


LPELC Webinar Series
May 17th, 2019

PARALLELS AMONG ANTIBIOTIC USAGE AND CULTURABLE ANTIBIOTIC RESISTANT BACTERIA FROM SOILS AMENDED WITH DAIRY MANURE OR COMPOST

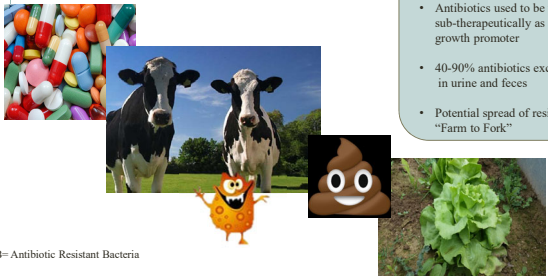
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ANTIMICROBIAL RESISTANCE IN AGRICULTURE



- Serious human health concern
- Antibiotics used to be used sub-therapeutically as a growth promoter
- 40-90% antibiotics excreted in urine and feces
- Potential spread of resistance from "Farm to Fork"

ARB= Antibiotic Resistant Bacteria

2

MANURE MANAGEMENT PRE-APPLICATION PRACTICES

- Untreated
- Anaerobically Digested
- Mechanically Dewatered
- Composted



CHECK OUT! <https://lpec.org/manure-treatment/>

3

REDUCING ANTIBIOTIC RESISTANCE FROM FARM TO FORK

EXPLORING HOW ANTIBIOTICS USED IN CATTLE MAY INFLUENCE MICROBIOTA OF VEGETABLES

USDA NIFA
United States Department of Agriculture
National Institute of Food and Agriculture

“Identify critical control points for antibiotic resistance transmission from manure to produce”

USDA FSMA Guidelines

- 120 day wait period
- Adhere to “stabilized compost” methods

USDA-NIFA 2014-05280

<https://www.fda.gov/food/food-safety-modernization-act/fsma/foods-from-to-unsafe-to-safe>

FIELD STUDY

[MARCH-JULY 2016]

Study Site & Field Conditions

No Amendment Control	Inorganic Fertilizer Control	Compost from cows not treated with antibiotics	Compost from cows treated with pirlimycin or cephalosporin	Raw manure from cows treated with pirlimycin or cephalosporin

Day 0: Application

Day 42

Day 67: Harvest

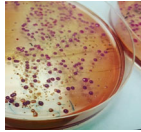
Quantification of Antibiotics & Fecal Coliforms in Amended Soils

Antibiotics

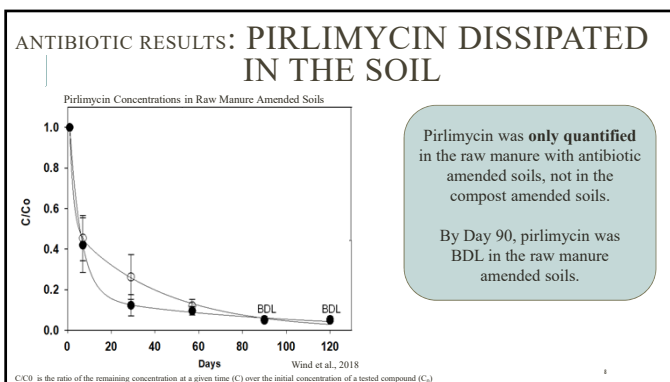
- **Pirlimycin** (Pirsue®) – lincosamide used to treat mastitis in cows
- **Cephapirin** (ie. Cefa-Dri®; ToMorrow®) – 1G cephalosporin used to treat mastitis

Antibiotic-Resistant Fecal Coliforms

- **Ceftazidime*** (ie. Fortaz®, Tazicef®) – 3G cephalosporin
- **Clindamycin*** (Cleocin®)- lincosamide
- **Erythromycin*** (ie. Erythro®, Gallimycin®, Erythromast®) - macrolide
- **Sulfamethoxazole** + (Sulfatrim®, Bactrim®) – sulfonamide + pyrimidine inhibitor
- **Tetracycline** + (ie. Aureomycin®, Terramycin®) - tetracycline



* Highly Important Antimicrobials (WHO, 2017)
* Critically Important Antimicrobials (WHO, 2017)



