Kan industriell storskala kompostering med fokus på effektivitet gi god nok kompost?

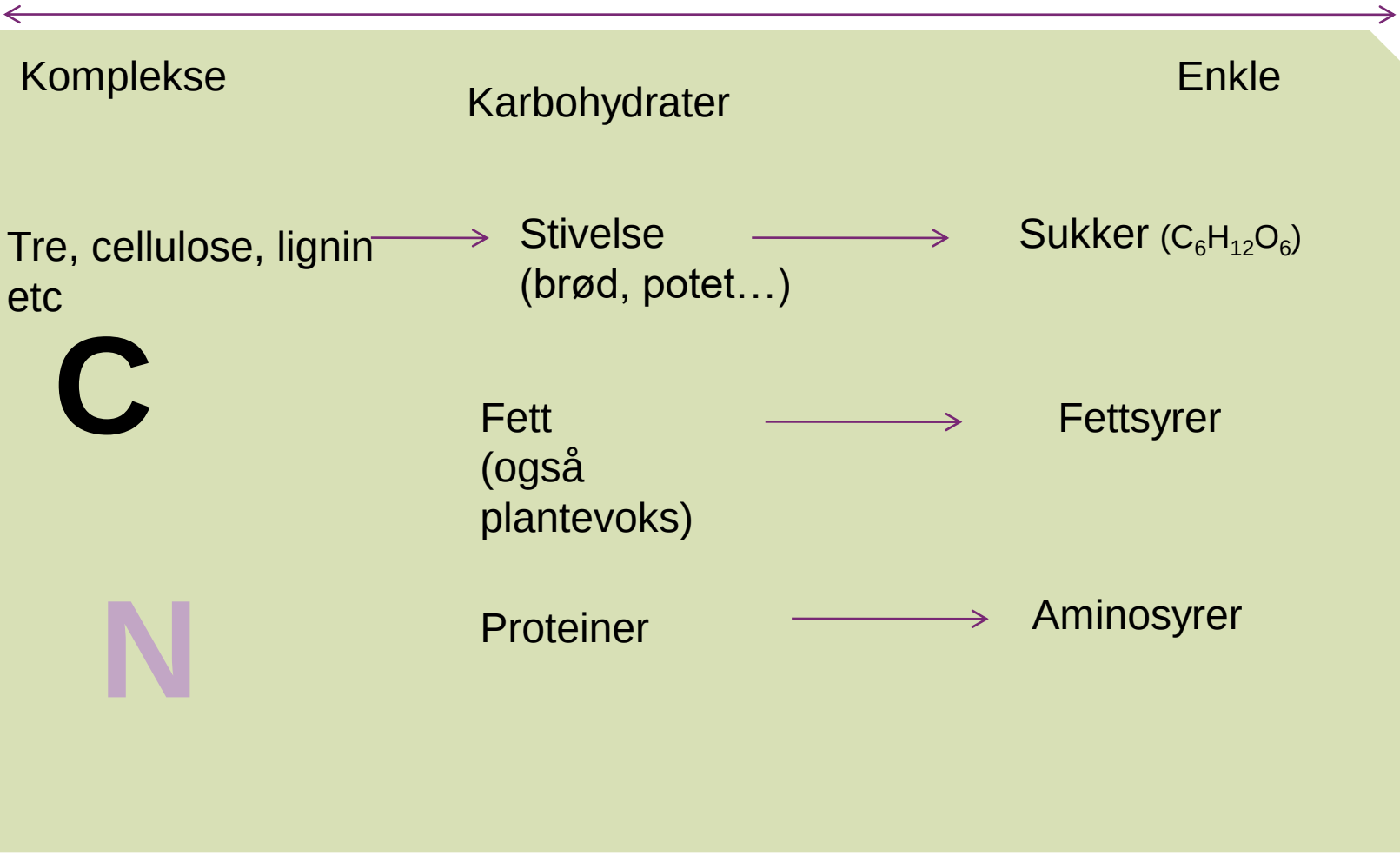
Diskusjon rundt biologisk prosess (ikke rundt eventuelle fremmedlegemer eller fremmedstoffer)

