
Food Security as National Security



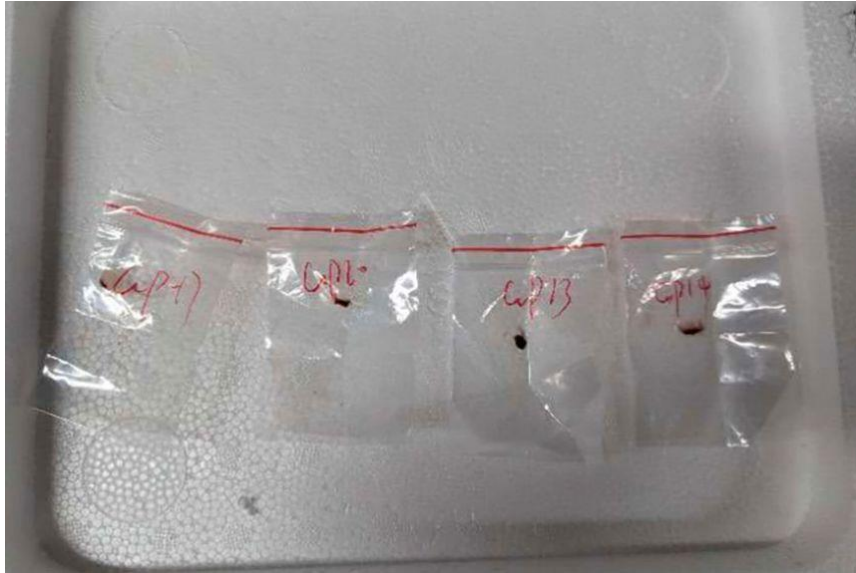
A Survey of Natural and Intentional Biological Threats to the U.S. Food Supply

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***Fusarium Graminearum*: A Recent Case**



Source: Associated Press, from United States District Court for the Eastern District of Michigan

- **Two Chinese Nationals, University of Michigan Researchers**
- **Charged with attempted smuggling of crop pathogen**

Executive Summary

PROBLEM

Developing threats
outpace current diagnostic
and investigative
frameworks.

Policy Implication

Understandings of agroterrorism are near obsolete in the contemporary threat landscape.

Policy Implication

Attribution and threat-differentiation processes for biological attacks are outdated and insufficient.

Policy Implication

Robust existing frameworks need gearing toward new technology.

Agricultural Terrorism Defined

“

Agroterrorism is the **deliberate introduction of a pathogen** against crops, livestock, or the food system — to undermine socioeconomic stability, generate public fear, or create general disorder.

Working definition used throughout this survey

Outbreak Case Studies

- 1916 — Glanders, U.S. East Coast
 - 1984 — Salmonella, Oregon
 - 1989 — Medfly, California
 - 1996 — Shigella, Texas
-

USDA Select Agents: Crop and Livestock Pathogens

9 CFR Part 121 (livestock) & USDA-PPQ (plant) · HHS–USDA Select Agents and Toxins List, 2025

LIVESTOCK PATHOGENS

13 agents

Foot-and-mouth disease virus ★	Mycoplasma capricolum
Rinderpest virus ★	Mycoplasma mycoides
African swine fever virus	Newcastle disease virus
Avian influenza virus	Peste des petits ruminants virus
Classical swine fever virus	Sheep pox virus
Goat pox virus	Swine vesicular disease virus
Lumpy skin disease virus	

PLANT PATHOGENS

6 agents

- Coniothyrium glycines
- Ralstonia solanacearum
- Rathayibacter toxicus
- Sclerophthora rayssiae
- Synchytrium endobioticum
- Xanthomonas oryzae

★ Tier 1 agents (highest priority)

Recent technological advancements outpace the utility of the literature's working definition for agroterrorism

Natural, Accidental, or Deliberate?



increasing intent →

A SPECTRUM, NOT A BINARY

Intent runs along a continuum; the clean Natural-or-Deliberate split rarely holds.

RARELY KNOWABLE IN REAL TIME

When a response is needed, the position on the spectrum is usually still unknown.



