

A tractor is shown in the middle ground, plowing a field of dark, rich soil. The tractor is a large, modern model with a glass-enclosed cab. The field is a mix of dark brown and black earth, with some green grass visible in the background. The sky is a clear, bright blue. The overall scene is a typical agricultural landscape.

***FOOD QUALITY ISSUES
AROUND USE OF
MANURE AND COMPOST***

D. Lynch

Organic Agriculture Centre of Canada

Manure and compost use..

A HOT topic!

FOOD QUALITY ISSUES AROUND USE OF MANURE AND COMPOST USE

1. NUTRIENTS

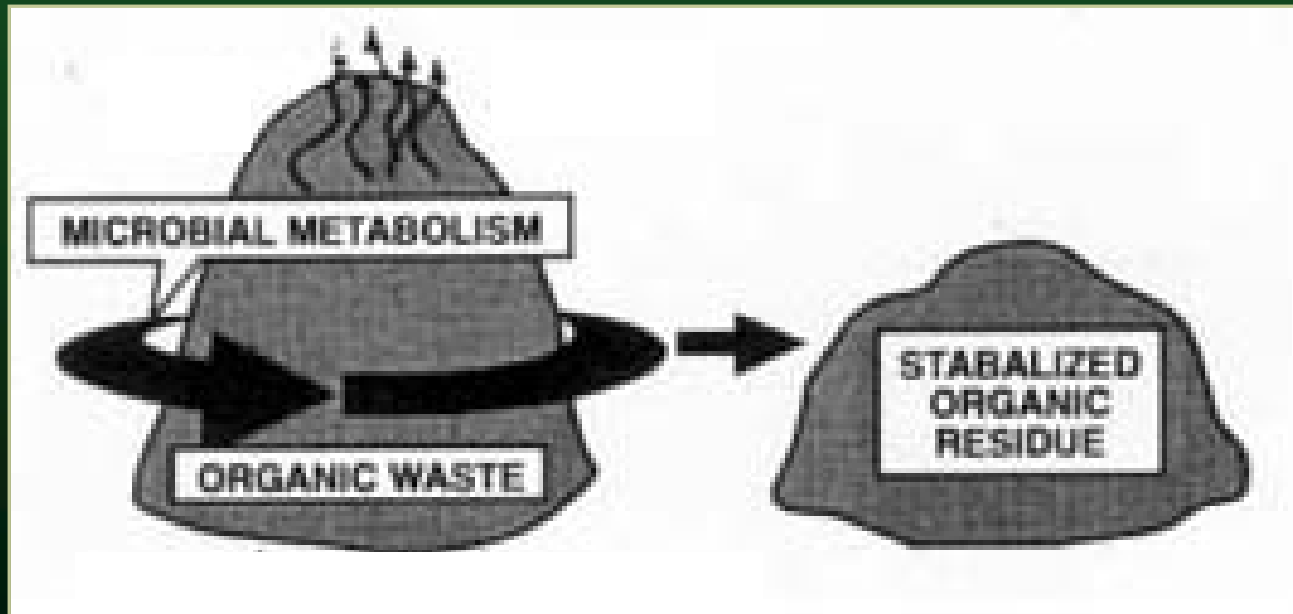
2. GM DNA

3. FECAL PATHOGENS

Composting is:

A managed process of biological oxidation, including a thermophilic phase, of a solid heterogenous organic substrate.

CAN/CGSB, 2004



Composting – A managed process

Organic materials are -

- Mixed
- Piled
- Heated above 55°C
- Cured



On-farm composting systems vary in terms of:

- Scale
- Methods
- Feedstocks
- Composting objective
- Intended market or use



Draft Canadian Standards

CAN/CGSB, 2004. Part I (Principles), 5.3.7

Manure and soil amendments ...Broad principles regarding appropriate use of manure and composts etc.

CAN/CGSB, 2004. Part II (Guidance), 5.4.2.

Un-composted farmyard manure ...must be applied at least 60 days prior to harvest, ..100 days where crop edible portion contacts soil.

Liquid Manure, or manure runoff....must not be applied to crops intended for human consumption.

NUTRIENTS

Challenges with compost use

➤ Predicting compost N release difficult

N'dyagamiye et al., 1997

Janssen, 1996

➤ Variability in compost quality

Rodd et al., 2002

Sikora and Enkiri, 2001

➤ Unfavourable ratio of PK to N

Eghball and Power, 1999

Reider et al., 2000

Challenges with compost use – some possible solutions

- Conserve nutrients during composting
- Combine compost and legumes
- Gauge soil nutrient availability

