Nitrogen leaching in an aquatic terrestrial transition zone

ATB
Agrartechnik Bornim

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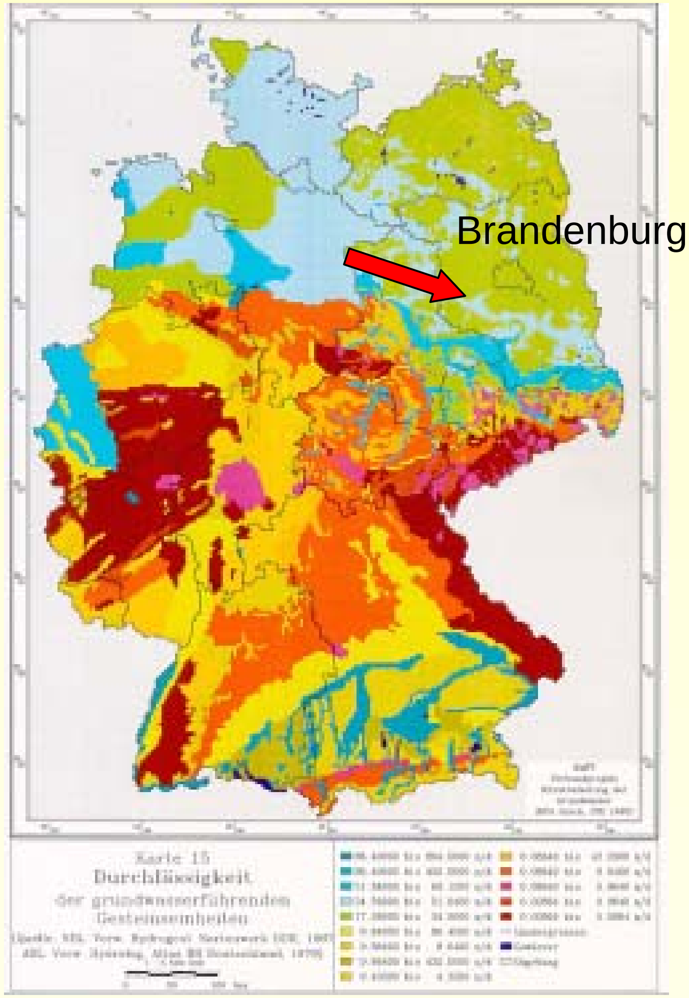
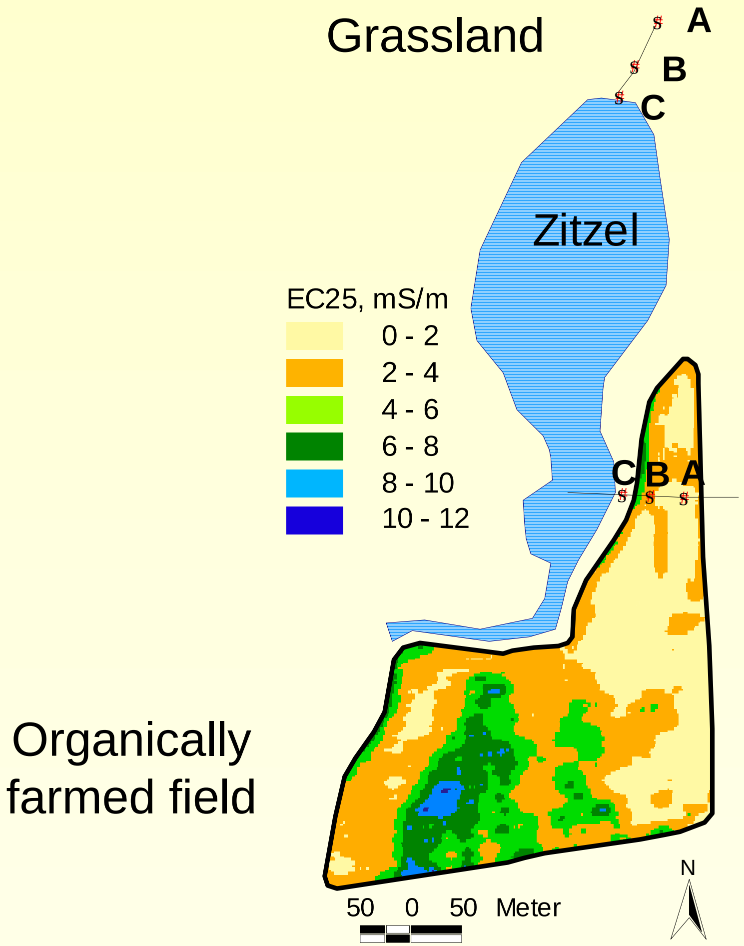
Study area


Brandenburg


Grassland
A
B
C
Zitzel
EC25, mS/m
0 - 2
2 - 4
4 - 6
6 - 8
8 - 10
10 - 12
C B A
Organically
farmed field
N
50 0 50 Meter

Objectives

- Estimating the N translocation along the transect *field – riparian zone – lake*
- Variability of soluble nitrogen
- Variability and limits of denitrification
- Function of the riparian zone as nitrogen buffer
- Assessment of organic farming in terms of N loss

Methods

- Measurement of soluble nitrogen (N_{min}) in soil and lake water after $CaCl_2$ extraction

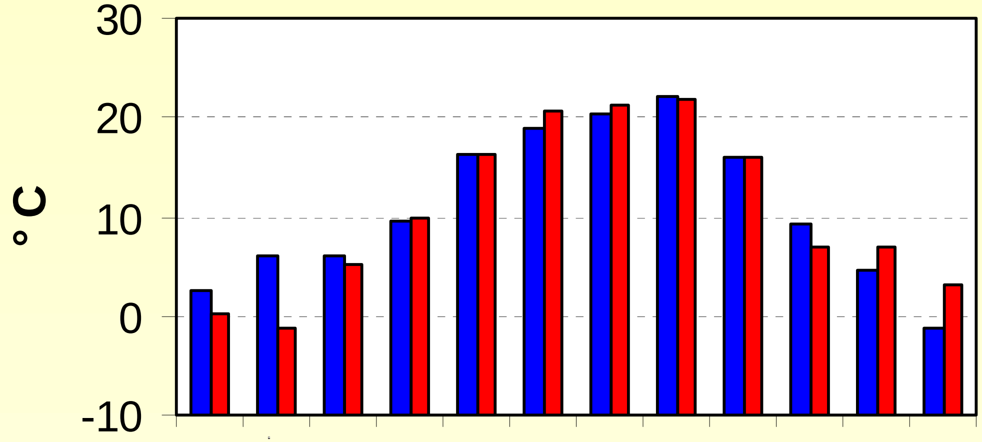
- Measurement of total nitrogen (TN) by dry combustion in an elemental analyser

- Soil incubation in closed chambers (N_2 atmosphere) applying the acetylene inhibition method
  1. Denitrification rate + C_2H_2
  2. Denitrification potential + C_2H_2 + NO_3

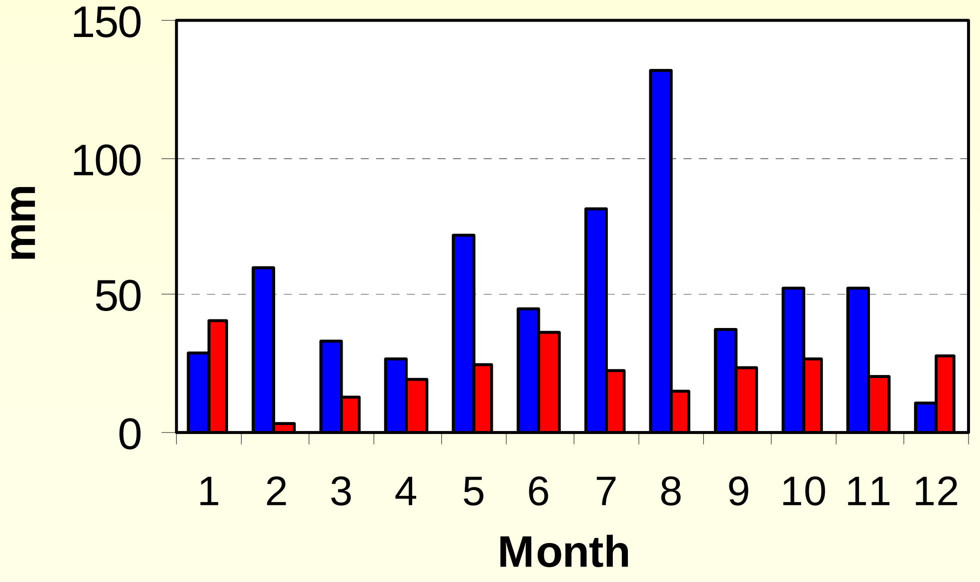
- N balance (plant uptake, N_{min} loss)

