

Managing microbiological hazards in fruit and berry production and harvesting

PROGRESS regional training webinar

**“Strengthening the capacity of fruit and berry producers in the
Eastern Partnership (EaP) to access the EU market”**

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Content

1. Overview of EU regulatory requirements

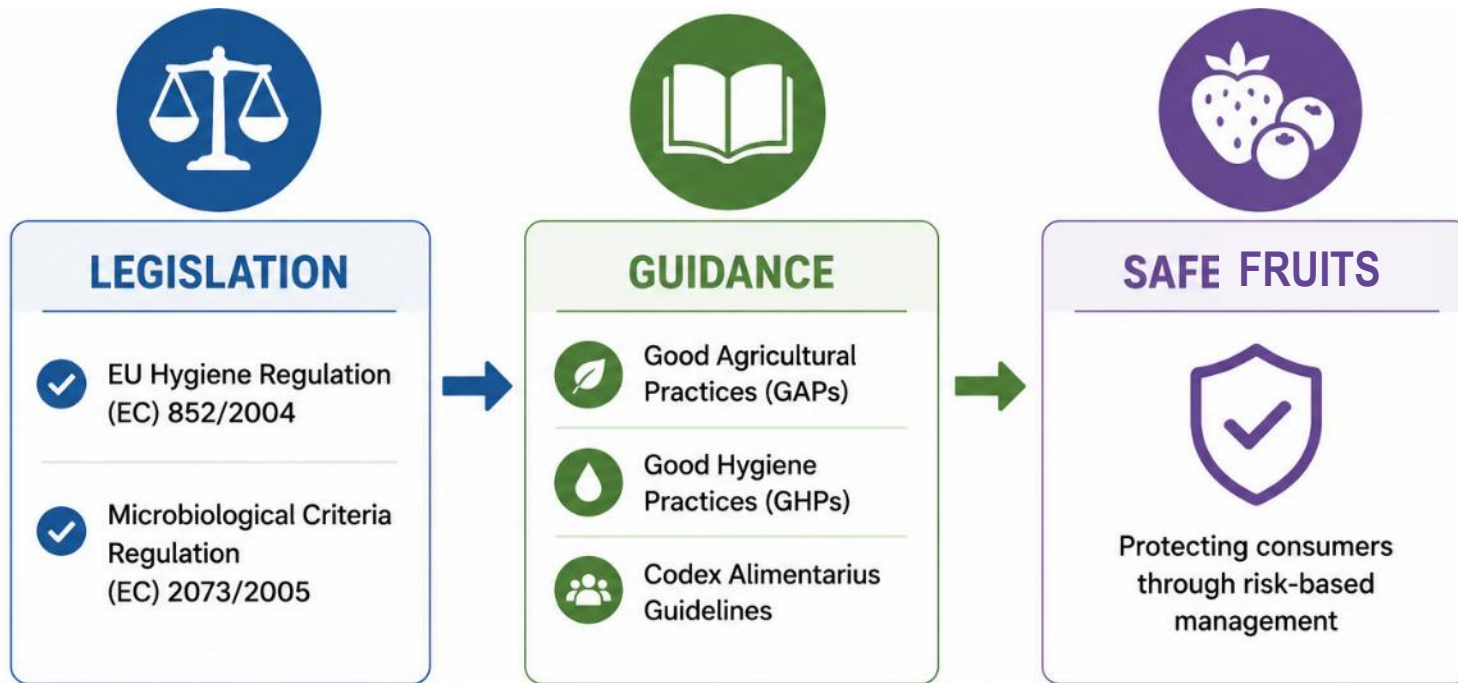
- Overview of EU food hygiene requirements:
 - [Commission Notice 2017/C, 163/01](#)
 - [Regulation \(EC\) 852/2004](#) food hygiene regulation,
 - [Regulation \(EC\) 2073/2005](#) on microbiological criteria for foodstuffs.
 - Other standards

2. Common challenges and solutions for achieving the requirements

- Best practices to prevent microbiological hazards in fresh fruits and berries
- Role of climate change adaptation in risk
- Addressing challenges for smallholder farmers



Available Resources





Overview of EU regulatory requirements

23.5.2017

EN

Official Journal of the European Union

C 163/1

IV

(Notices)

