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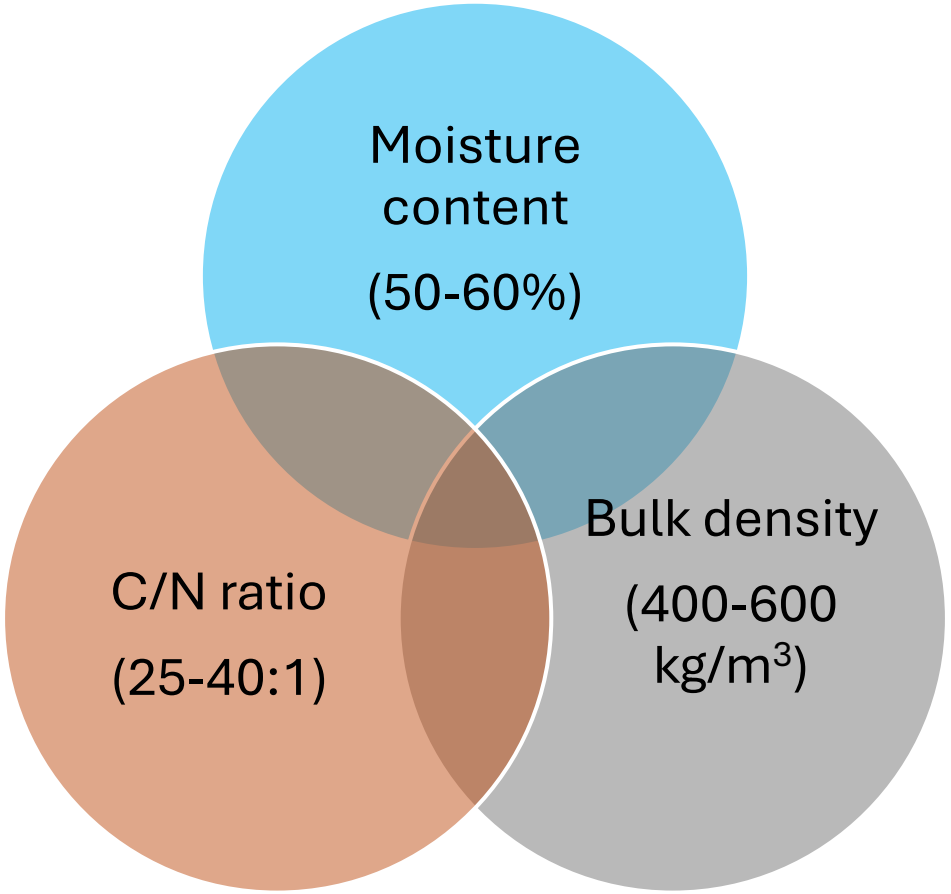
Composting Blue Materials

MariGreen Summer School at USAMV, Bucharest

28.05.2024 – Joshua Fenton Cabell

What is compost and how is it made?

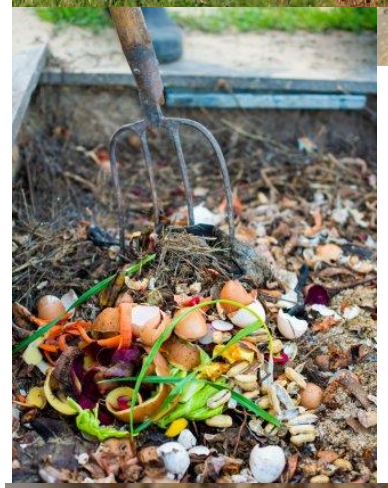


- Composting is the aerobic decomposition of organic matter by microorganisms under controlled conditions (The Composting Handbook)
- Usually thermophilic (> 45 °C), though can also be mesophilic (e.g., vermicomposting)

What can be composted?

- Biosolids
- Garden residues
- Kitchen and food processing waste
- Manure
- Bark/wood chips/straw
- +++
- … and marine (blue) residues!



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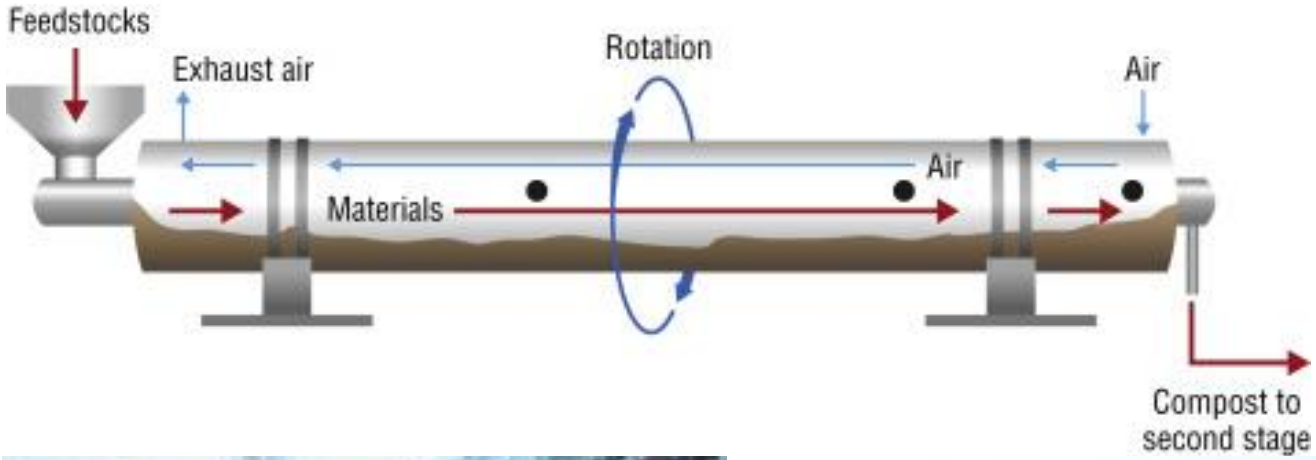
Why compost?

