



NIBIO

NORSK INSTITUTT FOR
BIOØKONOMI

Nedbrytning av *biofilm** i grønnsaksdyrking

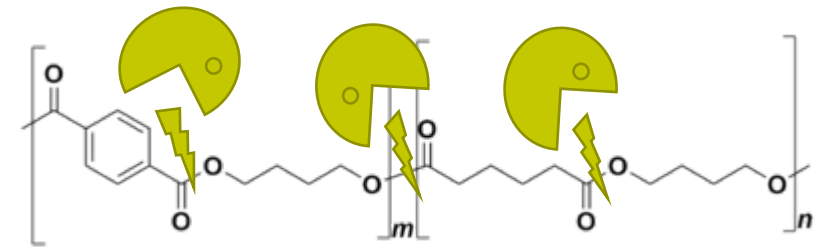
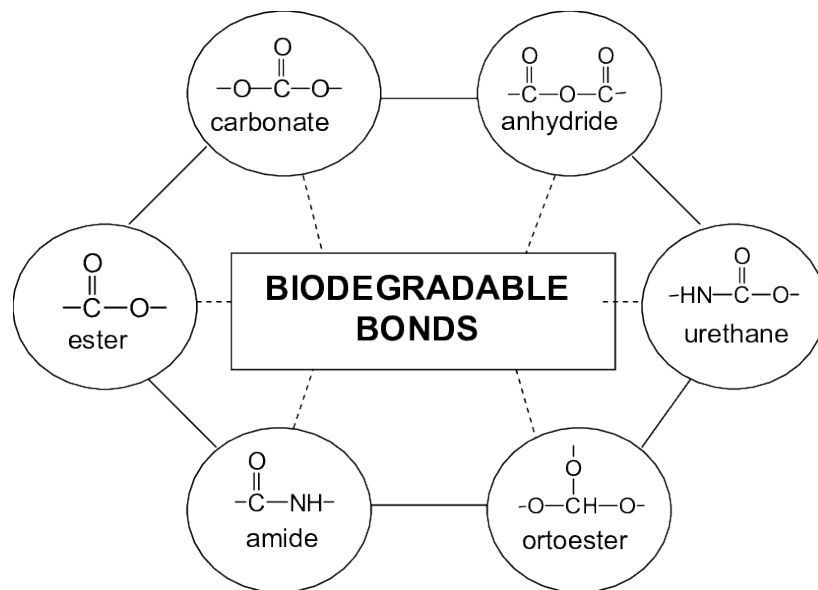
**bionedbrytbar markdekningsfolie*

Claire Coutris, forsker på NIBIO • Oppsummeringsmøte grønnsaker, 6.12.2023



Hva er bionedbrytbar plast?

Et materiale som med sin kjemiske struktur lett kan angripes av mikroorganismer og av enzymene som mikroorganismer skiller ut i miljøet



nye
mikroorganismer

vann
CO₂

CH₄

hvis tilgang på O₂ (f.eks. kompost)

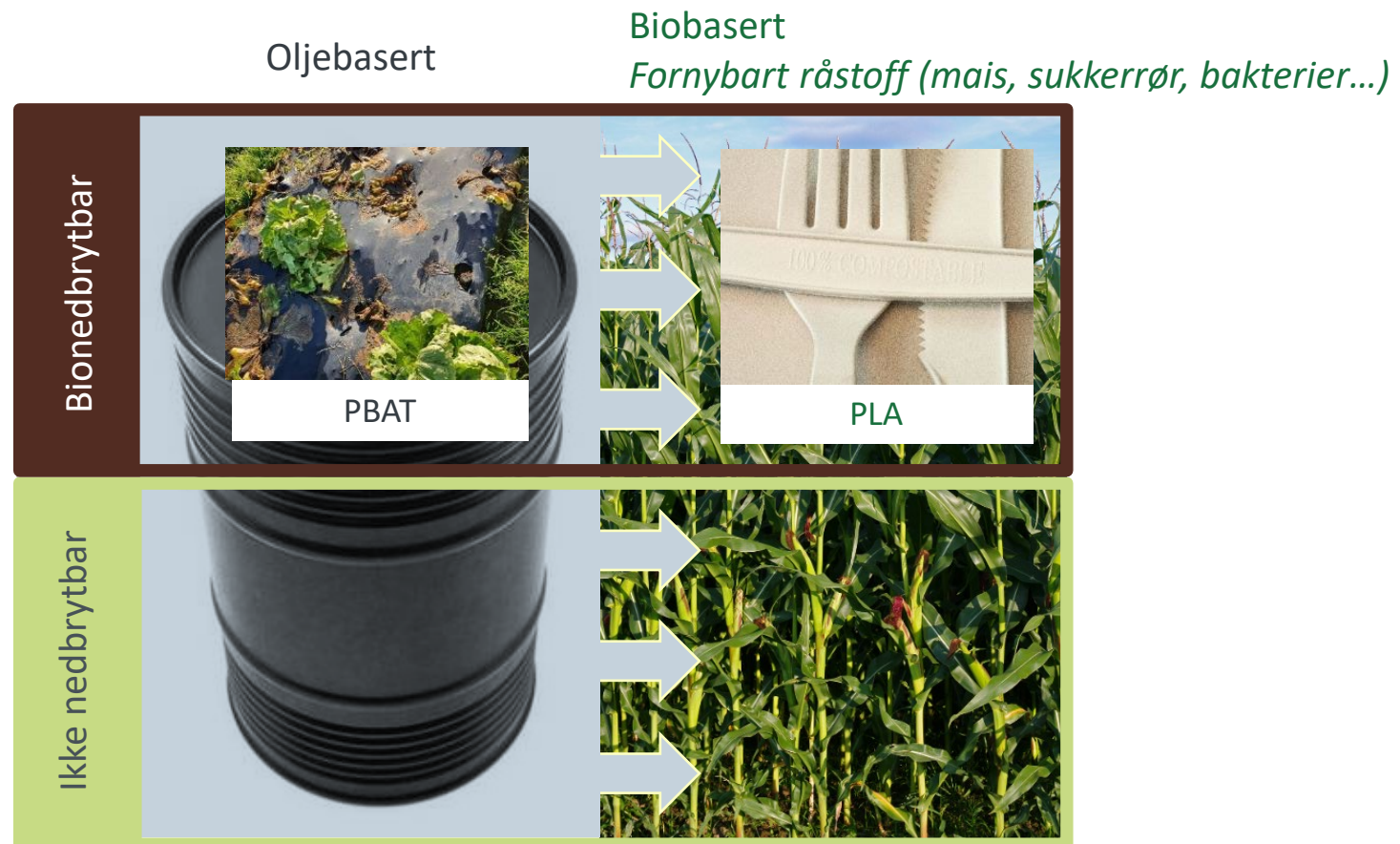
uten tilgang på O₂ (f.eks. biogassproduksjon)

Hva består bionedbrytbar plast av?

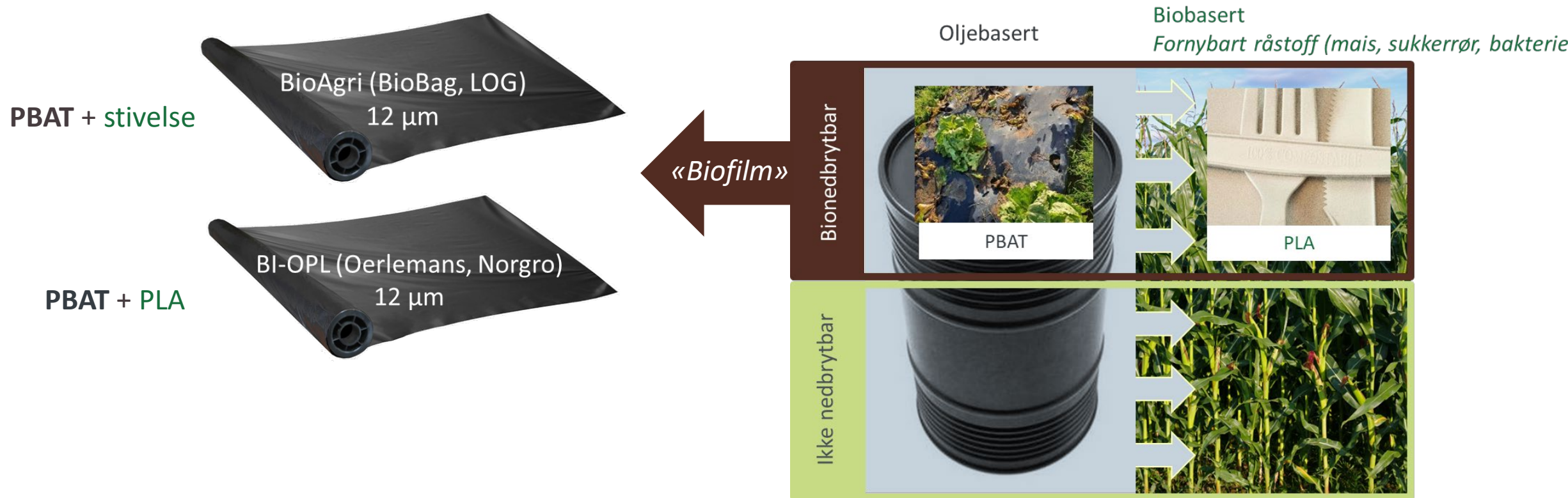
Bionedbrytbarhet er en **egenskap** som visse plasttyper har, og **sier ingenting om hva plasten består av**.

Den kan like gjerne være **laget av fossile som biologiske råstoffer...**

...og ofte en **blanding** av begge, så lenge den lar seg brytes ned i biologiske prosesser.



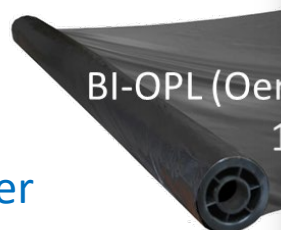
Hva består bionedbrytbar plast av?



Hva består bionedbrytbar plast av?

PBAT + stivelse + tilsetningsstoffer

PBAT + PLA + tilsetningsstoffer



Oljebasert

Biobasert

Fornybart råstoff (mais, sukkerrør, bakterier)

Lov om rett til miljøinformasjon og deltakelse i offentlige beslutningsprosesser av betydning for miljøet (miljøinformasjonsloven)

Dato	LOV-2003-05-09-31
Departement	Klima- og miljødepartementet
Sist endret	LOV-2006-05-19-16 fra 01.01.2009
Ikrafttredelse	01.01.2004
Rettet	25.08.2021 (faglige fotnoter fjernet)
Korttittel	Miljøinformasjonsloven – mlnfl
EØS/EU/Schengen	EØS-avtalen vedlegg XX nr. 1b (direktiv 2003/4/EF)

«Loven gir deg rett til informasjon om alt fra produksjonsprosesser til innholdet i de produktene som brukes og omsettes.»

Hva blir det av tilsetningsstoffene som frigjøres når folien brytes ned?





Foto: Yan Changrong

Veldig tynn landbruksfolie av polyetylen skaper problem i landbruksjord (her i Kina)

Opptil 380 kg polyetylenbiter per ha

Høy gjenvinningsgrad for landbruksplast i Norge
Hva brukes gjenvunnet plast fra landbruket til?

> 90% borte innen 2 år ved jordtemperatur på 25 °C



Foto: Martin Haarr

Norsk Standard

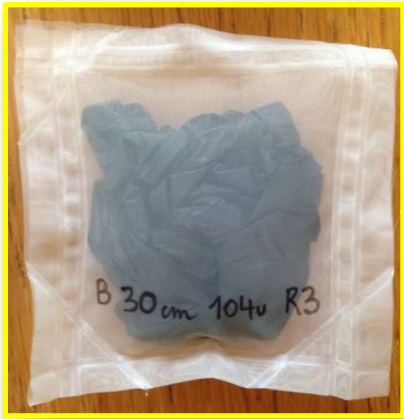
NS-EN 17033:2018

Publisert i Norge: 2018-04-01

Språk: Engelsk

**Plast
Biologisk nedbrytbare
markdekningsfilmer for
anvendelse i jordbruk og
hagebruk
Krav og prøvingsmetoder**

Plastics
Biodegradable mulch films for use in
agriculture and horticulture
Requirements and test methods



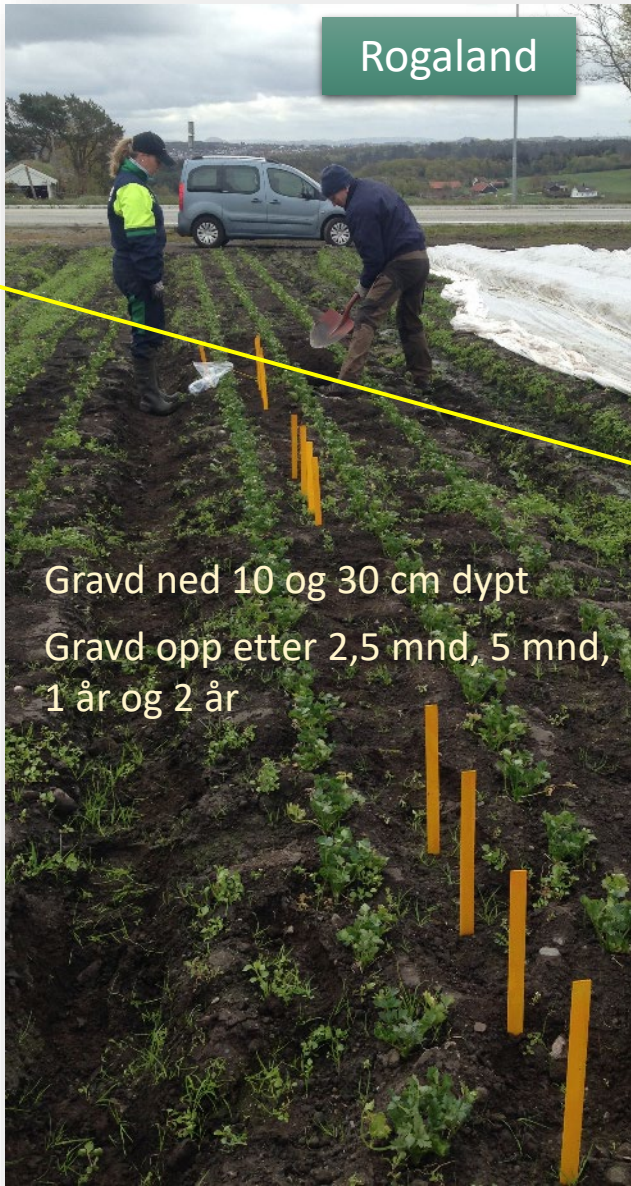
2 gårder i Rogaland
Oppstart 15. mai 2020

