SOIL ORGANIC CARBON AND PARTICLE SIZE DISTRIBUTION OF ARABLE SOILS IN WINTER WHEAT CROPPING

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Introduction

- Soil organic matter (SOM) plays an important role as a pool of terrestrial C and can be easily manipulated by agricultural practices (Janzen, 2004).
- Therefore, arable soils are implicated in C cycling and can be considered as a major reservoir and an important C sink for sequestering the atmospheric CO_2 (Smith, 2004).
- The maintenance of site-specific SOM content is a prerequisite for sustainable protection of soil function and could be observed as an important indicator of soil quality and agronomic sustainability of agroecosystems (Zentner *et al*., 1990; Reeves, 1997).

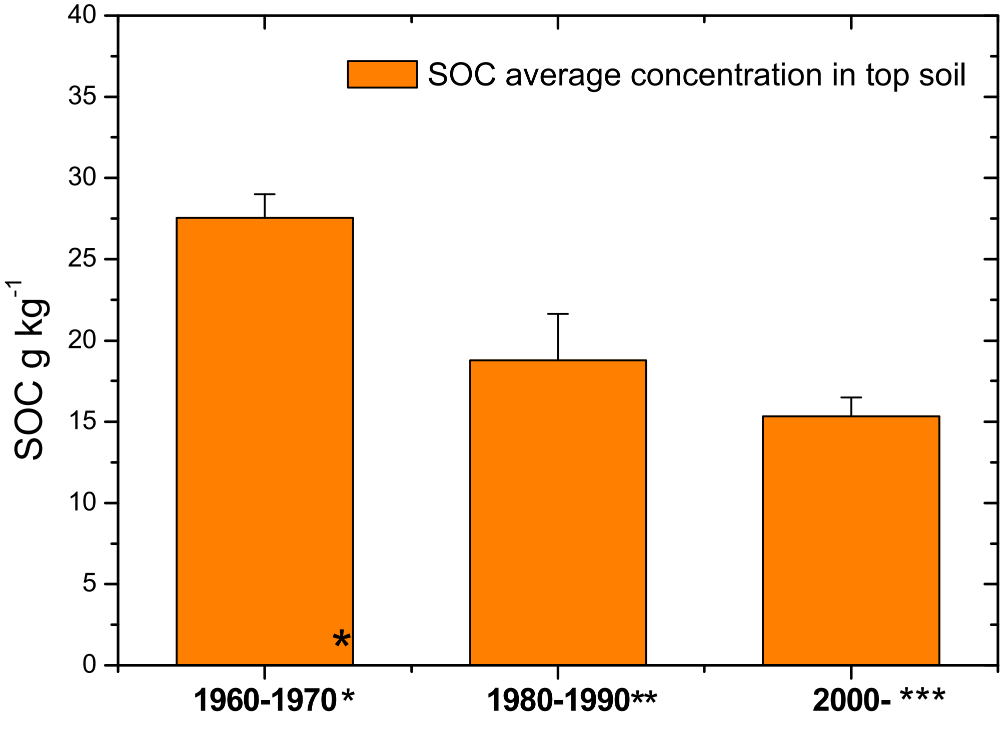
- Soil organic matter is the most important indicator of soil production capability (Reeves, 1997) but should be considered in the context of yield potential achievement and perpetual yield stability.
- Soil structure and SOM are among the first indicators of soil quality decline
- To confirm SOM changes it is necessary to monitor and quantify the decline of SOM in continuous long-term experiments (Rasmussen *et al*., 1998; Varvel *et al*., 2002; Körschens, 2004) and to verify the results in the cultivated agricultural areas.
- Chernozemic soil (*Phelozem*) is the prevalent soil type in the Vojovidna Province, covering 900000 ha of arable land. However, current management practice strongly contribute to the deterioration of physical and chemical properties.
- Cropping technology in most agricultural areas of the Serbia is not “SOM friendly” :
  - Crop residue burning
  - Mineral fertilizer use instead of organic fertilizers
  - High genetic potential of hybrid and varieties
  - Inappropriate crop rotation and management practice
  - Small number of livestock

