



HACCP Compost for Fruit and Vegetable Production



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What is HACCP?

What does it have to do with Compost?

HACCP: Hazard Analysis and Critical Control Point

A system which identifies, evaluates and controls hazards that are significant for food safety.

HACCP plans are usually designed for specific products or product groups.

Compost is a product and an input (soil amendment) in fresh produce cropping systems.



Composting & Fresh Produce Pathogens

- Pathogens are significantly reduced in properly composted O.M.
 - Bacteria, parasites, viruses
 - **N.B.!** Product is not considered 'pathogen-free'
- Production System Input Controls
 - Microbial standards for soil amendments
 - Protect Leafy Greens & Herbs, tomatoes, peppers etc.



HACCP Steps

5 Pre-Steps

- **Assemble the HACCP Team**
- **Describe Product**
 - Include composition, physico-chemical structure, microcidal treatments, packaging, storage, distribution
- **Identify intended uses**
- **Construct Process Flow diagram**
 - Diagram all steps of the operation including steps preceding and following the specified operation.
- **On-site confirmation of flow diagram**
 - Determine that the flow diagram is aligned with actual operations.

7 Steps of HACCP

1. Conduct a hazard analysis
2. Determine Critical Control Points (CCPs)
3. Establish Critical Limits
Develop processes that limit risk at CCPs.
4. Monitor CCPs
Develop process to ensure critical limits are followed
5. Establish preplanned corrective actions to be taken
6. Establish procedures for verification
7. Ensure proper documentation and records of HACCP process are maintained



1. Microbial Hazards

- **Bacteria**: growth can occur outside the host
 - *E. coli* O157:H7, *Salmonella*, *Listeria monocytogenes*, *Campylobacter* (animal manure)
- **Viruses**: **no** growth occurs outside the host
 - Hepatitis E (swine), H5N1 (avian, Orthomyxoviridae)
- **Parasites**: **no** growth occurs outside the host
 - *Cryptosporidium parvum* (bovine, swine, sheep manure)
 - *Giardia lamblia* (bovine & swine manure)
 - *Ascaris ova* (animal manure)

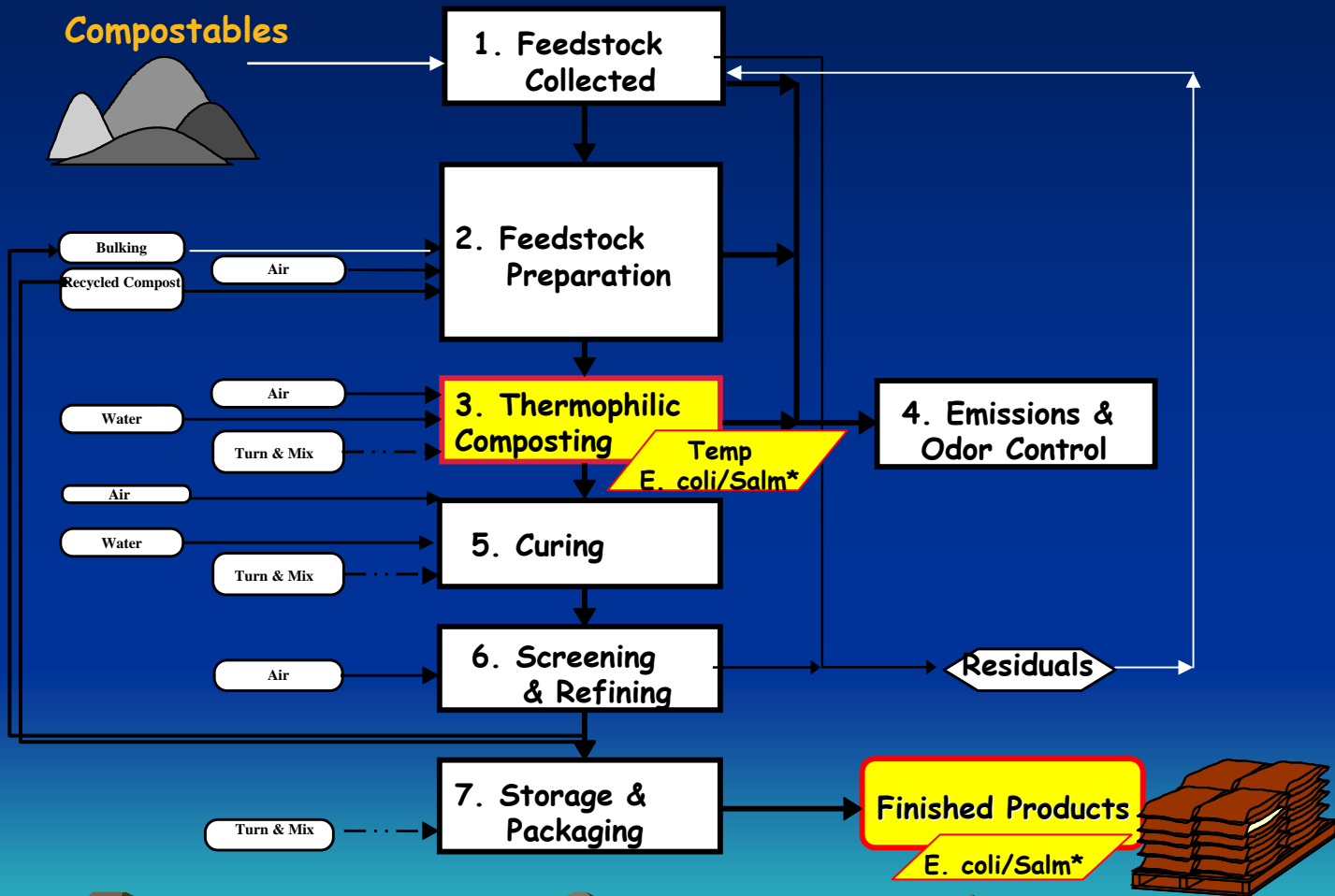
II. Leafy Green Metrics for Soil Amendments

