Enhancing Food Safety Efforts with 3rd Party Verification of Crop Inputs

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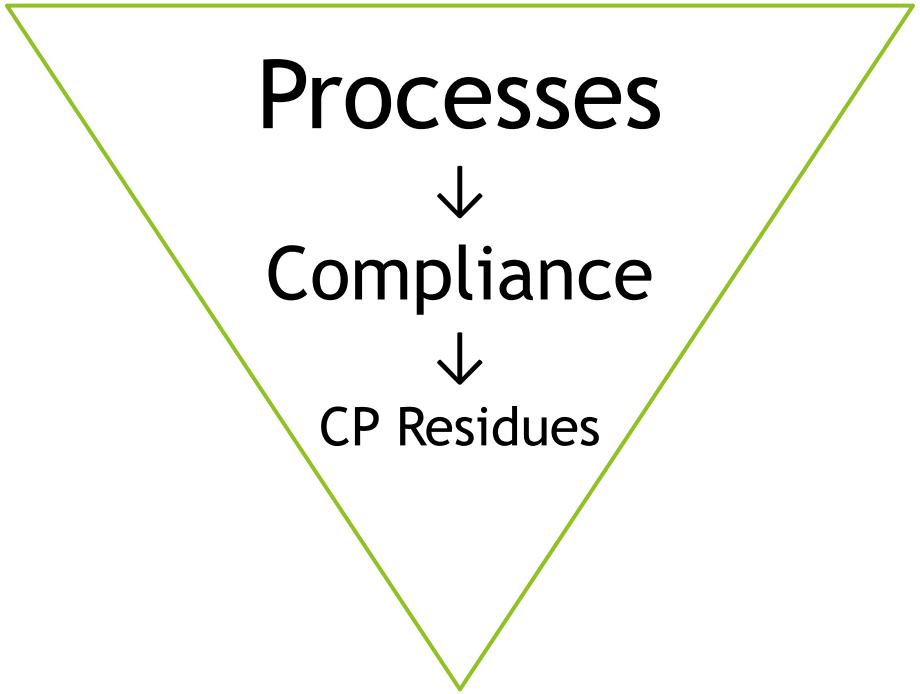
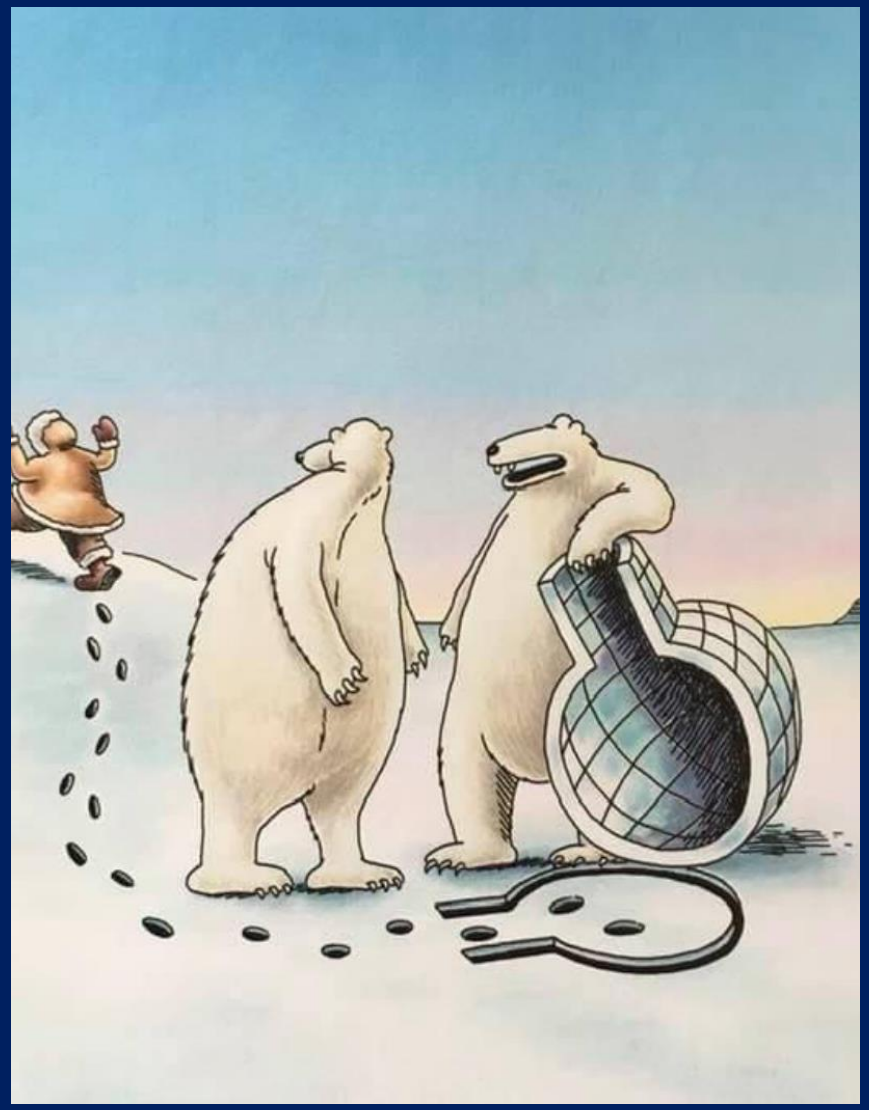
Dang! Why do I always have to sit next to some weirdo?

Outline

- Critereon Background
- Approaches to Verification – Process and Compliance
- Why Verify Crop Inputs
- Crop Protection Residues – What Matters
- Critereon Verification Efforts
- Using 3rd Parties for Verification





“I lift, you grab…
Was that concept just
a little too complex, Carl?”