Soil degradation and SOM status in Serbia

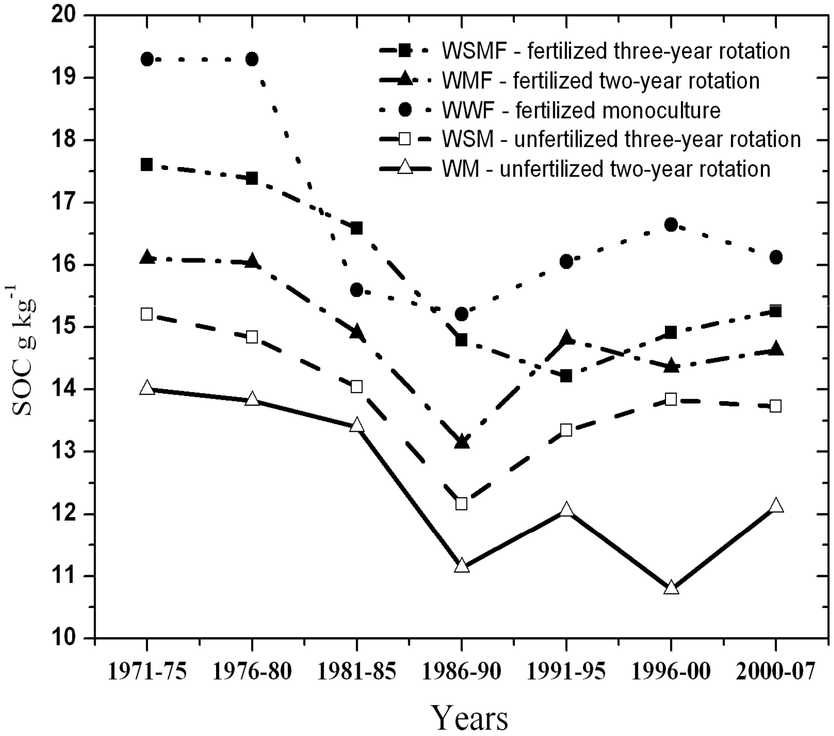
- **Currenly in Serbia there is no ongoing project or study to resolve to which extend soils are depleted in SOM or soil structure degraded**
- **Several studies individually (non systematically) intended to explain that phenomena in the agroecological condition of Vojvodina by comparing the earlier studies with recent results (Bečej, Bačko Gradište, Futog, Kać, Adaševci). The results showed 0,05-0,2% loss of humus (Hadžić et al.2004).**
- **Nešić et al.2008,2009 fund that average humus content (1992-2007) was lower for 0,22% (from 3.16 to 2.94) in average for Srem and South Bačka region.**
- **Seremesic et al. 2006 disscussed SOM status in the long-term experiment Plodoredi (Rimski Sancevi Novi Sad) and found that in the average humus content decreased 0.33% after 35 years of cropping**
- **In the central Serbia acid soil contain in average 1- 2 % humus in the top-soil**

Current SOC trends?

