



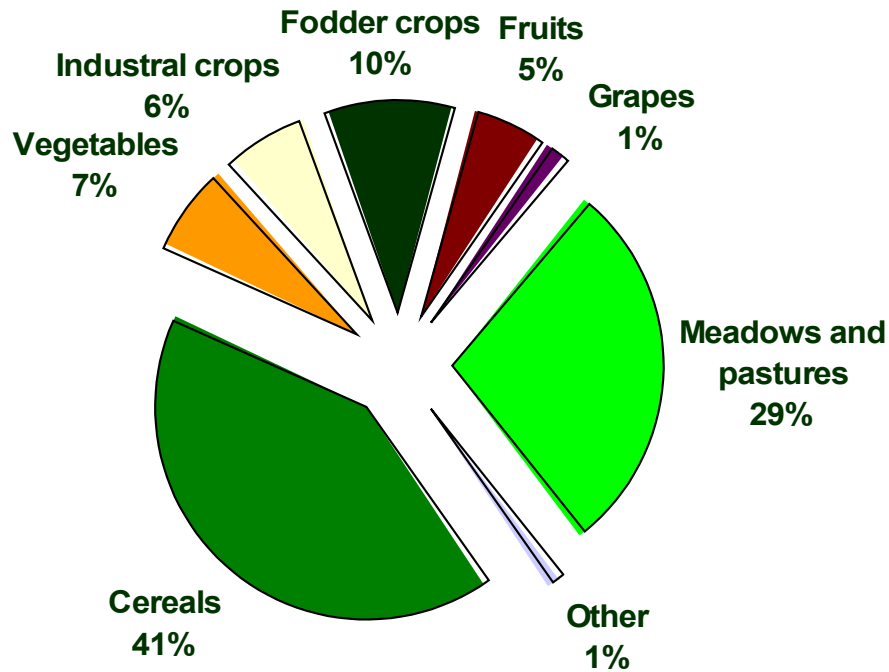
Humus management in Serbia - Research and implementation-

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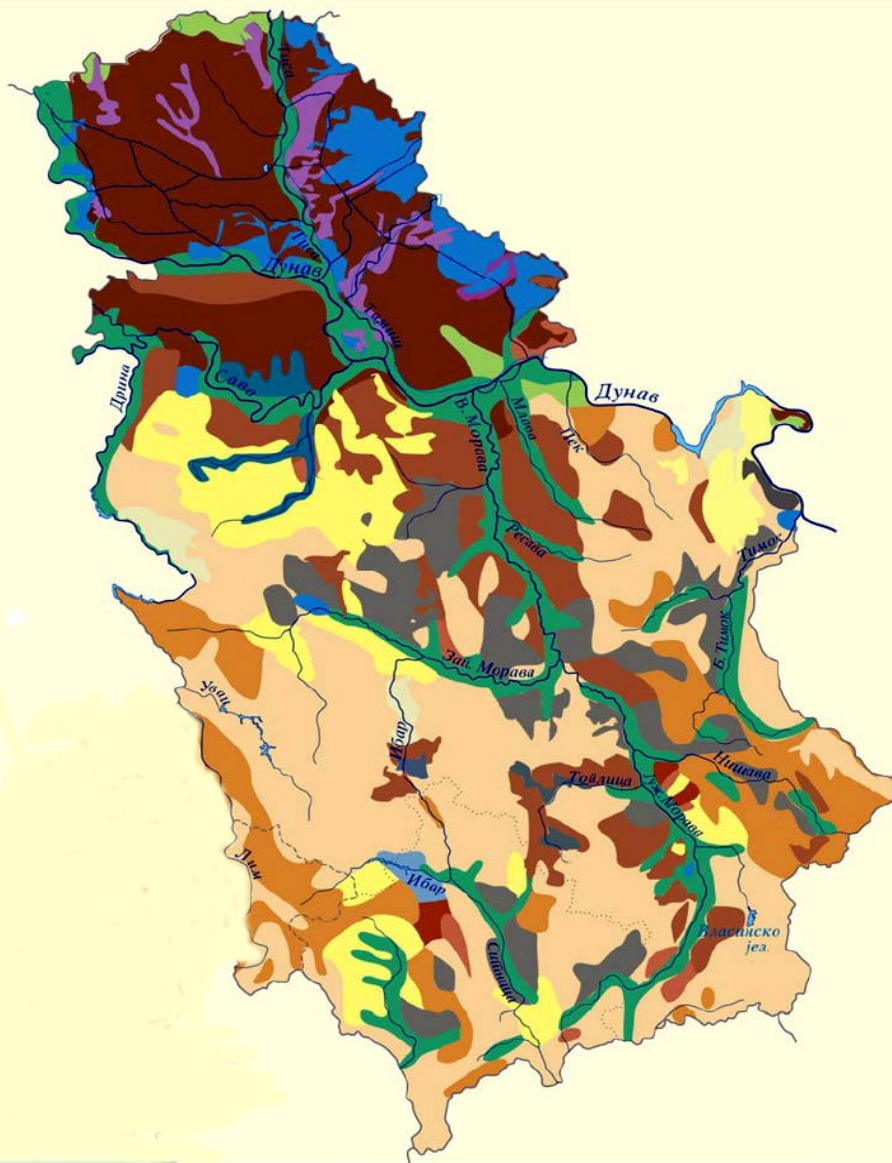


Structure of agricultural production in Serbia



5 092 000 ha of agricultural soil

Serbia - Soil map



Soil type	Area (ha)
Litosol	77.757
Arenosol	86.000
Calcomelanosol and Calkocambisol	910.000
Ranker	324.000
Chernozem	1.200.000
Vertisol	680.000
Eutric cambisol	437.000
Dystric cambisol	2.607.000
Soils on serpentine	268.000
Pseudogley	500.000
Fluvisol and Humogley	675.000
Solonshak i Solonetz	233.000

Chernozem	Eutric Cambisol (on loess)	Arenosol
Vertisol	Planosols - Luvisols	Fluvisols
Dystric Cambisol- Dystric Leptosol	Ferralic Cambisol	Regosols
Eutric Cambisol (on limestone) Mollic Leptosol	Lithic Leptosol- Dystric Cambisol	Solonetz- Solonshaks
	Stagnic Fluvisols - Mollic (Vertic) Gleysols	



Humus status in soils in Serbia

Monitoring

- Soil monitoring system not established
- Macro project:
“Control of soil fertility and determination of harmful and hazardous substances in soils on the territory of the Republic of Serbia”