Combining composts with legumes



Crop: Timothy or timothy & clover mixture

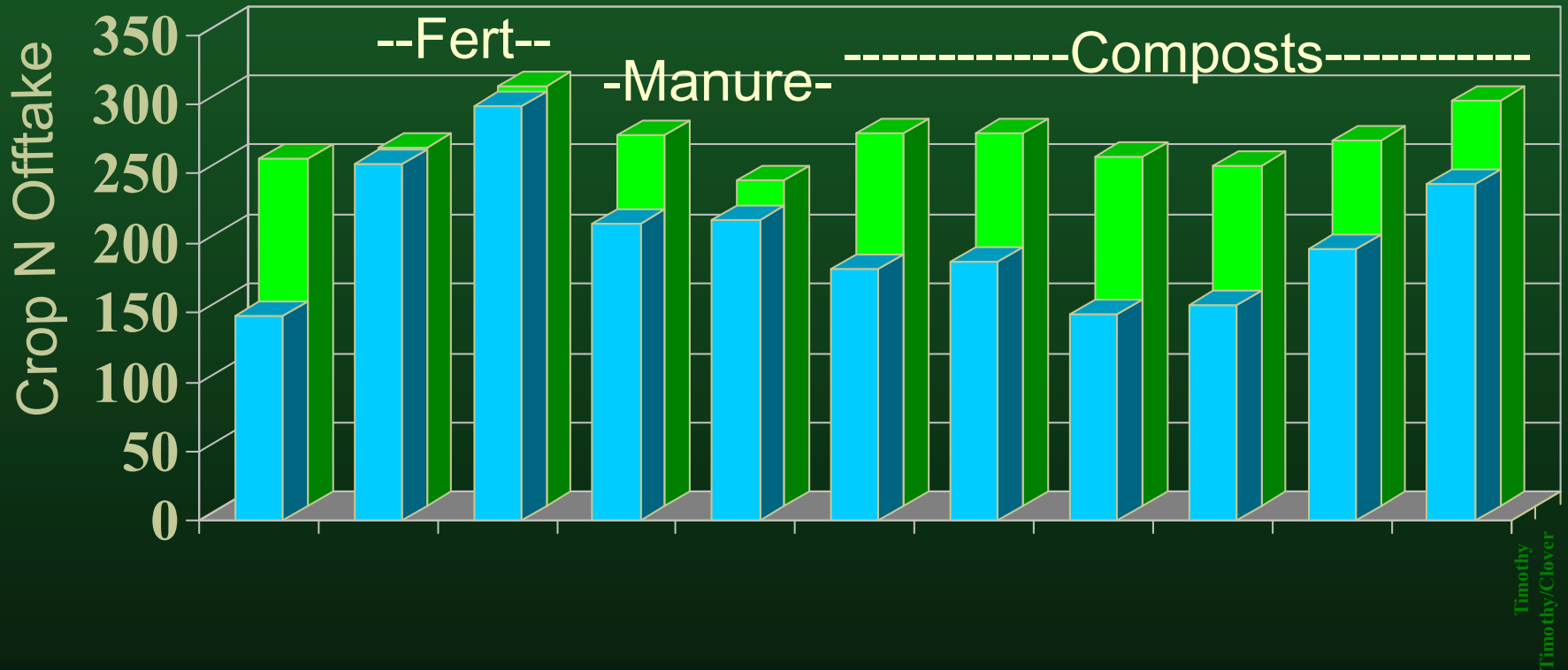
Treatments: Fertilizer, dairy manure, composts

Lynch et al., 2004

Forage quality

kg N ha⁻¹

■ Timothy ■ Timothy/Clover



Manure and Compost Use in Organic Potato Production



Varieties: Shepody,
A90586-11



Amendments

N applied (kg N/ha)