Addresses Step 3 of HACCP relative to Composting

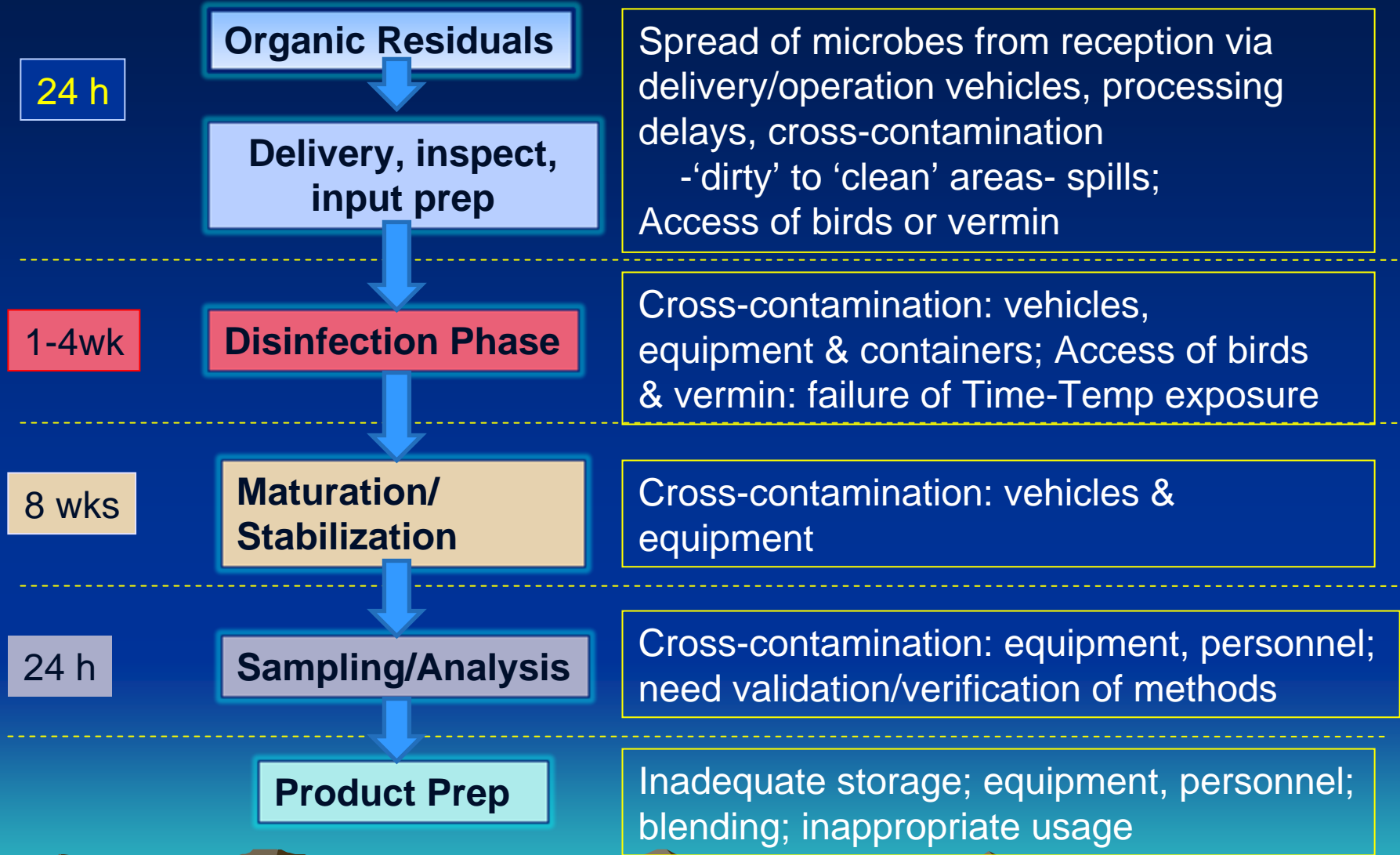
- **Fecal coliforms** <1000 MPN/gm
 - 3-tube, 3 dilution (9-tube)^α
- ***E. coli* O157:H7: Negative, < Detectable**
 - (<1/ 30 gms) BAM (FDA) *, EPA, AOAC, etc.
- ***Salmonella* spp.: Negative, < Detectable**
 - (<1/ 30 gms) (EPA 1682 biosolids method)[±]



