Seed Phytosanitary Testing Issues: Industry Perspective

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About ASTA

- Founded in 1883, ASTA is one of the most established trade associations in the U.S.
- Comprised of more than 700 member companies
- Represents all sectors of the seed industry
  - Integrated seed companies
  - Seed distributors
  - Licensing companies (genetics)
  - Seed treatments
  - Machinery
  - Testing
  - Universities

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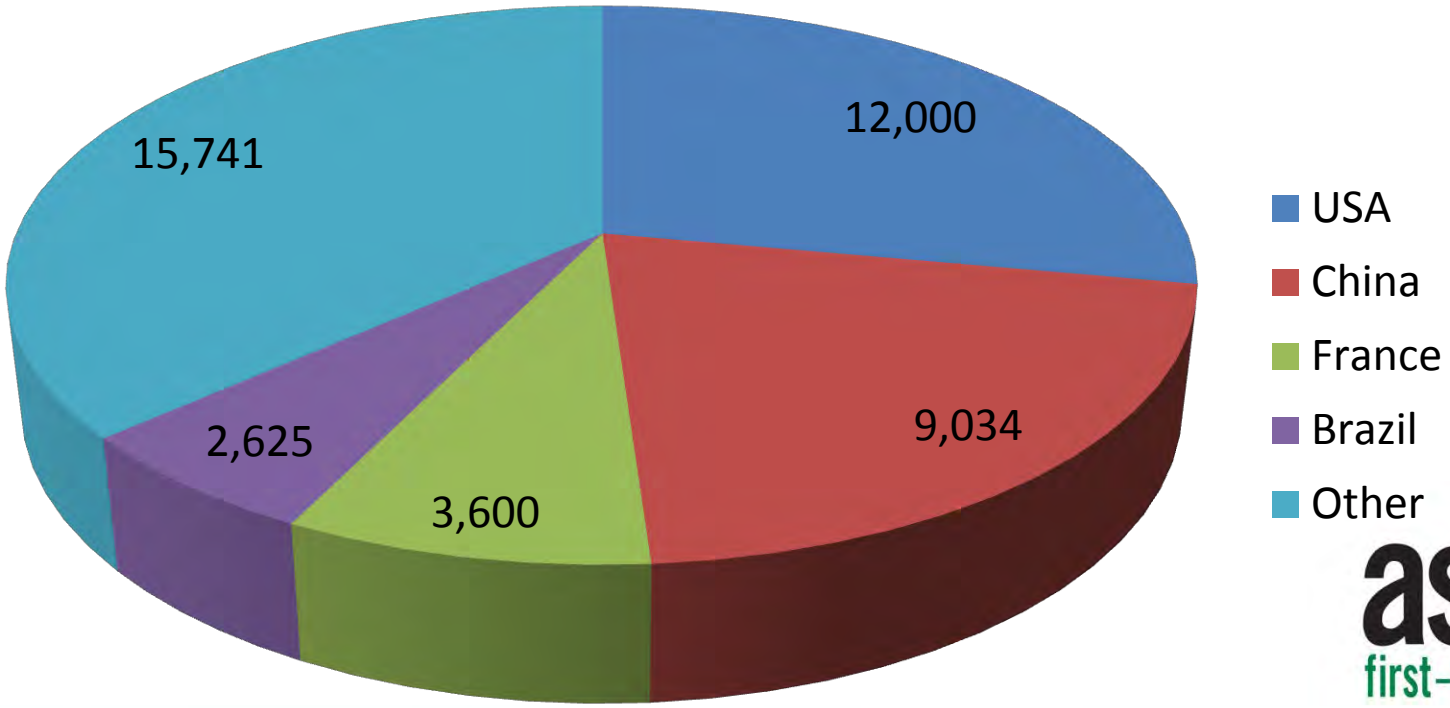
Global Seed Industry

- The commercial world seed market is valued at approximately USD 43 billion (ISF, 2011)

Estimated Value of the Top 4 Domestic Seed Markets – USD Millions (2011)