Ketil Stoknes, forsker

Lindum – for miljøets skyld

Finn forskjellen…

Sammensetning av biologisk materiale



Nedbrytningsprosesser med og uten luft, O_2

Aerob (med luft): Dyrs omsetning av mat / kompostering

O_2 →

Biomasse ($C_6H_{12}O_6$) →

→ CO_2

→ varme

→ Biomasse (høyere askeinnhold): Kompost

Batchprosess

Anaerob (uten luft): Forråtnelse, biogassproduksjon

Biomasse ($C_6H_{12}O_6$) →

Kontinuerlig prosess

→ Biogass $CO_2 + CH_4$

→ Biomasse (høyere askeinnhold): Biorest

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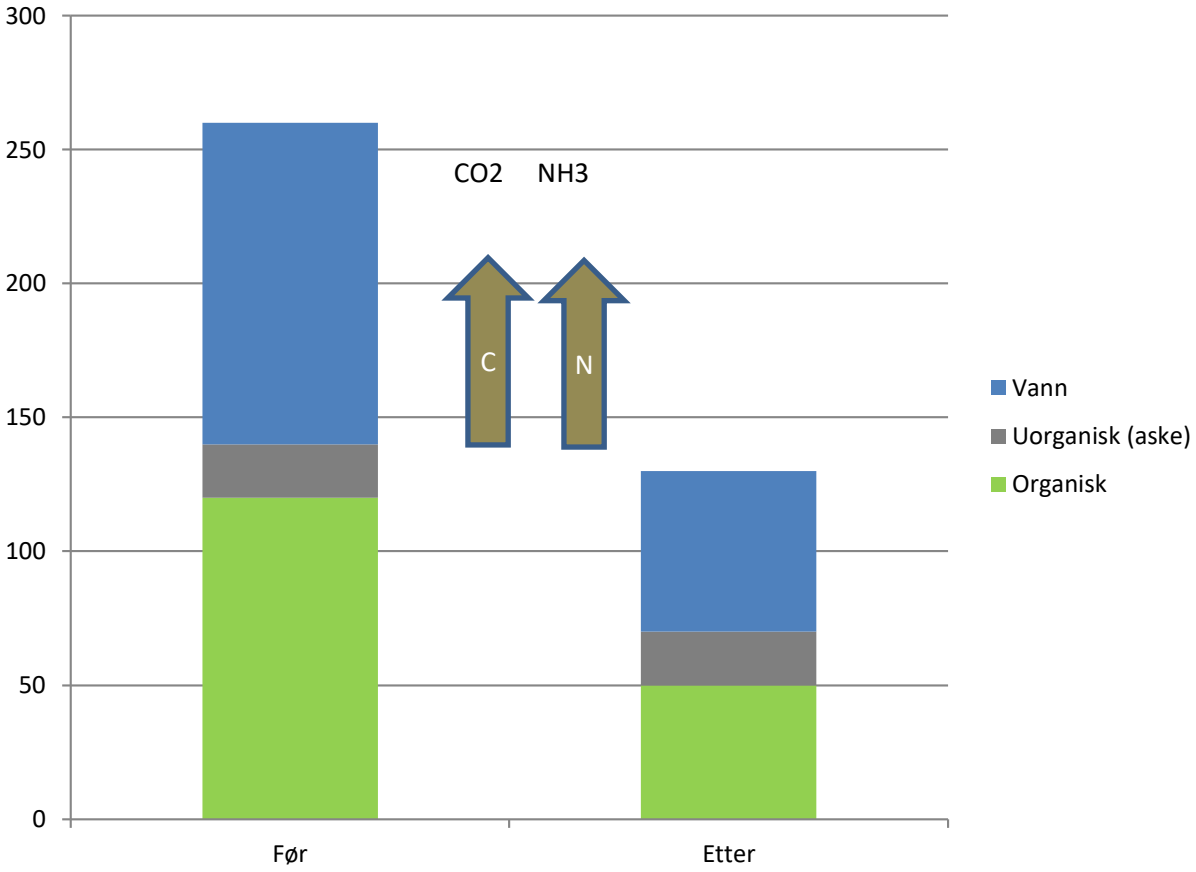
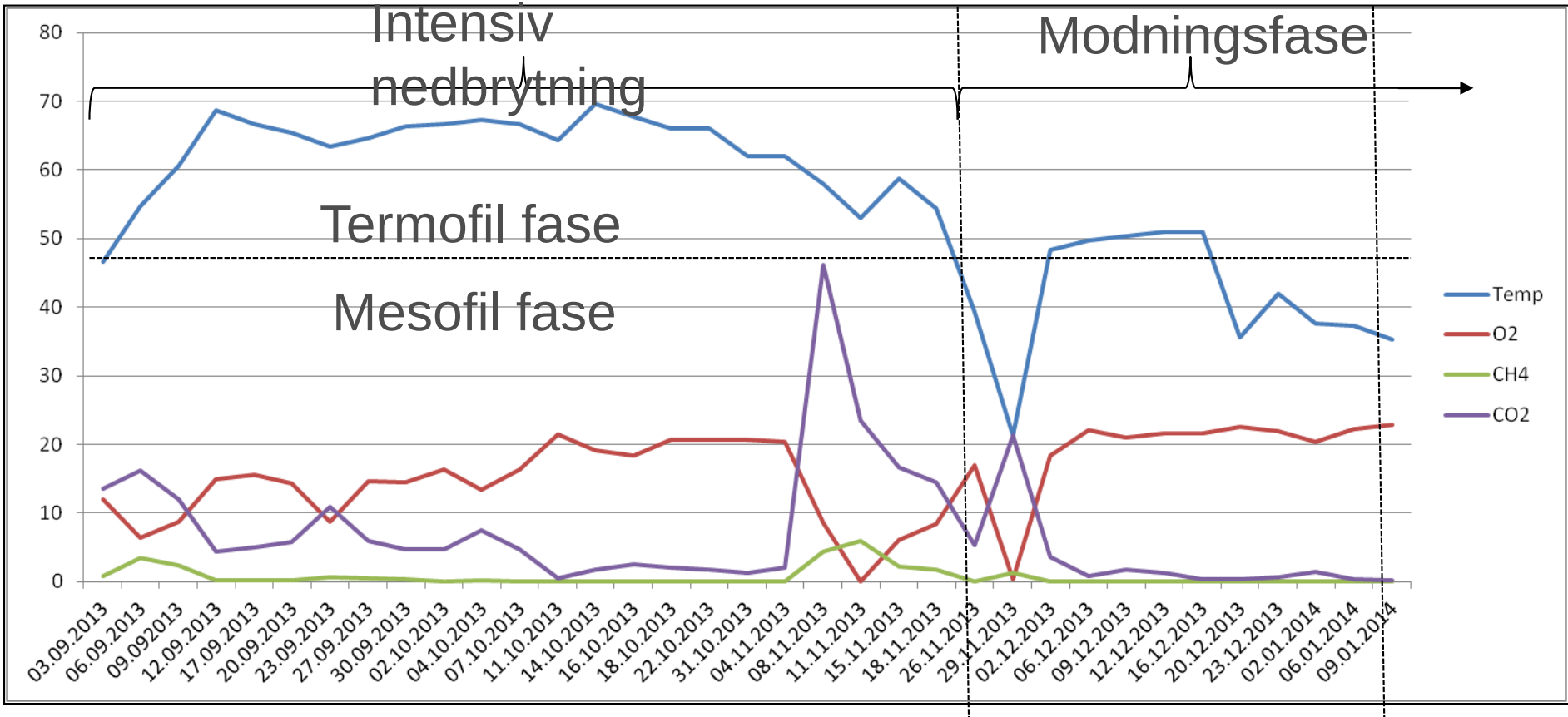
Før og etter komposteringsprosessen