Critical Control Points for Process Control, Monitoring and Sampling



II. CRITICAL CONTROL POINTS for COMPOSTING



Pathogen Disinfection Criteria

- **PROCESS BASED**: Time-Temperature
 - Establish threshold values for destruction of most resistant pathogens
- **MICROBIALLY BASED**: Measure presence and amount of pathogens or indicators before and after treatment



Requirements for Class A Equivalent Treatment

COMPOSTING

Extended actively aerated static piles:

>55° C, for 3 consecutive days

Windrows:

≥ 55° C, for ≥ 15 days with at least five (5x) windrow turnings during this time.



Criteria for Meeting Class A Requirements

PARAMETER	UNIT	LIMIT
Fecal Coliform	MPN/g TS	1000
or Salmonella	MPN/4g TS	<3



AND

ONE OF THE FOLLOWING PROCESS OPTIONS

Temp/Time based on % Solids

Pre-test: Enteric Virus/
Viable Helminth Ova

Composting

Thermophilic Aerobic Digestion

Beta Irradiation

Pasteurization

Alkaline Treatment

Post test: Enteric Virus/
Viable Helminth Ova

Heat Treatment

Heat Drying

Gamma Irradiation

'PFRP' Equivalent Process

Criteria for Meeting Class B Requirements



PARAMETER

UNIT

LIMIT

Fecal Coliform

2,000,000

MPN/g TS

AND

ONE OF THE FOLLOWING PROCESS OPTIONS

Aerobic Digestion
Anaerobic Digestion
Lime Stabilization

Air Drying
Composting
PSRP Equivalent

UK Compost Time-Temp Requirements

System	Minimum temp	Minimum time at minimum temp	Max particle size
Composting (closed reactor)	60°C	2 days	400mm
Biogas	57°C	5 hours	50mm
Composting (closed reactor) or biogas	70°C	1 hour	60mm
Composting (housed windrow)	60°C	8 days (in which windrow is turned at least 3 times, at no less than 2 day intervals)	400mm

Quality Assurance Management System

Reduce the risk of handling and distributing unsafe products

- Process
- Premises
- Transportation and Storage
- Equipment
- Personnel
- Sanitation & Pest Control
- Recall

