

Møre og Romsdal
county municipality

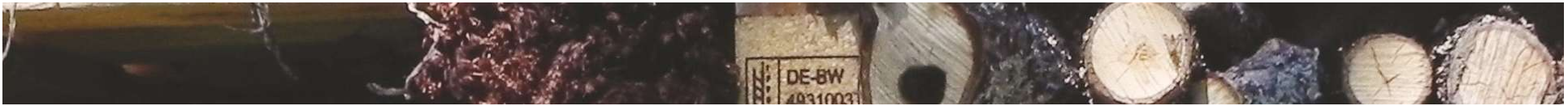
RESTOR

Benefits and challenges of marine-derived fertilisers

RELACS webinar

March 17, 2021

Anne-Kristin Løes

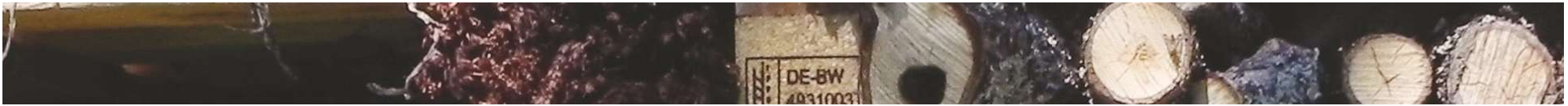


Norway has a long coastline



Fish capture: 2,5mill tons live weight/year (white fish, herring ++)
Aquaculture: 1,5 mill tons/year (mainly salmon)





Significant volumes of organic material
are poorly utilised



.... product development aims at pharmacy, food
and pet food... fertilisers are cheap

Starting point for NORSØK:

Bioeconomy project CYCLE 2013-2016 (SINTEF Ocean):

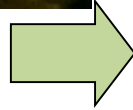
Hydrolysis of animal co-products,

here chicken bones (from MSM production)



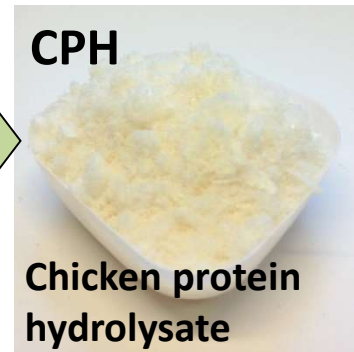
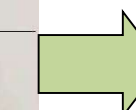
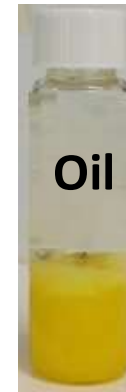
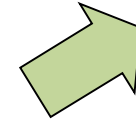
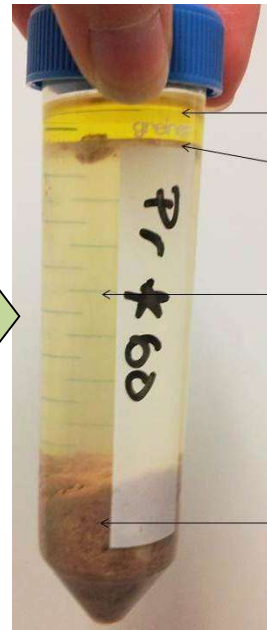
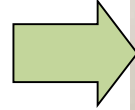
Raw material