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U.S. Seed Industry

- The United States is the largest market for seeds in the world with a value of USD 12 billion
- Contributed approximately 26.2% to the global commercial seed sales in 2011
- The U.S. market grew 7.7% 2005-2011
- U.S. + E.U. seed industries = ½ of world industry

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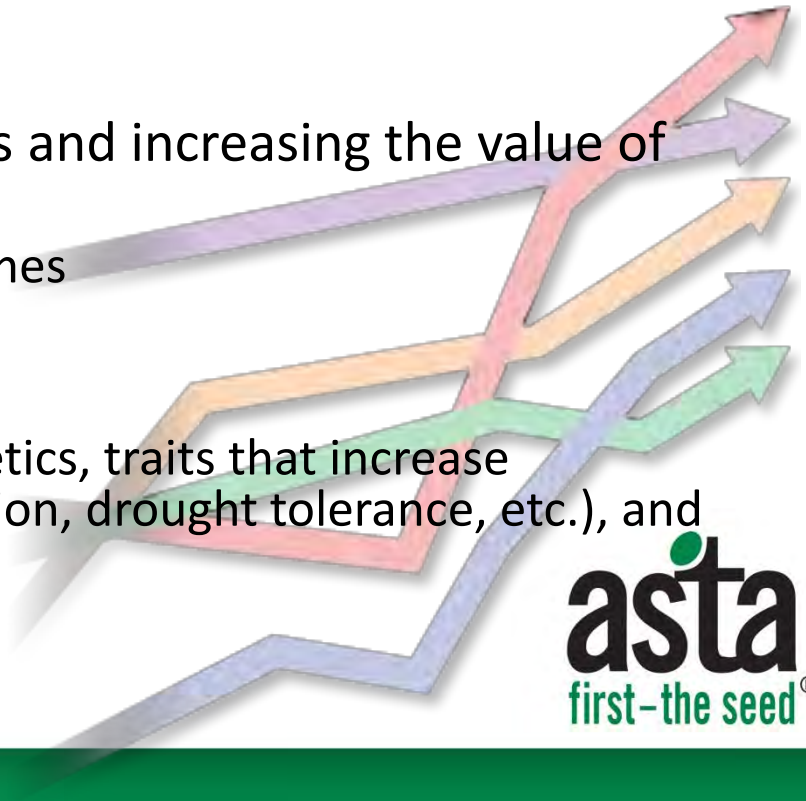
Trends in the Seed Industry:
Past & Present

Past: Focus of breeding was on improvements related to yield and crop inputs

- Yield and agronomic traits
- More efficient and improved uses of chemical inputs
- More efficient farming practices

Present: Innovation focused on genetics and increasing the value of the seed

- Better understanding of plant genomes
- Marker assisted selection
- New focus on end-use quality
- Seed as the delivery system for genetics, traits that increase production efficiency (nitrogen fixation, drought tolerance, etc.), and seed treatments



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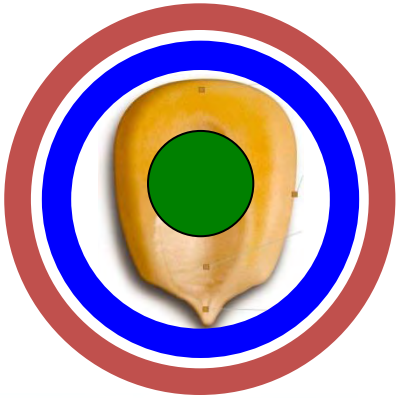
Trends in the Seed Industry:
Seed as the Delivery System

- 1996—Value of the seed primarily from germplasm

- 2013—Value of seed from germplasm, improved agronomic and physiological traits, seed treatments



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Trends in Seed Industry:
Global Movement of Seed

- Increasing importance of the movement of seed:
  - A global industry
  - Re-export of seed a common practice
  - Movement of seed is complex
- Parental seed is high value
  - Volume of trade may be limited
  - Progenitor lines for the production of the vast array of commercial seed varieties sold in large volumes to farmers.
- A single seed company could be moving thousands of different – and distinct – seed varieties at one time.