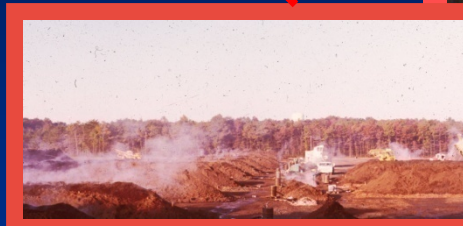


Types of Composting

- **Static Actively Aerated Pile**



- **Agitated Bay**



- **In-Vessel**

- **Windrow**

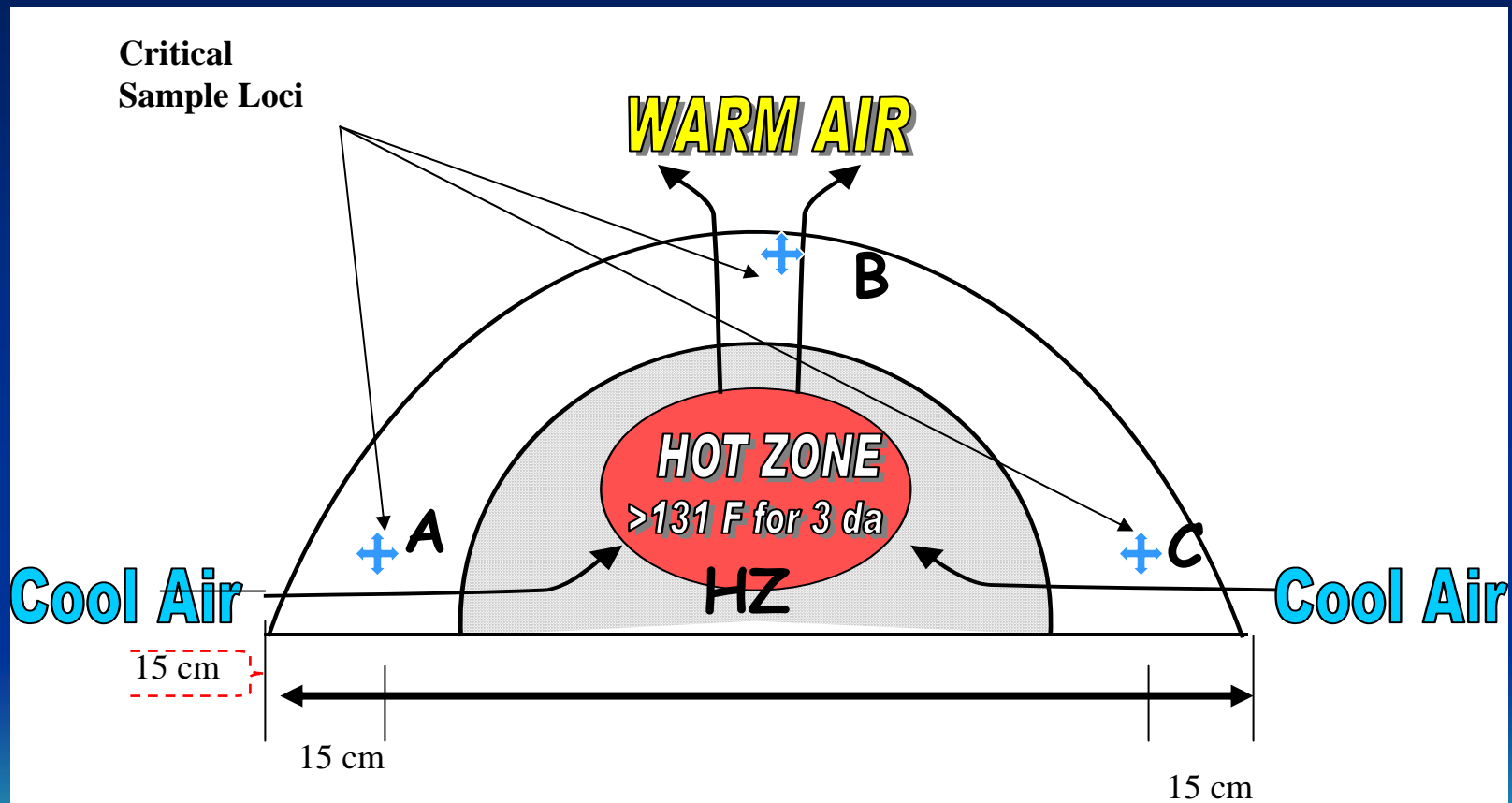
- **Bin**



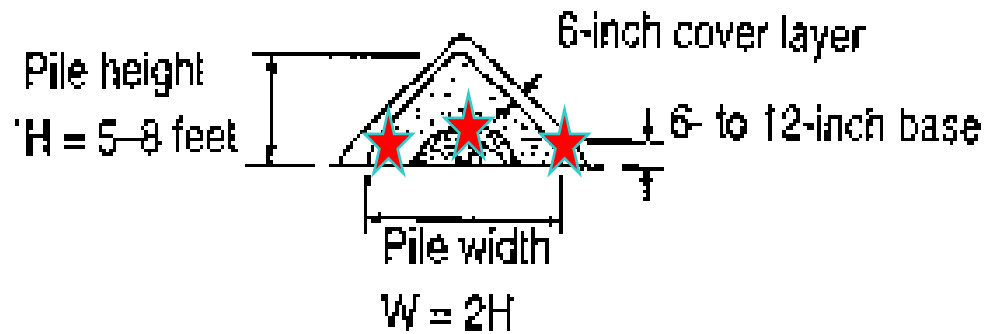
- **Static Passively Aerated Pile**

- **Vermi-compost**

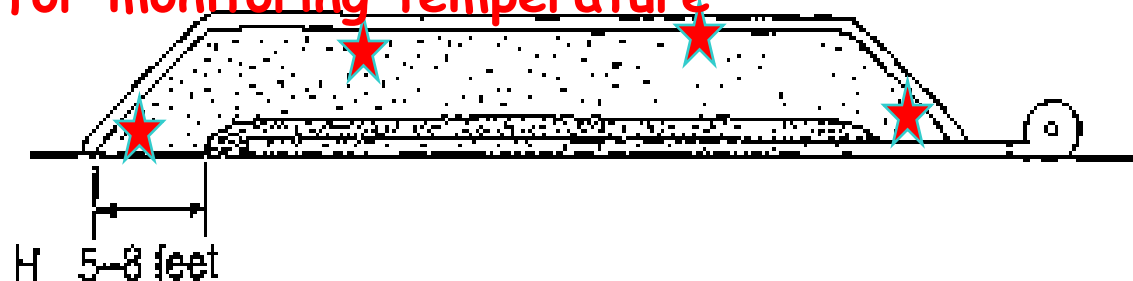
Compost Windrow Temperature Gradient (Cross-Section) with Recommended Sample Points at the Toe Ends



Critical Sampling Loci (A & C) relative to the "Hot Zone" (HZ) and Positive Checkpoint (B)

