

Effect of green manure management on barley yields and nitrogen recovery

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Green manure

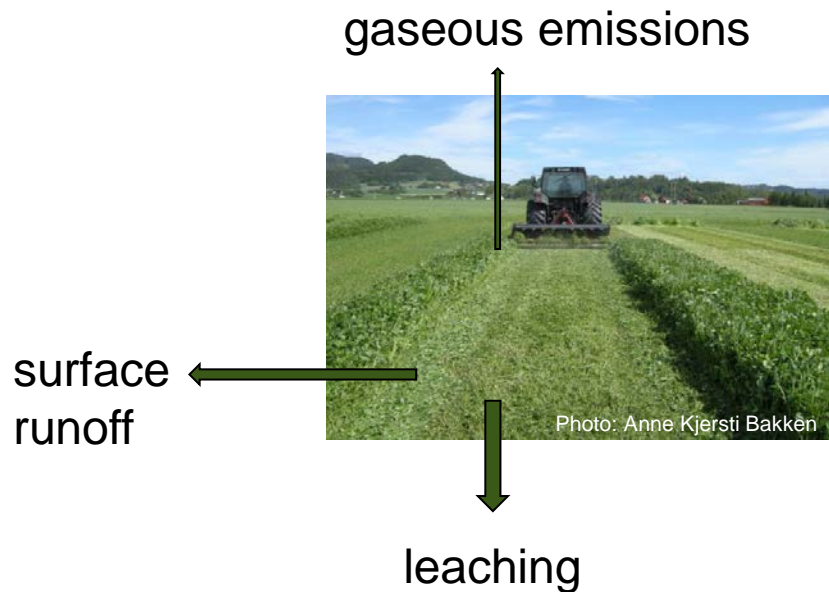
- Stockless farming systems
- Often grass-clover ley
 - Mown repeatedly
 - Chopped and mulched on the stubble



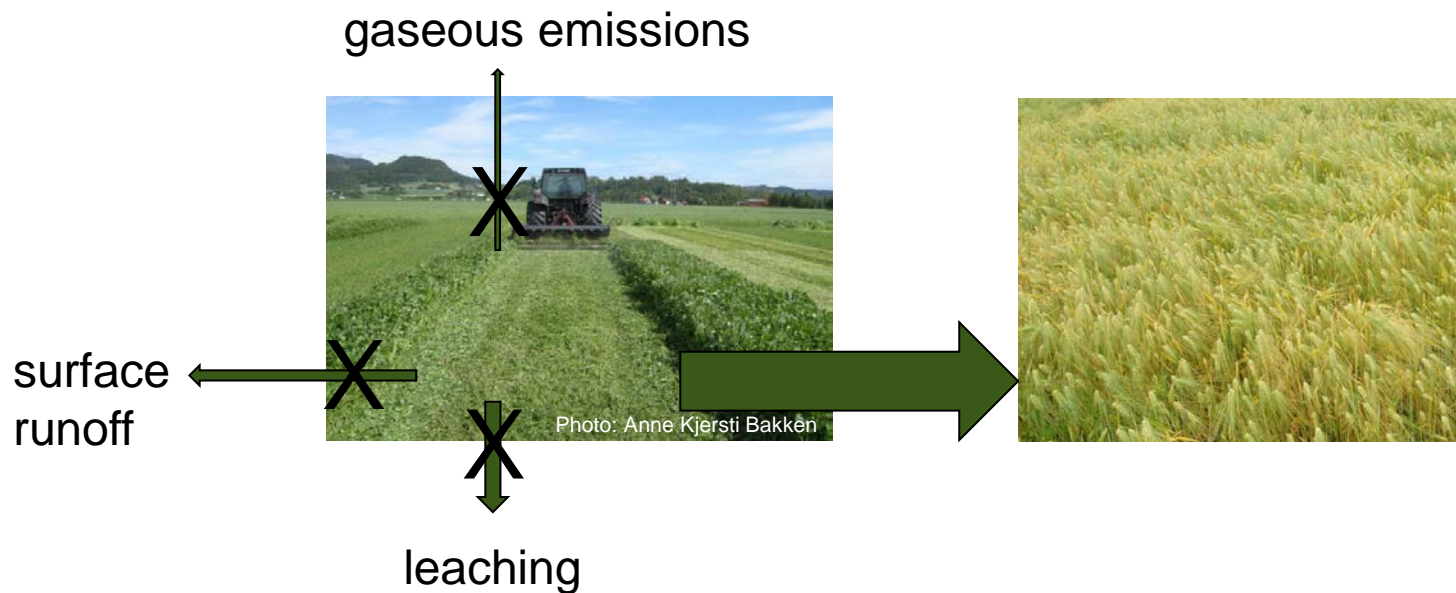
Regulation of economic interest for farmers:

- No harvesting or grazing

Nitrogen in green manure herbage is at risk of being lost from the cropping system



Nitrogen in green manure herbage is at risk of being lost from the cropping system



Key question !

How to best handle the green manure herbage to improve soil fertility, increase the total food production and minimize pollution risk?





Hypotheses

Removing herbage, compared with mulching, will not reduce the yield of a subsequent spring barley crop.