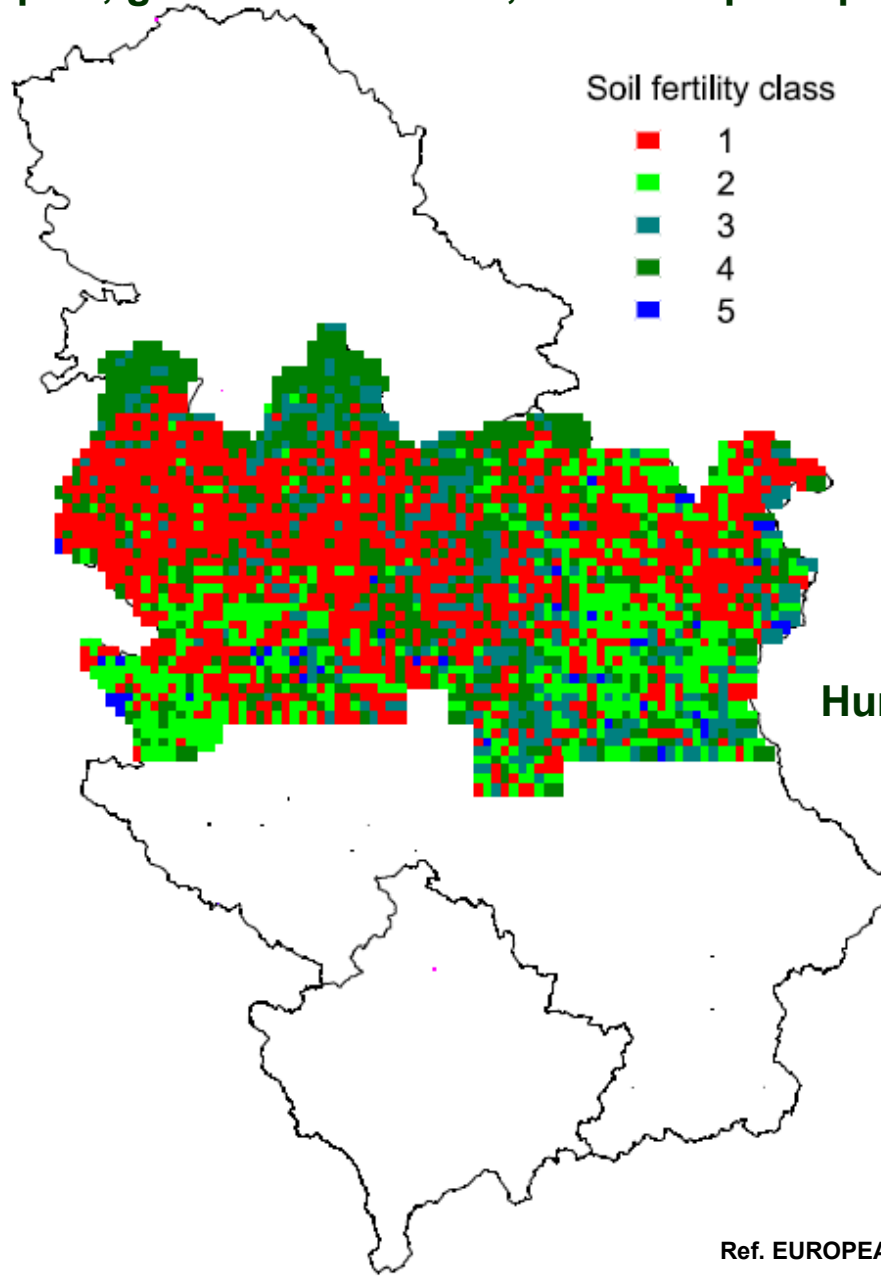


Research

- Humus loss
 - causes and effects
- Humus preservation and increase
- Humus quality
- Humus effect on:
 - soil properties
 - plant yield

Soil fertility classes in Central Serbia

(n = 1800 samples, grid scale 10 km², each sample representative for 1000 ha)