2 gårder i Viken
Oppstart 6. mai 2020

2 gårder i Agder
Oppstart 19. mai 2020



Rogaland



Gravd ned 10 og 30 cm dypt
Gravd opp etter 2,5 mnd, 5 mnd,
1 år og 2 år

Foto: Claire Coutris

Viken



Foto: Erik Jøner

Agder



Foto: Pierre-Adrien Rivier



Landbruksfolie

BioAgri (BioBag, LOG)
12 µm

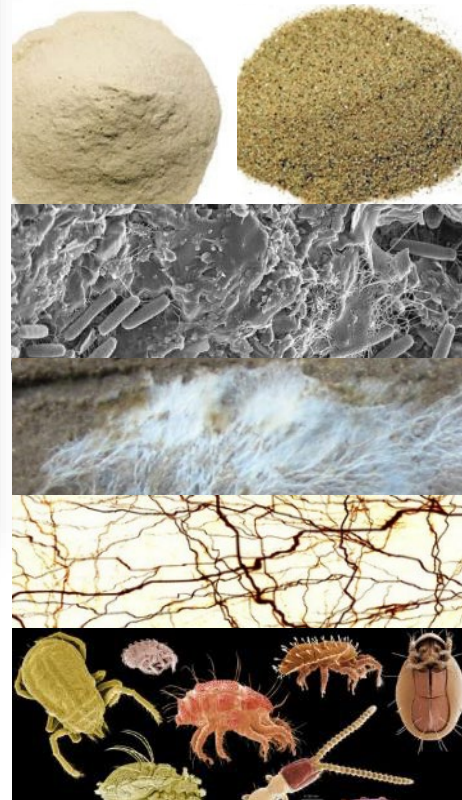


BI-OPL (Oerlemans, Norgro)
12 µm



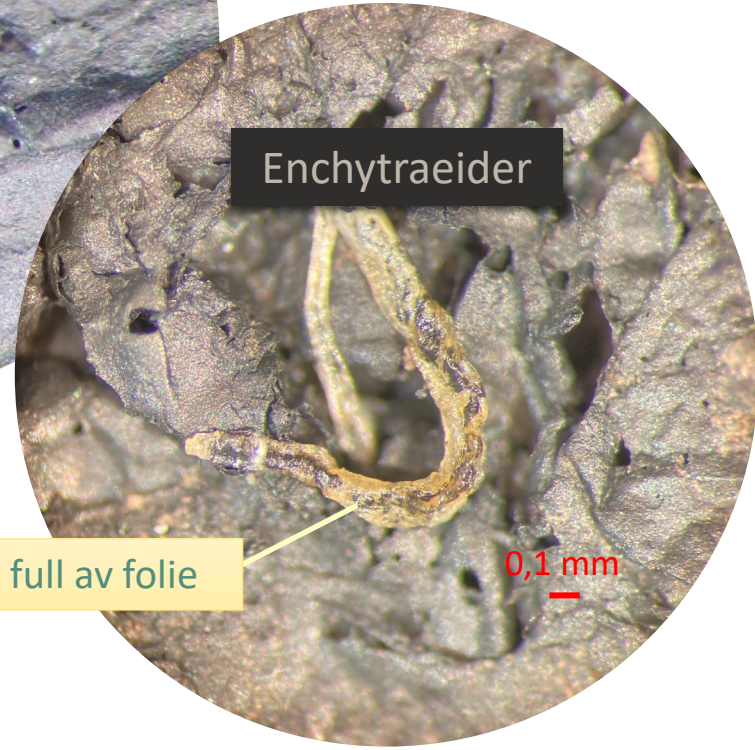
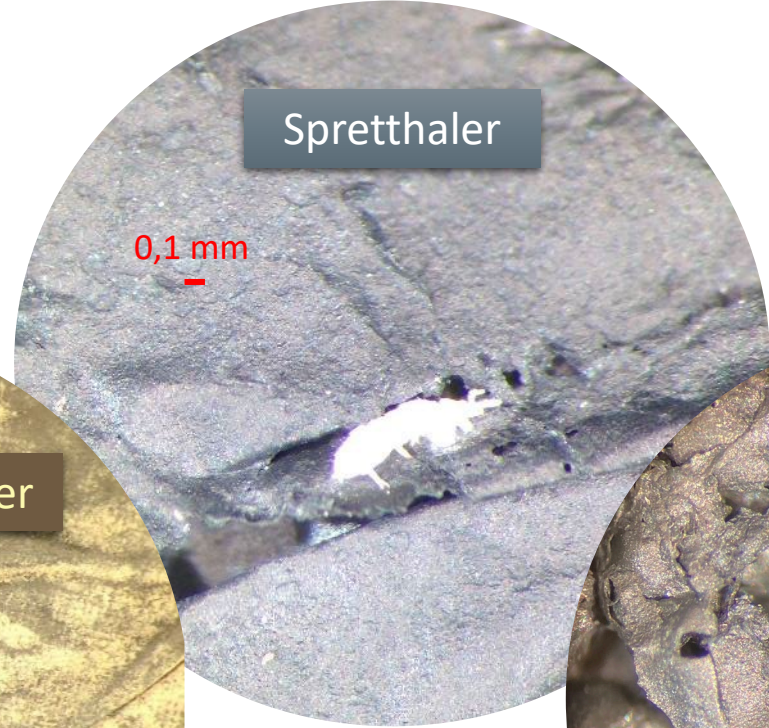
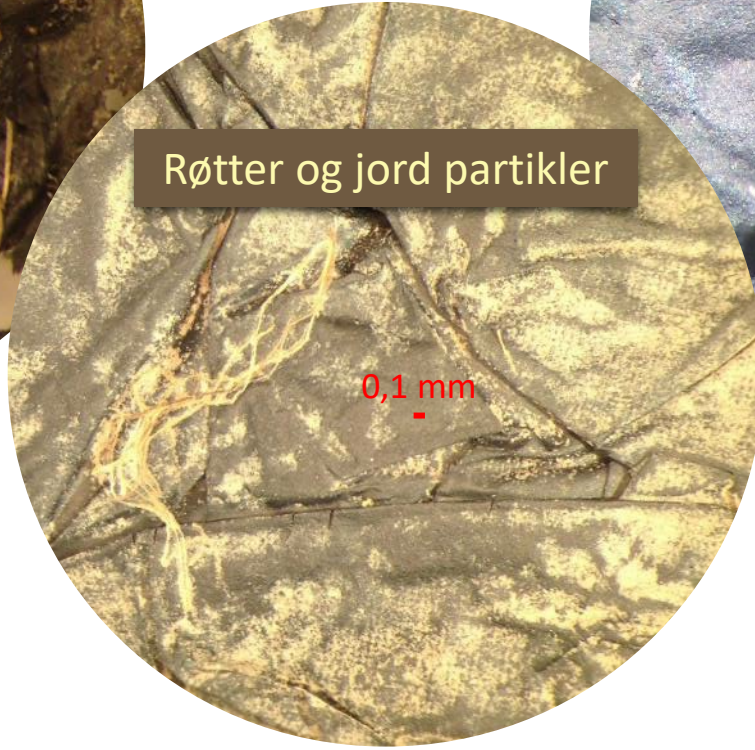
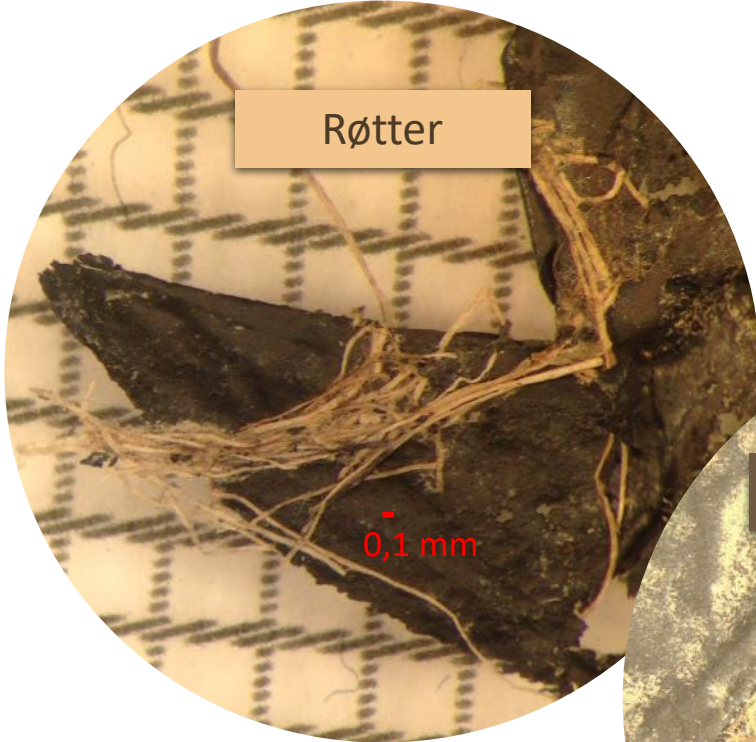
Nylon, maskevidde 100 µm

Alt under får tilgang til
bionedbrytbar plast inn i posen:

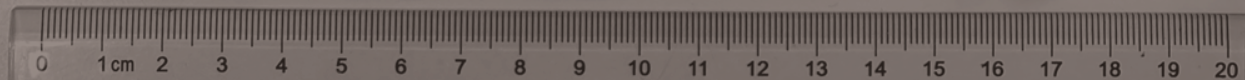


- ✓ **Jordvæsker**
- ✓ Leir
- ✓ Silt
- ✓ Fin sand
- ✓ **Bakterier**
- ✓ **Sopp**
- ✓ Planterøtter
- ✓ Mikrofauna
- ✓ Mesofauna (unge)

Røtter, jordpartikler og små virvelløse dyr inn i posene

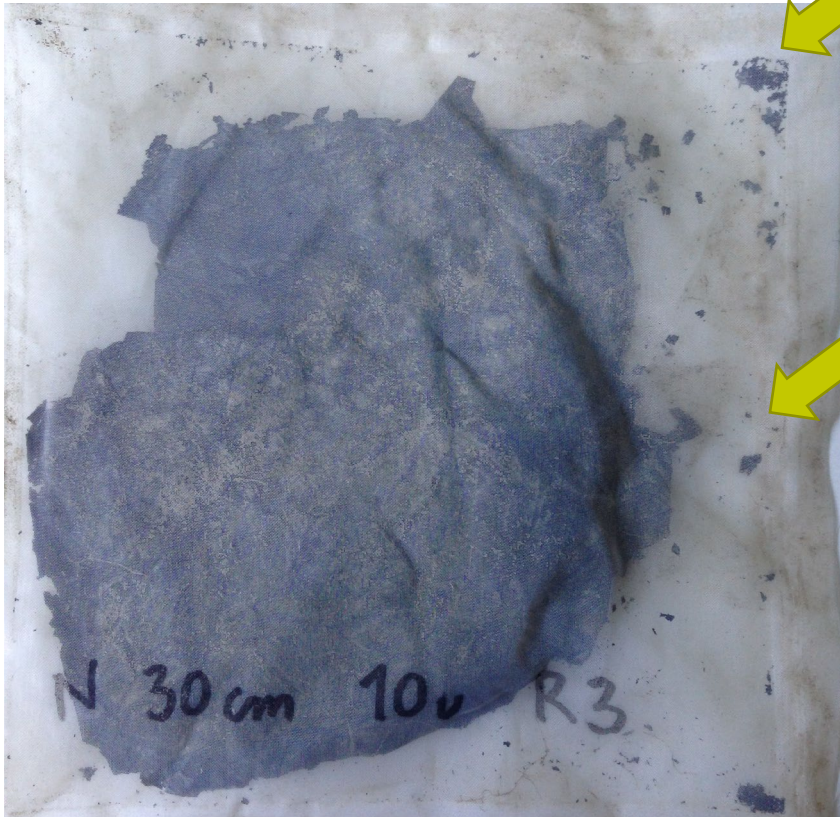


Hvordan gikk nedbrytning under jorda?