Soil organic carbon (SOC) change in the Vojvodina Province



Soil organic carbon (SOC) change in long-term experiment

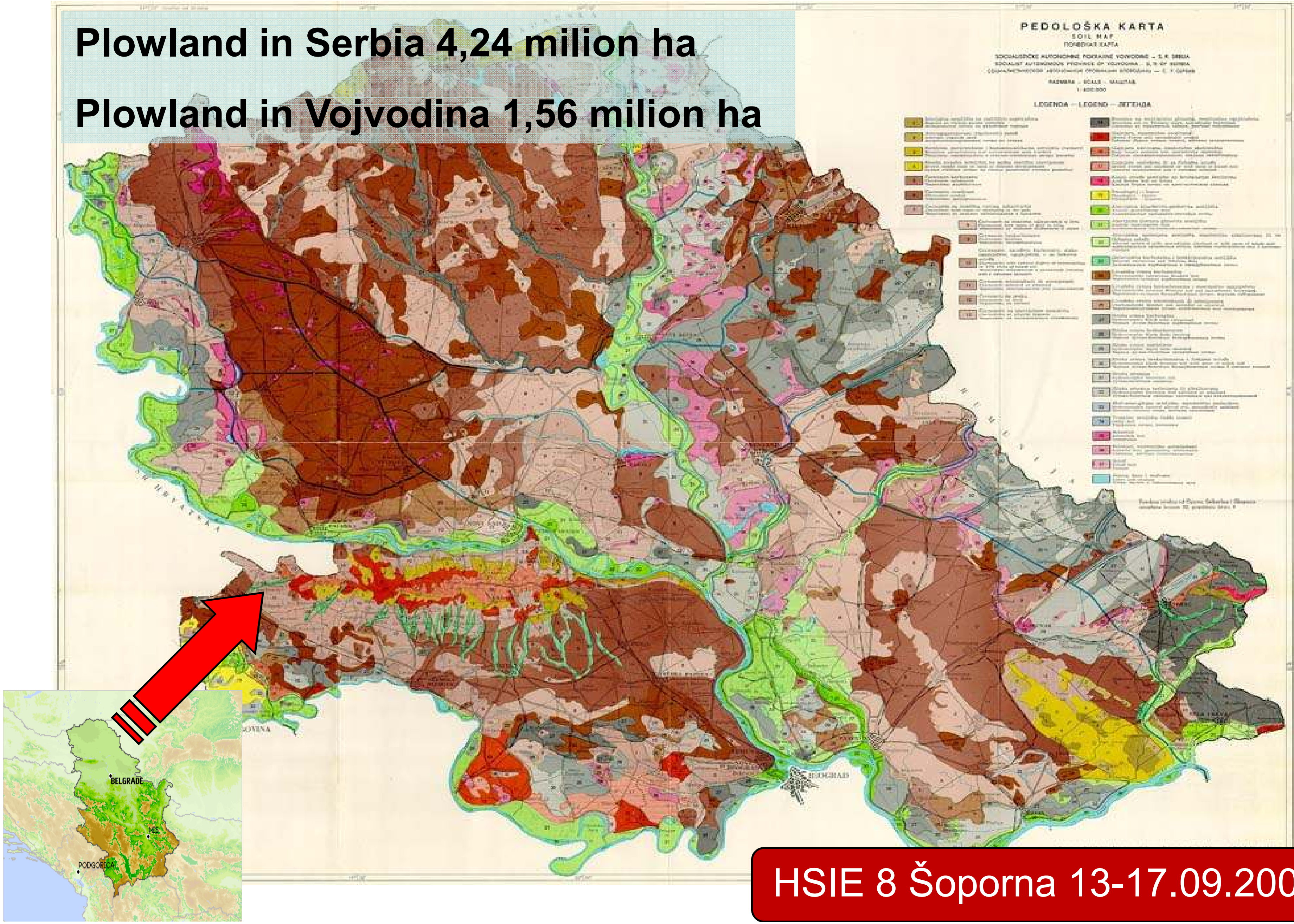


*Živković B, Nejgebauer V, Tanasijević Đ, Miljković N, Stojković L, Drezgić P. 1972. *Soils of Vojvodina*. Institute for Field and Vegetable Crops Novi Sad: Novi Sad
**Bogdanović D, Ubavić M, Dozet D. 1993. Chemical properties of Vojvodina soils and provision with essential macroelements. In: *Heavy metals and pesticides in the soils of Vojvodina province*, Kastori R. (ed). Istitute of Field and Vegatable Crops Novi Sad, 197-215.
***Vasin J. 2008. Soil Fertility in Vojvodina. In: *Fertilization in sustainable Agriculture*, Manojlović M. (ed). Faculty of Agriculture Novi Sad: Novi Sad. 45-53..

PEDOLOGICAL MAP OF VOJVODINE PROVINCE 1:400000

Plowland in Serbia 4,24 milion ha

Plowland in Vojvodina 1,56 milion ha



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Objective of study

- **In order to investigate effects of cropping systems on content of soil organic carbon (SOC) and distribution of particle size fractions of soil, different cropping systems of winter wheat were analyzed.**

Material and methods

- Soil samples were collected from 2 long-term experiments (IOSDV and Plodoredi) carried out at the Rimski Sancevi experimental station, Novi Sad.
- Samples were taken after winter wheat harvest in Jun
- Three soil depths were analyzed (0-20, 20-40 and 40-60 cm) with three replication for each treatment
- Sample was brought to laboratory and field moist soil was passed through an 8 mm sieve and stored until fractionation.
- Method for fractionation was adapted from Elliot, 1986.
- Particle size fractions (>2000 µm, 2000-250 µm, 250-53µm and <53µm) were obtained by dispersion in water with series of sieves.
- All fraction was oven dried (50°C) and weight.
- Organic carbon content was determined by CHNS analyzer. (ISO 10694:1995)