Lette karbohydrater	Fiber (humus)
Ustabil	Stabil
Næring (NPK) bundet organisk	Næring (NPK) plantetilgjengelig
Nedbryterne tar næringen	Nitrat, fosfat osv løses ut etter plantenes behov

Komposteringsforløpet



Hygienisert kompost

«Frisk» Stabil o moden kompos

•Karboninnholdet ofte jevnt høyt i de fleste organiske materialer (ca 40-45% av det organiske innholdet)
•Nitrogeninnholdet varierer mye mer
•Kjenner du protein-innholdet?
=>N-konsentrasjonen = proteininnholdet / 6,25

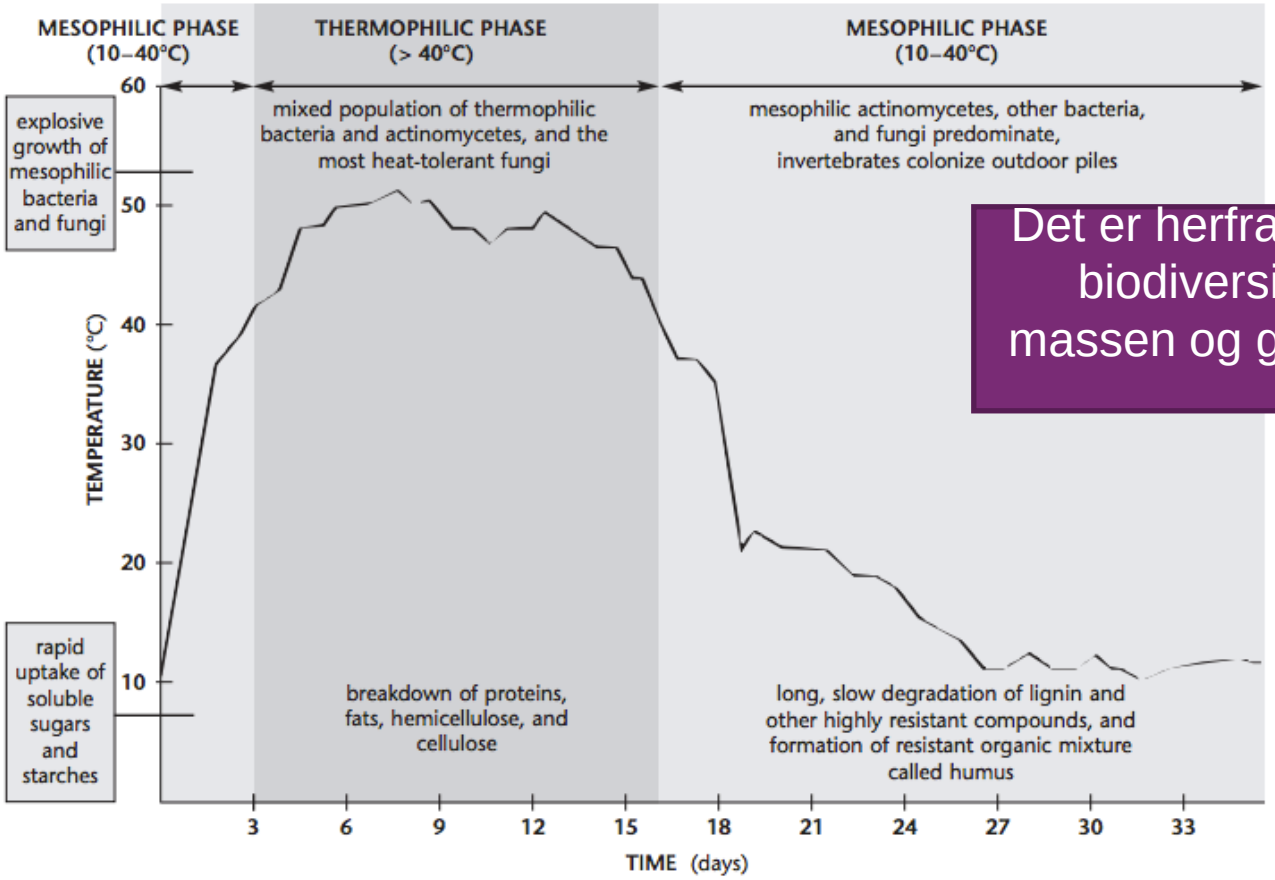
Nyblandet kompost:

Mer ammoniakk (og lyst-gass)
Høy temp, rask prosess
Mer stell

Mindre lukt
Kaldere og langsomere
Kan overlates mer til seg selv

«Brunt»: struktur:
Bark, flis, halm (Høyt C-innhold)
God lufting/grovporer som varer over tid selv under våte forhold
«Grønt»: Nitrogen-kilde:
Matavfall, bryggeriavfall, grønt: grønngjødsel, landbruksavfall, gress, fór etc

Fasene i industriell kompostering



Det er herfra det blir høy biodiversitet i hele massen og god kompost

Source: “The Science of Composting.” THE SCIENCE OF COMPOSTING (n.d.): n. pag. Cornell University. Web. 12 July 2015.