- Improves soil structure and porosity
- Increases infiltration and permeability
- Improves moisture holding capacity
- Improves the cation exchange capacity (CEC)
- Supplies organic matter
- Aids the proliferation of soil microbes
- Supplies beneficial microorganisms
- Encourages root growth
- More efficient nutrient utilization by plants, reduces leaching
- Enables soils to retain nutrients longer
- Contains humus – assisting soil aggregation and reduced erosion
- Buffers soil pH
- Enables the recycling of nutrients and organic matter
- Reduces the volume of organic waste
- Reduces the presence of pathogens, weed seeds, and some pollutants
- Stabilizes organic wastes and improves storability and transportability

List compiled by US Composting Council

Some equipment for composting



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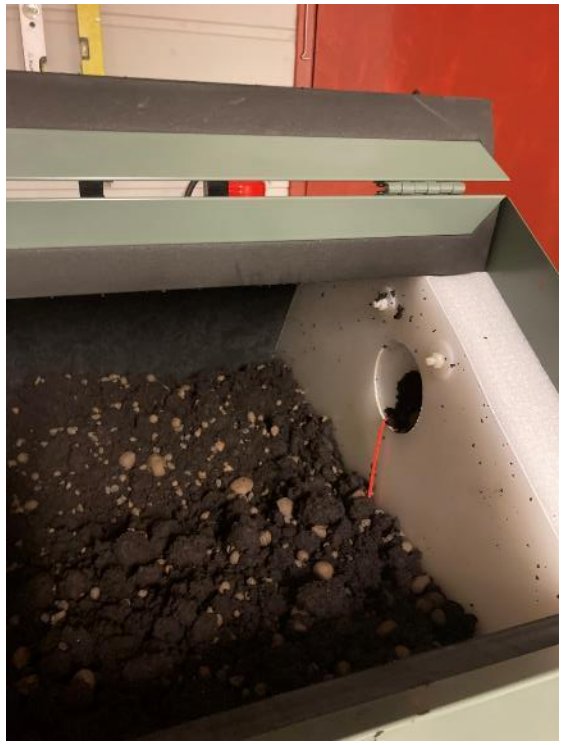
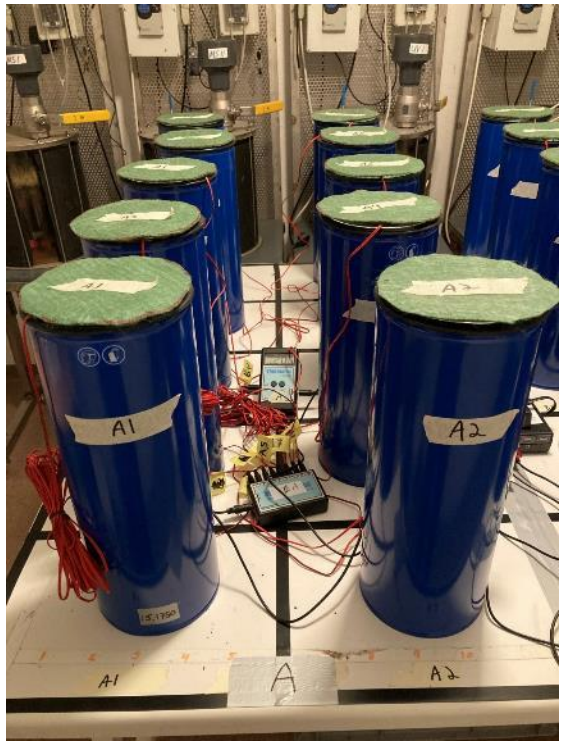
Composting trials at NORSØK





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Dewar flask experiments

Dewar «self-heating» test

- A standardized method for evaluating compost stability/maturity
- Well-insulated, open Dewar flasks filled with compost stored at room-temp
- Measure temperature 5 cm from bottom
- Level of maturity determined by temperature in flasks compared to ambient – «Rottegrad scale»
- Can also be used to evaluate «compostability»

Preliminary trials

On May 19, 16 days after filling the flasks, the appearance of straw or woodchips had not changed (no/little humification) and larger clumps of AF were still visible

In a treatment with AF+ woodchips, there was a lot of fungi, keeping the material aggregated (and with a pleasant smell)