- 17 % lipids
- 16 % proteins
- 5 % ash
- 63 % moisture



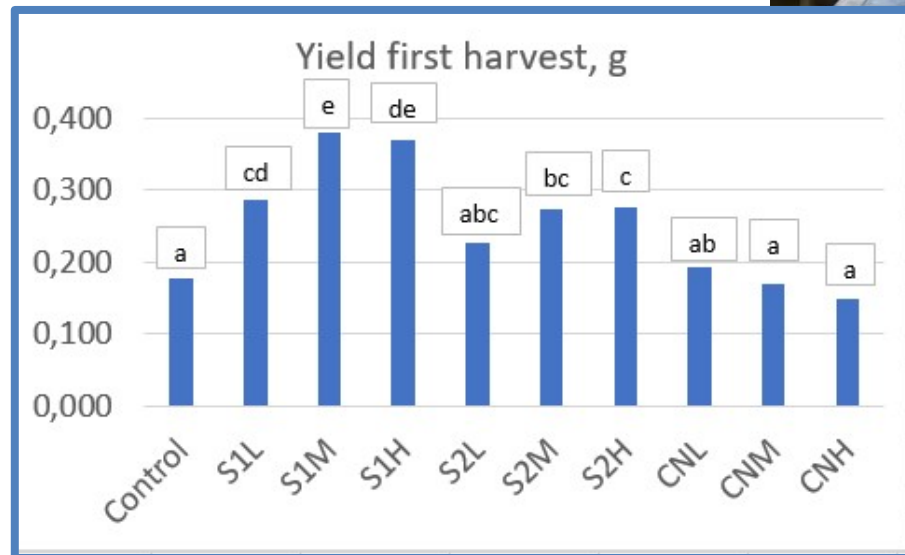
Raw material and water(1:1)
0.1 % enzyme (dry weight
enzyme/wet weight raw material)

50 °C, 120 min





2017: Very rapid growth effect of animal residues (slaughtered laying hens)



Mean yields of ryegrass, g DM/pot (n= 5/treatment), plants cut at 4 cm

S1= Sediment 1 finely grinded

S2= Sediment 2 less finely grinded

CN= CaNO₃

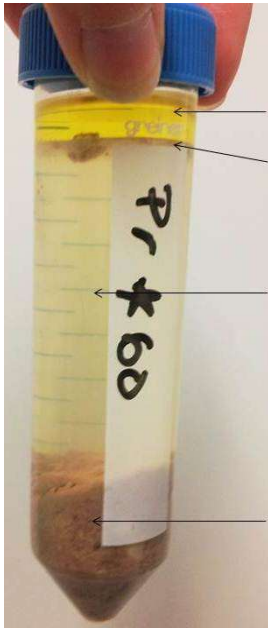
L = low, M= medium, H= high N

as 200, 400, 600 kg N/ha

Seeds germinated on March 14, 2017;
1st harvest March 31, 2017



Sediments from grinded fish residues conserved by formic acid (pH < 4)



Lab scale



Industry scale tank for hydrolysis



Sediments in IBC (1m³), ca. 50% DM



Air-dried and sieved sediments for field application



A rich source of P, Ca, N – but little K, Mg



pH	4.9
DM, %	80
N % of DM	4.1
P % of DM	9.3
Ca % of DM	16
K % of DM	0.1
Mg % of DM	0.08
S % of DM	0.2