The following treatments were analysed:

I. **Three–year crop rotation** (maize-soybean-wheat), mineral fertilizer 100 kg N ha^{-1} + crop residues **(Đ3)**

II. **Two–year crop rotation** (maize-wheat), mineral fertilizer 100 kg N ha^{-1} + crop residues **(Đ2)**

III. **Monoculture** (wheat-wheat), mineral fertilizer 100 kg N ha^{-1} + crop residues **(MO)**

IV. **Two–year rotation** (maize-wheat), without fertilizers + crop residues **(N2)**

V. **Three–year rotation** (maize-soybean-wheat), without fertilizers + crop residues **(N3)**

VI. **Four–year crop rotation** (sugar beet-spring barley-maize-wheat), 40 t ha^{-1} manure without mineral fertilizers **(B0)**

VII. **Four–year crop rotation** (sugar beet-spring barley-maize-wheat), 40 t ha^{-1} manure + mineral fertilizer 100 kg N ha^{-1} **(B2)**

VIII. **Four–year crop rotation** (sugar beet-spring barley-maize-wheat), mineral fertilizer 200 kg N ha^{-1} without crop residue **(C4)**

IX. **Four–year crop rotation** (sugar beet-spring barley-maize-wheat), mineral fertilizer 200 kg N ha^{-1} + crop residues **(A4)**

X. **Control,** native vegetation with short grasses **(C)**

Results and discussion

Agrochemical properties of investigated cropping systems

Tretments	Depth	pH KCl	pH H_2O	$CaCO_3$	Al-K_2O*	Al-P_2O_5*	Humus
B0	0-20	7,11	8,16	3,41	47,96	109,03	3,10
B2	0-20	7,06	8,24	2,94	47,16	111,13	3,03
A4	0-20	7,08	8,21	2,65	42,50	135,83	2,76
C4	0-20	7,14	8,24	4,83	44,83	151,50	2,48
N2	0-20	7,23	8,47	9,09	13,96	5,36	1,93
N3	0-20	7,34	8,37	5,54	17,40	5,60	2,33
MO	0-20	7,07	8,26	3,55	32,43	27,50	2,83
Đ2	0-20	7,17	7,97	0,35	34,10	32,90	2,54
Đ3	0-20	7,13	8,23	3,40	41,03	93,16	2,62
Control	0-20	7,33	8,21	7,08	90,83	167,00	3,22