Biogas digestate produced from the removed herbage will increase the crop yield and the N recovery

Green manure management compared at 4 sites 2008-2011

2008	2009	2010	
Barley + green manure undersown	3 mulched	Barley	
	Green manure ley 2 removed, 3rd mulched		Digestate (110 kg N/ha)
	3 cuts - herbage 3 removed		
	3 removed		



Photo: Anne Kjersti Bakken

Værnes, Sandy loam: Barley 26. juli 2010

Cereals + 110 kg N
in digestate in
spring



Cereals + 80 kg
inorganic N in
spring

Green manure
herbage removed +
110 kg N in
digestate in spring

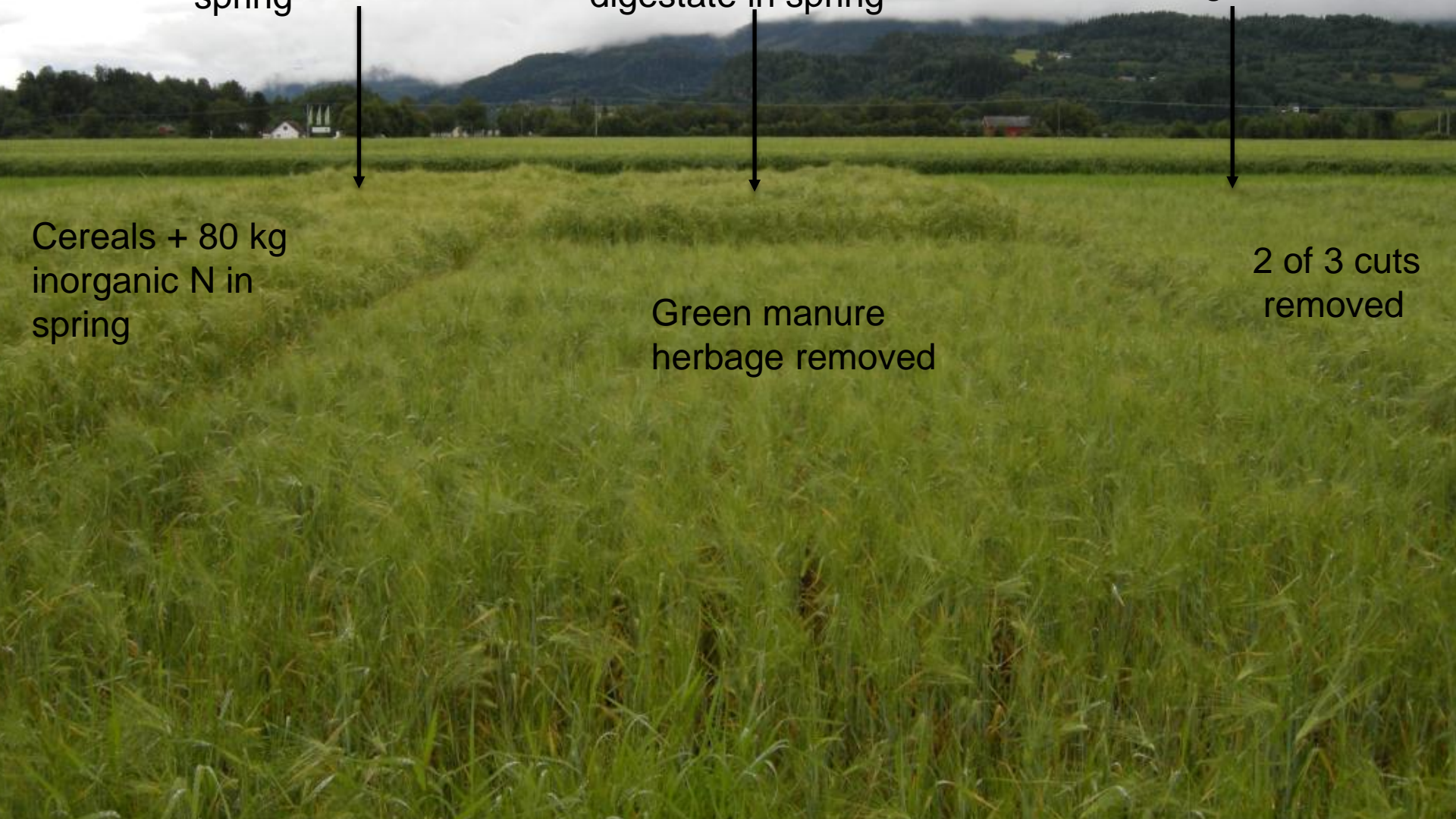


Green manure
herbage removed

Green manure
herbage removed



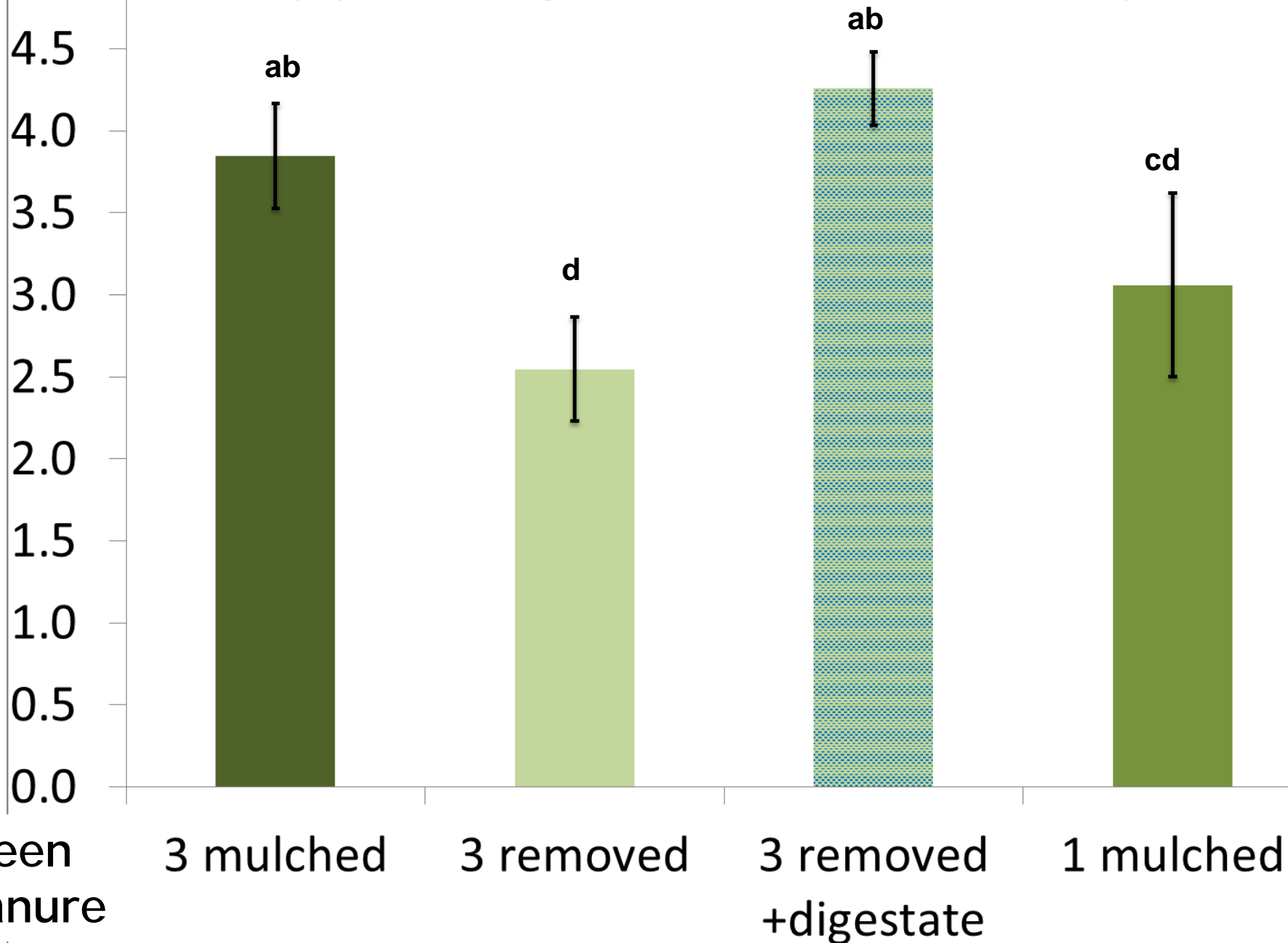
2 of 3 cuts
removed



Værnes, Sandy loam: Barley shortly before harvest



Barley yields Mg /ha (15% water) sandy loam



Apparent nitrogen recovery:



% of N added with green manure retrieved in barley (grain and straw)

The green manure is either mulched or applied in digestate

Sites	3 cuts mulched	3 cuts removed – digestate added in spring
Kvithamar, silty clay	4	10
Værnes, sandy soil	9	16
Apelsvoll, loam soil	10	24
Ås, clay soil	2	15

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1. Results - removal vs. mulching green manure

- Removing herbage reduced the barley yields following year with 23-33% on the sandy loam soils, but less on the clay soils.
- Nitrogen in the mulched or harvested green manure amounted to 200 kg/ha.
- Removal was not compensated for by increased clover growth and biological N-fixation in the green manure ley.