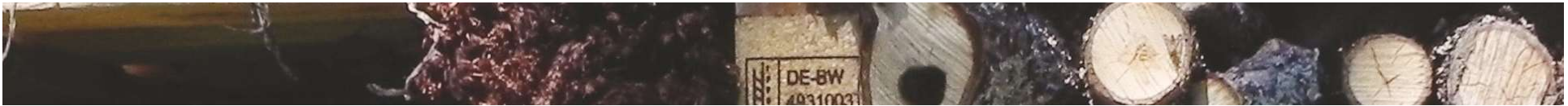
100 kg would contain

- 3.3 kg N
- 7.4 kg P
- 12.8 kg Ca
- 0.08 kg K

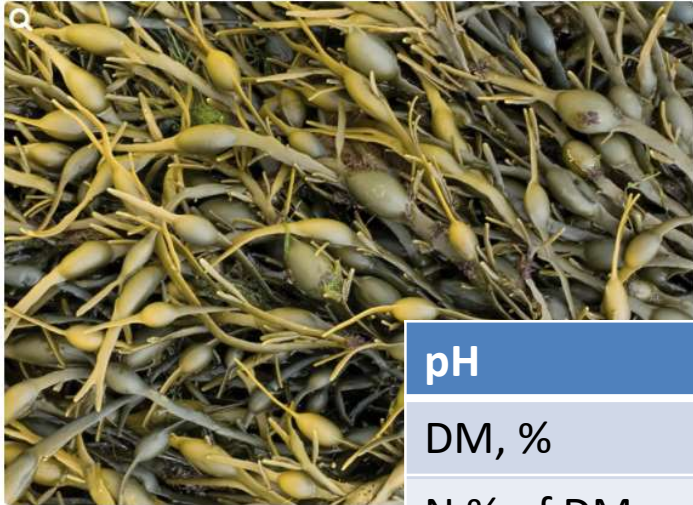


Norwegian Food Safety authority specifies that fish and formic acid are permitted inputs as long as fish is of category 3 (hence, not dead fish from aquaculture, which is cat.2)

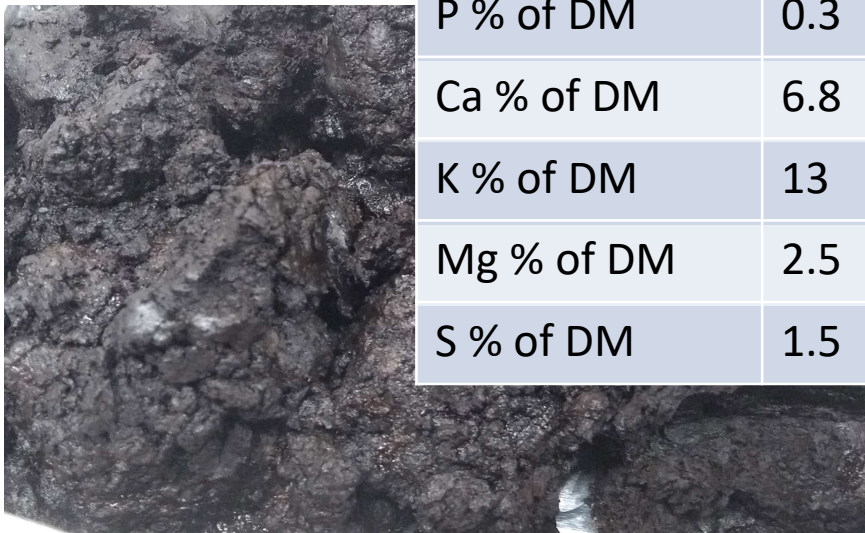




Rockweed contains significant K, S, Mg



pH	9.6
DM, %	30
N % of DM	1.5
P % of DM	0.3
Ca % of DM	6.8
K % of DM	13
Mg % of DM	2.5
S % of DM	1.5



Product for sale:
AlgaFert Base, pH 5



From the plant:
About 15 tons/week
of algae fibre,
currently
incinerated

Liquid fertilisers are permitted but
not fibre residues due to extraction
with HNO_3





Field experiment with ryegrass 2020 (4 cuts)

Fresh, ground fishbones (F)



Cultivator used to incorporate fertilisers in soil

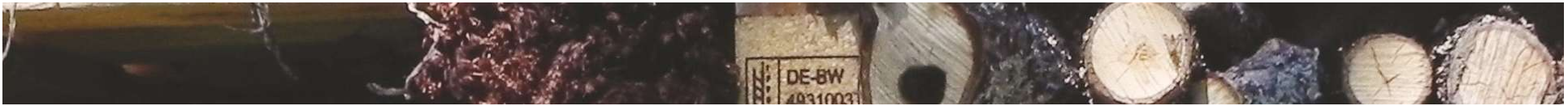


Dried fishbones conserved by formic acid (FB)



Clumps of algae fibre made smaller (AF)





Control: Enriched poultry manure, well balanced fertiliser («Green Organic», GO)