SOIL RESULTS: ANTIBIOTIC-RESISTANT FECAL COLIFORM LEVELS

3 Patterns of Resistance


1. Continued Detection
2. Initial Decline Followed by Post-Harvest Spike
3. No recovery

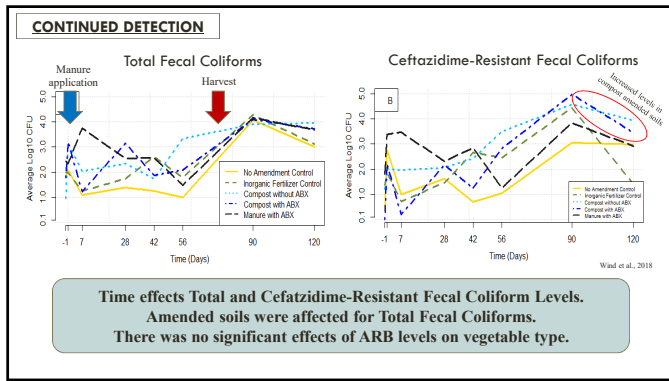
Compost vs Manure

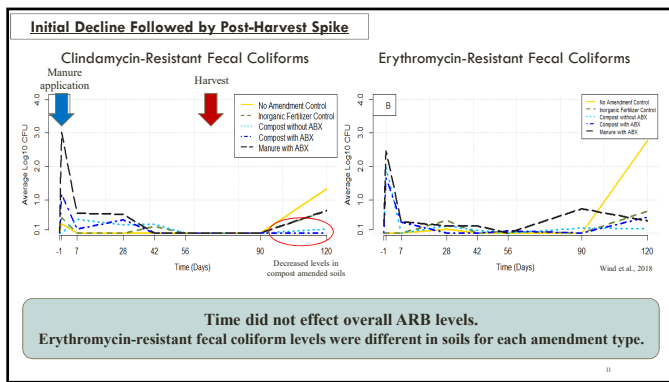
Some drugs had higher levels in compost amended soils, while others had higher levels in raw manure amended soils.

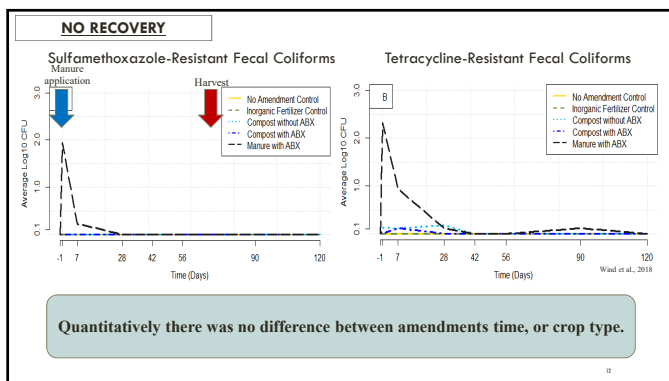
Vegetable Effect

There was no difference between root (radish) and above-ground (lettuce) ARB levels for all antibiotics tested, with the exception of erythromycin-resistant fecal coliform levels.





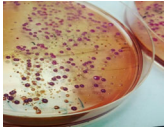




SURVIVAL & COMPETITION
COMPOST WITH RESPECT TO RAW MANURE AMENDED SOILS

Compost had lower ARB levels:

- 1) Clindamycin- Resistant
- 2) Erythromycin- Resistant



HOWEVER:
Compost had higher ARB levels:

- 1) Total Fecal Coliforms
- 2) Ceftazidime- Resistant

WHY?

- Enzymatic Capabilities
- Moisture Content
- Thermotolerant
- Supplies Nutrients

ANTIBIOTIC RESISTANT FECAL COLIFORMS PERSIST IN SOIL AFTER ANTIBIOTICS HAVE DISSIPATED

1) Composted amended soils has lower levels of ARBs than raw manure amended soils for Clindamycin and Erythromycin.
[These drugs happen to be in the same class of antibiotics as the antibiotics given to the dairy cows]

2) There was no significant difference for ARB levels in soils that grew radish vs. lettuce.

3) Antibiotics may not be the sole driver of ARB presence/ resistance.

REFERENCE PUBLICATIONS

Soils → Fate of Pirlimycin and Antibiotic-Resistant Fecal Coliforms in Field Plots Amended with Dairy Manure or Compost during Vegetable Cultivation
<https://dl.sciencesocieties.org/publications/ieq/abstracts/47/3/436>

Runoff → Fecal Indicator Bacteria and Antibiotic Resistance Genes in Storm Runoff from Dairy Manure and Compost-Amended Vegetable Plots
<https://dl.sciencesocieties.org/publications/ieq/first-look/pdf/ieq2018.12.0441.pdf>

Vegetables → Microbiota and Antibiotic Resistome of Lettuce Leaves and Radishes Grown in Soils Receiving Manure-Based Amendments Derived From Antibiotic-Treated Cows
<https://doi.org/10.3389/fsufs.2019.00022>

Project Website → Reducing Antibiotic Resistance from Farm to Fork
<https://arqs.hort.vt.edu/>