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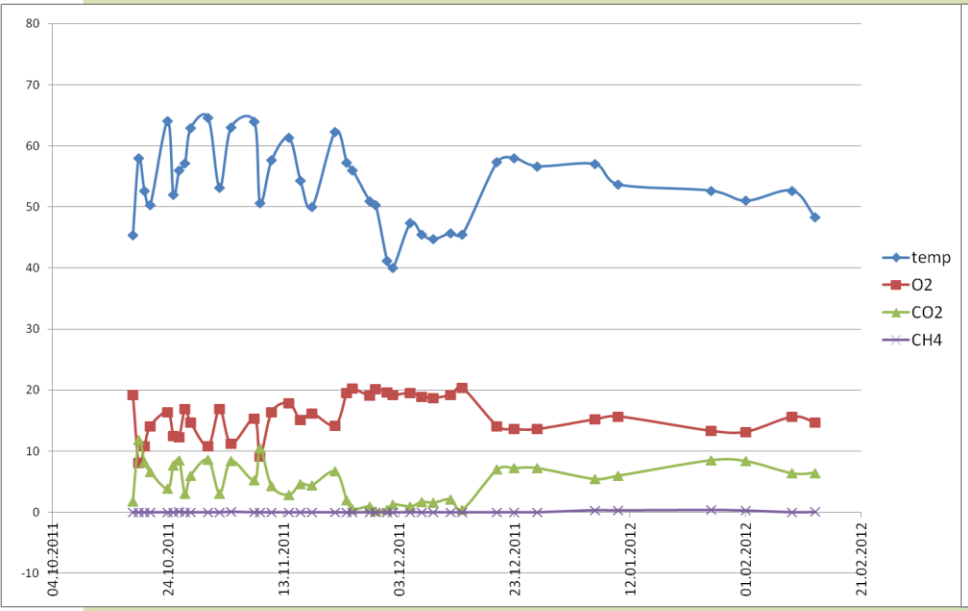
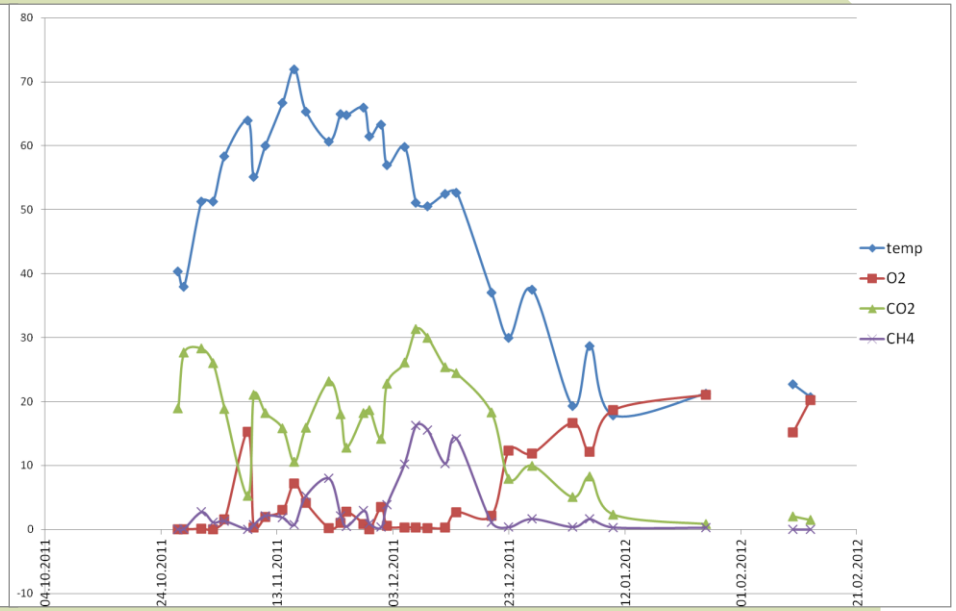
God og dårlig komposteringsprosess

En god hageavfallskompost



En mindre god matavfallskompost



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Hva gjør veldig høy temperatur?

- Hygieniserer (+)
- Men dreper biodiversiteten (unntatt i overflata)
- (Stimulerer nedbrytning opp til 50-55 grC)
- Bremser nedbrytning over 60 gr C
- Øker N-tap
- Kan sammen med anaerobe forhold stimulere til «spesielle forbindelser» som ikke er naturlige annet enn i ekstreme miljøer
- Kan arrestere komposten i en «glødefase»?
- Som gir mindre moden kompost og altså et ekstra behov for ettermodning før bruk?

Hvorfor modning?

- Hvis komposten fortsatt er fersk, eller har hatt høy temp (>60°C) må den modnes for å bli mer **stabil**
- Senke C/N ytterligere
- Bryte ned de «spesielle organiske forbindelsene» (som er giftige for planter)
- Gi bedre varianter av plantenæringa (for eksempel nitrat i stedet for ammonium)
- Gjensmitte den «kokte massen» med de gode mikrobene
- Redusere konduktiviteten

Uten modning får man

N-immobilisering:

Næringa blir ikke tilgjengelig for plantene (fordi mikrobene tar den til sin aktivitet). For eksempel hvis mye flis og kvist

Nitrogenmangel kan fikses på…

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Hva så med småkompost vs industriell kompost?

Contents lists available at ScienceDirect

Waste Management

journal homepage: www.elsevier.com/locate/wasman

Home composting versus industrial composting: Influence of composting system on compost quality with focus on compost stability

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ABSTRACT

Stability is one of the most important properties of compost obtained from the organic fraction of municipal solid wastes. This property is essential for the application of compost to land to avoid further field degradation and emissions of odors, among others. In this study, a massive characterization of compost samples from both home producers and industrial facilities is presented. Results are analyzed in terms of chemical and respiration characterizations, the latter representing the stability of the compost. Results are also analyzed in terms of statistical validation. The main conclusion from this work is that home composting, when properly conducted, can achieve excellent levels of stability, whereas industrial compost produced in the studied facilities can also present a high stability, although an important dispersion is found in these composts. The study also highlights the importance of respiration techniques to have a reliable characterization of compost quality, while the chemical characterization does not provide enough information to have a complete picture of a compost sample.

