Effect of Copper Spray on *E. coli*

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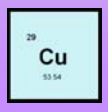


Three points of discussion:

What generally do the tomato GAP's say?

What is the risk of finding substantial E. coli on fruit in the tree in a citrus grove?

Is there an effect on a E. coli by pesticide sprays in use, e.g. copper hydroxide?

What generally do the tomato GAP's say?

40 CFR 141.63 - Maximum contaminant levels (MCLs) for microbiological contaminants

(a) The MCL is based on the presence or absence of total coliforms in a sample, rather than coliform density.

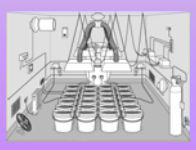
(1) For a system which collects at least 40 samples per month, if no more than 5.0 percent of the samples collected during a month are total coliform-positive, the system is in compliance with the MCL for total coliforms.

(2) For a system which collects fewer than 40 samples/month, if no more than one sample collected during a month is total coliform-positive, the system is in compliance with the MCL for total coliforms.

(b) Any fecal coliform-positive repeat sample or E. coli-positive repeat sample, or any total coliform-positive repeat sample following a fecal coliform-positive or E. coli-positive routine sample constitutes a violation of the MCL for total coliforms. For purposes of the public notification requirements in subpart Q, this is a violation that may pose an acute risk to health.

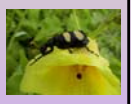
What is the risk of finding substantial E. coli on fruit in the tree in a citrus grove?

Overall, the microflora populations on a particular commodity will vary considerably depending on location, irrigation processes, type of crop, windbreaks, etc.



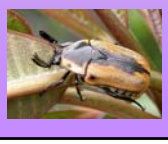
Study on occurrence of coliforms, fecal coliforms and streptococci on vegetation and insects

From flower buds, blossoms, flowering heads (81); 75% tested had negligible fecal coliforms but ≈790 fecal streptococci/g



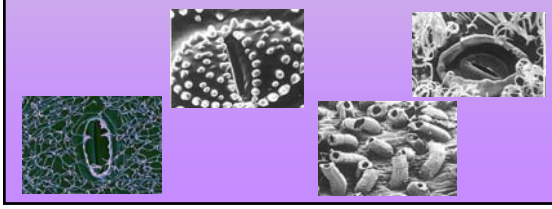
Garden vegetables, (27), also had negligible fecal coliforms but 75% had ≈ 490 fs/g.

Of 16 samples of Coleoptera, 75% had ≈ 4.9 X 10^8/g fecal coliforms and ≈ 4.9 X 10^9 fs/g



Outermost layer of most fruits is the cuticle; unless damaged has a smooth appearance and feel

Looking more closely at fruit peels one can see the epicuticular waxes are not arranged in a smooth and linear fashion



Relationships of microbes on plants can be:

transient organisms ("casuals")

epiphytic commensals ("residents")

mutualistic symbionts

endophytes

pathogens

Microorganisms on fruit surfaces need water, food and protection from temperature extremes, wind and UV light. Resident microorganisms are adapted to these conditions: can utilize the sugars and moisture that presents itself in epicuticular spaces.

Non-tolerant or organisms (such as E. coli), not part of the usual resident microflora on fruit find a hostile environment on the peel.

"Fitness" term to describe ability of microorganisms to survive and reproduce. Enteric pathogens (e.g. E. coli) are not as fit as epiphytes.

Most common way for microbial survival in the phyllosphere is in **Biofilms**

Biofilms are large mixed communities of microbes and can contain many bacteria, fungi (including yeasts), even algae and protozoans all imbedded in a EPS.

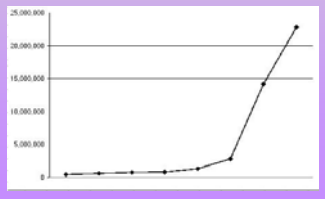
Is there an effect on E. coli by pesticide sprays in use, e.g. copper hydroxide?

E. coli

0 h: 3.9 X10^5

6 h: 1.42 X 10^7

Hours	CFU/mL
0	390,000
1	590,000
2	730,000
3	790,000
4	1,280,000
5	2,820,000
6	14,150,000
7	22,800,000



Grew E. coli in broth: washed cells

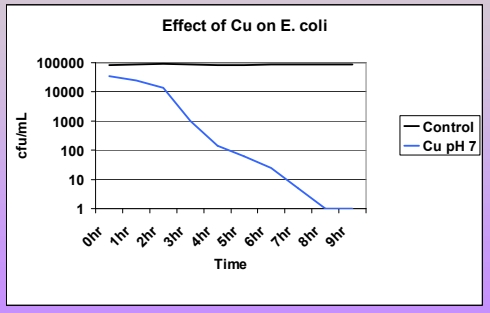
Cells in solutions of copper hydroxide (commercial rate); cells in buffer

Because copper hydroxide high pH: buffered it also

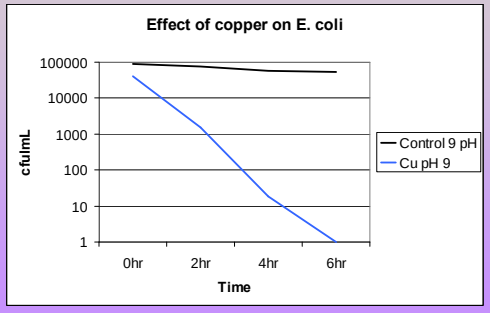
Final set-up:

- copper solution buffered to 7.2, not buffered 9.3
- in control buffer at 9.3 and at 7.2

Results



Buffered solutions



Unbuffered solutions

Survival of E. coli on citrus leaves and fruit

Coated cleaned leaves with buffer + E. coli cells (7.2 pH) and with copper solutions + E. coli cells (7.2 pH)

After 24 hours, leaves were assessed for presence of E. coli and none were found

Analogous studies with fruit show similar results: even under laboratory conditions, E. coli does not survive well on these surfaces

Conclusions:

Overview of tomato GAP's show moderate flexibility

Risk of E. coli on citrus tree fruits is very low: most contamination is picked up after harvest

Copper hydroxide solutions will destroy E. coli cells within 4-6 hours direct contact, even when the solution is buffered

There is no guarantee even with GAPs that produce will be pathogen free and diligence is ALWAYS necessary