Weather

Temperature



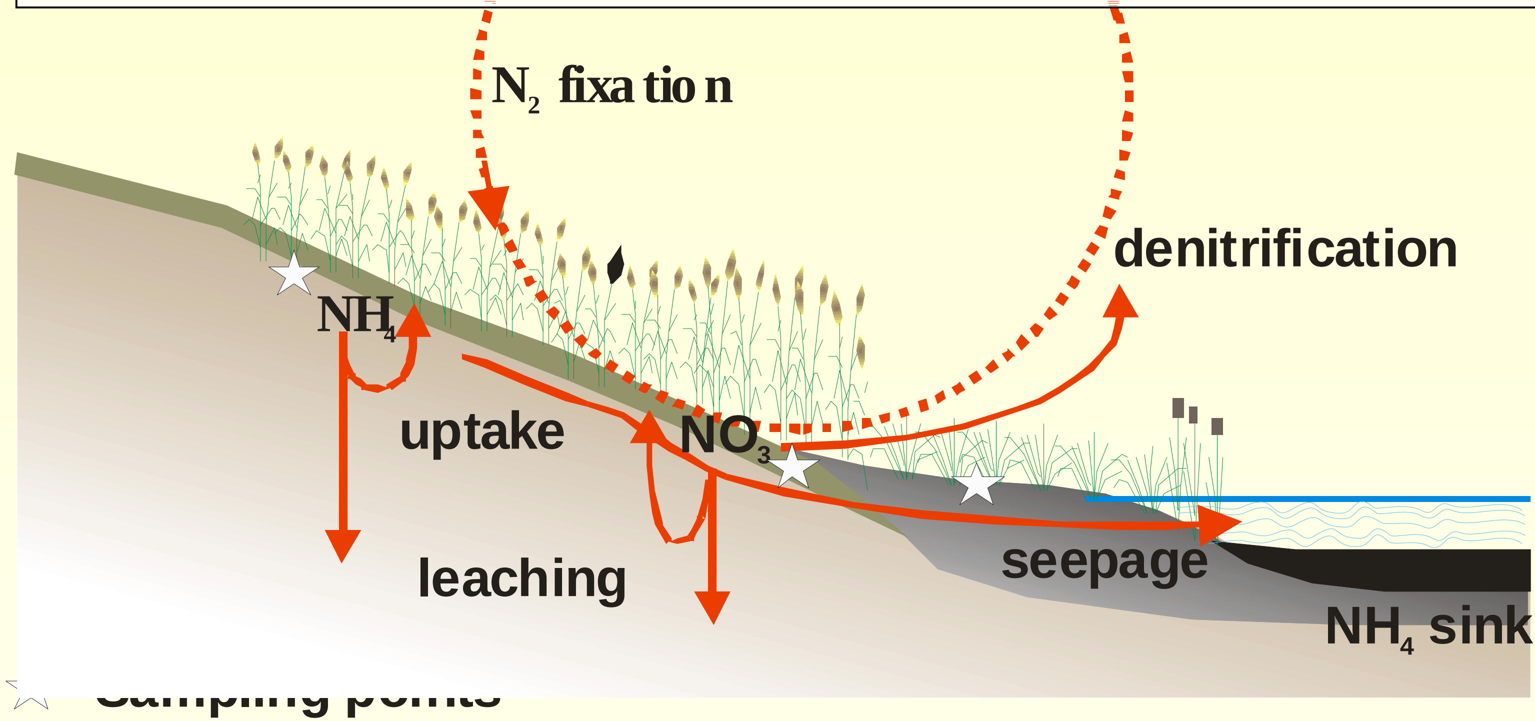
Precipitation



2002 2003

Nitrogen turnover in the transition zone between field and lake

Water content	4.5%	34.6%
Total C	0.4%	7.5%
Total N	0.4‰	2.8‰



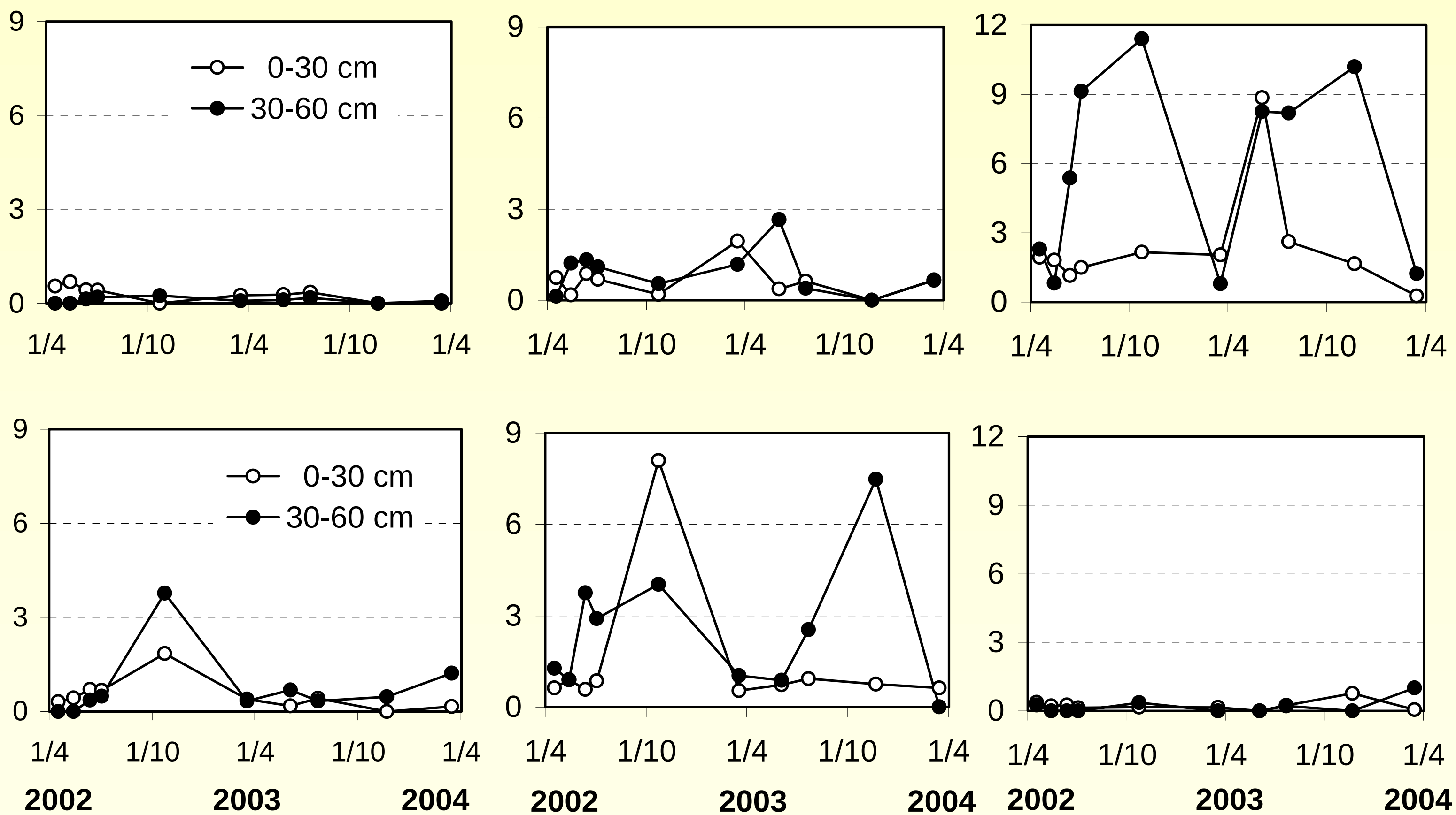
Seasonal variability of soluble nitrogen

April 2002 – March 2004 **7/20**

Site A **B** **C**

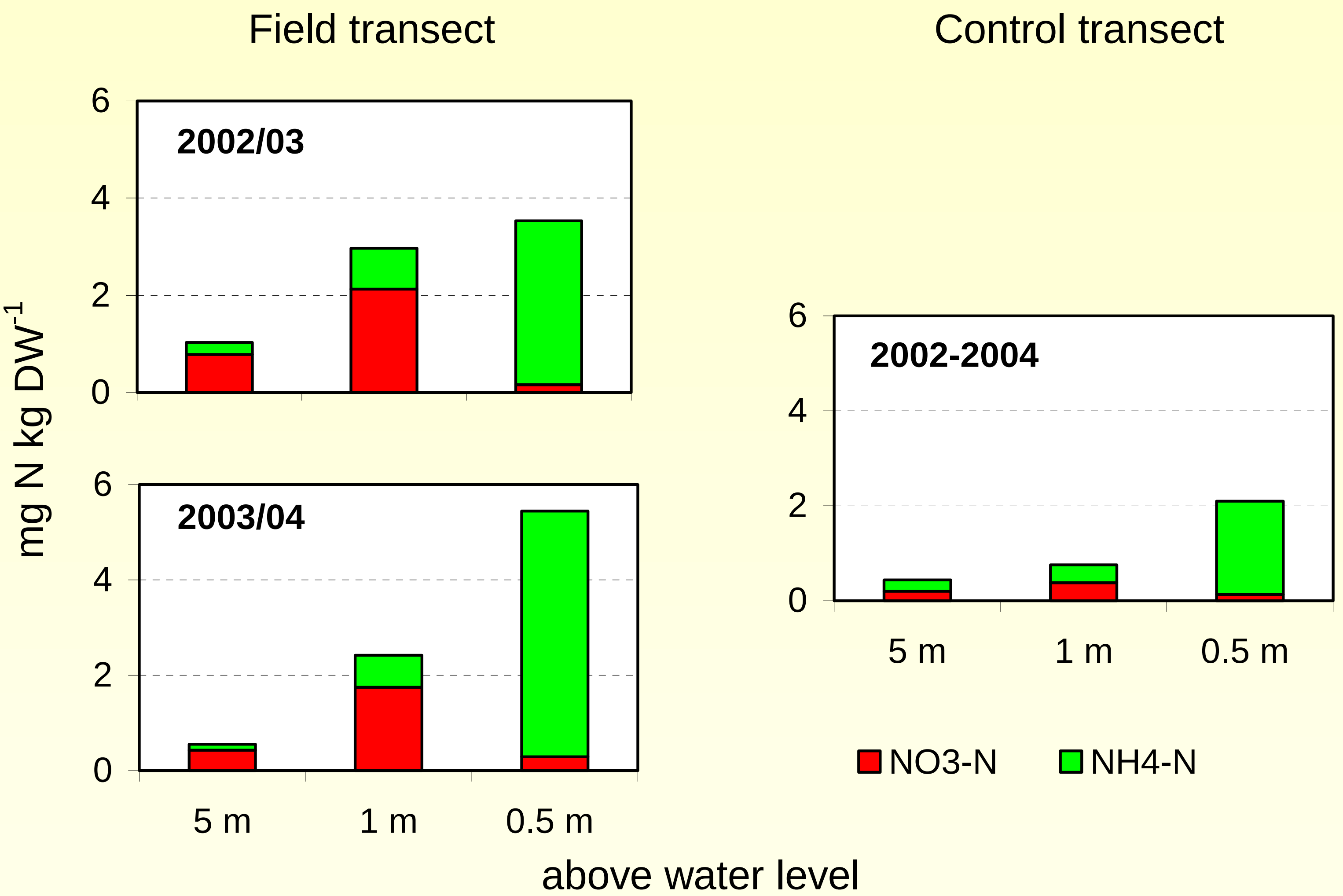
NH_4-N mg kg DW^{-1}

NO_3-N mg kg DW^{-1}



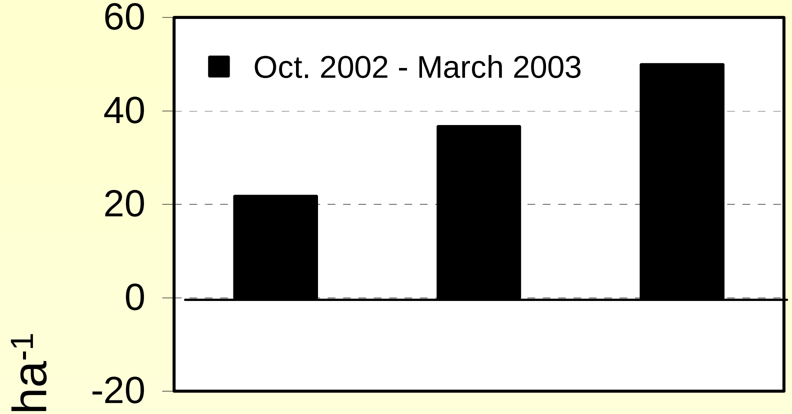
Soluble nitrogen (0-60 cm)