One Outbreak, Two Investigations

PUBLIC HEALTH

Stop the outbreak

Built for speed — contain spread and protect the public before the cause is even certain.

VS

LAW ENFORCEMENT

Prove who did it

Built for proof — court-admissible evidence that attributes the act to an actor.

Same outbreak. Opposite imperatives.

Who? Why? How Likely?

WHO

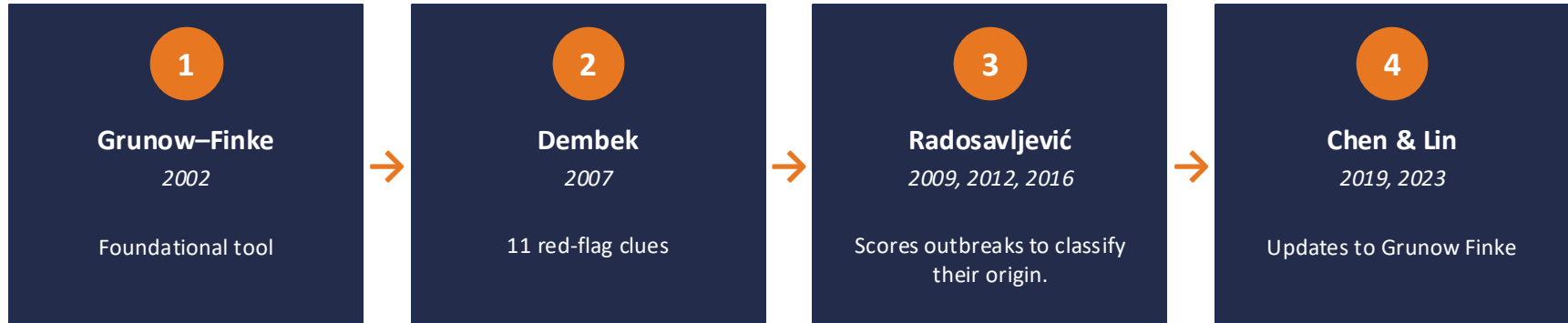
- Terrorists, domestic & international
- Economic opportunists
- Militant animal-rights groups
- Disgruntled employees

WHY

- Lone-wolf ideology
- Apocalyptic foretellings
- Political / religious motivations

But is it likely?

Evolution of Epidemiological Assessment Tools



OVERVIEW · Chen (2017)

Overview of models with developments, strengths, and weaknesses

DISSENT · Koch (2020)

Too hard to separate epidemiologically — prioritize preparedness & early detection.

AGRICULTURAL GAP

Almost all human-focused. Agricultural exceptions: Hugh-Jones (2006), Dembek (2007), Nichols (2015).

Government Policy Landscape

THREE MAIN THEMES

Investment in research

Biosurveillance &
monitoring

Coordination &
cooperation

Emerging Threats

Two technologies are reshaping what an agricultural attack can look like.

Synthetic biology

Lets bad actors culture and spread pathogens domestically — and AI software only lowers the barrier.

AI-generated deepfakes

Fabricated imagery could convince the public that an attack occurred, with no pathogen required.

THANK YOU

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Limitations of Current Definition

The working definition leaves two fast-growing threat vectors outside its scope.



Synthetic, bio-engineered pathogens

Lab-built or modified agents fall outside a definition framed around naturally occurring pathogens.



AI-driven misinformation campaigns

Manufactured belief that an attack occurred can do real damage without any pathogen at all.

EXCLUDED — yet increasingly central to the modern threat picture.

WOAH List A: The Literature's Framework

The literature leans on a threat list whose own gatekeeping criteria no longer exist.

Rapid spread, severe trade impact

List A threats were defined by fast transmission and serious trade consequence.

Weaponization-risk criteria

Inclusion criteria reflected weaponization risk and threat potential.

THE PROBLEM

WOAH removed these admission criteria in 2004 — making the literature's heavy reliance on the list inappropriate.

