Soil loss & Run off & Water erosion

Report of 16 years of investigations

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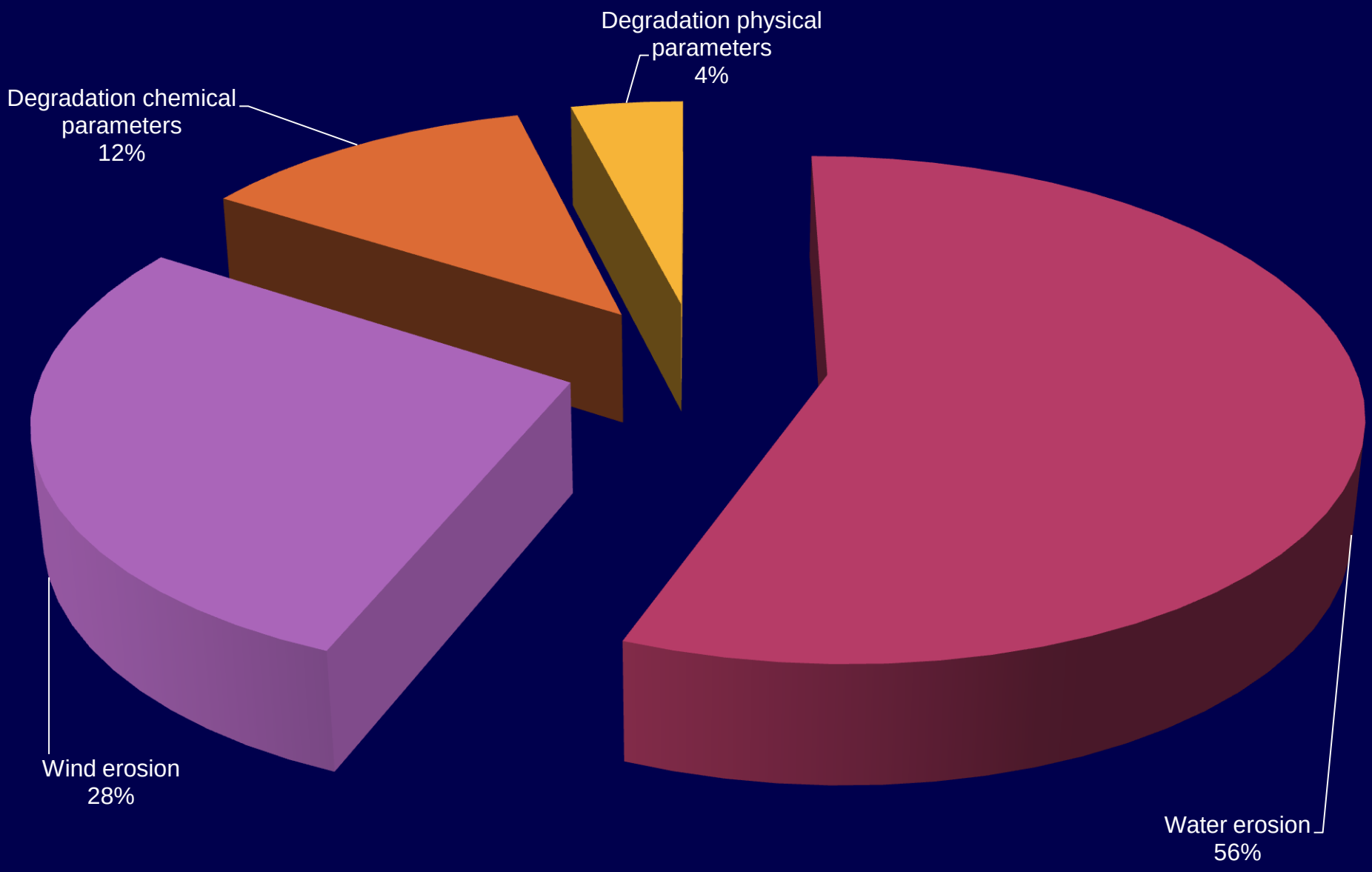
Graz, Austria

Global degradation of soils

Source: Soils, Society & Environment, 18. WCSS 2006., p. 36



MATERIALS AND METHODS

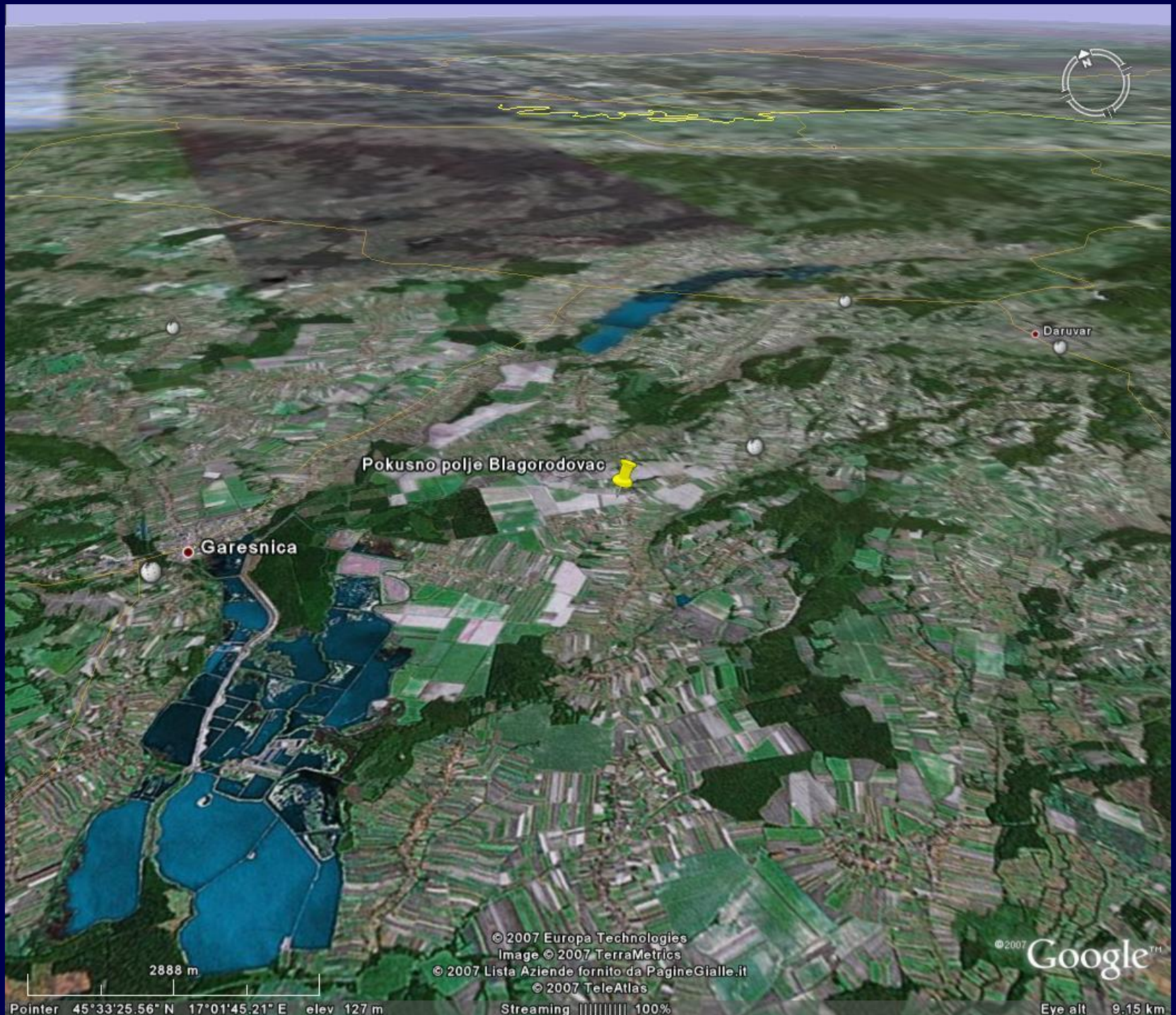
The trial was set up in the summer of 1994, on arable land of the Poljodar near Daruvar. The experimental station consists of the following plots:

1. **Check-standard plot–black fallow,**
2. **Ploughing up/down the slope,**
3. **No-tillage,**
4. **Ploughing across the slope,**
5. **Ploughing to 50 cm across the slope,**
6. **Subsoiling to 60 cm + ploughing across the slope.**

Stagnic Luvisols,

FAO & IUSS, 2006

(*Pseudoglej*)


Daruvar
Pokusno polje Blagorodovac
Garesnica
© 2007 Europa Technologies
Image © 2007 TerraMetrics
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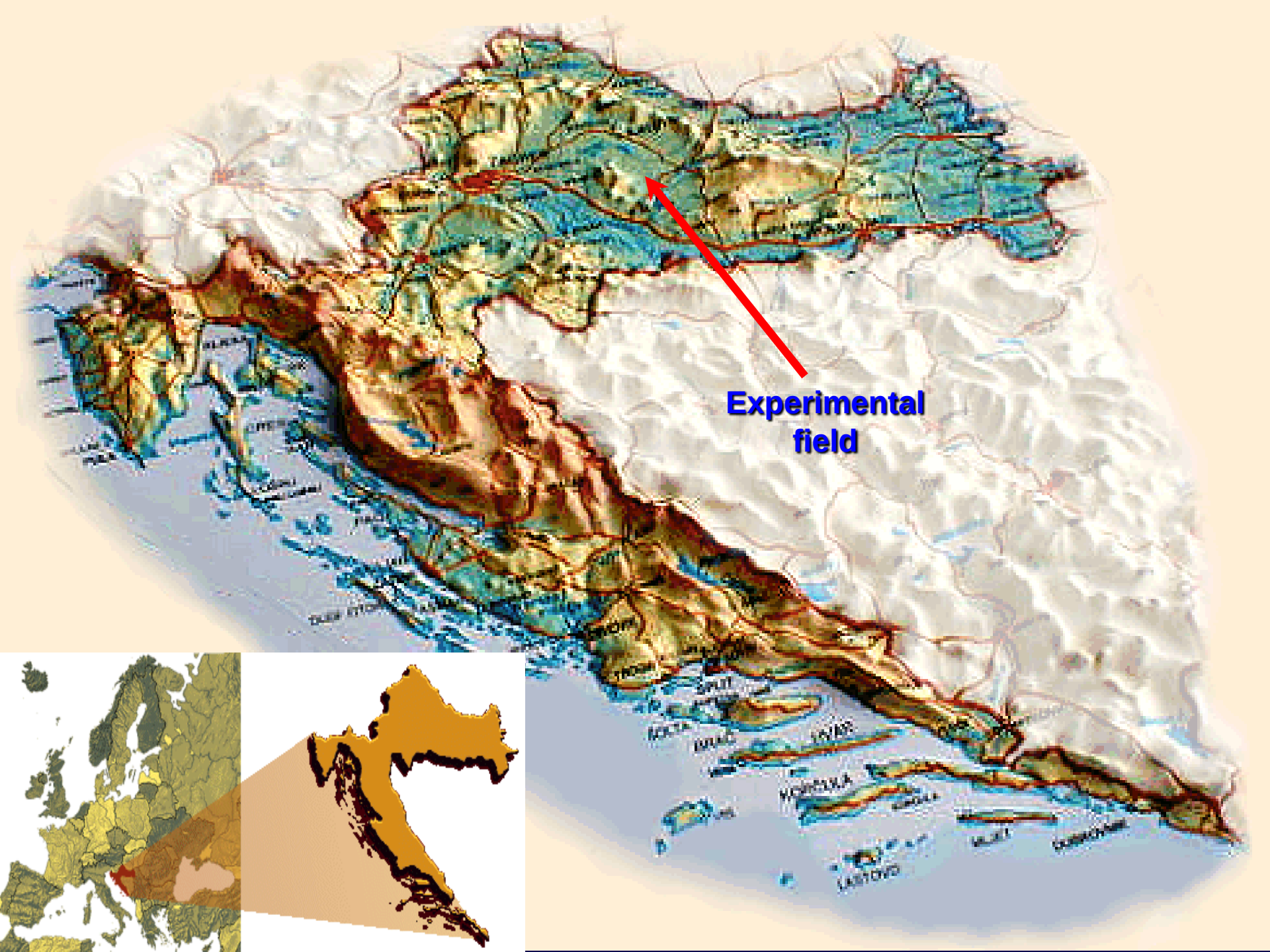
2888 m
©2007 Google
Pointer 45°33'25.56" N 17°01'45.21" E elev 127 m
Streaming 100%
Eye alt 9.15 km

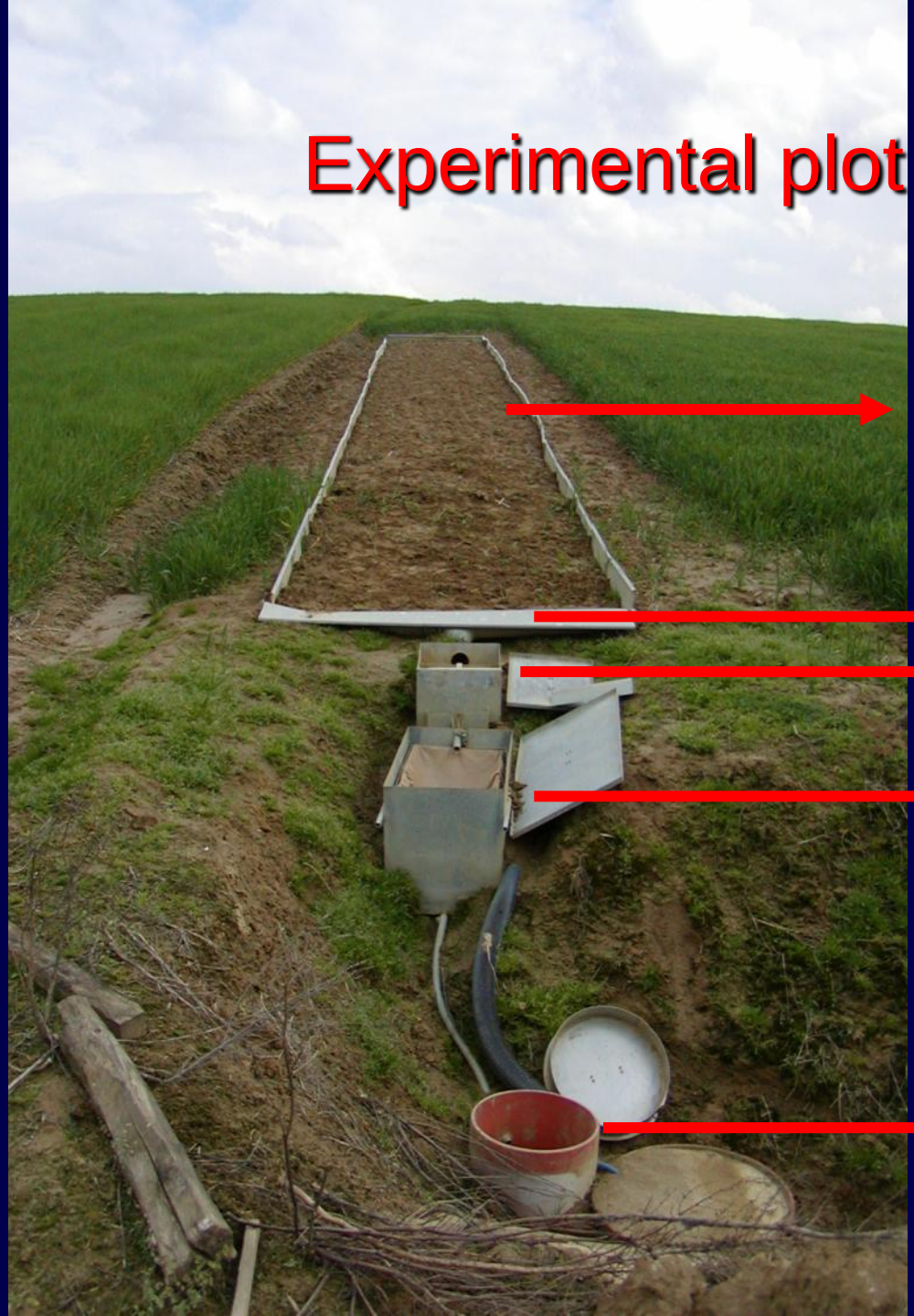

Experimental
field

On experimental plots (except for the check treatment - black fallow), crops were grown in the following crop sequence:

- 1995, 2000; 2008 - maize,
- 1996; 2001; 2005; 2009 - soybean,
- 1996/97; 2001/02; 2005/06 - winter wheat,
- 1997/98; 2002/03; 2006/07; 2010/11 - oil seed rape,
- 1998/99; 2003/04; 2009/10- spring barley&soybean.


Check
Ploughing up/ down the slope
No-tillage
Ploughing across the slope
Ploughing to 50 cm across the slope
Subsoiling to 60 cm + ploughing across the slope.