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TECHNOLOGY & QUALITY MANAGEMENT SERVICES

Process Design	System design and review, personnel training
Auditing	Process and Compliance Auditing services
Software	Software for quality and communications

- *Critereon® Authentix* *Supply Chain Compliance*
- RSW™ Receiving · Storage · Workflow
- Cropstream® Messaging platform

Critereon® Authentix

RSW™

Receiving • Storage • Workflow

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Critereon Authentix → Supply chain compliance

Primary deliverable

- Daily report of fields which comply

Evaluates

- Crop protection sprays
  - Maximum use rates per application
  - Maximum seasonal totals
  - Pre-Harvest Intervals (PHI)
- Nutrients
- Old soil insecticides and heavy metal residues
- Surrounding land use
- Re-treatment intervals

Scope

30 crops
1,500 fruit and vegetable farms
200,000 acres of fruit and vegetables
~7,500 crop input products

Geography

- USA, Mexico, Canada
- (Greece, Peru, Chile, etc.)

Grower Reports

- Worker Protection Standard (WPS)
- Spray Logs
  - Grower recordkeeping
  - Food Safety Audits

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Approaches to Verification

Verify the Process

Verify Compliance

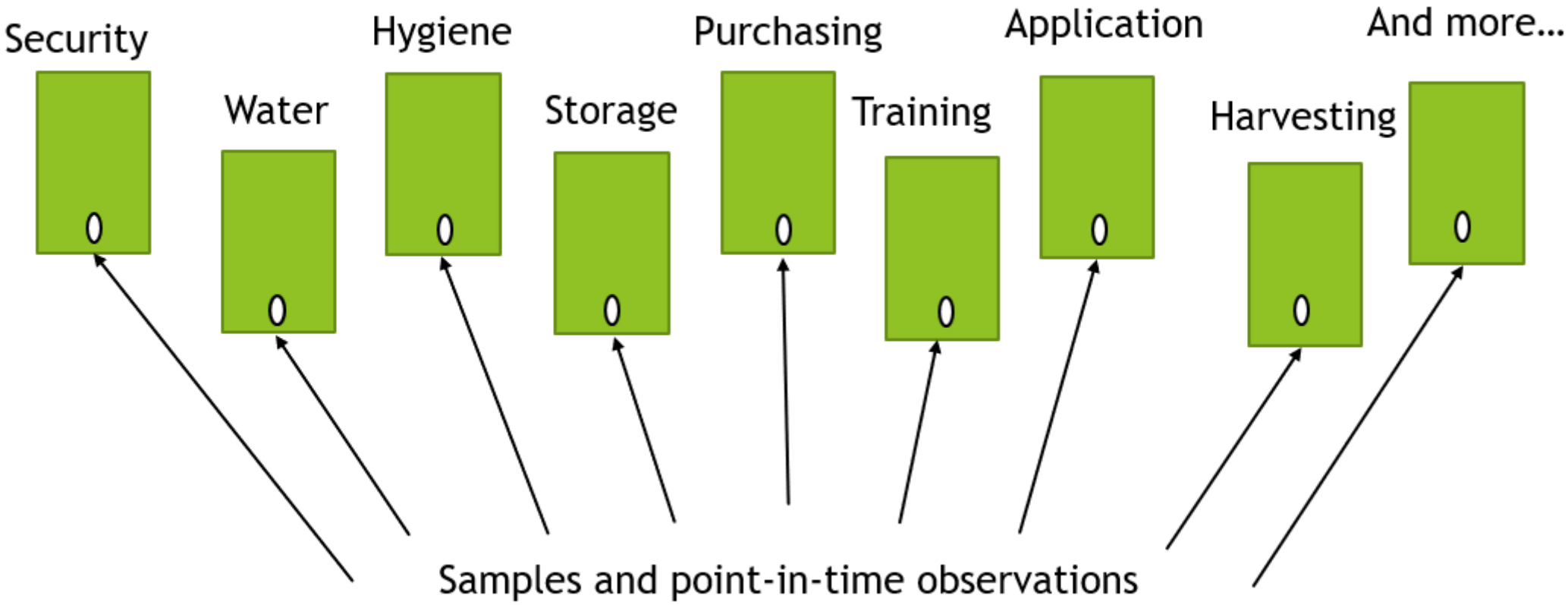
Process Verifications

- Evaluate conformance against known standards
- Look for opportunities to improve
- Small sample set in every area – water, crop inputs, storage, etc.
- Result in Findings, Cures, Suggestions
- “This process is working / not working”
- Certification / de-certification

GAP Process Verifications

Describe	Address GAP Requirements which identify and address Biological, Chemical, and Physical hazards for pickling cucumbers
Promise	• Up to 24 areas must be addressed by writing procedures and developing forms • Completed forms become records
Prove	A "moment-in-time" review by an auditor - Sampling to check select procedures & records - Conducts physical inspection of certain items
Improve	Auditor scores and reports with findings and conclusion
Audit Result	**Success = Certification**

