Seed Phytosanitary Issues and Industry Growth

Tom Moore
HM Clause
APSA Phytosanitary Workshop
Bangkok, Thailand
August 14, 2015

About ASTA

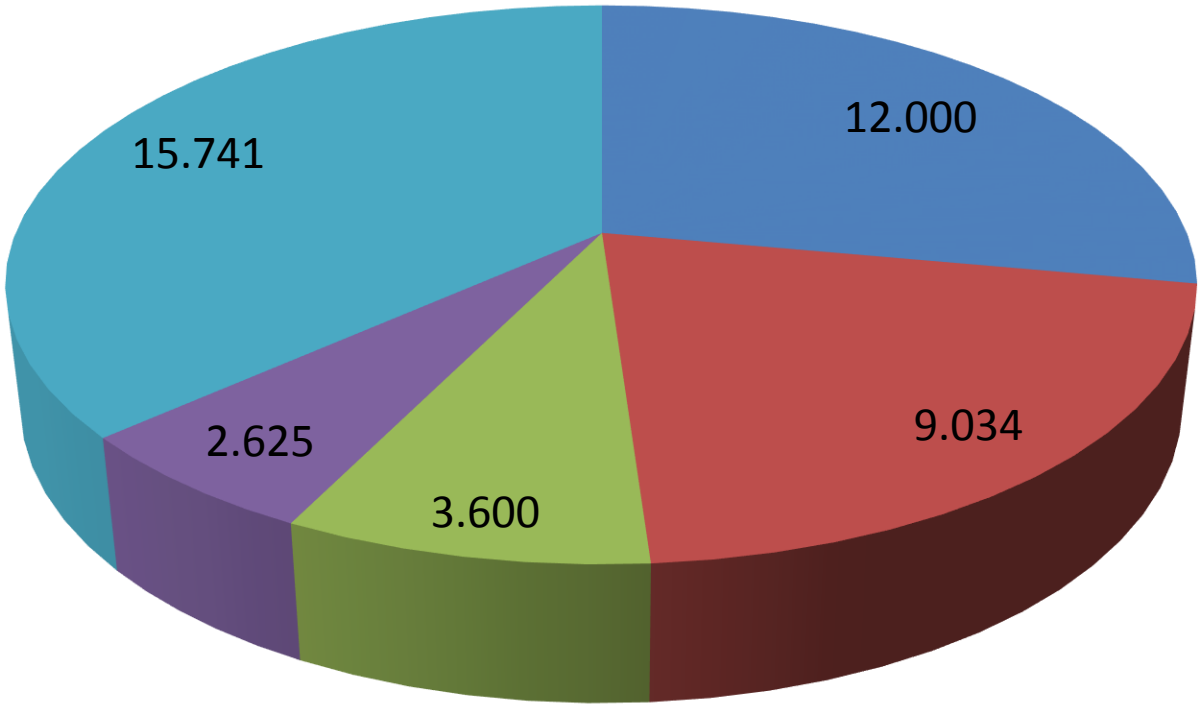
- Founded in 1883, ASTA is one of the most established trade associations in the U.S.
- Comprised of more than 700 member companies
- Represents all sectors of the seed industry
  - Integrated seed companies
  - Seed distributors
  - Licensing companies (genetics)
  - Seed treatments
  - Machinery
 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

asta
first-the seed®

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)



asta
first-the seed®

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

asta
first-the seed®

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

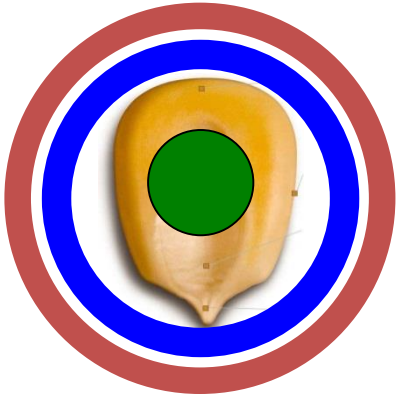
- Better understanding of plant genomes
- Marker assisted selection
- New focus on end-use quality
- Seed as the delivery system for genetics, traits that increase production efficiency (nitrogen fixation, drought tolerance, etc.), and seed treatments