A framework still cited widely, but built on criteria abandoned two decades ago.

Federal Select Agent Framework

The one federally recognized system for delineating biosecurity threats.

- 1 Joint authority**
A combined USDA-APHIS and CDC framework reserved for agents that threaten U.S. national security.
- 2 Defined scope**
Covers biological agents and toxins that pose a severe threat to public, animal, and plant health.
- 3 Federally regulated**
Possession, use, and transfer of listed agents are controlled by federal law.

The only federally recognized framework for delineating biosecurity threats.

II.1

SECTION II · DISTINGUISHING NATURAL, ACCIDENTAL & DELIBERATE OUTBREAKS

Intentional or Accidental? Attribution Under Uncertainty

The character of an outbreak decides who responds — yet it's rarely knowable in real time.

INTENT IS A SPECTRUM, NOT A BINARY



- **Dembek (2007)** — attribution cuts both ways
- **Chalk (2004)** — agriculture is a “soft,” exposed target
- **RAND (2026)** — “crosscutting” threats resist the binary

Intent usually turns on people-centered evidence, not the disease event.

WHEN INTENT IS UNMISTAKABLE

Russia's 2022 strikes on Ukrainian grain — kinetic, unmissable intent.

THE HARD CASE

Fusarium graminearum (2025).

Pursued as a criminal matter; malicious intent never established.

II.2

Two Modes of Inquiry: Public Health vs. Law Enforcement

One outbreak, two investigations whose aims collide.

EPIDEMIOLOGICAL

Inductive · effects → causes

Aim — stop the outbreak fast

Built for speed, not the courtroom

VS

CRIMINAL

Attribute acts to actors

Aim — prove who did it

Needs court-admissible evidence (Richards 2002)

Butler et al. (2002, CDC–FBI): two paradigms forced together.

ANTHRAX — THE CAUTIONARY TALE

One flask — yet ≥100 had access; suspect died pre-trial. NRC: the match was overstated. (Koblentz & Tucker 2010)

THE AGRICULTURAL GAP

Expertise (animal health) and authority (law enforcement) stay split. Hoard et al. (2026): still an unmet capability.

II.3

Who, Why, and How Likely?

Is it an attack? Ask who, why — and how likely at all.

WHO · Knowles et al. (2005)

Access-focused

- Terrorists — domestic & international
- Economic opportunists
- Militant animal-rights groups
- Disgruntled employees

WHY · Keremidis et al. (2013)

Motive-focused

- Political / religious groups
- Apocalyptic sects
- Lone radicals

HOW LIKELY?

EXCEEDINGLY RARE

4

documented cases in ~65 years
(Keremidis 2013)

2 of ~12

20th-c. cases plausibly
terrorism (Chalk 2004)

Rarity ≠ safety. Chalk: easy but mundane — no spectacle (not peer-reviewed). Even “natural” resists certainty: the 2014–15 avian-flu route into farms was never established.

If intent can't be known, the question becomes how to act without it.

Grunow–Finke Assessment Tool (GFT)

Grunow & Finke (2002) - the earliest and most widely used model. Scores an outbreak against weighted criteria to estimate the likelihood of biological-warfare use.



THE 13 CRITERIA

11 non-conclusive: bio risk, biothreat, special aspects, geographic distribution, environmental concentration, epidemic intensity, transmission mode, time, unusually rapid spread, population limitation, clinical features.

2 conclusive: agent identified as a biological-warfare agent; proof of release by a biological weapon.

CHEN (2017) VERDICT

Least accurate of the tools reviewed. Strong at quantifying criteria, but weak sensitivity to attacks (**3 of 8 intentional cases**); criteria are subjective and time-intensive.

Dembek's 11 Epidemiological Clues

Dembek (2007) · eleven red-flag clues that a deliberate attack may have occurred, tested across six case studies.