Data Collection - Process

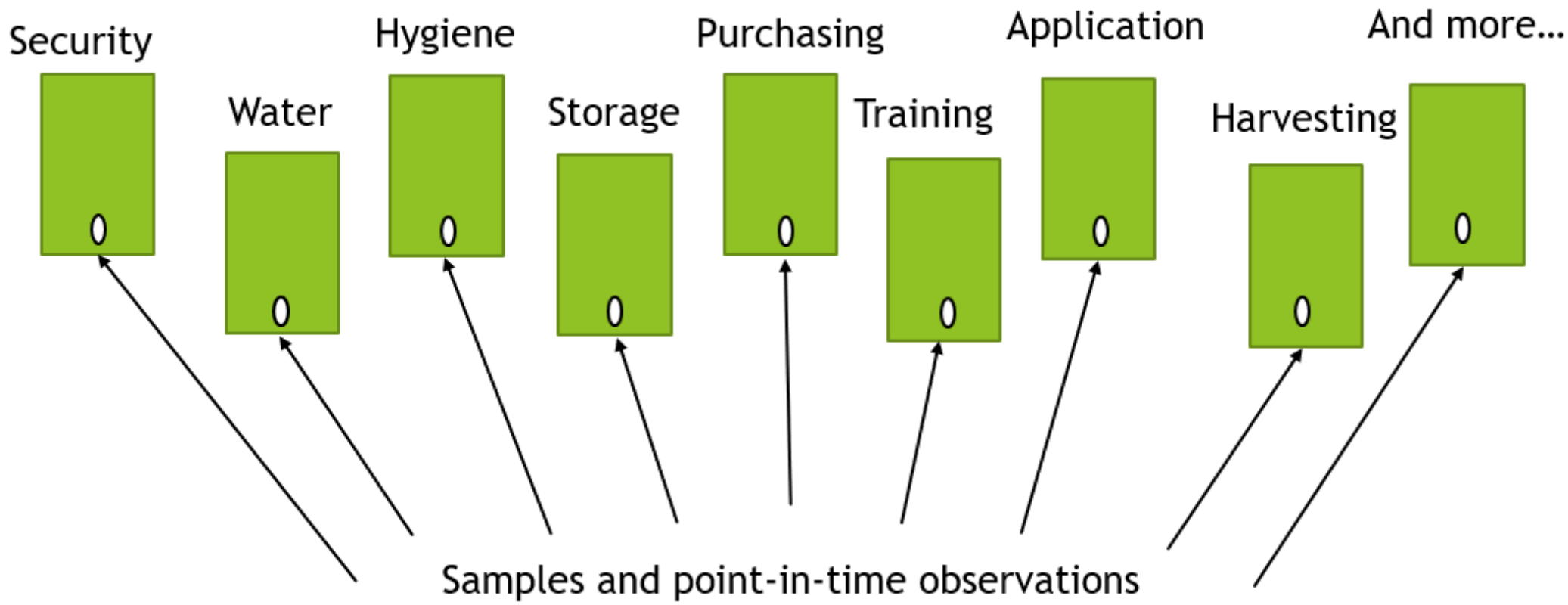


Compliance Verifications

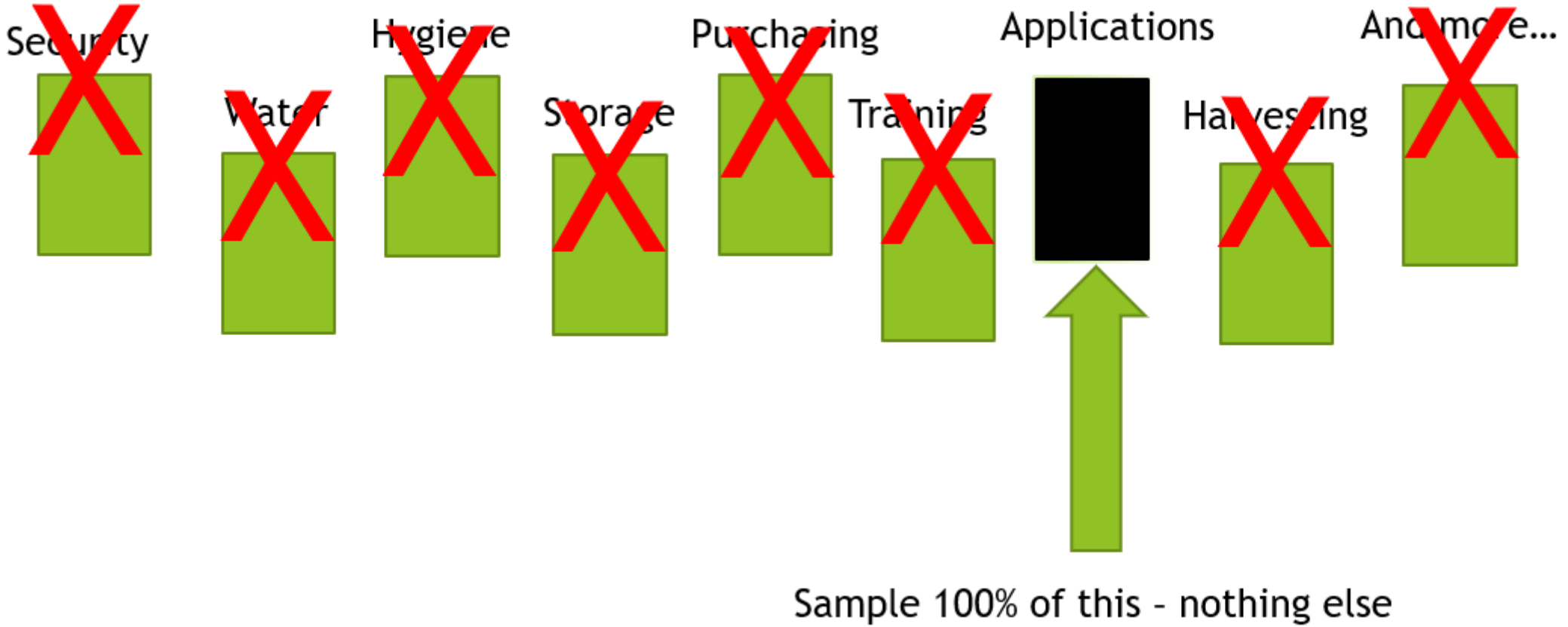
- Verify compliance to a regulatory standard – Crop examples
  - Growing Crops: EPA regulations (FIFRA/crop protection labels)
  - Harvested Food Crops: FDA regulations (FSMA et al)
  - Biotech Seed Research: USDA regulation
- Scored as Pass/Fail: 100% compliance needed to pass
- Consequences:
  - May be unable to sell crop if an error has been made
  - Fines
  - Negative publicity