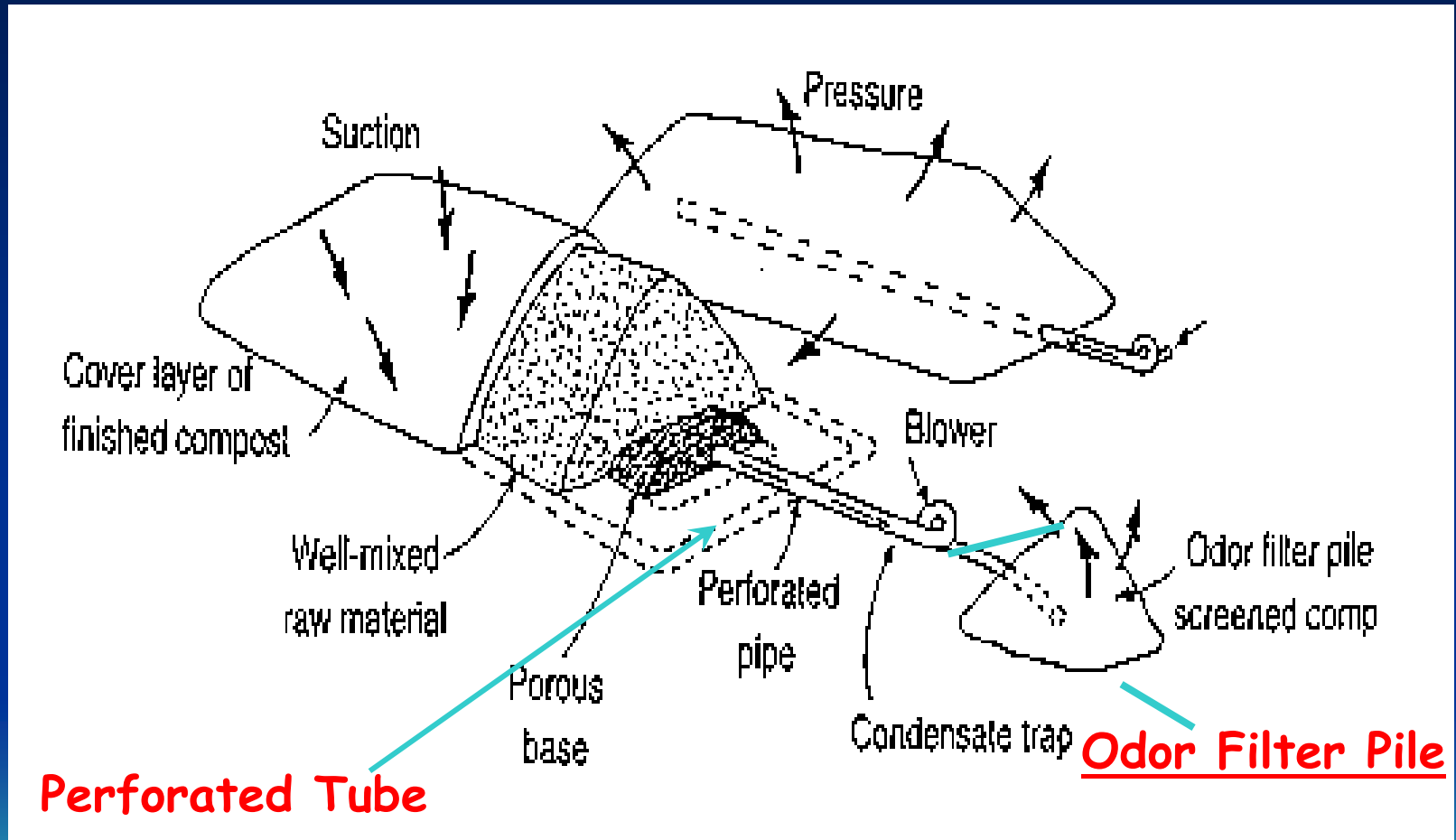


★ Points for monitoring temperature