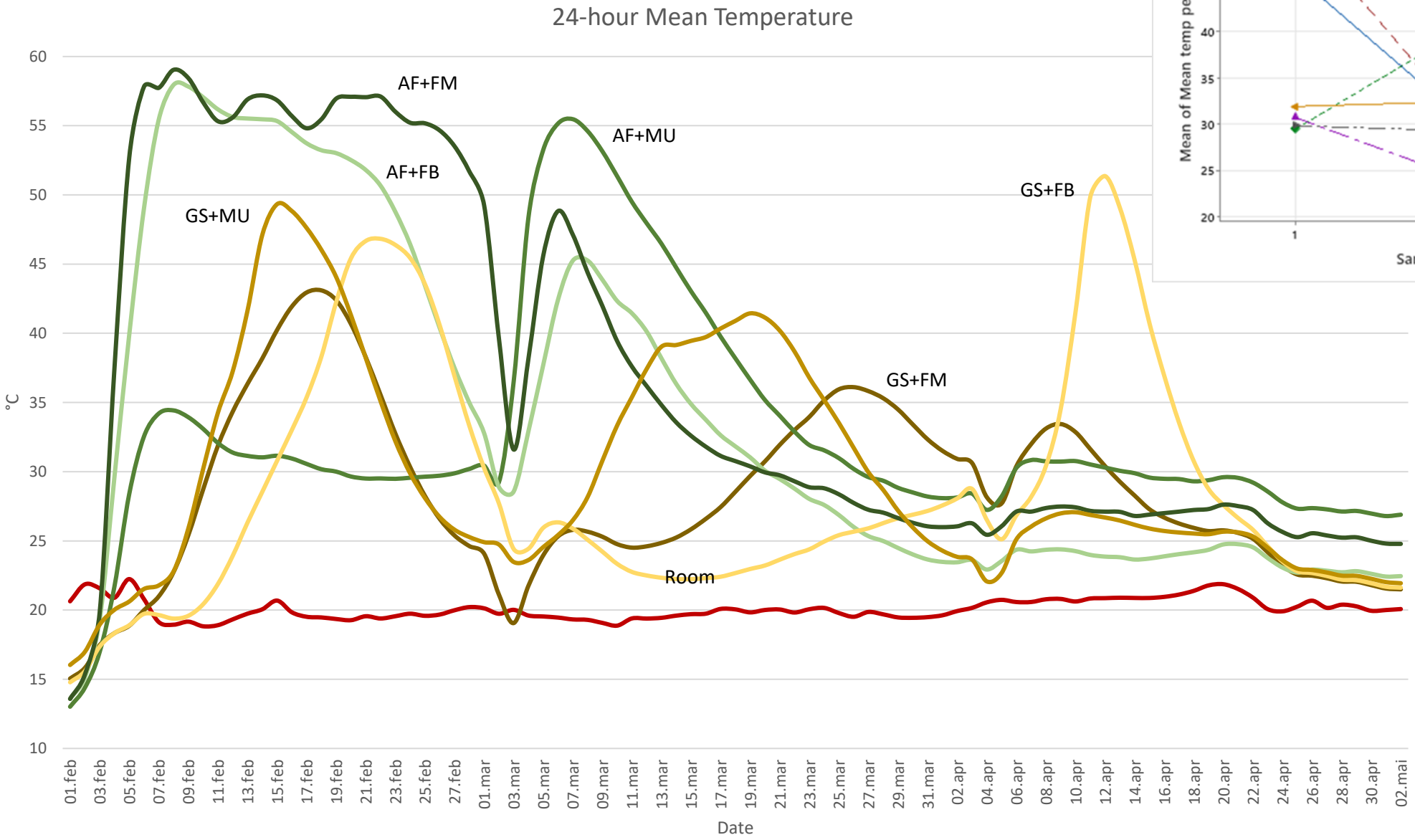
Composting algae fiber and ground seaweed

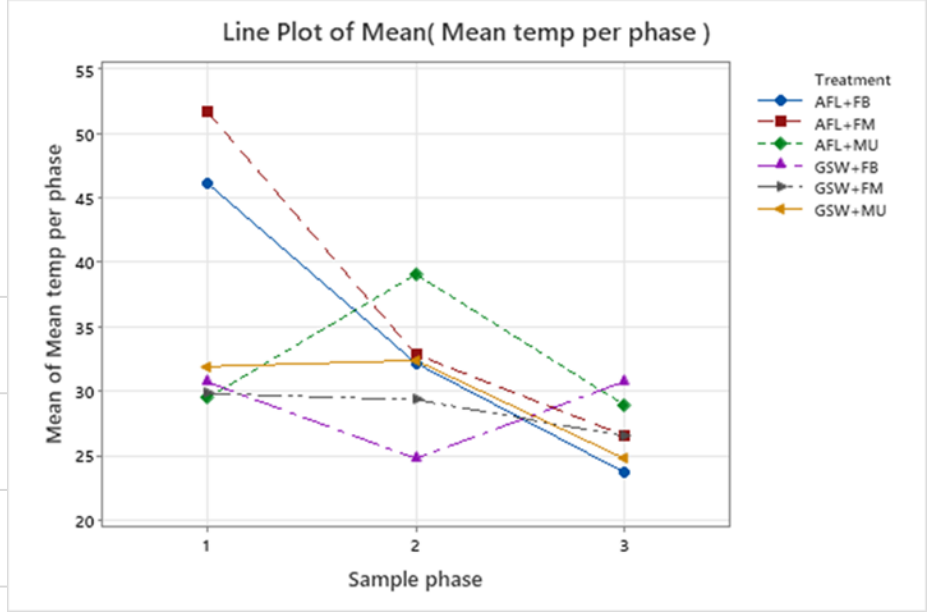
- Algae fiber «low nitrogen» (AF)
- Ground seaweed (GS)
- Fish meal (FM)
- Hydrolyzed fish bone (FB)
- Mussels (MU)
- Leca (lightweight clay aggregates) for bulking