April 2002 – March 2004



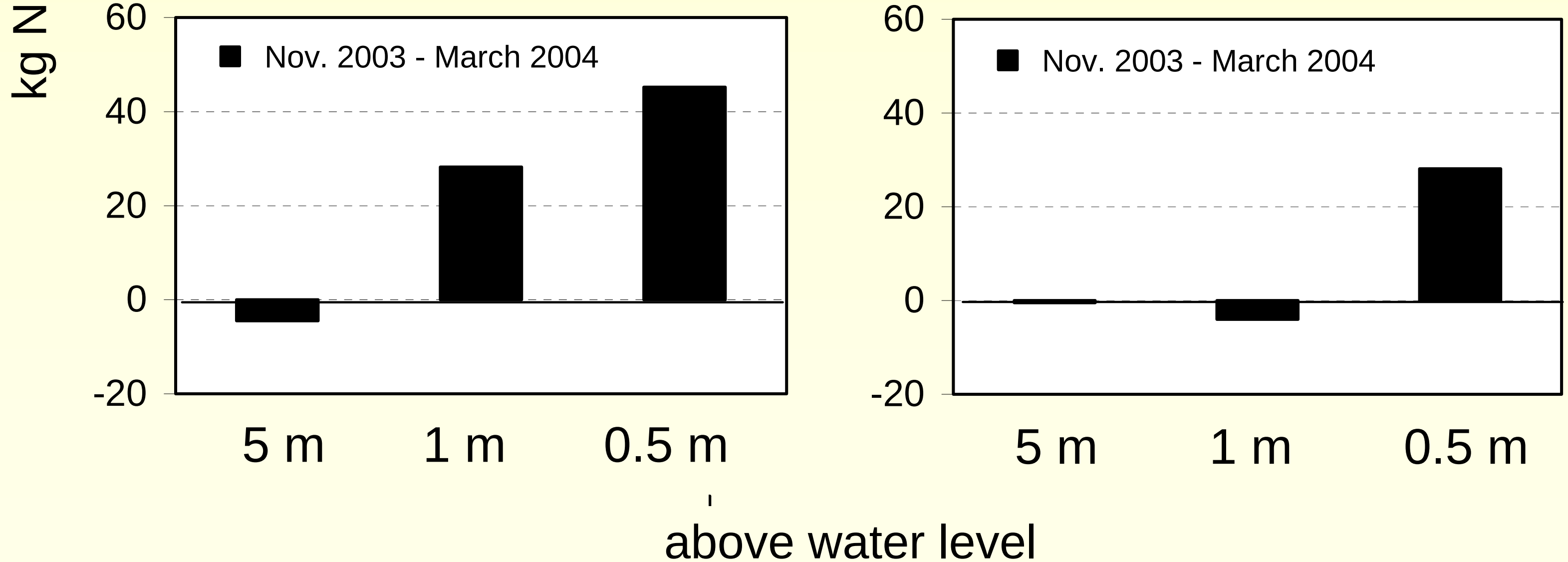
Nitrogen loss during the winter

Field transect

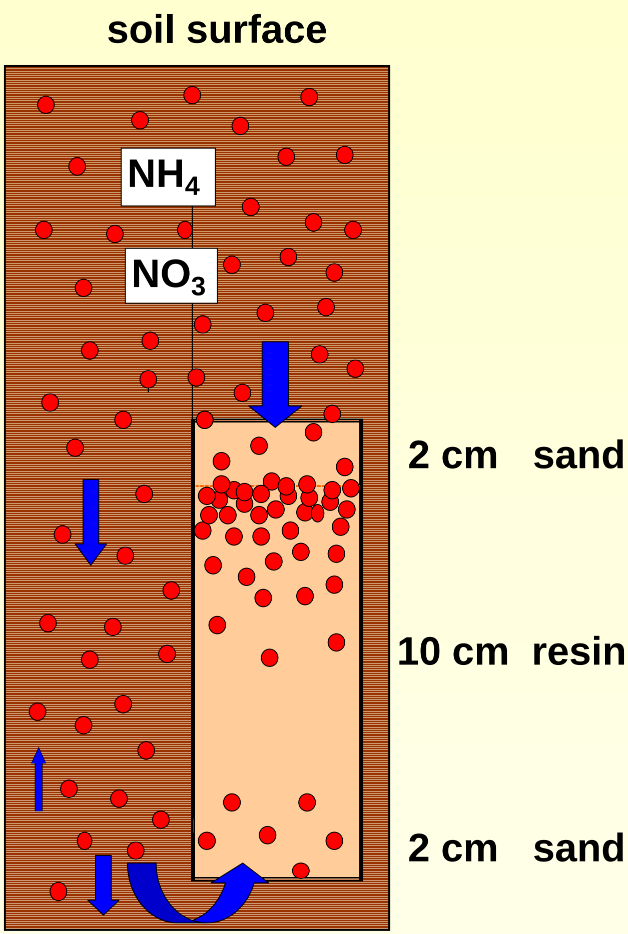


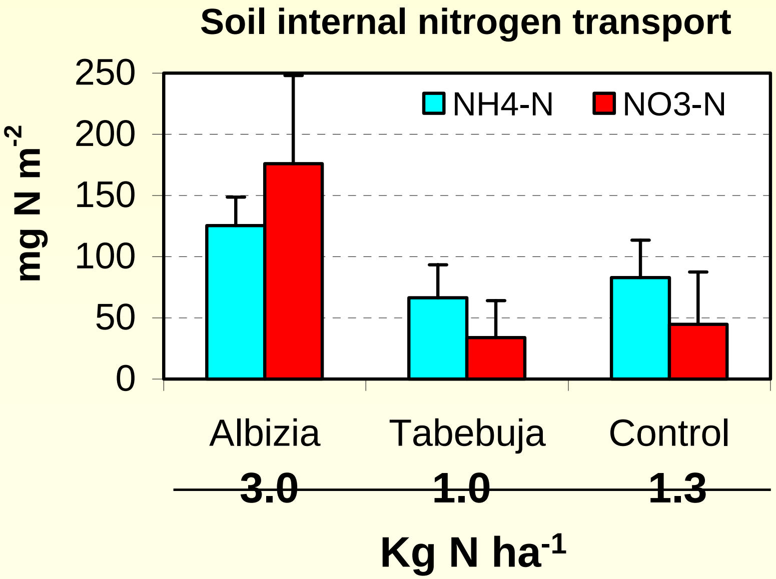
- (plant uptake)
- leaching
- denitrification