NOTICES FROM EUROPEAN UNION INSTITUTIONS, BODIES, OFFICES AND AGENCIES



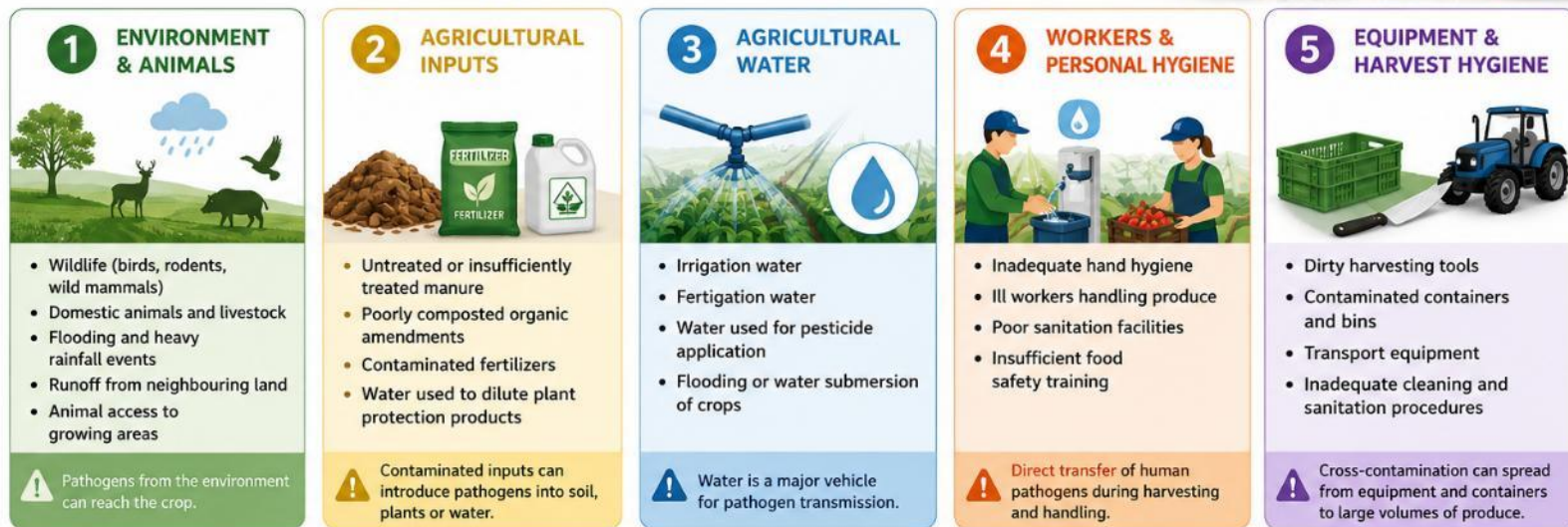
Guidance document on addressing microbiological risks in fresh fruits and vegetables at primary production through good hygiene

(2017/C 163/01)



Guidance document on addressing microbiological risks in fresh fruits and vegetables at primary production through good hygiene

Five major sources of microbiological contamination



CROSS-CONTAMINATION CAN OCCUR THROUGH:



Water



Workers



Animals



Equipment



Harvest operations



AGRICULTURAL WATER QUALITY REQUIREMENTS

A RISK-BASED APPROACH

The stricter the exposure pathway, the higher the required water quality

RISK LEVEL & USE OF WATER		INDICATOR OF FAECAL CONTAMINATION (E. coli)	WATER SOURCES	RELATIVE SUITABILITY*
 VERY HIGH RISK	 Ready-to-eat fruits & vegetables Water contacts edible portion	 Target: ≤ 100 E. coli /100 mL	 Municipal water Treated and distributed for human consumption	★★★★★
	 Ready-to-eat produce No direct contact with edible portion	 Target: ≤ 1,000 E. coli /100 mL	 Disinfected water Properly disinfected (e.g., chlorinated)	★★★★★
	 Produce normally cooked Direct contact with edible portion	 Target: ≤ 1,000 E. coli /100 mL	 Treated reclaimed water Wastewater treated for agricultural reuse	★★★★☆
	 Produce normally cooked No direct contact with edible portion	 Target: ≤ 10,000 E. coli /100 mL	 Rainwater Rainwater harvested and stored	★★★☆☆
 LOWER RISK			 Groundwater Wells, boreholes	★★★☆☆
			 Surface water Rivers, lakes, ponds, reservoirs	★★☆☆☆

* Relative suitability from highest (best quality) to lowest (highest uncertainty).



Water quality requirements should be proportional to the likelihood that contamination reaches the consumer.





Any Legislation?