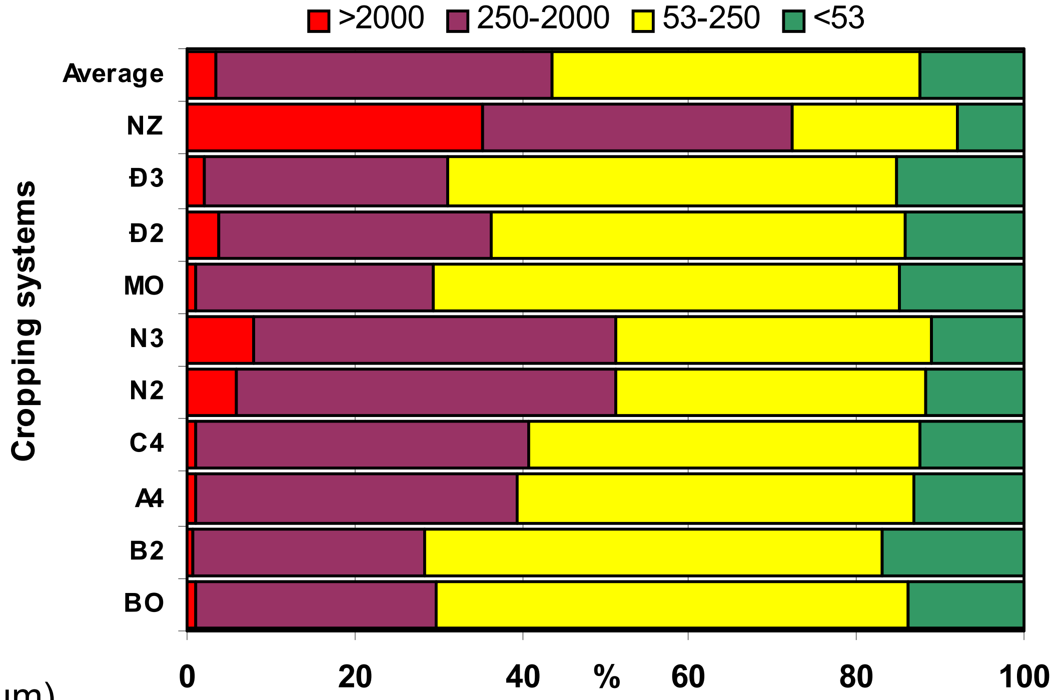
* mg/100g soil

Results and discussion

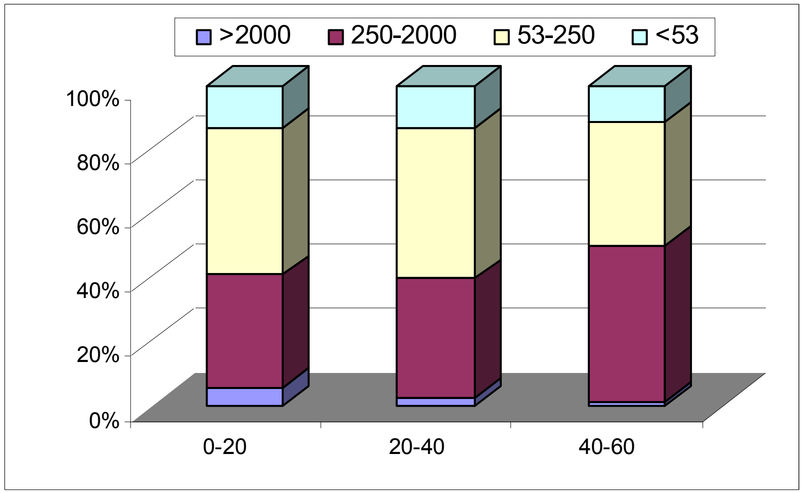
- Distribution of aggregates accros the soil profile was less altered with management practice

- Higher content of macroaggregates were found in the topsoil (0-20cm) as a result of applied cropping technology

Distribution of aggregates of different size (μm)



Distribution of aggregates with soil depth (μm)



- Deterioration of soil structure in arable soil compared with control as a result of applied management practice.
- Significantly higher content of macroaggregates in 0-20 cm soil layer was found in soil samples from control plots compared with wheat cropping systems.
- Addition of manure without crop residue incorporation was not sufficient for soil structure preservation.