Control transect

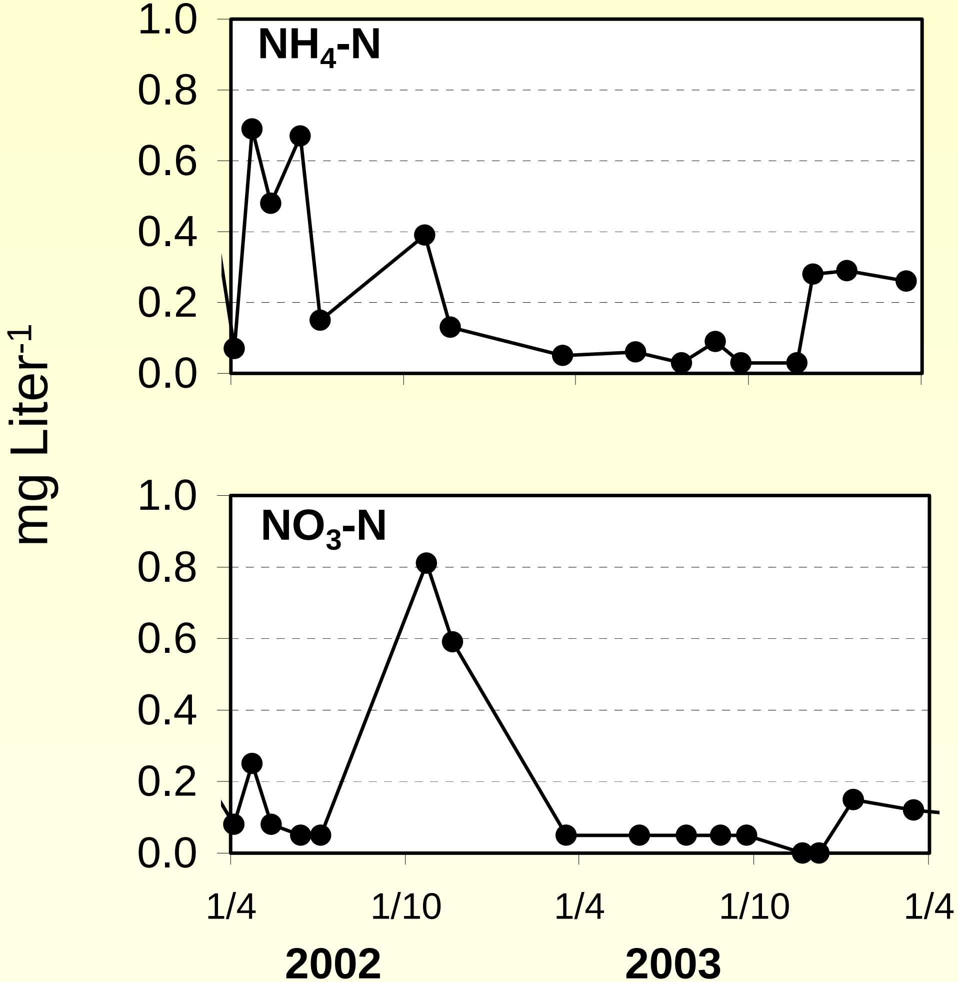


Resin core technique

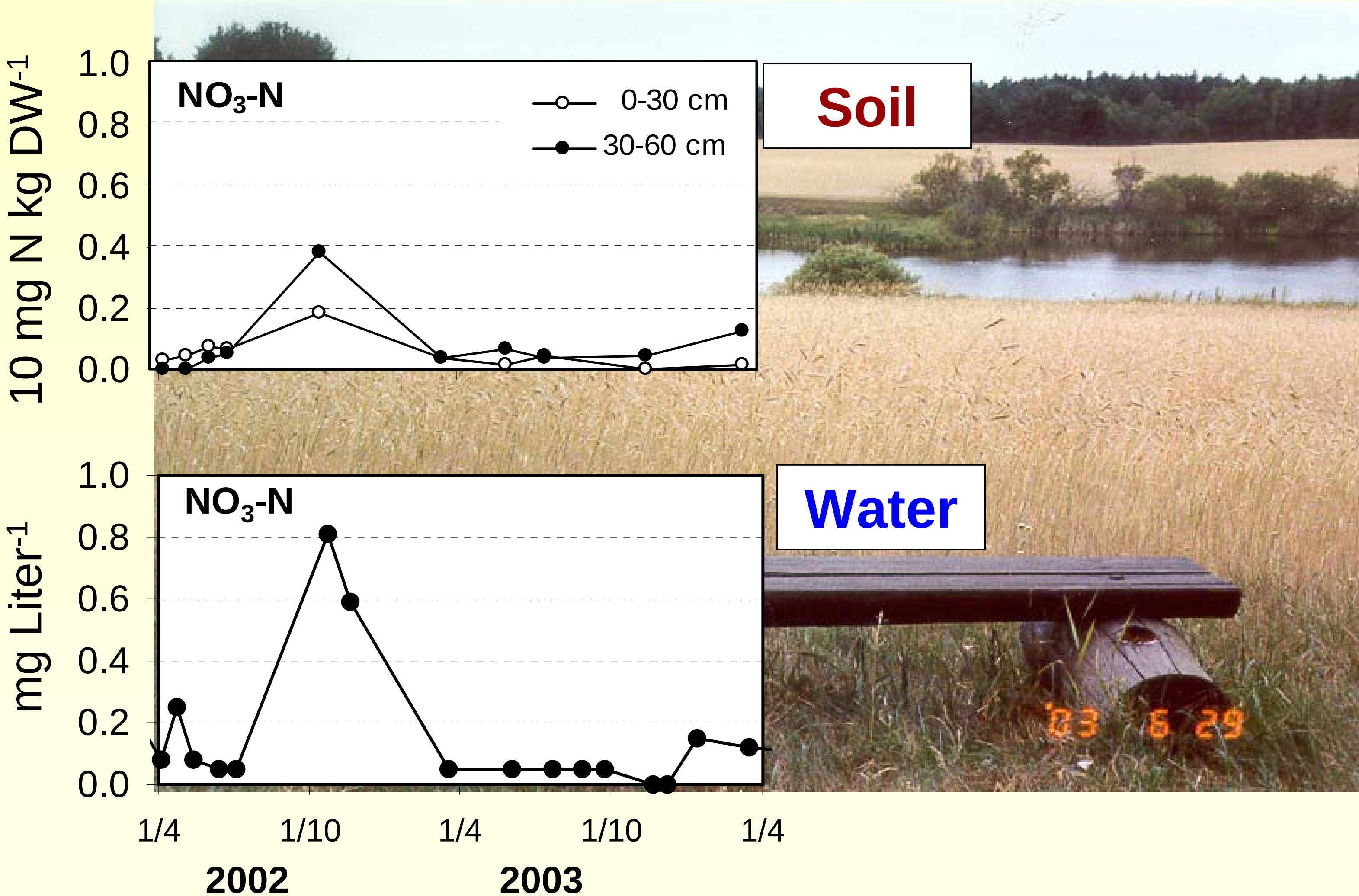




Seasonal variability of N_{min} in the water of Lake Zitzel

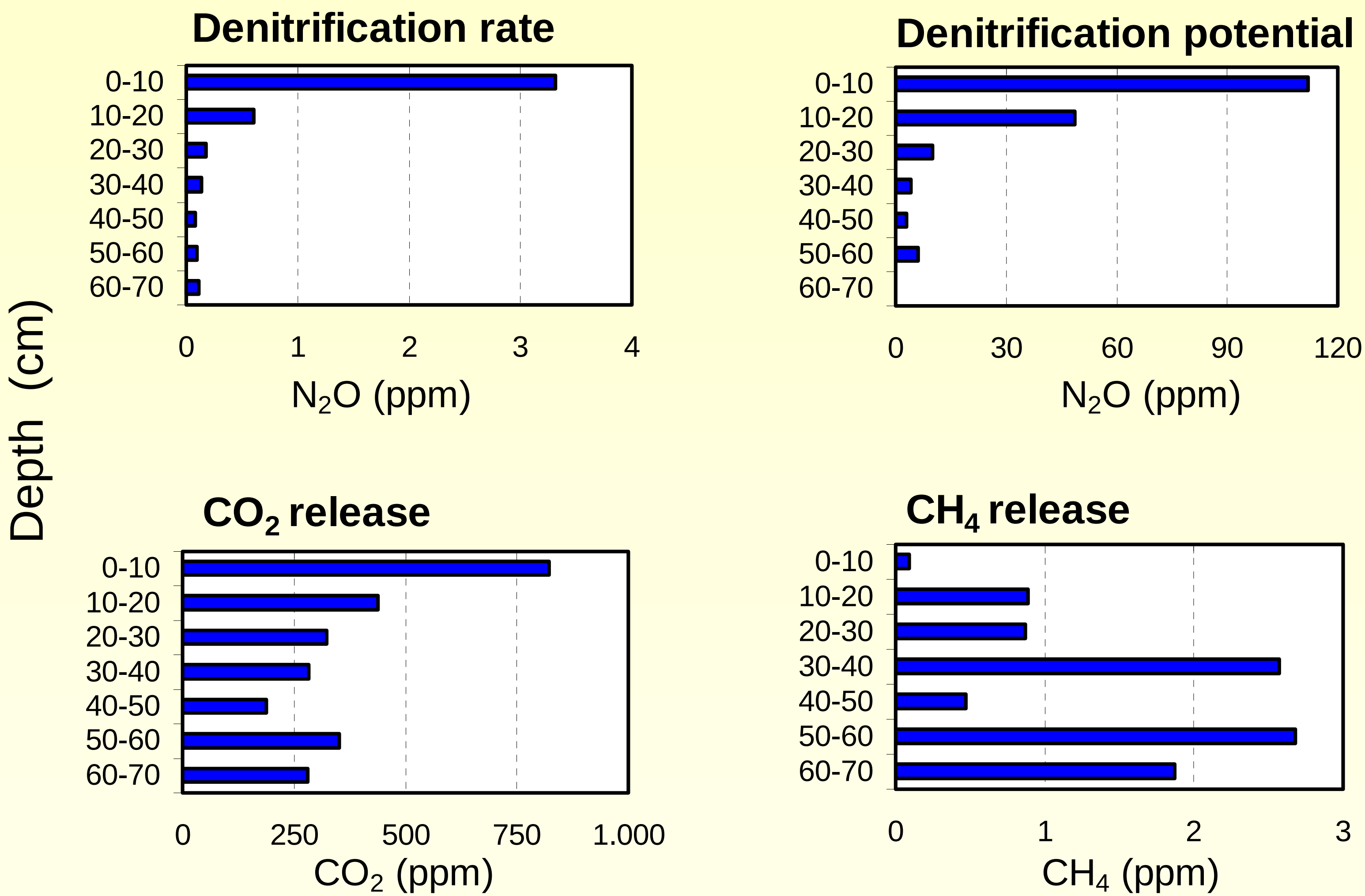


Indication for leaching of NO_3 from the field into the lake



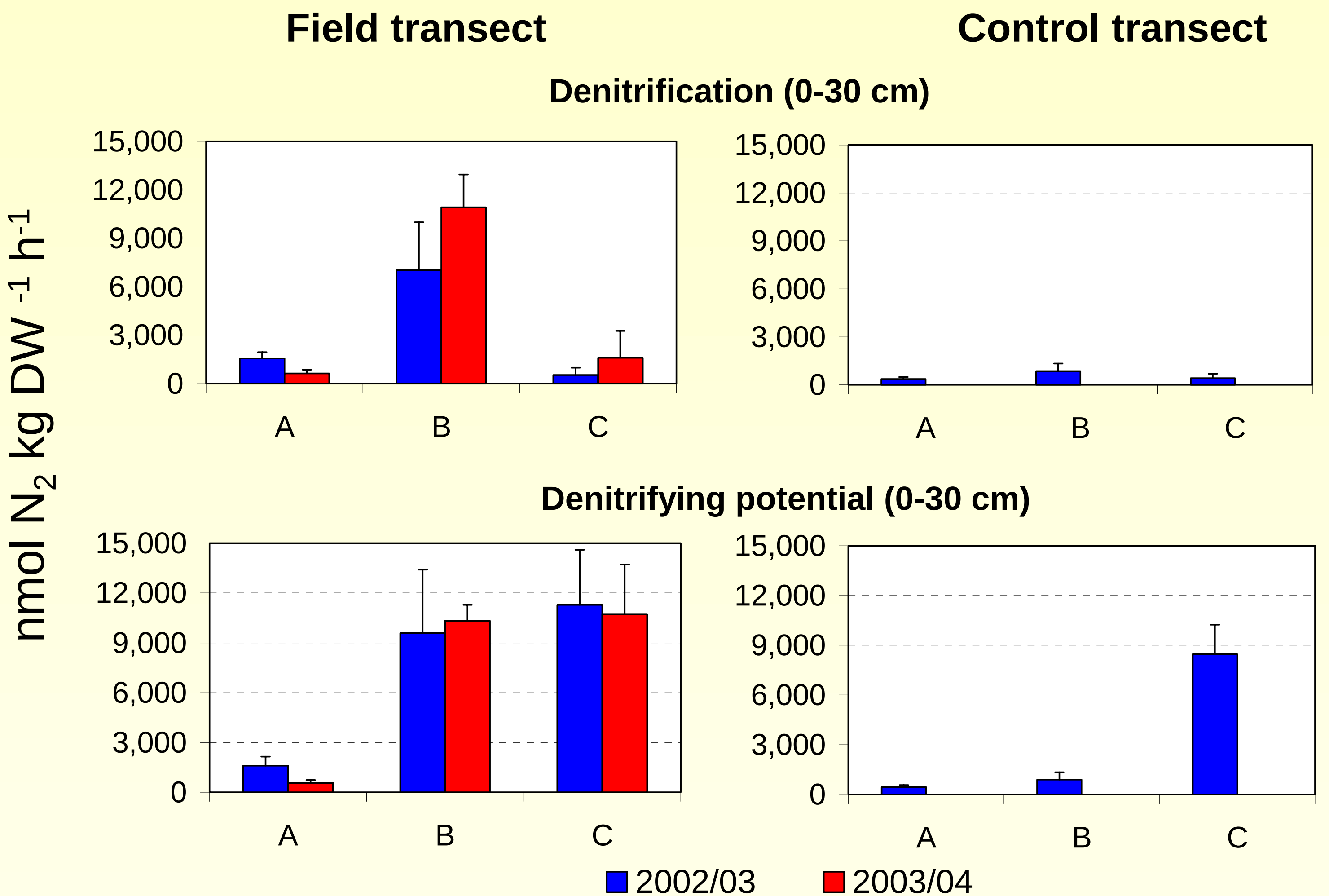
Microbial activity

Riparian site (C), 22.7.2003