Control

0

'Nutriwave' manure

300; 600

Compost

300; 600

Manure and Compost use in Organic Potato Production



Amendment application



Biomass sampling

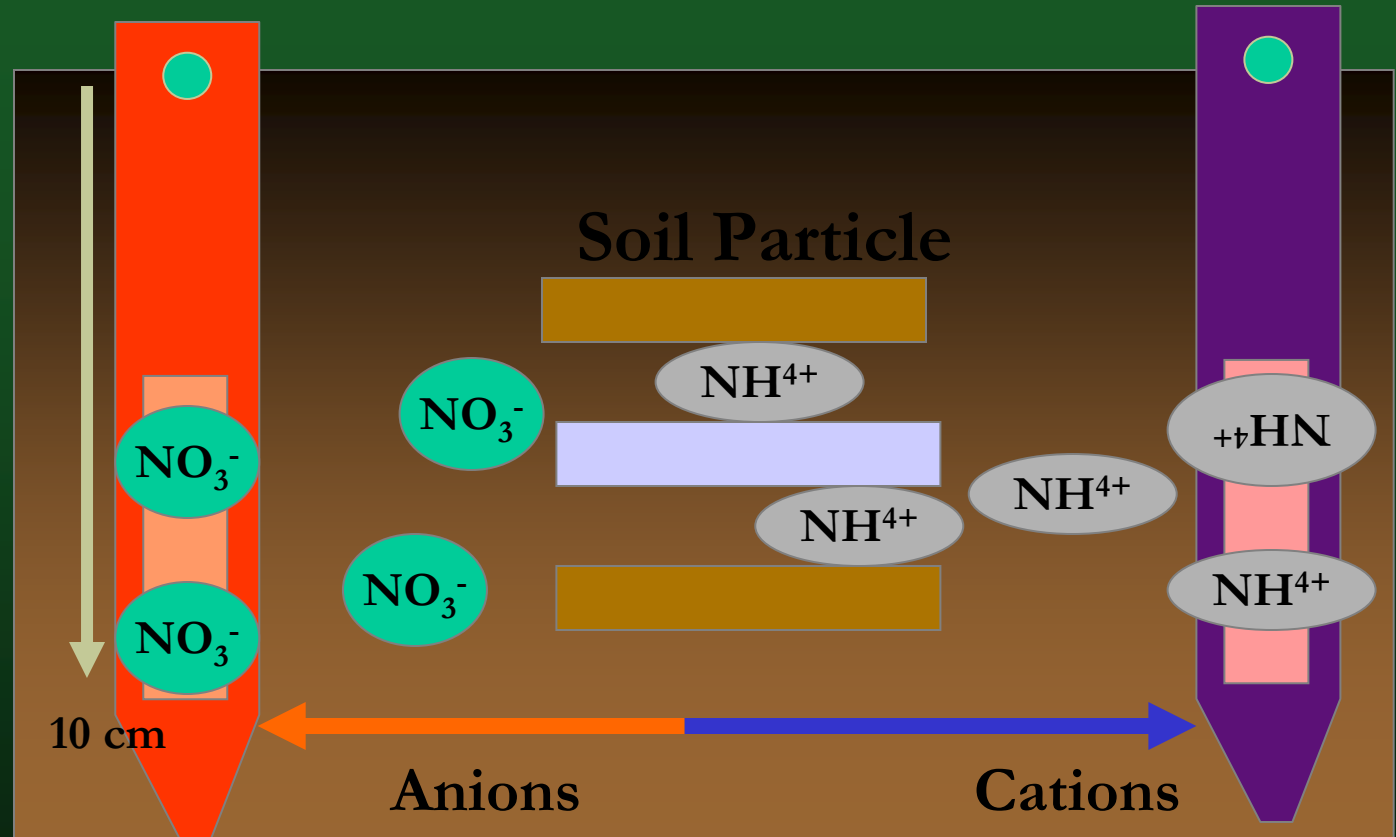


Soil N and moisture