FOOD HYGIENE

**REGULATION (EC) No 853/2004 OF THE EUROPEAN PARLIAMENT
AND OF THE COUNCIL
of 29 April 2004**





PRIMARY PRODUCTION

PART A: GENERAL HYGIENE PROVISIONS FOR PRIMARY PRODUCTION AND ASSOCIATED OPERATIONS

ANNEX I



**1. Environmental
Factors incl. animal
reservoirs**

**2. Fertilizers and
phyto-sanitary
products**

3. Water

**4. Staff hygiene and
health status**

**5. Hygiene
conditions at
primary production**

5. Food business operators producing or harvesting plant products are to take adequate measures, as appropriate:

(a) to keep clean and, where necessary after cleaning, to disinfect, in an appropriate manner, facilities, equipment, containers, crates, vehicles and vessels;

(b) to ensure, where necessary, hygienic production, transport and storage conditions for, and the cleanliness of, plant products;

(c) to use potable water, or clean water, whenever necessary to prevent contamination;

(d) to ensure that staff handling foodstuffs are in good health and undergo training on health risks;

(e) as far as possible to prevent animals and pests from causing contamination;

(f) to store and handle wastes and hazardous substances so as to prevent contamination;

(g) to take account of the results of any relevant analyses carried out on samples taken from plants or other samples that have importance to human health; and

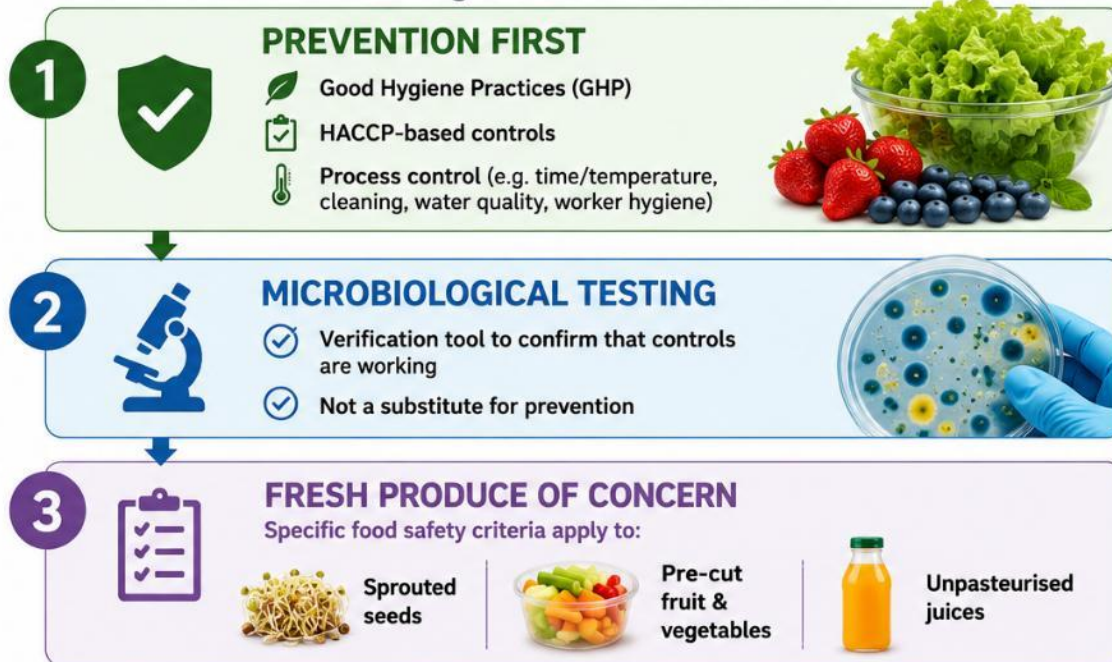
(h) to use plant protection products and biocides correctly, as required by the relevant legislation.



Regulation (EC) 2073/2005

What matters for fresh fruits and vegetables?

Microbiological Criteria for Foodstuffs



KEY REQUIREMENTS



Food must not contain pathogens or their toxins at levels that pose a risk to human health.



Food business operators must verify compliance with the microbiological criteria.



If results are unsatisfactory, appropriate corrective actions must be taken.



Sampling plans and analytical methods must follow the requirements of the Regulation.



Official controls by competent authorities ensure compliance throughout the food chain.