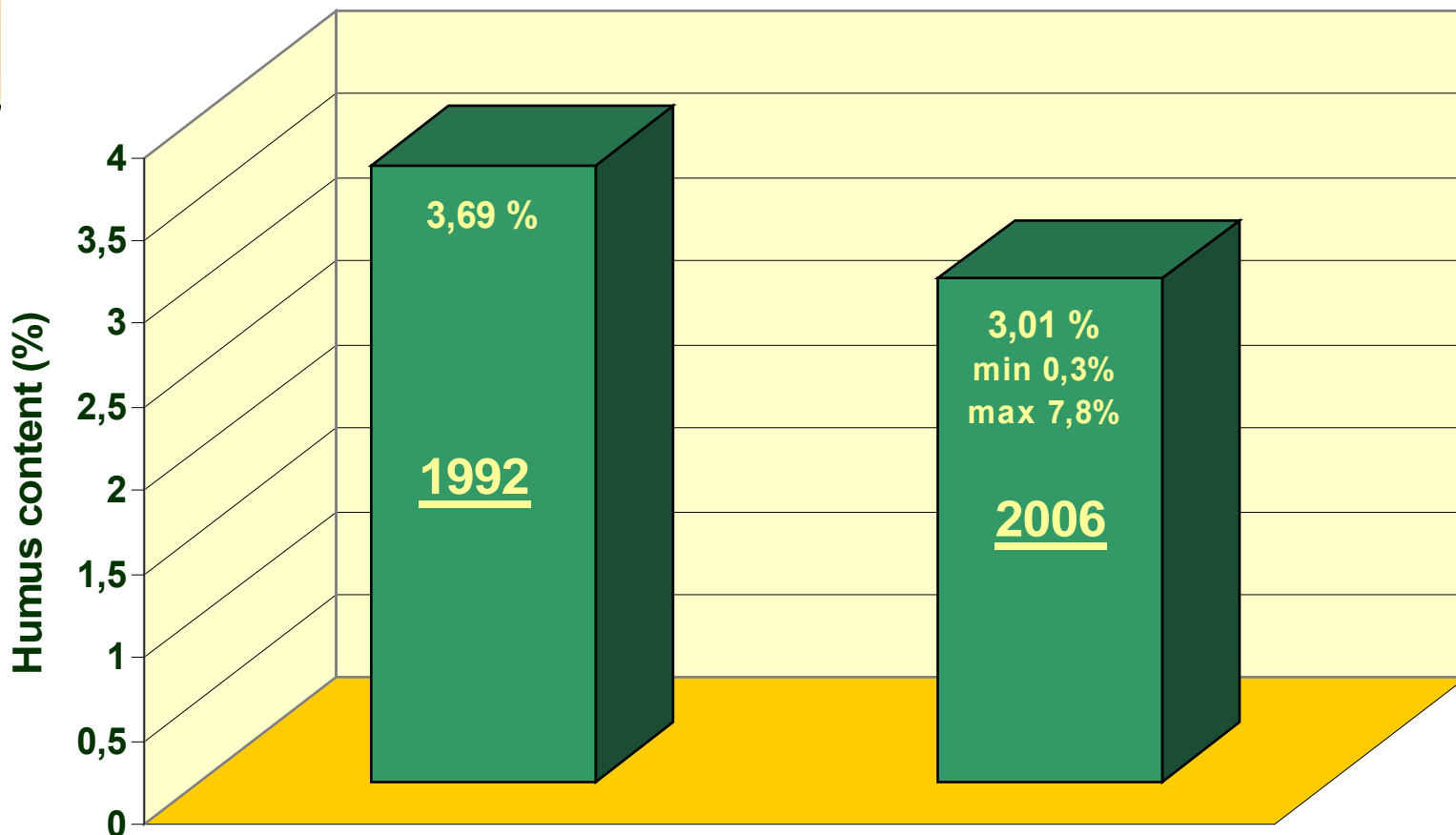
Humus content in the interval

1.5-2.5%

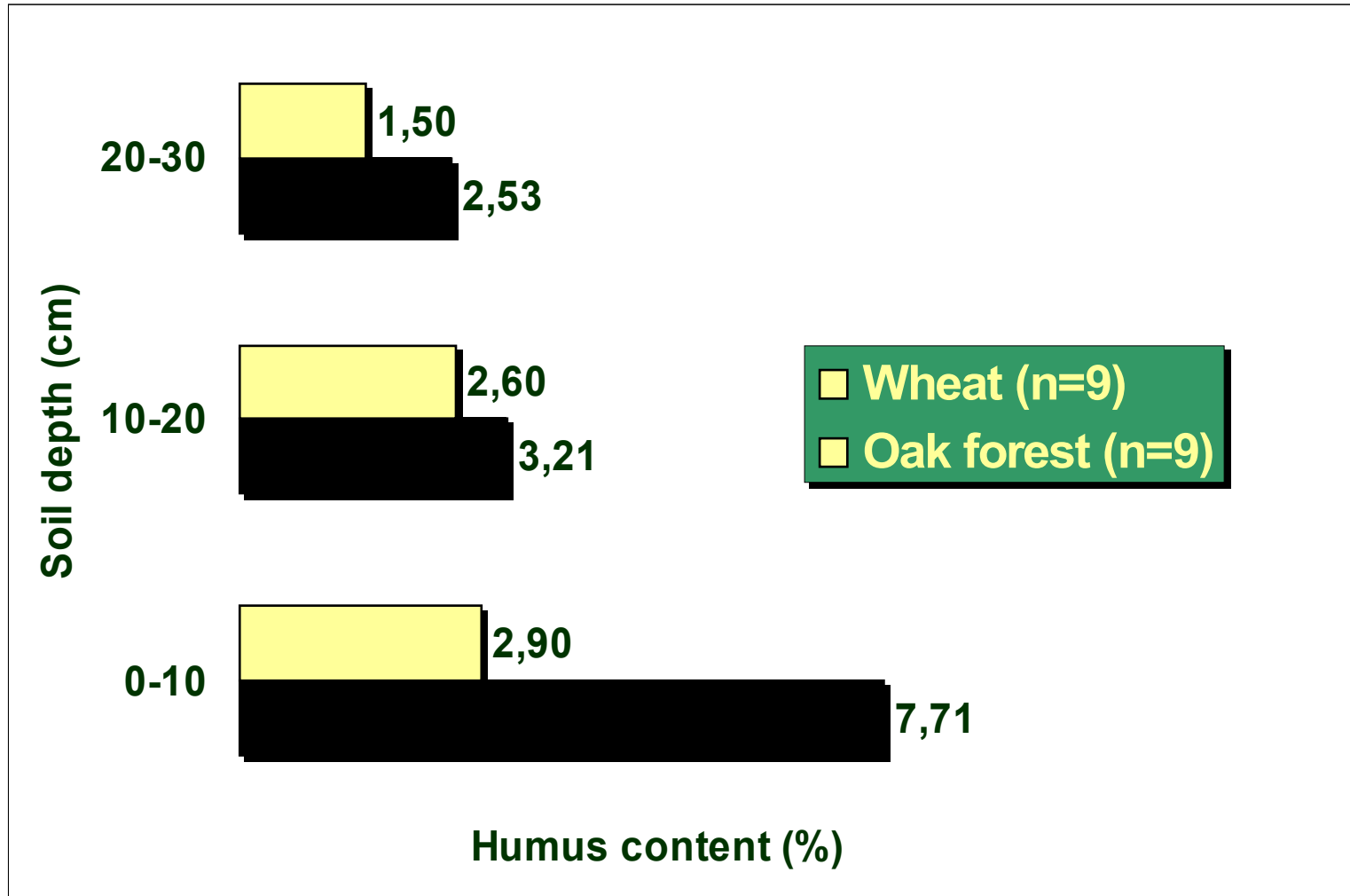
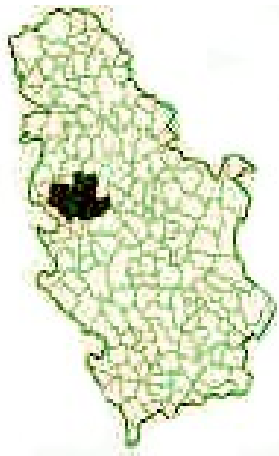


Humus status in Vojvodina soils (North Serbia)

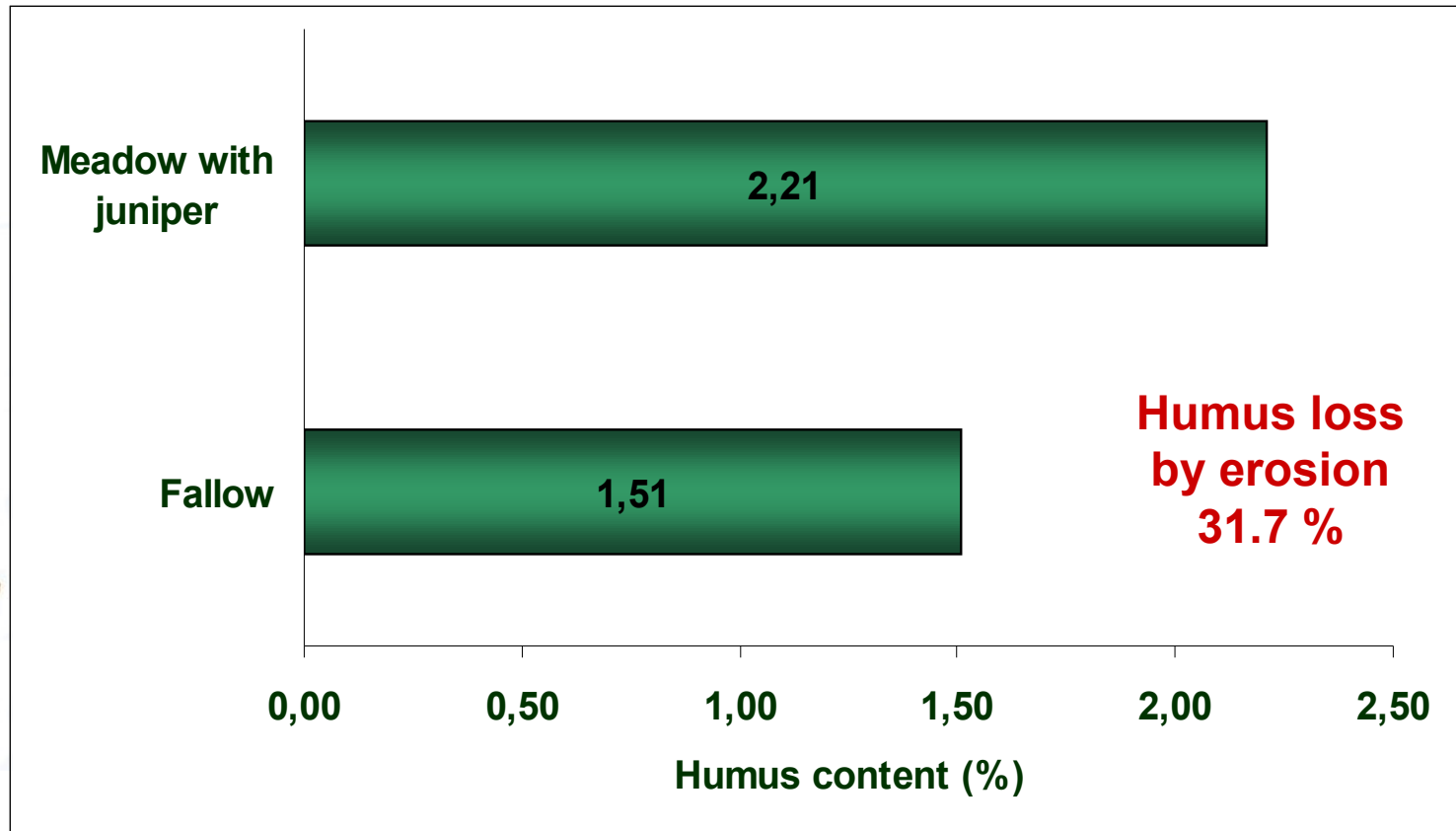
(n = 250 samples, grid scale 4x4 km, each sample representative for 1600 ha)



Decline of humus content in arable soils for 18.23 % in 14 years



Effect of cultivation (over 100 years) on humus content in gleyic fluvisol (part of West Serbia)



Effect of ploughing on humus content in Ah horizon (humus-silicate soil, Ranker)