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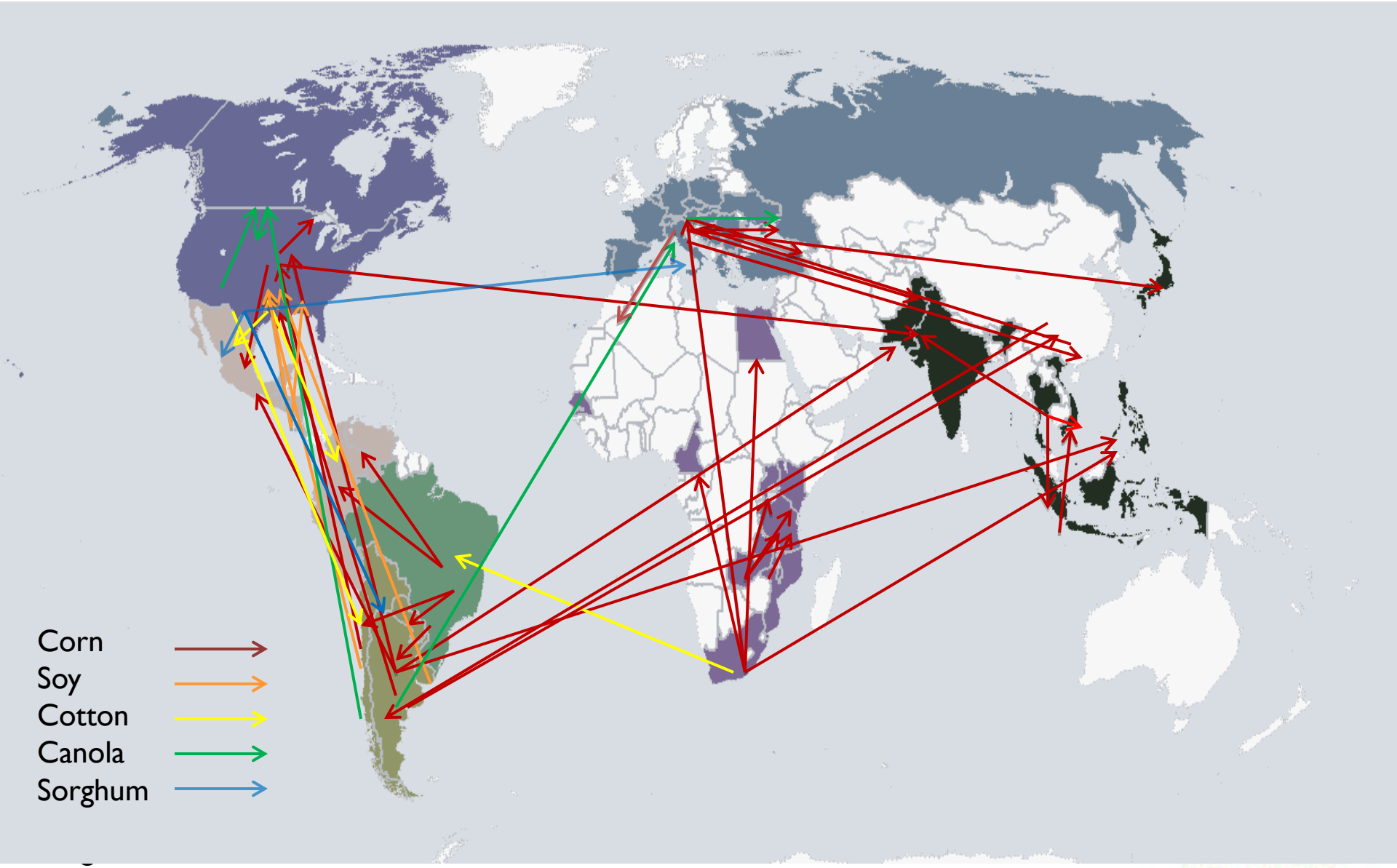
