

PATH ORGANIC

Risks and Recommendations Regarding Human Pathogens in Organic Vegetable Production Chains



Evelyn Hackl

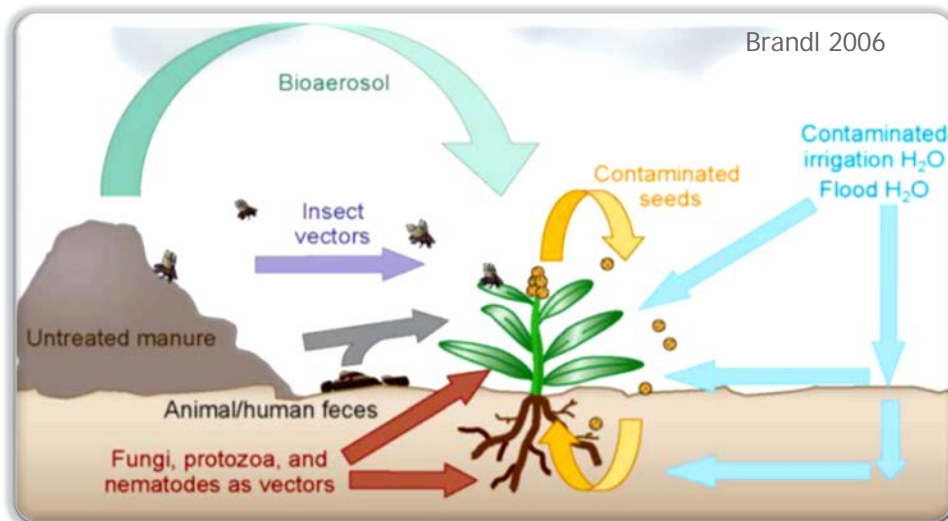
evelyn.hackl@ait.ac.at

Project aim:

to assess and reduce risks of contamination of organically grown vegetables with human pathogenic bacteria



Background: Outbreaks of disease have increasingly been traced back to the consumption of fresh plant produce contaminated with bacterial pathogens such as pathogenic *E. coli* or *Salmonella*



● **Use of manures and slurries as fertilizers** - important pathway of infestation of vegetables with bacterial pathogens, relevant especially in organic agriculture

● **Pathogens already present on/in vegetables on the field?**

BBC NEWS

EUROPE

29 May 2011 Last updated at 15:31 GMT

E.coli-infected cucumber scare spreads beyond Germany

Reaction to the cucumber crisis

Country

Action

Germany

Consumers told not to eat cucumbers, lettuces and raw tomatoes. 1,534 cases of E.coli confirmed; 16 deaths

Sweden

One death and 41 suspected E. coli infections, linked to travel in northern Germany.

Spain

Top European cucumber producer - threatens to seek compensation from the European Union for lost vegetables sales

Russia

Ban on all imports of cucumbers, tomatoes and fresh salad from Spain and Germany pending further notice

Assessing current practice and Harmonization of methods



rbfE (*E.coli* O157), *stx1*, *stx2* and *eae* virulence genes (*E. coli* others), *invA* (*Salmonella* sp.), *nuc* (*Staphylococcus aureus*), *hlyE* (*Listeria monocytogenes*), **16S rRNA** of *Campylobacter* spp.

Q1 Country Questionnaires

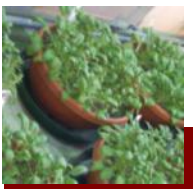
Farmers' associations
Farmers
Local experts



Survey of manures / slurries regarding enteric pathogen infestation in five European countries (AT, D, CH, SE, DK)



Survey of vegetables regarding enteric pathogen infestation in five European countries (AT, D, CH, SE, DK)



Mechanisms / factors affecting colonization



Leaflet
www.shop.fibl.org

Project Workshop

Recommendations

Farmers' Brochure
Farmers

Q2 Sampling Questionnaires

Q3 CCP Questionnaire

Agricultural associations
Farmers
Experts in organic farming
Ministries
General public

Manure for Vegetables

Farm practice recommendations for minimizing human pathogenic bacteria contamination in vegetable production

In brief

To obtain sufficient yields in vegetable production, fertilization with nitrogen, phosphorus and potassium is necessary. Manure is a valuable source of these nutrients. This guide is an overview of the latest scientific information concerning potential food safety risks related to the application of manure in vegetable production, and gives recommendations for minimizing these risks. While the focus is on manure handling, other potential contamination sources are also briefly addressed.