Compliance Overview		Crop Protection Example
Describe	Regulatory Requirement	- Directions for Use (label) must be in the user's possession at time of application - Must apply to labeled crop at prescribed use rates
Prove	Record Activities	- What was applied - When - Whom - Where - Etc.
Verify	Outside entity checks to see if the rules were followed	- 100% of sprays are reviewed - Communicate non-compliance to relevant parties - Consequences

Data Collection for Process Verifications

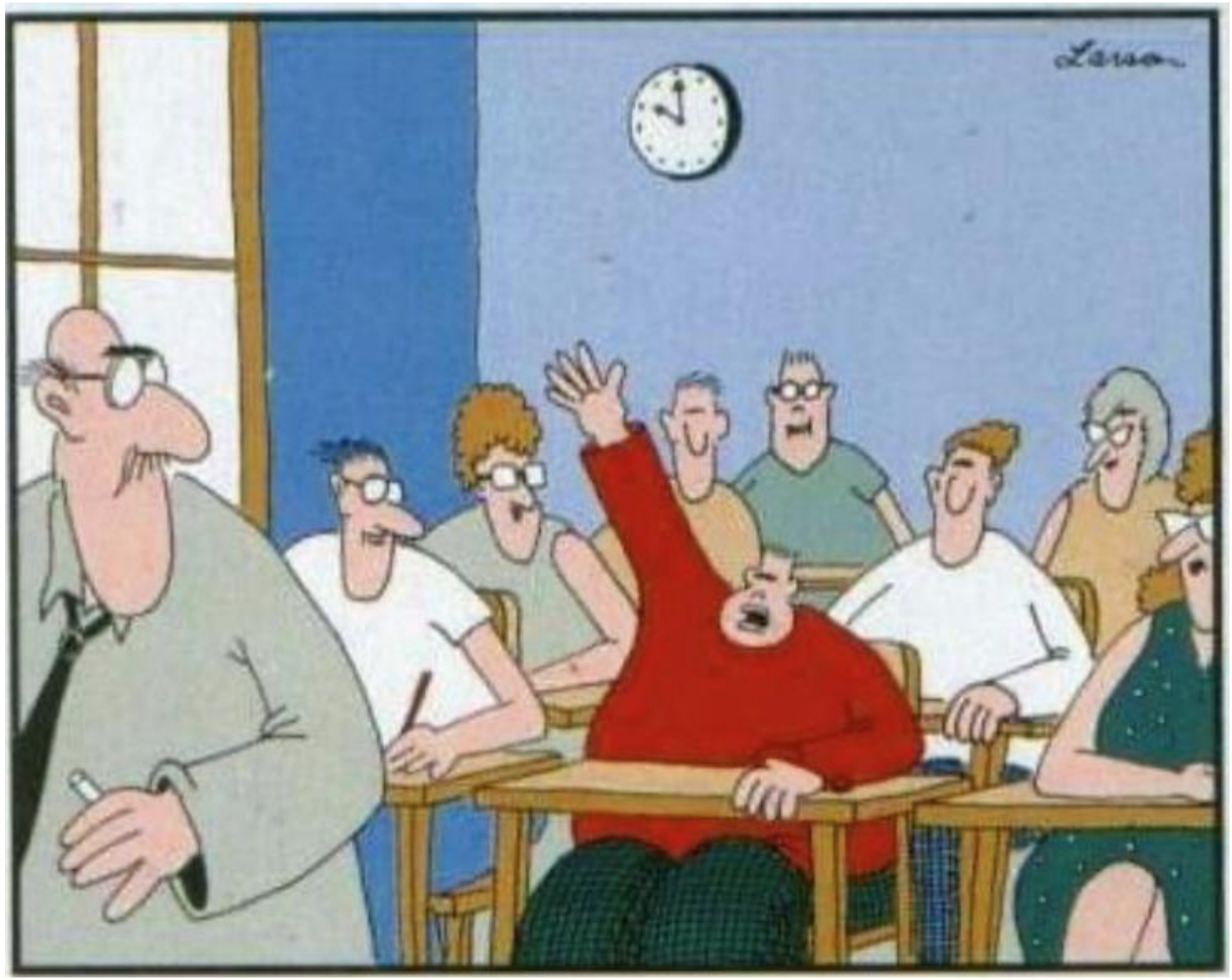


Data Collection for Compliance Verifications



Approaches to Food Safety Verification

- Process
  - Broad Scope
  - Evaluates the full system
  - “Point-in-Time” assessment
  - Small sample size
  - Findings and Cures
  - Advantage: Breadth
  - Examples: GAP, Organic
- Compliance
  - Narrow Scope
  - Evaluates a few select areas
  - Measure everything in a few critical areas
  - 100% = passing grade
  - Advantage: Deep dive
  - Example: Critereon’s Authentix



"Mr. Osborne, may I be excused? My brain is full."