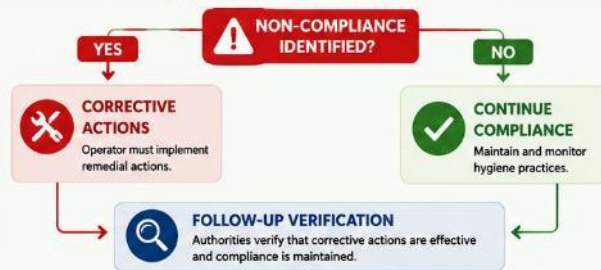
OFFICIAL CONTROLS AT FARM LEVEL

In-situ control of fruit and vegetables (FFV) at primary production level

1 INSPECTION PROCESS



2 OUTCOME OF CONTROL



SAFE FRUITS & VEGETABLES

Effective controls protect public health and support safe production.



Official controls ensure that Good Hygiene Practices (GHPs) are implemented and any deficiencies are corrected.

HYGIENE INSPECTION CHECKLIST

Key areas verified by officials

	WATER MANAGEMENT Source quality, protection, storage and distribution.	✓
	ORGANIC AMENDMENTS Use, storage, treatment of manure and compost.	✓
	WORKER HYGIENE Hand washing facilities, toilets, hygiene and training.	✓
	EQUIPMENT & TOOLS Cleaning, sanitation and maintenance of equipment and tools.	✓
	HARVEST & POST-HARVEST OPERATIONS Harvesting practices, handling, field containers and transport.	✓
	RECORD KEEPING Documentation of practices, monitoring, training and corrective actions.	✓
	SELF-ASSESSMENT CHECKLISTS Help growers prepare for official inspections, identify gaps and improve compliance.	

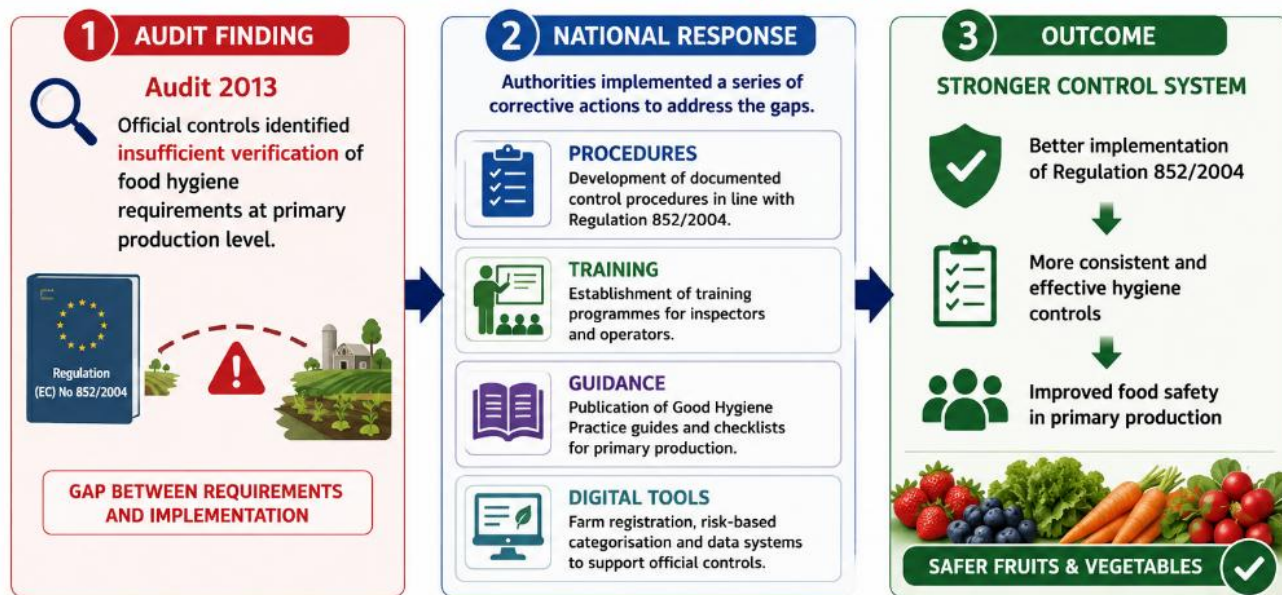


Good preparation and proper records lead to successful inspections and safer produce.



Lessons from Official Controls in Primary Production

Strengthening implementation of Regulation (EC) No 852/2004



KEY MESSAGE

Food safety is achieved not only through legislation, but through effective implementation, training and verification.