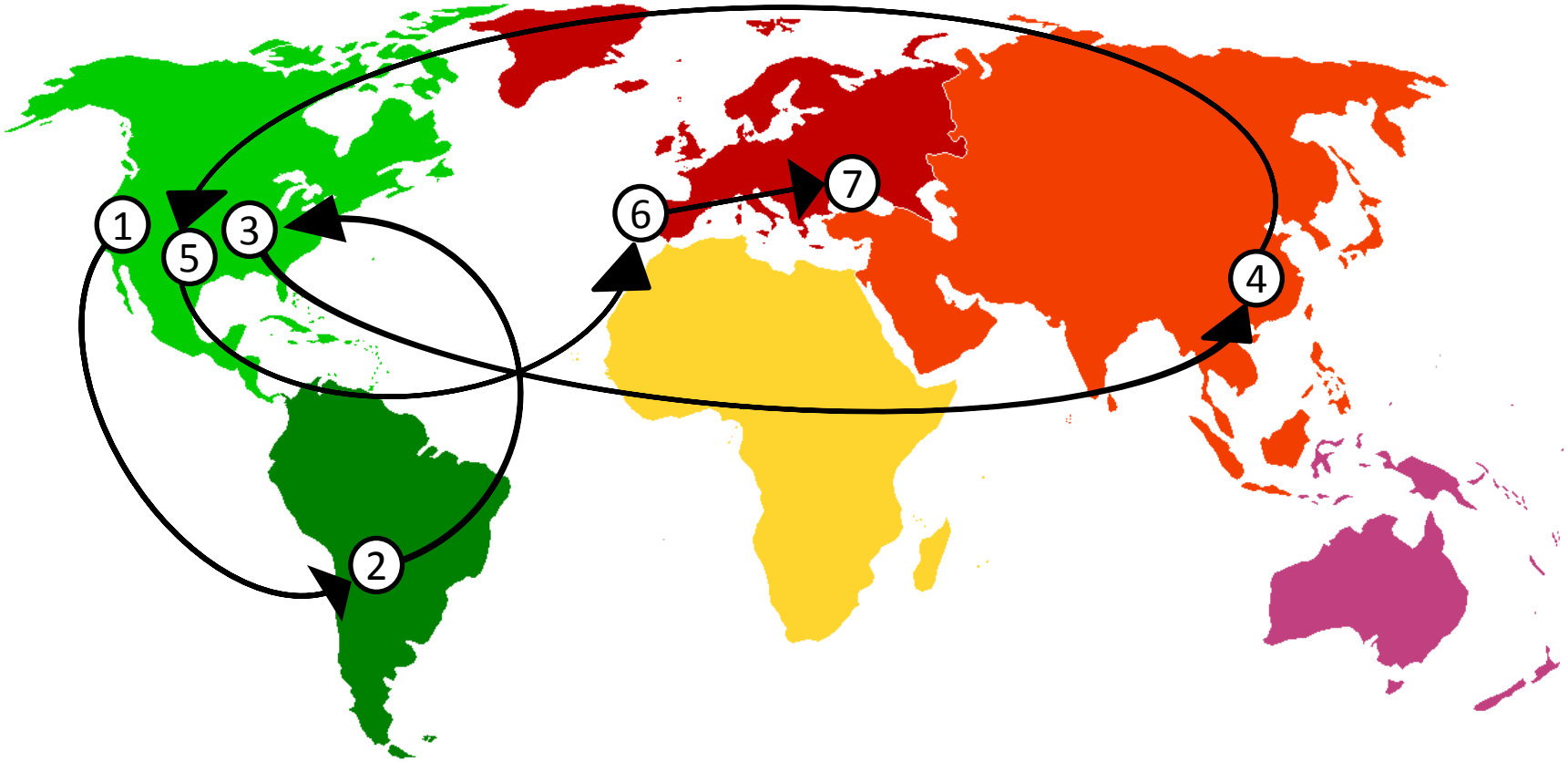
Global Seed Flows