Seaweed (A. nodosum) filter cake, "low-N"
Seaweed (A. nodosum) filter cake, "high-N"
Expanded clay ab
. morhua)


AFLH +FM
1. 3. 2023

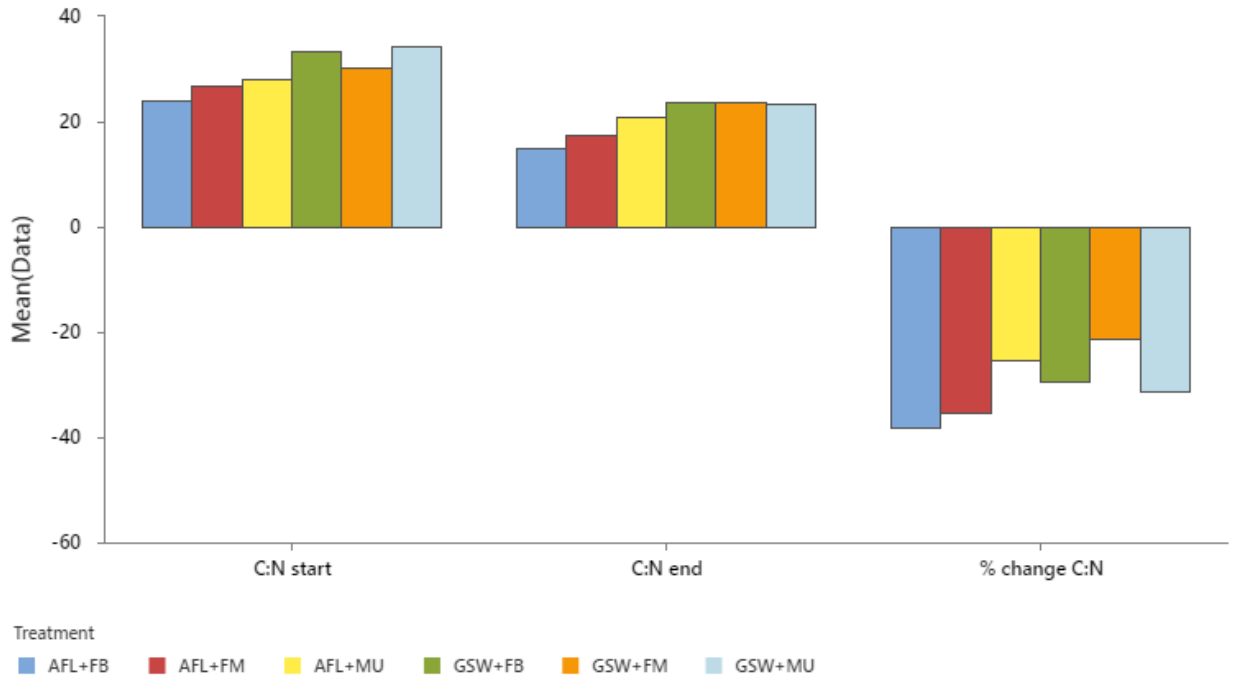

AFLH +FM
1. 3. 2023
A4

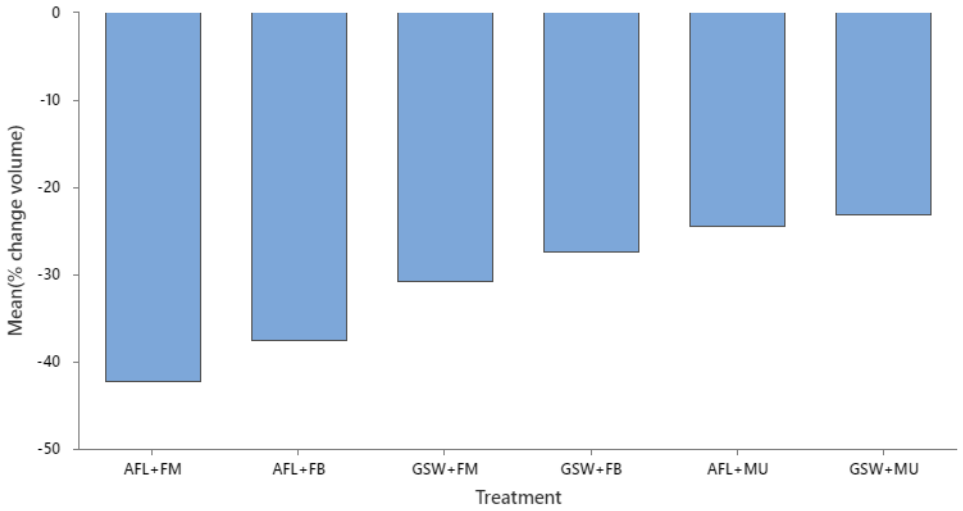

24-hour Mean Temperature
AF+FM
AF+MU
AF+FB
GS+MU
GS+FB
GS+FM
Room
°C
Date
60
55
50
45
40
35
30
25
20
15
10
01.feb
03.feb
05.feb
07.feb
09.feb
11.feb
13.feb
15.feb
17.feb
19.feb
21.feb
23.feb
25.feb
27.feb
01.mar
03.mar
05.mar
07.mar
09.mar
11.mar
13.mar
15.mar
17.mar
19.mar
21.mar
23.mar
25.mar
27.mar
29.mar
31.mar
02.apr
04.apr
06.apr
08.apr
10.apr
12.apr
14.apr
16.apr
18.apr
20.apr
22.apr
24.apr
26.apr
28.apr
30.apr
02.mai

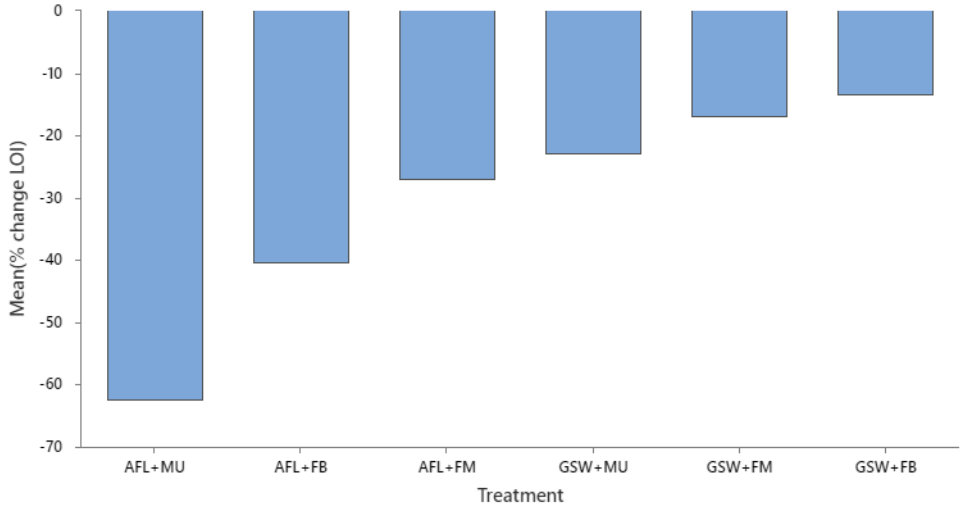

Line Plot of Mean(Mean temp per phase)
Mean of Mean temp per phase
Sample phase
Treatment
AFL+FB
AFL+FM
AFL+MU
GSW+FB
GSW+FM
GSW+MU
55
50