Mix 2	Mix	F	K0	GO 2	FB	GO	FB 2	AF
Mix	F	Mix 2	FB	GO 2	FB 2	GO	AF	K0
AF	FB 2	Mix	FB	GO 2	F	Mix 2	K0	GO
GO	K0	F	GO 2	FB	FB 2	Mix	Mix 2	AF

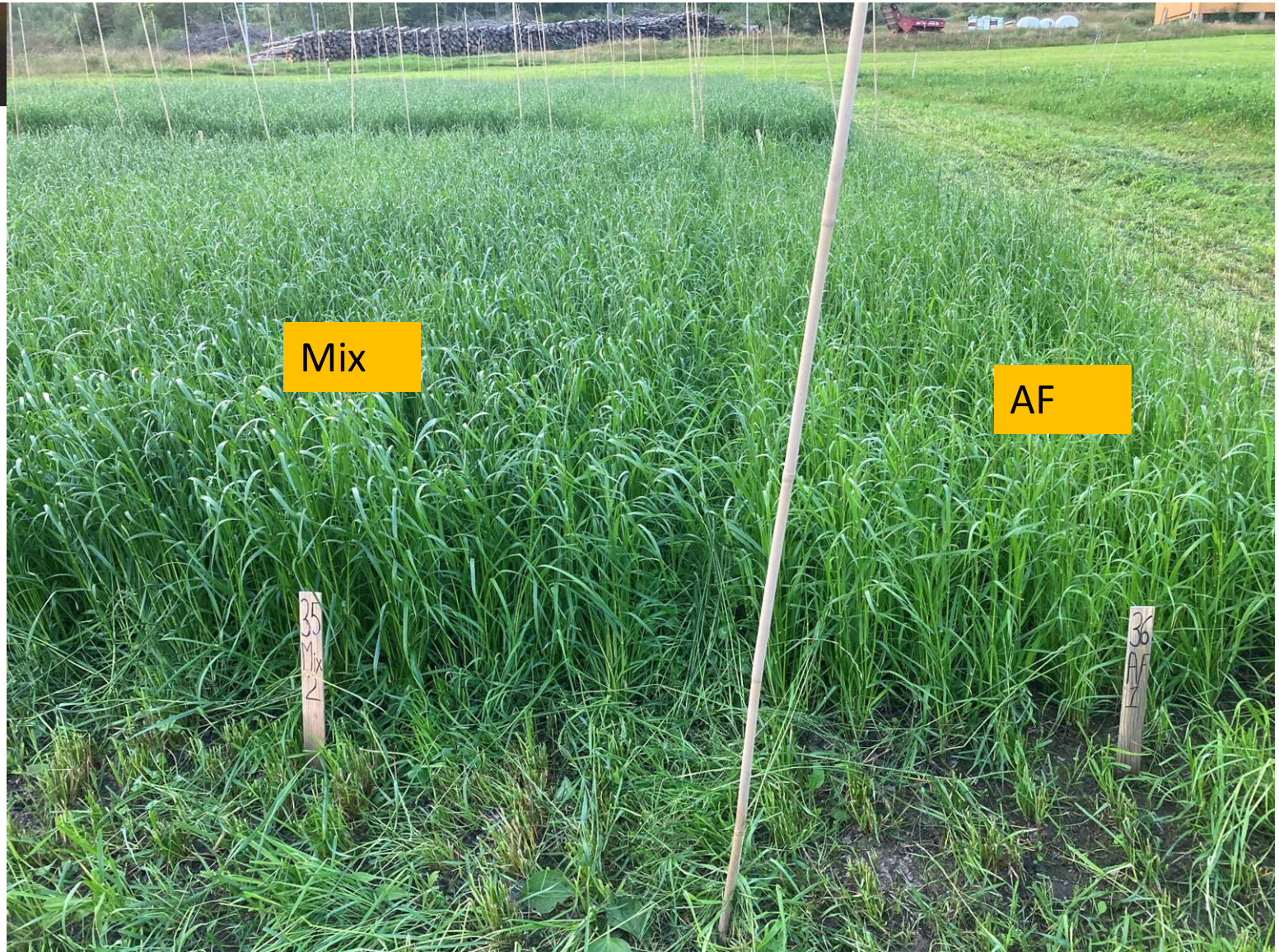


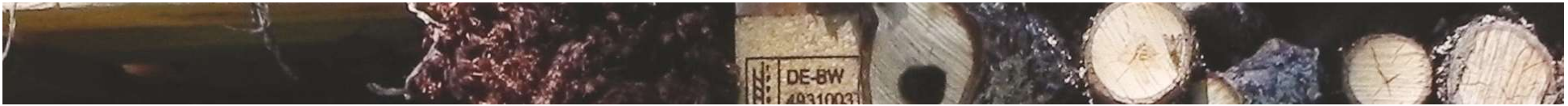
- 9 treatments, 4 replicates
- Control, 5 types of fertiliser, 2 N levels
- 300 or 600 kg N/ha in acid-conserved fish bones (FB), Mix (algae fibre + FB), poultry manure Green Organic (GO)
- Algae fibre (AF) and fresh ground fishbones (F) only 300 kg N/ha