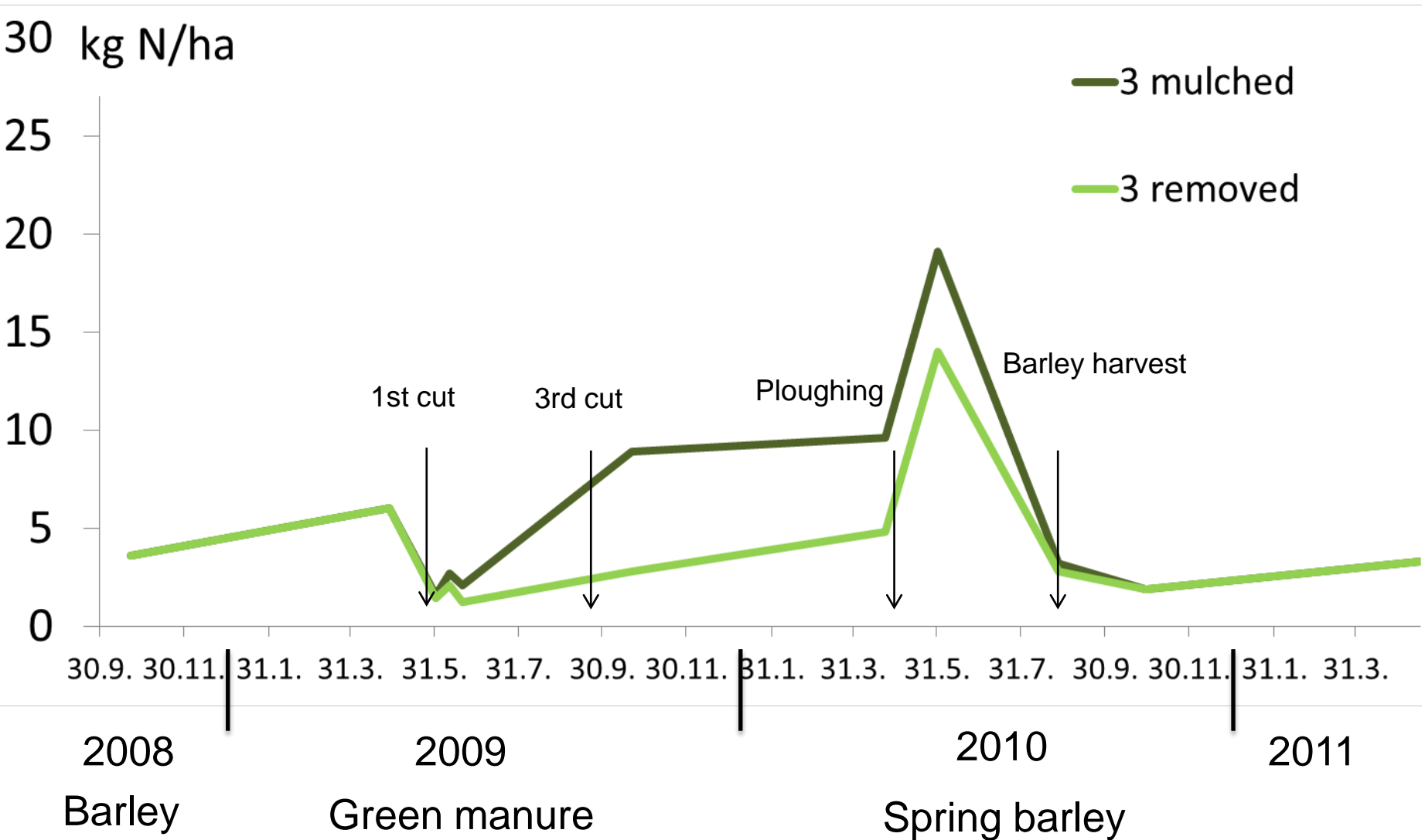


Digestate in spring vs. Mulching green manure

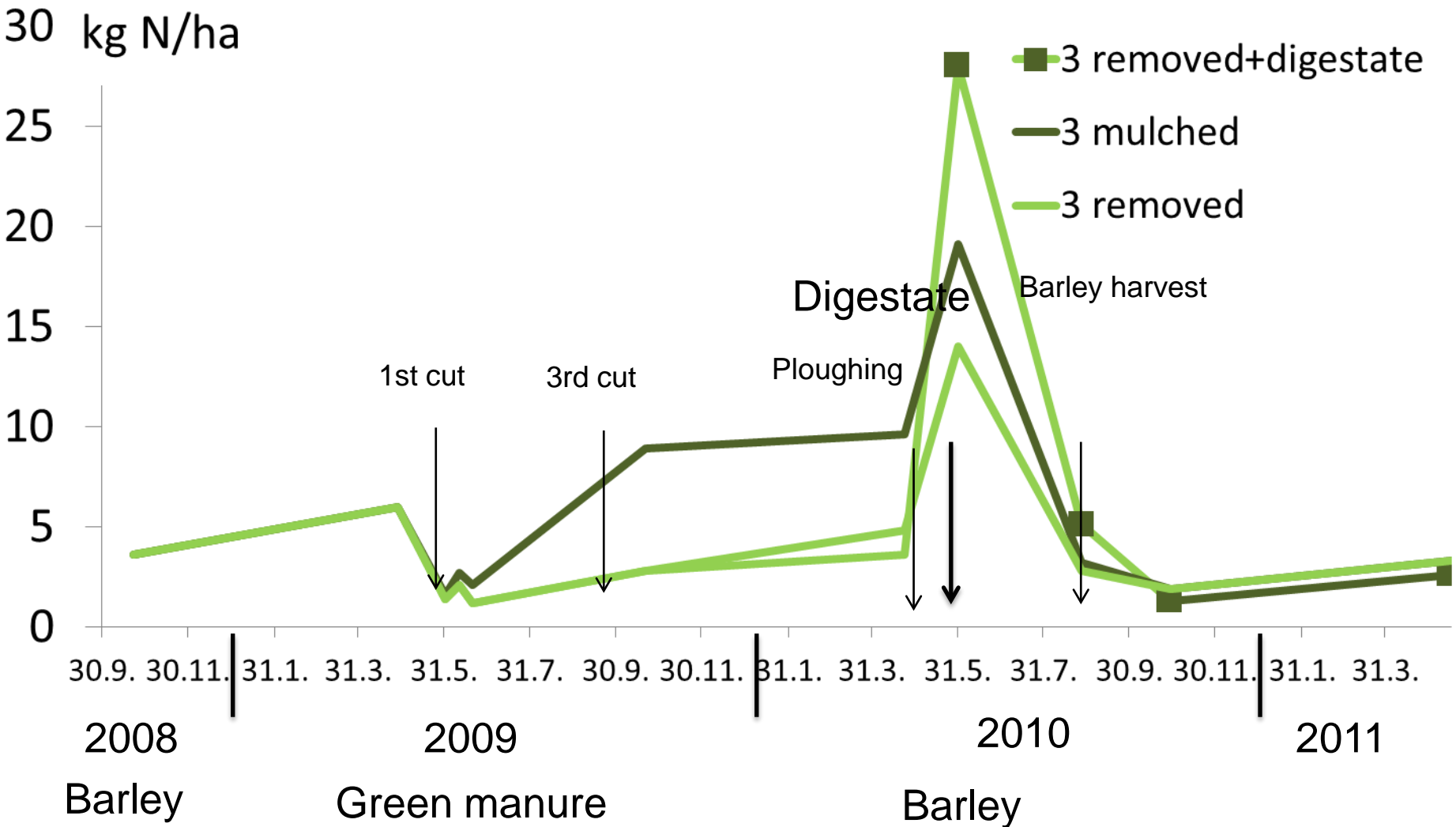
Summary of 4 sites

- Barley yields equally well as with mulched green manure
- Enhanced N recovery from 2-10% to 10-24%