Experimental plot



Enclosed plot

22,1 x 1,87 m, 9%

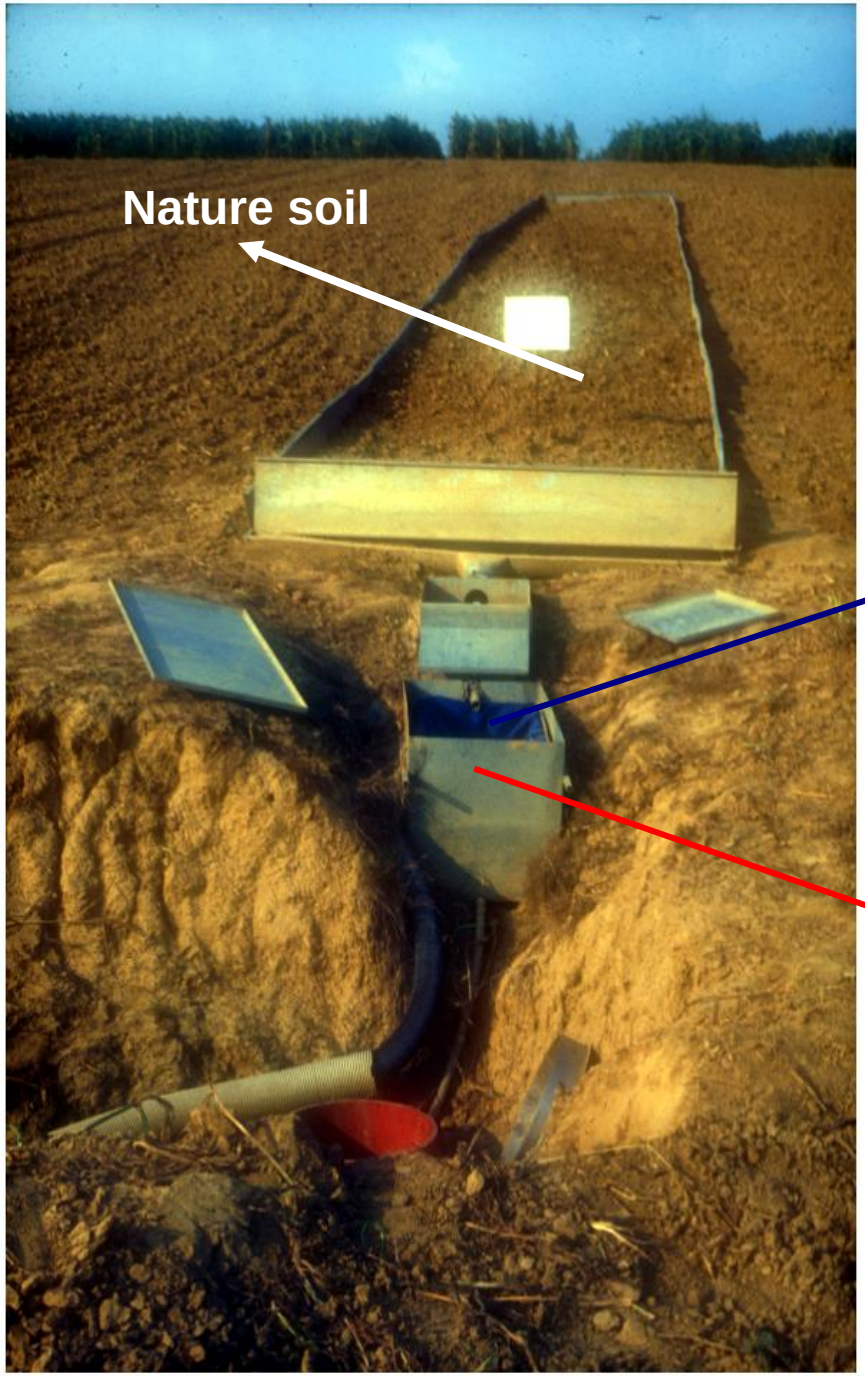
Colector of soil suspension

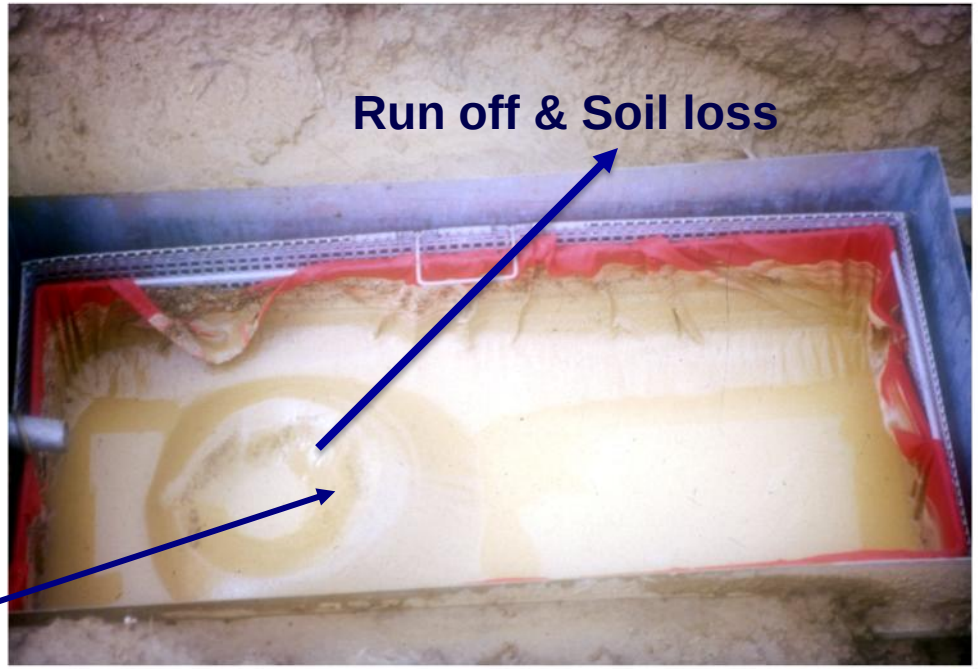
Container for retaining and separation of soil suspension

Container for filtration of soil suspension on water and soil

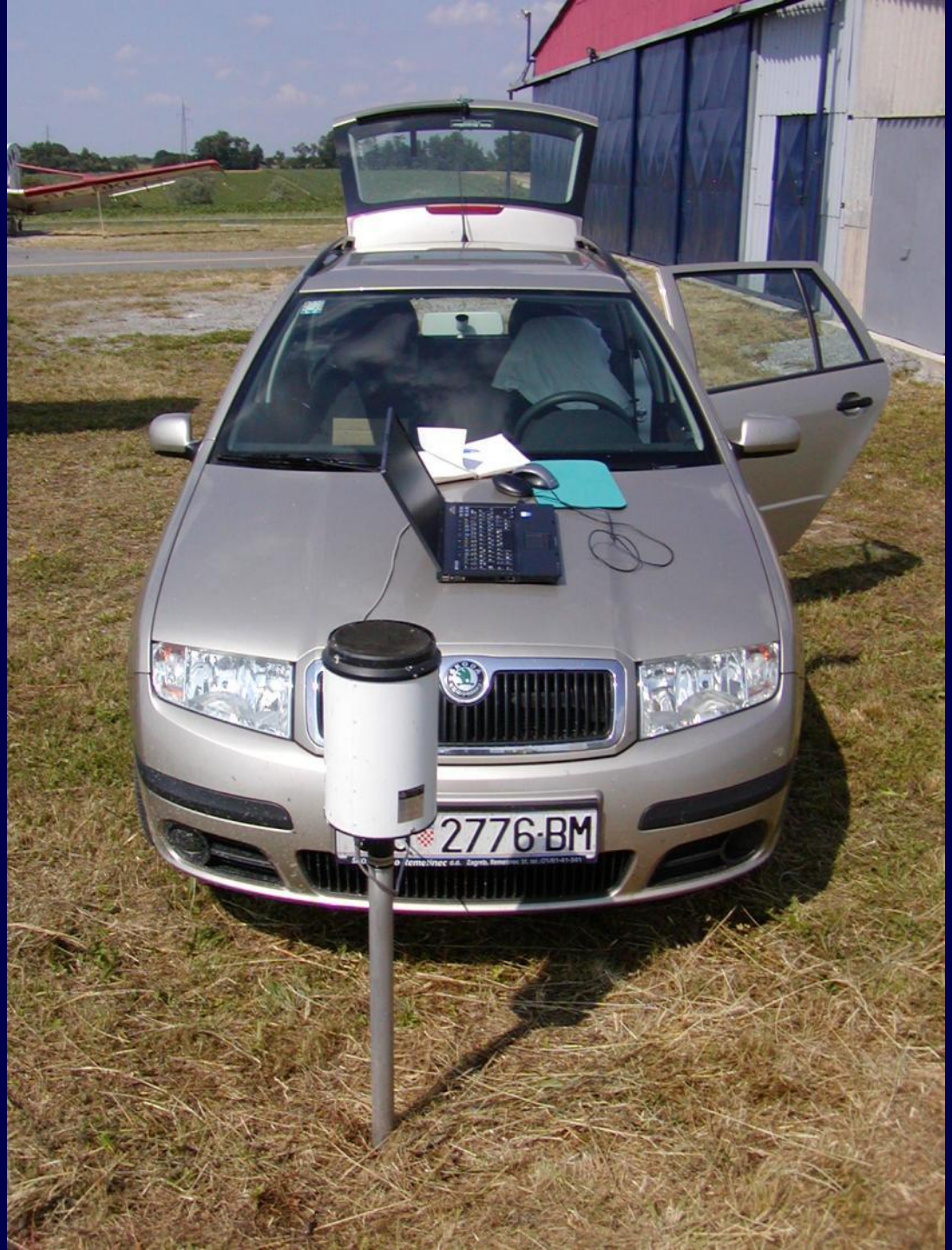
Tank for water

Creator: Prof. Othmar Nestroy, Graz, Austria.


Nature soil


Run off & Soil loss

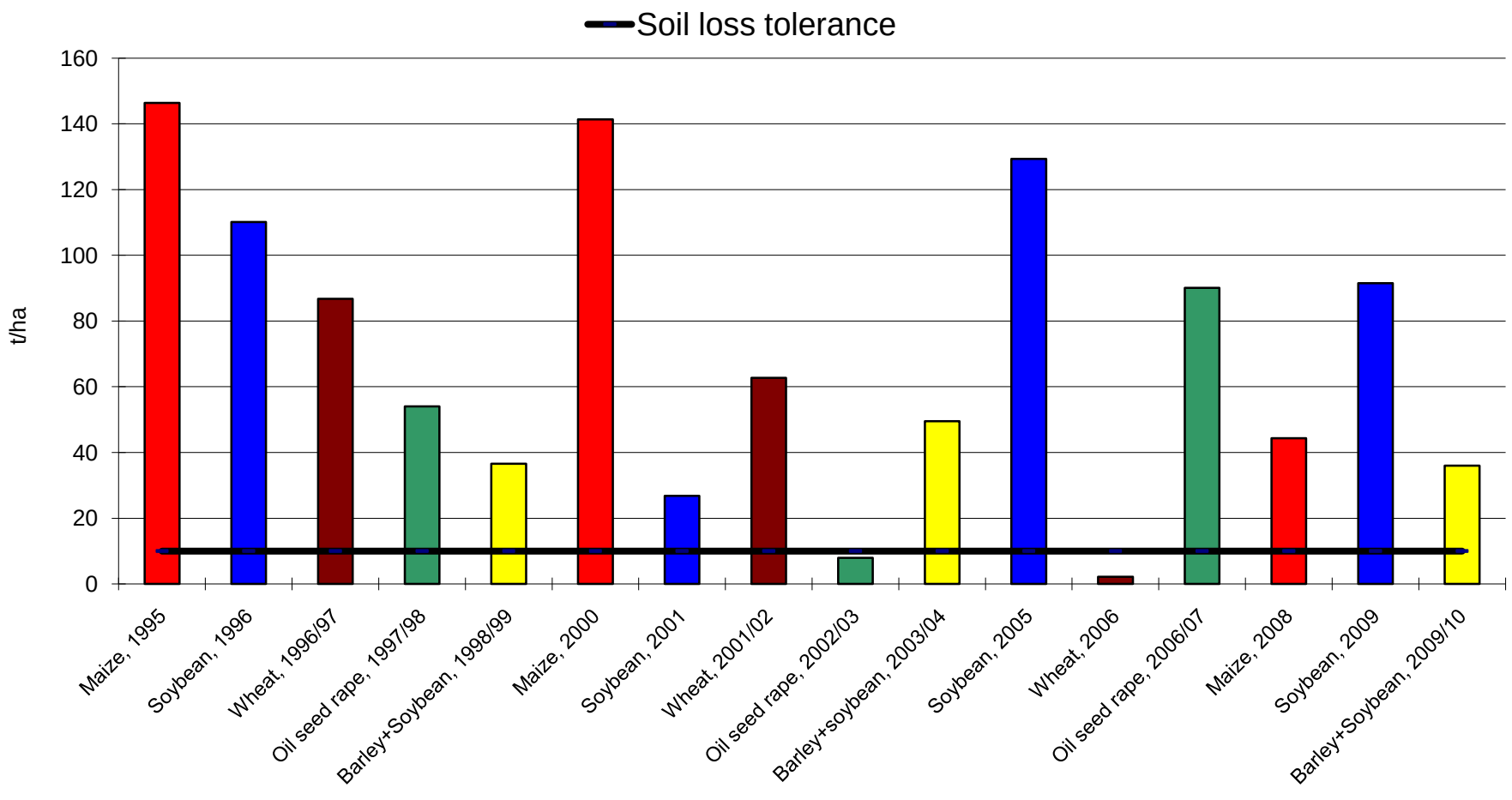

Run off & Soil loss


2776-BM

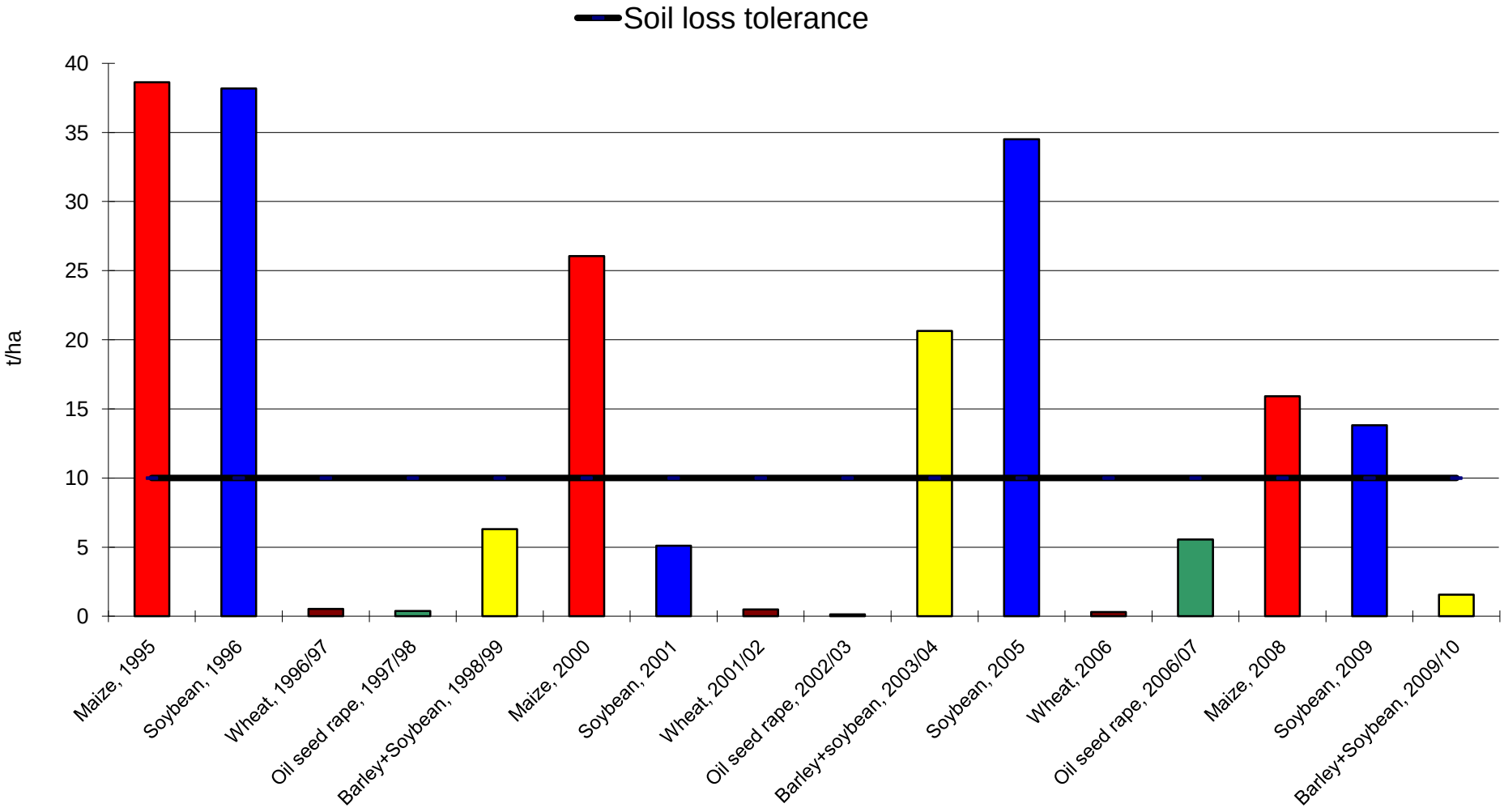
Run off and soil loss is monitored according to crop development per stages (*Wischmeier, 1960*):

- **Period F - rough fallow – primary tillage**
- **Period SB – (seedbed), month after seeding spring row crops**
- **Period 1 – (establishment of crop) - crop has developed 50% of canopy cover**
- **Period 2 (development of crop) - crop has developed 75% of canopy cover**
- **Period 3 (maturing crop) – till crop harvest**
- **Period 4 (residue or stubble)**