LEGISLATION



IMPLEMENTATION



VERIFICATION



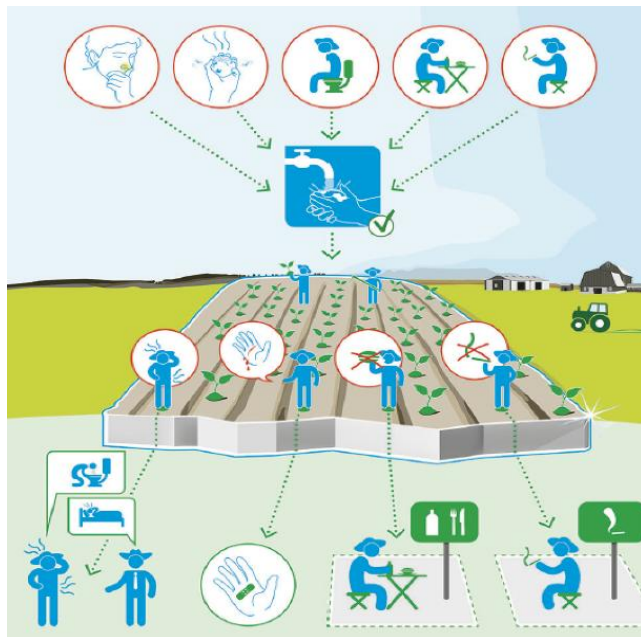
CONTINUOUS
IMPROVEMENT



FOOD SAFETY
ASSURED



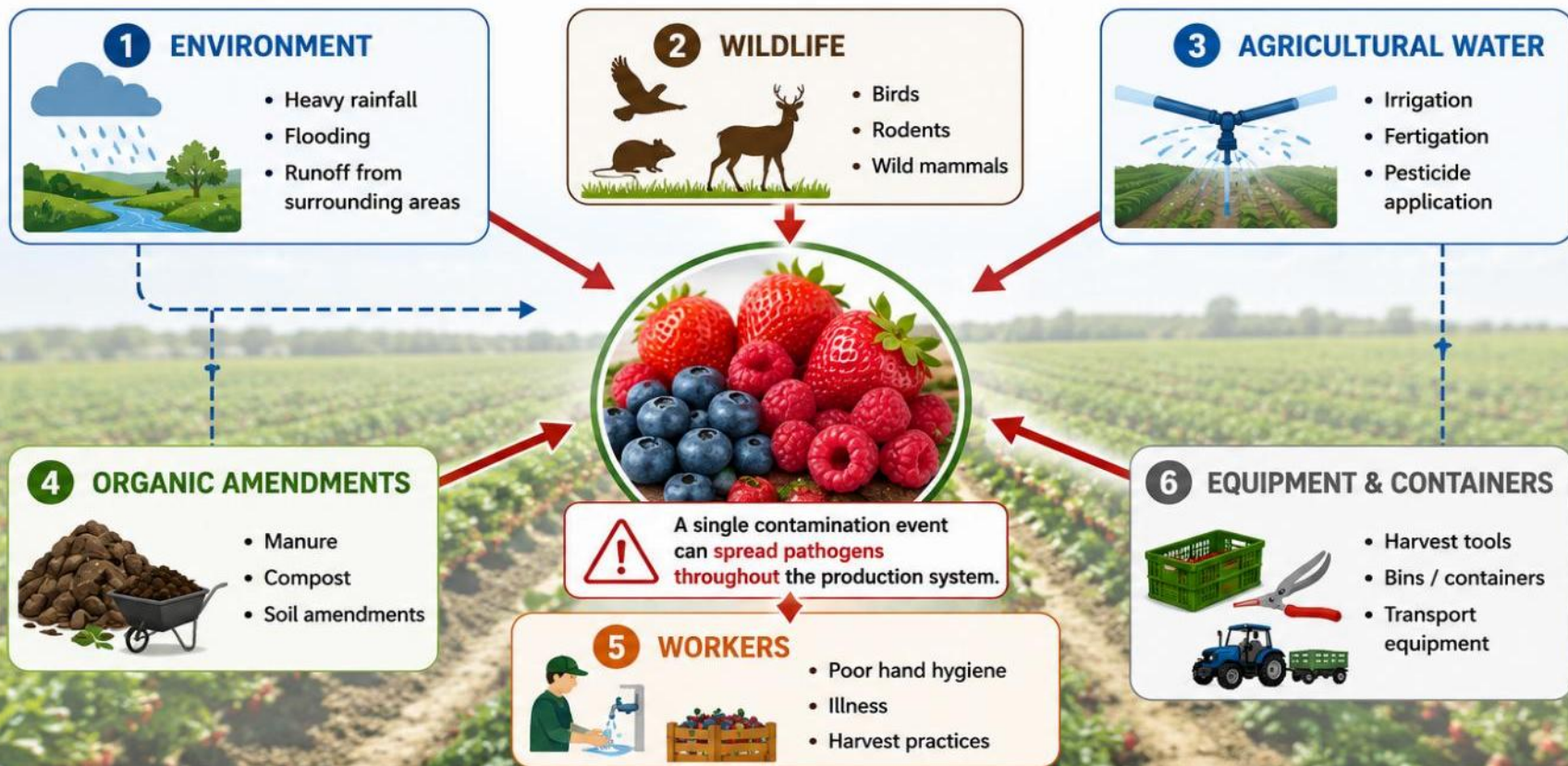
Other Standards



Minimizing the risk
of microbial contamination
in primary production
of berries



SOURCES OF CONTAMINATION FOR FRESH FRUITS





MICROBIOLOGICAL HAZARDS

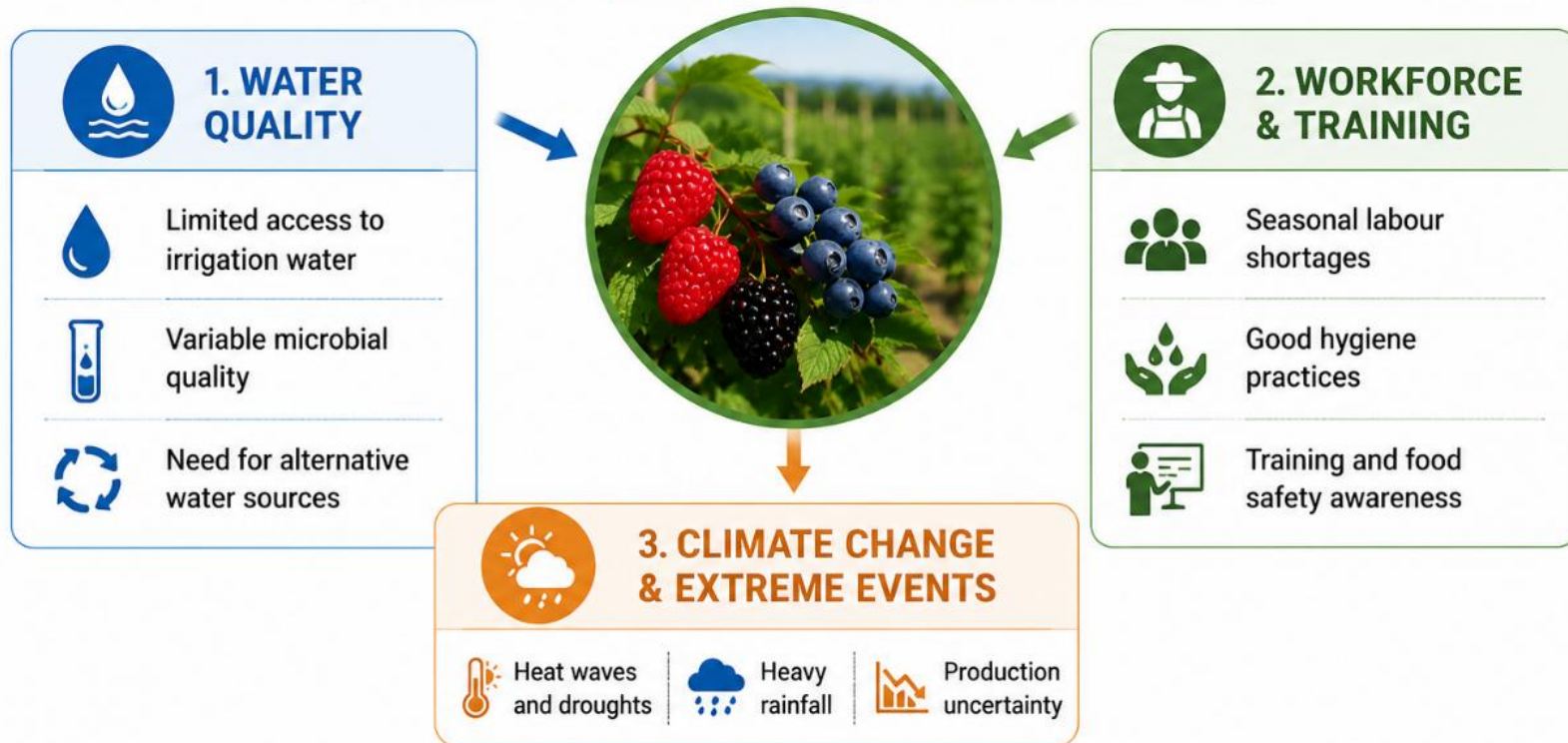
Main Challenges for Fruit Producers





CHALLENGES FOR SMALL BERRY GROWERS

Key areas that impact food safety and farm sustainability





MICROBIOLOGICAL HAZARDS



NOROVIRUS

MOST IMPORTANT HAZARD



- ✓ Leading cause of berry-associated outbreaks
- ✓ Frequently linked to frozen berries
- ✓ Human faecal contamination
- ✓ Water and infected handlers are key sources



Major public health concern
– responsible for most outbreaks



SALMONELLA spp.

IMPORTANT HAZARD



- ✓ Numerous outbreaks linked to fresh and frozen berries
- ✓ Can survive for extended periods on berry surfaces
- ✓ Associated with contaminated water, soil and handling practices



SHIGA TOXIN- PRODUCING *E. COLI* (STEC)

LESS FREQUENT, BUT SERIOUS