asta
first–the seed®

Trends in the Seed Industry:
Seed as the Delivery System

- 1996—Value of the seed primarily from germplasm

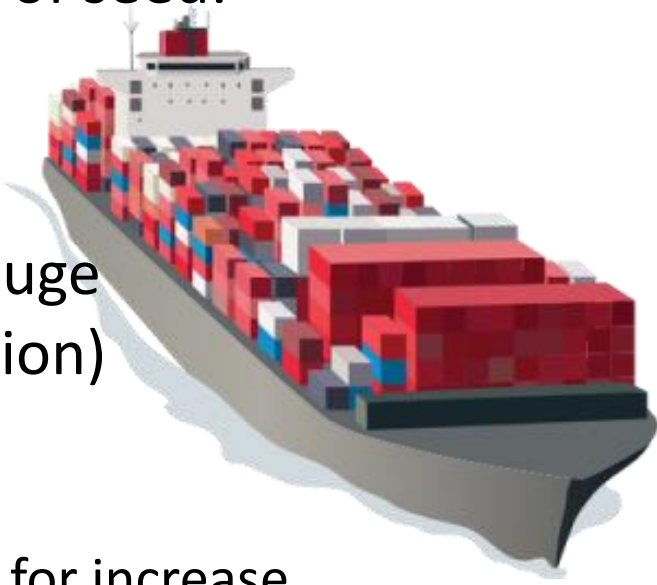
- 2013—Value of seed from germplasm, improved agronomic and physiological traits, seed treatments



asta
first-the seed®

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
- Movement of research/breeding seed: huge challenges (seed testing, phyto certification)
- Parental seed is high value
  - Volume of trade may be limited
  - Many lots of pre-commercial seed needed for increase
- A single seed company could be moving thousands of different – and distinct – seed varieties at one time to many different countries.



asta
first-the seed®

Why Phytosanitary Security?

- Most countries have regulations to protect against entry of unwanted pests, pathogens, and weeds
  - Protect their food supply
  - Prevent their Ag to exposure to pathogens and pests
  - Eliminate them when and where they pose a risk

- Under the IPPC, countries are only authorized to establish phytosanitary measures for regulated pests (quarantine, regulated non quarantine)

- Many of the regulations are all-encompassing
  - i.e. written for plant, fruit, plant parts which include seed

HM.CLAUSE

Why Phytosanitary Security for Seeds?

- Seeds, like any other raw agricultural commodity, can be a pathway for introducing unwanted pests into new environments-according to IPPC can be regulated;
  - Weed seed contaminants
  - Insect pests (mainly in storage situations)
  - Soil/nematodes
  - Plant pathogens
- Many companies serve global markets; seeds are frequently moved internationally many times during the life cycle and pests that are associated with the seed move too, without precautions
- **Pathogens and other pests can significantly reduce seed quality in all stages of the life cycle**

asta
first-the seed®

HM.CLAUSE

What are the issues with Phytosanitary Security for Seeds?

- Many countries list pests that are of concern to a crop but seed is not a pathway
  - Some are not even a pest of the host
  - Recent efforts on pest listing (ISF, ASTA) are demonstrating that 60-80% of pathogens regulated on seed are not even associated with seed!
- Many countries list pests of concern and expect exporting countries to prove that seed is not a risk
- Many countries lack centralized information and resources
- Many countries change regulations with government changes (elections or regimes)

asta first-the seed®

HM.CLAUSE

Seed Industry Planning
Advanced Preparation is Key!

- **Export Planning**
  - What Countries do we Sell to?
  - What is the Route of Export (Re-Export)?
  - Country of Origin Restrictions
  - Knowledge of Pests/Pathogens in Production Area
  - Country Import Requirements
    - Country Website (Brazil, Mexico)
    - PEXD and PCIT
    - State and County Agencies
    - Import Permits
    - Prior Experience

asta first-the seed®

HM.CLAUSE

Phytosanitary Measures for Seeds

- Phytosanitary field inspections
  - Bread and butter of seed phytosanitary certification
  - APHIS oversight
    - State agencies/CA County Commissioners
    - Accredited companies (NSHS)
- Seed testing for phytosanitary pests
  - NSHS accreditation
  - Backup to inspections
- Seed phytosanitary treatments
  - New products and enhancements
  - Need for NPPO and RPPO standards?
- Seed grown in pest free areas
  - ID bean seed program
  - Need information over years to obtain?

asta first-the seed®

HM.CLAUSE

Common Problems Encountered by Seed Companies

asta
first-the seed®

HM.CLAUSE

Misinterpretation on Country Requirement

- Different countries often have different phytosanitary entry requirements for the same pests for the same seeds
  - Stewart's wilt/corn
  - Field inspection vs. seed test
  - Seed Testing Differences – Tomato PSTVd
  - All over the place—hard to manage!