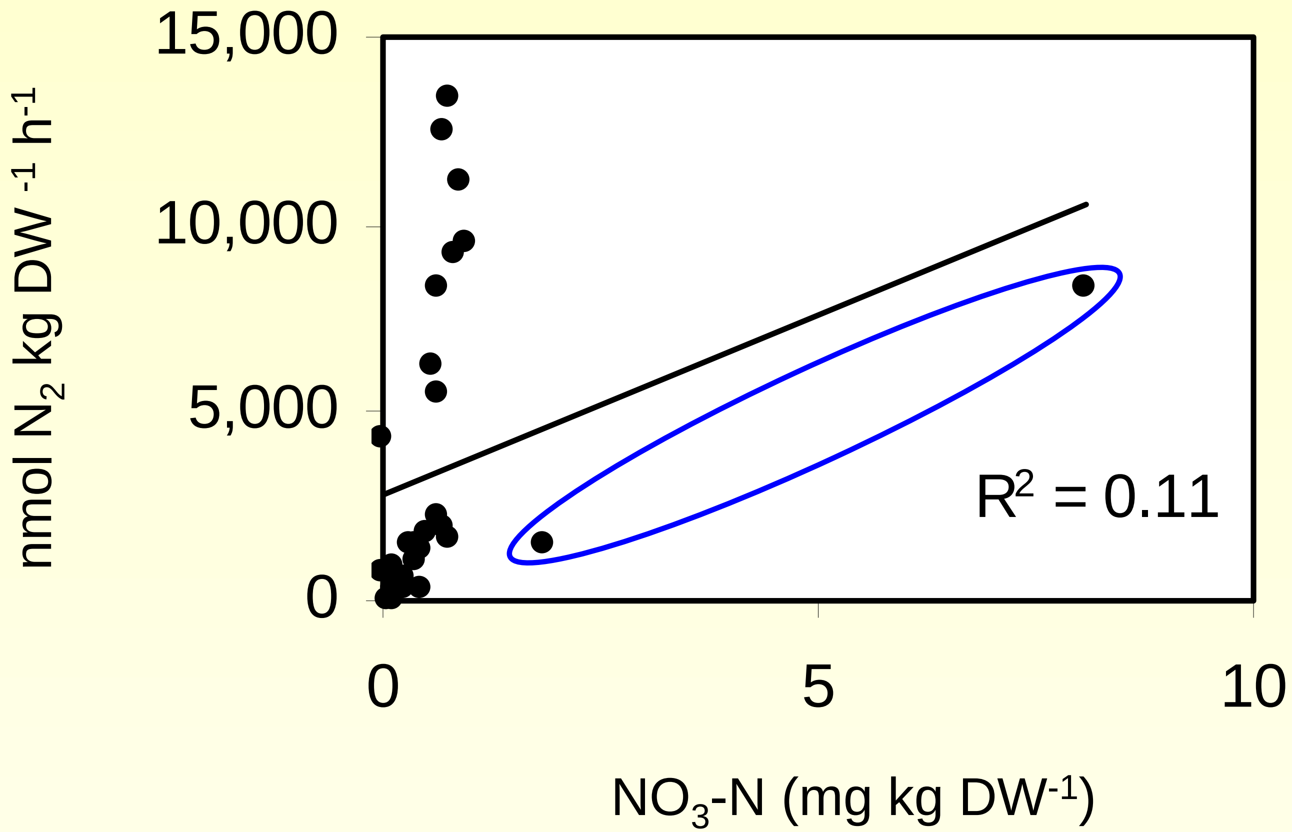
Denitrification (0-30 cm)

April 2002 – March 2004



Denitrification vs. nitrate supply

April 2002 – March 2004



Denitrification vs. nitrate supply

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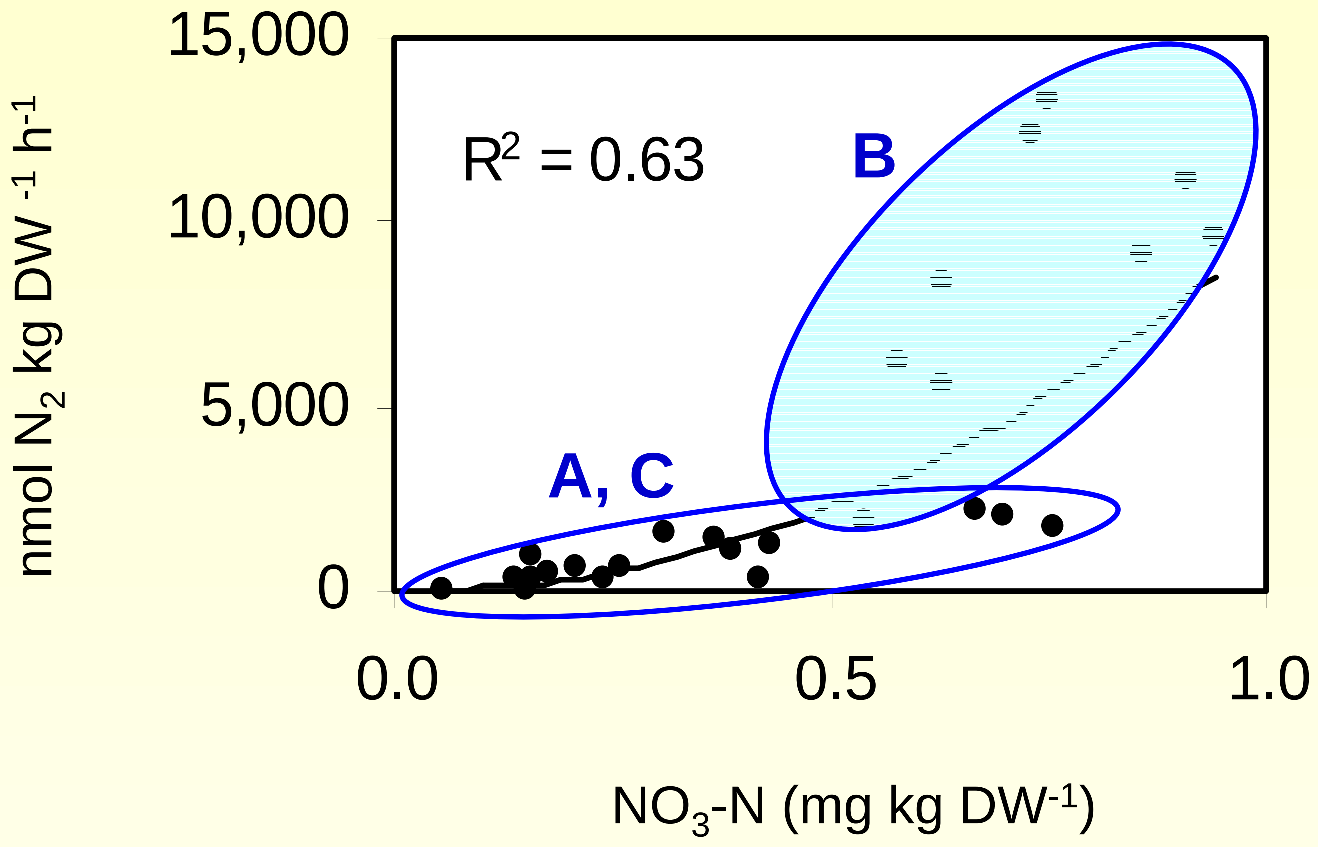

Denitrification vs. nitrate supply

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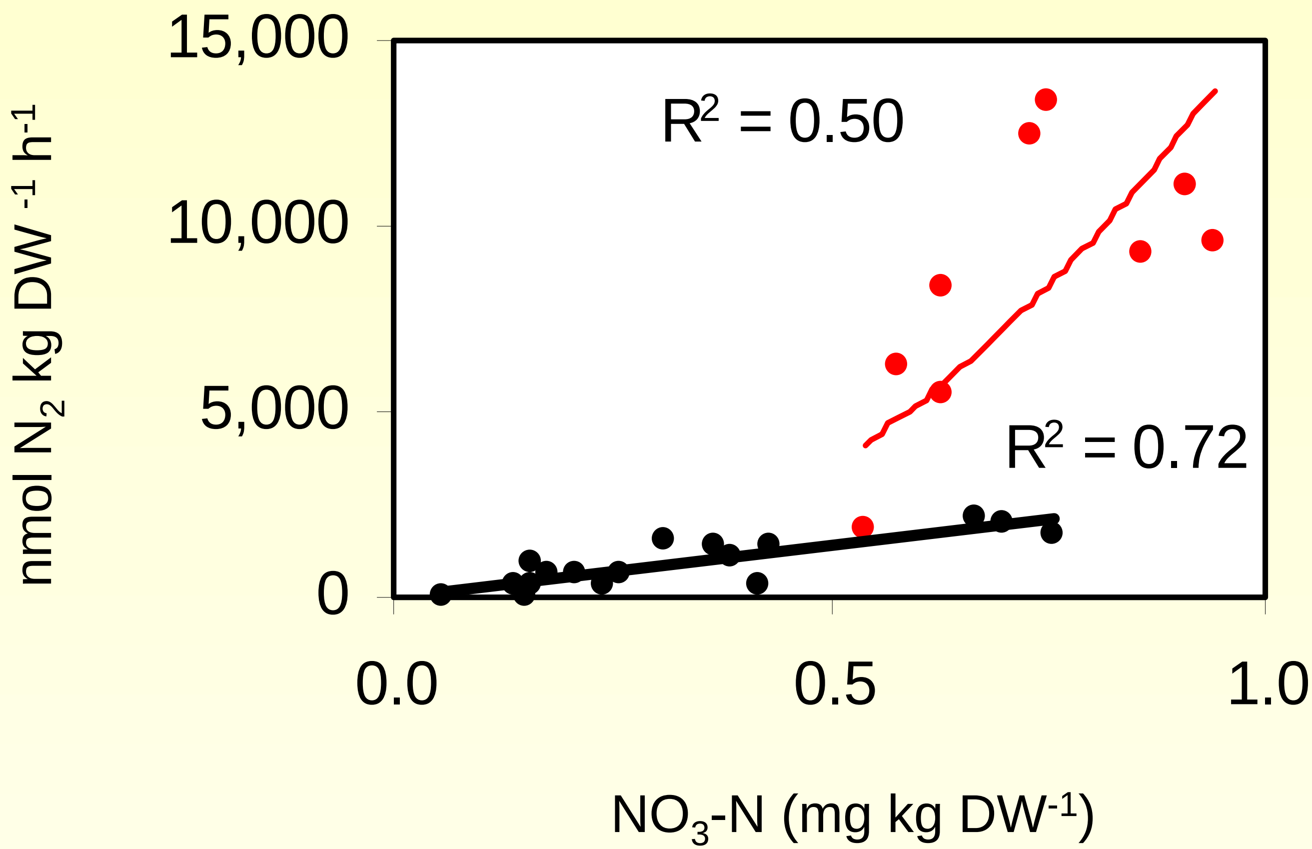