Tomato Example



1. Basic seed or breeder's seed production in Country A.
2. Foundation seed production in Country B.
3. Stock seed production in Country A.
4. Commercial seed production in Country C.
5. Shipment of commercial seed back to Country A for cleaning treating and packaging.
6. Shipment to Country D for distribution.
7. Shipment to final destination after sale (Country E).

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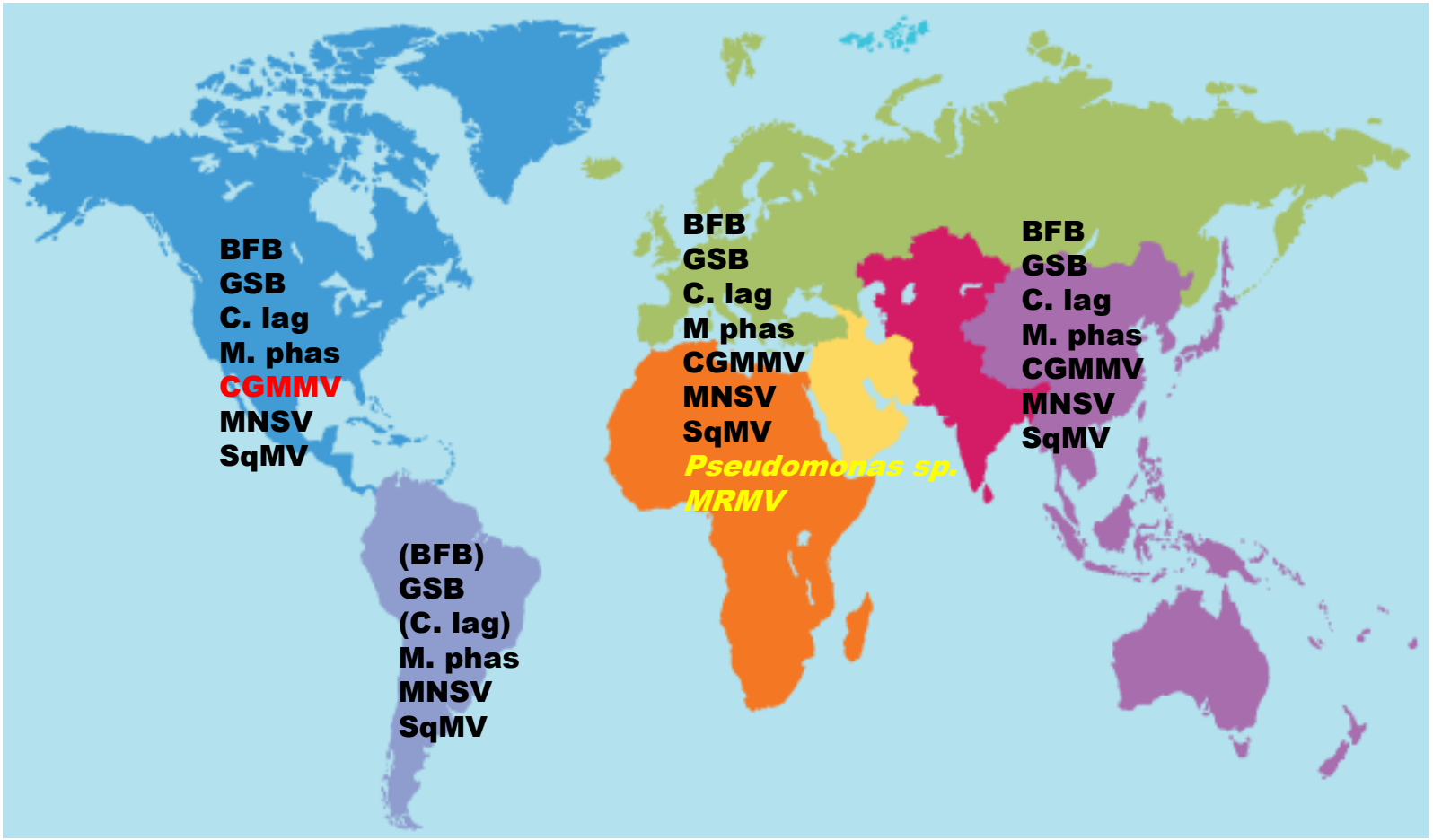
Challenge Example: Melons