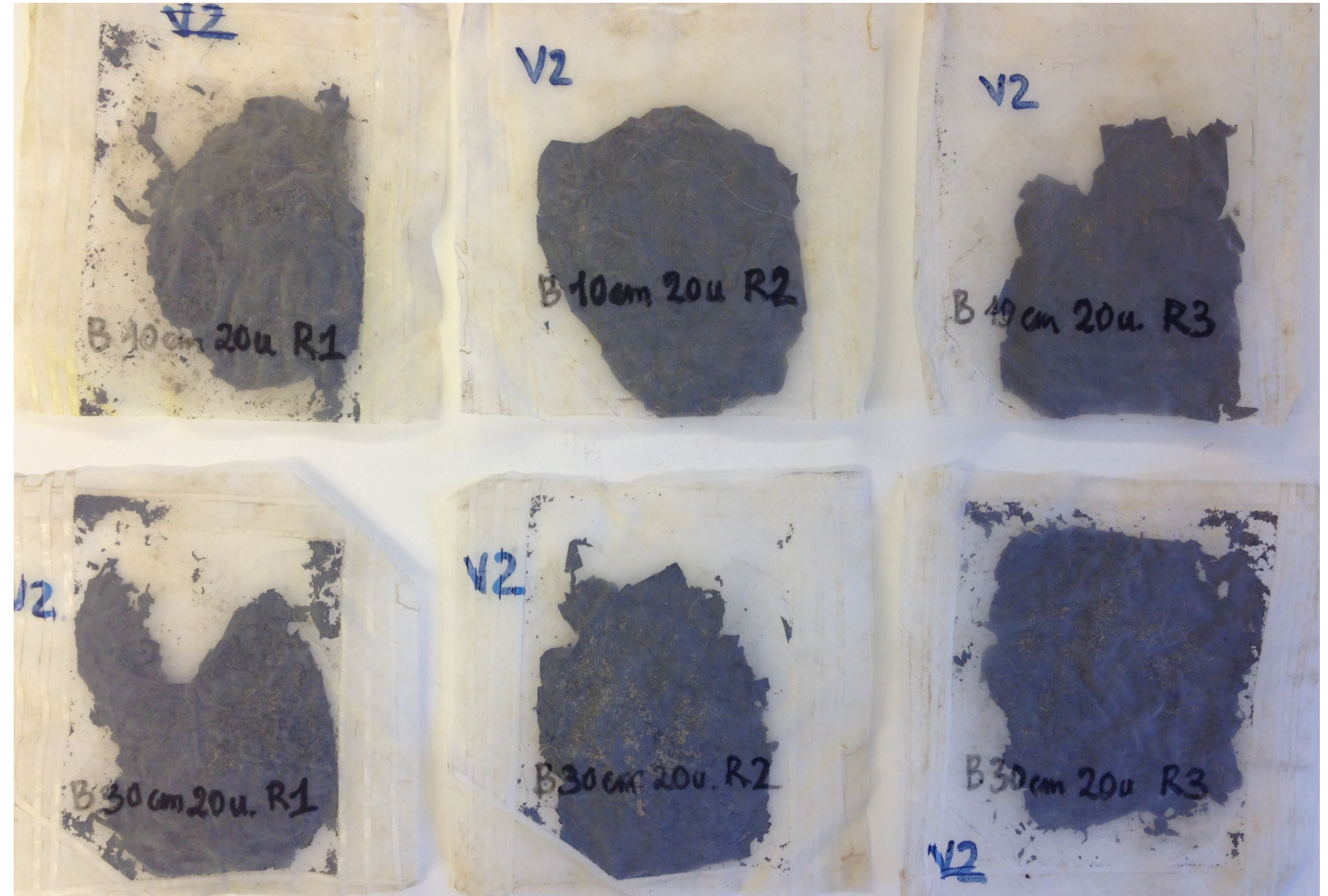


Fragmentering

Allerede etter 2,5 mnd enkelte steder

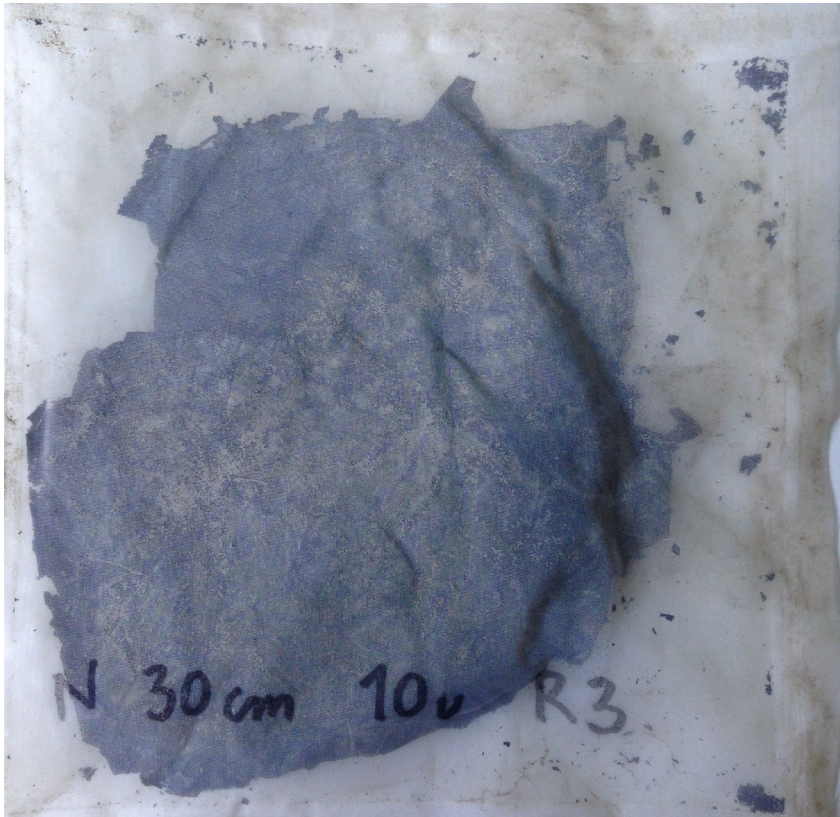


På alle gårder (begge folietyper og jorddybder) etter 5 mnd, 1 og 2 år

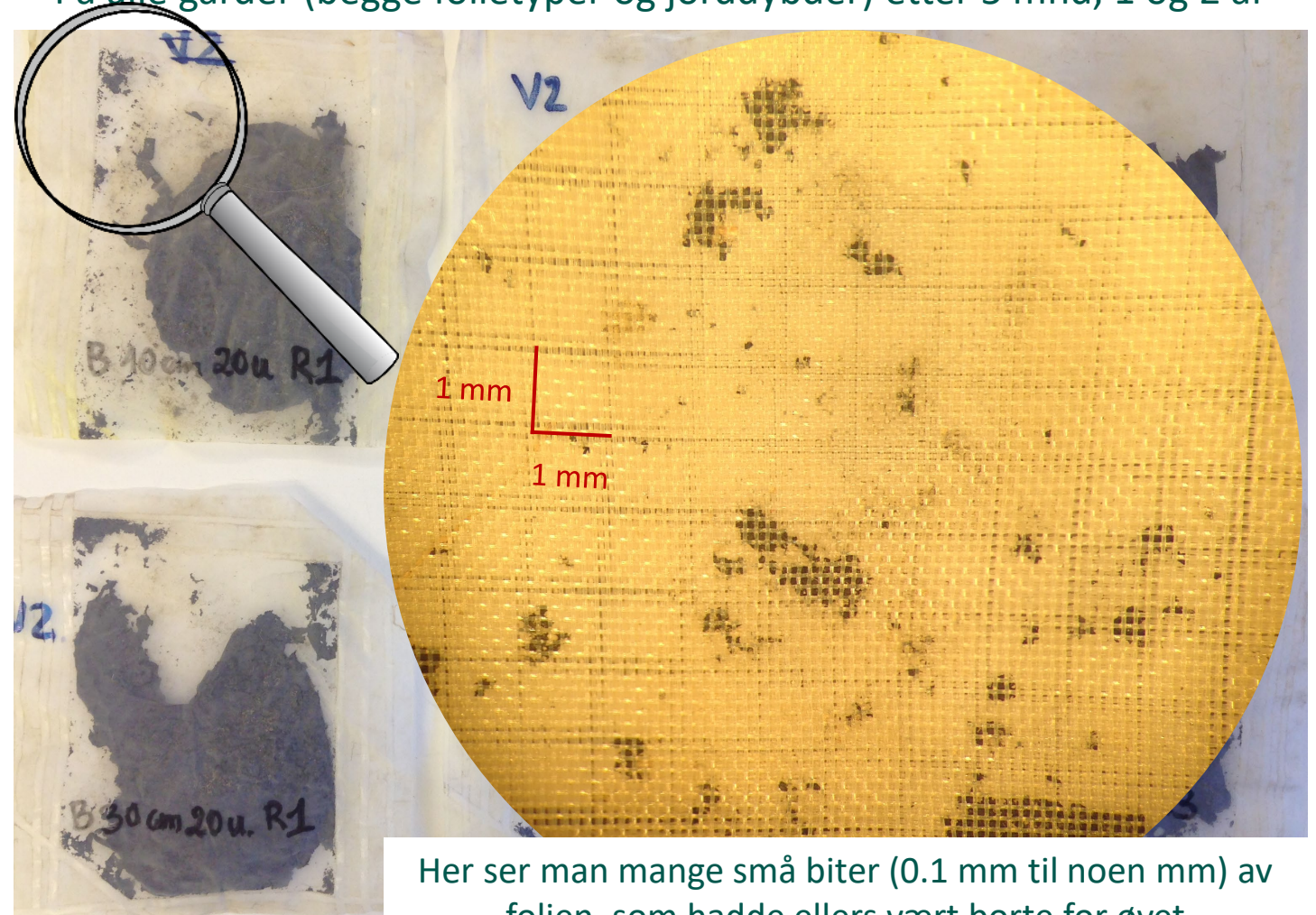


Fragmentering

Allerede etter 2,5 mnd enkelte steder



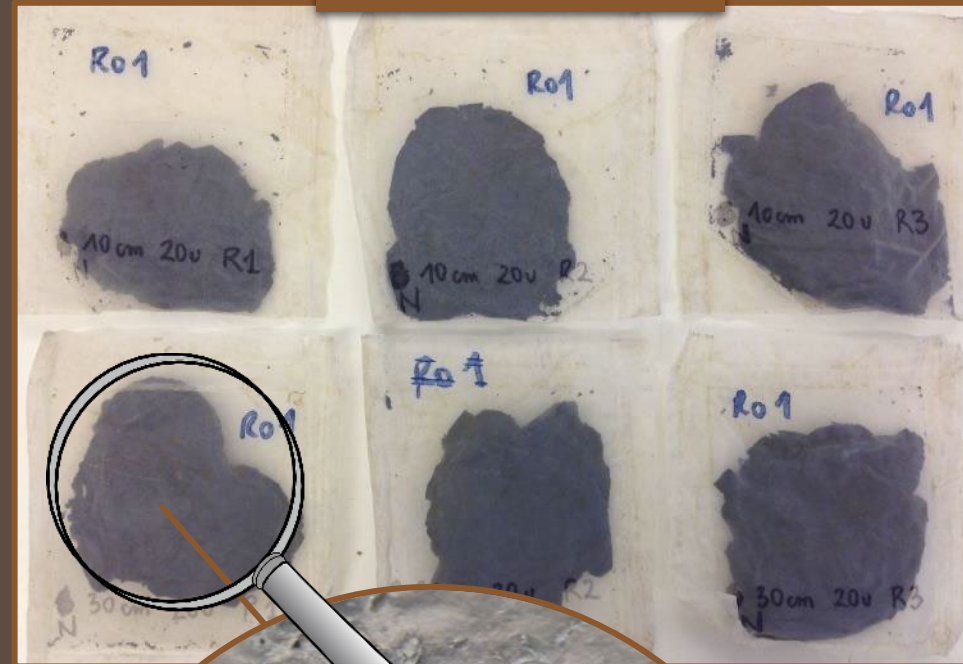
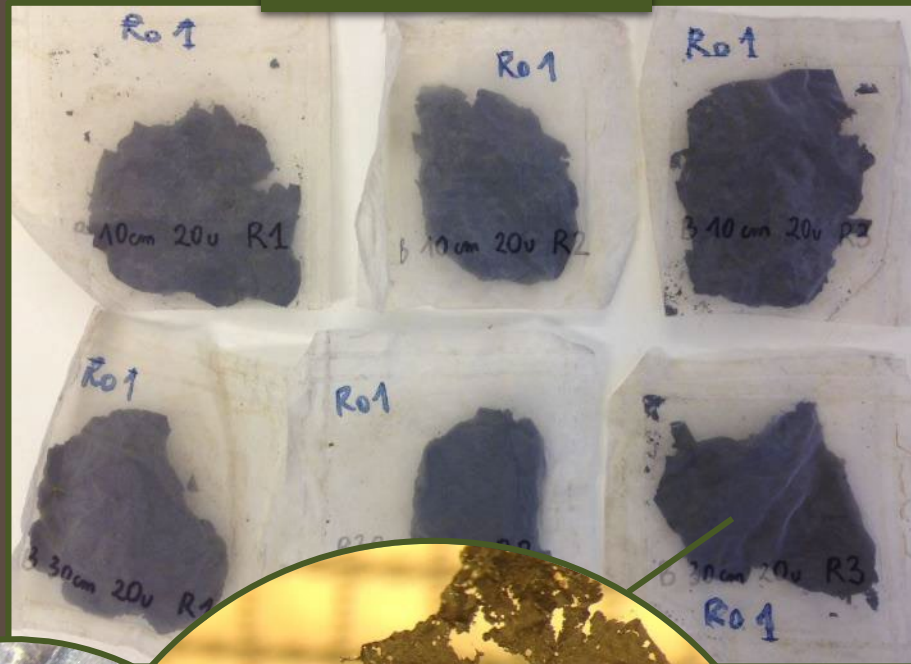
På alle gårder (begge folietyper og jorddybder) etter 5 mnd, 1 og 2 år



Her ser man mange små biter (0.1 mm til noen mm) av folien, som hadde ellers vært borte for øyet

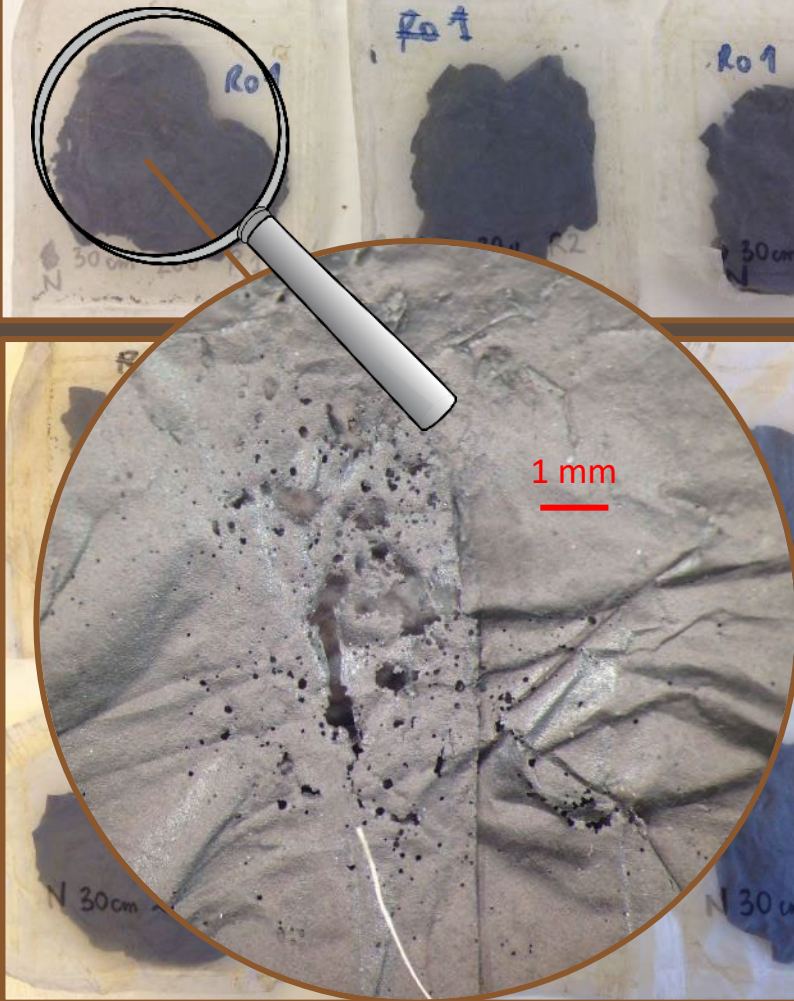
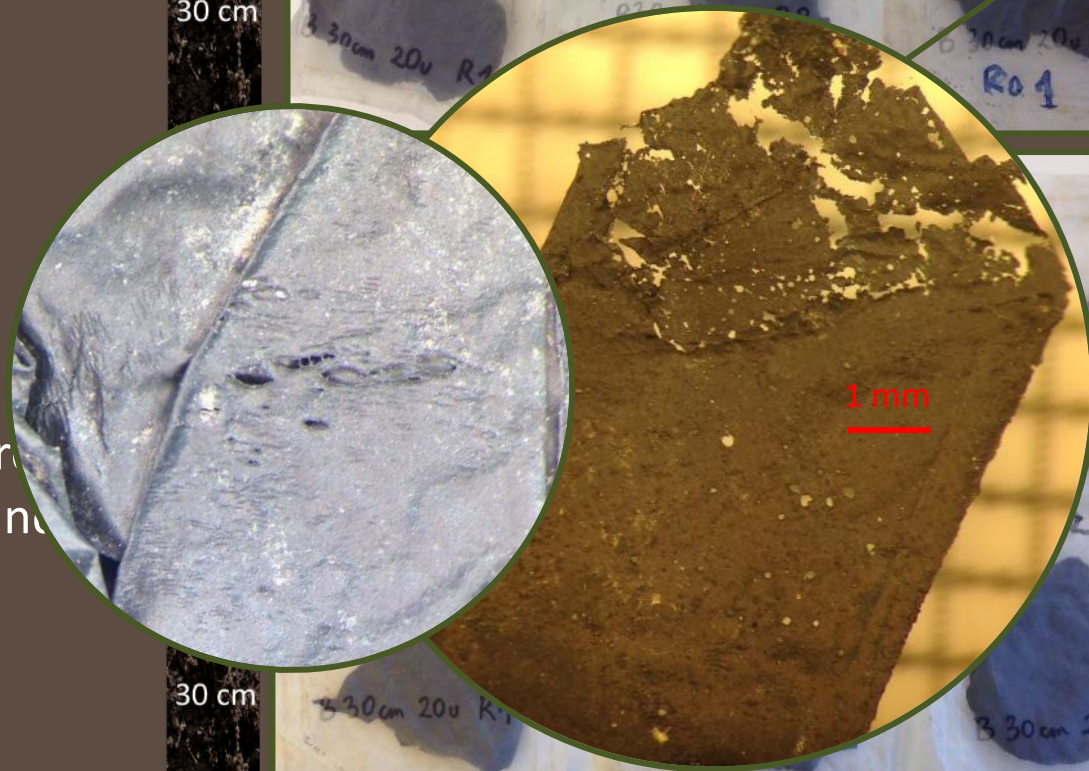
Bioagri (Biobag®)

BI-OPL (Oerlemans®)



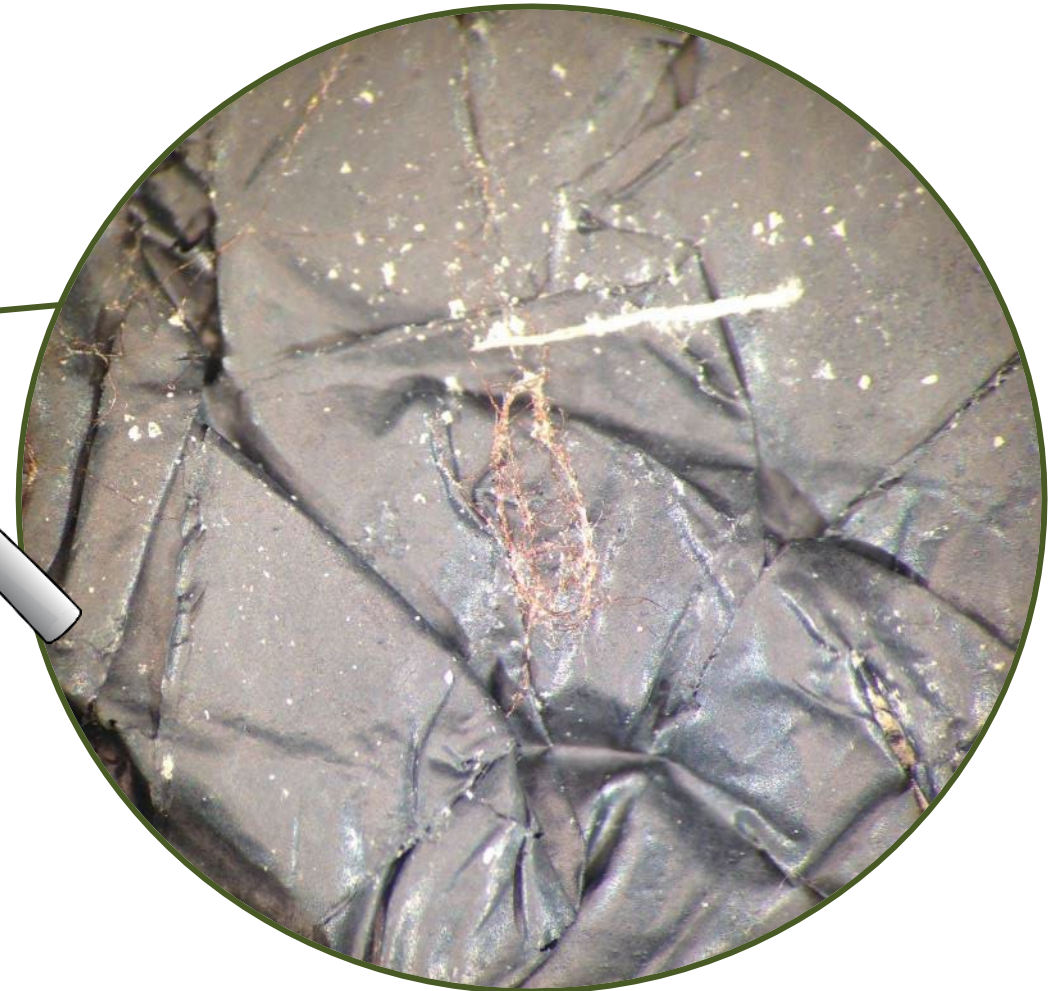
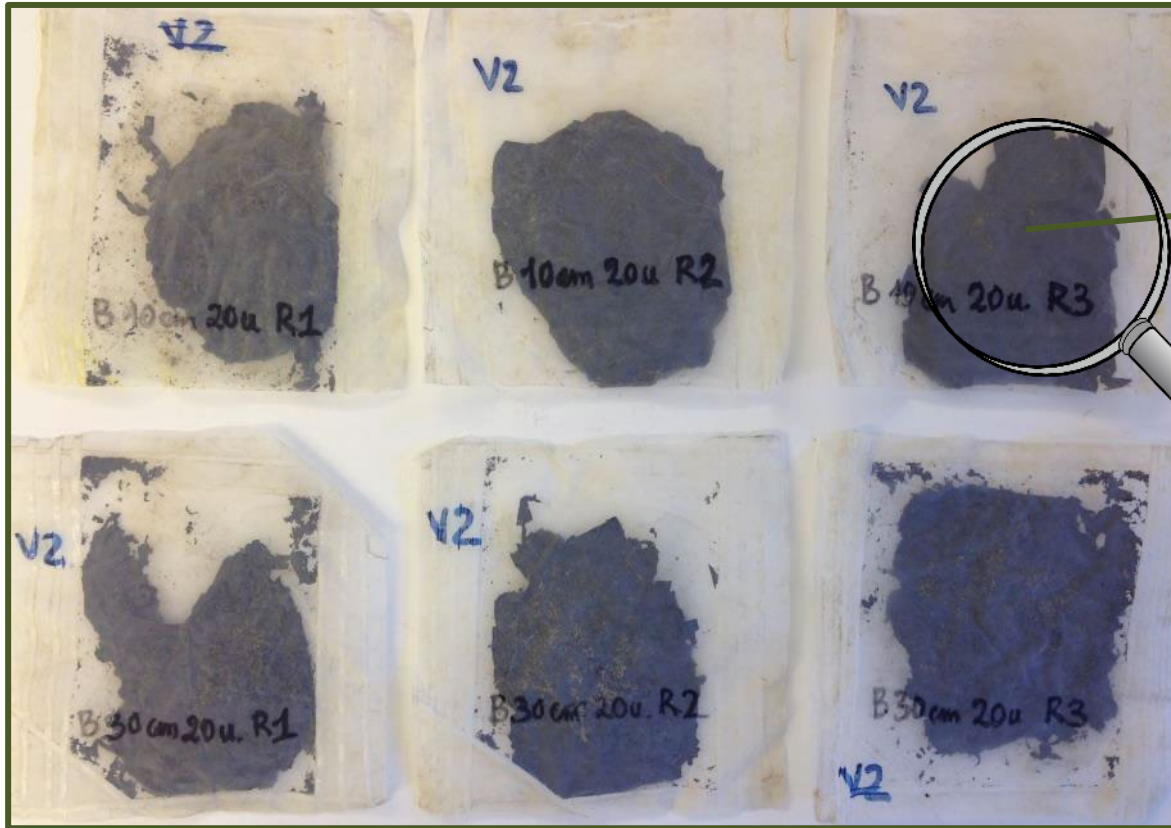
Rogaland Gård 1 →
Etter 5 mnd