Denitrification vs. nitrate supply

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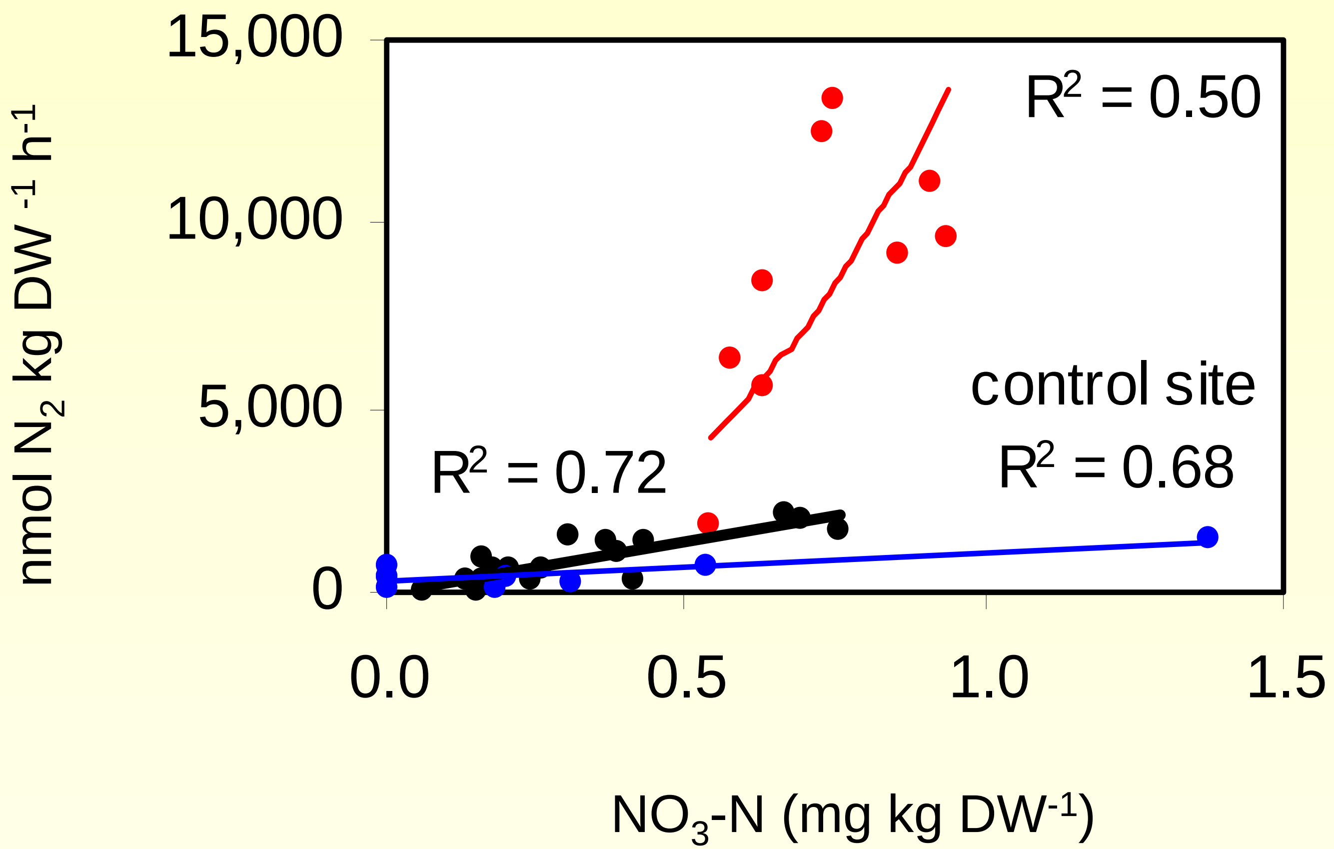
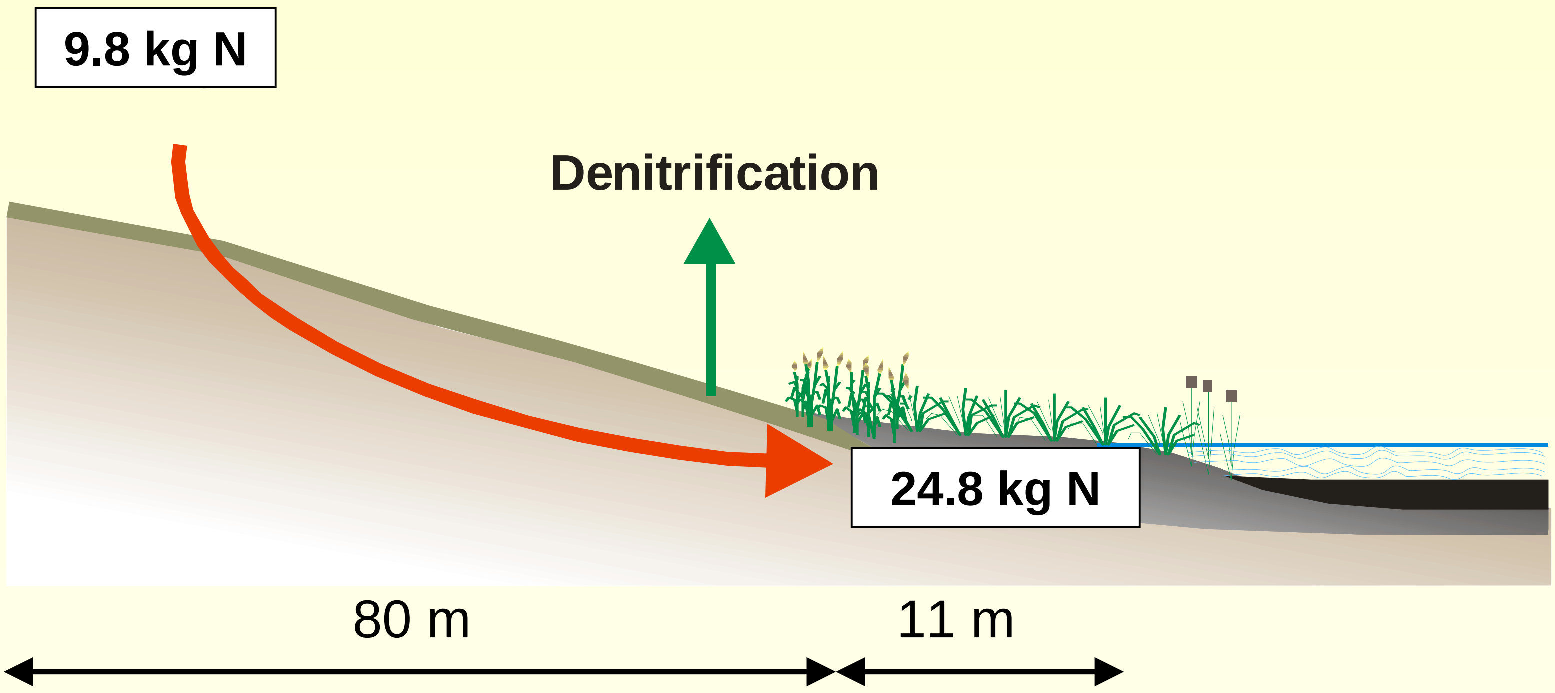


N retention in the riparian zone

- Model area = 0.008 ha
- Lake genesis ~ 60 years
- N_{min} loss in 2002/03 = 21 kg ha^{-1} a^{-1}



Conclusions

- Indication of leaching and loss of nitrogen
- High retention of nitrogen by biomass production and denitrification within the riparian zone
- No correlation between denitrification and supply of soil N > 1 mg NO_3-N
- Organic farming without applying N fertilisers is an appropriate management form on the sandy soils of Northeast Germany


Thank you for your attention

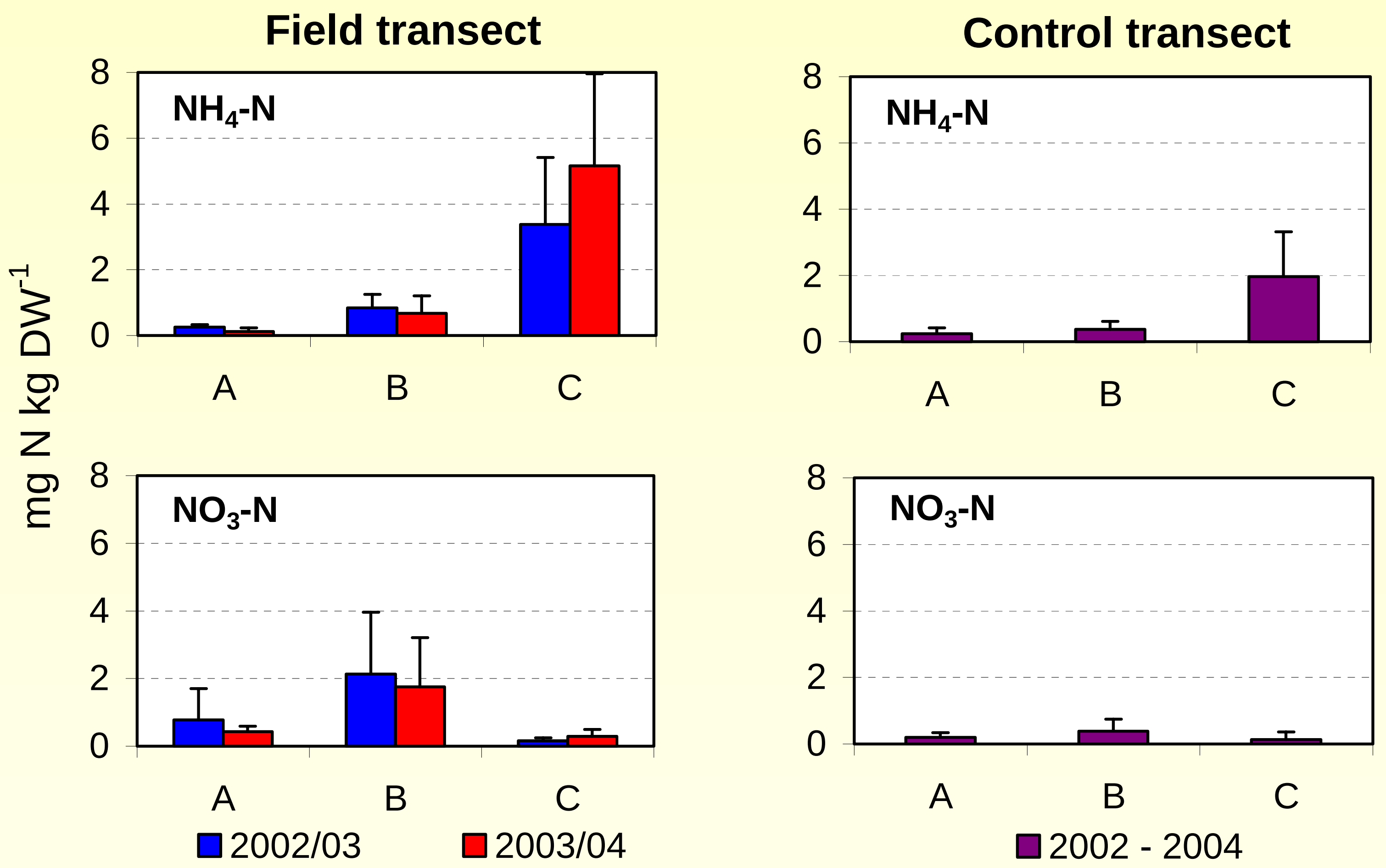
Soil characteristics (0-60 cm)