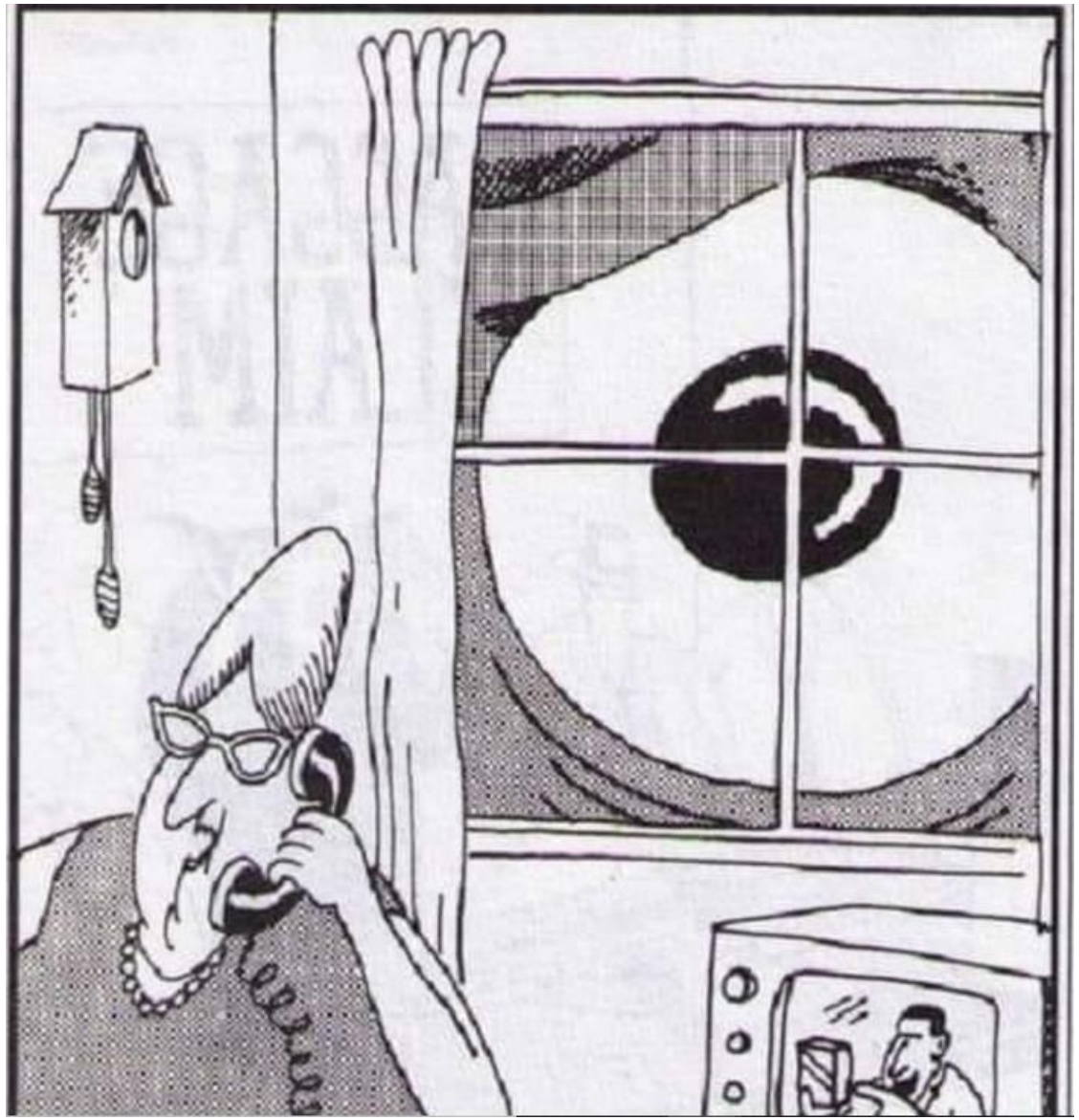
Compliance Verification

Why do a “Deep Dive” on Crop Protection Inputs?

Compliance Verifications: Why the “Deep Dive” on Crop Inputs?

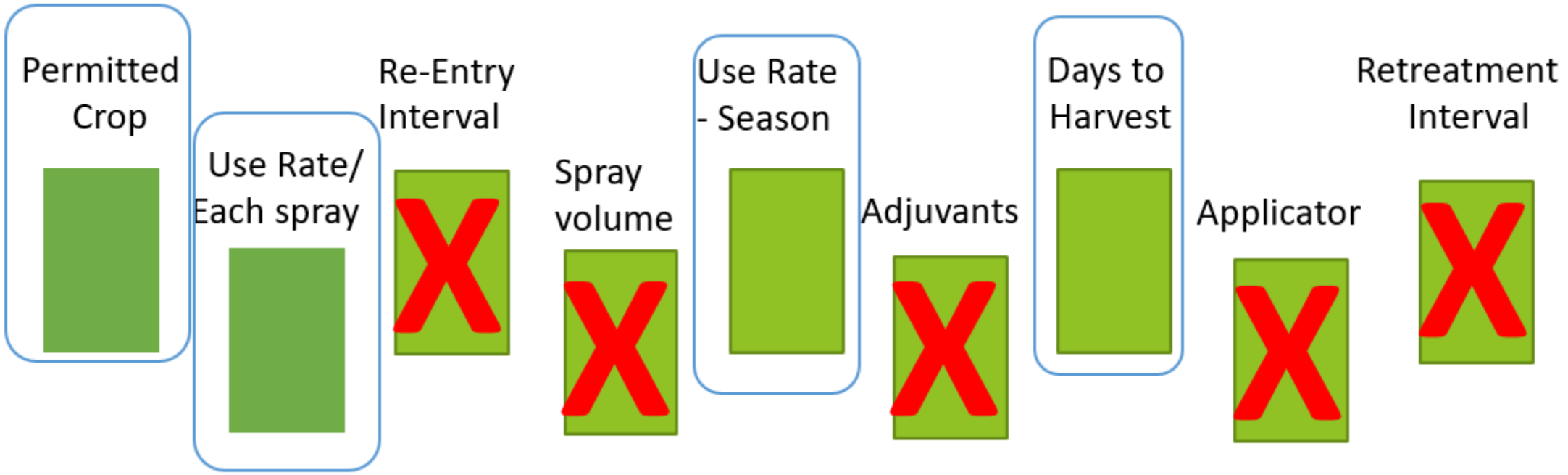
Crop Inputs:

- Beneficial while crop is growing – quality, yield
- Become a liability after harvest
- Get checked for residues by regulators



“Hello, Emily.
This is Gladys Murphy up the street.
Fine, thanks…Say, could you go
to your window and describe
what’s in my front yard?”