- Most NPPOs usually inspect and sometimes re-sample and test incoming seed consignments
  - Conflicting result needs sorting out (negotiation)
  - Mexico pepper mild mottle virus (PMMoV)
  - Kenya beans/bacterial wilt

asta first-the seed®

Complications with Field Inspections

- Pest/Pathogen not on normal list for field inspections in country of production (origin)
- NPPO frequently will not inspect for pests not on the list
- Countries may charge for extra inspections
- Lack of descriptions of the pathogens on species,
  - Acidovorax sp. on eggplant
  - Clavibacter michiganense pv michiganense (tomato pathogen) on sunflower

Complications with New Phytosanitary Requirements

- Often can't be met if the seed is harvested after the new requirement goes into force (mainly a counter season production issue):
  - **Striga/Argentina:** went from a recognition of pest free areas to a requirement for freedom from Striga based on field inspections
  - **PSTVd/Chile:** went from a field inspection to a field inspection PLUS testing of mother plants or seed test

asta
first-the seed®

PRA Complications

- Happens when a country decides to re-do all its PRAs at one time; impose unrealistic timelines on exporting NPPOs to get all the PRAs completed; no process for timely review of PRA submittals by the country; causes trade disruptions and high levels of uncertainty.
  - Even though there have been no interceptions
    - E.g. Vietnam, Brazil, Chile, Thailand
- Countries could start with highest risk species based on history of interceptions

asta
first-the seed®

HM.CLAUSE

Complications with Seed Health Test

- Lack of ‘official’ seed testing methods for many phytosanitary pests of concern
  - Lack validation
  - Pathogen not seed borne
- Several different test methods often exist for the same pathogen, and test results often vary
  - Bean testing for seed exported to Kenya-many U.S companies abandoned that market due to frequent rejections
- Sampling protocols often require too many seeds!
  - Australia requirement for testing tomato seed for PSTVd
- Technically unjustified import requirements
  - Brazil requirement for Broad Bean Wilt Virus on carrot seed