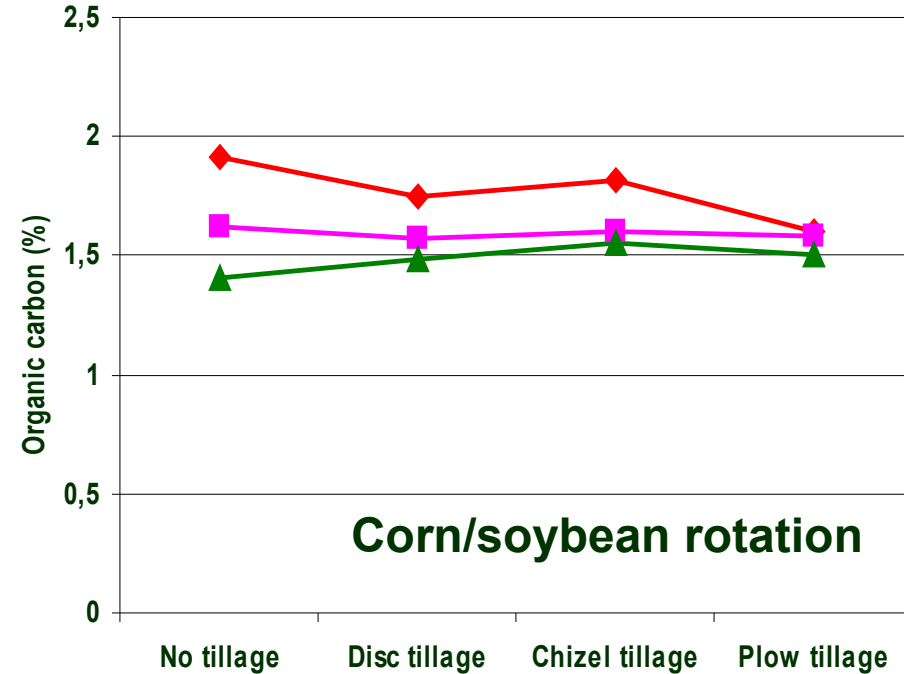
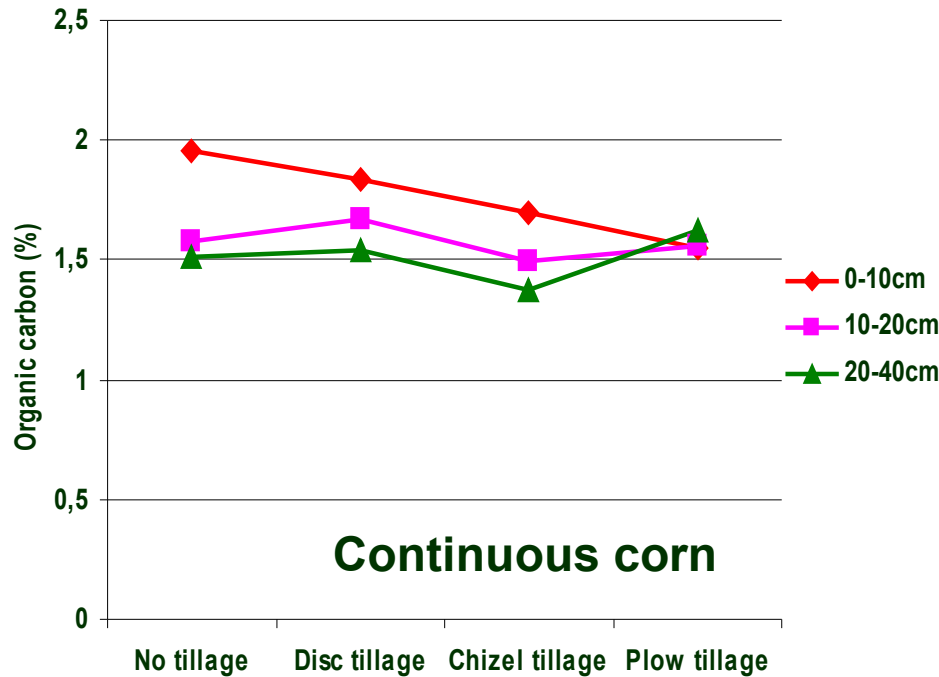
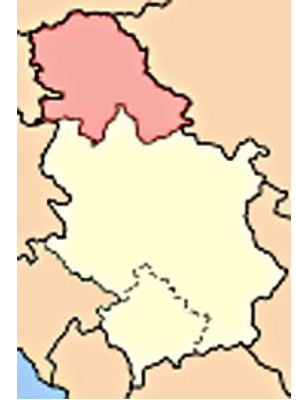
Effect of fertilization on humus content

Variant	0-20cm soil layer	20-40 cm soil layer
Control	2.89	2.69
Mineral fertilizer (664 kg/ha NPK 15-15-15)	2.90	2.82
Beef manure (60 t/ha - applied every third year)	3.28	3.14
Beef manure + NPK	3.10	3.20
Cornstalks (8t/ha - applied every year) + beef manure	3.33	3.07
Cornstalks + beef manure + NPK	3.32	3.06
		F= 2.979*
		Lsd (0.05)=0.32; Lsd (0.01)=0.11

- Long-term experimental field of the Maize Research Institute, set up in 1971. on Chernozem
- Soils samples taken after 25 years



Impact of tillage method and crop rotation on organic carbon concentration in Chernozem (North Serbia – Vojvodina province)

