Suppression of Plant and Animal Diseases with Composts

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Disease Control with Composts

1) Plant Diseases

- **Potted Crops**: practiced effectively since the 1970's for root diseases. Biocontrol agent inoculants improve efficacy for some root diseases and may provide systemic control of foliar diseases.

- **Field Agriculture**: Broad spectrum disease control is feasible but many factors must be considered. Introduced biocontrol agents have been less effective, so far.

Disease Control with Composts

1) Animal Diseases

- **Poultry**: Practiced since 1959 for broilers by composting sawdust-bedded manure between flocks. Reduces death rates over time through 4-5 cycles.

- **Dairy Cows**: Recycled bedding sand and deep sawdust systems suppress mastitis by reducing coliform populations in bedding and on teats. Practiced widely since 1998.

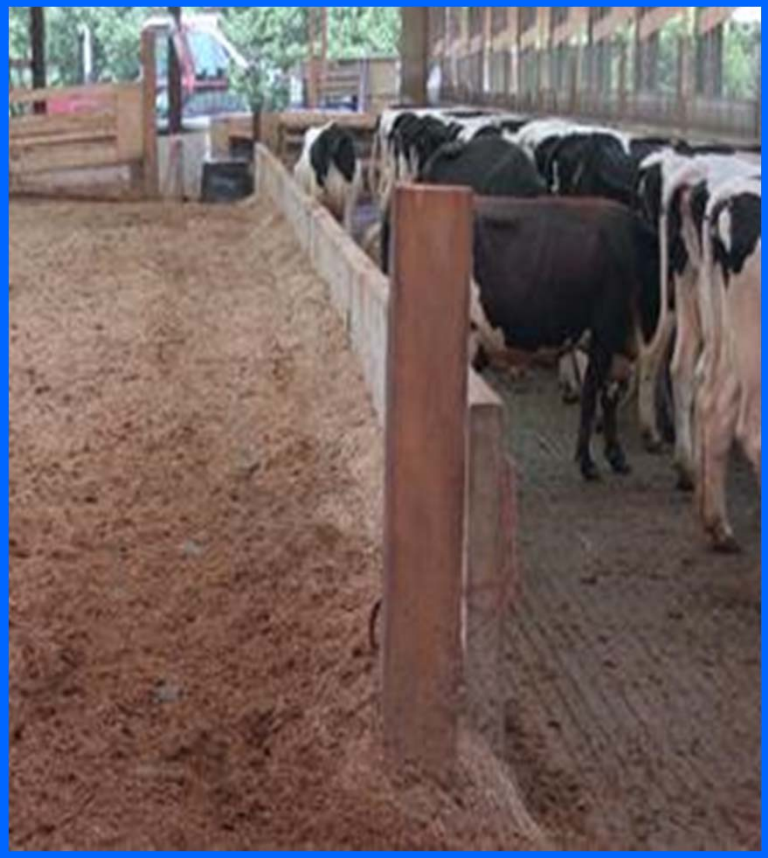
Bedding Options

- Mattress coved by sawdust results in high incidence of mastitis.

- Coliforms utilize glucose released from cellulose!!

Composting Bedded Pack

- New (experimental) technology
- Requires specific barn design
  - Feed alley
  - Bedded pack
  - Wall