asta first-the seed®

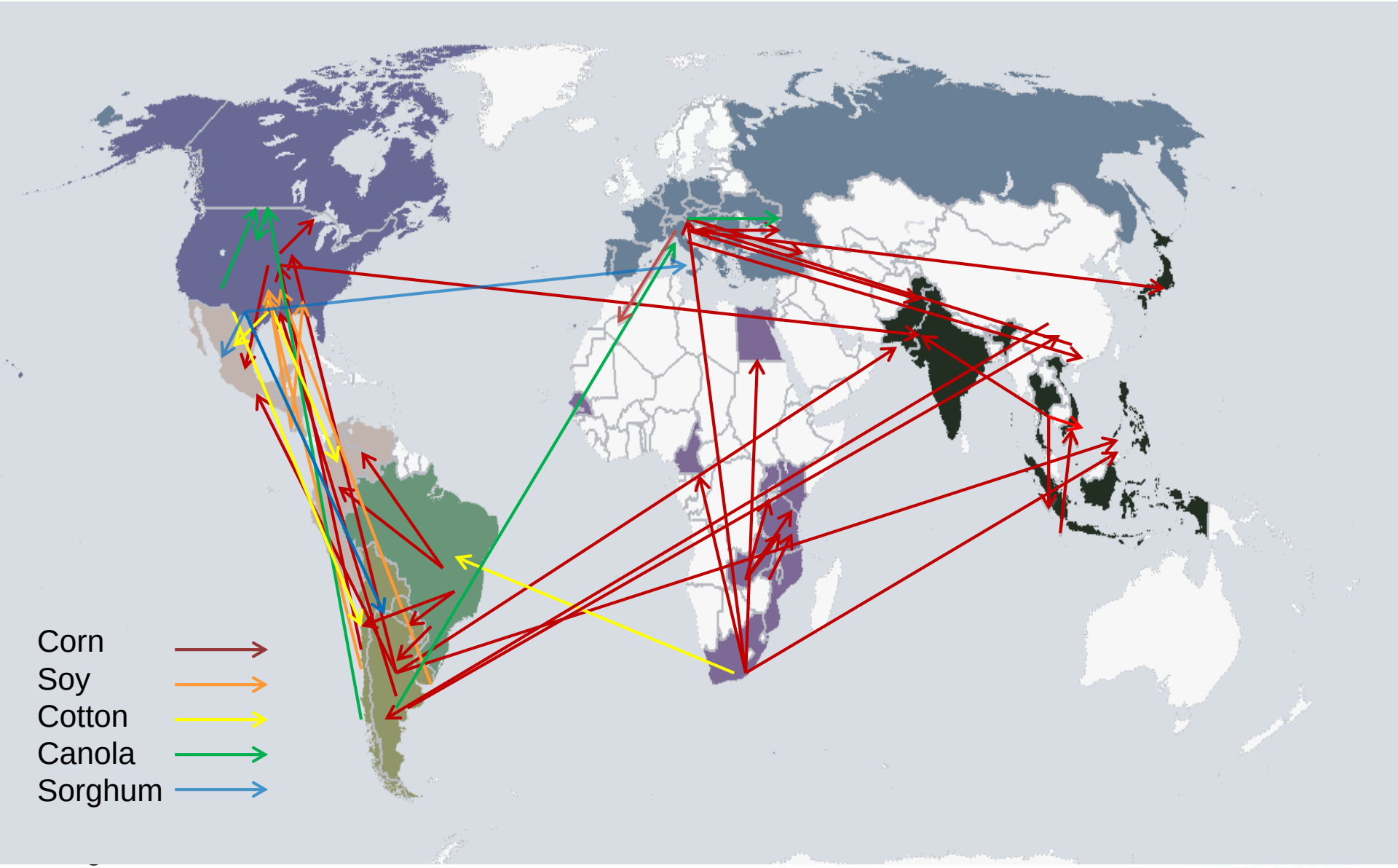
HM.CLAUSE

Re-Export:

A Mainstay for the Seed Industry

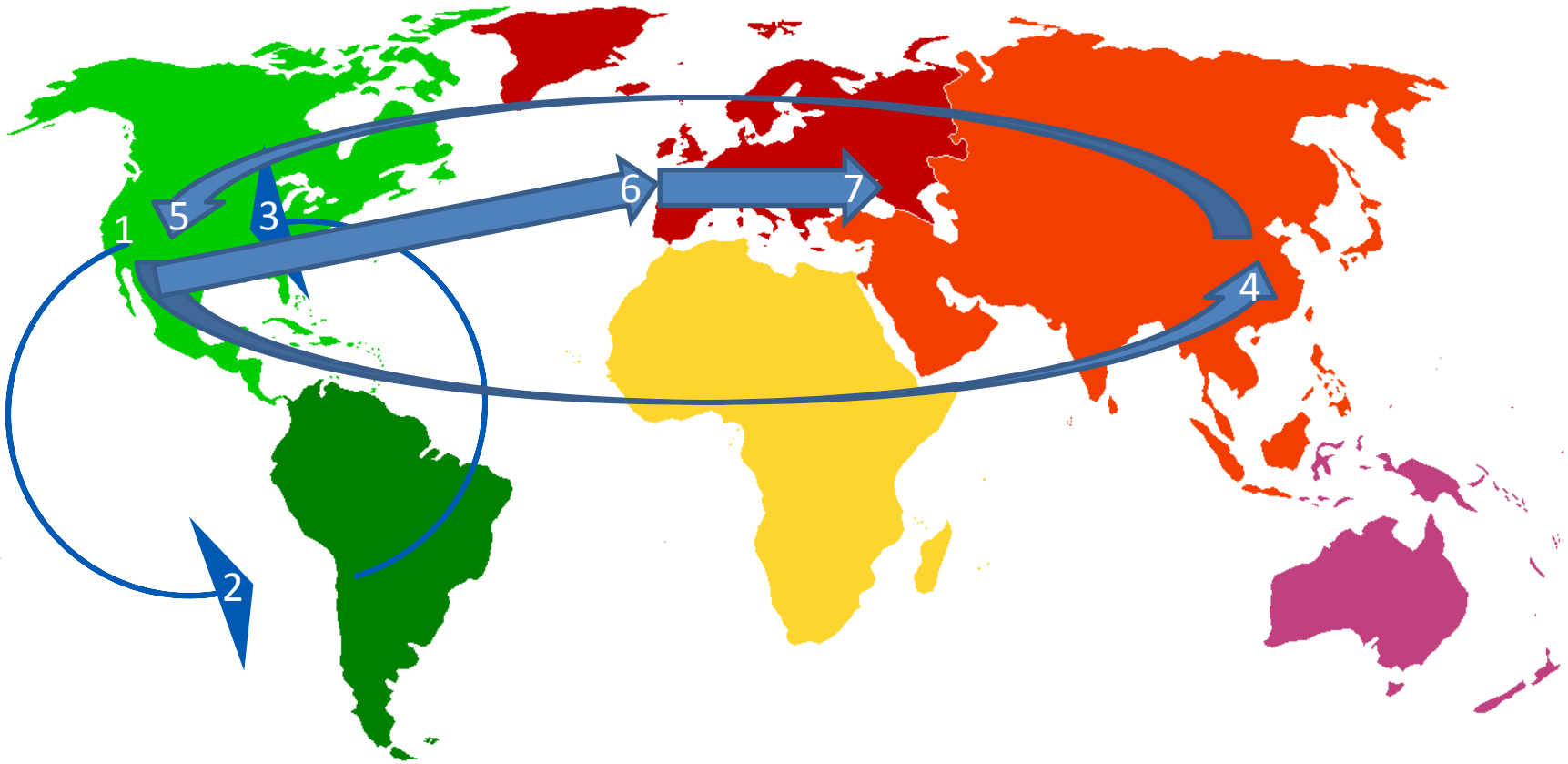
asta
first-the seed®

Global Seed Flows



HM.CLAUSE

Tomato Example (1)