Rogaland Gård 1 →
Etter 5 mnd

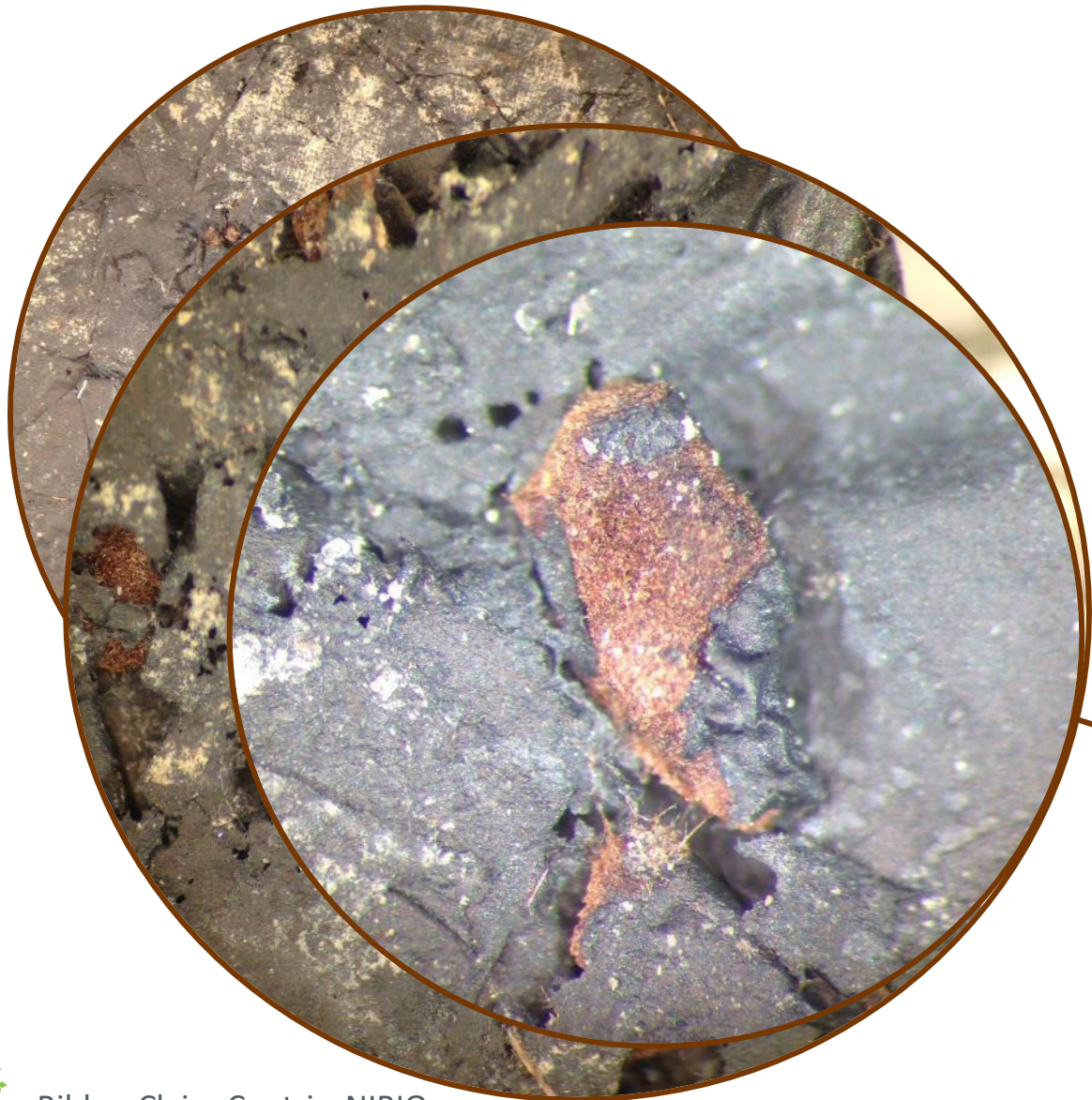
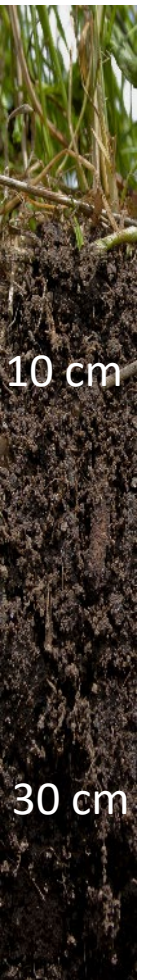


Noen merkelige kobberaktige tråder og strukturer...

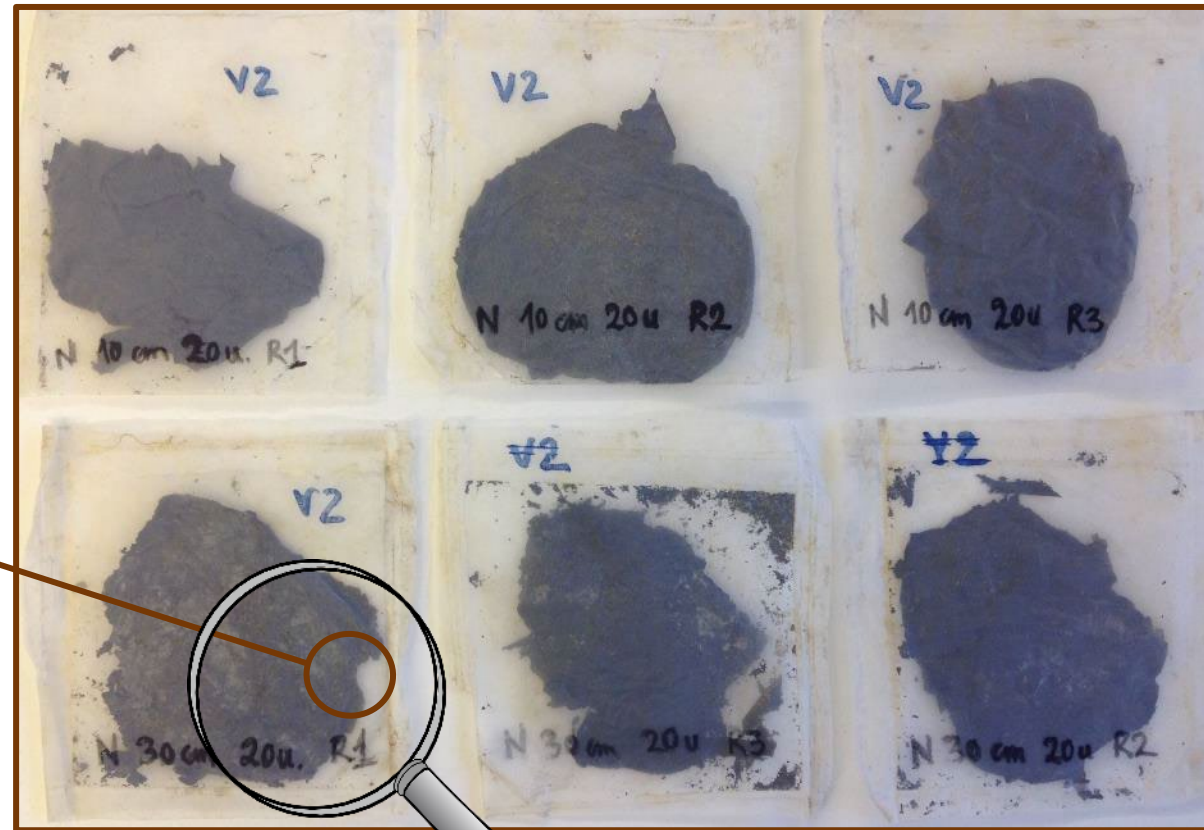
Bioagri (Biobag®)



Bilder: Claire Coutris, NIBIO



BI-OPL (Oerlemans®)

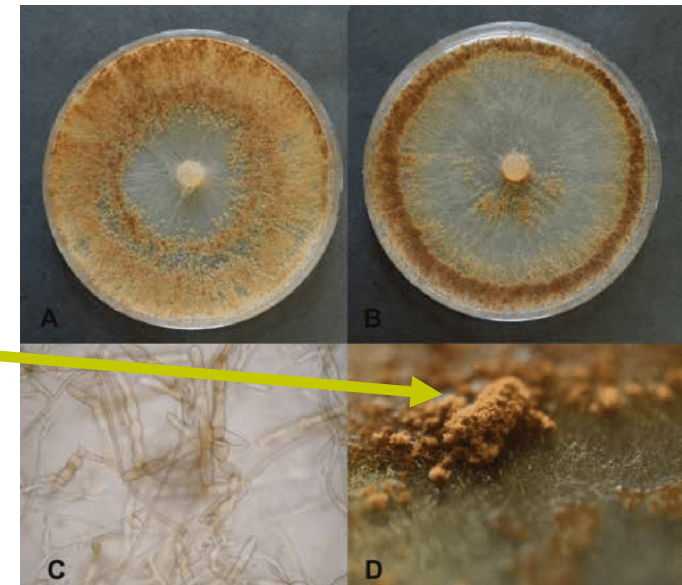
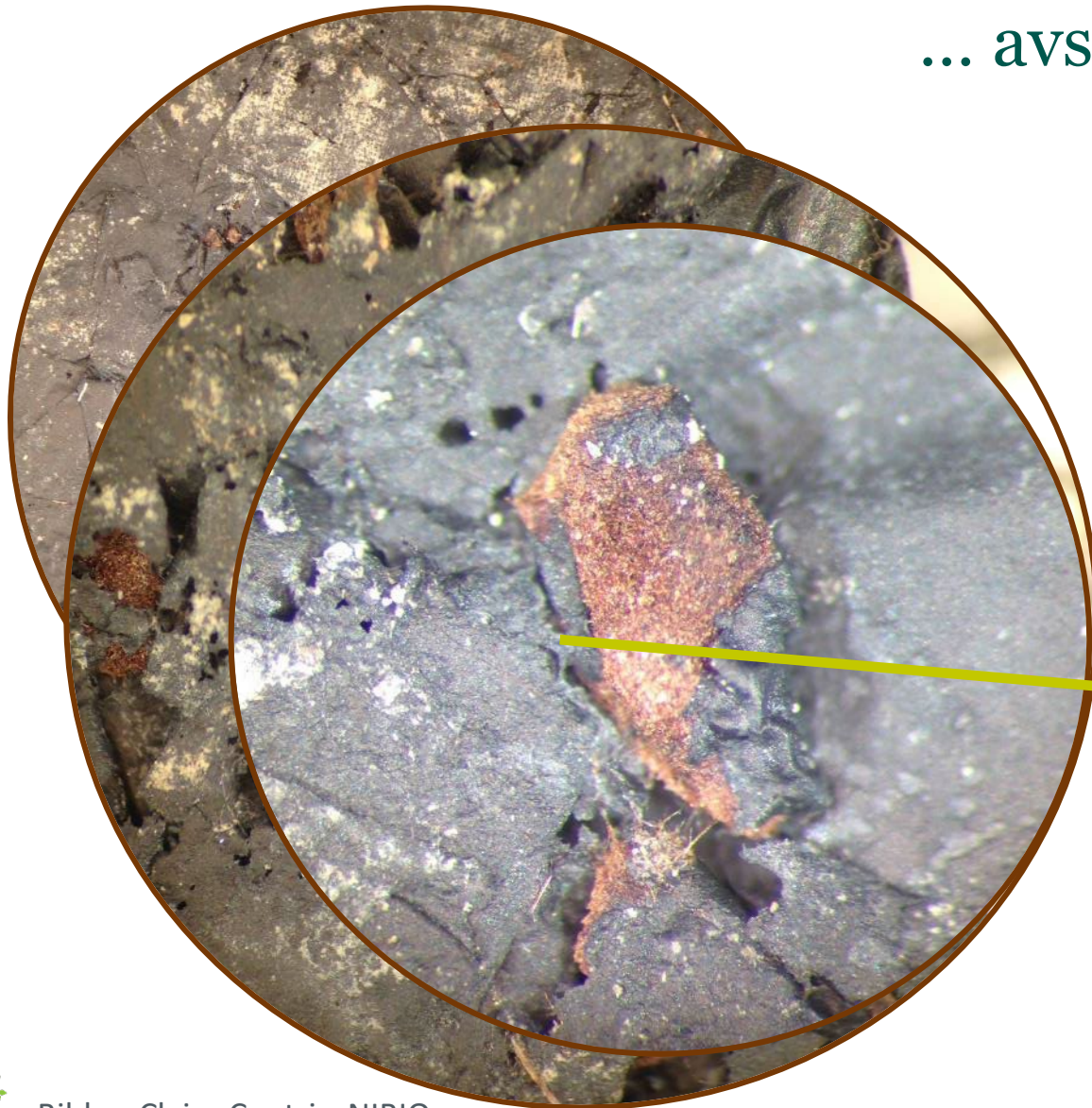
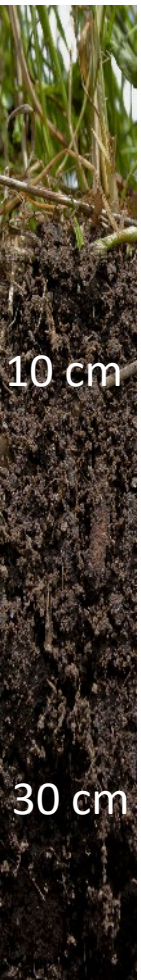


Bilder: Claire Coutris, NIBIO

... avslørt av DNA-analyse

Svartskurv!