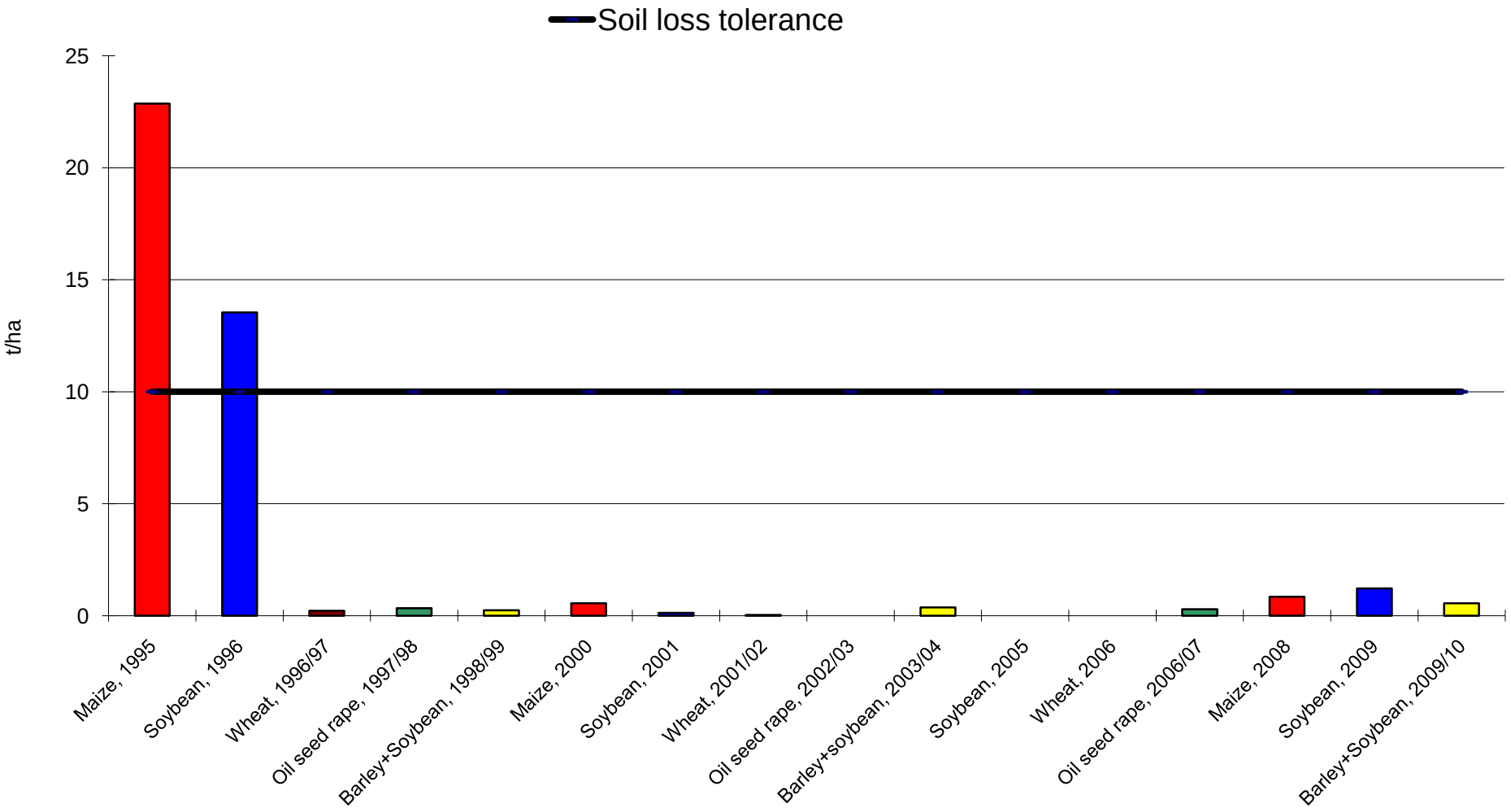
Soil loss on control treatment



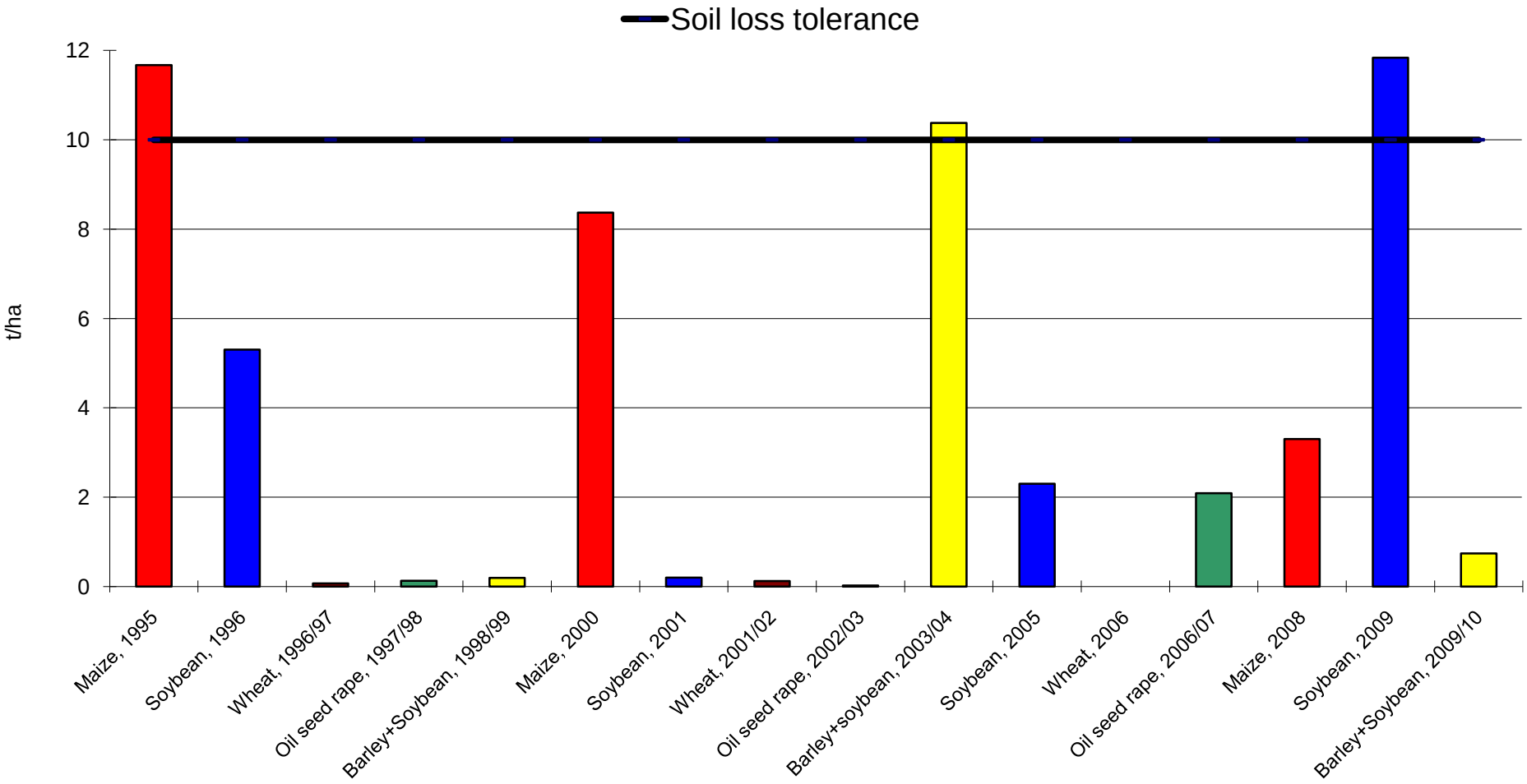
Soil loss on tillage & sowing up/down slope



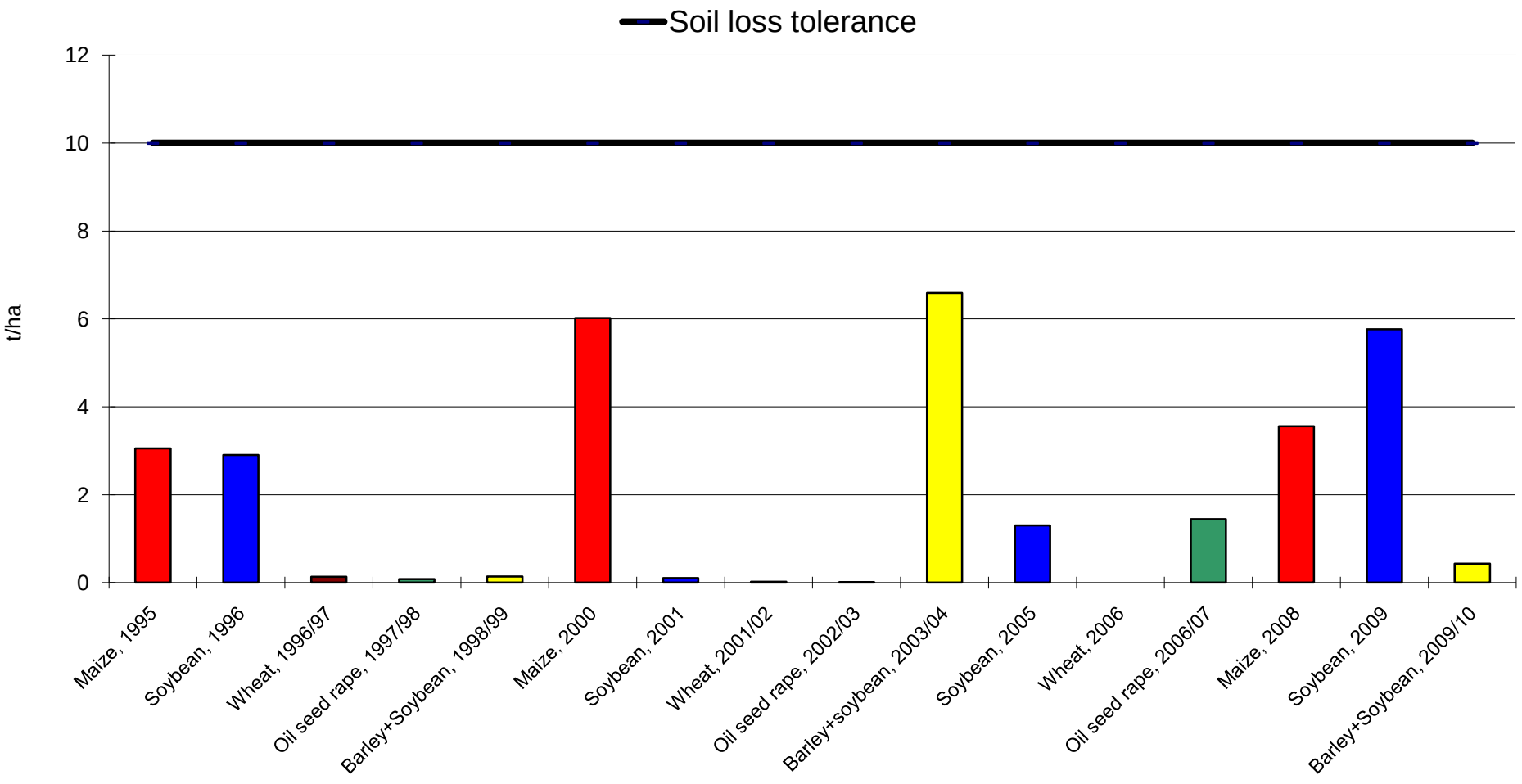
Soil loss on no tillage up/down



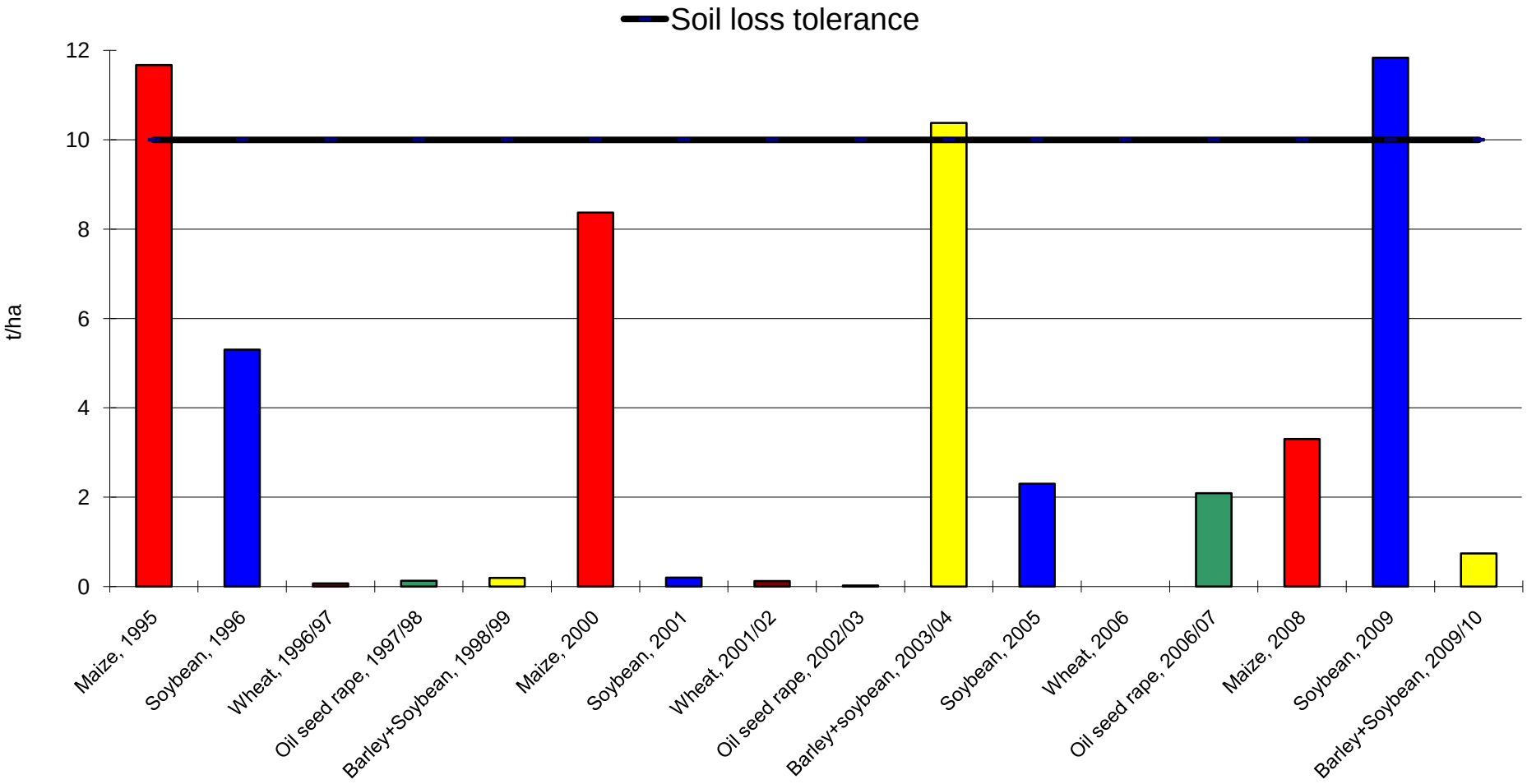
Soil loss on ploughing & sowing across the slope



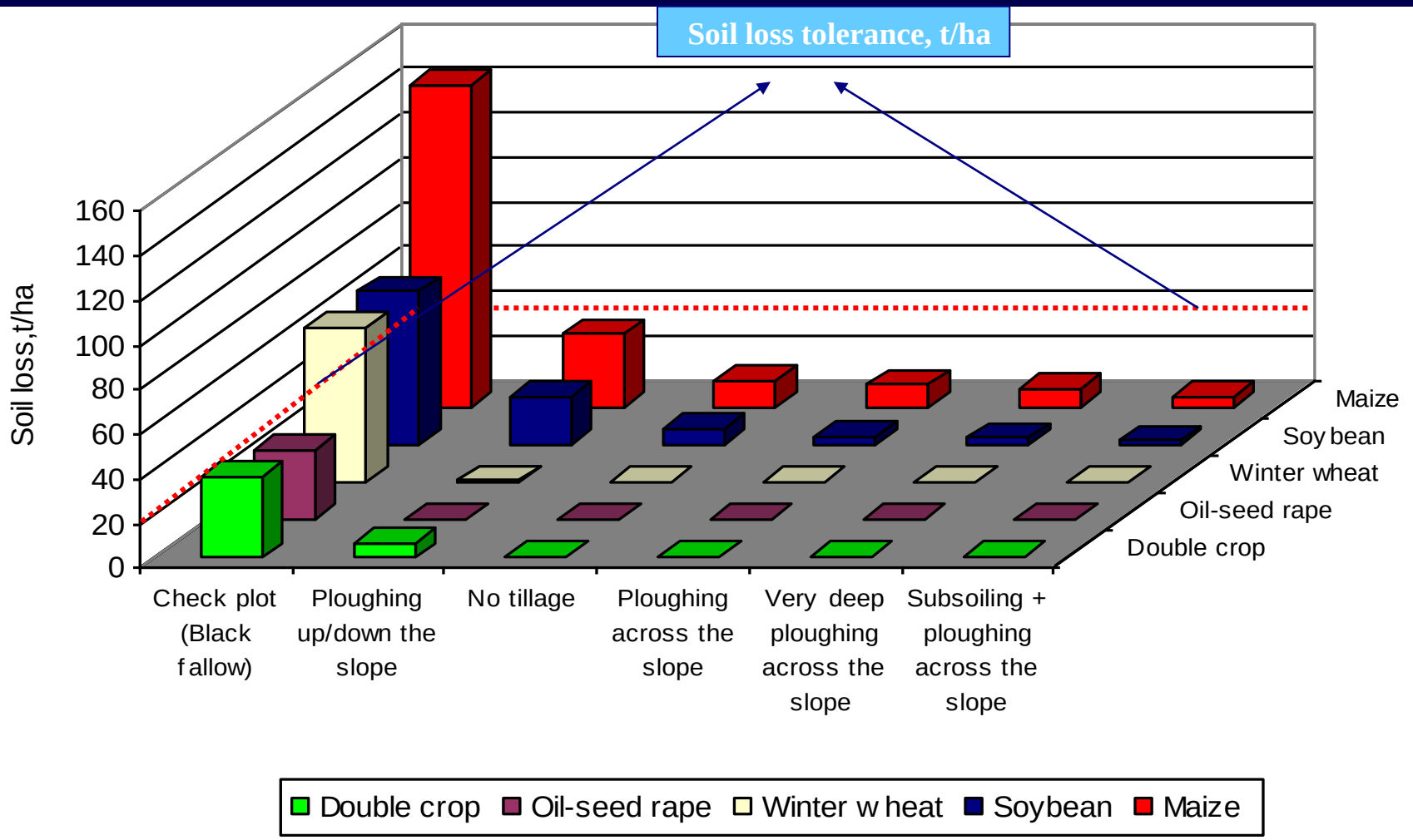
Soil loss on subsoiling & ploughing & sowing across the slope