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(matavfall)

- Lik kjemisk, men
- Hjemmekompost stort sett stabile
- Industrielle spriket voldsomt, mange ikke stabile

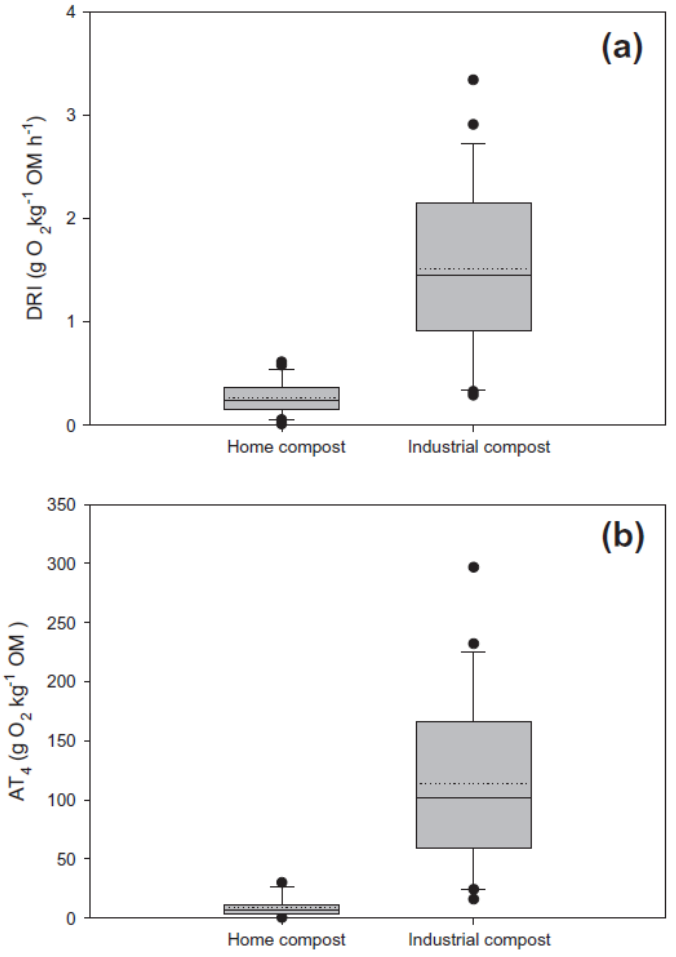

Fig. 1. DRI (a) and dynamic AT_4 (b) boxplots for home and industrial composts. Discontinuous line in boxplot indicates mean values.

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Hva betyr vendefrekvens og størrelse på rankene?

Compost Science & Utilization, (2010), Vol. 18, No. 2, 70-80

Effects of Turning Frequency, Windrow Size and Season on the Production Of Dairy Manure/Sawdust Composts

Sandra M. Tirado and Frederick C. Michel Jr.*
Department of Food Agricultural and Biological Engineering, The Ohio State University / OARDC, Wooster, Ohio
**E-mail contact: michel.36@osu.edu*

(Forsøk med kutalle)

- Høyere temp og mindre O2 i store ranker, men:
- Summen av prosessen (nedbrytning osv): Veldig liten forskjell mellom små ranker vendt hver 3. dag og store ranker vendt hver 10. dag…..

Industriell (municipal) kompost vs vermikompost og privat (backyard) vermi. Kvalitet og effekt på plantevekst

Compost Science & Utilization, (2005), Vol. 13, No. 1, 6-13

Composting vs. Vermicomposting: A Comparison of End Product Quality

C. Tognetti[1], F. Laos[1], M.J. Mazzarino[2] and M.T. Hernández[3]
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2. CONICET, Argentina
3. CEBAS- CSIC, Murcia, Spain

- Industriell vermi laget av industriell kompost fra tidlige termofil fase
- Industriell vermi ga mer plantetilgjengelig næring, mere stimulering av jordlivet og bedre plantevekst enn vanlig industriell kompost.
- Privat vermi på siste-plass