April 2002 – March 2004

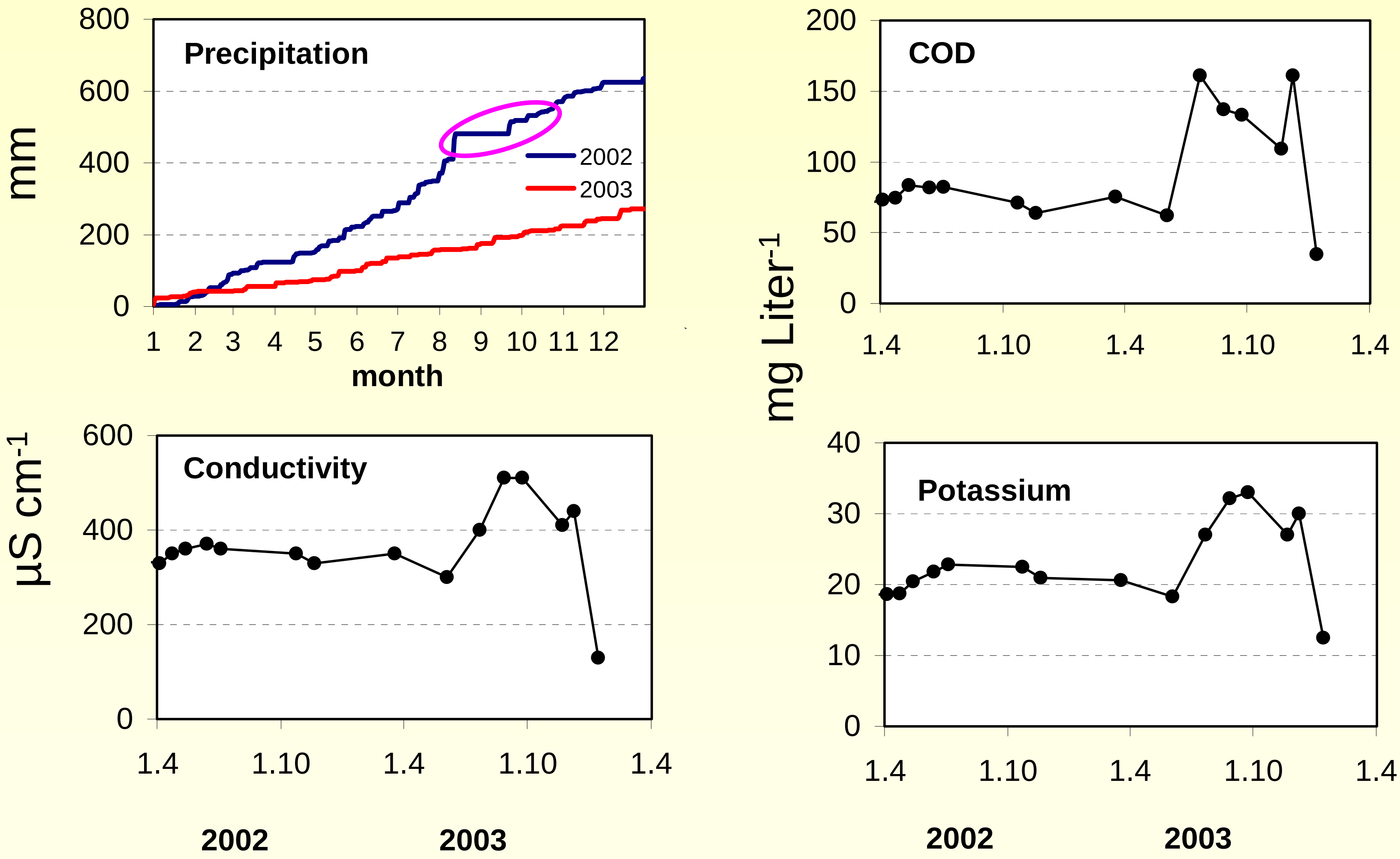
		A	B	C	A	B	C
		Winter rye		Littoral	Control		Littoral
pH		6.0	5.5	5.3	5.9	6.4	5.7
Electrical conductivity	µS cm^{-1}	30	58	83	41	48	70
Water content	%	4.5	18.5	34.6	4.9	5.3	36.9
Loss on ignition	%	0.8	5.9	12.0	1.1	1.0	8.9
Total C	g kg^{-1} DW^{-1}	4.1	35.0	74.7	5.4	5.1	46.2
Total N	mg kg^{-1} DW^{-1}	352	1,685	2,836	400	517	2,340
NH_4-N	mg kg^{-1} DW^{-1}	0.20	0.77	4.09	0.24	0.38	1.96
NO_3-N	mg kg^{-1} DW^{-1}	0.64	1.97	0.21	0.20	0.38	0.13
N_{min}	mg kg^{-1} DW^{-1}	0.84	2.74	4.30	0.44	0.76	2.09
Total P	mg kg^{-1} DW^{-1}	218	446	407	334	186	445
PO_4-P	mg kg^{-1} DW^{-1}	35	46	43	86	35	49
N removal (Oct.-March)	kg N ha^{-1}	8.7	32.4	47.6	-0.5	-4.1	28.1

Soluble nitrogen (0-60 cm)

April 2002 – March 2004

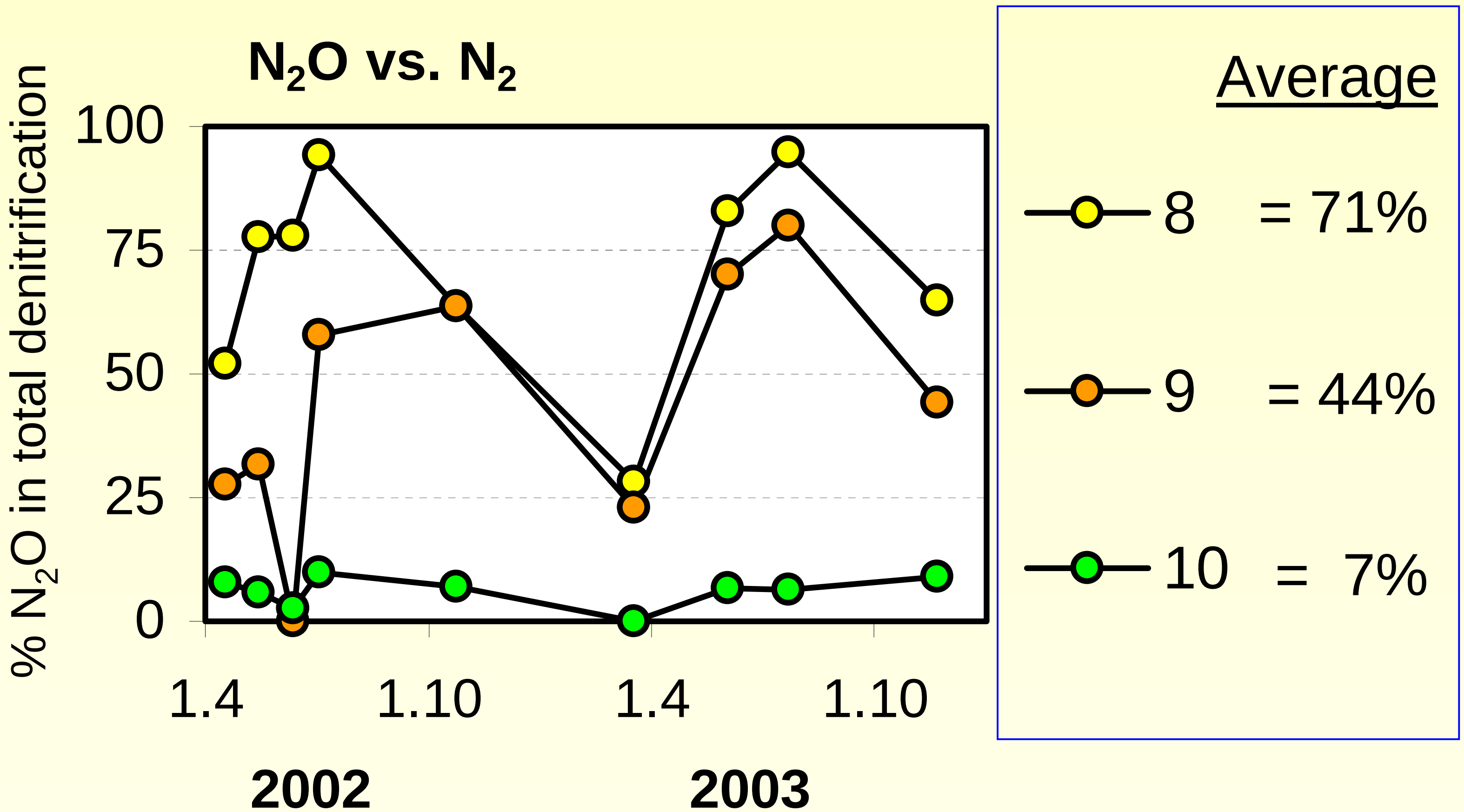


Möglicher Einfluss des Klimas auf die Hydrochemie des Zitzels



Importance of N_2O in denitrification (0-30 cm)

April 2002 – November 2003 **14/20**



Ertragsbilanz (März – Juli)

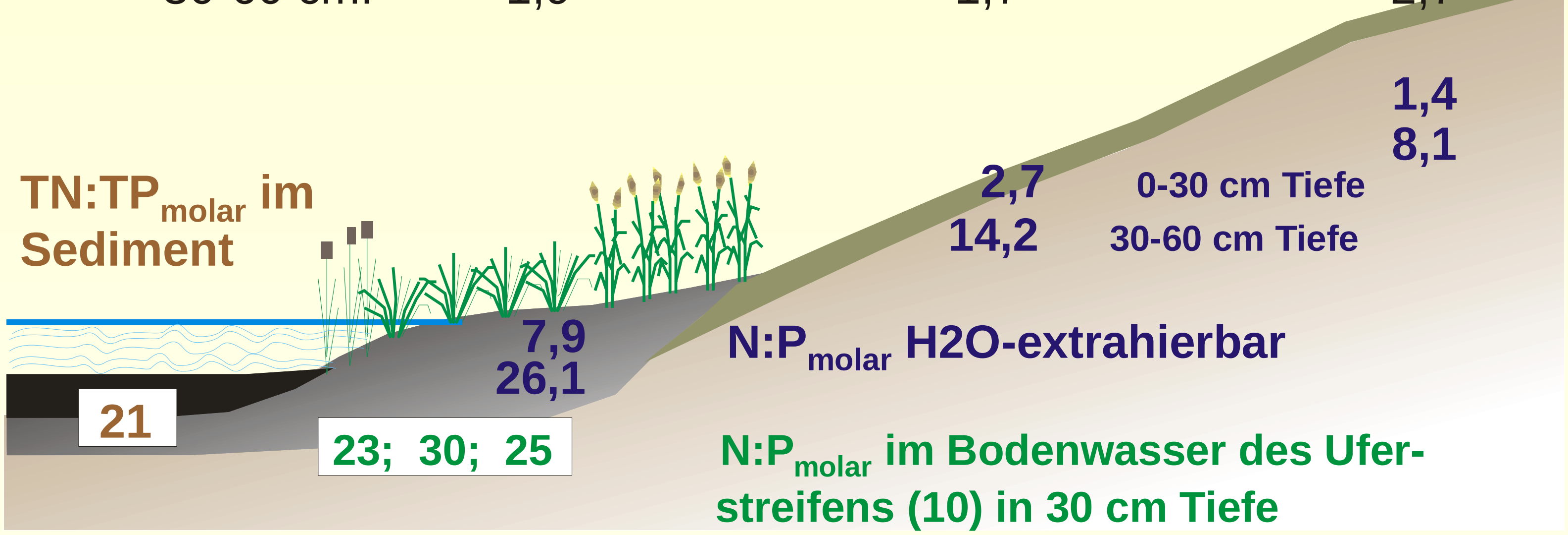
		2002	2003
N_{min} (0-60 cm)	kg N ha^{-1}	19,6	13,1
Kornertrag Winterroggen	dt ha^{-1}	20,9	7,2
N-Entzug (Korn)	kg N ha^{-1}	32,4	8,7
N-Entzug (gesamt)	kg N ha^{-1}	64,3	12,8