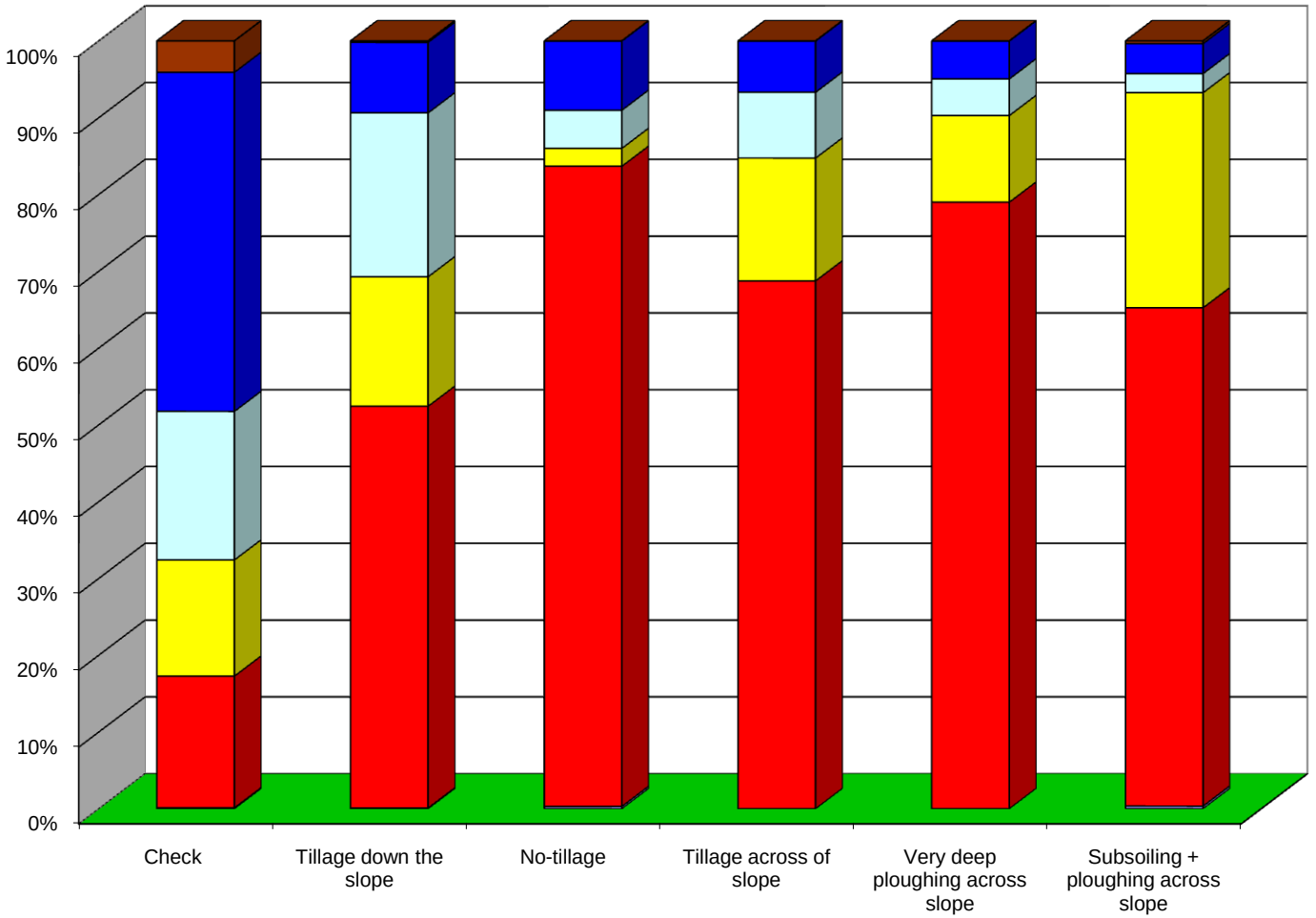
Soil loss on ploughing & sowing across the slope



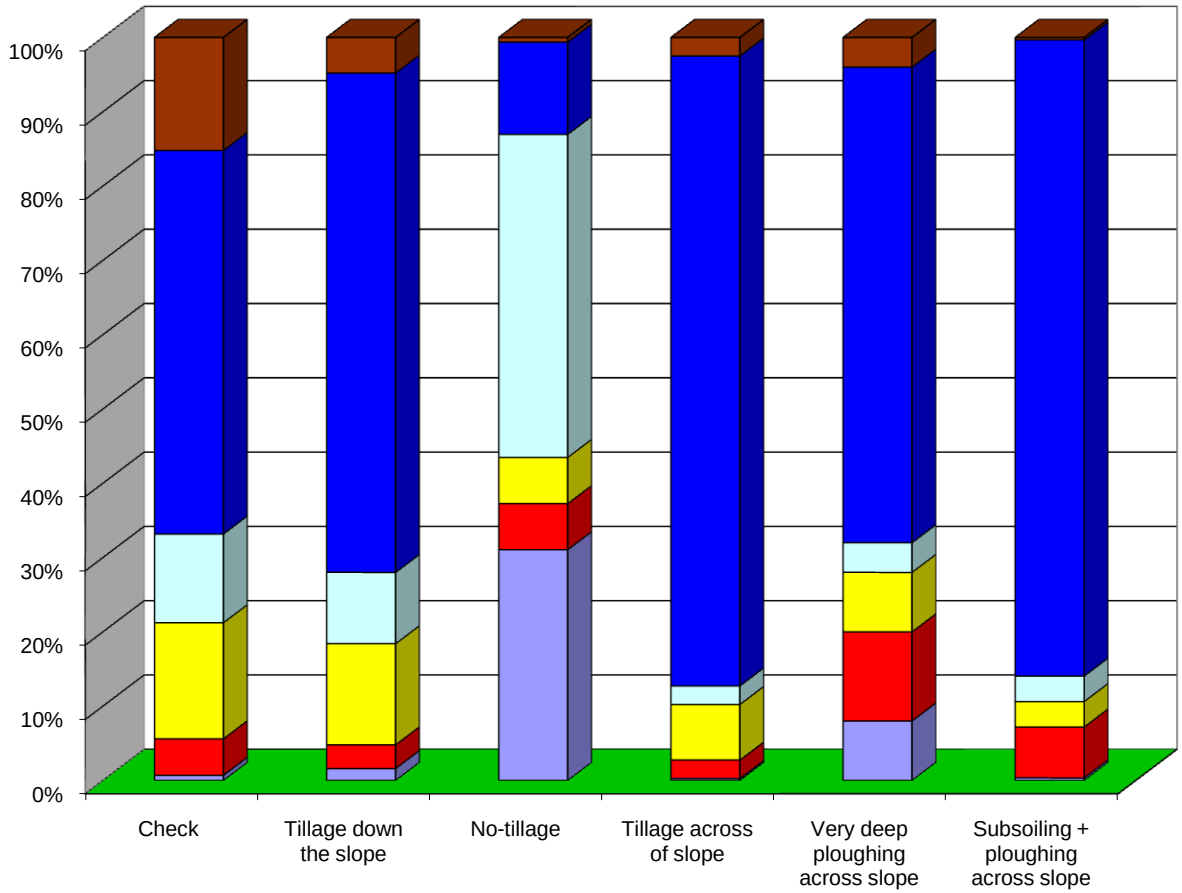
Soil loss (t/ha) – after 16 years of investigation

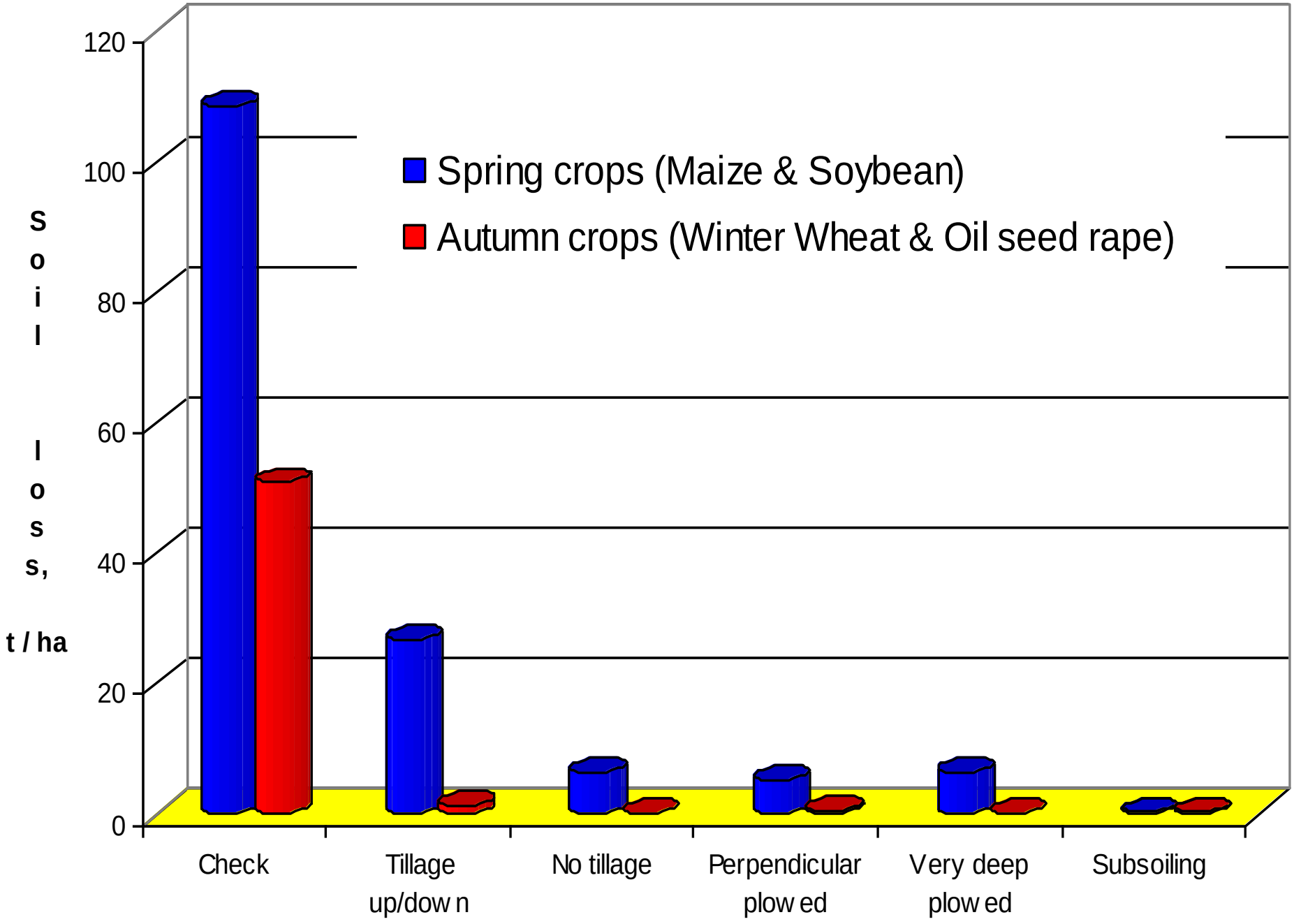


Soil loss according to crope development in growing spring row cropsps (maize & soybean)



Soil loss according to crop development in growing winter crops




Soil loss, t / ha
120
100
80
60
40
20
0
Spring crops (Maize & Soybean)
Autumn crops (Winter Wheat & Oil seed rape)
Check
Tillage up/down
No tillage
Perpendicular plowed
Very deep plowed
Subsoiling


What will happen with 50 mm
of rain in hilly region?


4-6 cm

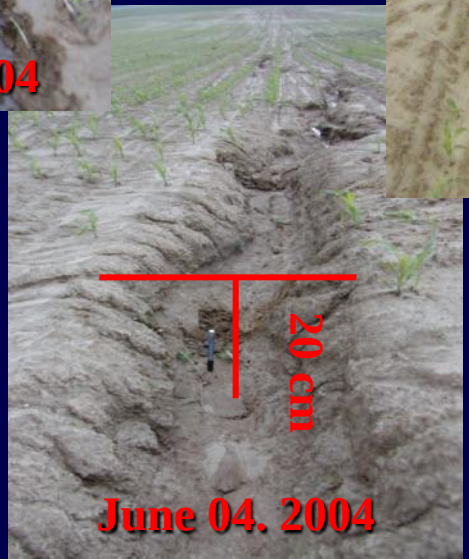

10 cm
May 14. 2004


April 30. 2004


30 cm
June 18. 2004


May 14. 2004


June 04. 2004


20 cm
June 04. 2004


July 10. 2004

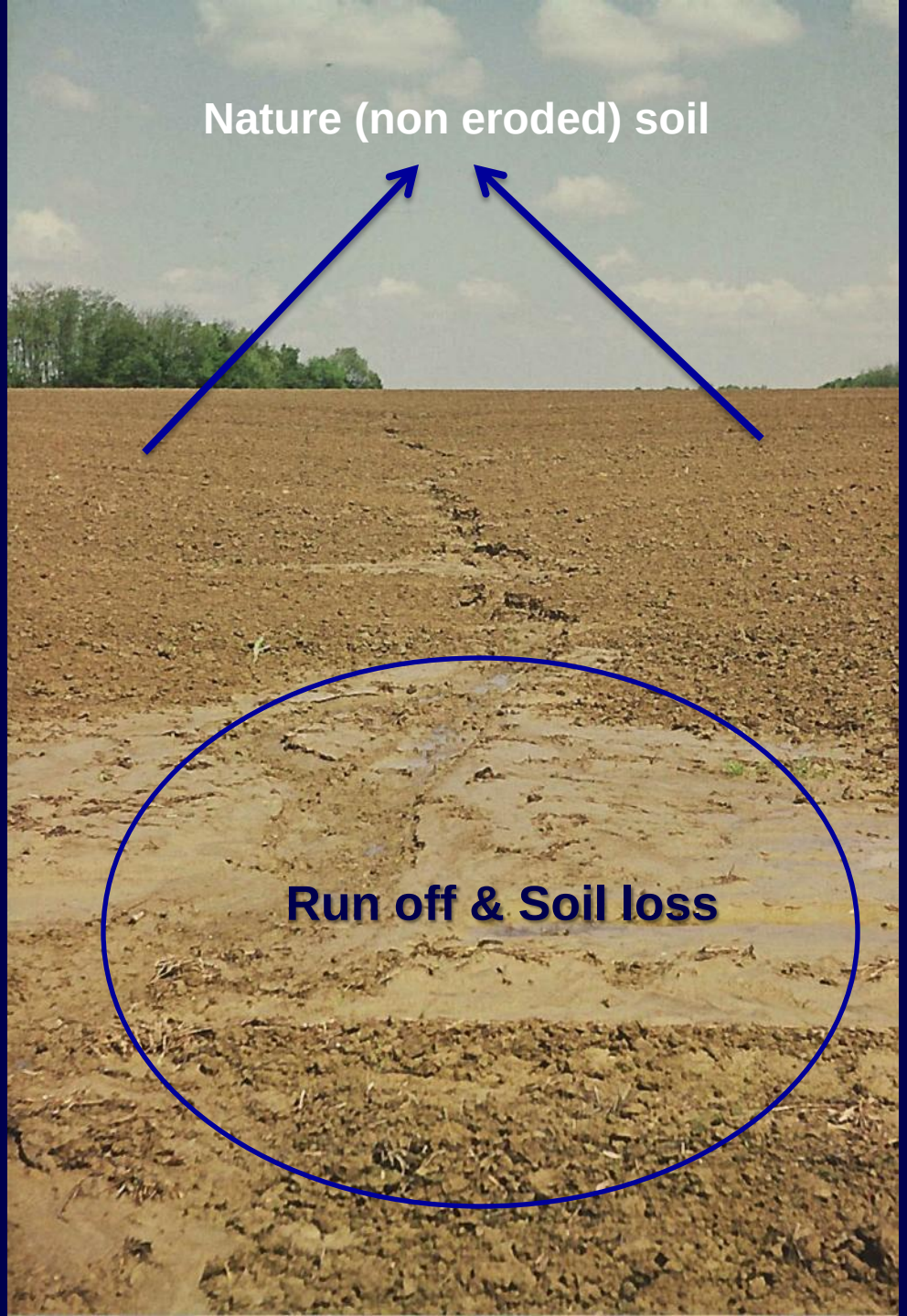
Run off on check (black fallow) and up and down tillage and planting direction

Run off on no-tillage and perpendicular tillage and planting direction

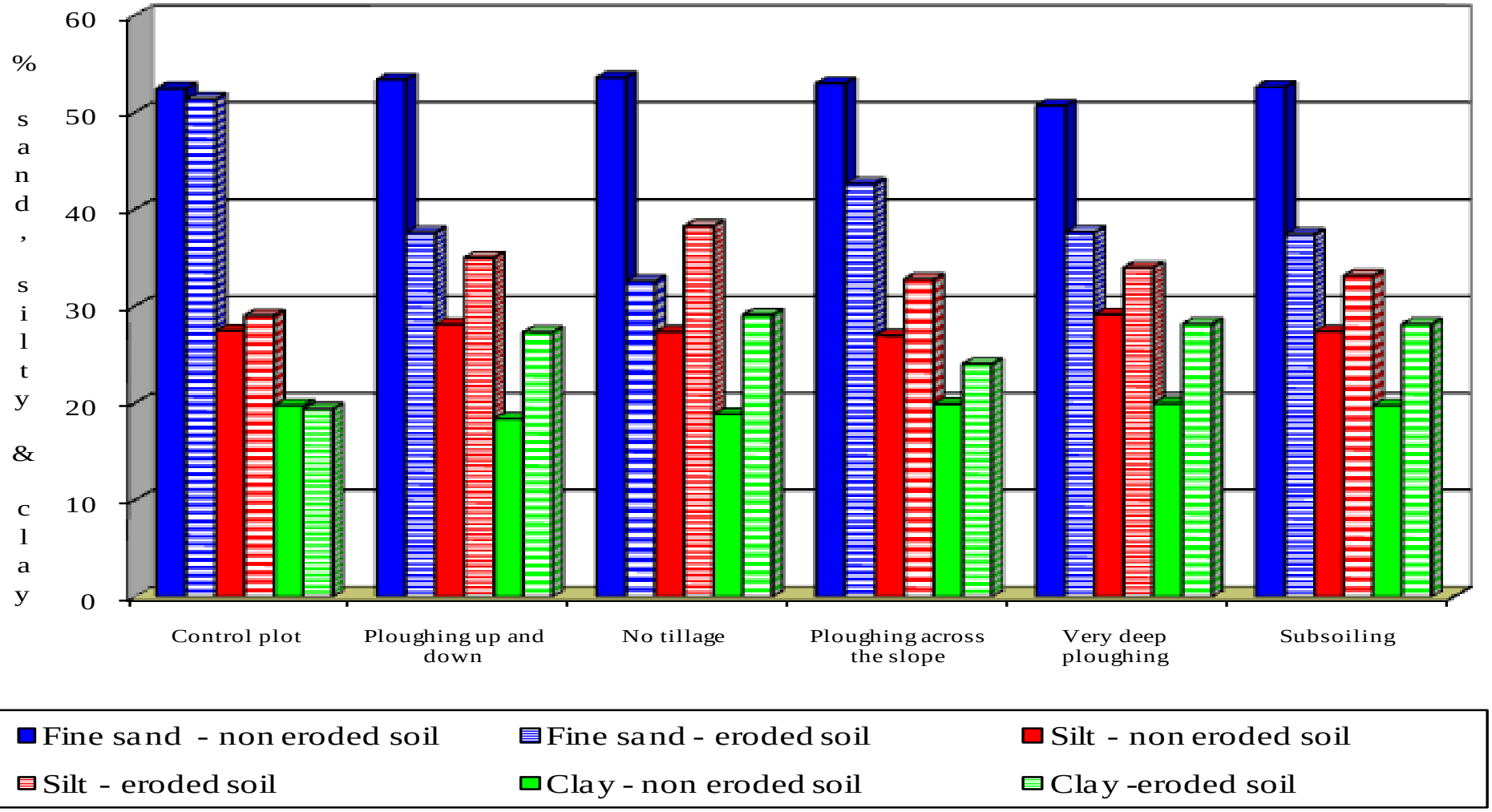
Runoff from total rain on diferent tillage systems and crops