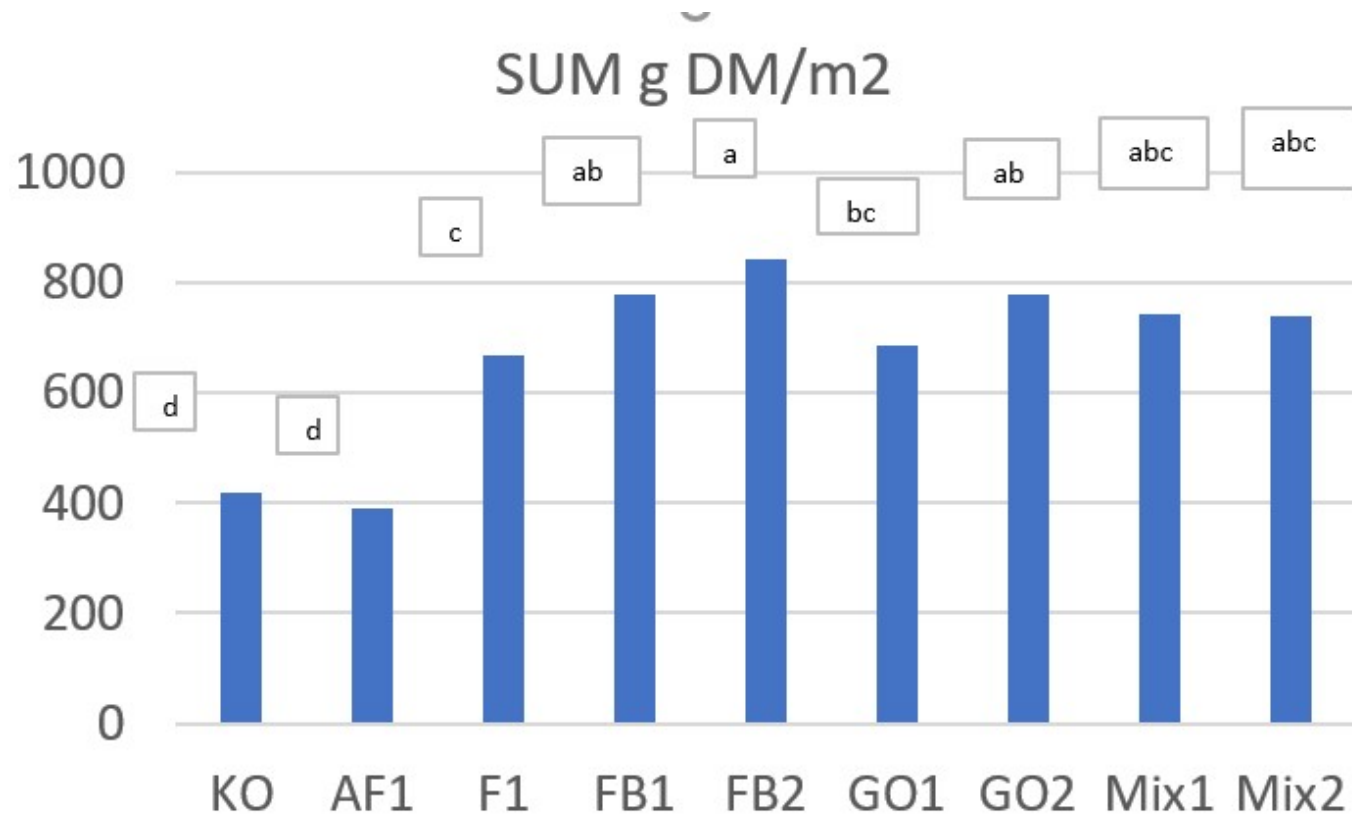


Ryegrass
experiment
3rd cut,
August 13,
2020





Ryegrass experiment, sum of 4 cuts 2020, about 8 t DM/ha



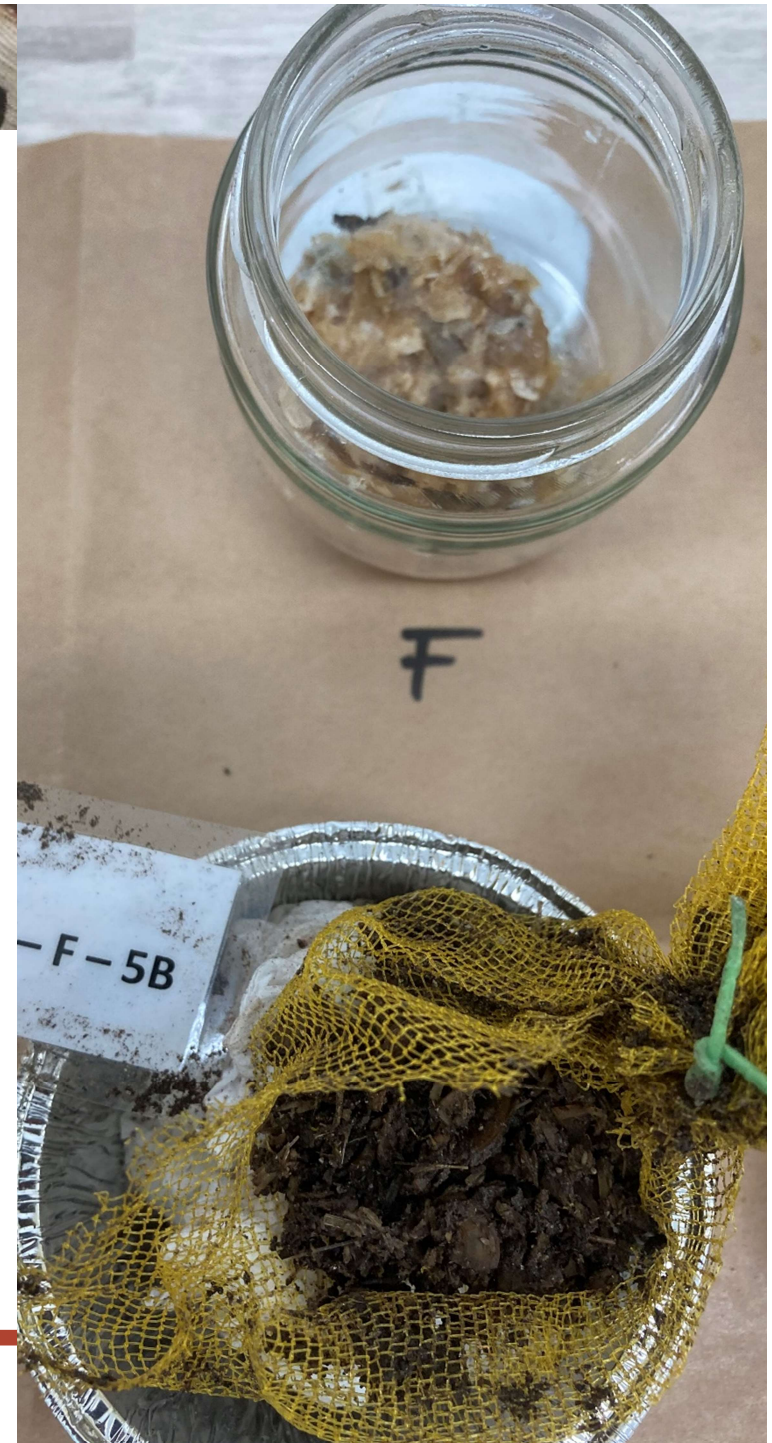
- KO= no fertiliser
- AF= 300 kg N/ha in algae fibre
- F1= 300 kg N/ha in fresh ground fish bones
- FB1, 2 = 300 and 600 kg N/ha in acid-conserved fish bones
- GO1, 2 = 300 and 600 kg N/ha in poultry manure
- Mix 1, 2 = 300 and 600 kg N/ha in AF+ FB where 30% N is from AF and 70% from FB