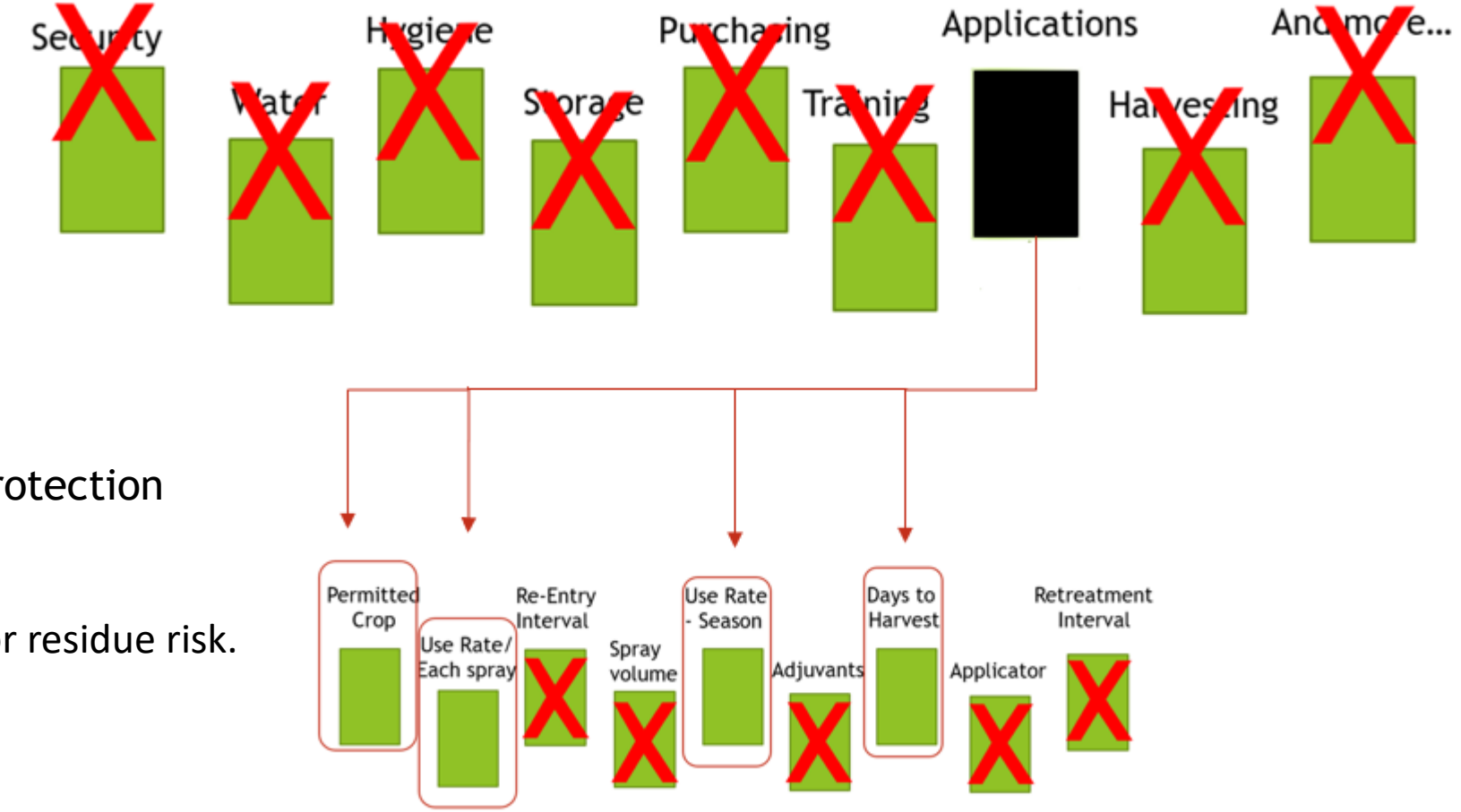
Crop Protection Residues – primary measurements



From a sampling of ***many*** farm Food Safety processes…

…To a deep dive of ***only*** Crop Protection application compliance…

…we isolate 4 factors to examine for residue risk.



Why do these 4 factors matter so much?

Crop Protection Residue Considerations

How/whether products break down (metabolic pathways)

- Soil/light
- Microbes
- Enzymes/oxidation

Chemistry

- Movement in plants
- Uses/functions/families

Unintentional application

- Tank contamination
- Drift
- Accidental application

Residue Considerations – Chemistry

Residue Considerations – Breakdown

- Soil/light degradation –
  - Example: pyrethroid insecticides
    - Pyrethrum breaks down in hours when exposed to sunlight
    - Addition of methyl group(s) yields synthetic pyrethroids – multiple days residual
- Microbial degradation
  - Example: glyphosate herbicide
  - Glyphosate binds to soil and quickly degraded by microbial action -> no soil residual
- Oxidation/enzymatic
  - Examples: many -> primary pathway for minimizing residues in harvested crops
  - Largely ceases upon harvest