Crops/Tillage methods (years of repetition)	Black fallow	Ploughing up/down the the slope	No-tillage	Ploughing across of the slope	Very deep ploughing across slope	Subsoiling + ploughing across slope
Maize (three years)	48	27	15	9	8	6
Soyabean (three years)	44	25	8	5	4	4
Winter wheat (three years)	41	7	6	3	3	1
Oil-seed rape (two years)	32	8	6	2	2	2
Spring barley + soyabean(two years)	28	8	6	2	2	1

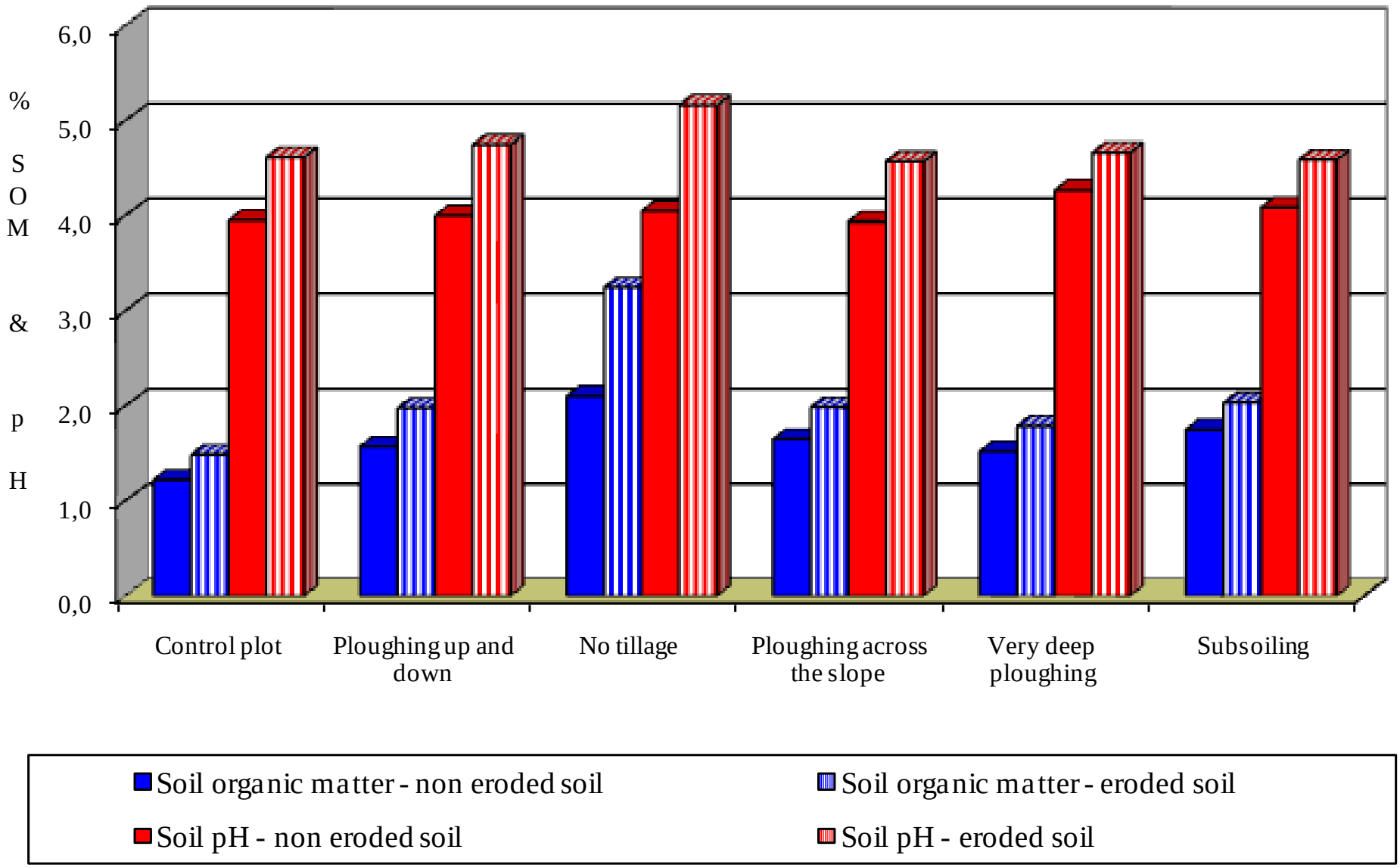

May 2005.
September 2005.
Check treatment


Nature (non eroded) soil
Run off & Soil loss

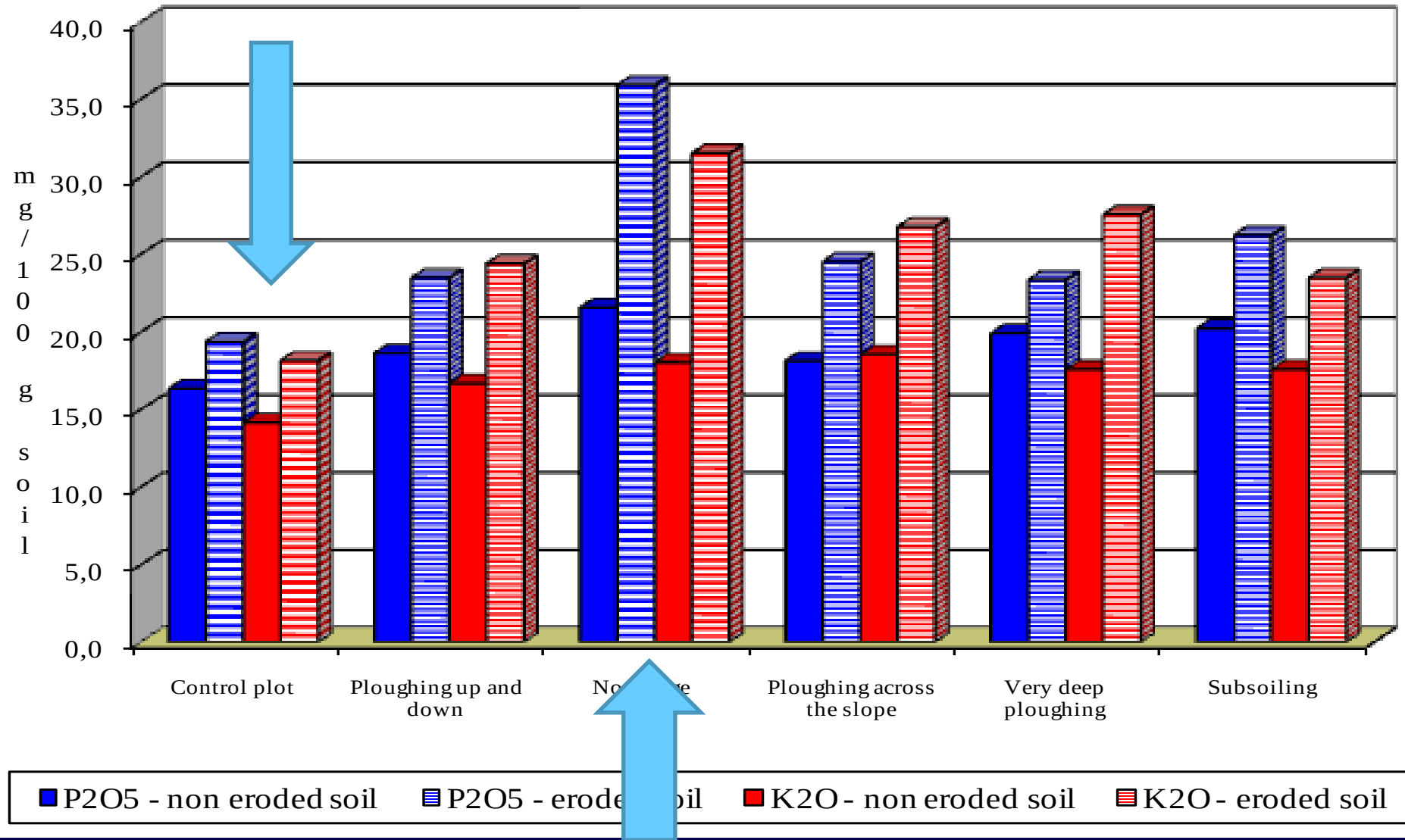
Average content of fine sand, silt and clay in non eroded soil and soil loss, average 16 years – 284 samples

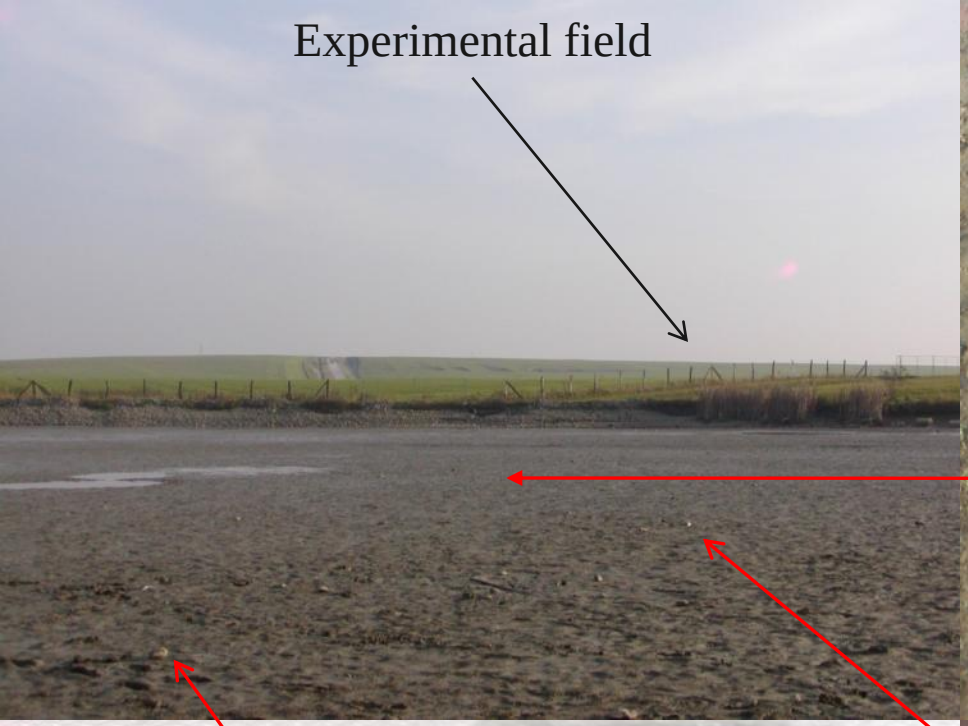


Soil organic matter and soil pH in non eroded soil and soil loss, average 16 years – 158 samples



Plant available phosporus and potassium in non eroded soil and soil loss, average 16 years – 118 samples




Experimental field


Mussel: *Anodonta woodiana*

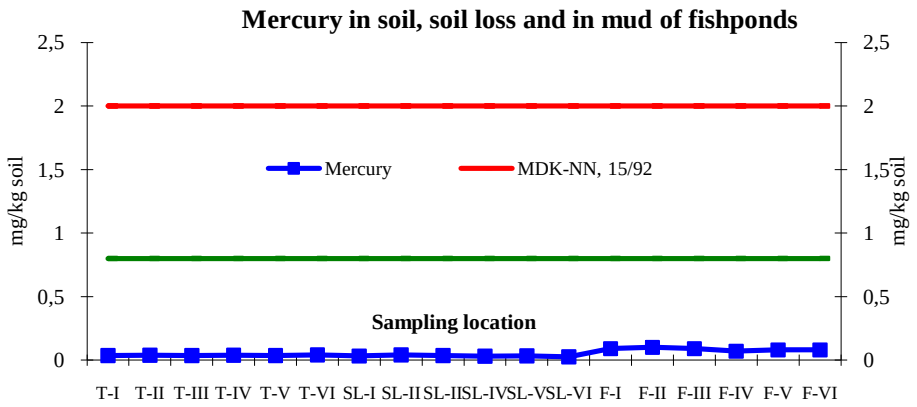
Concentrations of the elements (ash weight) determined in fresh water mussels

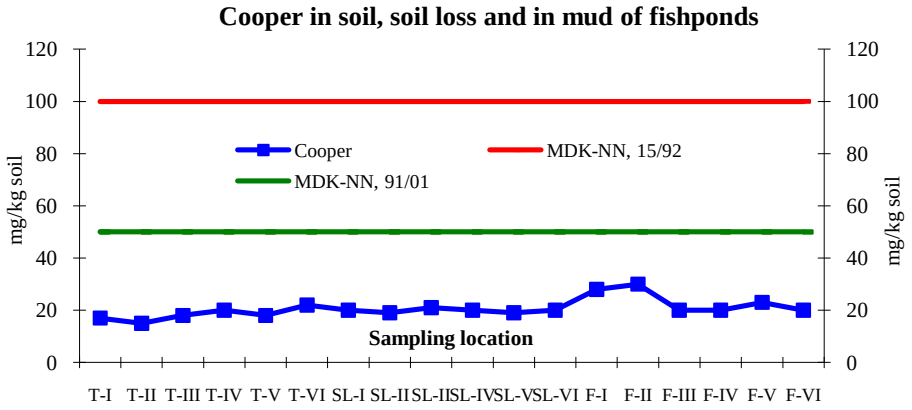
Element	1	2	3	4	5	6
Pb (ppm)	17	17	16	17	17	18
Rb (ppm)	7,4	7,5	7,3	7,5	7,4	7,6
Sr (ppm)	252	250	249	251	250	253
K (%)	1,68	1,65	1,63	1,67	1,66	1,69
Ca (%)	21	22	21	21	22	22
Mn (%)	1,21	1,14	1,12	1,19	1,14	1,24
Fe (%)	1,21	1,17	1,11	1,19	1,14	1,24
Cr (ppm)	18	24	18	21	19	24
Co (ppm)	3,0	2,6	2,5	2,7	2,4	3,1
Ni (ppm)	8	8	6	7	6	9
Cu (ppm)	34	34	33	34	33	34
Zn (ppm)	1055	1048	1041	1039	1052	1057

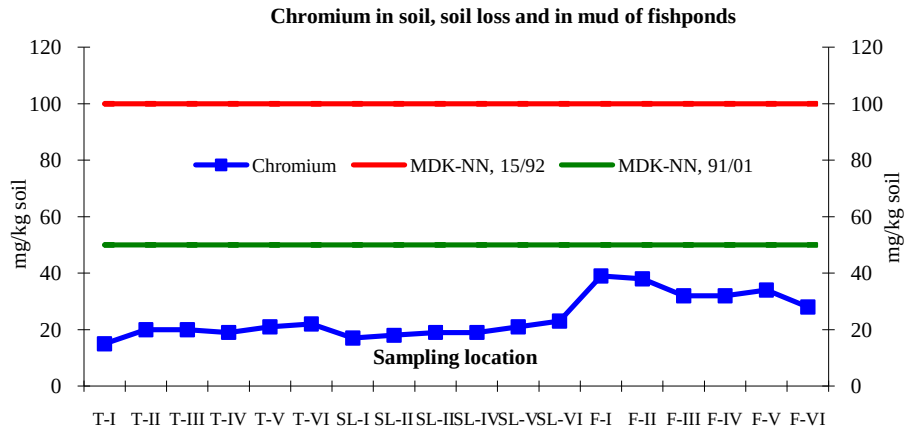
Basic statistic parameters for each element determined in fresh water mussels

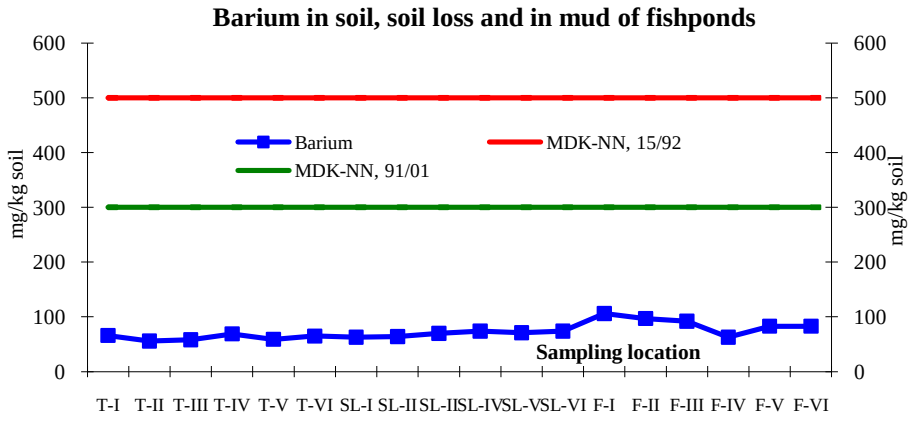
Element	**Mean**	Median	Min.	Max.	Std.Dev.
Pb (ppm)	**17,0***	17,0	16,0	18,0	0,6
Rb (ppm)	**7,5**	7,5	7,3	7,6	0,1
Sr (ppm)	**250,8**	250,5	249,0	253,0	1,5
K (%)	**1,66**	1,66	1,63	1,69	0,02
Ca (%)	**21,5**	21,5	21,0	22,0	0,5
Mn (%)	**1,17**	1,17	1,12	1,24	0,05
Fe (%)	**1,18**	1,18	1,11	1,24	0,05
Cr (ppm)	**20,7**	20,0	18,0	24,0	2,8
Co (ppm)	**2,7**	2,7	2,4	3,1	0,3
Ni (ppm)	**7,3***	7,5	6,0	9,0	1,2
Cu (ppm)	**33,7**	34,0	33,0	34,0	0,5
Zn (ppm)	**1048,7**	1050,0	1039,0	1057,0	7,4