45
40
35
30
25
20
1
2
3

Selected results

	Temperature		RDD		TDD		HDD	
Treatment	Mean	StDev	Mean	StDev	Mean	StDev	Mean	StDev
AF+FB	34.0^{AB}	1.74	1262^{AB}	160	178^{B}	34	12^{AB}	3
AF+FM	37.0^{A}	2.53	1529^{A}	221	283^{A}	39	41^{A}	30
AF+MU	32.5^{ABC}	3.12	1148^{ABC}	288	68^{C}	38	5^{B}	9
GS+FB	28.7^{C}	0.51	781^{C}	54	23^{C}	10	0^{B}	0
GS+FM	28.6^{C}	0.34	780^{C}	37	1^{C}	1	0^{B}	0
GS+MU	29.7^{BC}	1.45	884^{BC}	120	32^{C}	45	1^{B}	1







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Composting RAS filter cake and fishmeal

- Two types of filter cake:
  1. With Al coagulant (FCC): C/N = 55, DM = 28%
  2. Without coagulant (FC): C/N = 98, DM = 25%
- Both from RAS sludge treated with a flocculant, lignocellulose, and cellulose.
- «Kleppafisk» fish meal (FM) – dried and ground cod: C/N = 4, DM = 89%
- Measured temp and respiration