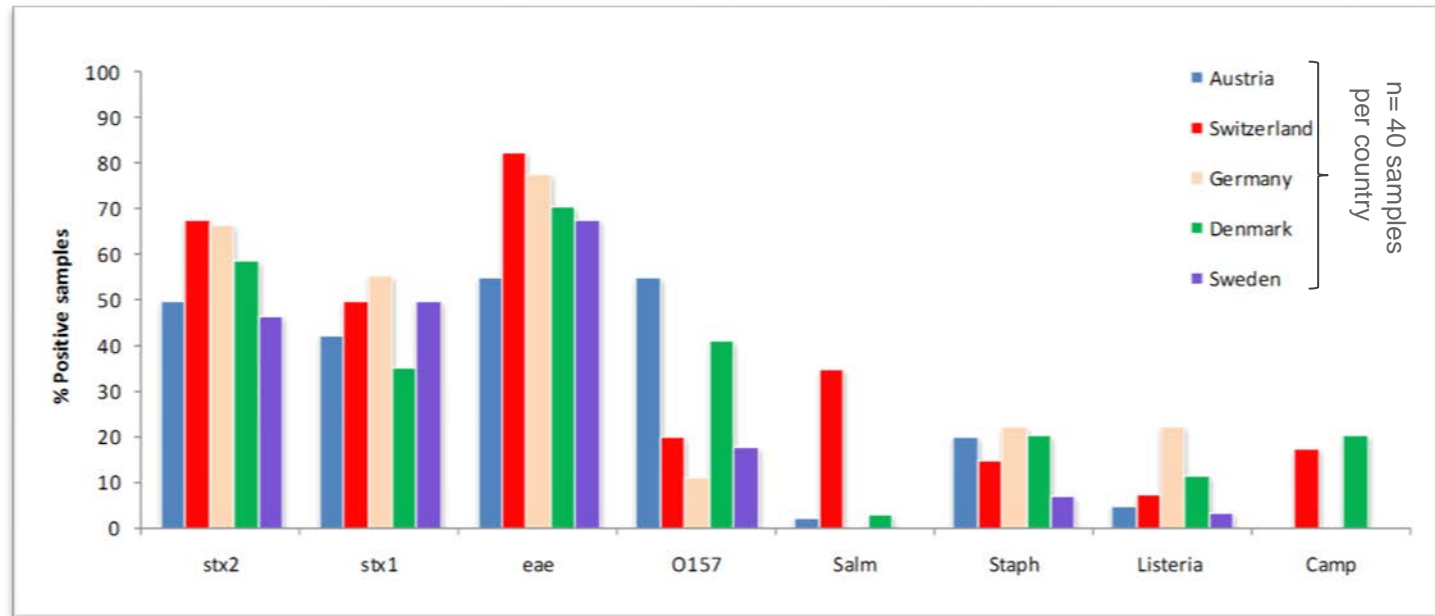
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Recommendations regarding the safe use of manures for fertilization in vegetable cropping; applicable in all countries that use the fertilization regimes described.

Most manures contain pathogenic bacteria

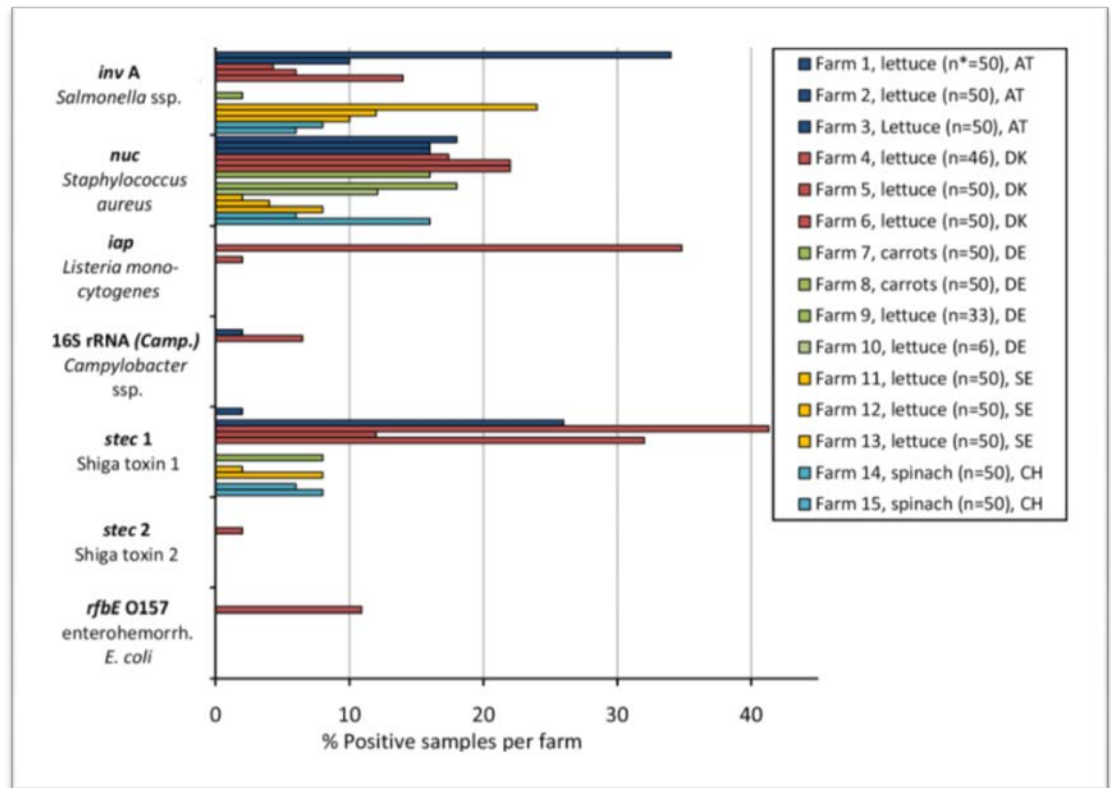
We found high baseline incidences of human pathogens in manure/slurry samples.