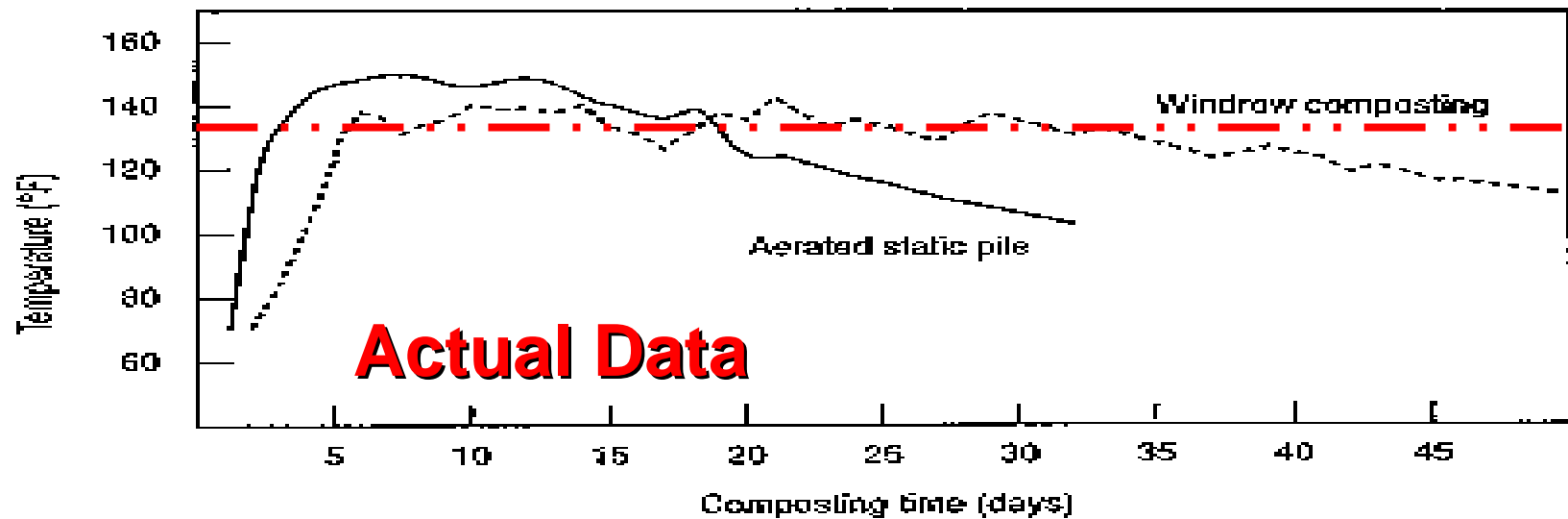
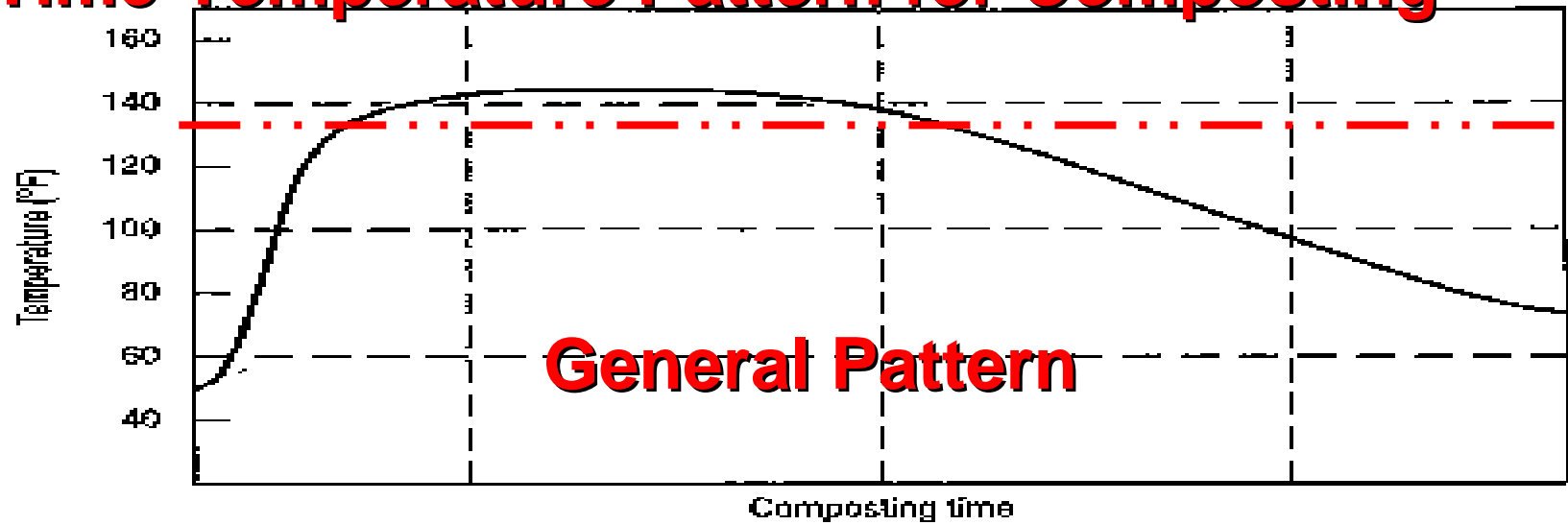