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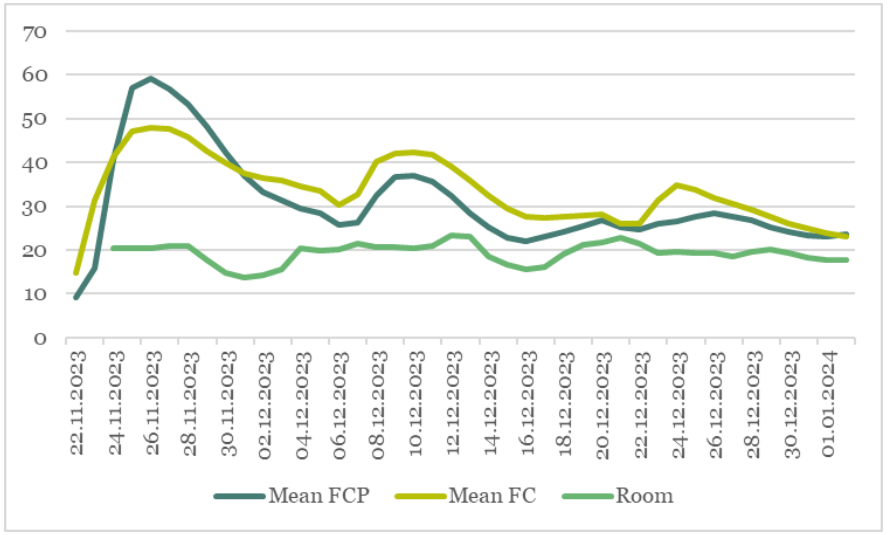
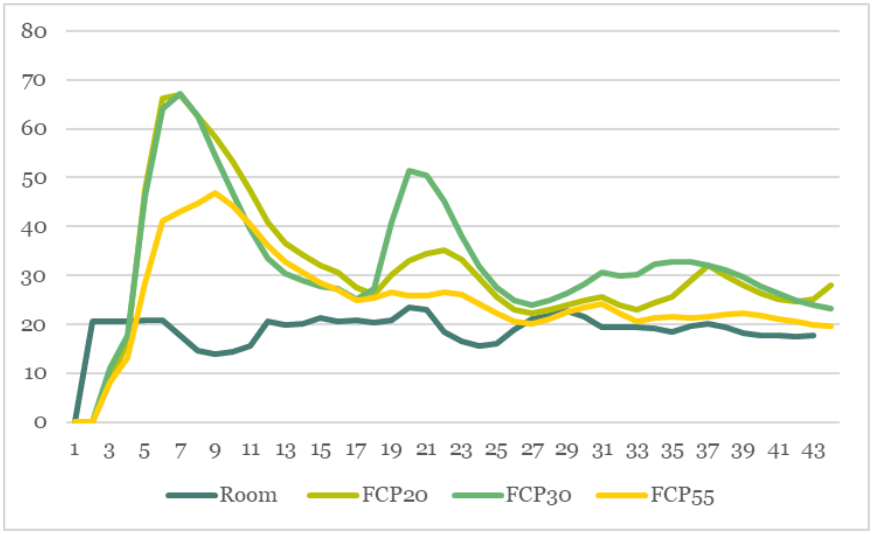
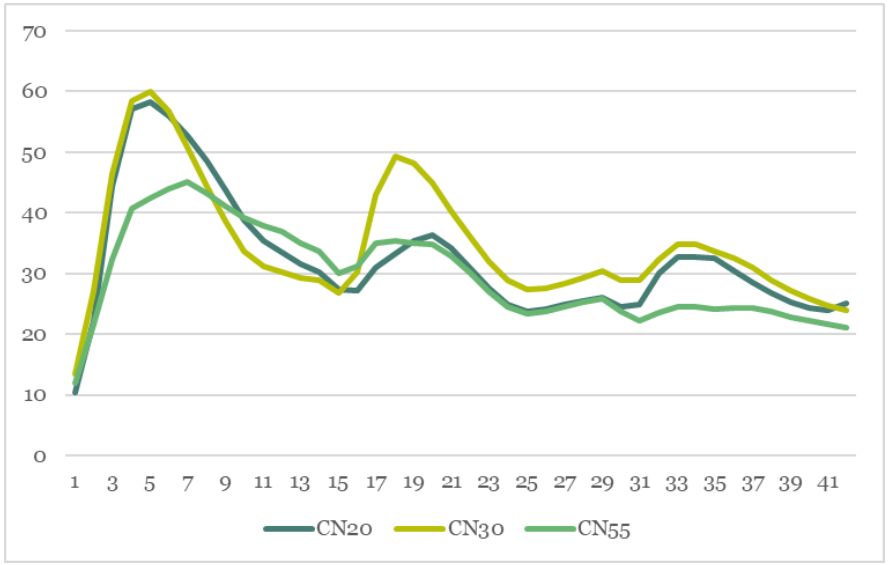
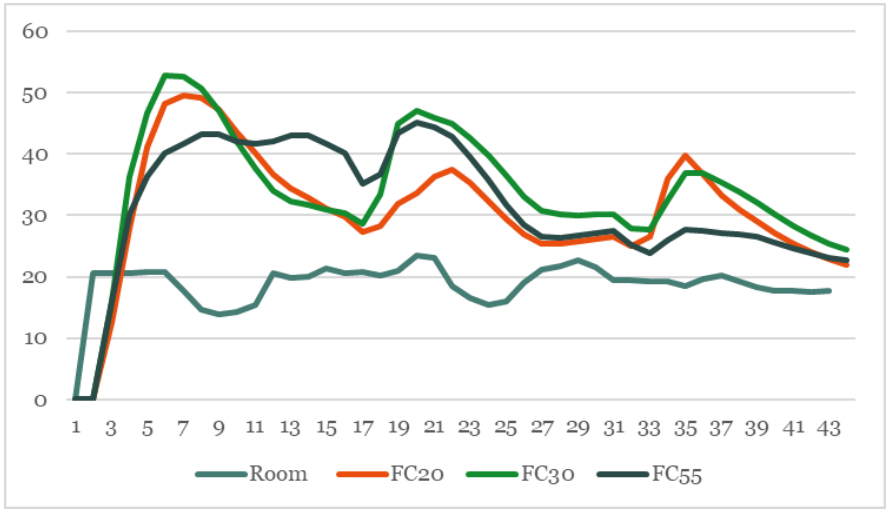
Temperature