- Surplus digestate makes it possible to fertilize other fields as well

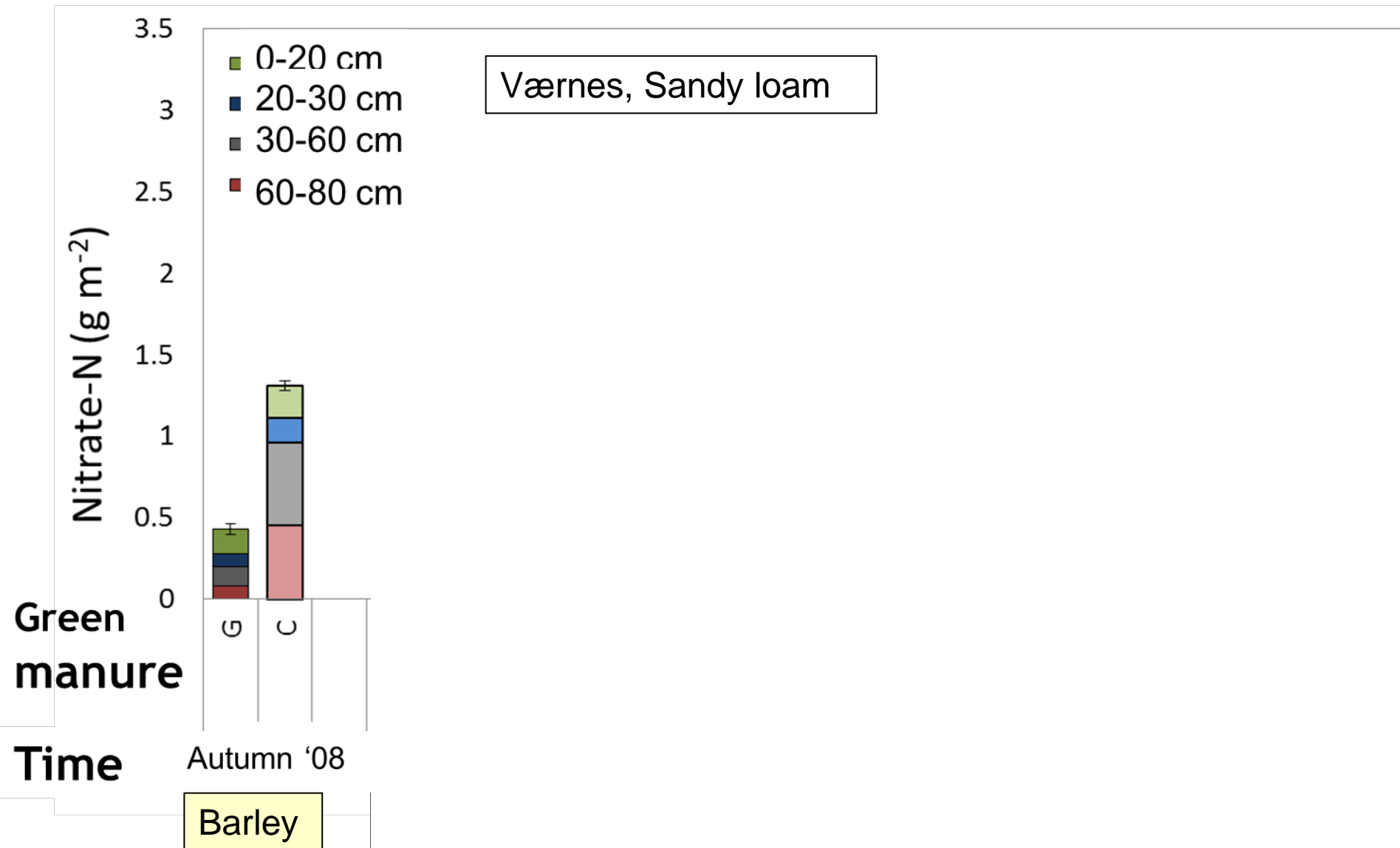
Soil mineral-N 0-20 cm depth with different treatment of green manure at Værnes (sandy loam)