- ✓ Particularly O157:H7 and O26
- ✓ Severe illness potential (HUS)
- ✓ Linked to irrigation water, wildlife and manure contamination

OTHER HAZARDS REPORTED IN THE LITERATURE

HEPATITIS A VIRUS



- ✓ Similar transmission routes to norovirus
- ✓ Several international outbreaks linked to frozen berries

CYCLOSPORA CAYETANENSIS



- ✓ Increasingly recognized in fresh produce outbreaks
- ✓ Associated with contaminated irrigation water
- ✓ Important in imported berries

LISTERIA MONOCYTOGENES



- ✓ Can survive on berry surfaces
- ✓ Occasionally detected in production environments
- ✓ Important for frozen berry processors (freezing does not eliminate *Listeria*)
- ✗ Very few berry-associated outbreaks compared with norovirus, *Salmonella* or STEC

Do microorganisms decay quickly in fruits incl. berries?



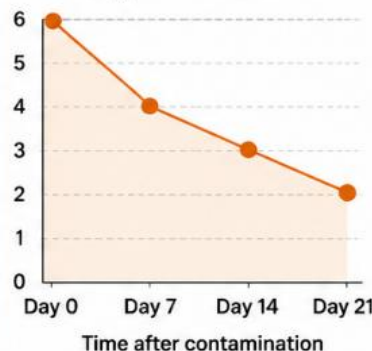
CONTAMINATION EVENT

Irrigation water / flooding / wildlife / workers



Salmonella

Log₁₀ reduction over time



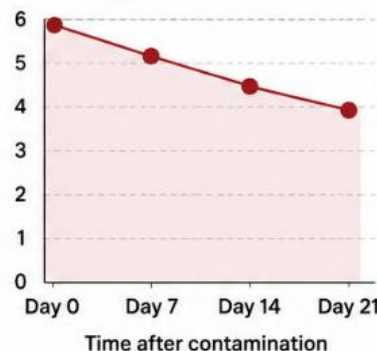
GRADUAL DECLINE

Survival for days to weeks depending on conditions.



Norovirus

Log₁₀ reduction over time



LIMITED DECLINE

May persist for prolonged periods. Major concern for outbreaks.



STEC (E. coli O157:H7)

Log₁₀ reduction over time



GRADUAL DECLINE

Similar behavior to Salmonella.



What does this mean?

After an initial contamination of berries, pathogens decline over time, but the rate of die-off differs among pathogens and environmental conditions.



Factors impacting microbial decay in fresh fruits



Environmental factors can greatly affect how long
pathogens persist on berry surfaces



TEMPERATURE

Higher temperatures
can enhance pathogen
survival.



HUMIDITY

High humidity supports
longer survival of
pathogens.



RAINFALL EVENTS

Rain and runoff can
introduce pathogens
and increase moisture.



UV EXPOSURE

UV radiation helps
inactivate pathogens.
Low exposure =
less die-off.



BERRY TYPE

Differences in surface
structure and chemistry
influence survival.



HOW THESE FACTORS AFFECT RISK



Warm conditions
can slow die-off
of pathogens.



Moist environments
increase persistence
on berry surfaces.



Heavy rainfall
increases contamination
risk from runoff and
splash.