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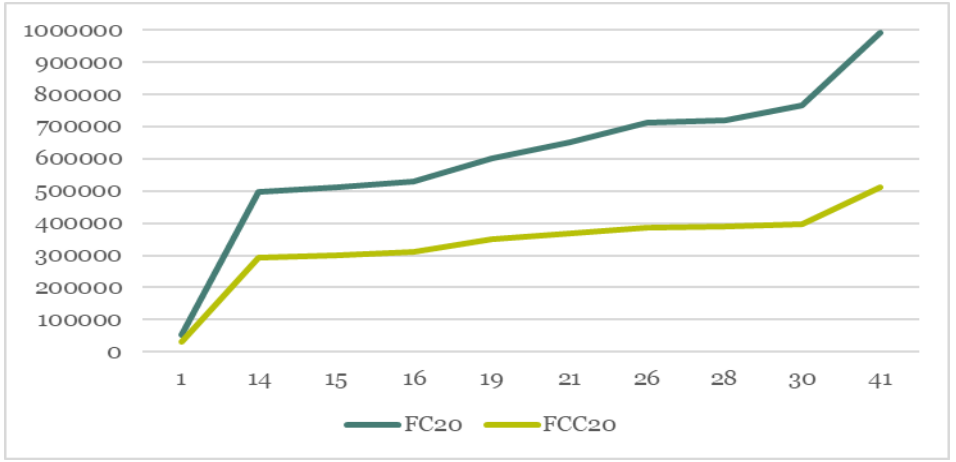
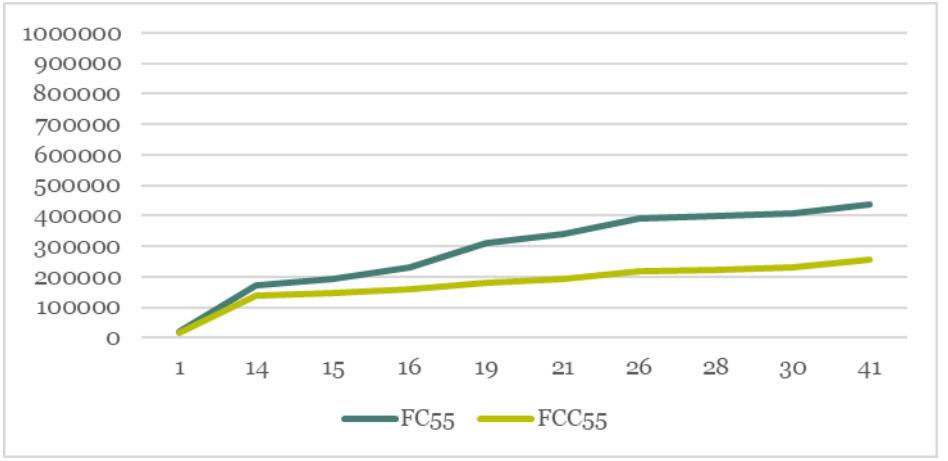
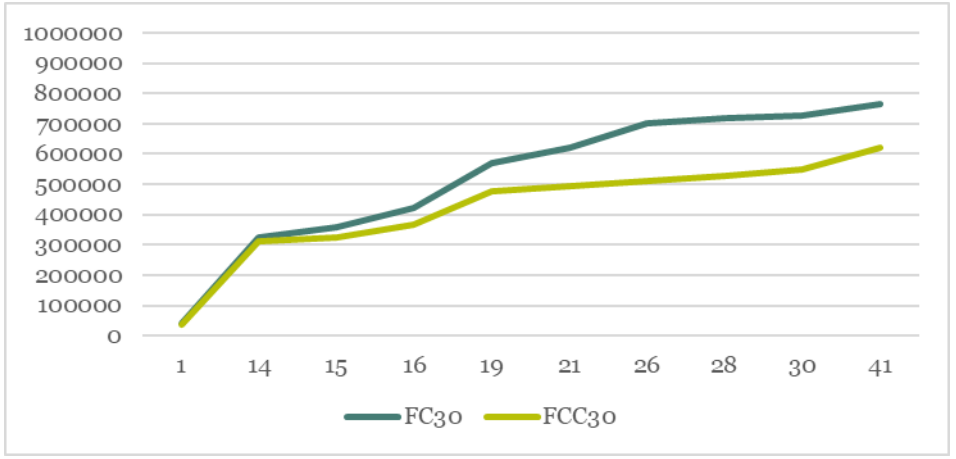
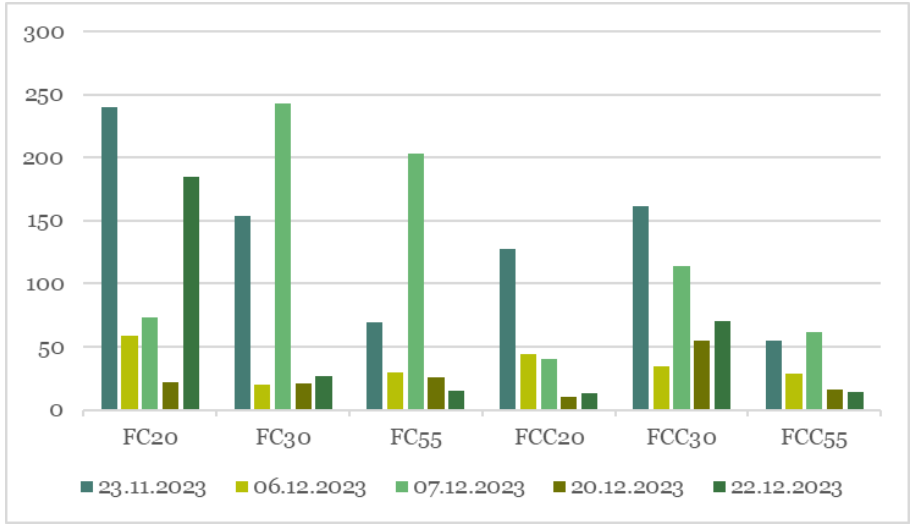
Respiration