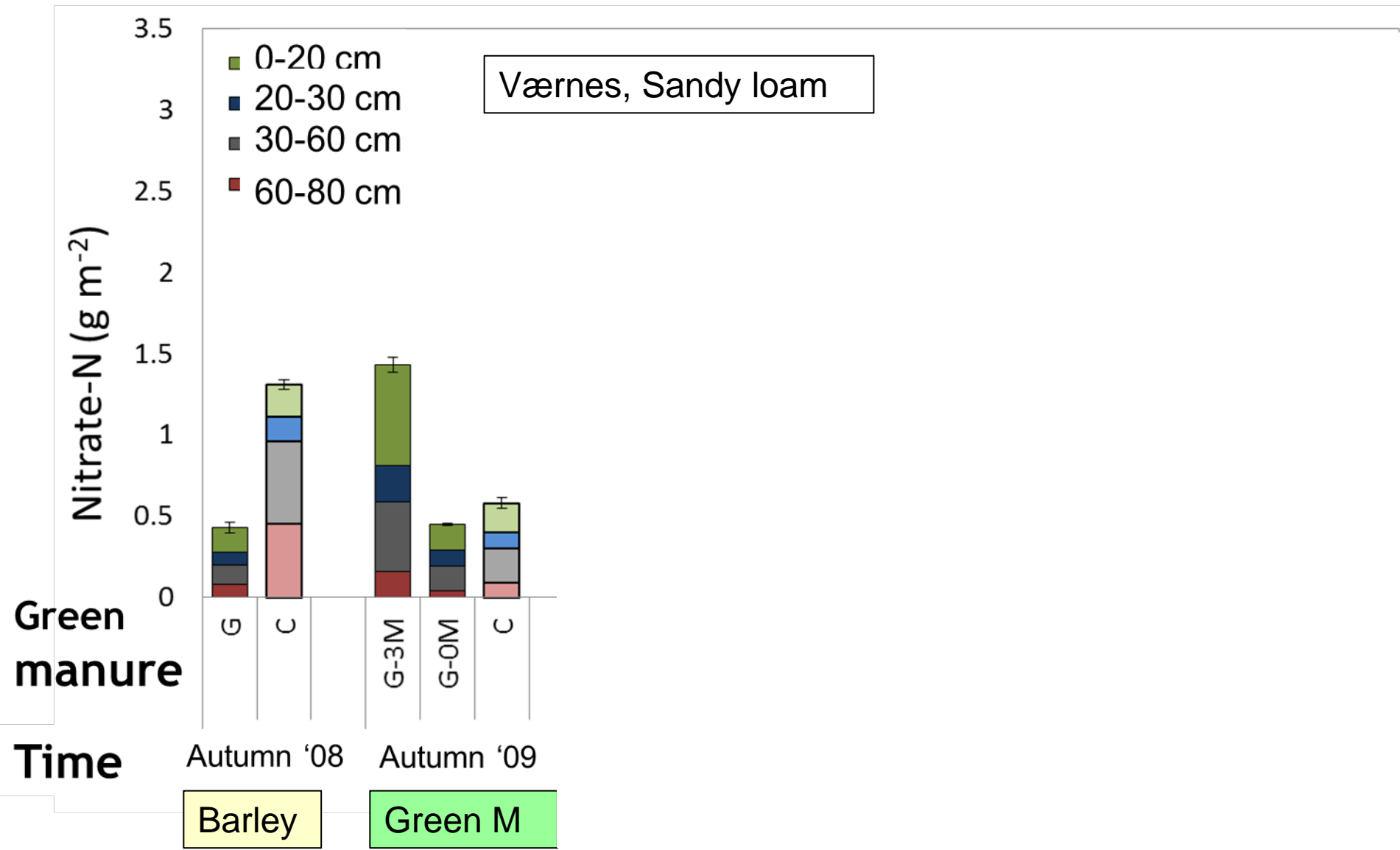
Soil mineral-N 0-20 cm depth with different treatment of green manure at Værnes (sandy loam)