Aerated static pile layout and dimensions.

Static Aerated Compost Pile

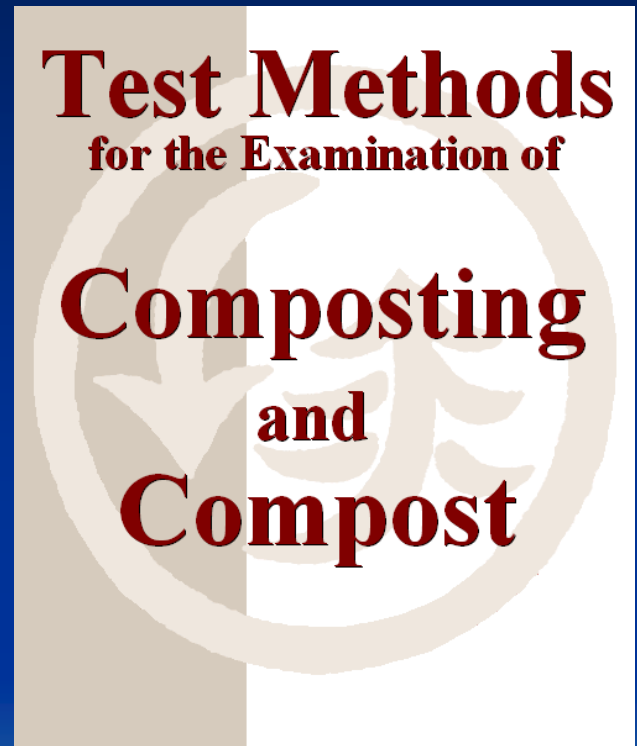


Time-Temperature Pattern for Composting



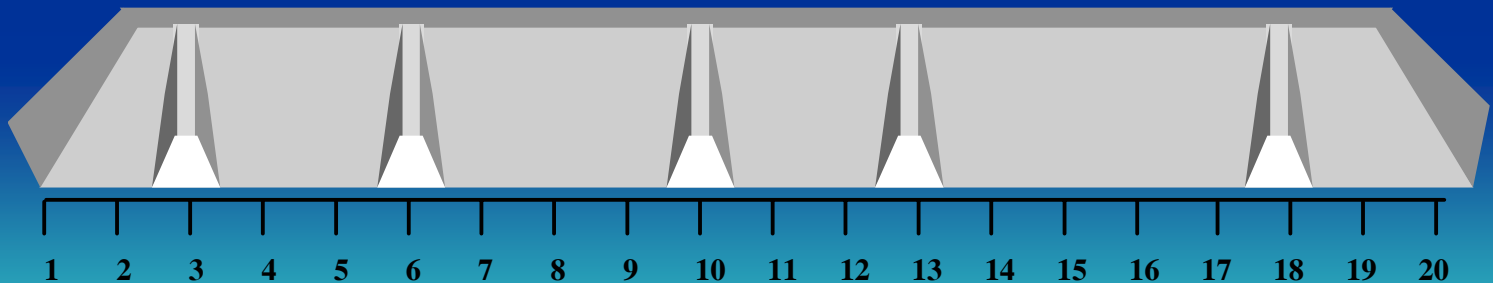
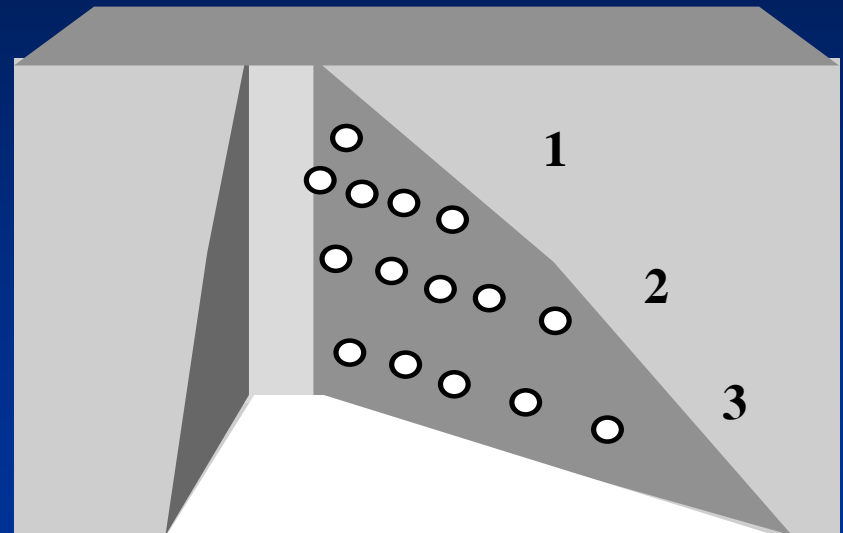
Sampling- When, Where, How Much

- USEPA 503 guidance for biosolids compost
- TMECC – US Composting Council



Sampling Compost Piles

- Selection of Sampling Locations
 - TMECC 2.01-B
 - *Composite Point-Samples*
 - *Stratified Samples across and/or within Cutouts*



Microbial Tests for Compost

- EPA 1680 Fecal Coliforms for Biosolids
- EPA 1682 Salmonella for Biosolids
 - Validated for treated biosolids
 - At least 15-tube (5 x 3) MPN
 - At least a 30 g sample
- **No *E. coli* test validated for compost**
- **No *E. coli* O157:H7 test validated for compost**



Western Growers Metrics for Soil Amendments

- Fecal coliforms <1000 MPN/gram
 - 3-tube, 3 dilution (9-tube) ❌
- *E. coli* O157:H7: Negative, < Detectable (<1/ 30 grams)
 - BAM (FDA) *, EPA, AOAC, other approved method
- *Salmonella* spp.: Negative, < Detectable (<1/ 30 grams) (EPA 1682) ±
- ❌ does not meet EPA basic compost detection method
- * food/other methods; not validated for composts; specify TS/wet wt.
- ± assumption: biosolids compost method OK for other composts



Western Growers Metrics for Soil Amendments

- **Sampling Plan:**
 - 12 point sampling plan composite sample (divide each lot/pile into a 3 x 4 grid and extract 12 equivolume samples.)
- Sample may be taken by the supplier if trained by the testing laboratory