Harvest

Gauging Soil N Availability



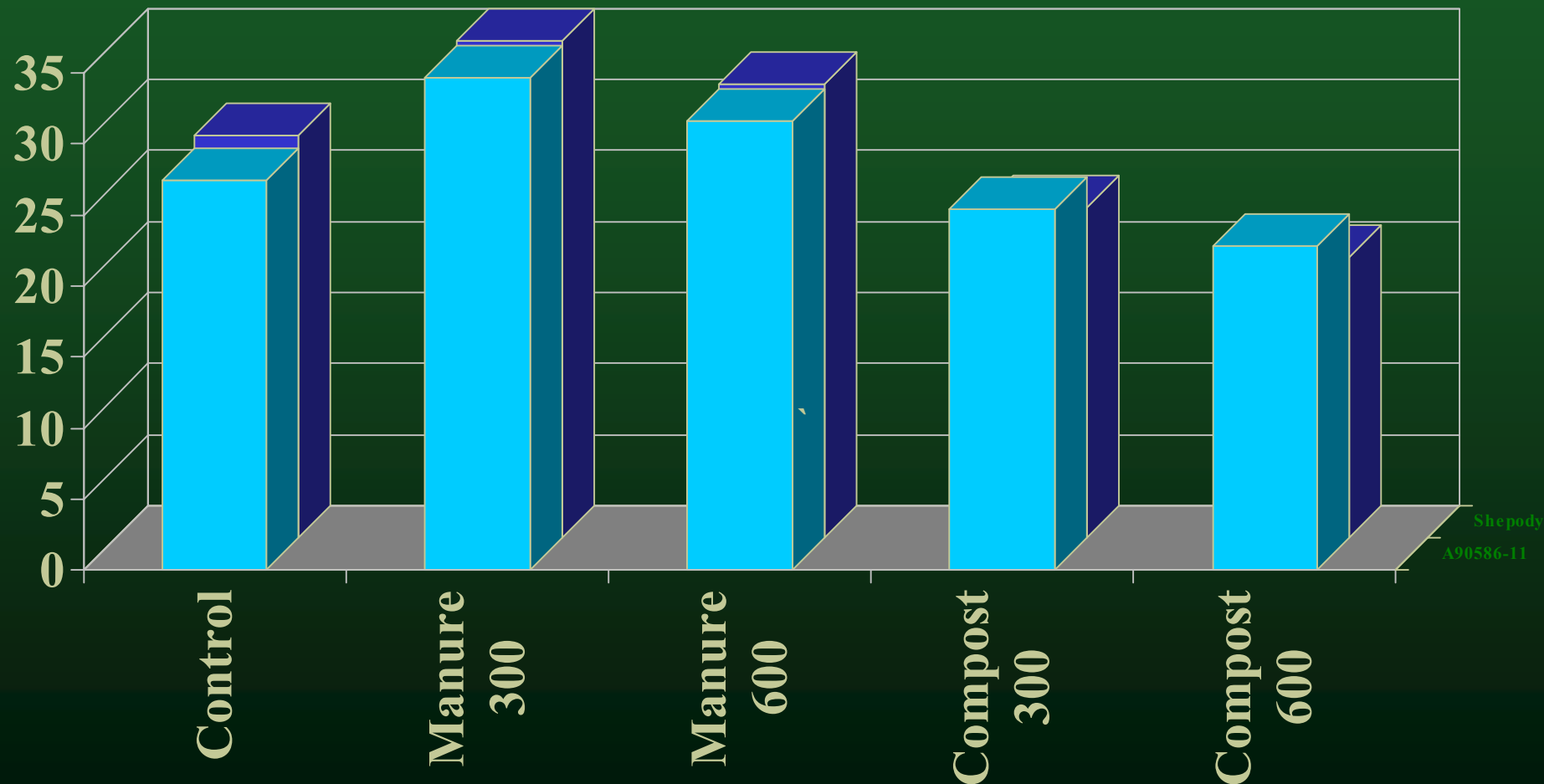
Plant Root Simulator (PRS)TM Probes

Yields -2003

T ha⁻¹

A90586-11

Shepody



Shepody
A90586-11

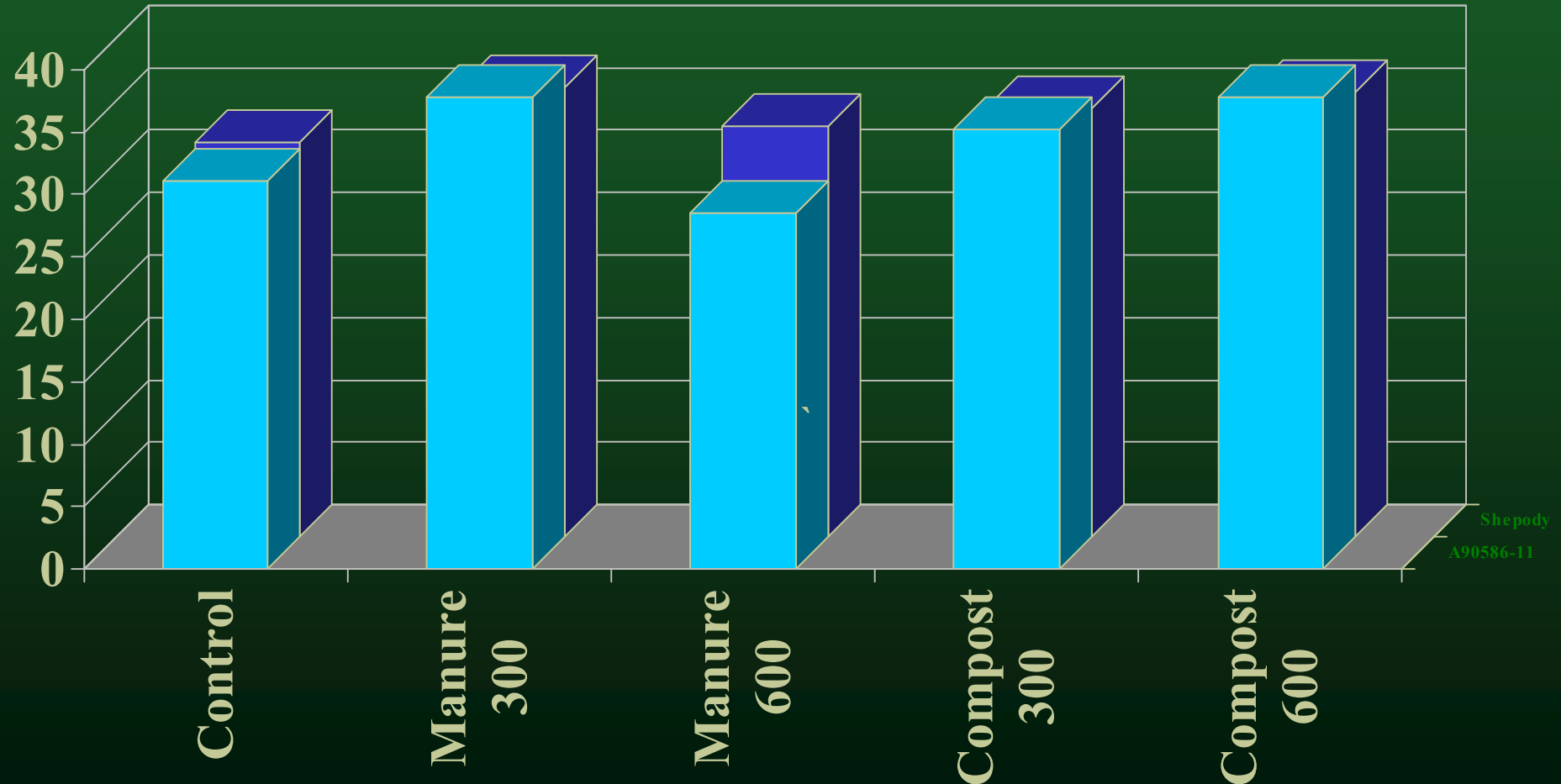