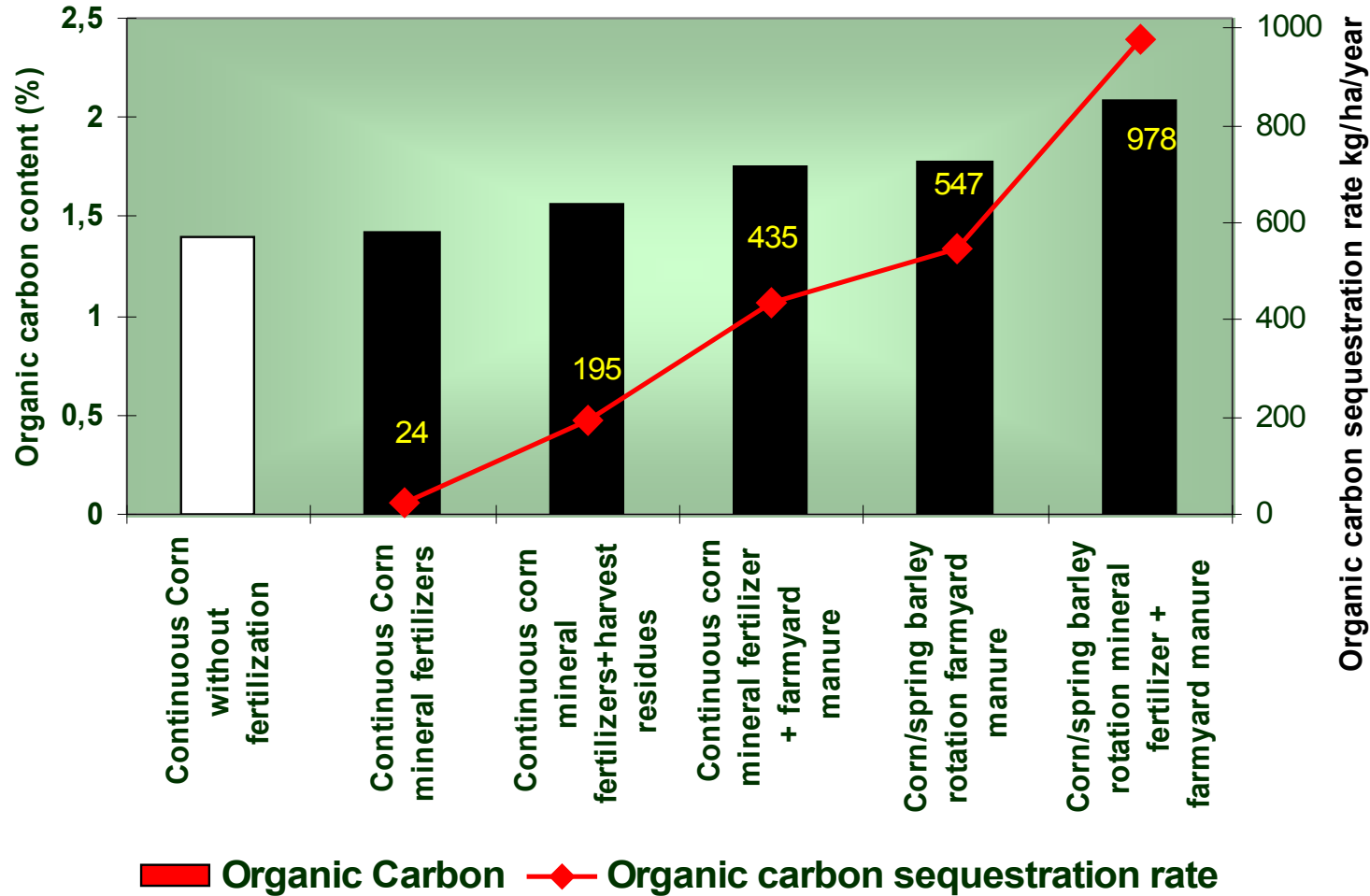


-Long-term experimental field of the Institute of Field and Vegetable Crops, established in 1988

-Mineral NPK fertilizer 15-15-15 added in the rate 300kg/ha for corn and soybean in the autumn, and 60 kgN/ha for corn in the spring, before sowing

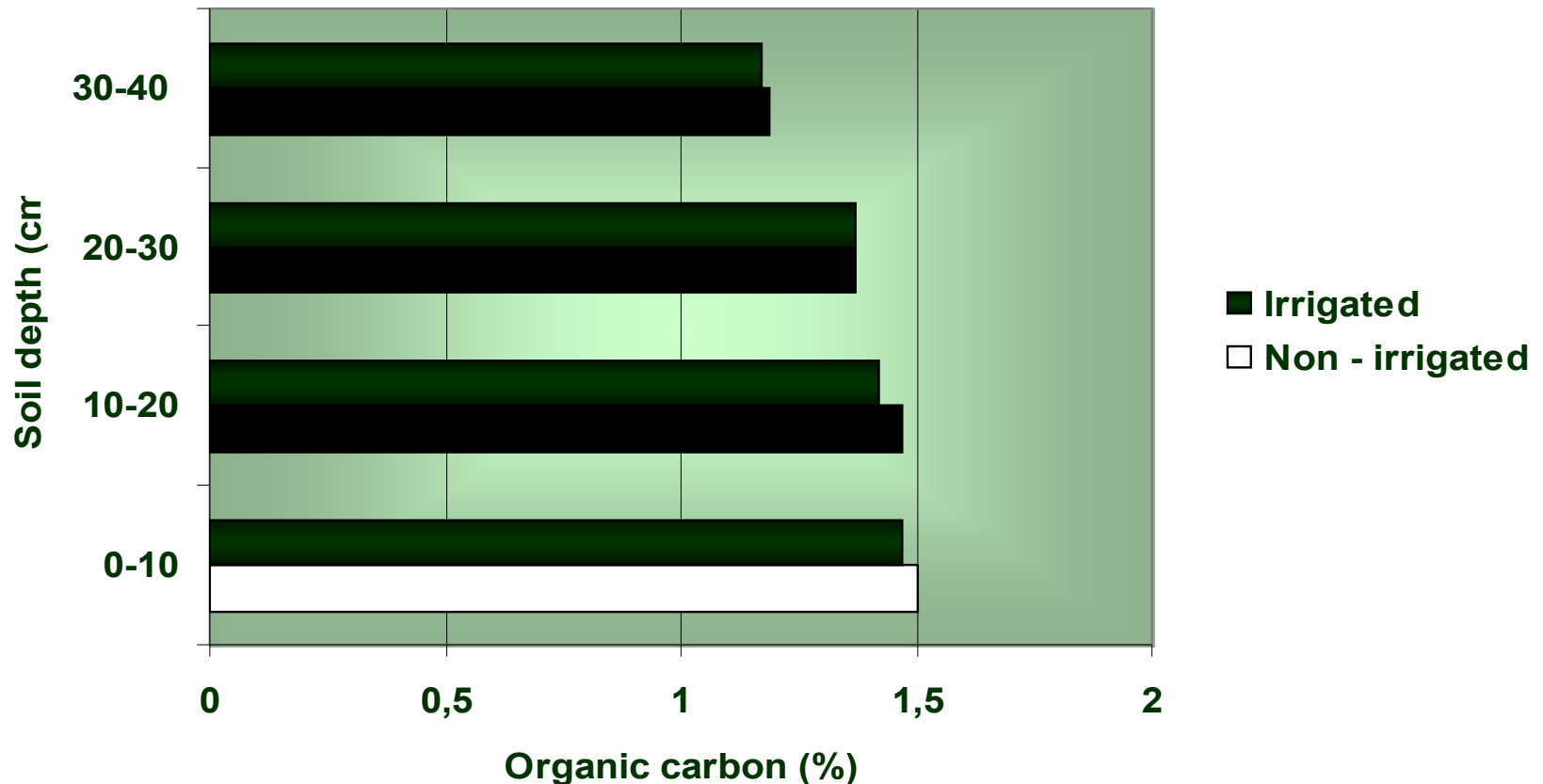
- Soils samples taken after 7 years

Impact of crop rotation and fertilization on organic carbon concentration in Chernozem (North Serbia – Vojvodina province)