1 Highly unusual event with large casualties

2 Higher morbidity / mortality than expected

3 Uncommon or non-endemic disease

4 Point-source outbreak

5 Multiple simultaneous epidemics

6 Lower attack rates in protected individuals

7 Dead animals in the area

8 Reverse spread (zoonotic crossover)

9 Unusual disease manifestation

10 Downwind plume distribution pattern

11 Direct evidence of release

Only tool to include **zoonotic diseases** — foundational to Radosavljević.

Limitation: the clues are red flags only — they offer no algorithm or model to differentiate outbreak types.

Radosavljević: Three Iterative Models

2009 → 2012 → 2012/2016 · each model builds on Dembek's clues and on its predecessor, moving from risk assessment toward full outbreak differentiation.



Each model scores qualitative and quantitative indicators 0/1, then sums to a probability band — see the next slide for how they diverge.

Radosavljević: How the Models Differ

Model	What it does	Scoring range	Validation / critique
2009	Risk assessment of a biological attack across 4 components (who, what, how, whom).	23 parameters, each 0/1	Tested only on Amerithrax — low external validity.
2012 (i)	Differentiates outbreak origin using person / time / place.	14 indicators → 1–4 natural ... 10–14 deliberate/accidental	Correctly classified 2 of 3 cases.
2012 (ii)	Expands to 4 outbreak types with richer criteria (the model Chen cites).	33 indicators → 0–8 lowly probable ... 25–33 certain	Differentiated 4 further cases correctly.
2016	Applies the 2012 (ii) model to the 2011 E. coli O104:H4 outbreak in Germany.	Same instrument as 2012 (ii)	A new application, not a new model.

Note: Chen (2017) attributes the second 2012 instrument to “Radosavljević 2016,” which is in fact the same model applied to a new case. Chen’s critique: refined criteria, but lacking quantitative measures.

Chen (2017): The Comparative Review

The lens over the field — benchmarks each tool against historical cases and tracks how they build on one another.

Tool	How it works	Retro. accuracy	Strength / weakness
GFT	Weighted 13-criterion score	8/13 overall; 3/8 attacks	Quantifies criteria / subjective, least accurate
Dembek	11 red-flag clues	4/6 cases	Includes zoonotic disease / no differentiating model
Rados. 2009	23-parameter risk profile	1 case (Amerithrax)	Detailed parameters / low validity
Rados. 2012/16	Refined multi-type scoring	2/3; +4 cases	Refined criteria / lacks quantitative measures

Chen's charge: improve sensitivity to attacks, specificity, and timeliness — and note that every tool has been tested only **retroactively**, never live during an epidemic.

Outbreak Case Studies, 1915–2017

▪ Agriculture & food-sector outbreak * Intentional attack

- **1915** — Anthrax, USA*
 - **1950** — *Serratia marcescens*, San Francisco*
 - **1971** — Smallpox, Aralsk*
 - **1979** — Anthrax, Sverdlovsk*
 - **1984** — **Salmonella, Oregon***
 - **1995** — Anthrax, Tokyo*
 - **1996** — **Shigella, Texas***
 - **1999** — West Nile Virus, New York City
 - **1999** — Tularemia, Kosovo
 - **2000** — Tularemia, USA
 - **2001** — Anthrax, USA*
 - **2003** — Ricin, USA*
 - **2009** — **Swine flu, Mexico & North America**
 - **2011** — **Haemolytic-uremic syndrome, Germany**
 - **2012** — MERS, Saudi Arabia
 - **2013** — Rabies, Taiwan, China
 - **2013** — Ebola, West Africa
 - **2017** — **Norovirus, Beijing**
-

Agriculture & Food-Sector Cases

A closer look at the outbreaks with direct food-supply, livestock, or food-terrorism significance.

1984

Salmonella (Oregon)

Deliberate contamination of salad bars — the classic U.S. food-terrorism case.

INTENTIONAL

1996

Shigella (Texas)

A disgruntled lab technician deliberately contaminated breakroom pastries at a Dallas medical center with a rare, severe strain of *Shigella dysenteriae* — an act of food tampering.

INTENTIONAL

2009

Swine flu (Mexico / North America)

Swine-origin disease with major implications for livestock industries, trade, and consumer confidence.