Composting Bedded Pack

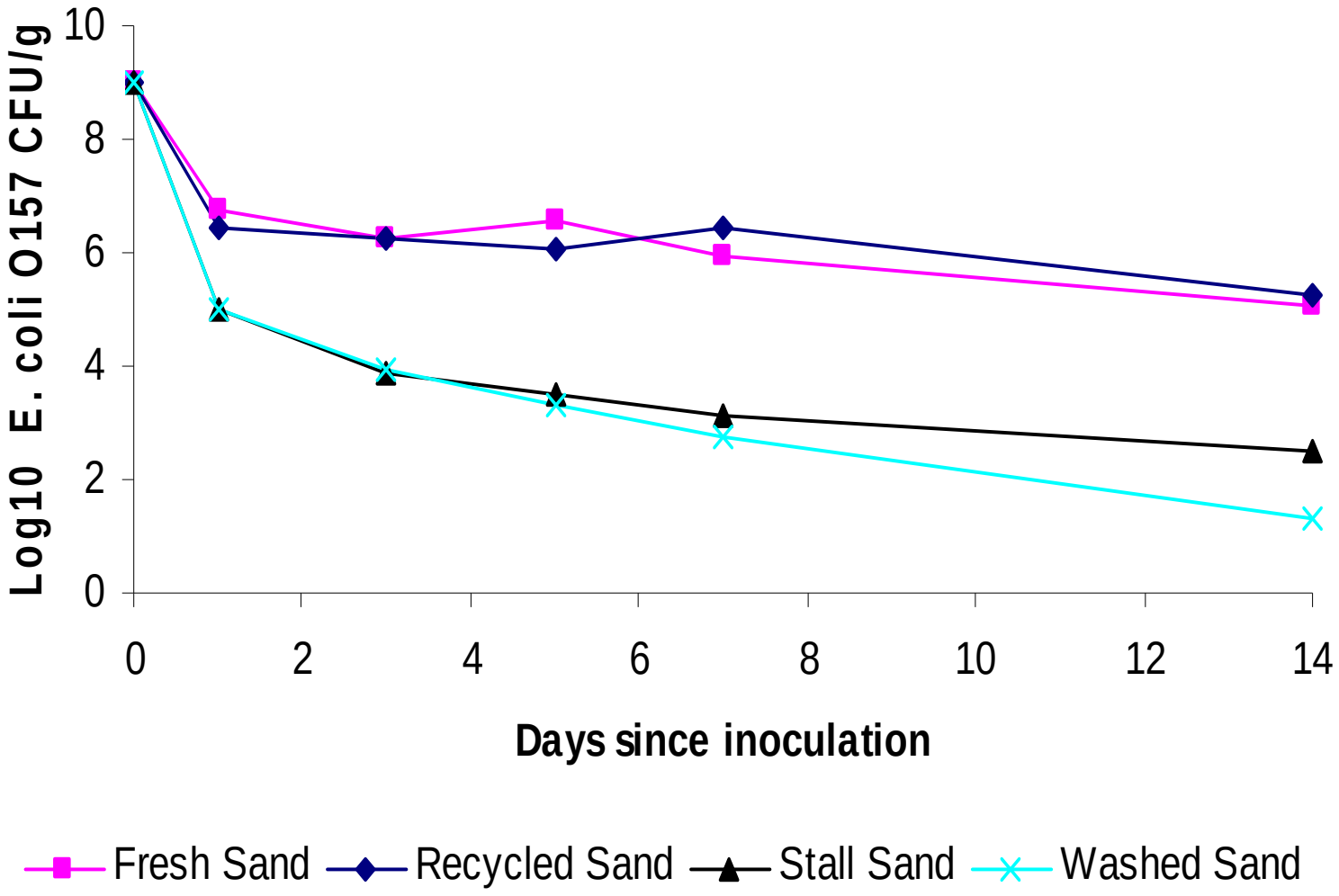
- Wood shavings or sawdust added at 3-4 week intervals
- Stirred at least twice daily
- Compost under cows reaches high temperatures (130^{o}F)

Sand Bedding: Benefits

- Comfort ?
- Health
  - Fewer swollen hocks/Fewer knee injuries
  - No differences in SCC
  - Mastitis reduction
- Environmental Hygiene
  - Food Safety
    - Less *E. coli* O157

Disadvantage: high bulk density

Survival of *E. coli* O157 in sand bedding



LeJeune et al., 2004,unpublished info.

Environmental mastitis / bedding pathogen inoculum interactions

- Mastitis incidence relates directly to pathogen population on the teat end
- Rate of clinical mastitis relates directly to number of mastitis-causing organisms in bedding
- Population of Coliforms in bedding should be < 10^6CFU/g

Mechanisms of Biological Control

- **Microbiostasis** (competition & antibiosis): effective for suppression of pathogens with propagules < 200 U diam. (coliforms, *Phytophthora*, Pythium, etc.).

- **Parasitism**: required for suppression of pathogens with propagules > 200 U diam. (*Rhizoctonia*, *Sclerotium*, etc.).

- **Systemic Induced Resistance:** induced by ISR-active rhizosphere microorganisms against root and foliar diseases.

Microbiostasis

- Most composts provide this effect naturally after biocontrol agents colonize the substrate (*Phytophthora*, Coliforms, etc.).
- Organic matter decomposition level critically affects efficacy.
- Compost salinity impacts efficacy.

Stone et al., 2004; Franz et al., 2008 Env. Microbiol. 10:313-327

Parasitism

- Few composts provide this effect naturally (< 20%).
- Controlled inoculants (e.g.*Trichoderma*) improve efficacy for *Botrytis, Rhizoctonia*, *Sclerotium*, etc.
- Organic matter decomposition level critically affects efficacy (glucose and other soluble nutrients repress lytic enzymes).

Systemic Induced Resistance (ISR)

- Effective for suppression of foliar diseases (Botrytis, powdery mildews), stress canker, bacterial, some viral and vascular wilt diseases
- Rarely provided naturally by composts (< 2%).
- ISR inoculants can significantly improve efficacy.
- Substrate chemistry matters!


Phytophthora blight on rhododendron foliage
Control
T382

ISR Mechanism

- Differs from SAR pathway.
- Jasmonic acid/ethylene pathways are involved (Pieterse et al., 2003; Soresh et al., 2005).
- Extensin proteins and PR 5 seem to play a role in ISR mechanism induced by *Trichoderma* (Alfano et al., 2007).

Questions

Do cows have an equivalent ISR mehanism?