow only certified organic seeds
  - Major bottleneck in short term
- Allow conventional untreated seeds after testing
  - Less impact on genetic diversity
  - Depends on crop (may be difficult to pass conventional canola seed lots)

Looking down the road…

- What will a GMO be in 10 years?
- Companies beginning to use technologies that do not require federal oversight
- New technologies coming on line - may be difficult to detect GE contamination

Transformation is excluded under NOP but what about new biotechnologies?

- Companies are using transformation techniques that avoid federal oversight (don't know what is GMO and what is not)
- Cisgenics – transformation with genetic material from same species
- Genome editing – site directed mutations (CRISPR, CAS9)

How do we define GMOs?

- There are a guiding set of principles in the works of Edith Lammerts van Bueren
- Ethics of Plant Breeding: The IFOAM Basic Principles as a Guide for the Evolution of Organic Plant Breeding (http://orgprints.org/16766/1/2300.pdf)