Rhizoctonia solani/Thanatephorus cucumeris



<https://doiserbia.nb.rs/img/doi/1820-3949/2019/1820-39491901019V.pdf>

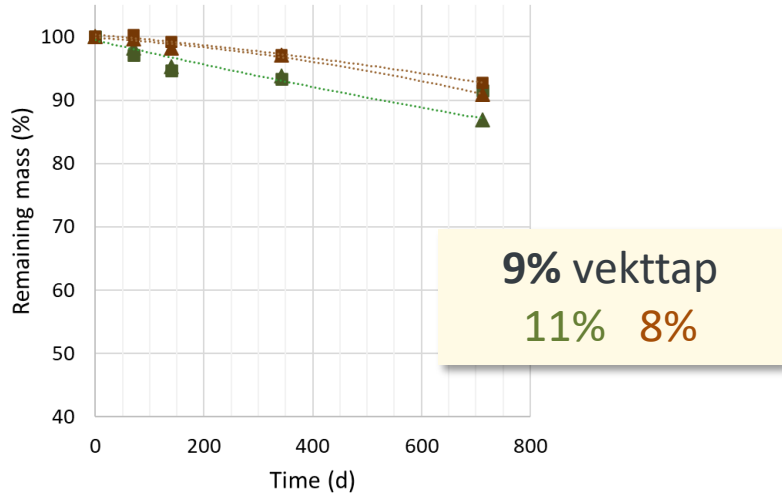


Bilder: Claire Coutris, NIBIO

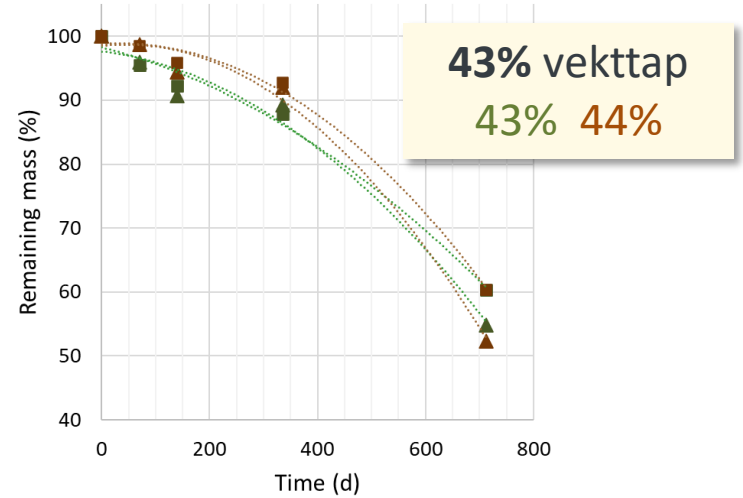
Vekttap over tid

- ▲ Bioagri 10 cm ▲ BI-OPL (Norgro) 10 cm
- Bioagri 30 cm ■ BI-OPL (Norgro) 30 cm

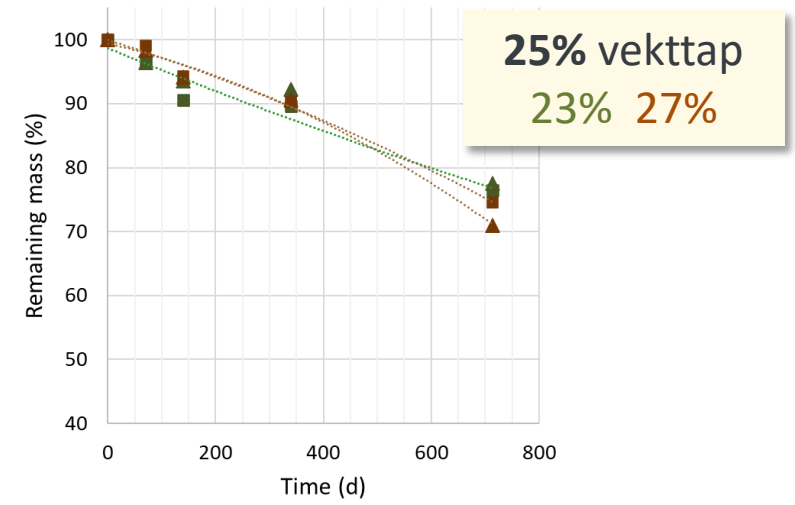
Viken 1



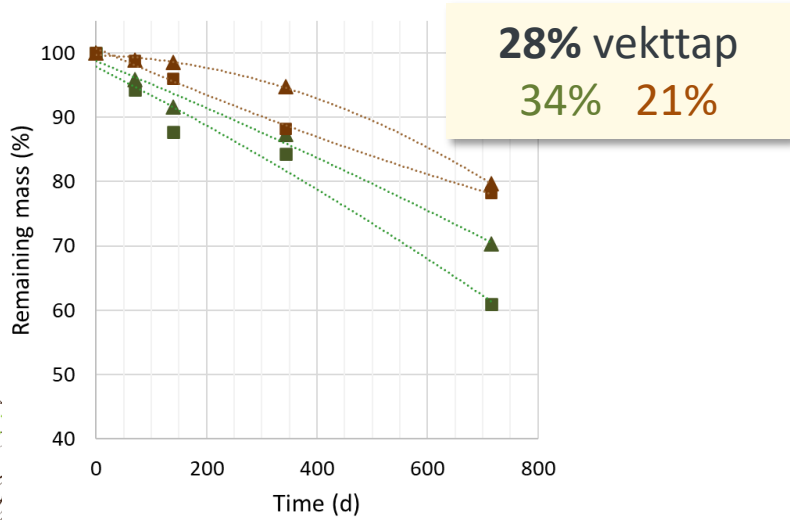
Rogaland 1



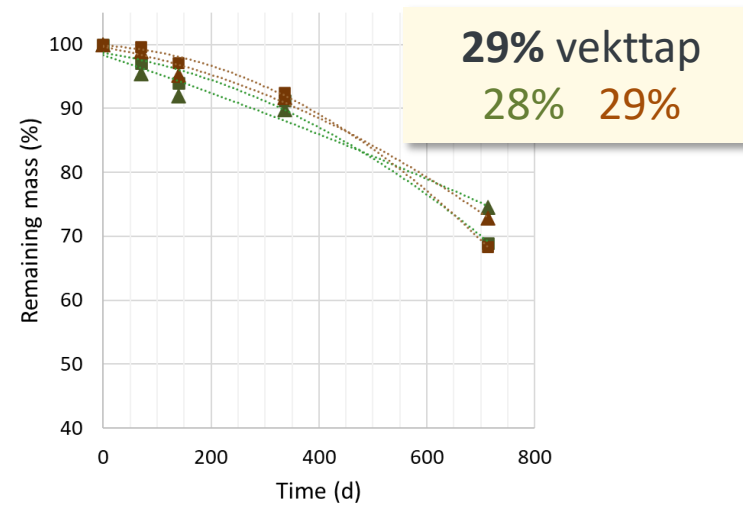
Agder 1



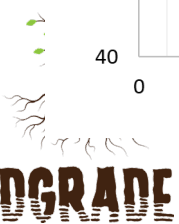
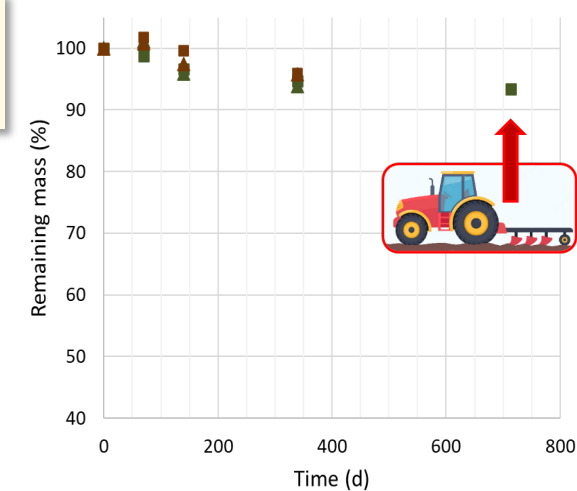
Viken 2



Rogaland 2



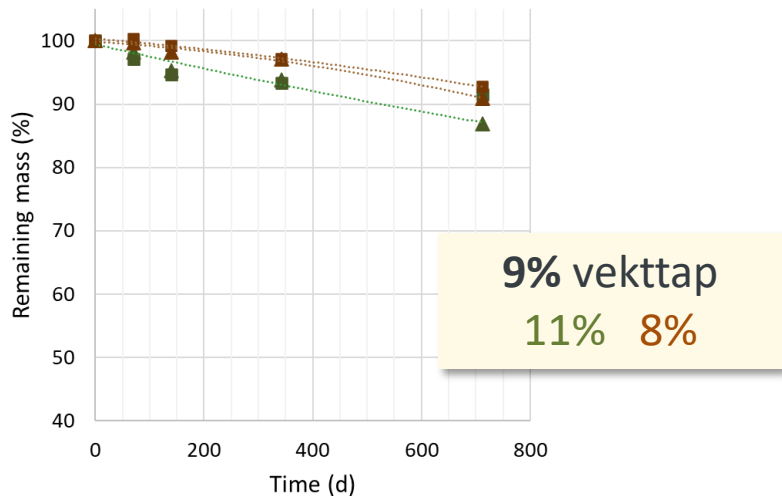
Agder 2



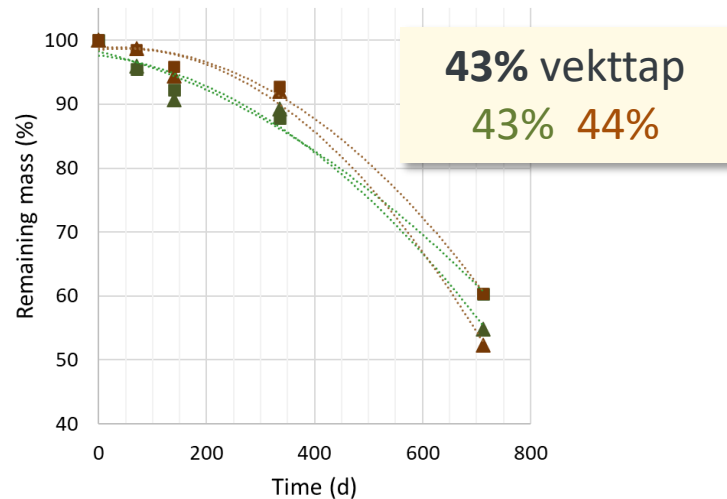
Vekttap over tid

- ▲ Bioagri 10 cm ▲ BI-OPL (Norgro) 10 cm
- Bioagri 30 cm ■ BI-OPL (Norgro) 30 cm

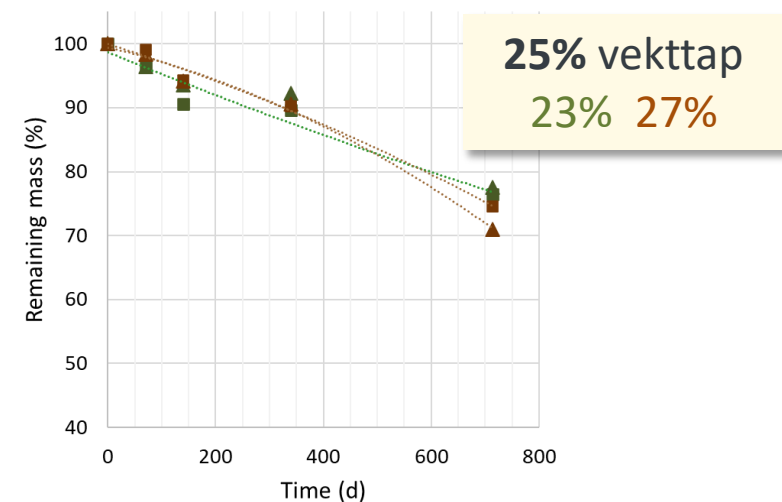
Viken 1



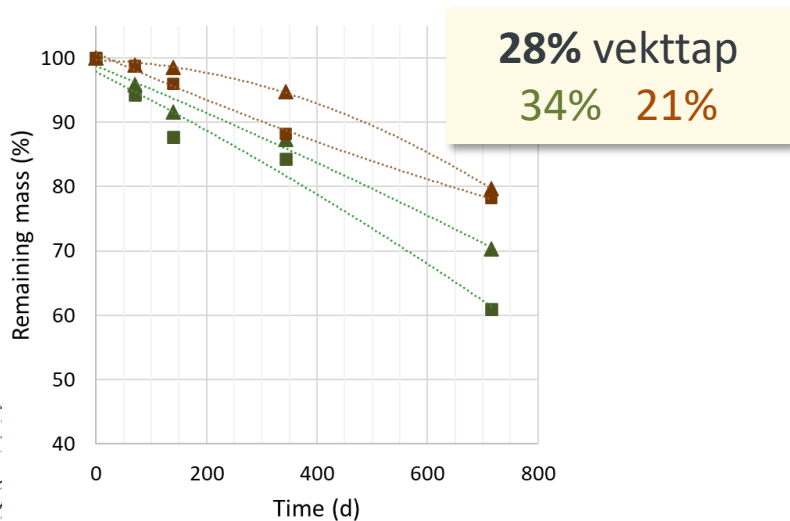
Rogaland 1



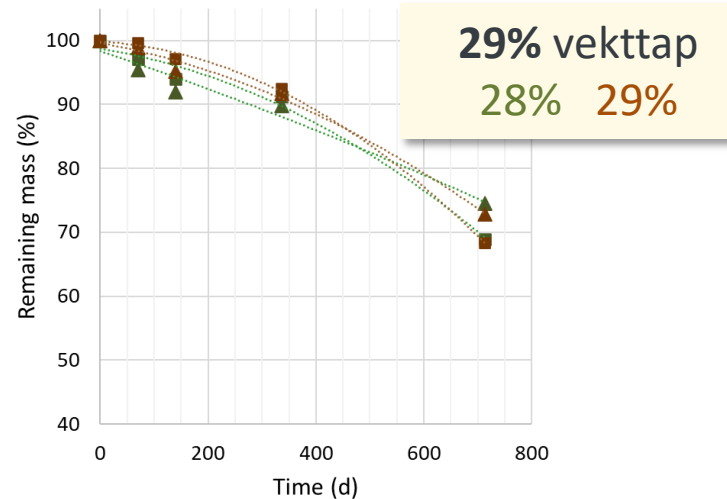
Agder 1



Viken 2



Rogaland 2

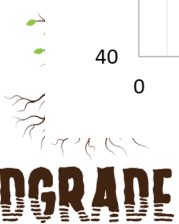


Fra 8-44% vekttap ila 2 år i jord

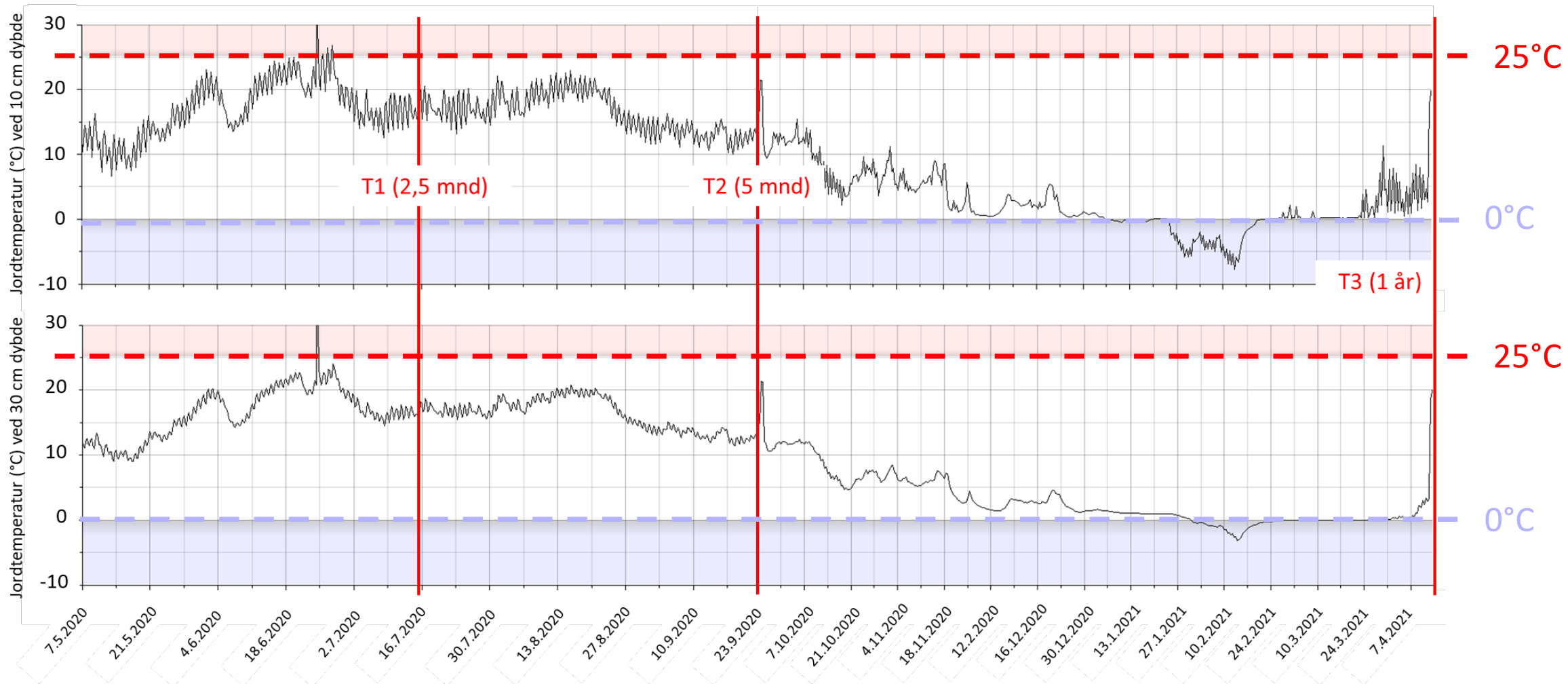
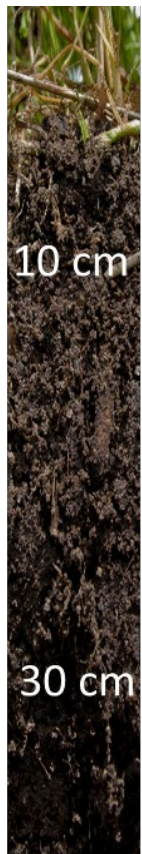
Lite forskjell på folietype og jorddybde