Disease Codes

BFB: Acidovorax citrulli
GSB: Didymella bryoniae
C. lag: Colletrotrichum lagenarium
M. phas: Macrophomina phaseolina

CGMMV: Cucumber Green Mottle Mosaic Virus
MNSV: Melon Necrotic Spot Virus
MRMV: Melon Rugose Virus
SqMV: Squash Mosaic Virus

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Vegetable Seed Industry Challenges:

Industry Practices

- Increased risk of diseases
- Concentration of activities by plant raisers
- Size of horticultural enterprises (open field crops and protected cultures)
- Use of techniques such as grafting on rootstocks (Solanaceous crops, Cucurbits)
- Higher costs and liability
- Intensification of production leading to high financial risks for growers and plant raisers
- Infected seed the first suspect in case of a disease outbreak
- Tests demanded for pathogens for which seed is not a pathway

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Vegetable Seed Industry Challenges: *Technological Innovations*

- Rapid developments in techniques
- Sensitivity of tools such as bio-PCR and real time-PCR
- Quick development of highly sensitive PCR-tests in cases of emergency, without validating the method for suitability of use on seeds
- Adaptation and validation to ensure sound and reliable results that have biological “relevance”
- Adaptation of tests for treated seed
  - Sanitation products and processes
  - Crop protection products

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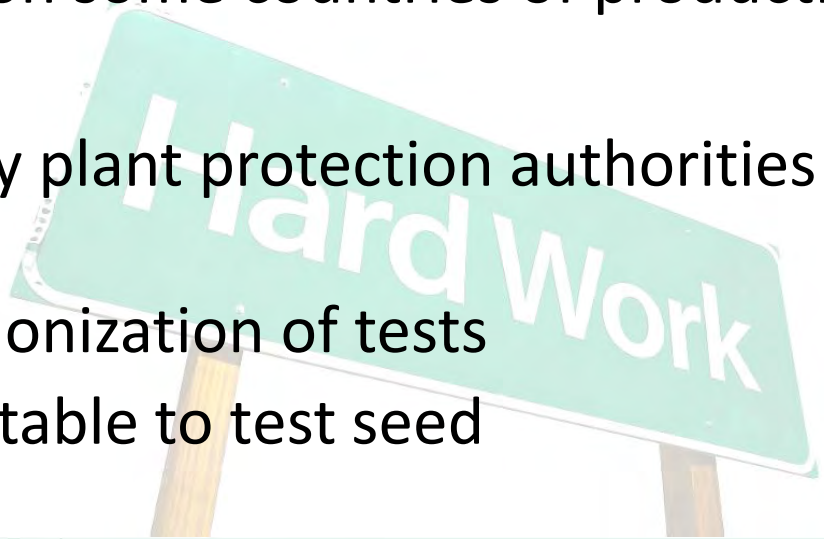
Vegetable Seed Industry Challenges:
Regulatory Environment

- Heightened attention on seed-borne pathogens
- Many types of seed (e.g. vegetable) are produced in many countries, shipped to central facilities for processing, sanitation and upgrading, treating, testing and repacking before being re-exported
- Import restrictions on some countries of production
- Pest Risk Analyses
- Greater emphasis by plant protection authorities on seed testing
- Reliability and harmonization of tests
- Use of protocols suitable to test seed



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Vegetable Seed Industry Challenges:
Example – CGMMV in Australia

Costs:

- Typically $50k /company in testing
- Over $600k in obsolete seed/lost sales

Delays:

- 80% delayed
  - Offshore - 3 weeks *(normal 3-4 days)*
  - Onshore - 8-10 weeks (normal 4 weeks)

Specialty Lines:

- Up to 50% reduction with much greater reduction expected next year

Product Development:

- Significant reduction in screening of new breeder lines

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Opportunities in the Seed Industry:

Overview

- Develop and validate seed health test methods
- Validate new techniques for their suitability
- Comparative tests for new protocols as well as for reviewing and maintaining existing ones
- Seek agreement on harmonized methods with national, regional, and international (IPPC) authorities
- Explain to regulators aspects of seed transmission, seed health testing, and seed health management

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Opportunities in the Seed Industry: *The Ideal Seed Health Test*

- Specific to the relevant pathogen
- Matrix (for seed, leaves, treated seed)
- Sufficiently sensitive (sample size also important!)
- Validation of the test (supporting data)
- Determine viability of the pathogen (dead or alive)
- Harmonized (to minimize differences in methods used by seed companies and NPPOs)
- Robust (usable by all labs)
- Quick to use (facilitates routine testing)

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Seed Testing Discrepancy Trade Disruptions:

Bean Seed/Curtobacter flaccumfaciens

- Phytosanitary certificate issued in U.S. based on seed testing
- Seed re-tested at POE; rejected based on a (false?) positive (NPPO-developed PCR method, not internationally validated)
- U.S. companies no longer ship bean seed to that country

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Seed Testing Discrepancy Trade Disruptions:

Pepper Mild Mottle Virus (PMMOV)

- Pepper seed is produced in China; brought to the U.S. for further testing, processing, packaging, and then re-exported.
- PMMoV is a QM pest to the industry; all efforts are made to keep it out of the seed pathway
- Seed is first tested (ELISA); if negative, it is brought into seed processing facility, often re-tested (ELISA, PCR), packaged and re-exported

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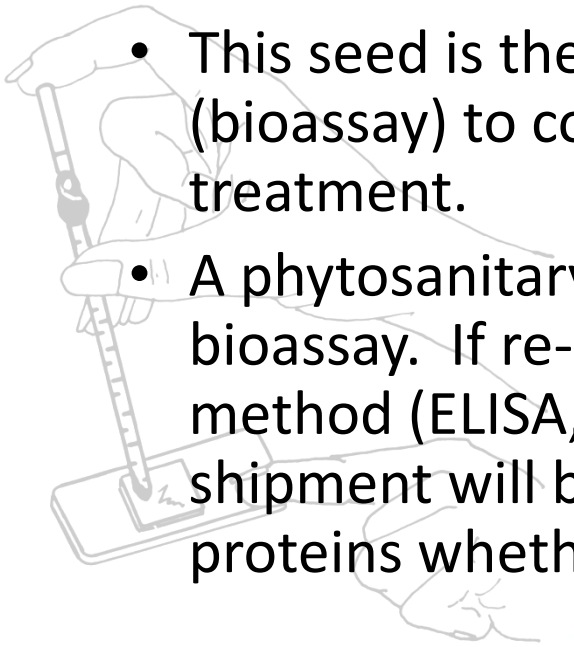
Seed Testing Discrepancy Trade Disruptions:

Pepper Mild Mottle Virus (PMMOV)

- Seed is often re-tested at POE of country of importation. If positive, the shipment is rejected.
- ALTERNATE SCENARIO: seed produced in China tests positive (ELISA, PCR) and is then treated (e.g. TSP).
- This seed is then re-tested with a biological method (bioassay) to confirm 100% efficacy of the seed treatment.
- A phytosanitary certificate is issued on the basis of the bioassay. If re-tested at a POE using a molecular method (ELISA, PCR, etc.) it will test positive and the shipment will be rejected (molecular methods detect proteins whether or not they have been inactivated)



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Opportunities in the Seed Industry:

Possible Solutions to Seed Testing

- NPPOs and Industry use same method(s) for a given pathogen (harmonization)
  - NAPPO list of official seed test methods/protocols
  - Tests jointly evaluated/certified by NPPO, university, and industry seed testing experts
- Develop a protocol for joint (Canada, U.S., Mexico) recognition of bioassay test results without need for 100% re-testing
- Encourage development of simpler, more reliable (possibly nondestructive) seed testing methods

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