2011

E. coli O104:H4 / Hemolytic-uremic syndrome (Germany)

Major foodborne outbreak linked to contaminated sprouts; caused substantial agricultural and economic losses.

2017

Norovirus (Beijing)

Outbreak including a foodborne cluster tied to contaminated food handlers or food products.

Developments of the GFT

Since 2002 the GFT has been recalibrated to cut subjectivity and sharpen its sensitivity to unnatural outbreaks.

CHEN (2019)

Recalibrating the score

- Removed weak criteria and adjusted weighting factors.
- Added refinement criteria across model iterations.

38% → 100%

sensitivity to unnatural outbreaks (100% specificity retained)

LIN (2023)

Grey Relational Analysis

- Added 5 new criteria to the GFT: types of biological agents, point source outbreak, concurrent outbreak, reverse zoonotic transmission, intelligence
- Scores each outbreak against an “ideal” unnatural case using GRA — objective and suited to small samples.

100%

retrospective accuracy on original + new case studies

Both cite advances in **synthetic biology and genetic engineering** — making differentiation harder, and more important.

Accidental Outbreaks of Laboratory Origin

Pilch (2020) & Dhawan (2026) · a parallel vein that uses genetics and epidemiology to characterize accidental releases from a laboratory.

1

PILCH (2020)

Genetic mutation signatures

- Sequence the sample and compare its genome with well-characterized genomes of the same strain.
- Mutations consistent with the natural strain point to a natural origin.
- Inconsistent or unexpected mutations flag a possible alternative — e.g., laboratory — origin.

2

DHAWAN (2026)

Lab-associated indicators

- Combines epidemiological and genetic indicators characteristic of a laboratory-linked release.
- Extends the lab-origin question with more recent forensic and surveillance evidence.
- Reinforces that accidental release sits between “natural” and “deliberate” on the intent spectrum.

Like **Dembek and Hugh-Jones**, both supply indicators and red flags — not a model that formally differentiates outbreak origin.

Nichols (2015): A Disease-Specific Roadmap

An EPA roadmap for *Bacillus anthracis* — a rapid, easy-to-use key separating natural from intentional outbreaks in humans **and** animals.

1 Unexpected genetic strains

Strains that do not match the expected natural population.

2 Vaccine-efficacy anomaly

Disease appearing where vaccination should have prevented it.

3 Site anomalies

Environmental or location signals inconsistent with a natural source.

4 Epidemiological anomalies

Spread, timing, or distribution patterns that defy natural spread.

WHY IT MATTERS

Addresses the **agricultural gap** that human-focused tools leave open.

Disease-specific and **fast** — a usable field key, not a research instrument.

Covers **humans and animals**, a possible template for filling the crop & livestock gap.

Agricultural Biological Threats: How Each Source Contributes

Three frameworks, three distinct lenses on the agricultural threat picture which is unique.

Hugh-Jones (2006)

- Analyzes intentional outbreaks targeting livestock and crops
- Impacts are delayed & economic: trade loss, export bans, control costs
- Extended case: Newcastle disease; contaminated feed, illegal imports, farm epidemiology

Dembek (2007)

- Dead animal data increase sensitivity for detecting deliberate epidemics
- Livestock deaths & herd illness absent from prior bioterrorism tools
- Livestock are early-warning indicators for zoonotic threats before human cases appear