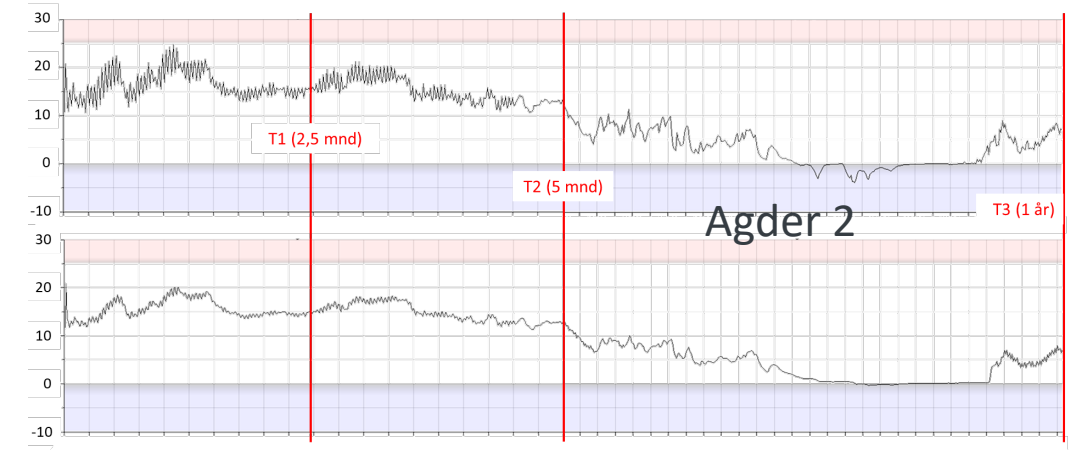
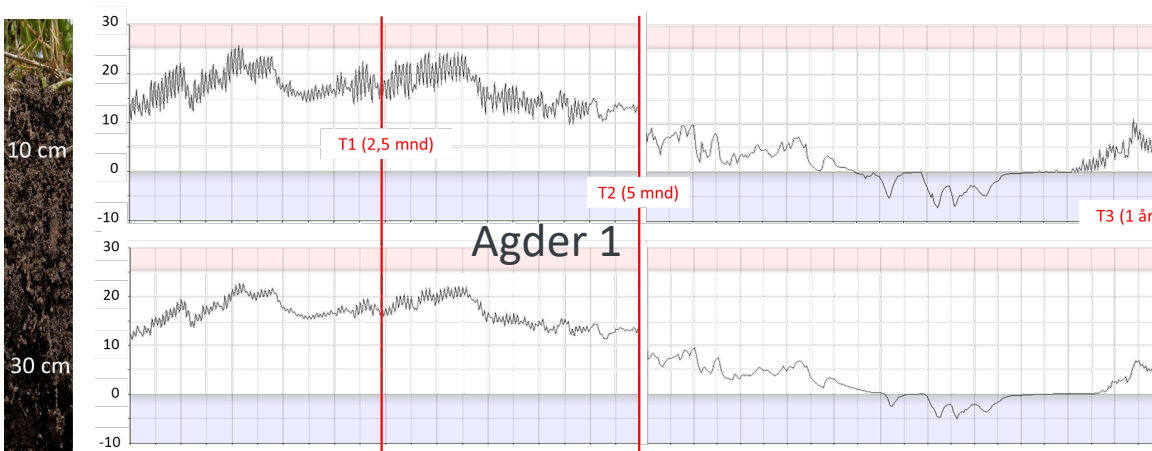
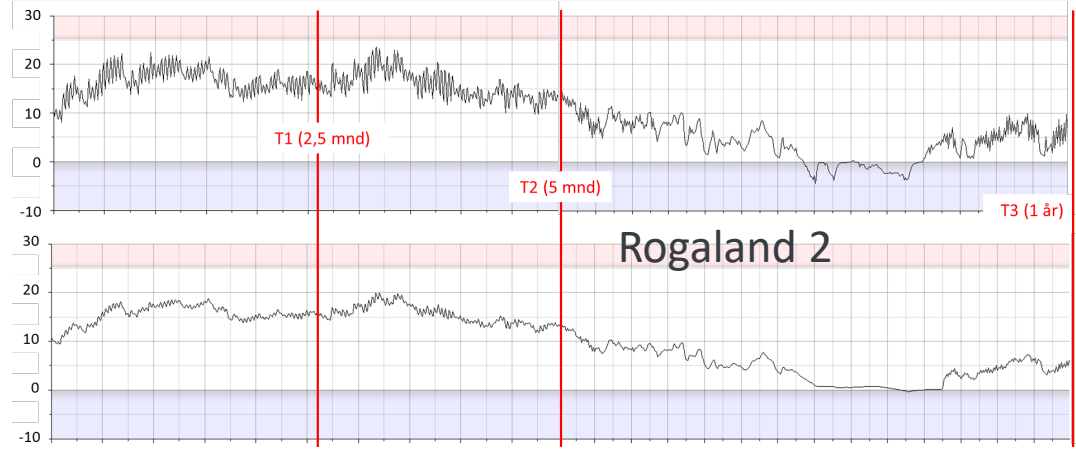
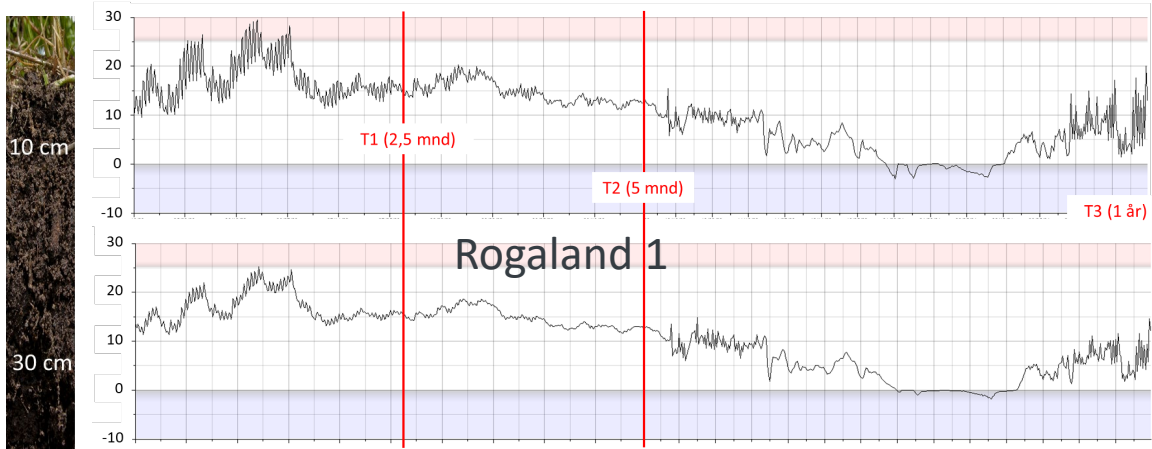
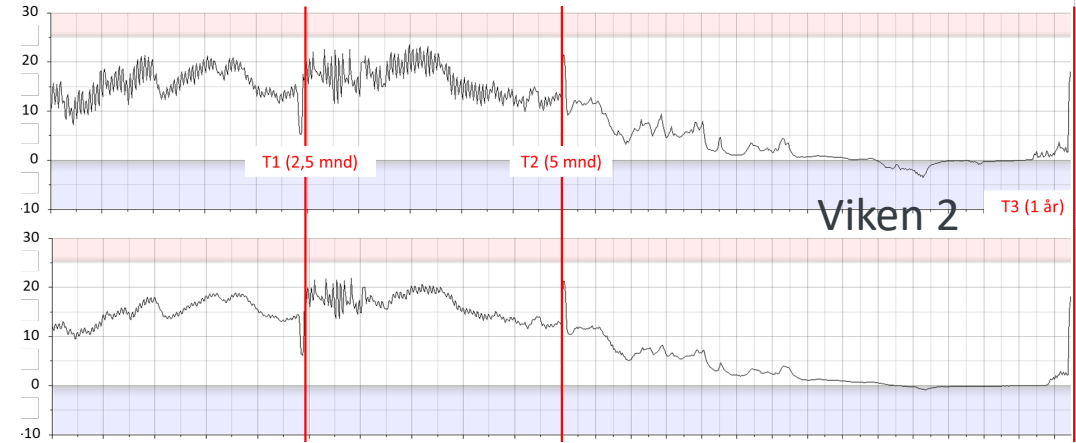
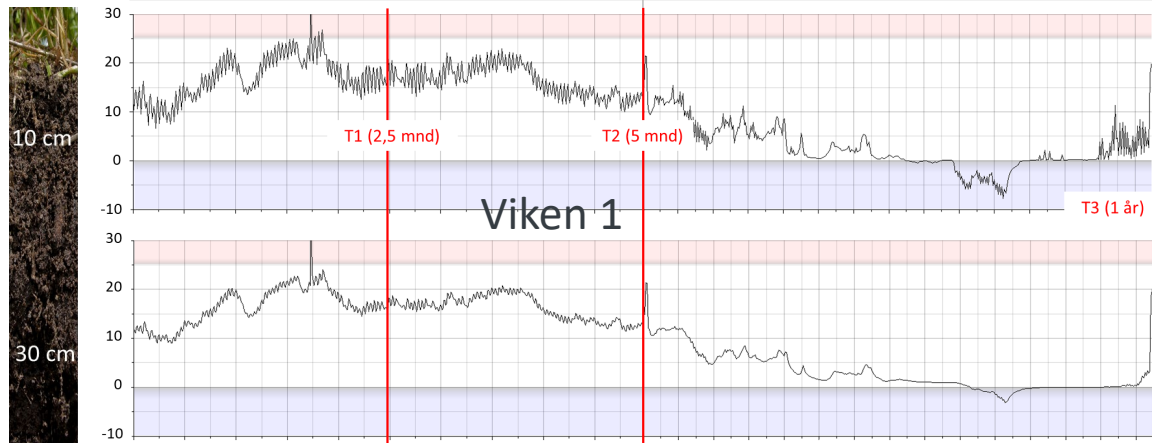
Høyere jordtemperaturer gjør både kjemiske og biologiske prosesser raskere

Kan jordtemperatur forklare det meste?



Jordtemperatur ved 10 og 30 cm ble målt 2-4 ganger hver dag i 2 år



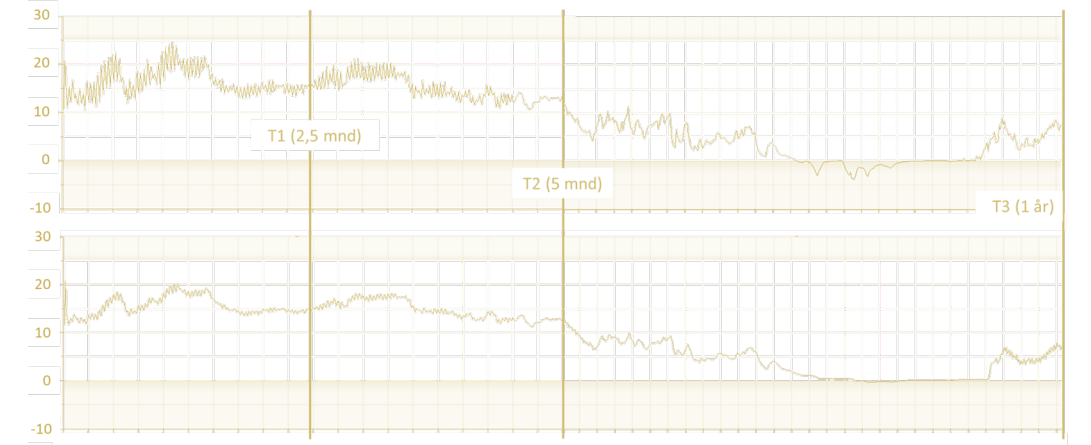
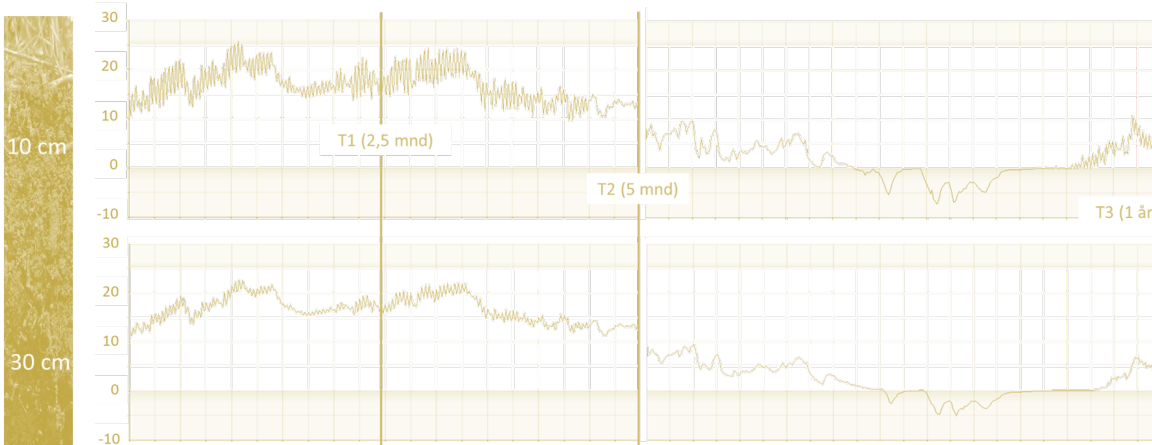
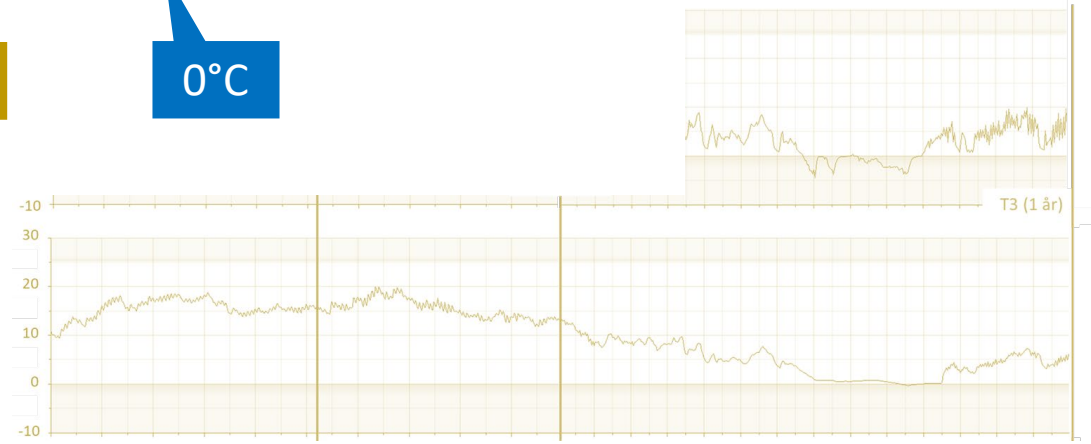
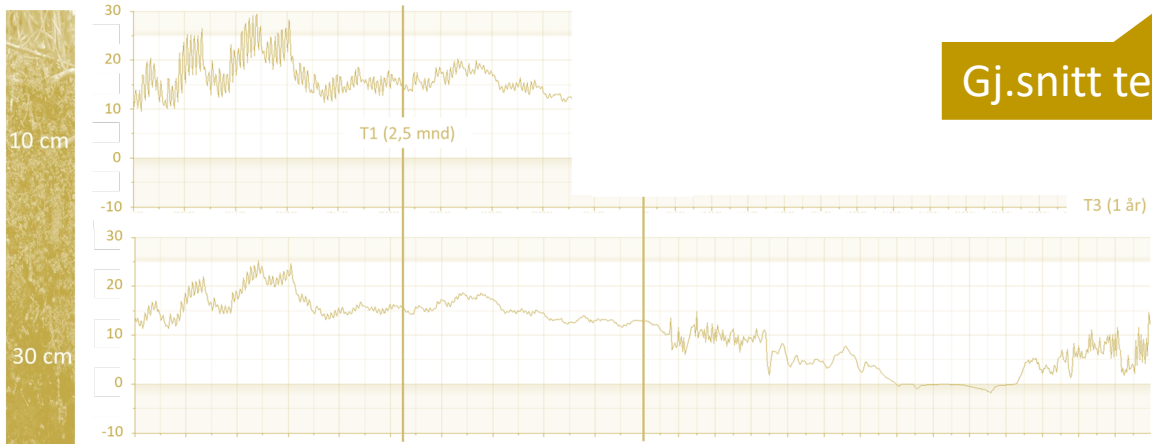
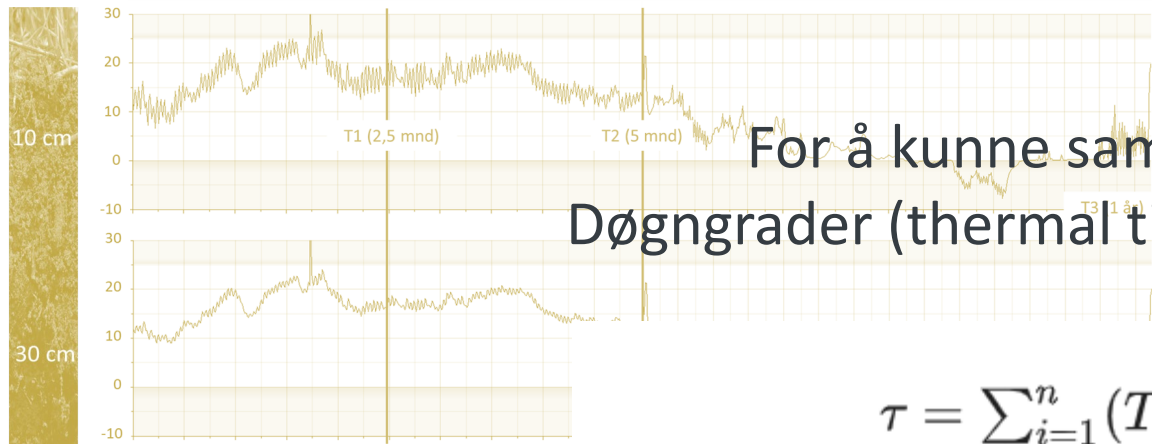


