Plant Pathogens in Composted Green Waste: Risk of Transmission

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Outline

- Sources of information
- Introduction
- Literature review
- Experimental results
- Conclusions

Sources of info

Noble & Roberts (2004) Eradication of plant pathogens and nematodes during green waste composting: a review. *Plant Pathology* 53: 548-568.

For a pdf reprint e-mail: s.roberts@planthealth.co.uk


REVIEW ARTICLE

Eradication of plant pathogens and nematodes during composting: a review

R. Noble*† and S. J. Roberts

Sources of info

Noble & Roberts (2003) *A review of the literature on eradication of plant pathogens and nematodes during composting, disease suppression and detection of plant pathogens in compost.*

Available from wrap web-site: *http://www.wrap.org.uk/document.rm?id=250*


STANDARDS

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Research Report

A REVIEW OF THE LITERATURE ON ERADICATION OF PLANT PATHOGENS AND NEMATODES DURING COMPOSTING, DISEASE SUPPRESSION AND DETECTION OF PLANT PATHOGENS IN COMPOST

Sources of info

Noble *et al.* (2004) Investigation of the effect of the composting process on particular plant, animal and human pathogens known to be of concern for high quality end uses.

Available from wrap web-site: *http://www.wrap.org.uk/document.rm?id=567*


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Investigation of the Effect of the Composting Process on Particular Plant, Animal and Human Pathogens known to be of Concern for High Quality End-Uses

R&D Report Organics

Project code: STA0012

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Introduction

- Nothing in life is without risk !
- For pathogens in green waste:
  - Need to understand the risks
  - and manage them
  - Balance the risks against any benefits

Introduction

- Main concern:
  - If you use composted green waste are you going to create / introduce new disease problems ?
- WRAP funded us to address this issue
- Not a new concern:
  - considerable body of published data in the scientific literature esp. from 1980's and 1990's

Literature review

- Examined *ca.* 80 publications (1926-2003)
- Covered 64 pathogens/nematodes
- Several problems in reviewing, interpreting and comparing the literature:
  - different methods
  - differing, poor, or unknown detection limits
  - vague temperature records
  - conflicting results

Literature review

- Good news and bad news:
  - Most not detectable after composting for up to 21 d with peak temperatures of 64-70°C
  - Certain pathogens were more temperature tolerant and were not reliably eradicated:

    'Fungi': club root of brassicas, Fusarium wilt of tomato, dry root rot of beans

    Viruses: CGMMV, PMMV, TRV, TMV, ToMV

Consultation with end-users

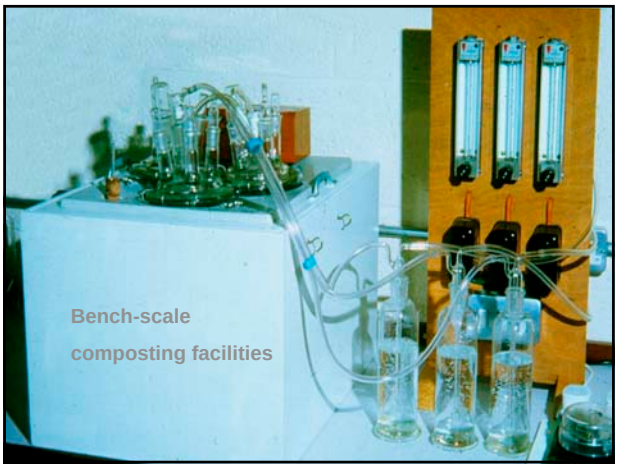
- Pathogens most frequently mentioned as being of concern:
  - *Phytophthora* spp. (root rots)
  - *Pythium* spp. (damping off)
  - *Plasmodiophora brassicae* (club root)
  - *Rhizoctonia solani* (damping off)
  - *Fusarium oxysporum* (wilts)
- Also for health and safety:
  - *E. coli*
  - *Salmonella*

Experimental work

- Pathogens selected
  - end-user concern, un-reliable or no published data, temperature tolerant
- Examined in bench-scale system
  - infected plant material or propagules ad-mixed with carrier
- Tests in commercial systems
  - selected pathogens
  - insulated windrow or tunnel