Some conclusions:

- 600 kg N/ha is too high in a field experiment with ryegrass
- Very rapid growth effect of acid-conserved fish bones
- Less rapid, but positive growth effect of fresh fish bones (popular feed for soil animals!)
- Initiation of positive growth effect of algae fiber after about 3 months (May-August)

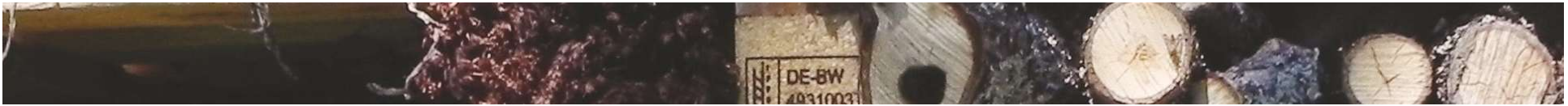




Challenges – chemical composition: Potentially toxic elements

Potentially toxic element, mg/kg TS	Algae fibre	Acid-conserved fish bones	Grinded fresh fish bones	Limit in EU regulation Annex 1	Poultry manure «Green Organic»
As	33	1.3	6.9	No limit in Ann. 1 General EUreg 40?	0.15
Cd	0.9	<0.10	0.02	0.7	<0.1
Cr	3.8	<0.3	0.68	70	4
Cu	9.4	7.3	1.8	70	23
Hg	0.08	0.09	<0.7	0.4	0.01
Ni	<1.5	<1.5	2.1	25	1.6
Pb	<0.3	<0.3	0.34	45	0.71
Zn	94	100	67	200	170





Challenges – chemical composition: Mineral balance- feed quality



- Fish bones = N, P, Ca fertiliser; not well balanced for crop needs
- Horticulture or meadow purpose? (early spring application)
- AF not permitted for use in organic growing (Cd, possibly As, contains residues of HNO_3)
- AF has high concentrations of K: what about feed quality? High uptake of K decreased uptake of Ca in pot exp with ryegrass





Challenges – accessibility, logistics

- Competition for residual materials: From gate fee to purchase
- Industry will always search for products with higher profits
- Low interest for making recycled fertilisers in the home country of Yara
- Long distance from sea to farmland; two highly different cultures
- Lots of practical issues still to be solved (innovational «valley of death»)



Good fishing places are top secret
.....and nobody sees what the sea hides



Agricultural practice is visible for all