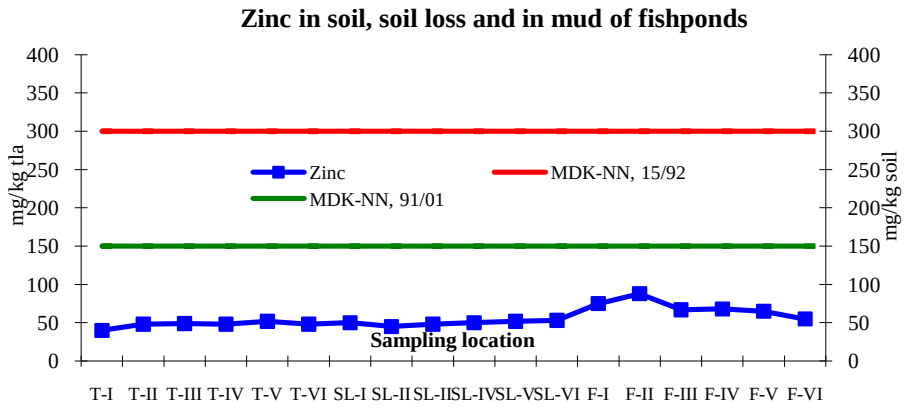
*Less from Regulations about maximum tolerant levels of some polutants in food, OG 154/08

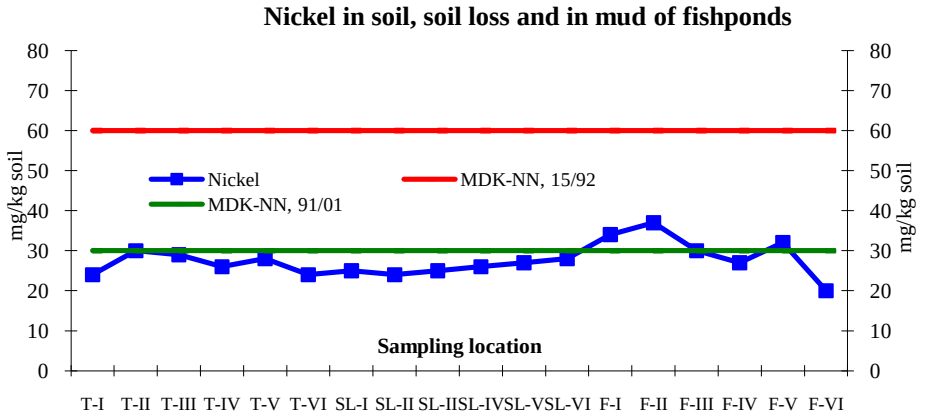

Mercury in soil, soil loss and in mud of fishponds
mg/kg soil
Mercury
MDK-NN, 15/92
Sampling location
T-I T-II T-III T-IV T-V T-VI SL-I SL-II SL-III SL-IV SL-V SL-VI F-I F-II F-III F-IV F-V F-VI

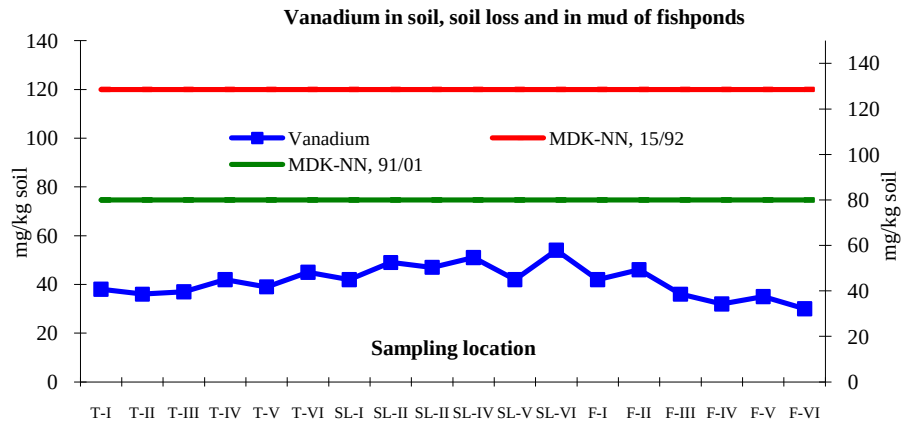

Cooper in soil, soil loss and in mud of fishponds
mg/kg soil
Cooper
MDK-NN, 15/92
MDK-NN, 91/01
Sampling location
T-I T-II T-III T-IV T-V T-VI SL-I SL-II SL-III SL-IV SL-V SL-VI F-I F-II F-III F-IV F-V F-VI

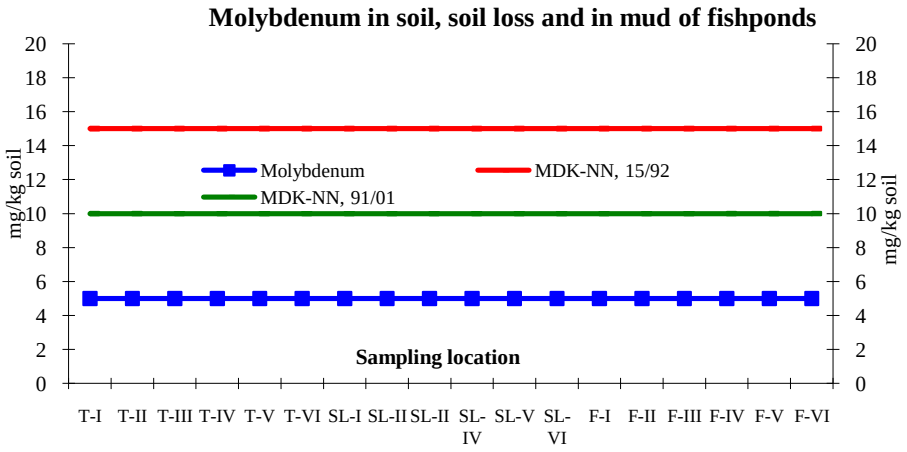

Chromium in soil, soil loss and in mud of fishponds
mg/kg soil
Chromium
MDK-NN, 15/92
MDK-NN, 91/01
Sampling location
T-I T-II T-III T-IV T-V T-VI SL-I SL-II SL-III SL-IV SL-V SL-VI F-I F-II F-III F-IV F-V F-VI

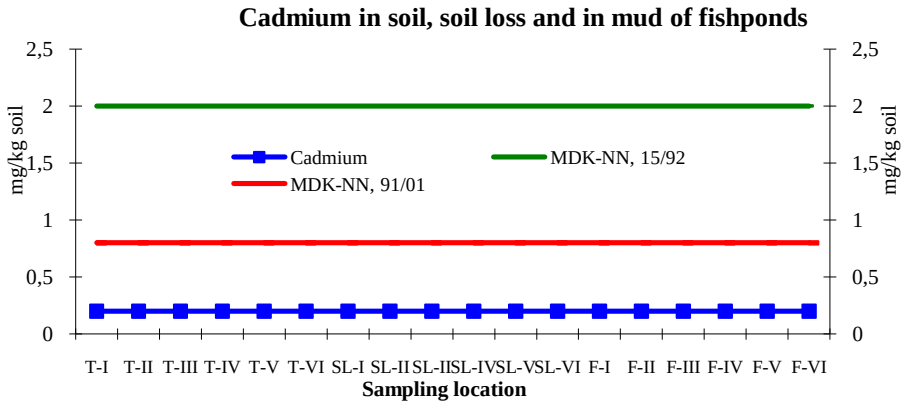

Barium in soil, soil loss and in mud of fishponds
mg/kg soil
Barium
MDK-NN, 15/92
MDK-NN, 91/01
Sampling location
T-I T-II T-III T-IV T-V T-VI SL-I SL-II SL-III SL-IV SL-V SL-VI F-I F-II F-III F-IV F-V F-VI

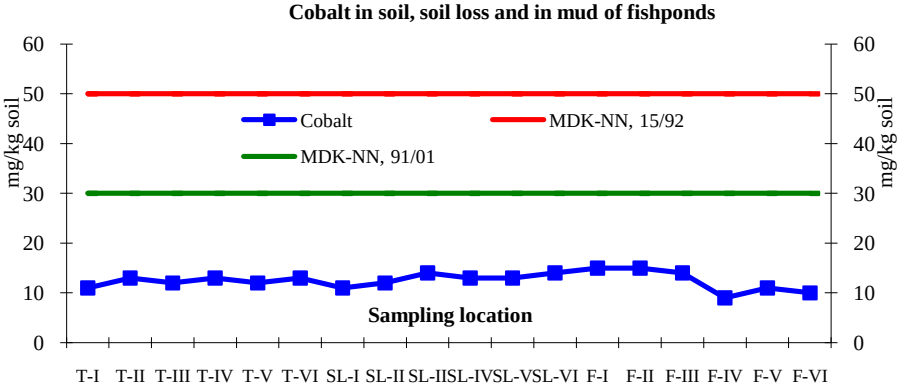

Zinc in soil, soil loss and in mud of fishponds
mg/kg tla
mg/kg soil
Zinc
MDK-NN, 15/92
MDK-NN, 91/01
Sampling location
T-I T-II T-III T-IV T-V T-VI SL-I SL-II SL-III SL-IV SL-V SL-VI F-I F-II F-III F-IV F-V F-VI

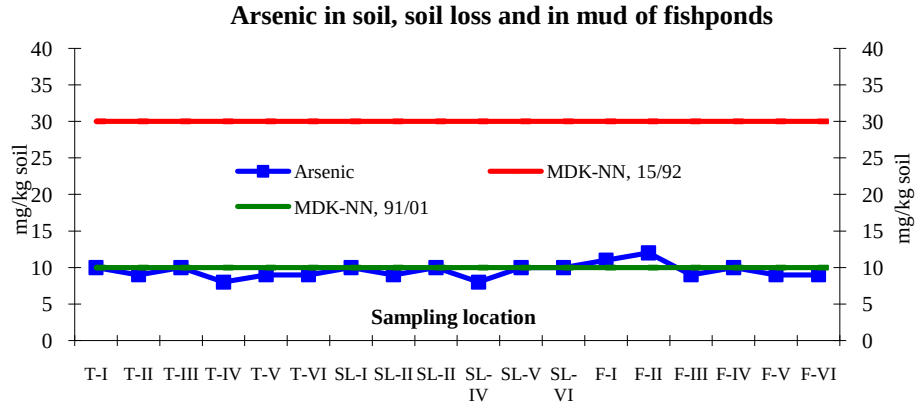

Nickel in soil, soil loss and in mud of fishponds
mg/kg soil
Nickel
MDK-NN, 15/92
MDK-NN, 91/01
Sampling location
T-I T-II T-III T-IV T-V T-VI SL-I SL-II SL-III SL-IV SL-V SL-VI F-I F-II F-III F-IV F-V F-VI

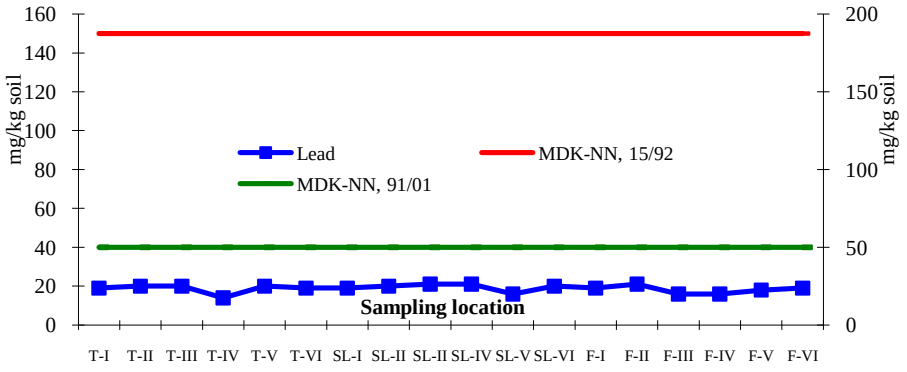

Vanadium in soil, soil loss and in mud of fishponds
mg/kg soil
Vanadium
MDK-NN, 15/92
MDK-NN, 91/01
Sampling location
T-I T-II T-III T-IV T-V T-VI SL-I SL-II SL-II SL-IV SL-V SL-VI F-I F-II F-III F-IV F-V F-VI


Molybdenum in soil, soil loss and in mud of fishponds
mg/kg soil
Molybdenum
MDK-NN, 15/92
MDK-NN, 91/01
Sampling location
T-I T-II T-III T-IV T-V T-VI SL-I SL-II SL-II SL-IV SL-V SL-VI F-I F-II F-III F-IV F-V F-VI

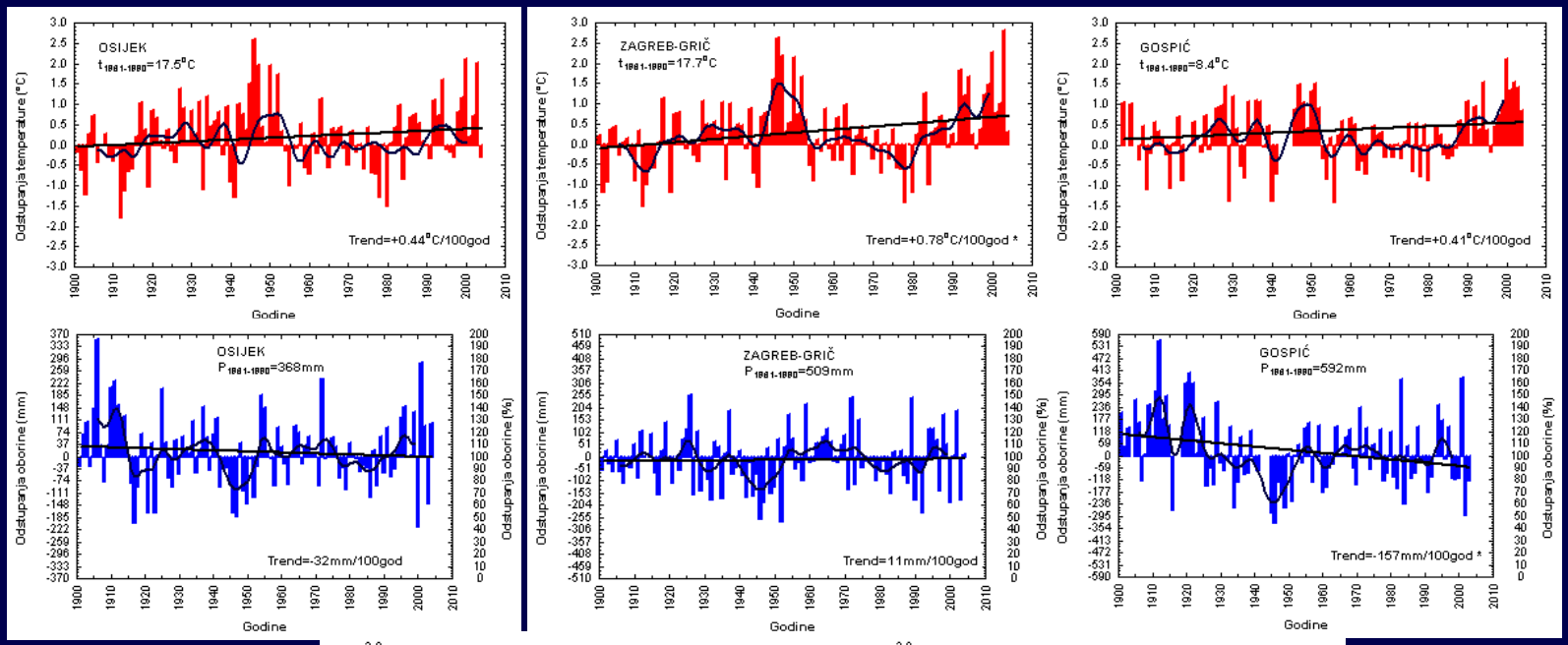

Cadmium in soil, soil loss and in mud of fishponds
mg/kg soil
Cadmium
MDK-NN, 15/92
MDK-NN, 91/01
Sampling location
T-I T-II T-III T-IV T-V T-VI SL-I SL-II SL-II SL-IV SL-V SL-VI F-I F-II F-III F-IV F-V F-VI