For å kunne sammenligne alle gårder:
Døgngrader (thermal time/cumulative degree days)

$$\tau = \sum_{i=1}^n (T_{daily,i} - T_{base}) \Delta t$$

Gj.snitt temp

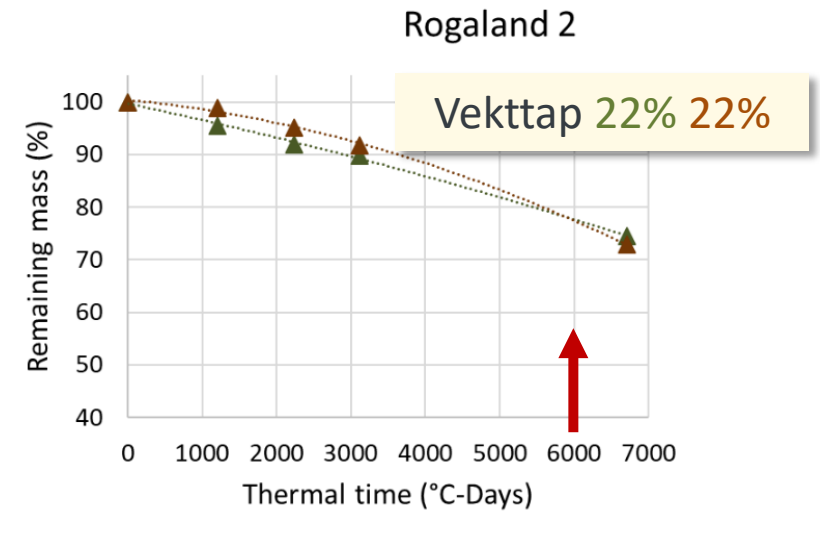
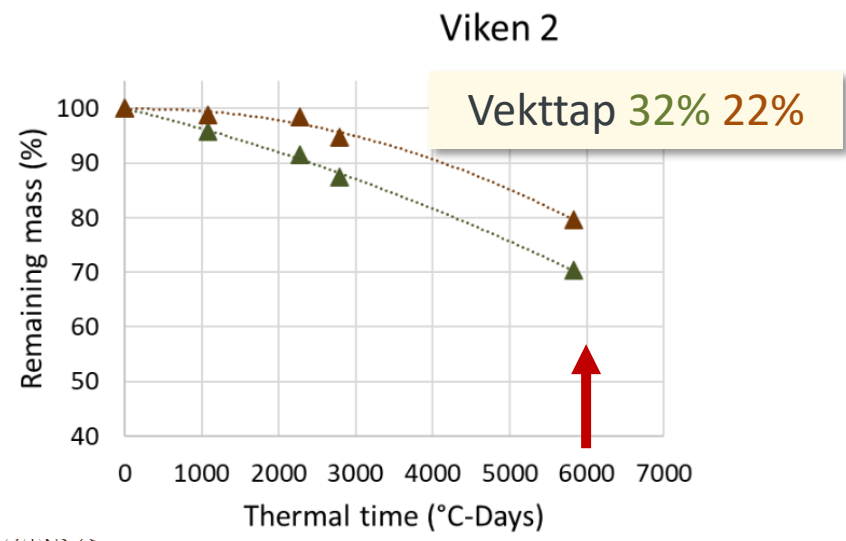
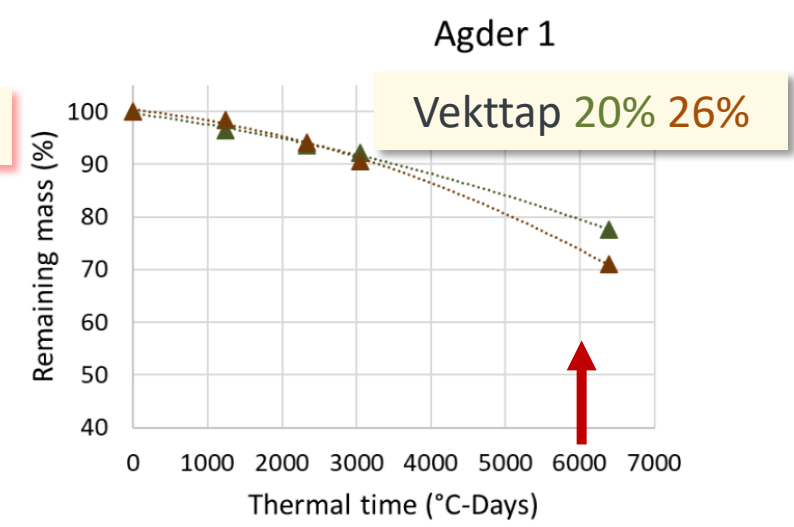
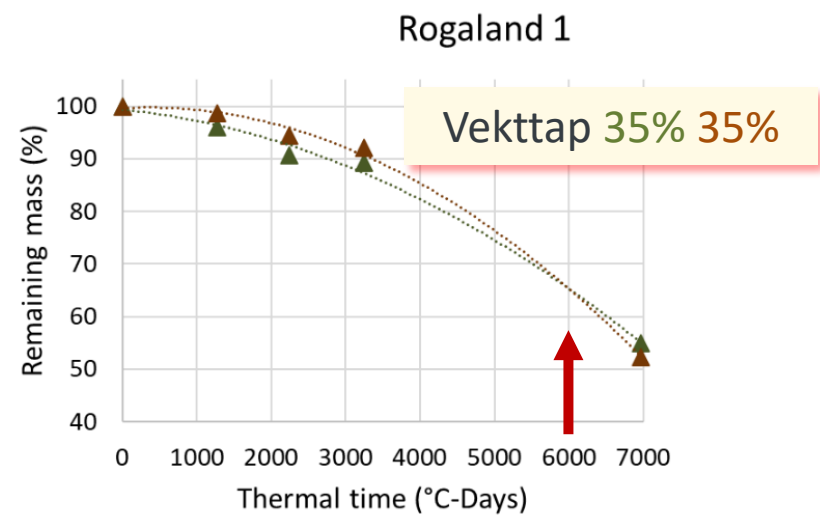
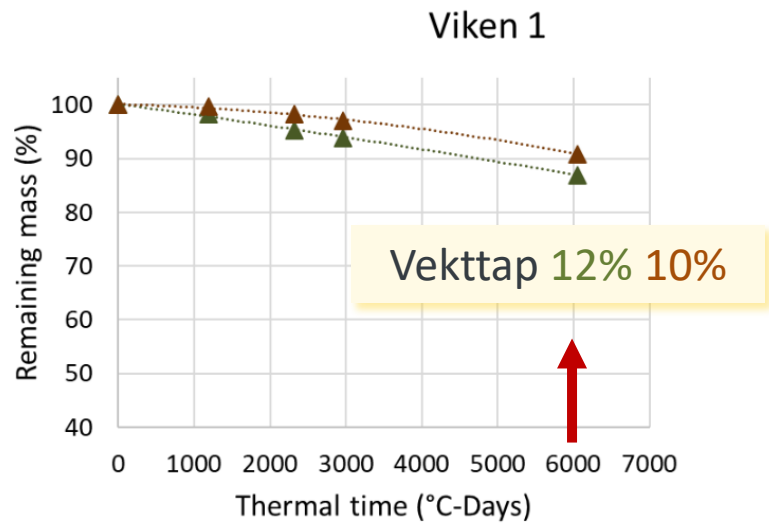
0°C



Vekttap over (termisk) tid

▲ Bioagri 10 cm

▲ BI-OPL (Norgro) 10 cm



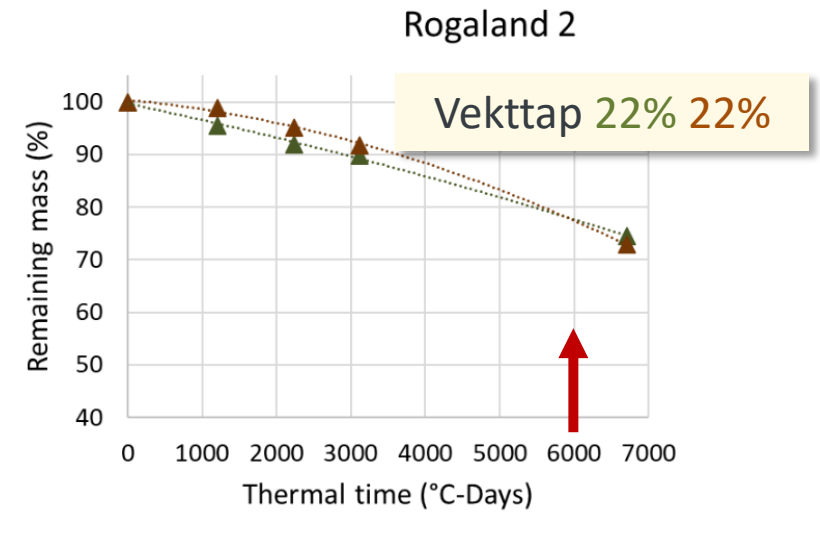
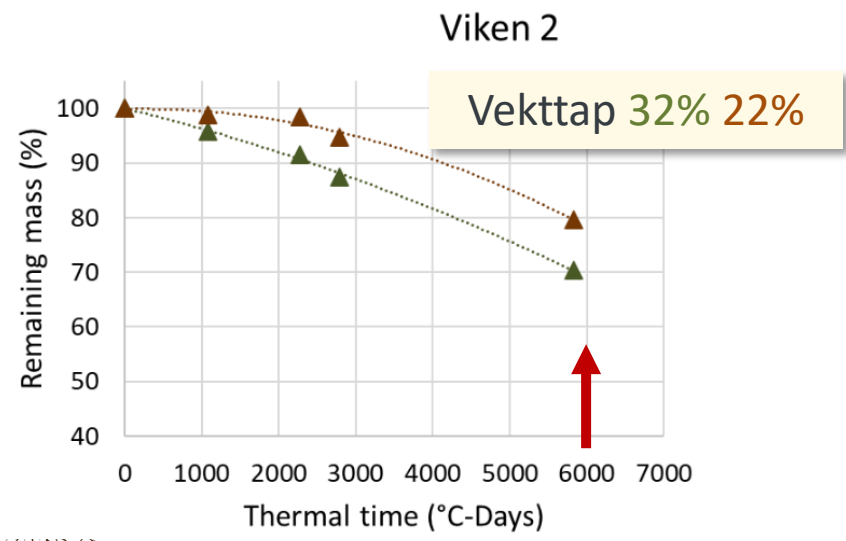
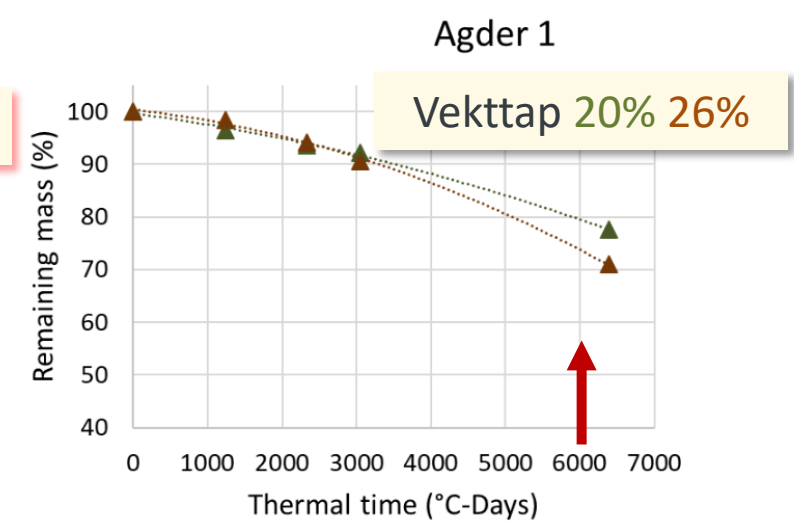
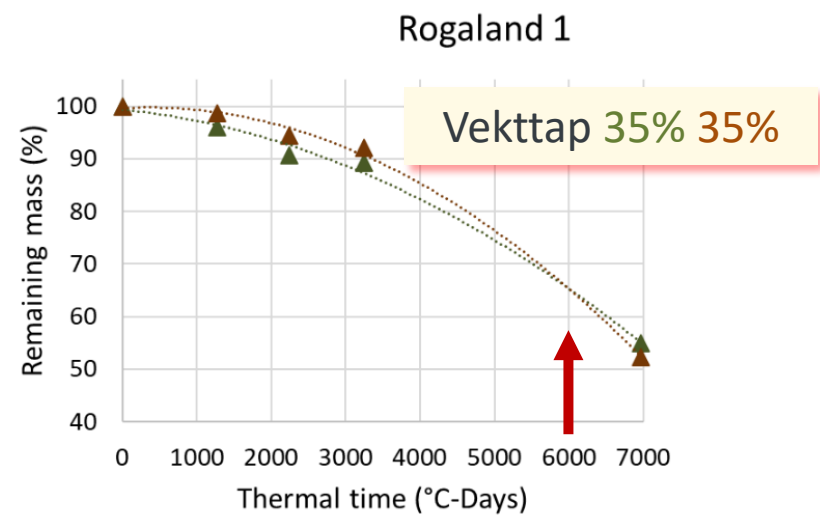
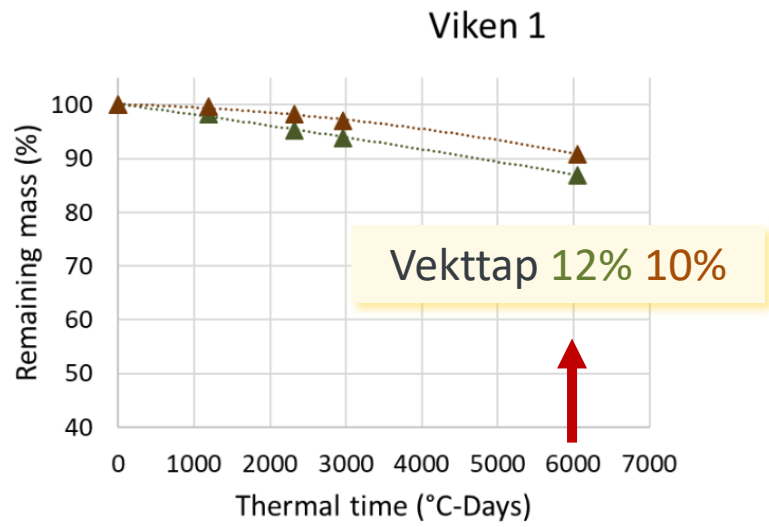
Mindre variasjon mellom gårder:
Bekrefter rollen av **jordtemperatur**

...men ikke som eneste
forklaringsfaktor

Vekttap over (termisk) tid

▲ Bioagri 10 cm

▲ BI-OPL (Norgro) 10 cm



Moldfattig jord (0-2,9 %)

Moldholdig jord (3-4,4 %)

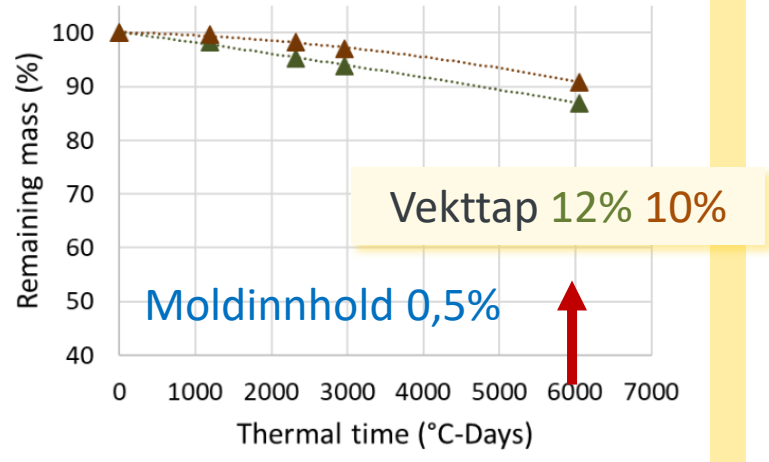
Moldholdig jord (4,5-12,4 %)