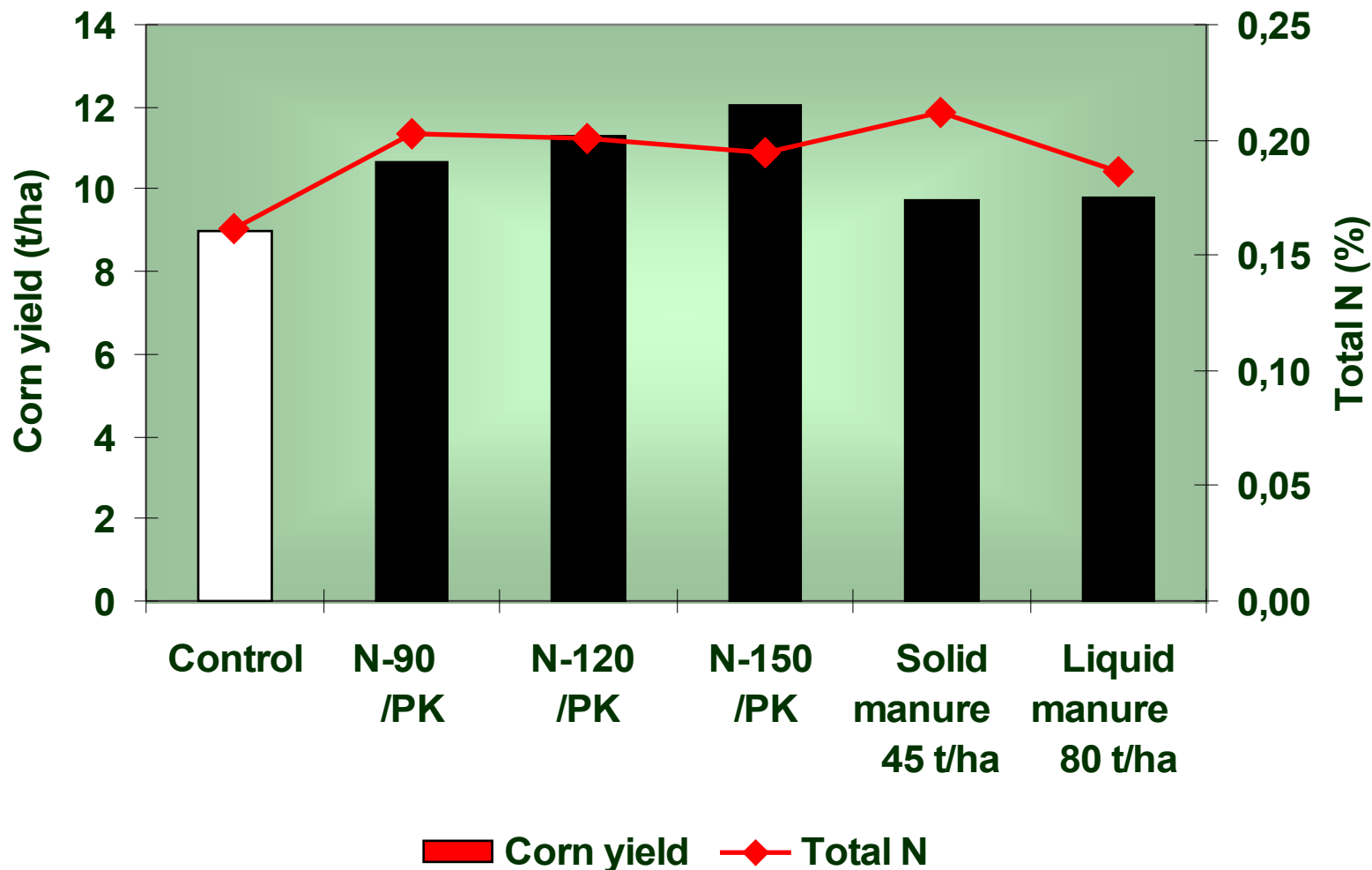
- Long-term experimental field of the Institute of Field and Vegetable Crops, established in 1962-1967
- The doses of mineral fertilizers: 130 kg N/ha; 70 kg P₂O₅/ha, 70 kg P₂O₅/ha every year
- Farm yard manure applied every other year in amount 25 t/ha
- Soils samples taken after 30-35 years

Effect of irrigation and crop rotation on organic carbon concentration in Chernozem (North Serbia – Vojvodina province)



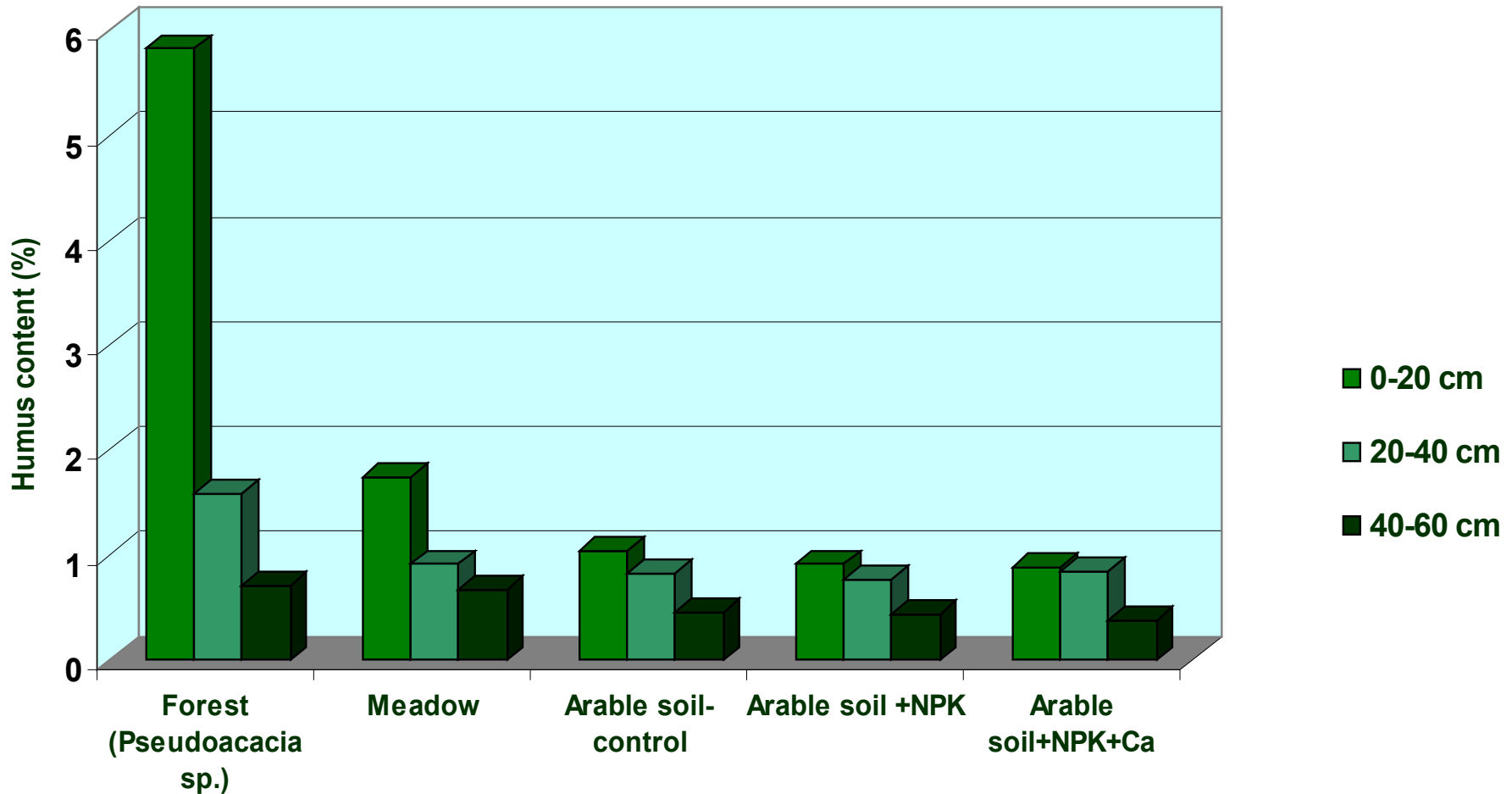
- Long-term experimental field of the Institute of Field and Vegetable Crops, established in 1964
- Crop rotation: wheat/corn/sugar beet/soybean
- The doses of mineral fertilizers: 600 kg NPK 15-15-15/ha in autumn; 100 kg N/ha for corn, 120-150 kgN/ha for sugar beet and 70kgN/ha for wheat
- Soils samples taken after 28years

Effects of fertilization on corn yield and total soil nitrogen (three years field experiment)



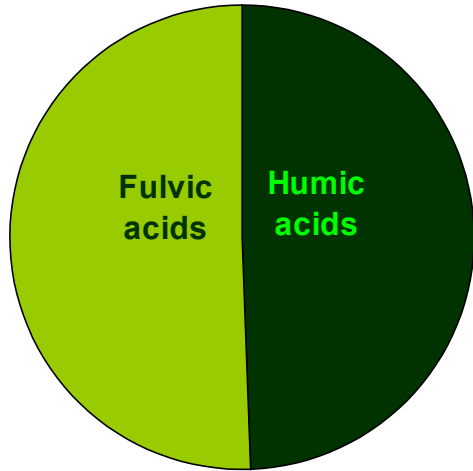
- Experiment conducted on Vertisol (pH – 5.01, humus – 2.68%), at Experimental field of Faculty of Agronomy in Čačak
- Mineral fertilizers applied every year
- Organic fertilizers applied in the first year