Kentdale 2003

Yields -2004

T ha⁻¹

A90586-11

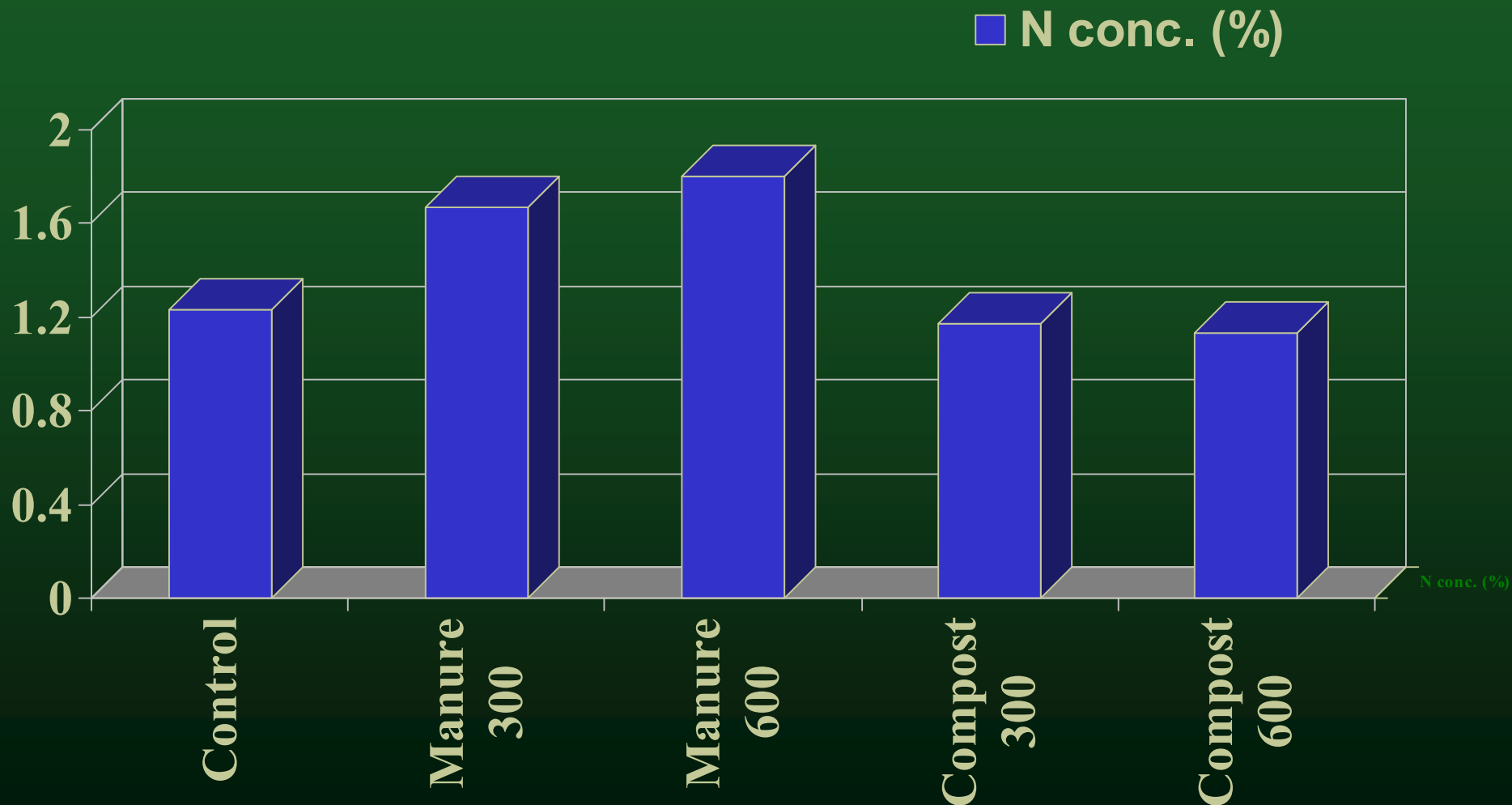
Shepody



Shepody
A90586-11

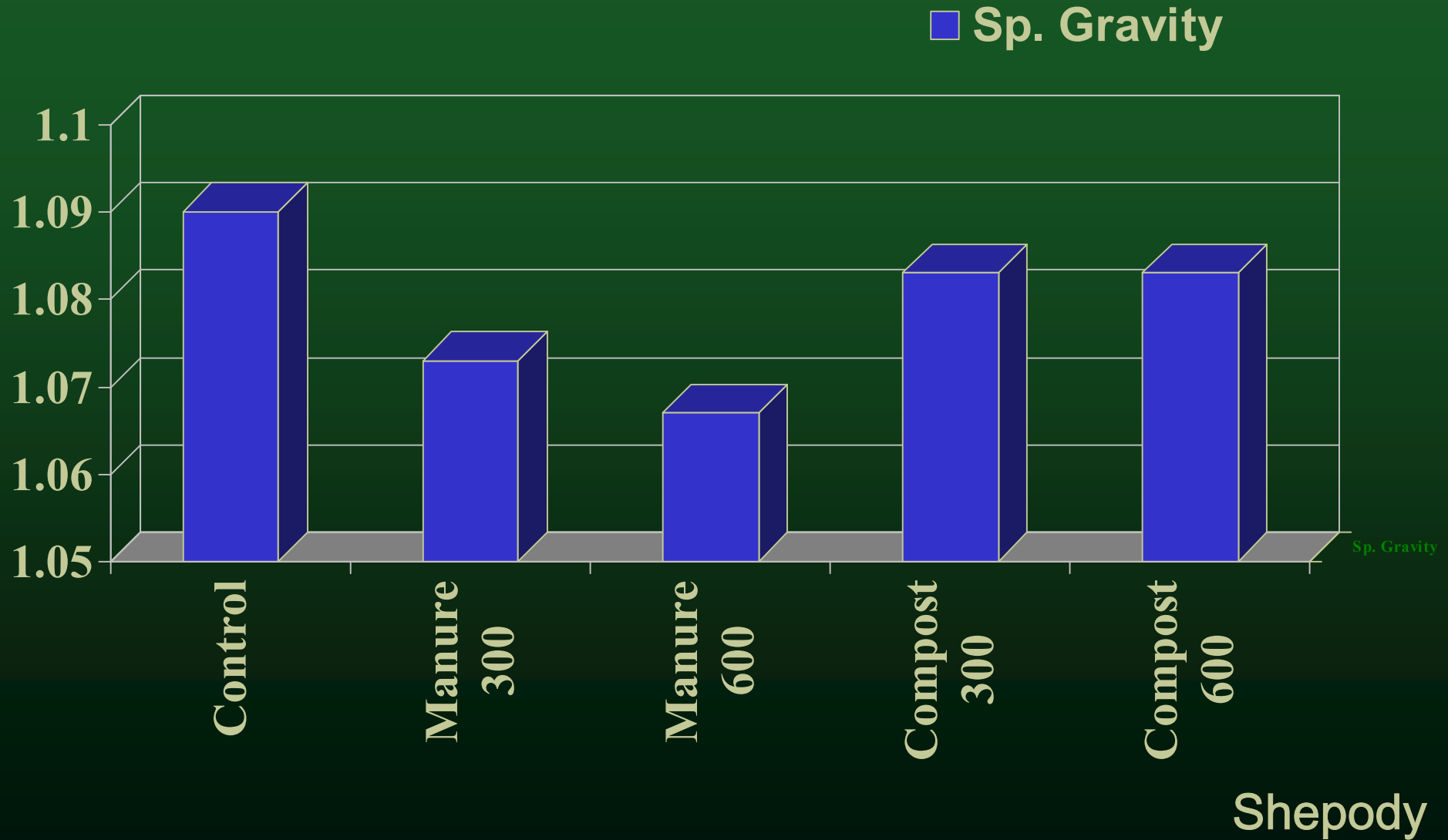
Kentdale 2004

Tuber Quality

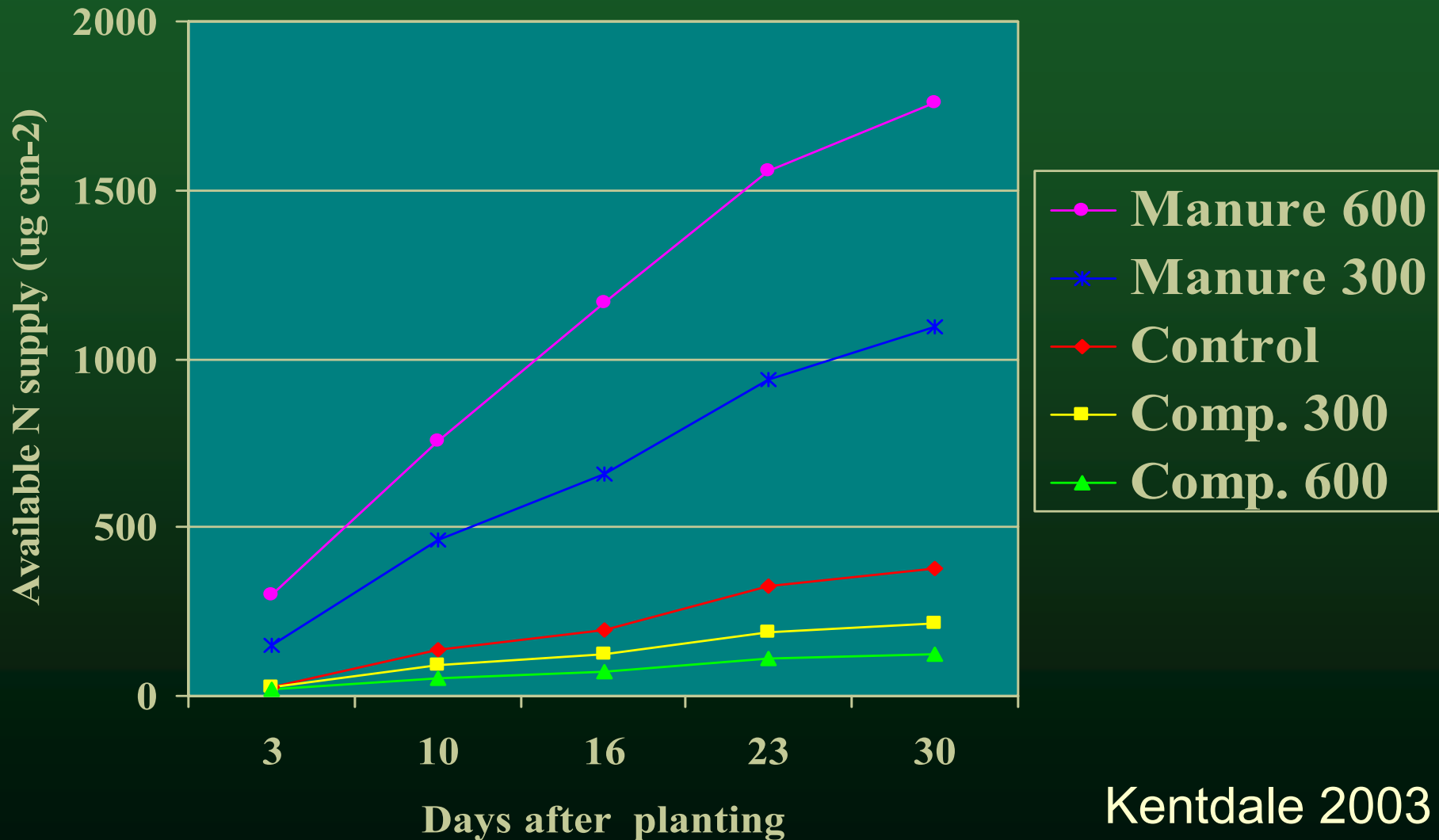