- Laboratory must be certified/accredited for microbial testing by an appropriate process authority



Critical Technical Issues

- Sampling and Compositing
 - Training, standardization, shipping
- Sample preparation and handling
 - Sample homogenization, splitting
- Primary dilution amount
- Dilution / enrichment protocol(s)
- Target Microbe detection
 - Standardization



Compost Analytical Testing Needs

- **Establish a quality assurance plan for each microbial target assay, include appropriate controls and lab performance standards for compost samples.**



Compost Specifications:

- 1) **Grade or category designations**
- 2) **Appropriate end-use and limitations**
- 3) **Feedstock ingredients**
- 4) **Process descriptions including cure times**
- 5) **Contamination limits, including regulatory standards**
- 6) **Physical-chemical characteristics e.g. pH**
- 7) **Performance characteristics**
- 8) **Adjusting for local conditions (soil, etc.)**
- 9) **References (literature, web sites, etc.)**
- 10) **Vendor notes (delivery, spreading, etc.)**



Compost and Mulch Benefits the Agriculture in a Number of Ways

1. Supplies macro- and micronutrients
2. Supplies beneficial microorganism
3. Suppresses certain soil-borne diseases
4. Binds and degrades specific pollutants
5. Improves soil tilth
6. Water holding capacity
7. Improves soil drainage potential
8. Reduces the need for fertilizers and pesticides
9. Encourages slow release of nitrogen
10. Improves drought tolerance
11. Improves plant health and vigor
12. Increases biodiversity



QUESTIONS?



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