Humus content in pseudogley influenced by land use and fertilization – case study (Central Serbia)

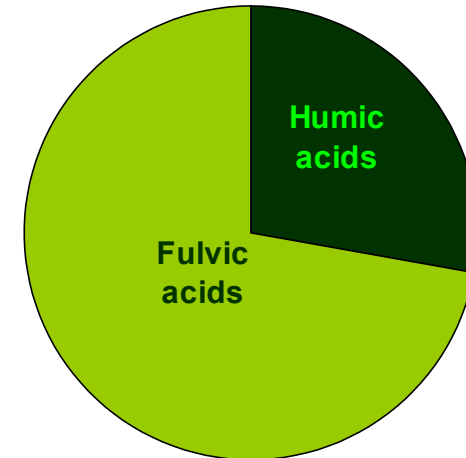


Humus quality influenced by land use and fertilization (Pseudogley - Central Serbia)

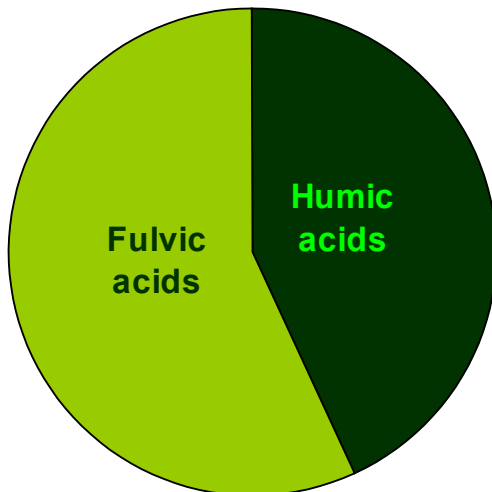
Forest (Pseudoacacia sp.)



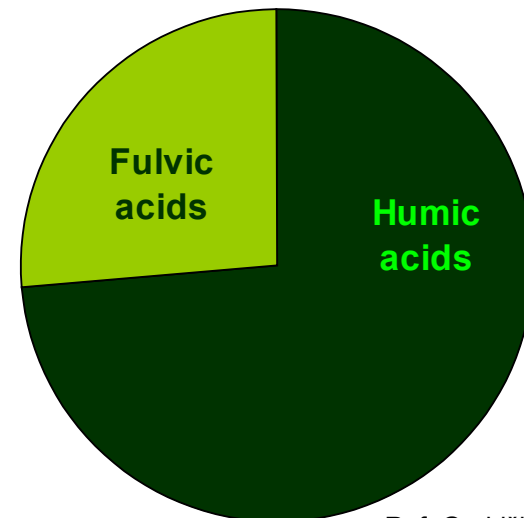
Arable soil (control)



Arable soil + NPK

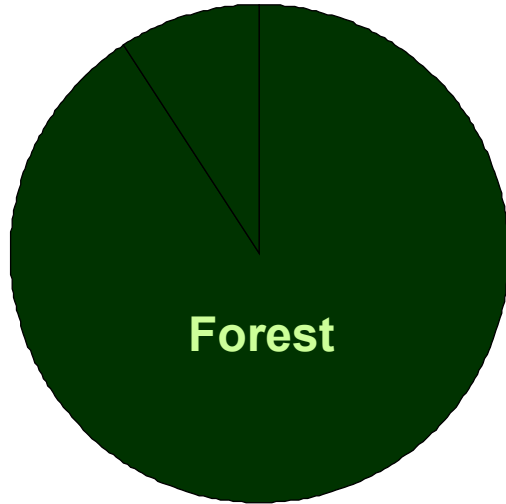


Arable soil+NPK+Ca



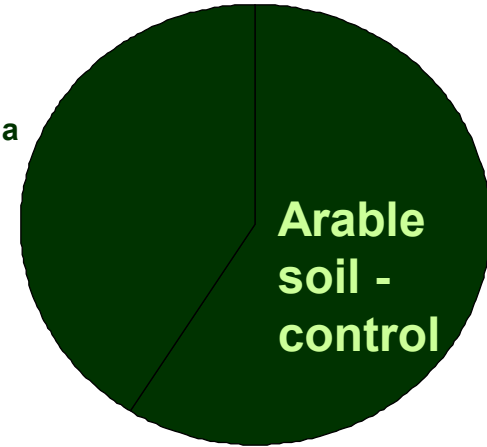
Connection of humic acids with mineral soil fraction depending on land use and fertilization (Pseudogley - Central Serbia)

Bound to Ca
9%



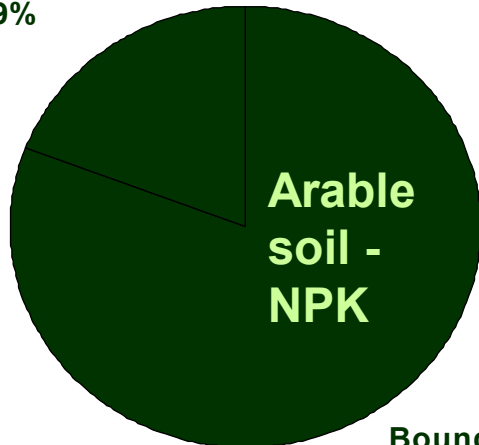
Bound to R₂O₃
91%

Bound to Ca
41%



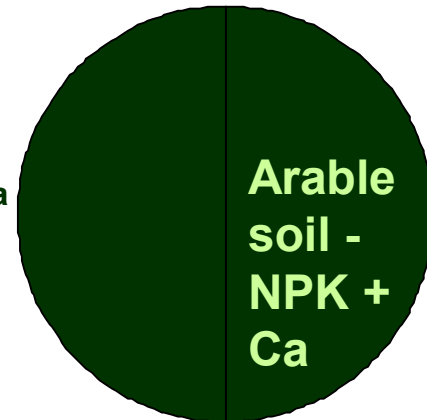
Bound to R₂O₃
59%

Bound to Ca
19%



Bound to R₂O₃
81%

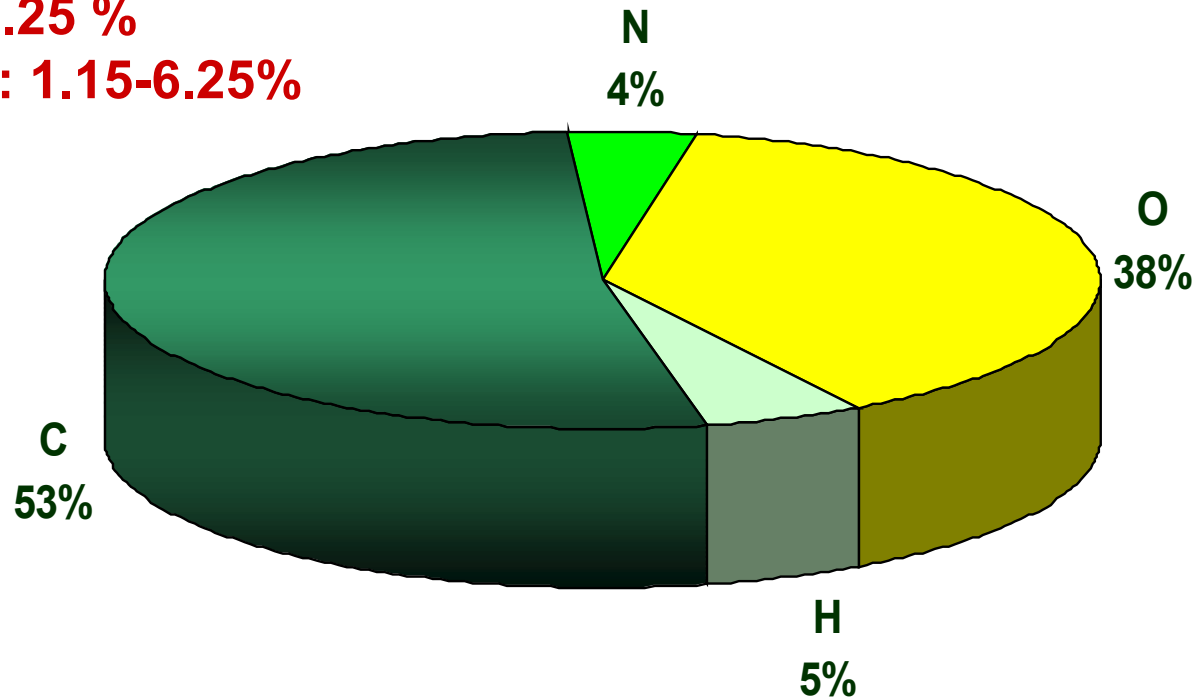
Bound to Ca
50%



Bound to R₂O₃
50%

Elemental composition of humic acids of Rendzina (n=16)