80% of the total manure/slurry samples tested positive for at least one pathogen or EHEC virulence gene, with similar distribution in all countries except O157, *Salmonella* and *Campylobacter*.

2 Vegetables frequently contain pathogenic bacteria

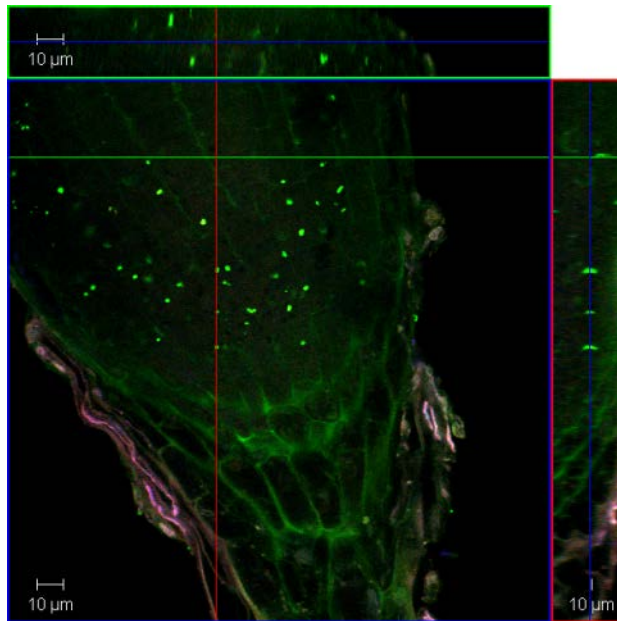
We found high incidences of human pathogens on/in vegetables, but presumably low numbers.



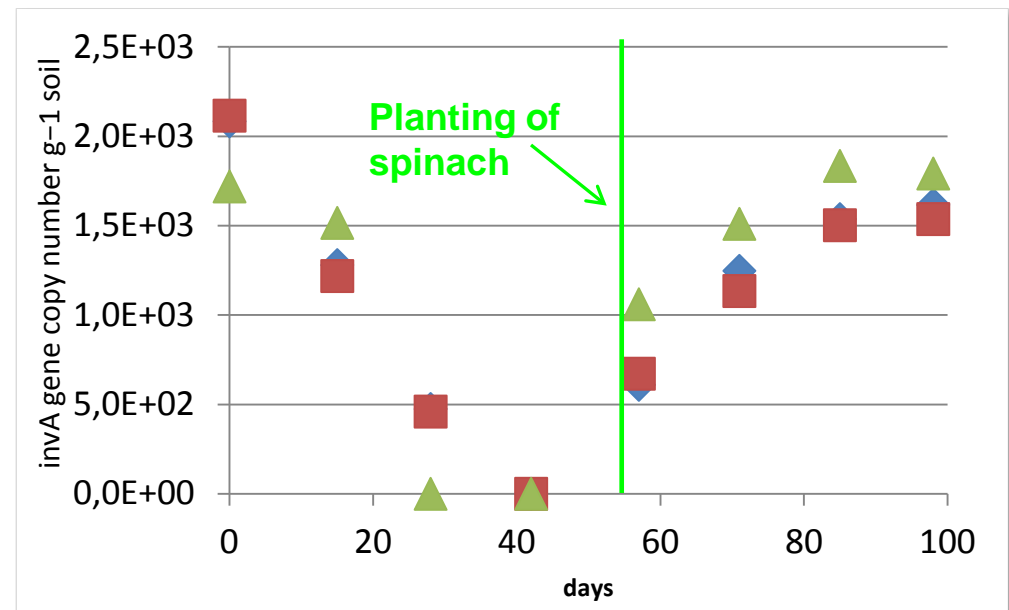
Except for one field (carrot), samples that tested positive for one or several pathogens or *E.coli* virulence genes were collected from all farms. *Salmonella* and *Staphylococcus* were the pathogens most often retrieved.