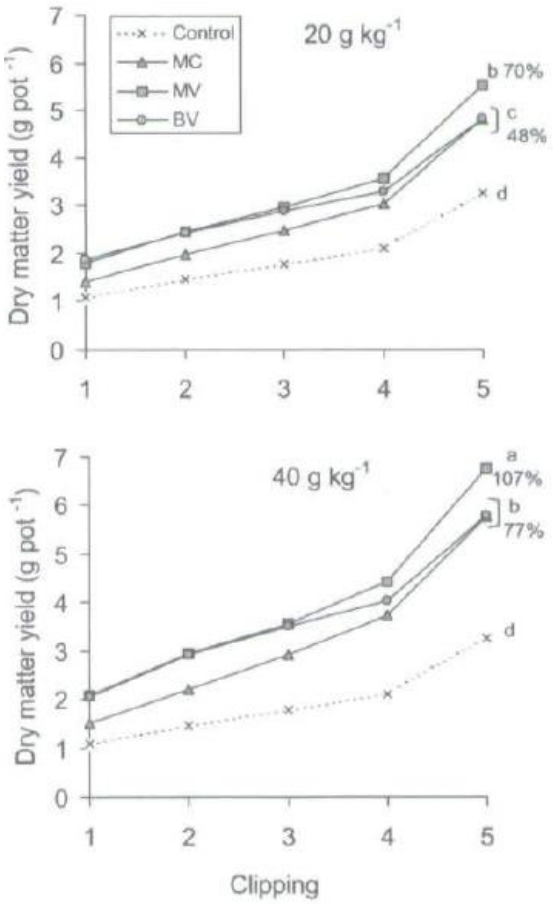

FIGURE 4. Dry matter yields of ryegrass grown in a volcanic soil amended with compost and vermicomposts. Symbols as in Figure 1. Different letters indicate significant differences at $P < 0.05$. Percentages indicate increases of dry matter yields compared with the control.

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Sykdomshemmende egenskaper ved kompost og modenhet

Soil Biology & Biochemistry 42 (2010) 136–144

Contents lists available at ScienceDirect

Soil Biology & Biochemistry

journal homepage: www.elsevier.com/locate/soilbio

Review

Identifying the characteristics of organic soil amend that suppress soilborne plant diseases

Giuliano Bonanomi*, Vincenzo Antignani, Manuela Capodilupo, Fel

Dipartimento di Arboricoltura, Botanica e Patologia Vegetale, Università di Napoli Federico II, via Università 100, F

Den beste komposten er moden men ikke veldig gammel….

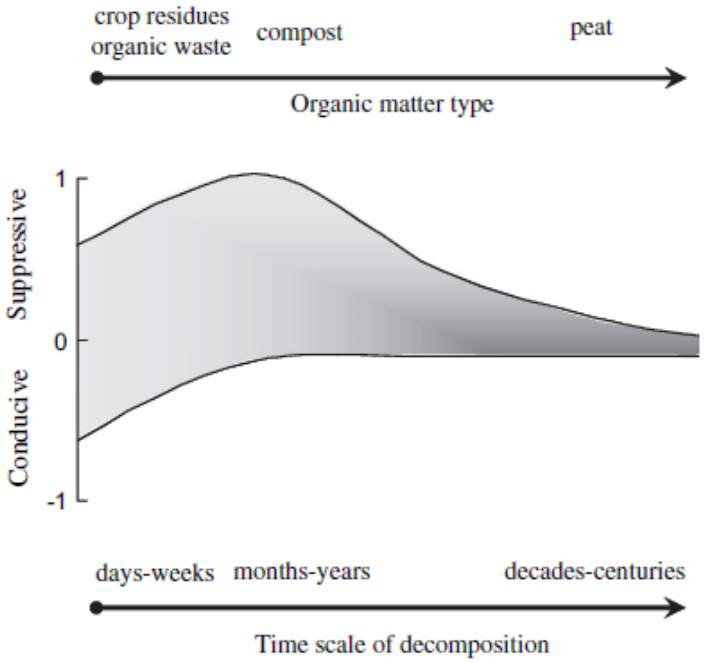

Fig. 4. Schematic representation of disease suppression dynamics during organic matter decomposition.

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Et studie som identifiserer bakterier og sopparter i kompost som motvirker råte på melon i Spania. Testet også betydning av *lufting* under komposteringen og *når* i komposterings-prosessen det er flest av disse organismene (nedbrytningsgrad)

ELSEVIER

Crop Protection 26 (2007) 46–53

Antagonistic activity of bacteria and fungi from horticultural compost against *Fusarium oxysporum* f. sp. *melonis*

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Received 3 November 2005; received in revised form 29 March 2006; accepted 1 April 2006