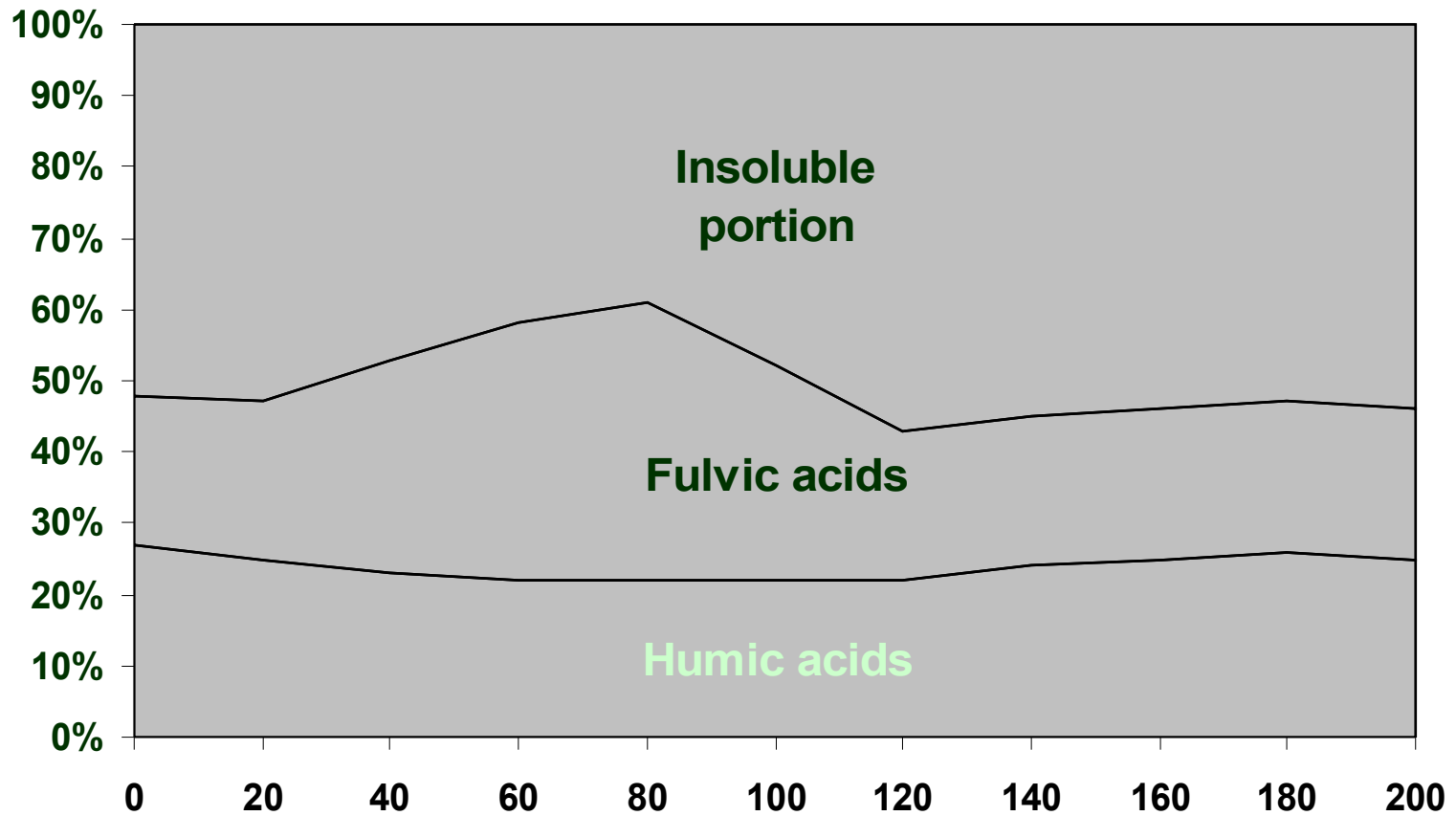
Average humus content
3.25 %
Interval: 1.15-6.25%



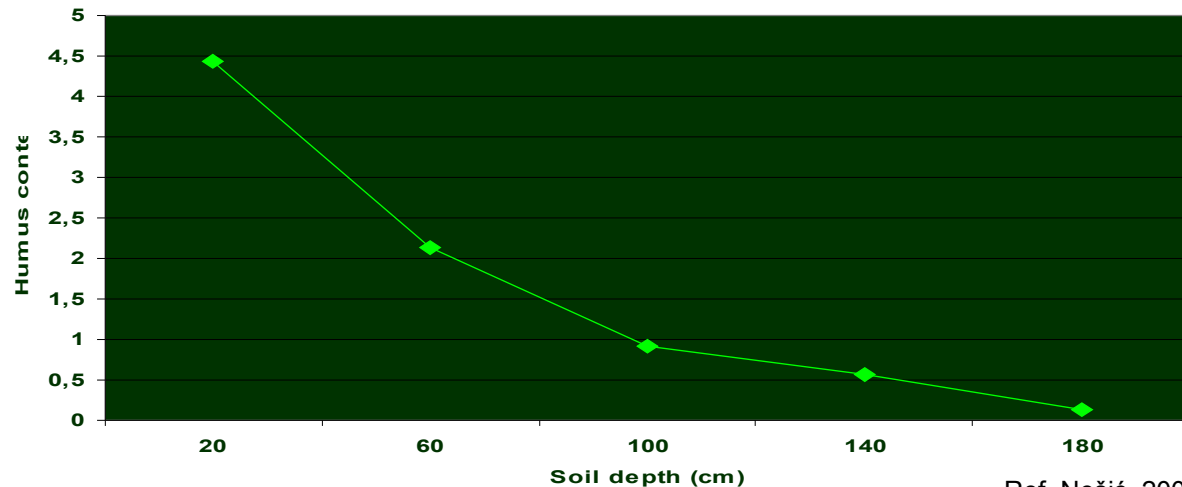
H/C ratio – 1.18
C/N ratio – 15.21



**Medium degree of
humification
and condensation**



Humus content and composition in solodic soil (North Serbia)



Humus management in Serbia

- Research and implementation-

What are the facts?

- **Low humus content**
- **Humus content decline**
- **Medium degree of humification**
- **Insufficient application of organic fertilizers**
- **Positive effects of crop rotation, tillage and fertilization on humus built-up in a soil**

What need to be done?

- **To establish soil monitoring system**
- **To increase or prevail humus content**
- **To improve humus quality**
- **To intense research of:**
 - ✓ **new approaches to increase soil humus**
 - ✓ **humus influence on soil fertility**
 - ✓ **humus influence on reducing potential risks to the environment (nutrient leaching, heavy metals mobility, radionuclide retention)**