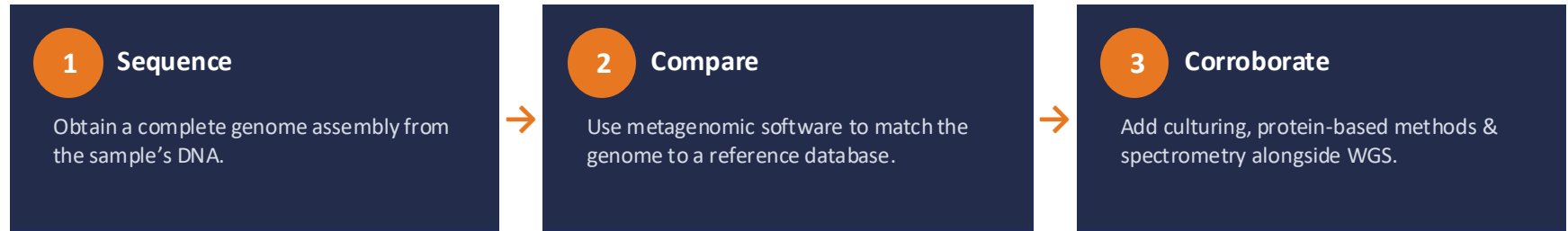
Nichols (2015)

- Livestock anthrax cases from Sverdlovsk release — 67 km on same wind vector
 - Flags animal-specific anomalies: populations unexpectedly resistant to anthrax
 - Epidemiological patterns distinguish natural from intentional anthrax at farm scale
-

Gene Sequencing in Microbial Forensics

Gilchrist (2015) argues DNA sequencing is faster and more accurate than information-limited, real-time assessment tools.

WHOLE-GENOME SEQUENCING (WGS) — THE GILCHRIST PIPELINE



OLIVEIRA (2024) • NEXT-GENERATION SEQUENCING (NGS)

A faster WGS technology that reads **longer genetic sequences and yields more data**. Together, Gilchrist & Oliveira map the route of transmission and the probable source of an outbreak.

Genetic Markers of a Deliberate Introduction

A whole genetic fingerprint can reveal modification, weaponization, or novelty. The clearest marker is **genetic engineering**.

1 Engineered virulence

Virulence altered beyond what the natural strain exhibits.

Hugh-Jones

2 Diagnostic evasion

A pathogen built to evade standard diagnostic DNA tests.

Hugh-Jones

3 Genome discontinuities

Breaks in the genome suggestive of human engineering.

Hugh-Jones, Pilch

4 Inconsistent mutations

Mutations that diverge from the known natural strain.

Pilch

5 Phylogenetic anomalies

Evolutionary-tree mismatches flagging modified segments.

Gilchrist

Today microbial forensics **supports** epidemiological tools. As synthetic biology advances, future models should weight it far more heavily.

Technology & the Future

Mathematical, algorithmic & geospatial methods — mostly built to **track and predict spread**, with potential to help distinguish origin.

FLETCHER (2006)

Weather & spatial modeling

- The Australian **DYMEX** weather-based model asks whether site conditions would even support natural disease development.
- Pairs with spatial-pattern algorithms to flag unnatural spread.

MACINTYRE (2018)

Modeling & open-source intel

- Mathematical transmission models track outbreak dynamics and impact.
- Open-source intelligence (**OSINT**) supports early detection — popular in academia, rarely used in practice.

The open question: Can these methods reliably separate natural from deliberate outbreaks?

Bioterrorism Preparedness Act (2002)

- Expanded FDA authority over food manufacturing and imports, and imposed stricter controls on the movement and transfer of select biological agents.
 - Created the Federal Select Agent Program jointly with the CDC, establishing regulated oversight of the most dangerous pathogens.
 - Expanded security at USDA sites, the first major post-9/11 statute to directly address agricultural bioterrorism prevention.
-

Homeland Security Act (2002)

- Created the Department of Homeland Security and transferred agricultural border inspections from USDA to Customs and Border Protection, while USDA retained a significant presence.
 - Transferred jurisdiction over the Plum Island Animal Disease Center to DHS, a key federal facility for researching dangerous animal pathogens.
 - Set the template for USDA-DHS cooperation that would define executive agroterrorism policy for the following two decades.
-

Post-Katrina Emergency Management Reform Act (2006)

- Redefined how the federal government responds to emergencies by incorporating both 'natural disasters' and 'acts of terrorism' under a unified all-hazards framework.
 - Did not address agroterrorism directly but established the emergency response infrastructure that applies to agricultural biological attacks.
 - Marked the first time formal rapid-response mechanisms capable of covering an agroterrorism event were encoded into federal law.
-