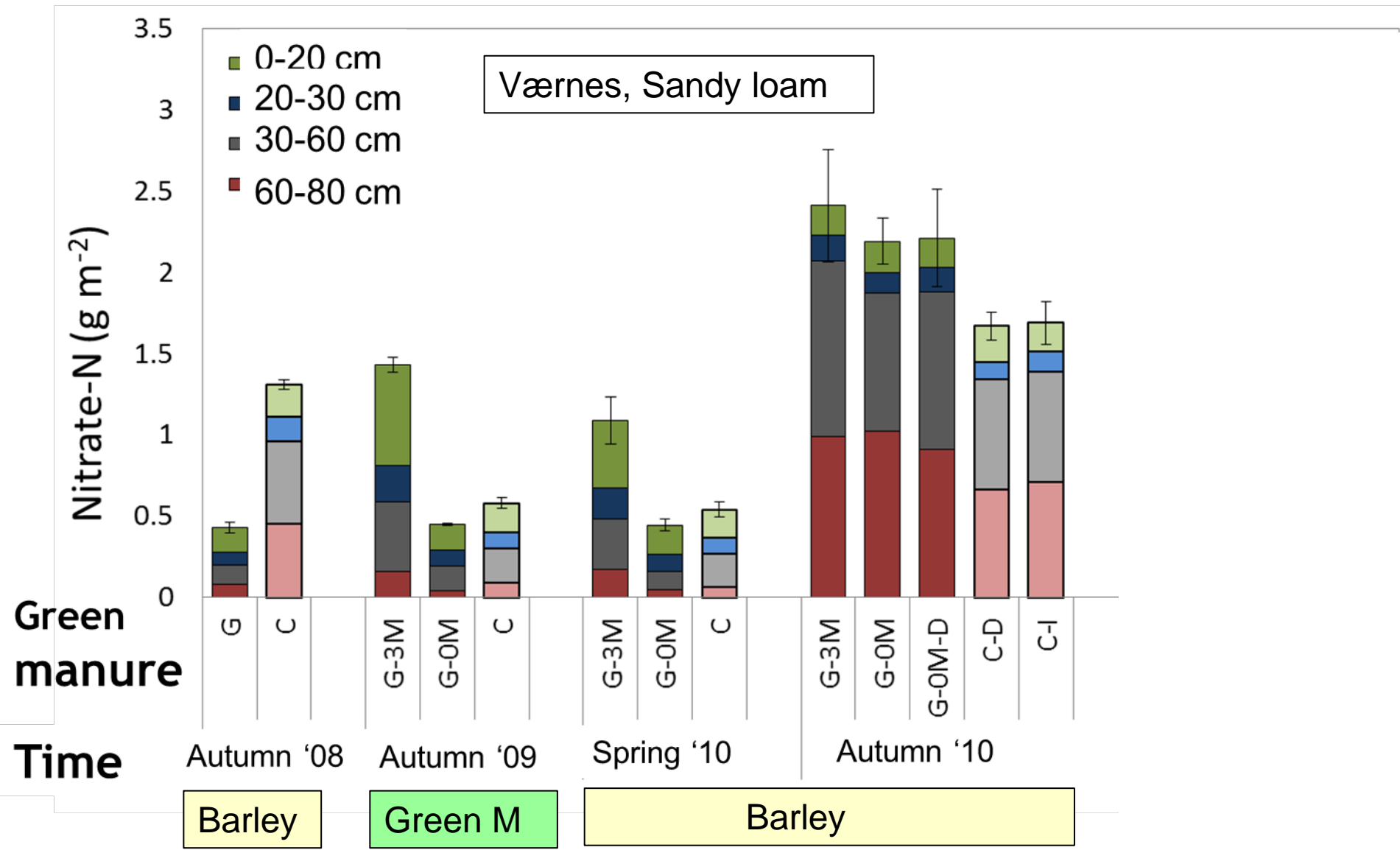
No high level of inorganic N in soil caused by mulching