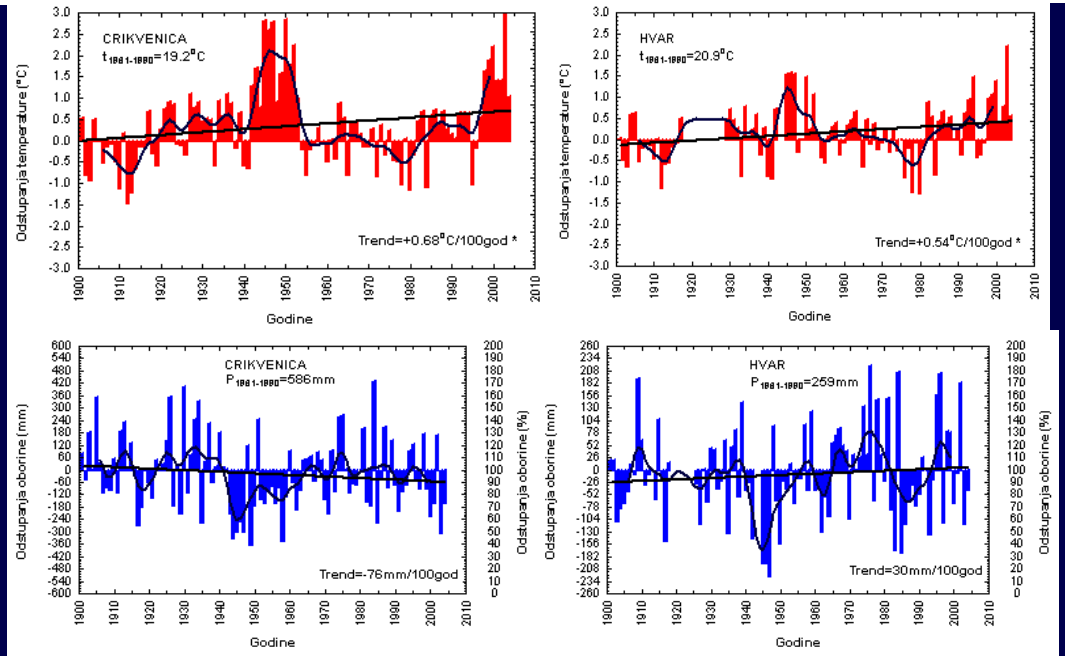

Cobalt in soil, soil loss and in mud of fishponds
mg/kg soil
Cobalt
MDK-NN, 15/92
MDK-NN, 91/01
Sampling location
T-I T-II T-III T-IV T-V T-VI SL-I SL-II SL-II SL-IV SL-V SL-VI F-I F-II F-III F-IV F-V F-VI


Arsenic in soil, soil loss and in mud of fishponds
mg/kg soil
Arsenic
MDK-NN, 15/92
MDK-NN, 91/01
Sampling location
T-I T-II T-III T-IV T-V T-VI SL-I SL-II SL-II SL-IV SL-V SL-VI F-I F-II F-III F-IV F-V F-VI


Lead in soil, soil loss and in mud of fishponds
mg/kg soil
Lead
MDK-NN, 15/92
MDK-NN, 91/01
Sampling location
T-I T-II T-III T-IV T-V T-VI SL-I SL-II SL-II SL-IV SL-V SL-VI F-I F-II F-III F-IV F-V F-VI

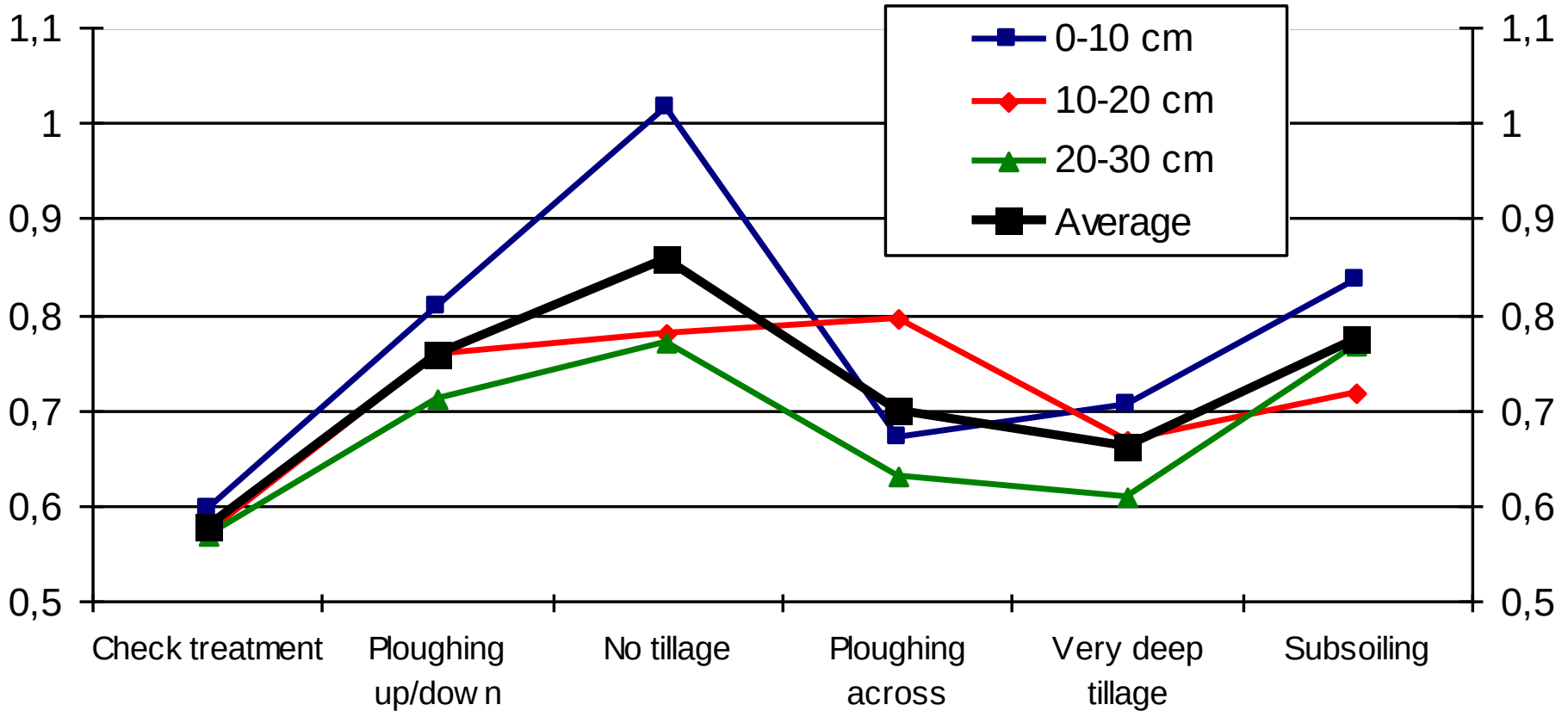
Çlimatic situation in Croatia, 1900-2000.



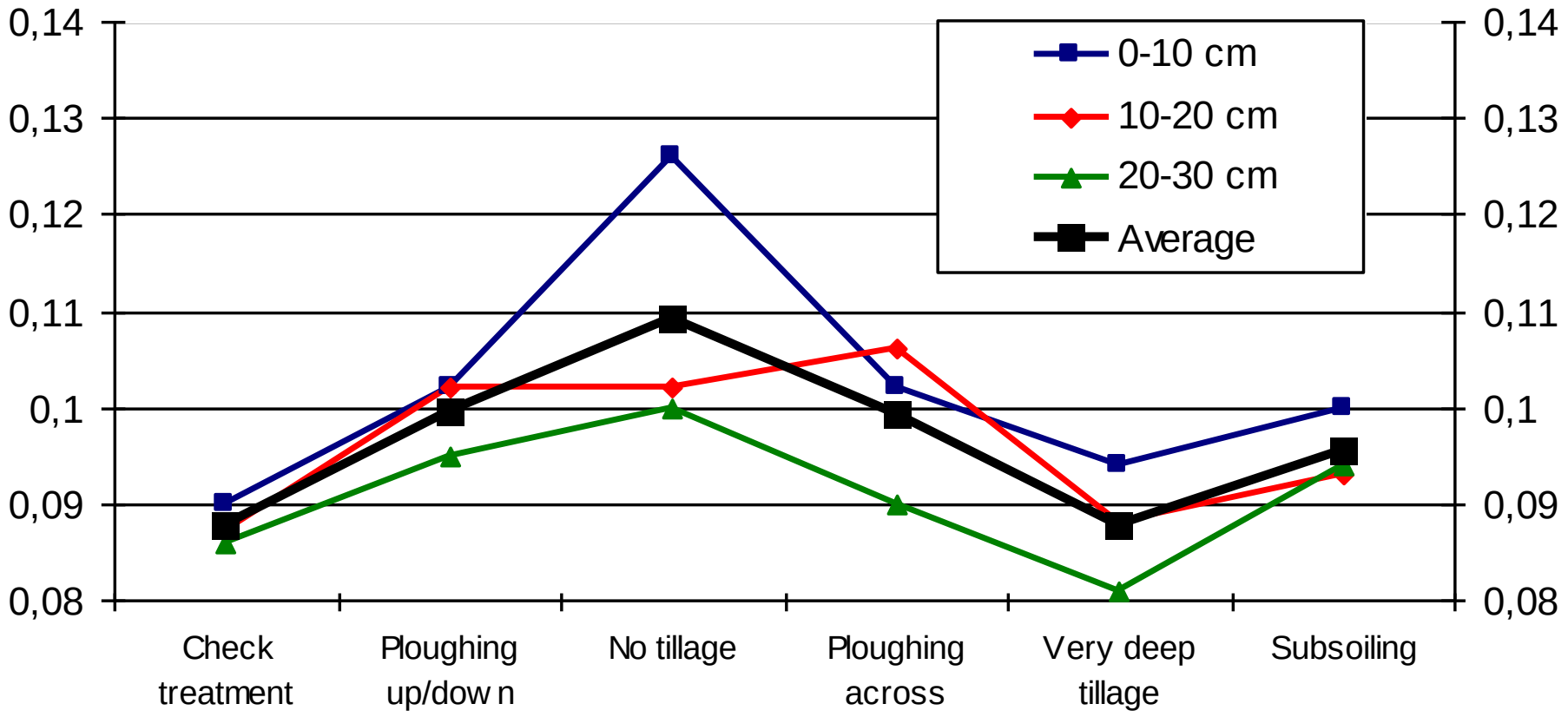


Source: National Action Plan to Combat Desertification RC, 2008.

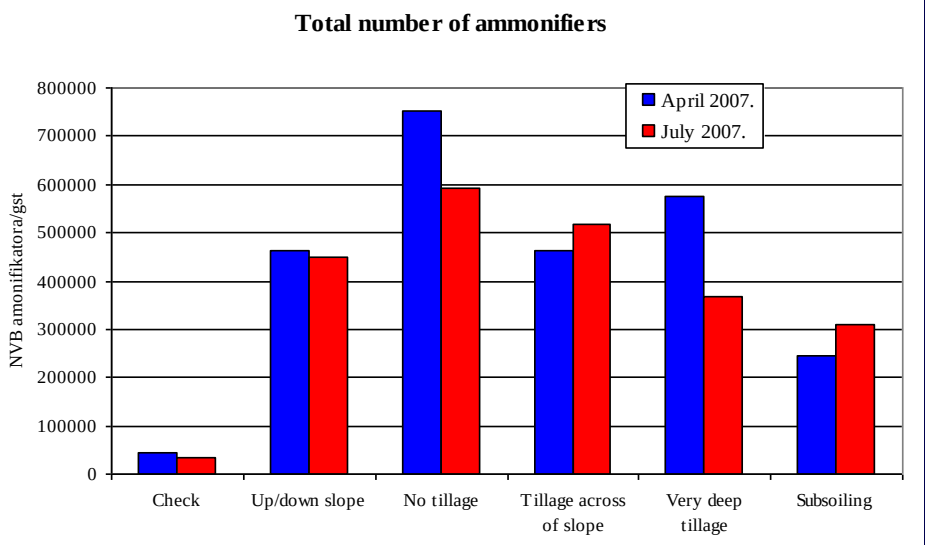
Changing of carbon (%) after 13 years of investigation

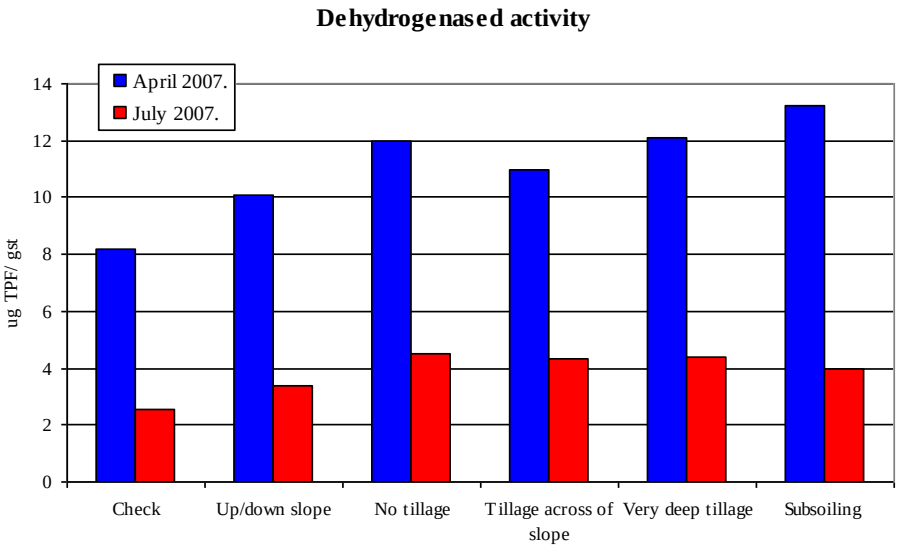


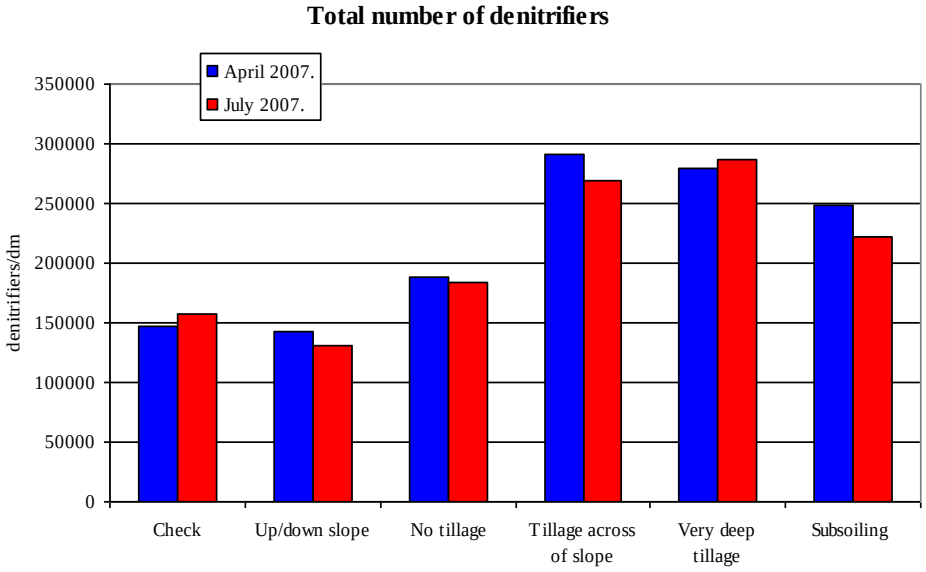
Changing of nitrogen (%) after 13 years of investigation

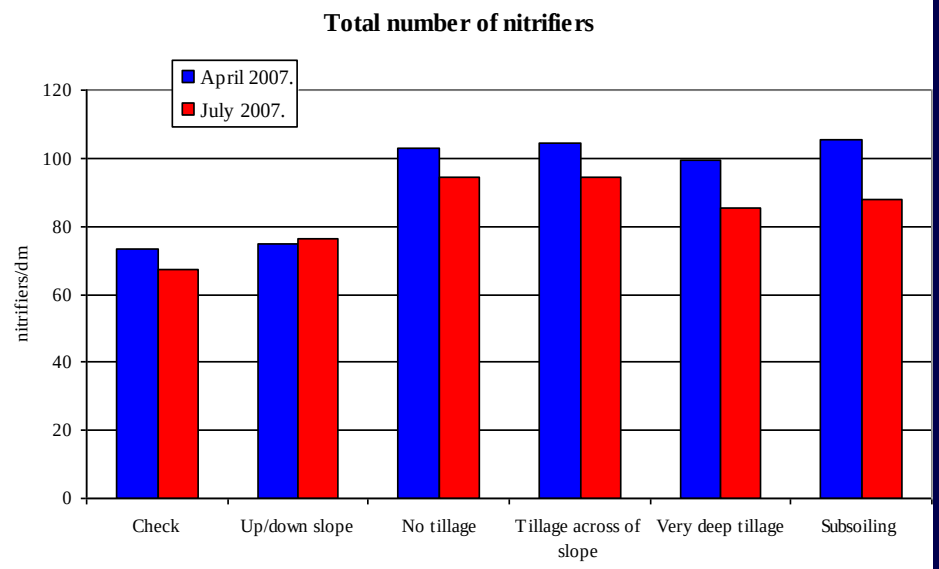


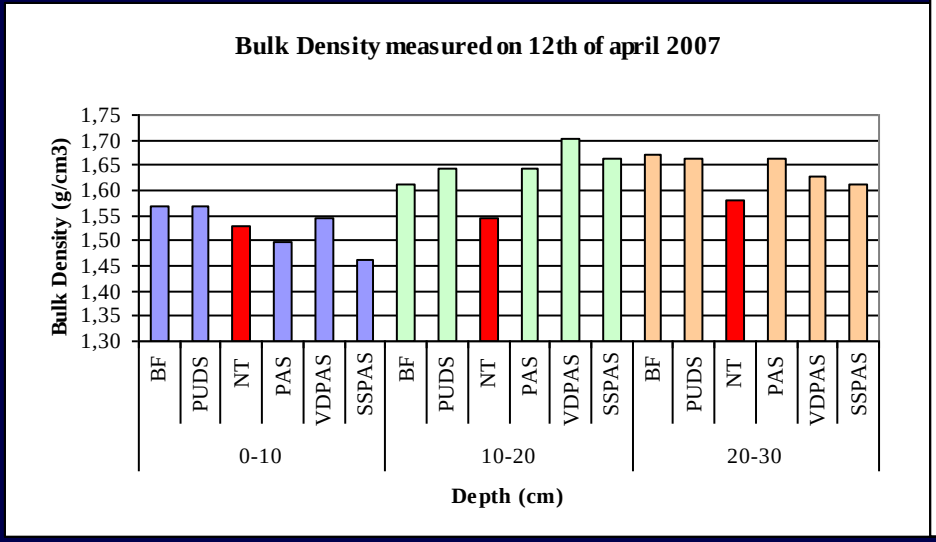
Microbiology pictures of soil after 13 years of use different tillage treatments