Residue Considerations - Chemistry

- Movement in Plants - Systemic, Protectant, Mixed
  - Protectant – e.g., mancozeb: sits on the plant surface -> spray before disease is present
  - Systemic – many - e.g., glyphosate; moves into the plant to the site of action
- Uses/functions/families
  - Sethoxydim/Clethodim use in cucumbers
  - Same chemical family: both are “dim”, not “fop”
    - Sethoxidim (Poast®) has a PHI of 3 days
    - Clethodim (Select®/Volunteer®/others) has a PHI of 14 days

Residue Considerations – Unintentional Application

- Tank contamination
  - Inadequate cleanout and/or counting on dilution
- Drift
  - Weather conditions
  - Characteristics of crop protection compounds
- Accidental application
  - Wrong field
  - Change in cropping plans

Critereon Compliance Verification Efforts

Compliance Requirements

- Sprays entered
- “History is Complete” box is checked to confirm the record is complete
- A harvest date has been entered
- All sprays meet requirements:
  - Permitted Crop
  - Single spray use rate
  - Purchaser-specific criteria
  - Total Season Use
  - Pre-Harvest Interval (PHI)

Critereon Authentix

- Focus on measuring key on-farm factors which may influence whether crop protection residues are found in harvested crops
- Cooperative effort with growers and crop purchasers
- Both growers and potential purchasers receive notice of non-compliant sprays
- Growers and purchasers work to mitigate where possible

Using Third Parties to Verify

Why Use Third-Party for Process and Compliance Verification?

- Independence
- Specialization/Expertise
- Growers' programs can be verified one time for multiple crop purchasers
- Economics
- Customer requirements

TECHNOLOGY & QUALITY MANAGEMENT SERVICES

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Managing Cucurbit Downy Mildew

Dr. Mary K. Hausbeck and Matthew R. Uebbing

December 2021

Historically, Michigan growers produce over 1.4 million tons of cucurbits valued at about $83 million on 43,000 acres. Michigan ranks number 1 in the nation for production of pickling cucumbers, and in the top 6 for fresh market cucumber and fresh market/processing pumpkin and squash. Cucurbit downy mildew (DM), caused by *Pseudoperonospora cubensis*, infects cucumber, watermelon, cantaloupe, honeydew, zucchini, gourd, summer and winter squash and pumpkin. DM reemerged as a problem on Michigan cucumbers in August 2005 when the disease spread across the eastern region of the United States and has recurred annually since then.

Recognizing Downy Mildew on CUCURBITS

- Yellowing on top surface of leaves bound by veins
- Velvety or fuzzy dark spore growth on the underside of leaves

DM causes symptoms on the leaves similar to angular leaf spot. Yellow lesions may be visible on the top surface of infected leaves (Fig. 1A). The telltale sign of DM is the gray to black fuzz on the underside of the leaf giving a somewhat "dirty" or "velvet" appearance (Fig. 1B). This fuzz may be most evident in the morning.

DM is well-known for causing catastrophic losses in a brief period of time. *Ps. cubensis* is an obligate biotroph, meaning it cannot live long without a host plant. This condition restricts the pathogen to warmer climates during the winter months, including southern states and greenhouses. DM spreads to surrounding fields on air currents via tiny, microscopic spores that act as seeds of the pathogen. Cool (~ 60°F), wet, and cloudy conditions create an ideal environment for DM spores to survive outside the host. When the conditions are favorable, unprotected foliage can become completely blighted within 14 days of the initial infection, resulting in catastrophic yield losses.

To help achieve early detection of airborne spores, volumetric spore traps (Fig. 2A) have been placed in Michigan counties during the growing season. Spore traps continuously sample the air and collect spores by imbedding them on a film that is removed and taken to the laboratory for identification and quantification. Quantitative PCR (qPCR) is used to identify *Ps. cubensis* spores (Fig. 2A, inset) that are present on the tapes. The spore traps help us to detect the presence of spores in the production regions where the spore traps are located. Thus, when spore detection occurs, alerts can be issued for growers to begin their fungicide spray program.

Figure 1. A. Top side of cucumber leaf with yellow lesions and necrosis defined by the veins. B. Underside of cucumber leaf displaying dark fuzzy spore masses.

DM must be managed through a fungicide spray program. Before the DM outbreak of 2005, the disease was effectively controlled through host resistance. Since 2005, the formerly-resistant cultivars have showed slower progression of the disease; however, no current cucumber cultivar has been identified that exhibits complete DM resistance.

A fungicide management strategy should include application of the most effective products.

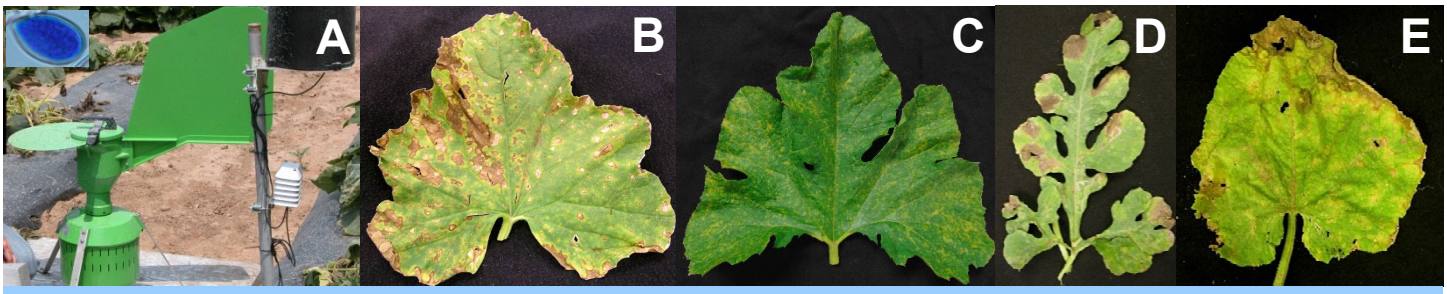

Figure 2. A, spore trap for monitoring airborne DM spores, inset (upper left) spore observed using a compound microscope and blue dye. DM on: B, cantaloupe, C, pumpkin, D, watermelon and E, yellow squash.