Shepody

Tuber Quality



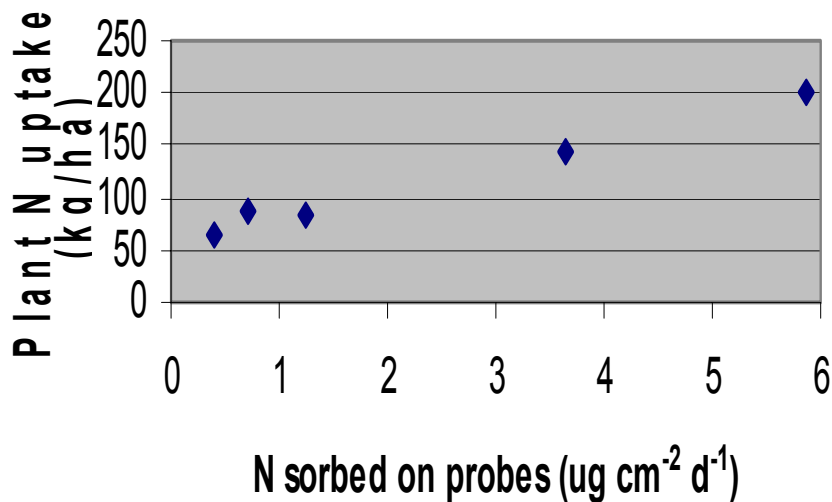
Gauging Soil Available N: PRSTTM Probe N Flux



Kentdale 2003

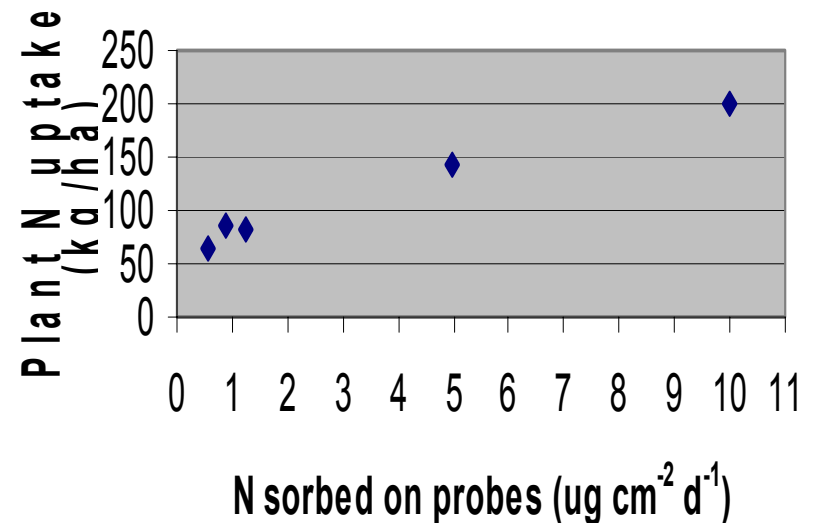
Can we predict N needs of crop?