Gelöste und wasserlösliche Nährstoffe

Ackertransekt, Juni, Juli 2003

mg kg TS $^{-1}$

	10	9	8
$N_{H2Oextr}$			
0 -30 cm:	10,6	6,3	6,3
30-60 cm:	22,4	9,2	9,9
$P_{H2Oextr}$			
0 -30 cm:	5,3	5,5	10,8
30-60 cm:	1,9	1,7	2,7

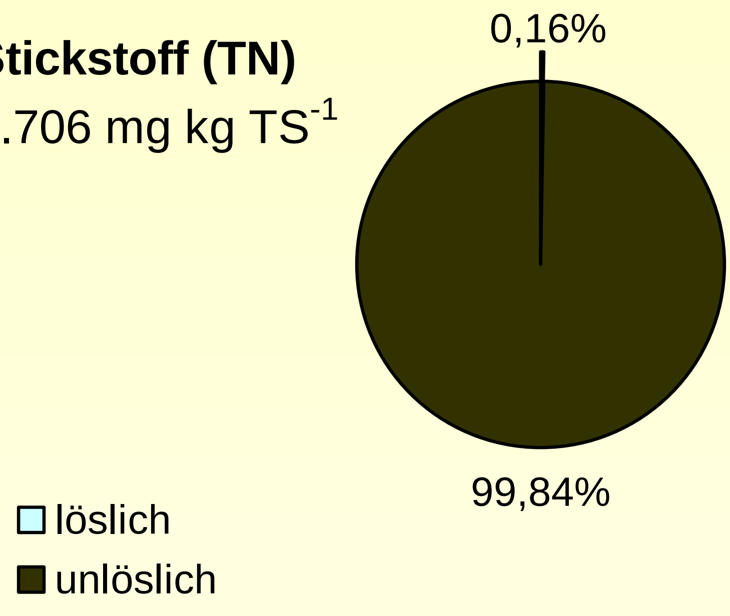


Nährstoffgehalte

Ackertransekt, April – Oktober 2002

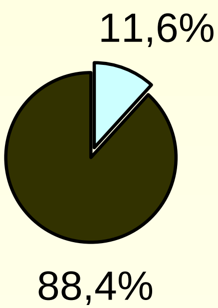
Stickstoff (TN)

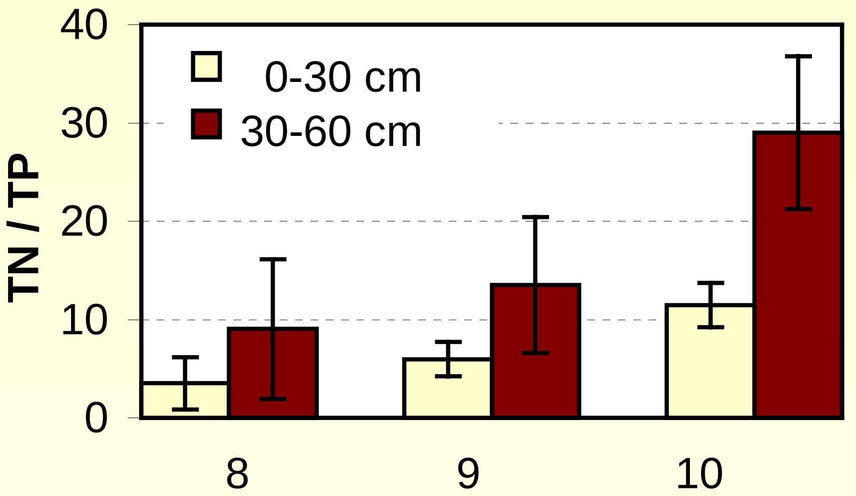
1.706 mg kg TS^{-1}



Phosphor (TP)

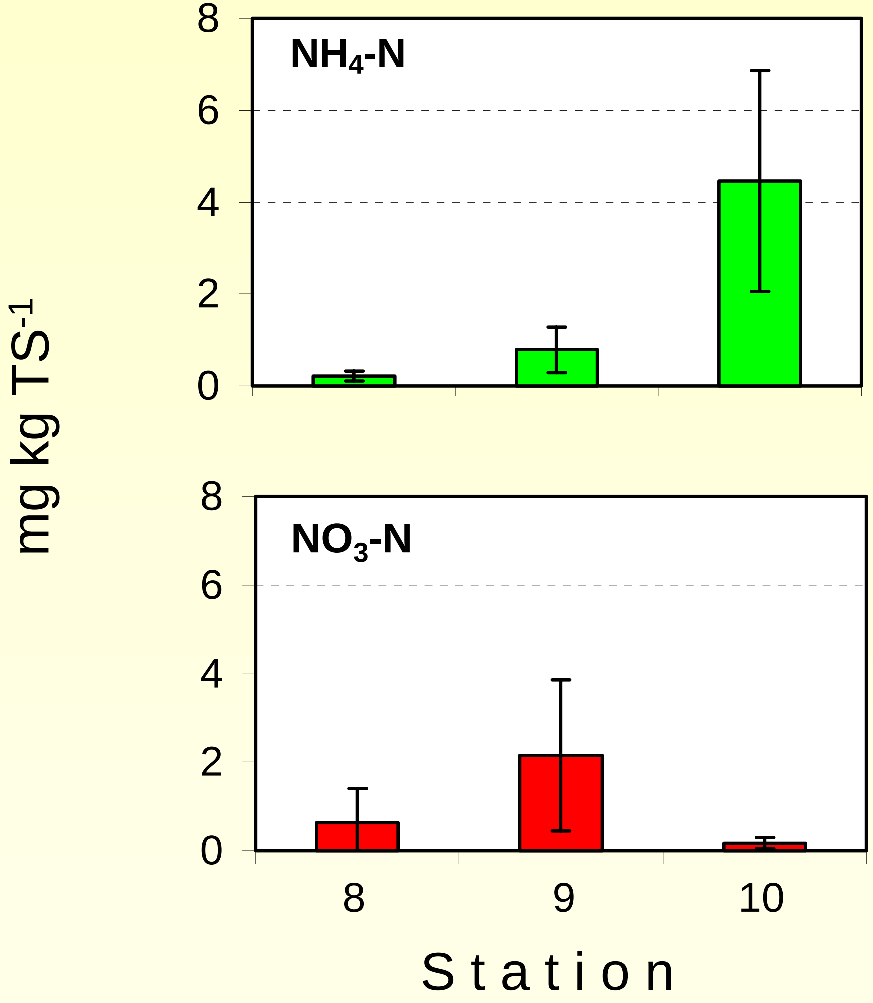
362 mg kg TS^{-1}

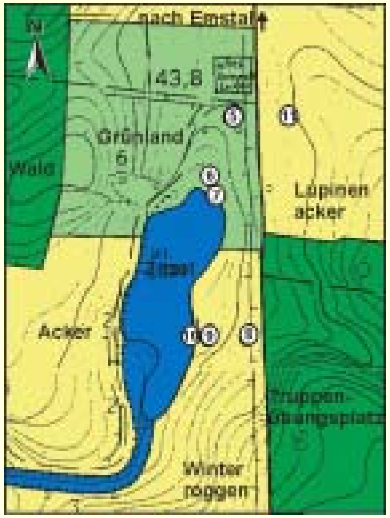




Löslicher Stickstoff (0-60 cm)

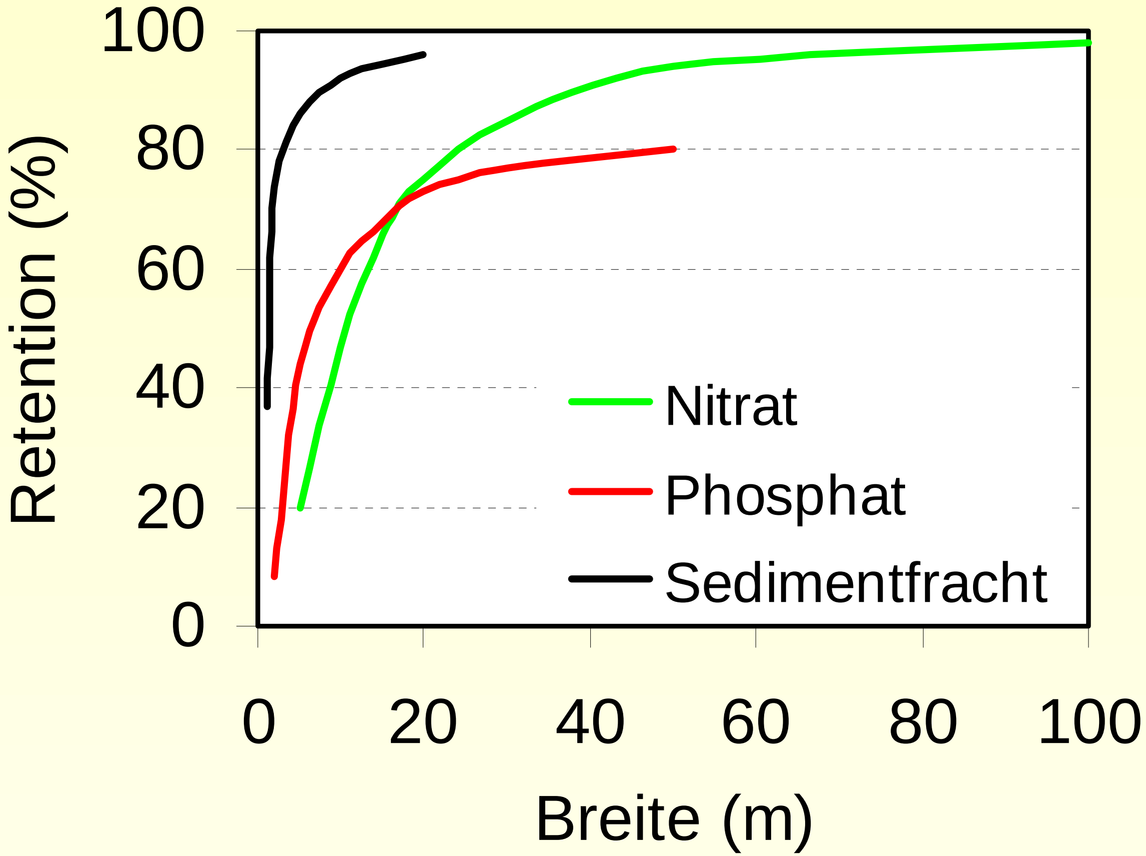
April 2002 – November 2003





Stoffrückhalt in Gewässerrandstreifen

Landesumweltamt Brandenburg, 1996



N/P-Verhältnisse

Ackertransekt, April – Oktober 2002

Eintragsform	Korn-größe	Organik	C/N	C/P	N/P	
Grundwasser	sehr gering	mäßig - hoch	5 -10	130 - 300	~ 7	Literaturwerte
Erosion Deflation	Ton, Sande	gering	< 10	< 100	< 1	
Höhere Pflanzen	gering	hoch	~ 40	> 550	~ 30	
Ackerboden	Sande	gering	21	130	6	Zitzel
Seesediment	grob, faserig	hoch	19	383	21	