Figure 3. DM on A, untreated cucumber plants, and plants treated with B, Orondis, C, Previcur Flex, and D, Ranman

The Hausbeck Lab continues to evaluate new and existing products annually to determine the most effective fungicide products available for DM control (Fig. 3A-D). Research has found that the DM pathogen may be resistant to fungicides that were once extremely effective.

Rotating among FRAC groups (different modes of action) is imperative to delay development of resistance in the DM pathogen to new chemistries. The table below lists the products that have been tested and are effective against DM in field trials.

Preferred Downy Mildew Fungicides for CUCURBITS			
Product	**A.I.**	**FRAC**	**Comment (maximum applications/season)***
Orondis Opti**	oxathiapiprolin/ chlorothalonil	49/ M05	Do not use for more than 1/3 of the total foliar fungicide applications. (6)
Previcur Flex**	propamocarb	28	Mix with chlorothalonil or mancozeb. (5)
Ranman 4SC**	cyazofamid	21	Mix with chlorothalonil or mancozeb. (6)
Omega (Orbus)**	fluazinam	29	Mix with chlorothalonil or mancozeb. (4)
Zampro	ametoctradin/ dimethomorph	45/40	Mix with chlorothalonil or mancozeb. (3)
Elumin	ethaboxam	22	Mix with chlorothalonil or mancozeb (2)
Use the following fungicides before symptoms and in combination with other fungicides:			
Gavel 75DF	zoxamide/ mancozeb	22/ M03	(8)
Zing! SC	zoxamide/ chlorothalonil	22/ M05	(8)
Bravo Weather Stik	chlorothalonil	M05	See label for mixing restrictions. (10)
Koverall	mancozeb	M03	See label for mixing restrictions. Re-entry interval is 24 hours. (8)
***Follow label recommendations for resistance management.**			

* The pesticide label is the legal document on pesticide use; read the label and follow all instructions closely. The use of a pesticide in a manner not consistent with the label can lead to the injury of crops, humans, animals, and the environment, and can also lead to civil or criminal fines and/or condemnation of the crop. Pesticides are good management tools for the control of pests on crops, but only when they are used in a safe, effective and prudent manner according to the label

** Products considered to be especially effective based on Michigan field trials.

This material is based upon work that is supported by MSU project GREEEN, a Michigan Specialty Crop Block Grant awarded to the Michigan Vegetable Council, Pickle Packers International (Agricultural Research Fund and Pickle and Pepper Research Committee), and the National Institute of Food and Agriculture, U.S. Department of Agriculture, award number 2020-51181-32139.

Enhancing Food Safety Efforts with 3rd Party Verification of Crop Inputs

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1

Process Verifications

Examples: GAP, Organic

- Evaluate conformance/progress against known standards
- Broad Scope: Evaluates the full system
- Look for opportunities to improve conformance and quality
- Small sample set in every area – water, crop protection, fertilizers, storage, etc.
- Scored on a scale/percentage → Net result = certification (a passing grade)
- Result in Findings, Cures, Suggestions → lead to certification/de-certification
- Advantage: Breadth
- Disadvantage: Shallow in any one area

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2

Compliance Verifications

Example: Critereon's Authentix Spray Program

- Verify compliance to a regulatory standard – e.g.,
  - Growing Crops: EPA regulations (FIFRA/crop protection labels)
  - Harvested Crops: FDA regulations (FSMA et al)
  - Biotech Seed Research: USDA regulation
- Scored as Pass/Fail: 100% compliance needed to pass
- Consequences for noncompliance
  - May be unable to sell crop if an error has been made
  - Fines
  - Negative publicity

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Why Verify Compliance of Crop Inputs?

Crop Inputs…

- Beneficial while crop is growing – quality, yield
- Become a liability after harvest
- Get checked for residues by regulators

Residue Considerations

- How/whether products break down after spraying
- Chemistry with similar uses
- Chemistry from similar "families"
- Spray drift

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Critereon's Verification Efforts

- Focused on measuring key on-farm factors which may influence whether crop protection residues are found in harvested crops
- Designed specifically for food crops
- Deliver a daily report to clients listing growers and fields which comply with their purchasing requirements

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Critereon Authentix

Evaluates
- Crop protection sprays
  - Maximum use rates per application
  - Maximum seasonal totals
  - Pre-Harvest Intervals (PHI)
- Nutrients
- Old soil insecticides and heavy metal residues
- Surrounding land use
- Re-treatment intervals

Geography
- USA, Mexico, Canada
- (Greece, Peru, Chile, etc.)

Scope

30 crops
1,500 fruit and vegetable farms
200,000 acres of fruit and vegetables
~7,500 crop input products

Grower Reports
- Worker Protection Standard (WPS)
- Spray Logs designed for
  - Grower recordkeeping
  - Food Safety Audits

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6

Summary
Third Party Food Safety Verifications

- Process Verifications
  - Broad Scope
  - Evaluates the full system
  - Small sample in every area
  - Findings and Cures
  - Advantage: Breadth
  - Examples: GAP, Organic
- Compliance Verifications
  - Narrow Scope
  - Evaluates a few select areas
  - Measure everything in a few critical areas
  - Aims for 100% compliance
  - Advantage: Depth, especially for highly visible items like crop protection inputs
  - Example: Critereon's Authentix

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Offerings...

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8