Abstract

The use of composts to suppress soil-borne plant pathogens has been extensively reviewed in recent decades, and several micro-organisms have been identified as biocontrol agents in compost-amended substrates. The aim of this study was to investigate the in vitro and in vivo inhibition and suppression of antagonistic bacteria and fungi from several compost classes toward *Fusarium oxysporum* f. sp. *melonis* (FOM). This fungus causes Fusarium wilt of melon which is considered a critical problem in most melon crop zones where it results in extensive economic losses. In addition, effects of the raw material, aeration conditions during composting process and compost maturity on the isolation of biocontrol agents were also analysed. Microbial strains (493) were isolated from compost samples at different maturation phases (245 bacteria, 73 actinomycetes and 175 fungi). Initial soil dilution plate screening detected 179 isolates inhibiting FOM growth. Cell-free extracts of the 179 selected strains were prepared, concentrated and then assayed for their effects on FOM growth from which 10 fungi were antagonistic. The effect of selected fungi on Fusarium wilt of melon was assayed under greenhouse conditions. Results showed that optimal aeration during the composting process was favourable for the isolation of biocontrol agents. Strains with the highest biological control activity were isolated from mature compost samples and were mostly identified as *Aspergillus* spp. These were consequently considered as potential biocontrol agents against FOM.
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Keywords: *Aspergillus* spp.; Biocontrol; Compost; *Fusarium oxysporum* f. sp. *melonis*; Suppressive soils; *Trichoderma* spp.

Flest av de effektive organismene ved dag 100-150

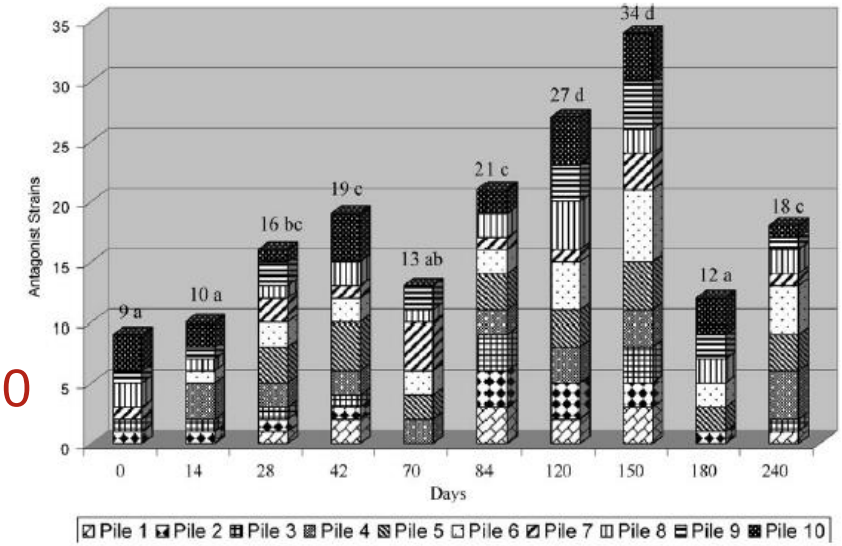

Fig. 1. Numbers of antagonist strains recovered over time from ten different compost piles. Different letters denote significant difference according to Fisher's LSD test at $P<0.05$.

Antall sykdomshemmende arter. Ikke-vendte ranker til venstre, vendt + luftet til høyre

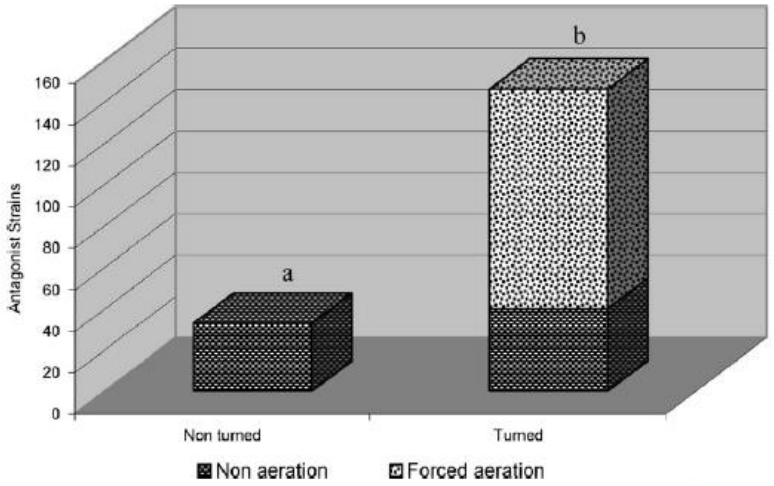

Fig. 2. Number of antagonist strains recovered from compost that was forced aerated or mechanically turned. Different letters denote significant difference according to Fisher's LSD test at $P<0.05$.

Ketil Stoknes

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Konklusjoner:

- (Antagelse: Høy kvalitet = kompost forenlig med plantevekst)
- Industriell kompost kan være av høy kvalitet dersom:
  - Man drifter godt: god startmiks, sørger for aerobe forhold og ikke altfor høye temperaturer hele veien. Måle måle måle!!
  - Eventuelt sørger for lang modningsprosess etter høy temp/anaerobe forhold
- Test kompostene for plantevekst
- Vanskelig å generalisere: Gode og dårlige industrielle, gode og dårlige småskalakomposter (sorry ☹)