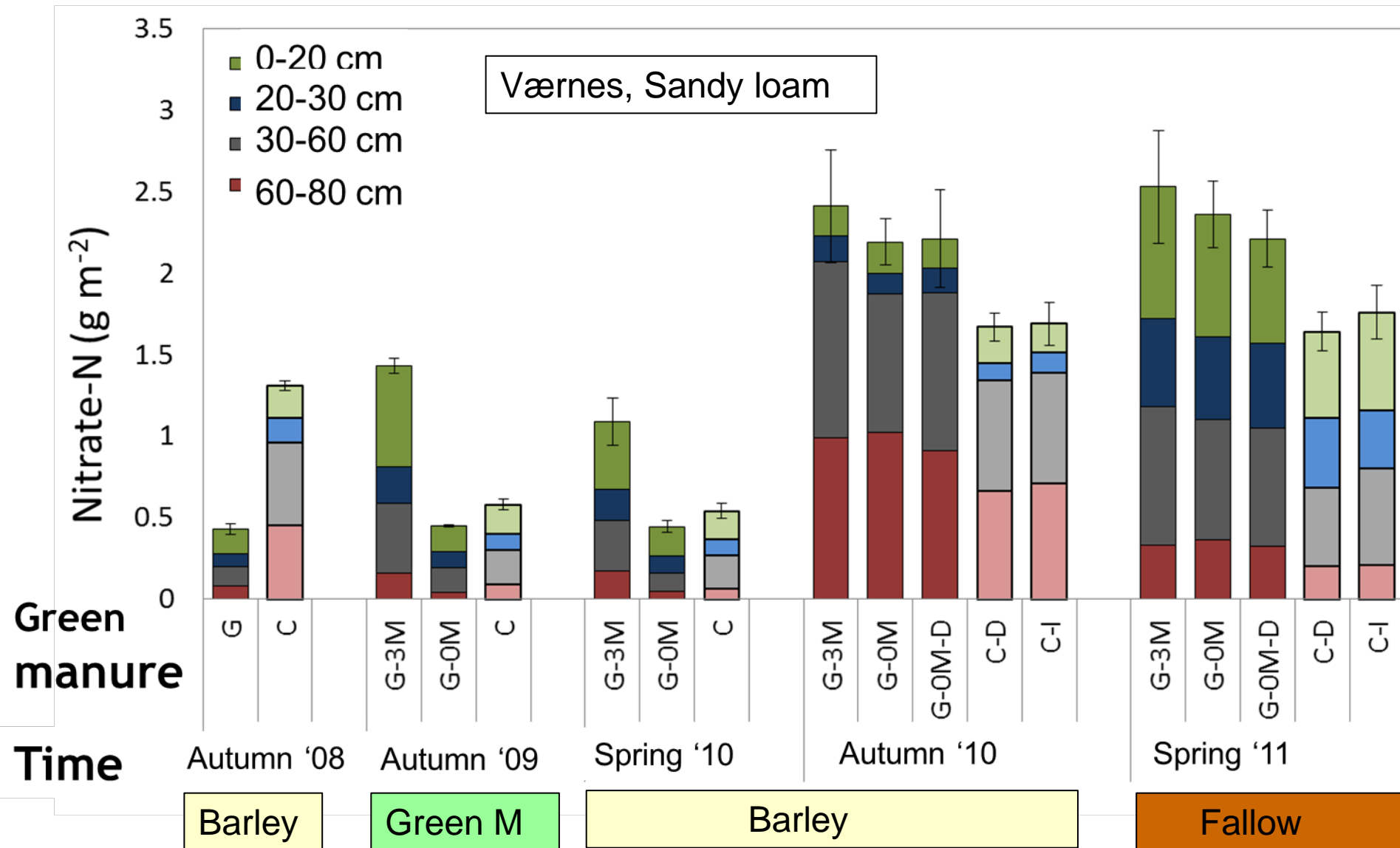
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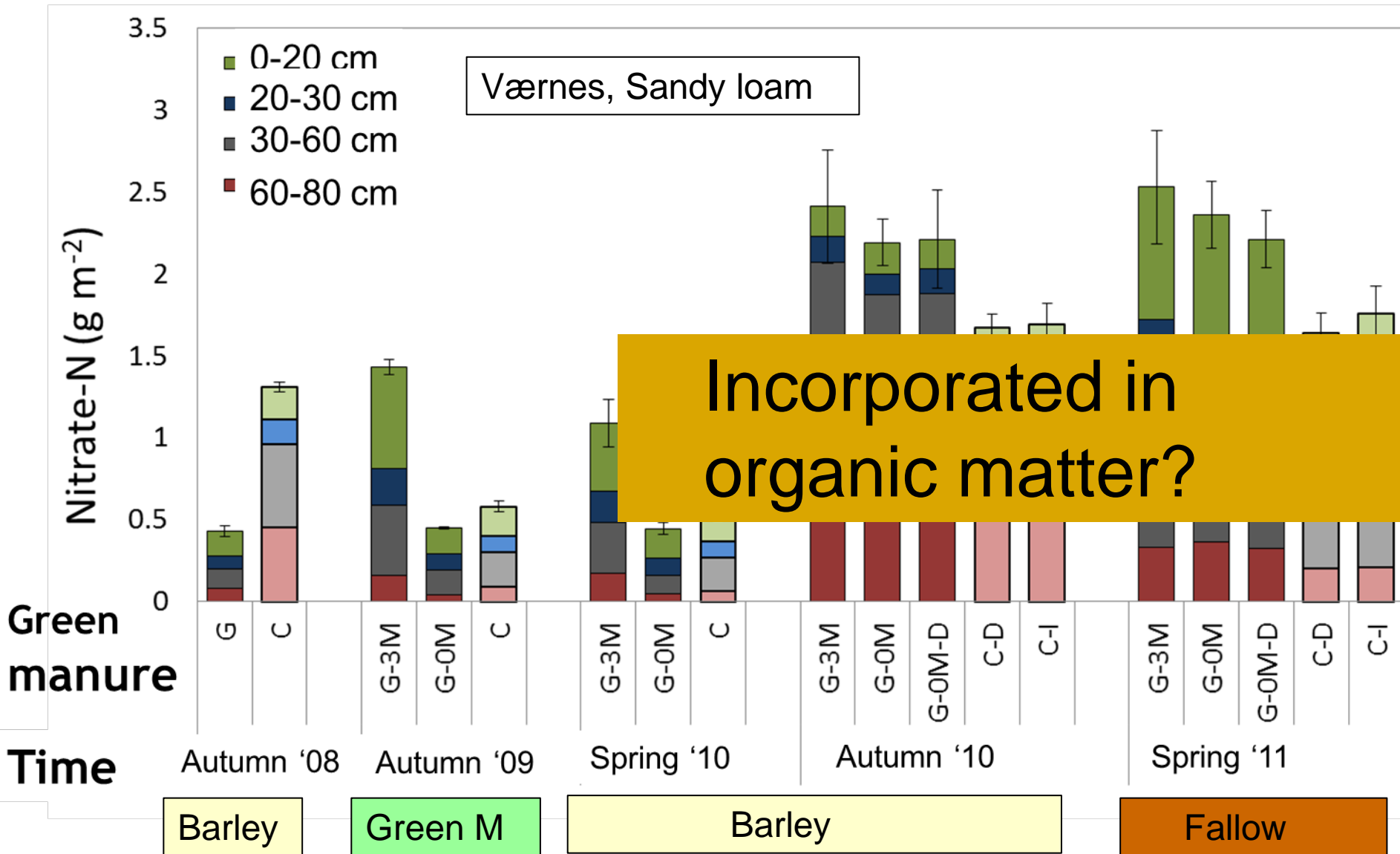
No high level of inorganic N in soil caused by mulching



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No high level of inorganic N in soil caused by mulching



Implications

When spring barley follows green manure ley from which the herbage has been removed, nitrogen deficiency is highly probable unless the soil is very fertile.



Implications

If the final cut is mulched (and previous cuts removed), the risk of nitrogen loss will be reduced compared to mulching all cuts, but the barley yields may also be lower.



Implications

Removing ley herbage from the field involves the possibility for selling it as forage or using it to produce biogas and digestate in a reactor.



Implications

Cooperation with biogas plants with continuous feeding throughout the year, e.g. those based on livestock manure, seems to be the best solution until new technology is developed that is suitable for biogas production from grass-clover herbage supplied at intervals



More to read:

- Frøseth et al. Submitted. *Effects of green manure herbage management and its digestate from biogas production on barley yield, N recovery, soil structure and earthworm populations*. European Journal of Agronomy
- Bioforsk tema vol 8, nr 2, 2013
<http://www.bioforsk.no>

Thank you for your attention