Vekttap over (termisk) tid

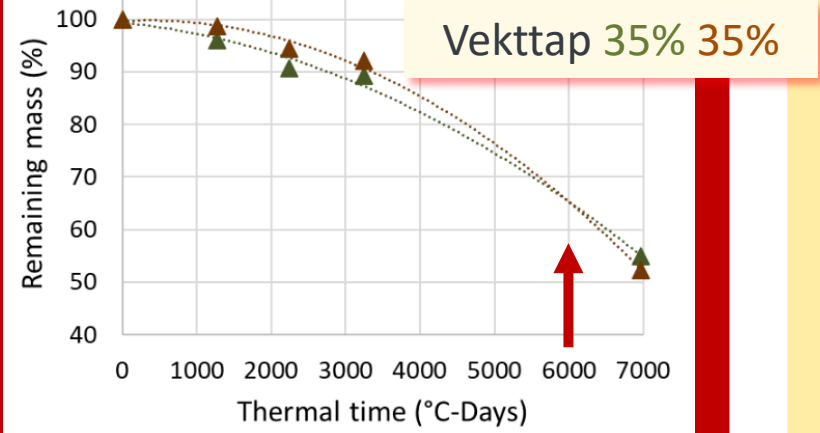
▲ Bioagri 10 cm

▲ BI-OPL (Norgro) 10 cm

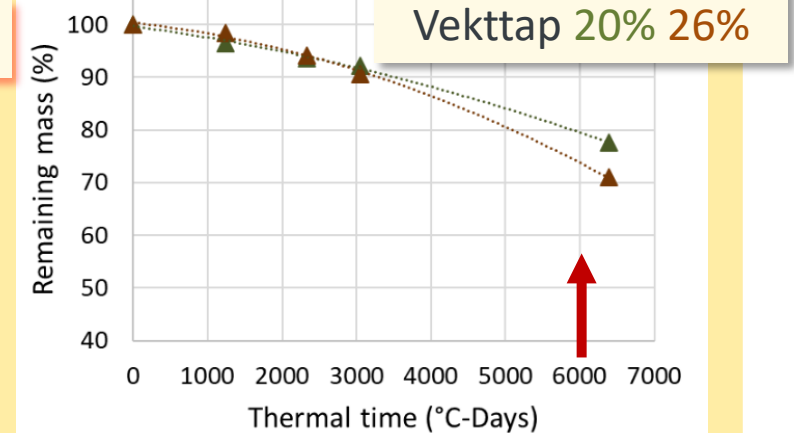
Viken 1



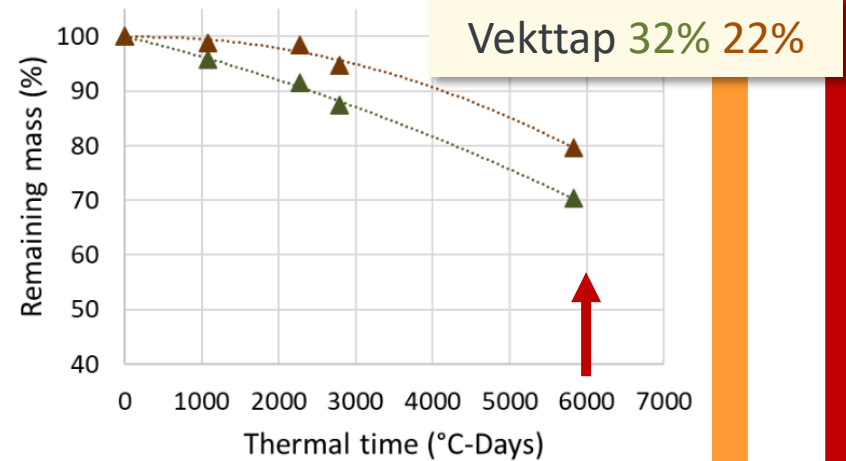
Rogaland 1



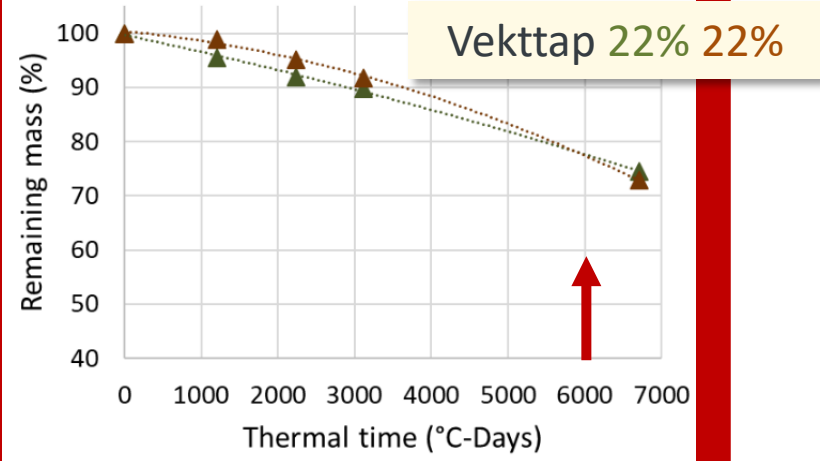
Agder 1



Viken 2



Rogaland 2



Moldfattig jord (0-2,9 %)

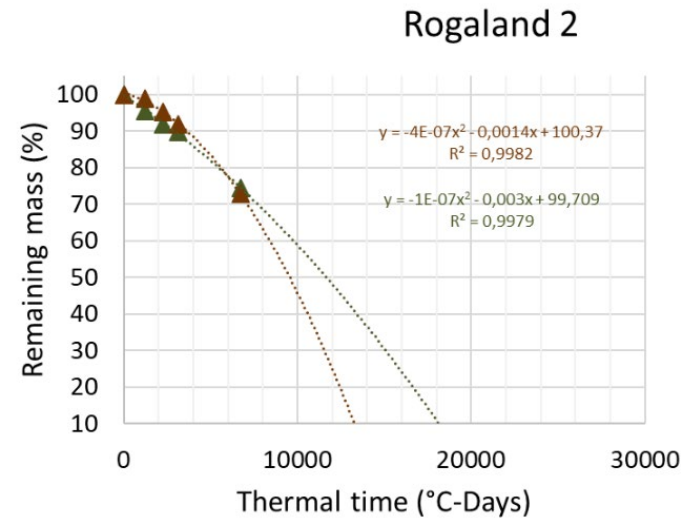
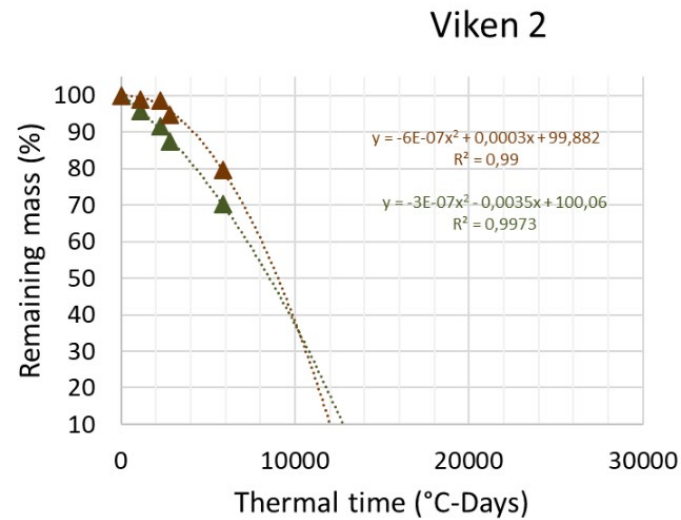
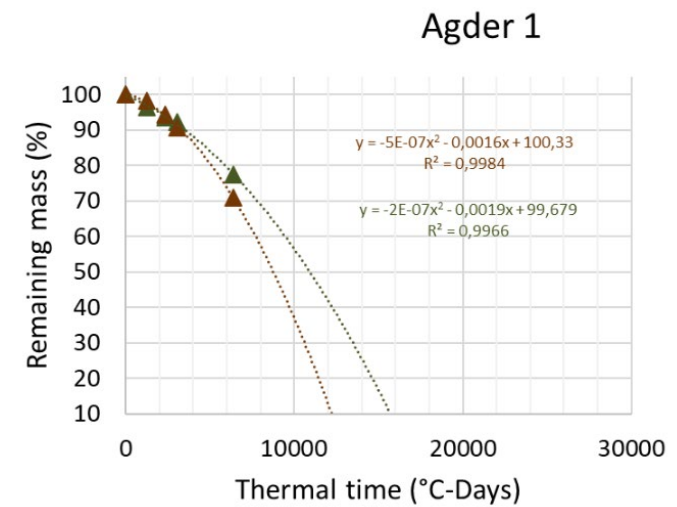
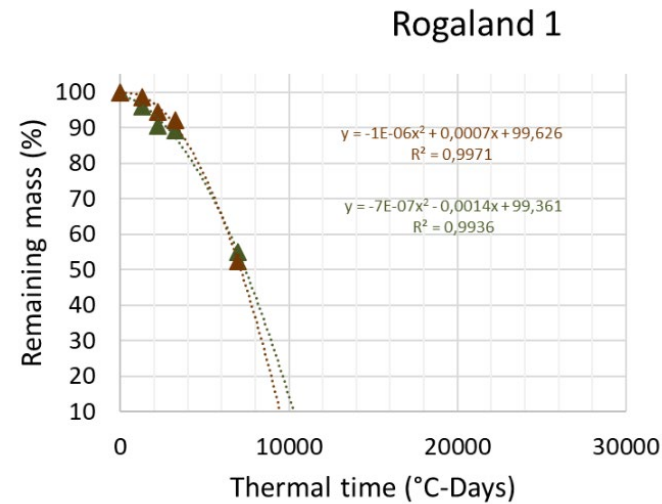
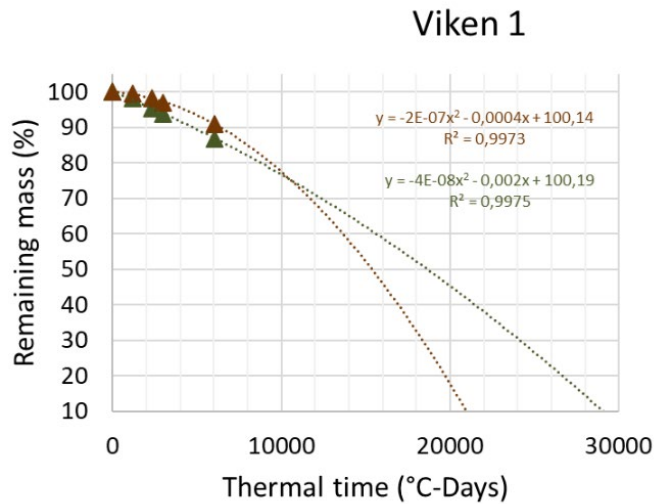
Moldholdig jord (3-4,4 %)

Moldholdig jord (4,5-12,4 %)

Nedbør, næringsstoffer, andre landbrukspraksis (inkl. gjødsling)

90% nedbrytning om (mindre) enn...

▲ Bioagri 10 cm ▲ BI-OPL (Norgro) 10 cm



	Døgngader/år	BI-OPL	BIOAGRI
Viken 1	3089	6,8 år	9,4 år
Viken 2	2910	4,1 år	4,5 år
Rogaland 1	3644	2,5 år	2,7 år
Rogaland 2	3368	3,9 år	5,3 år
Agder 1	3300	3,6 år	4,8 år

Worst-case scenario



Nedbrytning i jord

Fullstendig nedbrytning kan ta 3-9 år i norsk jord

Utlekking av tilsetningsstoffer i jord?

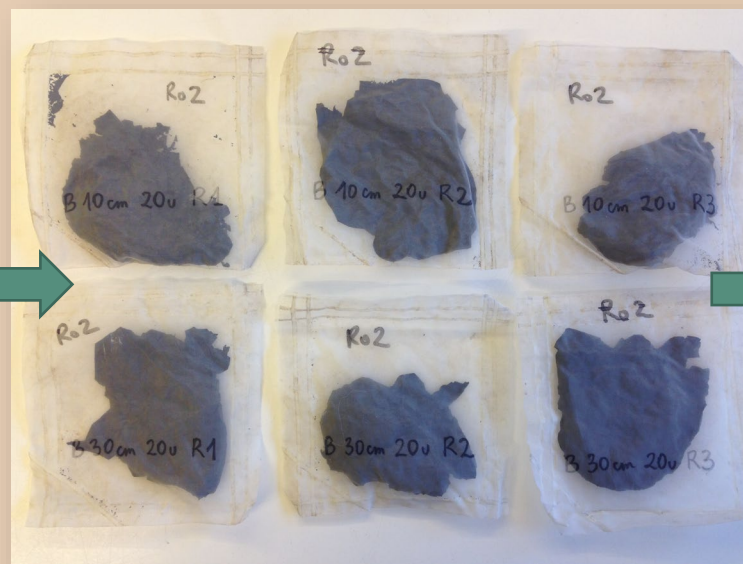
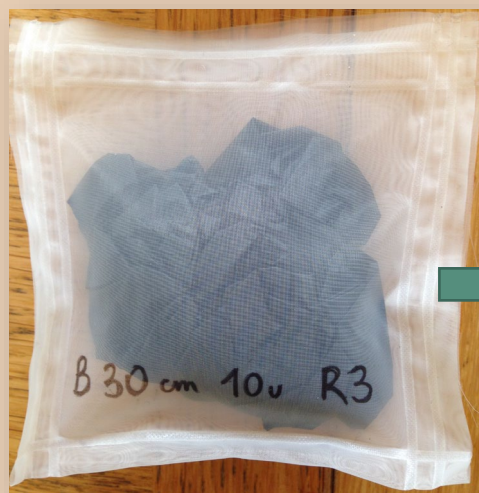
Folien er merket som komposterbar, men den blir nok ikke samlet og kompostert, eller?

Store variasjoner fra gård til gård

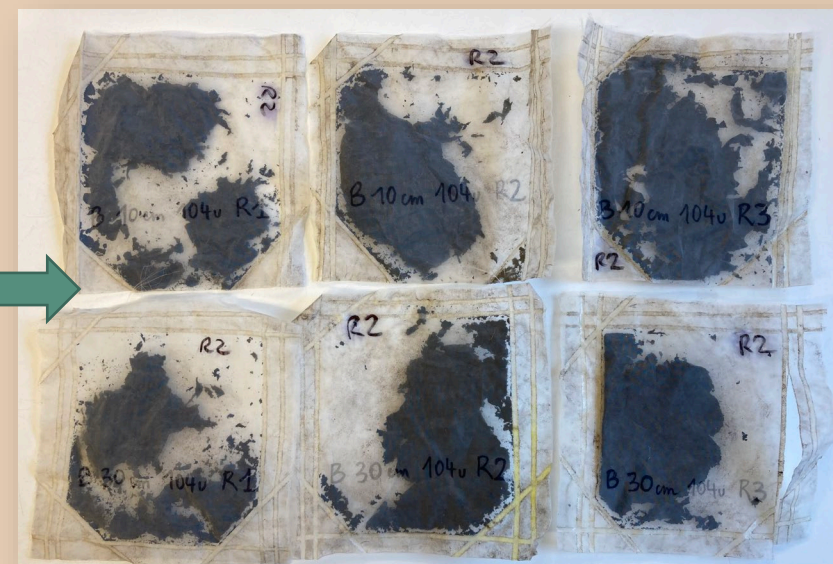
Raskere nedbrytning av plast med

Høy jordtemperatur

Høyt moldinnhold



Etter 5 mnd i jord



Etter 2 år i jord

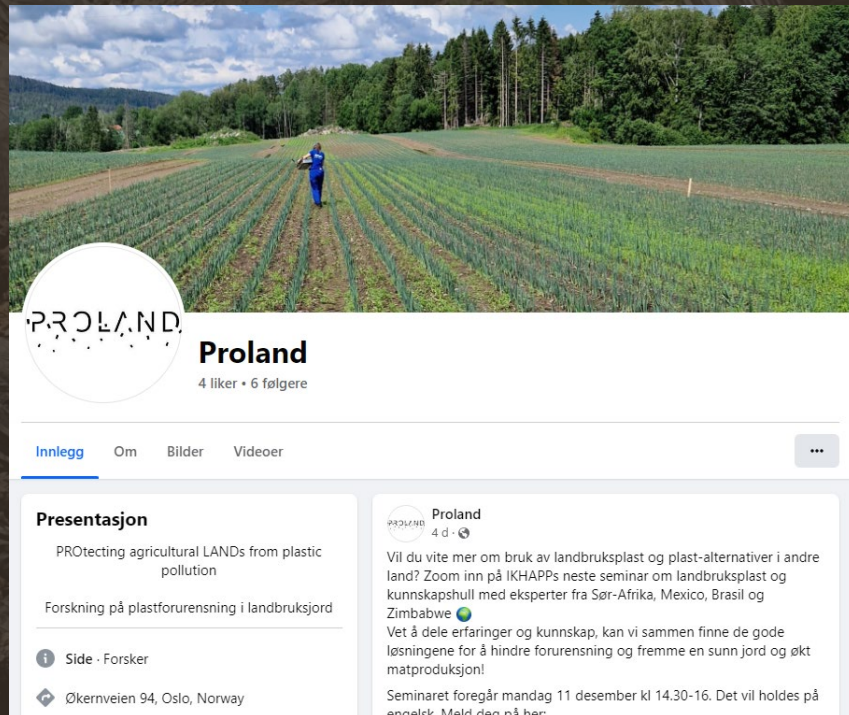


NIBIO

NORSK INSTITUTT FOR
BIOØKONOMI

Bionedbrytbar landbruksfolie kan være en del av løsningen mot plastforsøpling, hvis

- Den gis nok tid og gode forhold for fullstendig nedbrytning
- Inneholder kun bionedbrytbare og ufarlige tilsetningsstoffer (mer åpenhet fra plastprodusenter)
- Folien pløyes ned rett etter dyrkingssesongen (unngå plast på avveie)



Tusen takk for deres oppmerksomhet!

Tusen takk til alle samarbeidspartnere og forsøksvertene i DGRADE prosjektet

Tusen takk til Norges Forskningsrådet (303560) og Handelens miljøfond