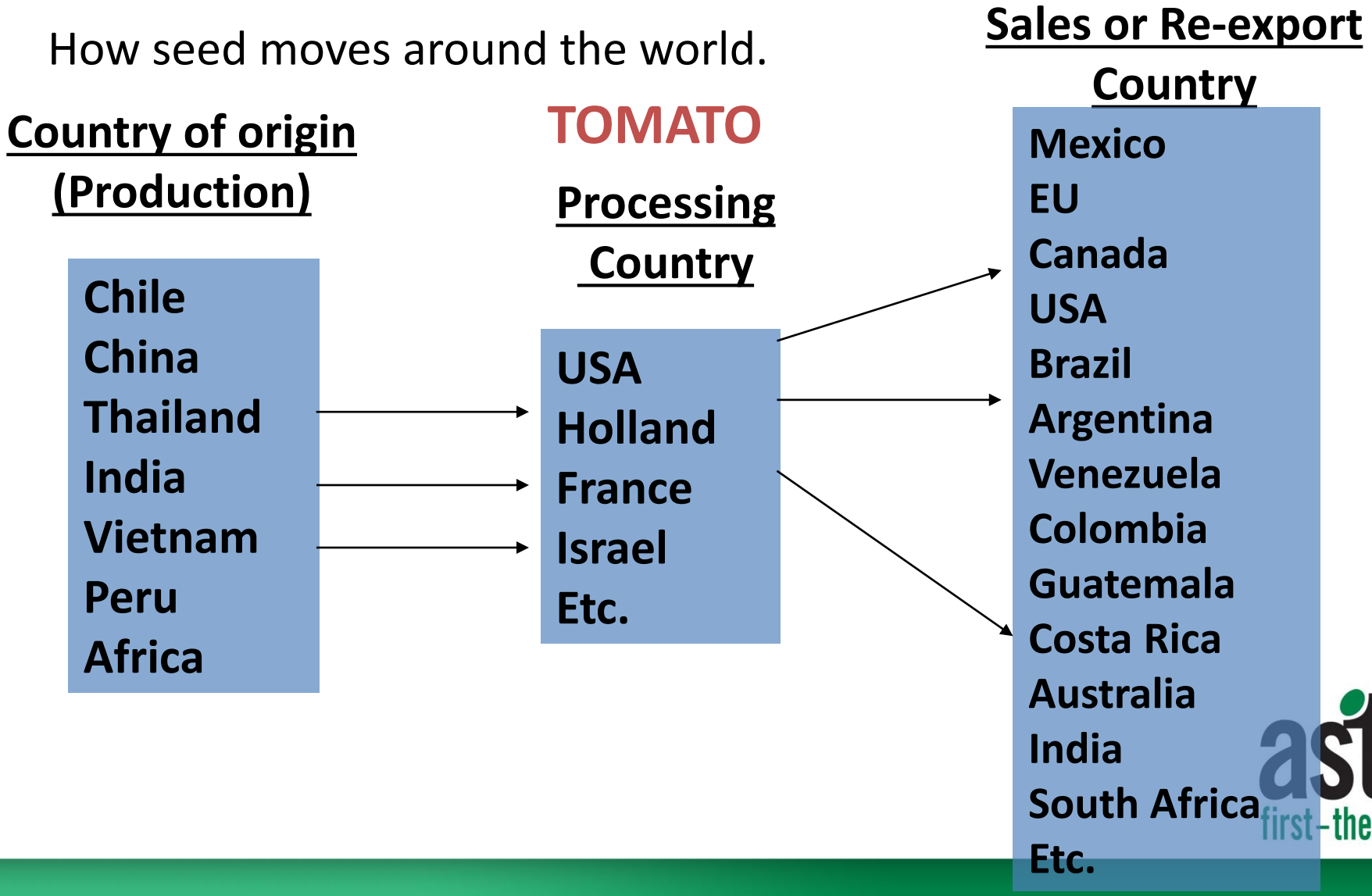


asta
first-the seed®

HM.CLAUSE

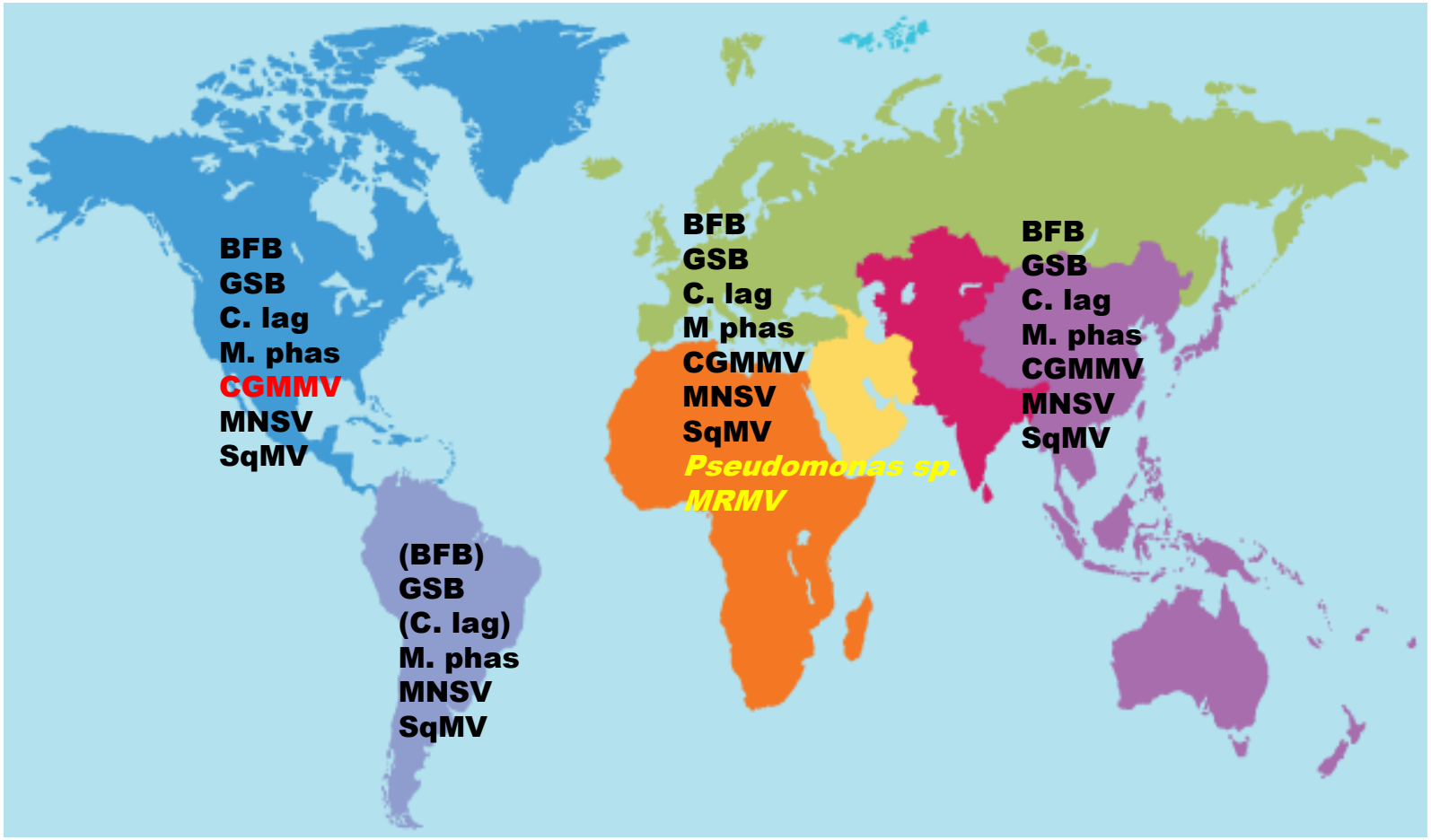
Seed Industry Preparation

How seed moves around the world.



asta first-the seed®

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

asta
first–the seed®

HM.CLAUSE

Resources Available to the Seed Industry

- In the U.S., the seed Industry is respected in APHIS PPQ and THEY listen to the ASTA representatives
- ASTA has international network (USDA-FAS, ISF, RSAs, NSAs, state Seed Associations) to help resolve issues worldwide
- ASTA has established VTSC-seed industry experts that can quickly organize to find scientific data to help resolve issues
- California Seed Association (CSA) has established relations with key CDFA staff
- CSA Collaborates with ASTA to resolve issues
- APHIS monthly calls to discuss phytosanitary issues

asta
first-the seed®

HM.CLAUSE

In an Ideal World Phytosanitary Cert.