Relationship between plant N uptake and N sorbed on PRS probes (0-30 d).



$$R^2 = 0.98; y = 58.76 + 23.8x$$

Relationship between plant N uptake and N sorbed on PRS probes (0-3d)



$$R^2 = 0.98; y = 66.68 + 13.76x$$

Kentdale 2003

GM DNA

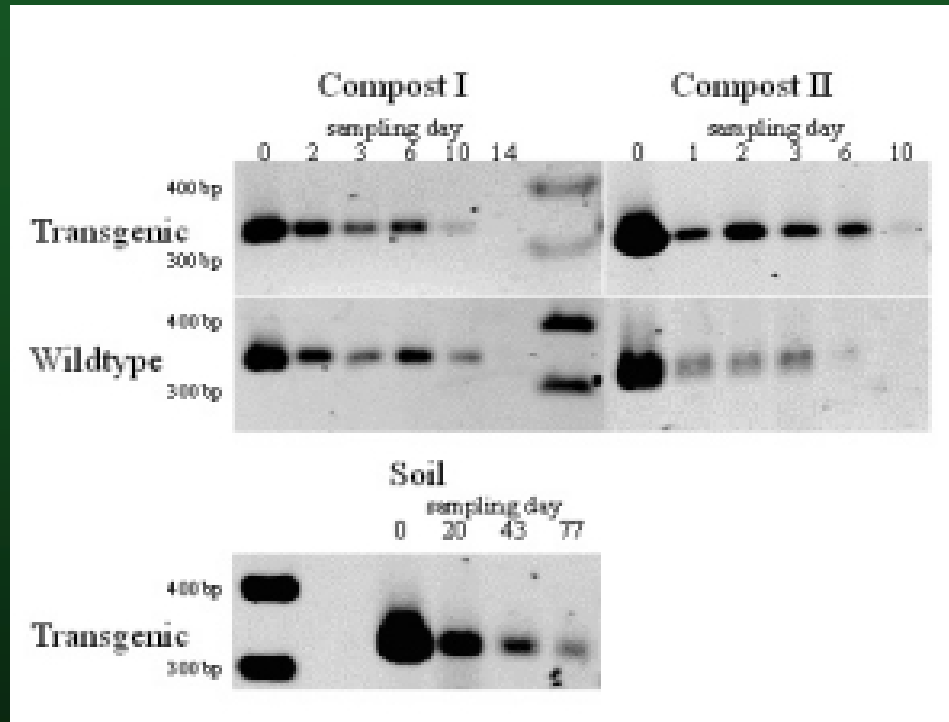
GM in plant residues

Is composting a useful method for the elimination of transgenic DNA from GM plant residues?

Rasmussen et al., 2004



**In-vessel
composter**



**Degradation of GM-DNA
with time**

GM DNA and Conventional Manure on Organic Farms

**Do transgenes from genetically modified (GM)
corn and soybean fed to animals, survive in
manure and composted manure?**

Martin, R., Van Acker, R. and McLean, N. 2005.

- **Feed and manure from 4 farms:**
 - 1) **conventional dairy**
 - 2) **organic dairy**
 - 3) **conventional poultry**
 - 4) **organic poultry**
- **Manure samples composted by standard and vermi-composting methods**
- **Composting lasted 16 weeks and samples collected every 4 weeks for DNA analysis.**

- **DNA was extracted from feed, manure and compost**
- **Polymerase chain reaction (PCR) was used to amplify:**
 - **a 101 base pair sequence unique to the 35S promoter (from cauliflower mosaic virus)**
 - **a 151 base pair sequence unique to the nos terminator (from Agrobacterium)**

Both sequences are found in most GM plants

- **As expected, both GM DNA sequences were detectable in 100% of the conventional feed samples**
- **Unexpectedly, feed samples from an organic poultry farm showed that 6 of 8 tested samples, amplified one of the GM sequences.**
- **There were similar results in 4 of 7 feed samples from other organic farms.**

- In manure, the DNA from feed was not always degraded. The 101 bp sequence from the 35S promoter region was amplified in 3 of 9 poultry samples and in 1 of 4 dairy manure samples.
- In poultry manure, it was possible that the GM DNA originated from uneaten feed that was spilled onto manure.
- However, the dairy manure was collected directly from the cow.

- In compost, GM DNA sequences were not detected in any of the dairy compost samples.
- However, 3 of 15 poultry compost samples had low levels of the 35S promoter sequence of DNA. Two were from 3-month compost and one from 2-month compost.
- Poultry vermicompost also tested positive for the 35S sequence at 4 months.
- Further tests could determine if these segments are part of functional genes.
- Manure contaminated by feed might be more resistant to degradation during composting. A concern for farmers wanting to compost conventional poultry manure.