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Other selected results

Treatment	21.11.23	6.12.23	21.12.23	15.01.24
FCC55	28.0	23.4	24.6	27.4
FCC30	23.4	24.4	25.0	27.5
FCC20	24.6	25.8	27.0	29.4
FC55	26.0	20.7	21.1	24.1
FC30	24.0	22.6	22.6	23.9
FC20	17.7	21.2	21.1	22.3

Dry matter content (%)

Treatment	21.11.23	6.12.23	21.12.23	15.01.24
FCC55	257	186	167	166
FCC30	221	196	169	164
FCC20	242	208	187	181
FC55	265	181	156	157
FC30	254	249	209	161
FC20	225	239	212	192

Dry matter content (g/flask)

Treatment	21.11.23	6.12.23	21.12.23	15.01.24
FCC55	Not measured	3.8	4.6	3.3
FCC30	5.4	6.8	7.3	6.9
FCC20	9.2	9.9	10.7	10.6
FC55	4.1	4.5	4.8	10.0
FC30	5.7	7.7	8.0	8.1
FC20	4.4	10.7	11.0	10.7

Ash content (% DM)

Other experiments (ongoing and future)

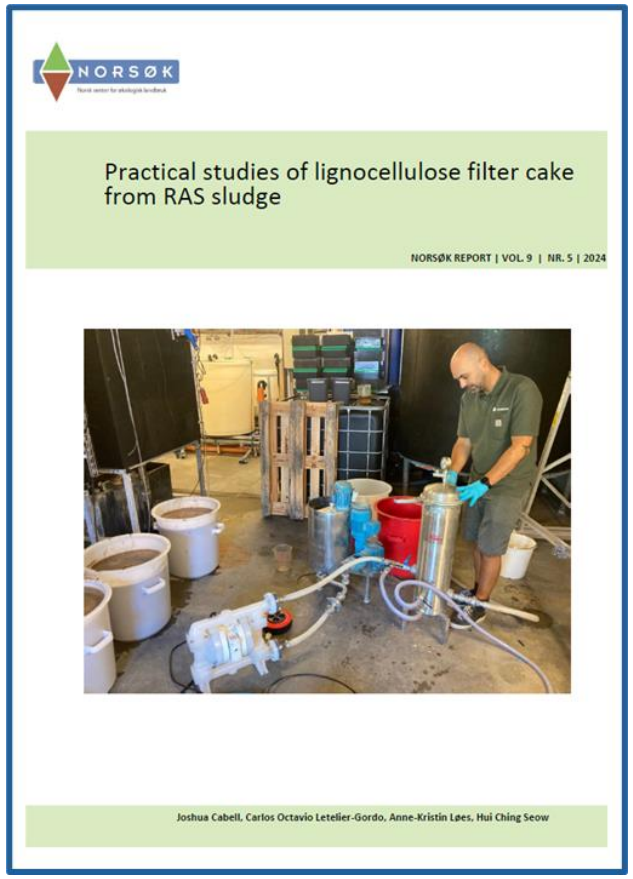
- Mussels
  - Whole vs crushed
  - Different ratios of bulking material and carbon source
  - Mussel compost as mulch and fertilizer
- Large-scale compost with algae fiber and fish residues
  - Leca vs. wood chips as the bulking agent
- Blue compost tea as a biostimulant

Experiences

- Dewar flasks work!
- Composting with blue materials works!
- We achieved thermophilic temperatures with all residues and almost all combinations – and even met hygiene standards in some (> 55 °C)
- Important to start with the parameters (C/N, MC, BD, etc.) at or near optimal (though works outside optimal)
- Smell can be a challenge!

Publications

https://orgprints.org/id/eprint/50477/



https://orgprints.org/id/eprint/53376/

- + forthcoming articles

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Thank you!

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