- Transparent and understandable
- Based on good science and not politics
- Be standard throughout the world
- Centralized information
- Multiple measures to ensure security
- Seed would have to be shown to be a pathway

asta
first-the seed®

HM.CLAUSE

To Meet the Needs of World Food Production the Seed Industry needs:

- Harmonized phytosanitary import requirements
- Harmonized seed testing methods/protocols
- Seed Treatments that ensure phytosanitary security
- Standard language used in additional declarations of certificates
- Harmonized approach for seed PRAs
  - Demonstration that seed truly is a pathway!
- ***International Seed Standard is the goal!***

asta
first-the seed®

HM.CLAUSE

Case Studies

- **Imports** – Containers of Spinach Seed from Denmark stopped at USA boarder

  - APHIS & Customs and Boarder Protection (CBP) identified Phomopsis sp. on the seed.
  - Phomopsis sp. was considered an “Exotic” pest in the USA
  - The immediate solution was to destroy seed or re-export
  - Now compulsory visual inspection

asta first-the seed®

HM.CLAUSE

Phomopsis on Spinach Seed

- Visual inspections by NAKT prior to shipment
- Still a risk of rejection at the border
- Inspections seem to effective, no/fewer rejected lots now

first-the seed®

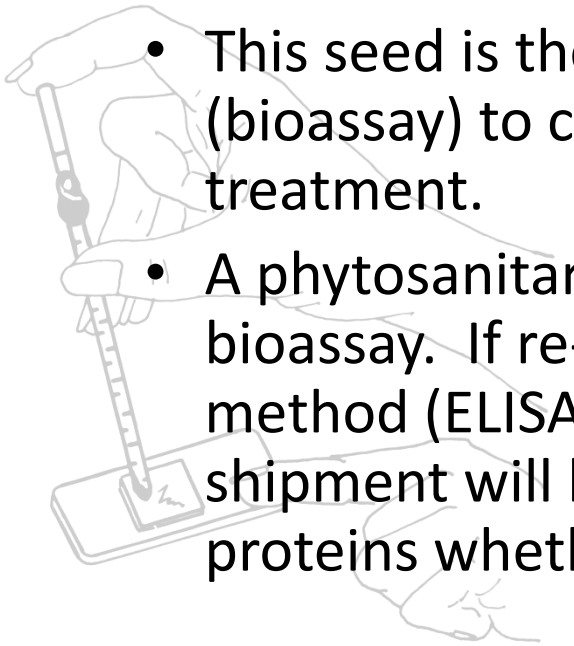
Seed Testing Discrepancy Trade Disruptions: *Pepper Mild Mottle Virus (PMMOV)*

- 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

asta
first-the seed®

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)



asta first-the seed®

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
  - NAPPO commitment on PMMoV
- **Develop a protocol for joint recognition of bioassay test results without need for 100% re-testing**
- **Encourage development of simpler, more reliable (possibly nondestructive) seed testing methods**

asta
first-the seed®

Phytosanitary Into the Future…Finding Common Ground

- **NAPPO phytosanitary workshop July 28-29, 2015**
  - Agreement to move forward with harmonization of seed test methods for PMMoV
  - Discussed pest listing efforts and need to standardize approaches and share information
  - Need to explore broader uses of accreditation for risk management

asta
first-the seed®

Probabilistic Risk-Based Model: *Assessment of Phytosanitary Risk Reduction Associated with Seed Quality Management Practices*

Tim R. Gottwald, Ph.D.
Research Leader/Plant Pathology
U.S. Dept. of Agriculture

Gary Munkvold
Professor
Iowa State University

José Laborde, Ph.D.
Biostatistician
USDA, ARS - Fort Pierce, FL (ASTA contractor)

Weiqi Luo, Ph.D. and Dan Anco, Ph.D.
Visiting Scientist
North Carolina State University

Alissa B. Kriss, Ph.D.
R&D Scientist/Statistician
Syngenta NC

asta
first–the seed®

Probabilistic Risk-Based Model to Assess Seed *Phytosanitary Risk Reduction*

Motivation

- **Consumers expect healthy, disease-free seeds.**
- **Identify and optimize phytosanitary issues: Costly and damaging to the entire seed industry when are not timely identified.**
- ***Aid in the development of International phytosanitary standards to support a more predictable trade environment.***

Expected Outcomes

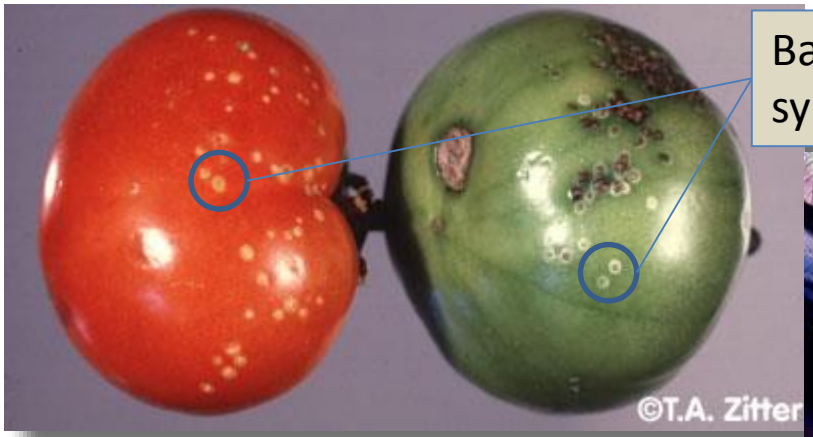
- **Method to quantitatively assess how steps in production practices reduce phytosanitary risks.**
- **General framework that can be applied to any seed production system (pathosystem).**
- **Framework on which to develop/justify international phytosanitary standards, possibly revise PRA approaches for seed, and eventually support the development of a new accreditation category for seed companies.**