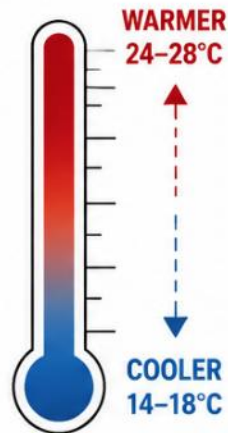
More UV exposure
accelerates inactivation
of pathogens.



**Berries with more
irregular surfaces**
may harbor pathogens
longer.

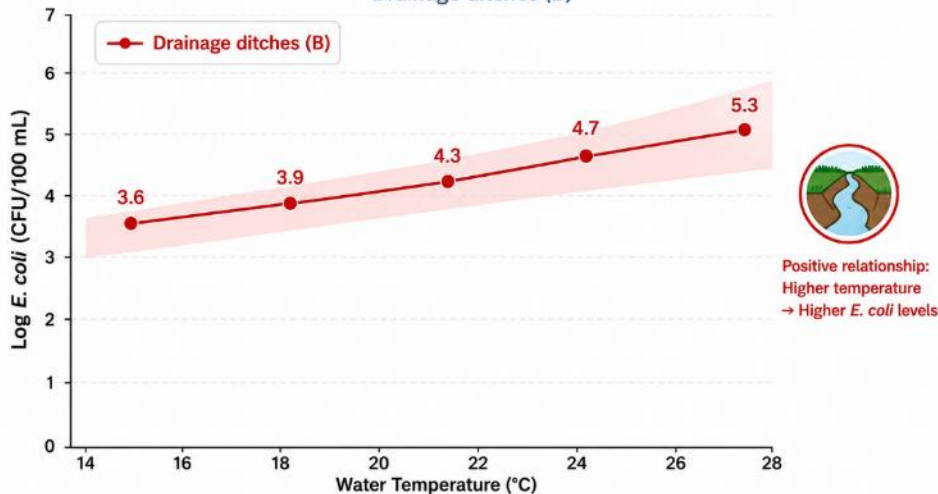
How can climate change have an impact on the safety of fresh fruits?

WATER TEMPERATURE



Effect of Water Temperature on *E. coli* Levels

Drainage ditches (B)



In drainage ditches, *E. coli* concentrations increase as water temperature rises.

HIGHER RISK FOR BERRY CONTAMINATION



Poor quality water
+ warmer temperatures



Higher risk of contamination of berry crops

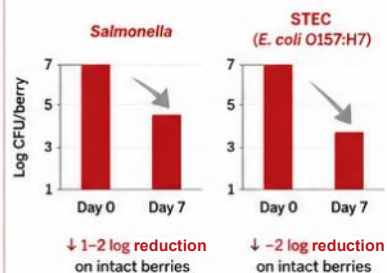


Is storage affecting survival?

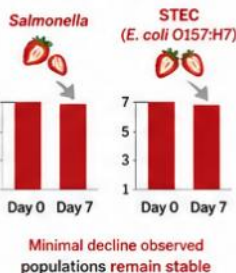
PATHOGENS SURVIVE ON STRAWBERRIES

Knudsen et al., J Food Prot. 2001

REFRIGERATED STORAGE (5°C)



CUT BERRIES (5°C)



FROZEN STORAGE (–20°C)

STEC (E. coli O157:H7) survives >30 days
Only 0.7–2.2 log reduction after 30 days



Low pH limits growth but does not eliminate pathogens.
Contaminated berries can remain contaminated throughout storage.

PACKINGHOUSES DO NOT ELIMINATE MICROBES

Quansah et al., Food Control 2019



- ✗ No kill step in the packing process for the fresh market.
- ✗ No significant reduction in microbial counts from unpacked to packed berries.

Study results (n = 124 samples from 6 packinghouses)



Fecal coliforms
found in 11 samples
(3 packinghouses)



Enterococci
found in 1 sample
(1 packinghouse)

STORAGE PROVIDES LIMITED NATURAL REDUCTION



Fresh storage

At 24°C for 48 h: populations did not decline.
At 5°C for up to 7 days: only small reductions (≤2 log) on intact berries.



Frozen storage

E. coli O157:H7 survived >30 days
at –20°C with only 0.7–2.2 log reduction.



Pathogens are hardy and can remain on berries through storage and distribution.

Knudsen DM, Yamamoto SA, Harris LJ. Survival of *Salmonella* spp. and *Escherichia coli* O157:H7 on fresh and frozen strawberries. *J Food Prot.* 2001;64(10):1483–1488.



Take home message