Food Safety Modernization Act (2011)

- Shifted the FDA's posture from reactive to preventive, requiring food facilities to assess their own vulnerabilities and implement forward-looking controls.
 - Mandated explicit strategies to prevent intentional adulteration—i.e., deliberate sabotage—of food at processing and production facilities.
 - The most comprehensive overhaul of federal food safety authority in decades, covering both human and animal food supply chains.
-

Homeland Security Presidential Directive 7 (HSPD-7)

- Required all federal agencies to develop risk-mitigation plans and guidelines for protecting critical infrastructure from terrorist threats.
 - Formally classified 'agriculture and food' as critical infrastructure for the first time, placing it alongside energy, transportation, and water.
 - Established the framework for agency-level implementation across USDA, DHS, HHS, DOJ, and EPA—the agencies that would carry forward agroterrorism policy.
-

Homeland Security Presidential Directive 9 (HSPD-9)

- The first executive directive focused exclusively on food and agriculture: ordered intelligence sharing on biological threats to the sector among six federal agencies and the Director of Central Intelligence.
 - Directed agencies to strengthen surveillance and monitoring programs to identify, detect, and track biological agents threatening agriculture.
 - Promoted higher education initiatives in veterinary medicine, animal disease, and plant pathogens—directly responding to the shortage of qualified agricultural biosecurity personnel.
-

Strategic Partnership Program Agroterrorism (SPPA) Initiative

- Interagency partnership launched in 2005 among DHS, USDA, FBI, FDA, and private-sector partners to assess food and agriculture sector vulnerabilities.
 - First annual report (2006) identified food processing and agricultural production as the highest-risk sites, and prescribed physically securing facilities, site-specific vulnerability assessments, and biosecurity practices such as isolating new livestock.
 - Published two annual status reports (2006 and 2007); no further public reports were identified after 2007, leaving the initiative's continuity unclear.
-

National Biosurveillance Science and Technology Roadmap (2013)

- Published by the National Science and Technology Council to build on the prior National Strategy for Biosurveillance, translating strategic objectives into specific research and development priorities.
 - Identified three cross-cutting needs: advanced anomaly-detection models for communities and ecosystems, integrated data technologies for synthesizing biosurveillance information, and faster diagnostic tools for earlier threat detection.
 - The Roadmap represented the federal government's most technically detailed statement on biosurveillance infrastructure, though implementation remained uneven.
-

USDA Office of Inspector General Audit Report (2017)

- Concluded that USDA had not sufficiently developed the plans, guidelines, or operational processes needed to combat agroterrorism—more than fifteen years after the first major post-9/11 legislation.
 - Found that OHSEC (the Office of Homeland Security and Emergency Coordination) lacked a detailed process for overseeing USDA's agroterrorism response, relying instead on 'broad and high-level' directives.
 - Individual USDA agencies were managing their own response plans without cross-agency coordination or synthesis—the same interagency gap flagged by earlier scholarship and directives.
-

National Security Memorandum 16 (NSM-16)

- Directed USDA, HHS, and DHS to conduct risk analyses, vulnerability assessments, and policy reviews of the food and agriculture sector, with an emphasis on coordinated multi-agency effort.
 - The resulting 120-Day Interim Risk Review (2023) identified three core security risks: concentrated market power in the industry, foreign acquisition of U.S. farmland, and a preparedness gap between the federal government and the private sector.
 - Provided short-, mid-, and long-term coordination frameworks for federal, state, and local authorities—the most structured agroterrorism response framework to date.
-

National Farm Security Action Plan (2025)

- Expressed concern about the acquisition of U.S. farmland by foreign nationals, particularly from adversarial nations, framing agricultural land ownership as a national security issue.
 - Directed USDA to ensure that all research and programs within the Department support American agricultural interests and do not benefit 'adversarial interests.'
 - Called for minimizing reliance on international agricultural supply chains and investing in domestic manufacturing — reflecting a geopolitical framing of agricultural security distinct from prior administrations.
-