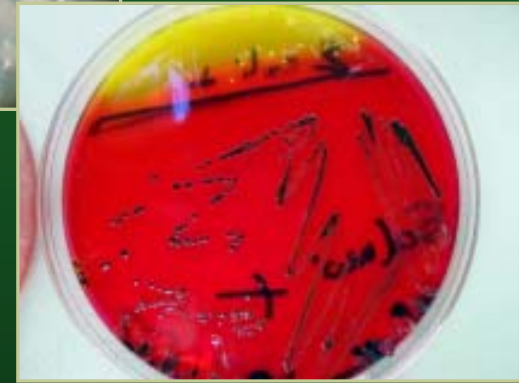
Fecal Pathogens

Fecal Pathogens

- E. coli 0157
- Salmonella
- Campylobacter
- Cryptosporidium
- Giardia



E.coli 0157



Salmonella

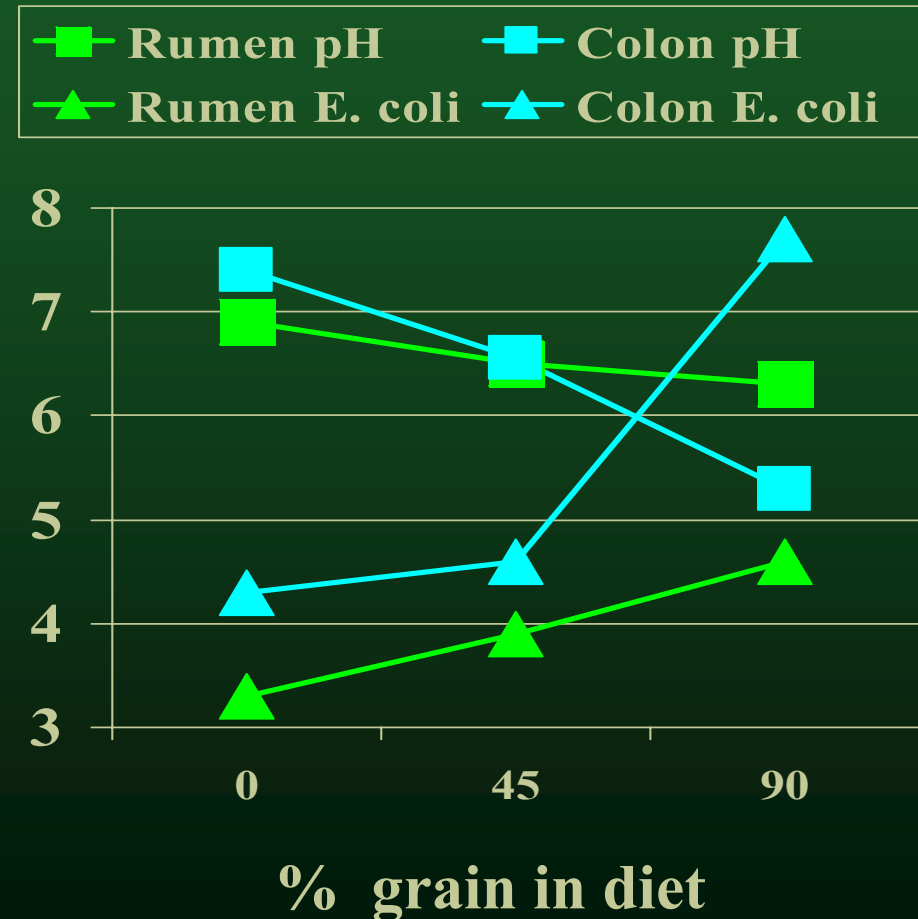
Woods End Laboratory, 2005

<http://www.woodsend.org/>

Effect of organic animal nutrition on rumen and colon pH and *E.coli* cfu

E. coli O157

- asymptomatic in cattle
- faecal contamination of carcasses at slaughter
→ food chain (meat)
- infective dose: 10 cells!!!
- highly pH-resistant



Diez-Gonzalez *et al.* (1997) *Science*

Potential Survival of Fecal Pathogens in the Environment

Material	Temp.	Salmonella	E-coli
Soil	Cold (5C)	12-28 weeks	100 days
	Warm (30C)	4 weeks	2 days
Cattle Manure	Cold (5C)	12-28 weeks	100 days
	Warm (30C)	4 weeks	10 days
Liquid Manure		13-75 days	10-100 days
Compost		7-14 days	7 days

Survival of Fecal Pathogens in the Environment

Cote and Quesy, 2003.

- **Evaluated recommendations of Canadian Horticulture Council**
- **Contaminated liquid hog manure applied in carrot, cabbage and cucumber production.**
- **E.coli undetectable in soil after 60d, and not on vegetables.**

Islam et al., 2004.

- **In re-contaminated compost Salmonella and other pathogens persisted >120d.**

Compost Tea and Fecal Pathogens



...a special concern?



Compost Tea and Fecal Pathogens

- **US Research by - Ingram USDA-ARS, Beltsville,
- Brinton et al. (2004) , Woods End**
- **US Compost Tea Task Force recommendations
- Test teas for E.coli IF**
 - (1) tea contains nutrient additives**
 - (2) are to be used > 1 hr after production
and are to be used on**
 - (3) food crops harvested <90d after application**

Fecal Pathogens and Organic Produce

- **Minnesota study of produce in fields of 32 organic and 8 conventional farms**
- **Analyzed unwashed. tomatoes, lettuce, cabbage, cucumbers, broccoli, strawberries, apples**
- **Ordinary E.coli levels on produce:**

Conventional: 1.6%

Certified organic: 4.3%

‘Organic’: 11.4%

Mukherjee et al., 2004, J. Food Prod.

Fecal Pathogens and Organic Produce

- **No E.coli 0157:H7 or other pathogenic strains found.**
- **Ordinary E.coli incidence was 19 times higher when manure or compost was < 1 year old.**
- **Lower incidence in certified farms attributed to guidelines re. composting and interval between manure application and harvest.**

Mukherjee et al., 2004, J. Food Prod.

A collage of four photographs related to organic agriculture. The top-left photo shows a white sheep standing in a field. The top-right photo shows a pig in a field. The bottom-left photo shows two farmers in a field, one holding a tool. The bottom-right photo shows a person standing next to a basket of produce. The text "Thank you!" is overlaid on the top two photos, and the website "www.organicagcentre.ca" is overlaid on the bottom two photos.

Thank you!

www.organicagcentre.ca