Pathogens

Pathogen	Disease
Fusarium oxy. f.sp. *lycopersici*	Tomato wilt
F. oxy. f.sp. *radicis-lycopersici*	Tomato foot/root rot
Microdochium nivale	Fusarium patch of turf
Phytophthora nicotianae	Root and stem rots
Pythium ultimum	Damping off, root rots
Plasmodiophora brassicae	Club root of brassicas
Rhizoctonia solani	Damping off, black scurf of potato
Thielaviopsis basicola	Black root rot
Verticillium dahliae	Wilts on range of hosts
Xanthomonas campestris	Black rot of brassicas
TMV	Tobacco mosaic virus



Bench scale

- Constant temperatures
  - 18, 40-70°C in 6°C increments
  - 7 days
- Green waste and onion waste

Bench – pathogen propagules

Pathogen	Inoculum	Not detected after 7d at: (°C)
Fusarium ox. f.sp. *lycopersici*	Chlamydospores / talc	46 (green waste) 52 (onion waste)
F. ox. f.sp. *radicis-lycopersici*	Chlamydospores / talc	40 (green waste) 46 (onion waste)
Microdochium nivale	Chlamydospores / talc	64
Phytophthora nicotianae	Oospores / peat	52 (green waste) 58 (onion waste)
Pythium ultimum	Oospores in chopped potato/soil medium	40 50 (1 day)
Thielaviopsis basicola	Conidia	40

Bench - infected material

Pathogen	Inoculum	Not detected after 7 d at: (°C)
Fusarium oxysporum f.sp. lycopersici	Tomato plants	46 (green)
Plasmodiophora brassicae	Galls	50-65 (moisture effect) 65 (1 day, 51% moist.)
Rhizoctonia solani	Barley grains	50 (1 day)
Verticillium dahliae	Oat grains	40 (green) 46 (onion)
Xanthomonas campestris	Brassica leaves	40
Tobacco Mosaic Virus	Tobacco leaves	80 (survived at 70)

Bench scale

- Green waste - pH 6.8, moisture 43%
- Onion waste – pH 4.3, moisture 75%
  - low pH, high moisture = less favourable for aerobic bacterial activity than green waste ?

Commercial systems

- Systems
  - Insulated aerated tunnels
  - Turned windrows
- Infected plant material
  - mesh bags
  - 50 cm depth
- Temperatures monitored with probes and electronic logger

Commercial systems

Pathogen	Inoculum	Not detected after 7 d at: (°C)
Fusarium oxysporum f.sp. lycopersici	Tomato plants	>60 for 2 days peak 70
Plasmodiophora brassicae	Galls	>65 for 1 day
Verticillium dahliae	Oat grains	>60 for 2 days peak 70

Conclusions

- Main concern:
  - If you use composted green waste are you going to create/introduce new disease problems ?
- Answer:
  - Probably not unless you are planning to grow certain higher risk crops
- Assurance
  - Composting done properly according to PAS100 standards (min 55°C for 7 or 14 d)

Conclusions

- If growing high risk crops (e.g. brassicas, TMV susceptible tomatoes, turf)

  either:
  - need assurance that higher temperatures (>65°C) have been achieved in the batch

  and / or:
  - test for the presence of the specific pathogen of concern

Conclusions

- Testing for pathogens
  - no standard protocols developed, agreed or validated
  - consider assay design
    - sampling and sample size
    - detection limits and sensitivity
    - tolerance standards
  - no such thing as ‘zero’ only ‘not detected’ or ‘less than ….’
  - expect to have results reported with indications of detection limits/sensitivity

Conclusions

- Key factors during composting:
  - minimum temperatures must be achieved throughout the bulk, not just in the core
  - if not turned, monitoring should be done near the surface (i.e. ~ 10 cm)
  - >51% initial moisture for reliable eradication of club root

Conclusions

- Problem of TMV
  - tolerant of high temperatures
  - evidence in the literature suggests that it does degrade over longer periods at lower temperatures (4 w at 66°C, 26 w at 31°C)
  - does it matter ?
    - most commercial tomato cultivars have resistance
  - widespread => need to consider risk in relation to other potential sources

Finally

- Remember nothing is without risk
- We can minimise the risk of most pathogens in green waste by ensuring adequate temperatures are achieved during the composting process
- Balance these risks against the potential benefits (e.g. to the environment and from disease and weed suppression)

The end

Thankyou for listening