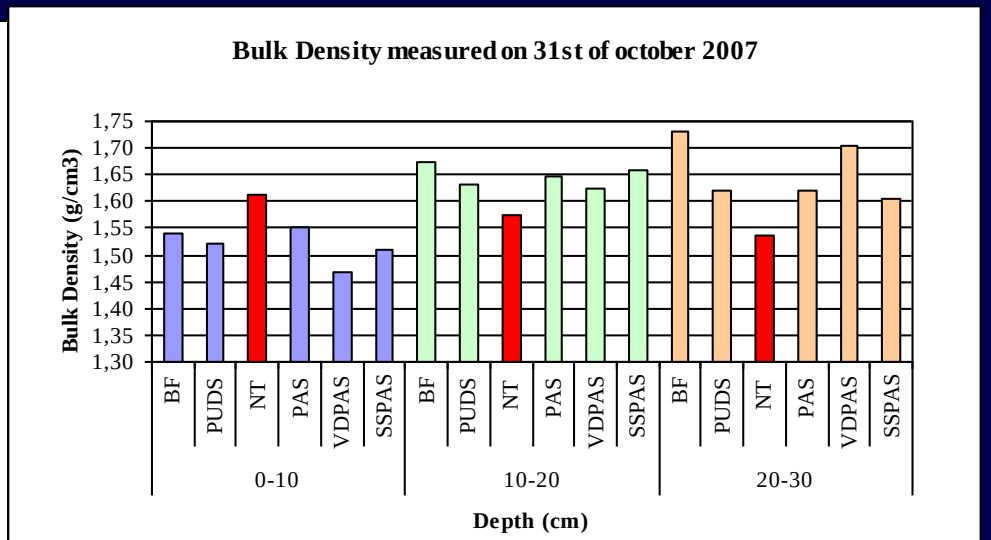


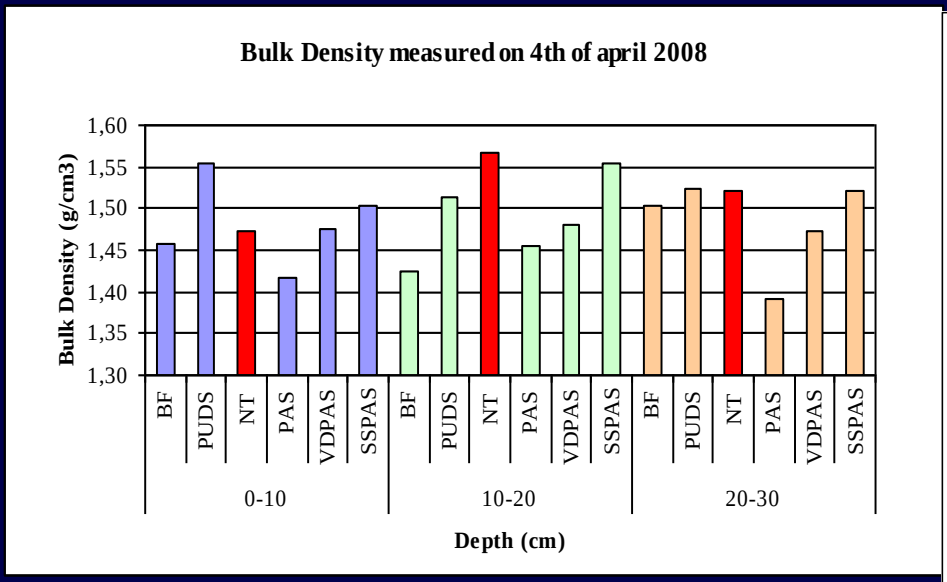







Bulk Density measured on 12th of april 2007
Bulk Density (g/cm3)
1,75
1,70
1,65
1,60
1,55
1,50
1,45
1,40
1,35
1,30
BF
PUDS
NT
PAS
VDPAS
SSPAS
0-10
10-20
20-30
Depth (cm)


Bulk Density measured on 31st of october 2007
Bulk Density (g/cm3)
1,75
1,70
1,65
1,60
1,55
1,50
1,45
1,40
1,35
1,30
BF
PUDS
NT
PAS
VDPAS
SSPAS
0-10
10-20
20-30
Depth (cm)


Bulk Density measured on 4th of april 2008
Bulk Density (g/cm3)
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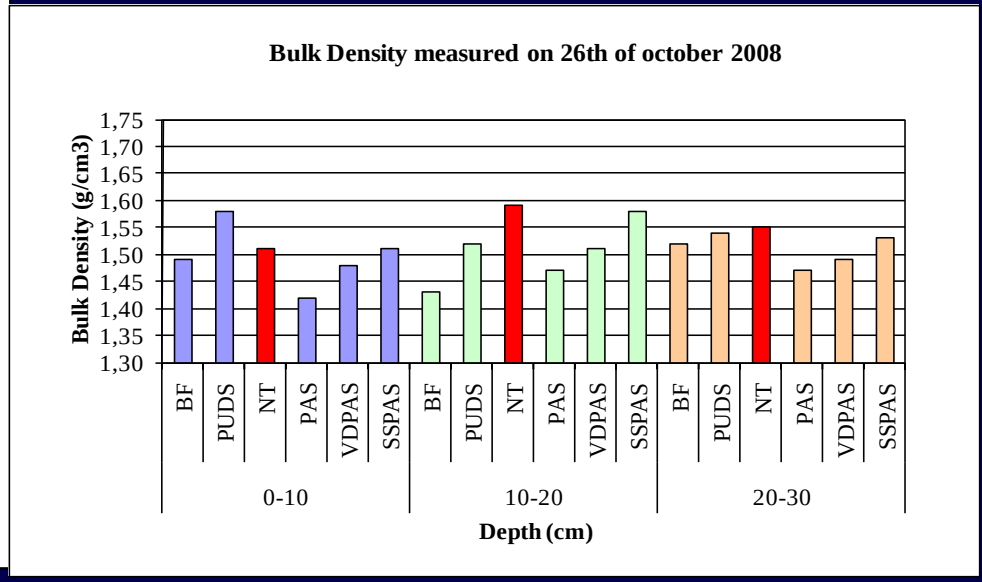
1,55
1,50
1,45
1,40
1,35
1,30
BF
PUDS
NT
PAS
VDPAS
SSPAS
0-10
10-20
20-30
Depth (cm)


Bulk Density measured on 26th of october 2008
Bulk Density (g/cm3)
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1,70
1,65
1,60
1,55
1,50
1,45
1,40
1,35
1,30
BF
PUDS
NT
PAS
VDPAS
SSPAS
0-10
10-20
20-30
Depth (cm)

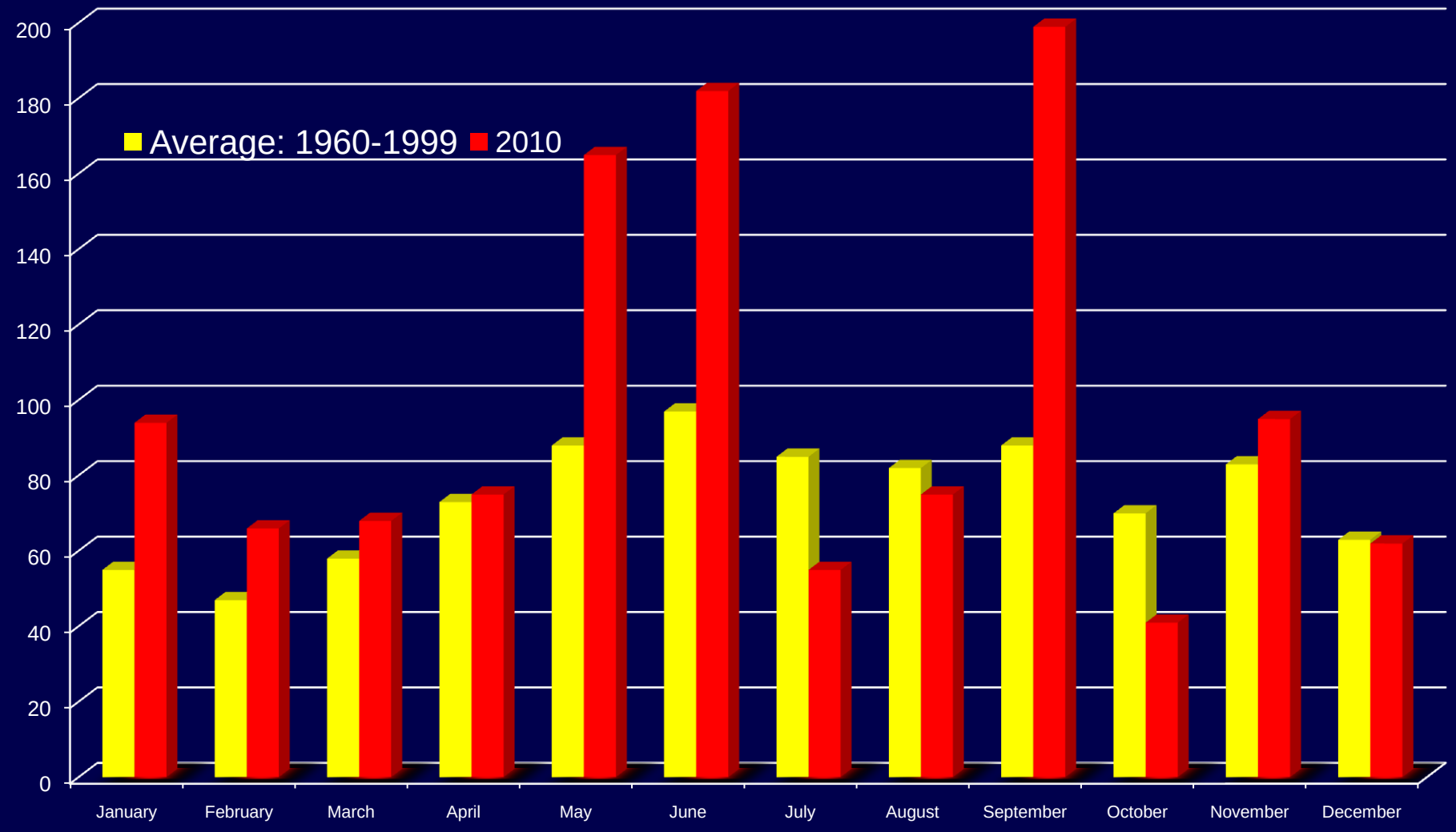
Conclusion

- Appreciably higher soil loss were recorded in the growing of low-density spring crops than in high-density winter crops in the same tillage systems.

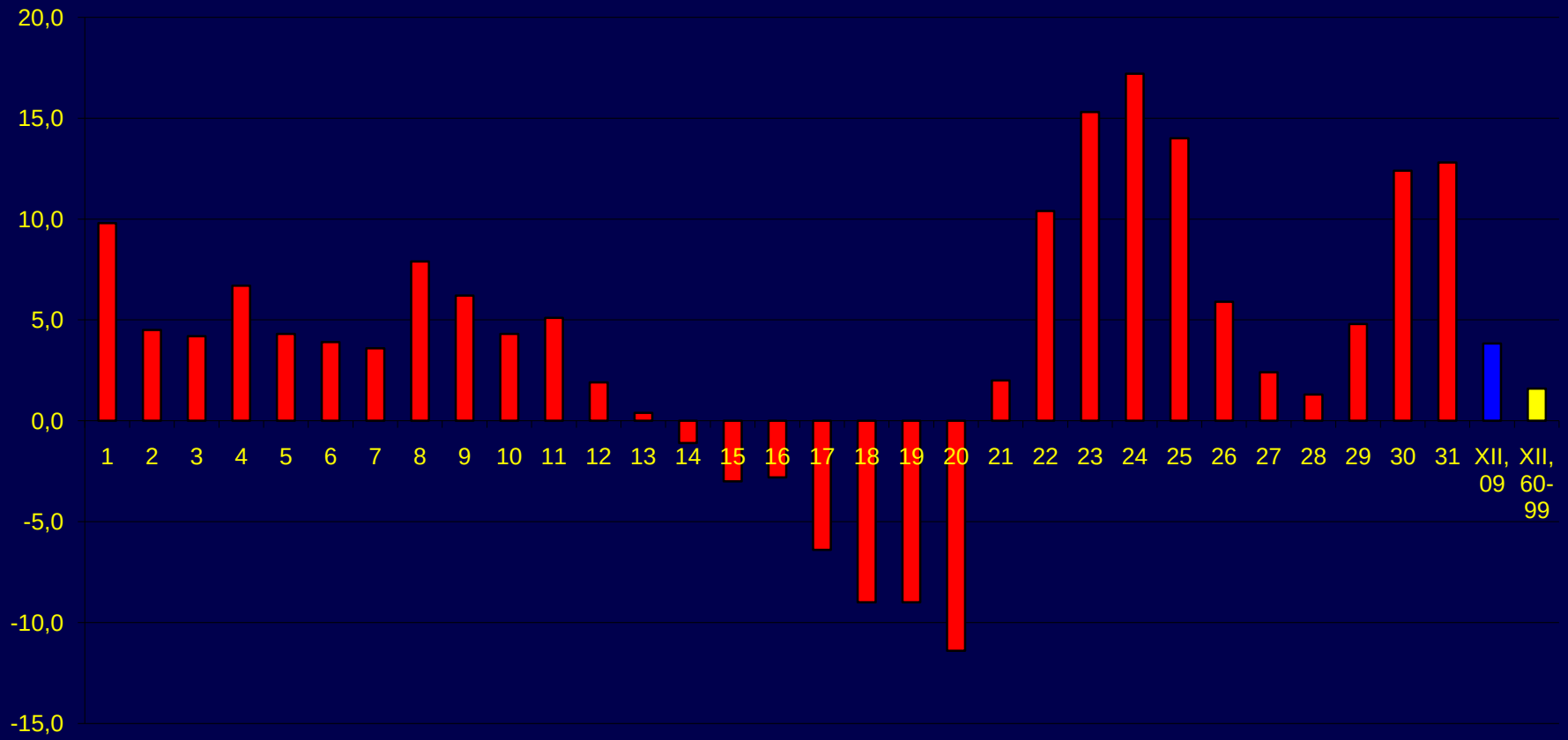
- The time immediately following the sowing of spring crops (SB-seedbed) is the most critical period (if are in field spring crops) - that is, the period when highest run-off and soil loss occur.

- Some kind of reduced tillage or tillage across the slope, growing of high-density crops are recommended as efficient practices of sustainable land management in the agroecological conditions of central Croatia.

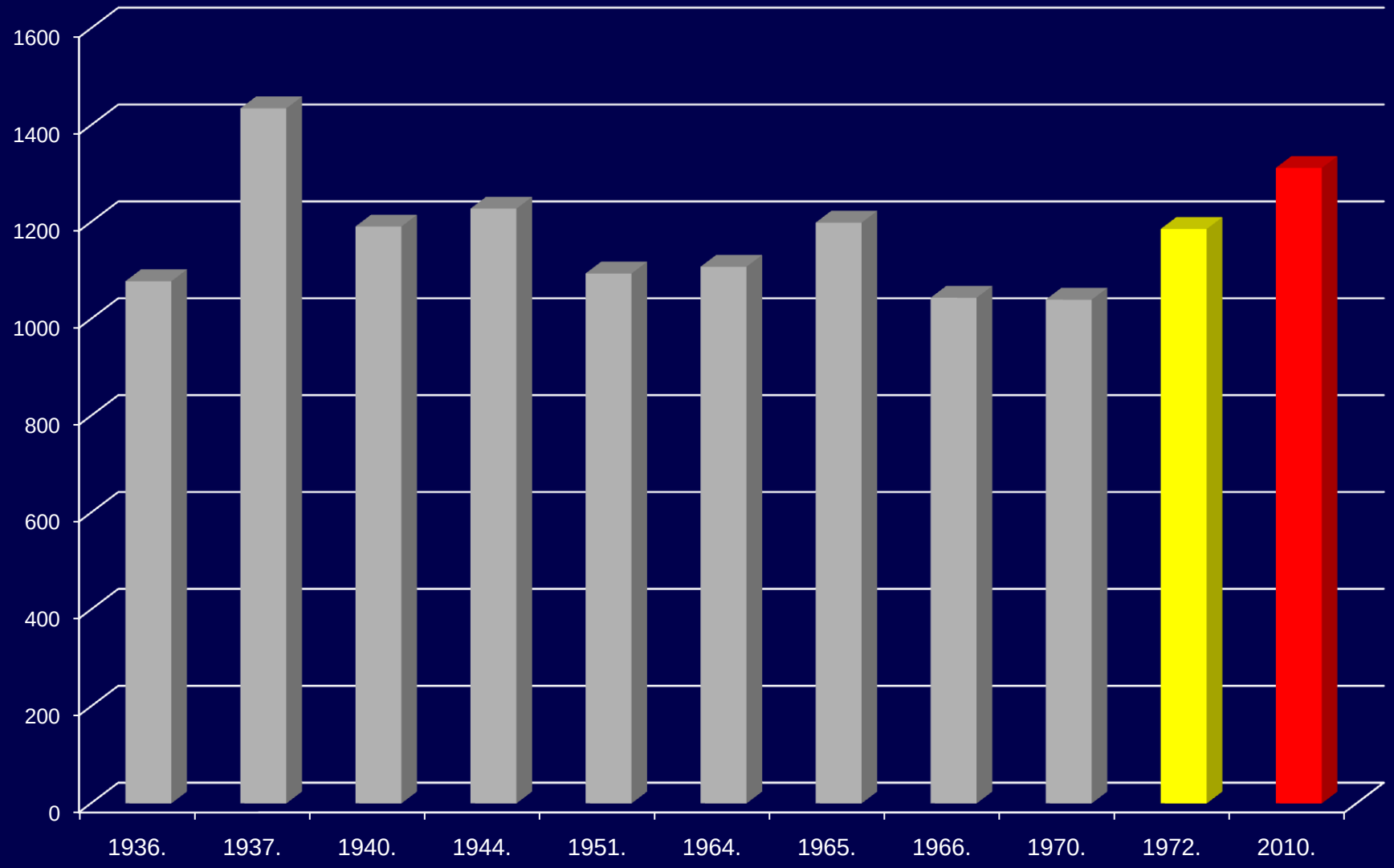
Mean monthly precipitation in the multiyear (1960-1999) and in the studied year (2010)



Daily temperature (oC) on the Daruvar area, December 2009. year



Years with more from 1000 mm of precipitations, Daruvar 1936-2010.



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