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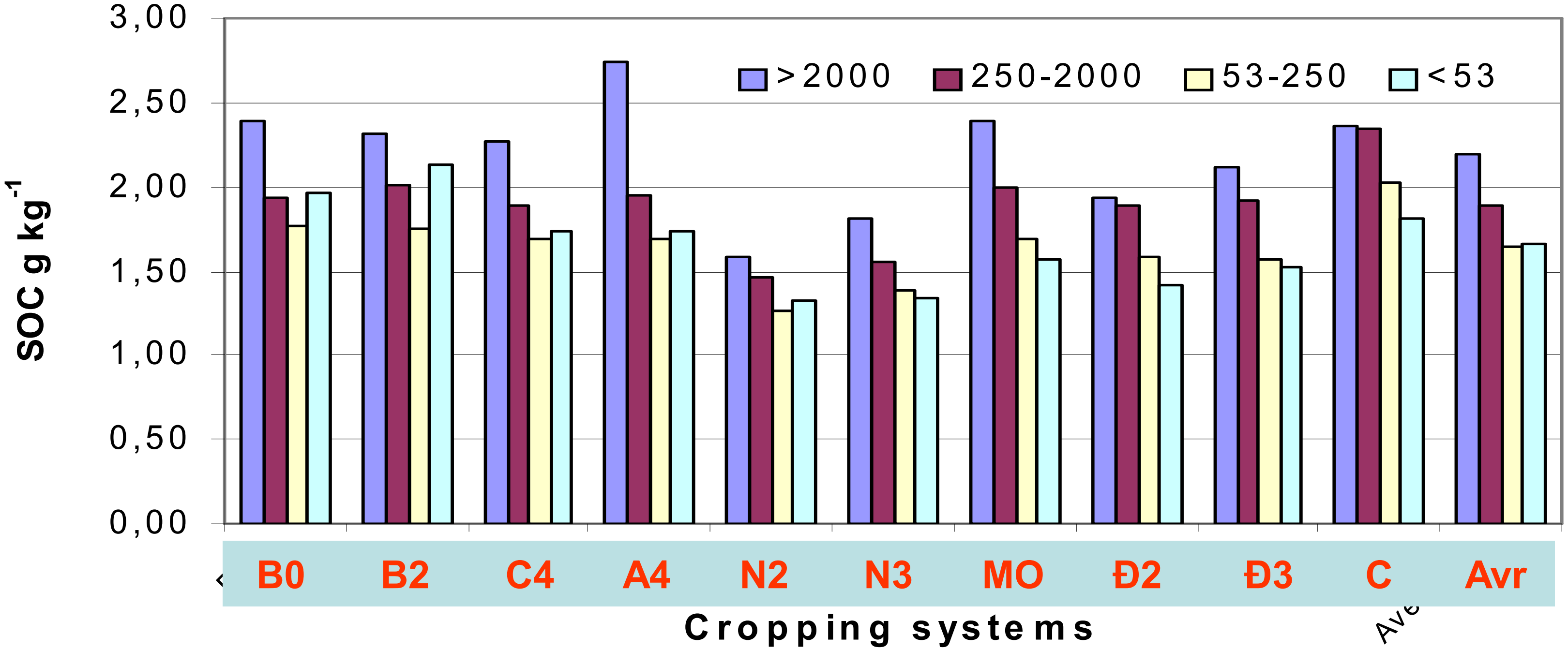
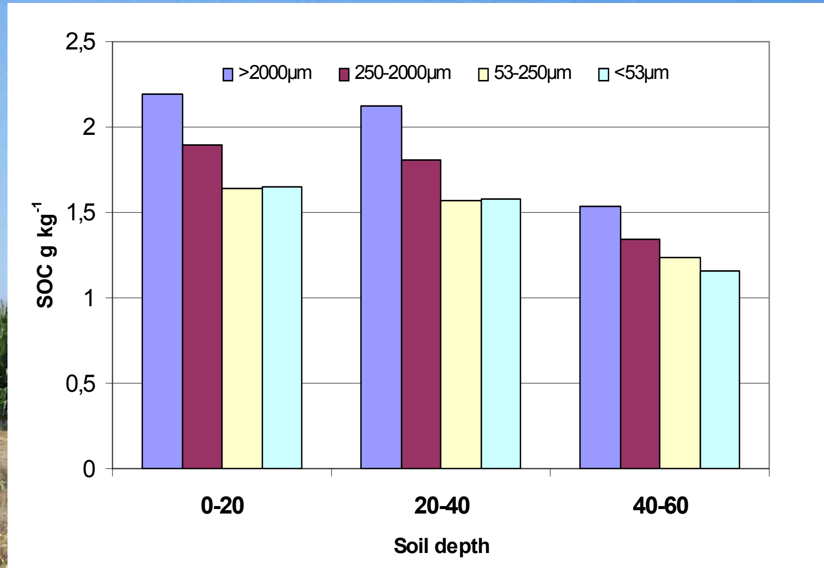
SOC content in aggregates of different cropping systems



- Highest SOC content was found at >2000 µm aggregates
- A4 with crop residue incorporation had highest content of SOC in >2000 µm
- Addition of manure (B0 and B2) incresed SOC content in <53 µm
- Even though control is higher in total SOM treatment showed similar distribution of SOC in soil fractions

SOC content in aggregates of different depth in investigated cropping systems



- SOC decrease with soil depth
- Highest content of SOC across the soil depth was found in >2000µm fraction and lowest in <53µm soil fraction
- The effects of added (incorporated) crop residues, manure and mineral fertilizers can be observed in 0-20 and 20-40 cm

Conclusions

- Soil structure was affected with cropping technology of investigated systems
- SOC content decreased in with the soil depth
- Higher content of SOC in 0-20 cm depth of different size fractions was observed in > 2000 µm with addition of 200 kg N ha^{-1} and crop residues.
- An increase of SOC content with increased particle size was observed.