asta
first–the seed®

Proposed Risk model Pathosystems - Tomato

1. *Clavibacter michiganensis* subsp. *michiganensis*

Very complex system:
- Multiple tomato production methods.
- **Cmm** can survive for long periods under broad conditions.
- Tomato infected with **Cmm** may remain asymptomatic for some time.



Bacterial canker symptoms on fruit

- Survival possible in soil, plant debris, weed hosts, volunteer plants, and seed.
- Dispersal through wind and water.

2. *Potato spindle tuber viroid* (PSTVd) – *On Tomato*!

- Mechanical transmission
- Frequency of seed transmission appears uncertain at this time.

Data Sources

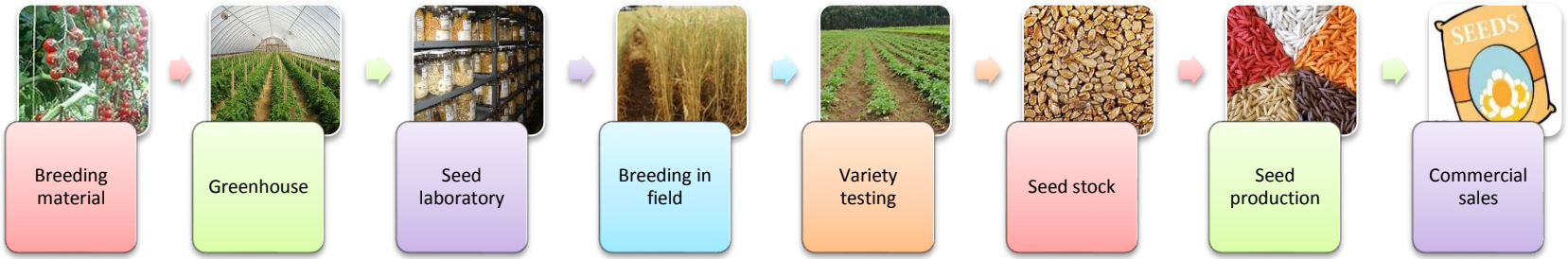
- **Data mining of Published Literature**
  - Much is available
- **Acquire data directly from seed production companies**
  - Some production methods may be specific to individual company
  - Need data resulting from specific method application
- **Where no data is available:**
  - Define precise missing data
  - Design and conduct experiments to fill data gap
  - Analyze data and use to populate model

asta
first-the seed®

Risk assessment of seed production:

From breeding to sale

Goal: Quantify risk reduction associated with company QM practices at each stage of seed production

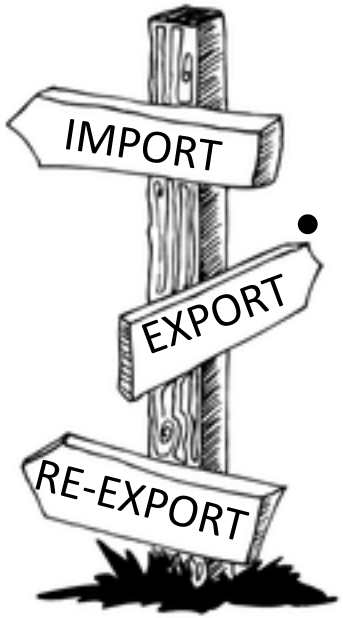


Tim R. Gottwald, Ph.D.
Research Leader/Plant Pathology
U.S. Dept. of Agriculture, Agricultural Research Service
Tim.Gottwald@ARS.USDA.GOV
ASTA contact: Ric Dunkle, Ph.D
rdunkle@amseed.org

asta
first-the seed®

Conclusions

- Seed exports and imports are continuing to increase. In addition, seeds are becoming more valuable and costly to produce.
- Seed movements through multiple countries (re-export) is a business practice that potentially exposes seed to new phytosanitary risks
- It is in the best interest of the seed industry to invest in practices and technologies that satisfy quality as well as regulatory concerns.



asta
first-the seed®

Conclusions

- Limitations in personnel, resources, and overall capacity provide opportunities to explore new approaches to phytosanitary security
- The TASC/Gottwald project is the first attempt to quantify inherent phytosanitary risk reduction associated with seed QM practices.
- A new category of accreditation that recognizes the phytosanitary protection associated with seed QM practices could be a possible new outcome.

asta
first-the seed®