3 Vegetables are an apt environment for human pathogens

Human pathogenic bacteria can colonize vegetable plants internally, and plants promote the growth of pathogens that reside in the soil.



Root tip a of spinach plant inoculated with *Listeria monocytogenes* sv. 1/2a EGD-E GFP tagged



The abundance of *Salmonella enterica* ssp. increases in the soil upon planting of spinach.

Implementing a safe fertilization management can minimize risks

Recommendations for Using Manure for the Cultivation of Vegetable Crops

- › Feeding roughage and not concentrates to cattle minimizes the propagation of pathogenic E. coli (including EHEC strains).
- › Manure should be composted whenever possible.
- › If not (aerobically) composted, storage of manure and slurry for 4 months without adding new material is recommended.
- › Shallow incorporation, instead of deep ploughing or surface application. Surface application would allow a faster decrease of pathogens, but leads to higher ammonia evaporation.
- › Solid manure is preferable to slurry.
- › After planting and sowing, manure and slurry should not be applied and is even prohibited under certain organic regulations and Global GAP.
- › In vegetable crops with a short cropping period (< 100 days), which are intended for raw consumption and for raw convenience food (e.g., chopped salad), fresh manure/slurry should be applied at the latest 4 months before crop establishment.

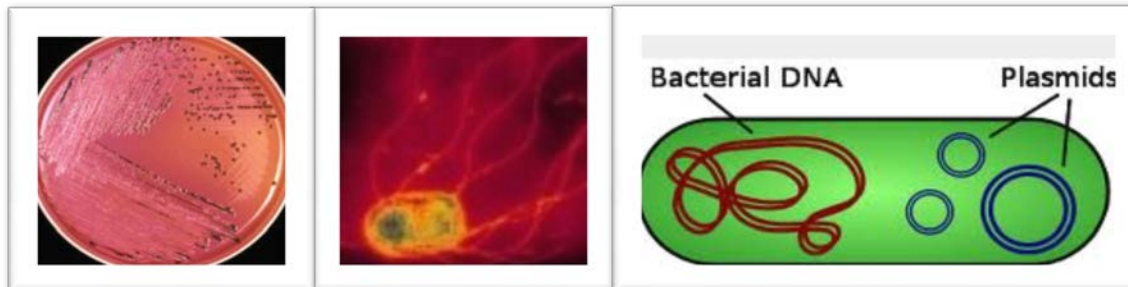
The rationale for these recommendations is based on literature findings and research outcomes of PathOrganic, but these recommendations need further validation in the field.

➤ What are the genetic traits of vegetable-colonizing human pathogens?

→ We explore the phenotypic and genotypic characteristics of plant- versus animal/human-associated enteric pathogens (e.g. *Salmonella*)


● Which **capabilities** must a pathogen have to successfully invade and colonize a plant environment versus an animal/human environment or both?

● Identifying **genetic markers** that correlate with plant colonization traits will be valuable for the use in **epidemiological surveillance** programs




Novel concepts in plant breeding

→ Interactions of agricultural crops with both pathogenic and beneficial bacteria should be addressed in plant breeding programs

 **Bacteria for biocontrol.** Bacterial strains applied as inoculants may render specific plant cultivars less prone to being colonized by plant pathogens as well as by human pathogens.

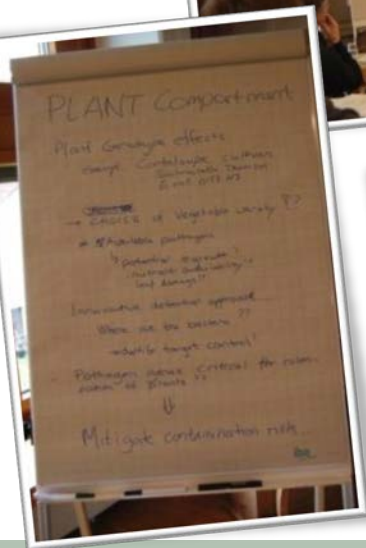
 **Bacteria as biofertilizers.** Plant beneficial bacteria improve plant growth and health.

 **Promoting plant interactions with beneficial microorganisms in plant breeding** will make better use of natural beneficial interactions, leading to better plant stress tolerance, better plant nutrition, and less colonization by pathogens.





Thank you!



Veronica Arthursen, Kerstin Brankatschk, Dorte Baggesen, Brion Duffy, Claudia Fenzl, Jürgen Friedel, Anton Hartmann, Andreas Hofmann, Lotta Jäderlund, Annette Nygard Jensen, Martin Koller, Bettina Landau, Paul Mäder, Marteen Nauta, Michael Schmid, Agnes Schweinzer, Angela Sessitsch, Ariena van Bruggen, Franco Widmer, Gabriela Wyss