



Influence of post-harvest residues on properties of humic acids of different types of soils

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The aim of the work was to define the influence of the kind of post-harvest residues, particularly their chemical composition on a structure of humic acids coming from different kinds of soils. The study material is composed of vegetable residues (a mixture of straw and roots) of corn, rape, sunflower, potato and rye.

**This study was conducted within
the research project N N 310 3281 33 financed by
the Ministry of Scientific Research and Information Technology.**

The study material is composed of the following residues:

- ▶ Corn
- ▶ Rape
- ▶ Sunflower
- ▶ Potato
- ▶ Rye

Which were incubated with the following kind of soils:

- Haplic Luvisol
- Chernozem
- Haplic Arenosol
- Haplic Gleysol

Chemical composition of post-harvest residues and share of easily-decomposing compounds (C₁), slowly-(C₂) and hard-decomposing compounds (C₃)

Kind of residues	Ash	C	N	P	C/N	C/P	C ₁	C ₂	C ₃
	%	g/kg					%		
Corn (K)	6,8	487	13,6	1,8	35,8	270	19,4	62,6	18,0
Rape (Rz)	14,5	444	12,9	1,6	34,4	277	10,7	56,5	32,9
Sunflower (Sł)	10,6	433	14,4	1,8	30,1	240	15,3	58,4	26,3
Potato (Zm)	31,7	355	20,1	1,9	17,7	187	20,2	50,7	29,0
Rye (Ž)	12,4	455	9,7	2,0	46,9	227	9,6	55,3	35,1

C₁ – monosaccharides, proteins, starch

C₂ – hemicellulose, cellulose

C₃ – lignine

Content of carbon and nitrogen in soils

Kind of soil	C _{org} g/kg	N _t g/kg	C _{org} /N _t
<i>Haplic Luvisol (Lo)</i>	13,9	1,55	8,97
<i>Chernozem (Hh)</i>	21,1	2,53	8,34
<i>Haplic Arenosol (Re)</i>	5,1	0,93	5,48
<i>Haplic Gleysol(Ge)</i>	17,7	2,33	7,60

The project has been carried out at the Department of Pedology and Geology of the Slovak Agricultural University in Nitra as a model incubation experiment

Conditions of the experiment

Incubation time: 0 days; 360 days

Incubation temperature: 25°C

Moisture: 60 %FWC

Post-harvest residues mixed with soil material in ratio 1:10

The scheme of experiment

Symbol of variant	Variant
LoK-0	Haplic luvisol+ corn residues before incubation
LoK-360	Haplic luvisol+ corn residues after incubation
LoRz-0	Haplic luvisol+ rape residues before incubation
LoRz-360	Haplic luvisol+ rape residues after incubation
LoSł-0	Haplic luvisol+ sunflower residues before incubation
LoSł-360	Haplic luvisol+ sunflower residues after incubation
LoZm-0	Haplic luvisol+ potato residues before incubation
LoZm-360	Haplic luvisol+ potato residues after incubation
LoŽ-0	Haplic luvisol+ rye residues before incubation
LoŽ-360	Haplic luvisol+ rye residues after incubation

Research methods:

Humic acids according to Schnitzer were isolated from soil samples without residues and mixed with residues before and after 360 days incubation.

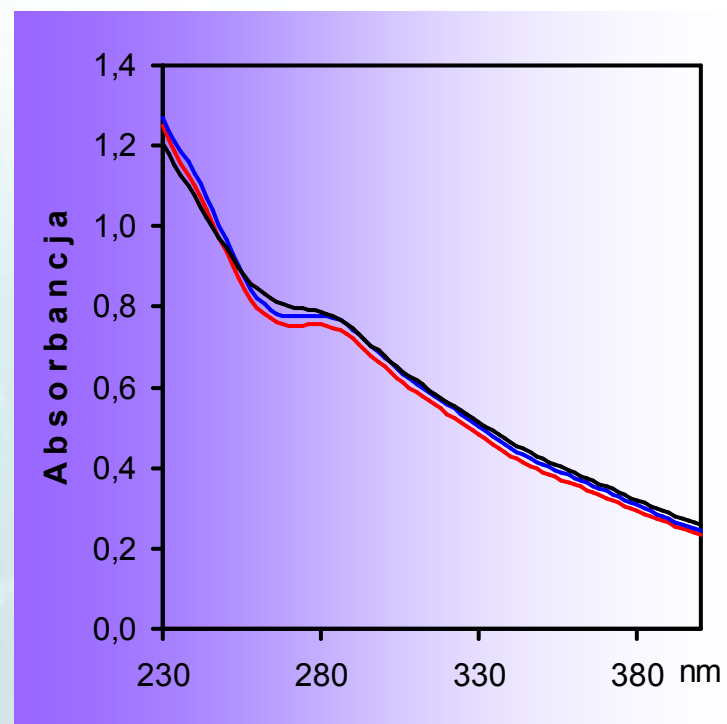
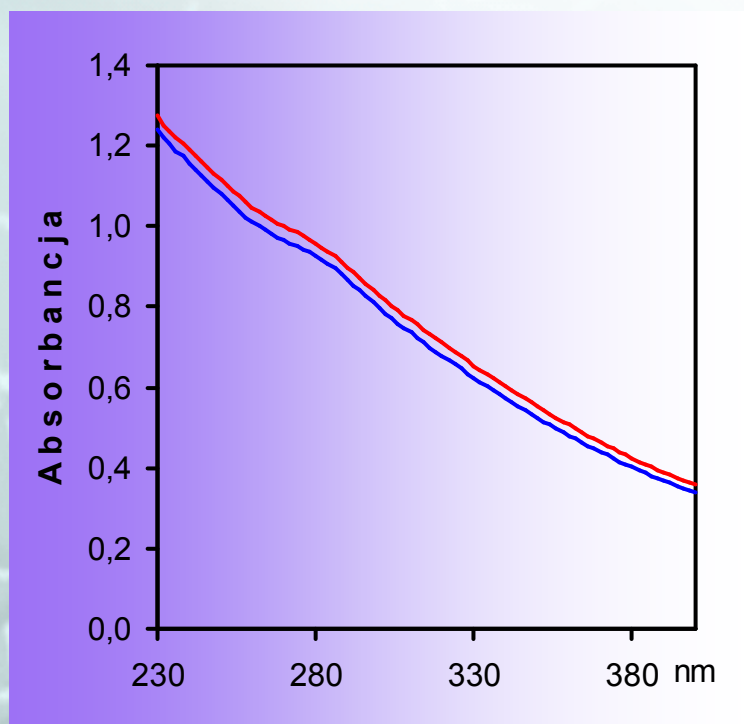
The extracted humic acids were analysed for:

- ◆ **elementar composition**

C, H, N, O

H/C, N/C, O/C, O/H, ω

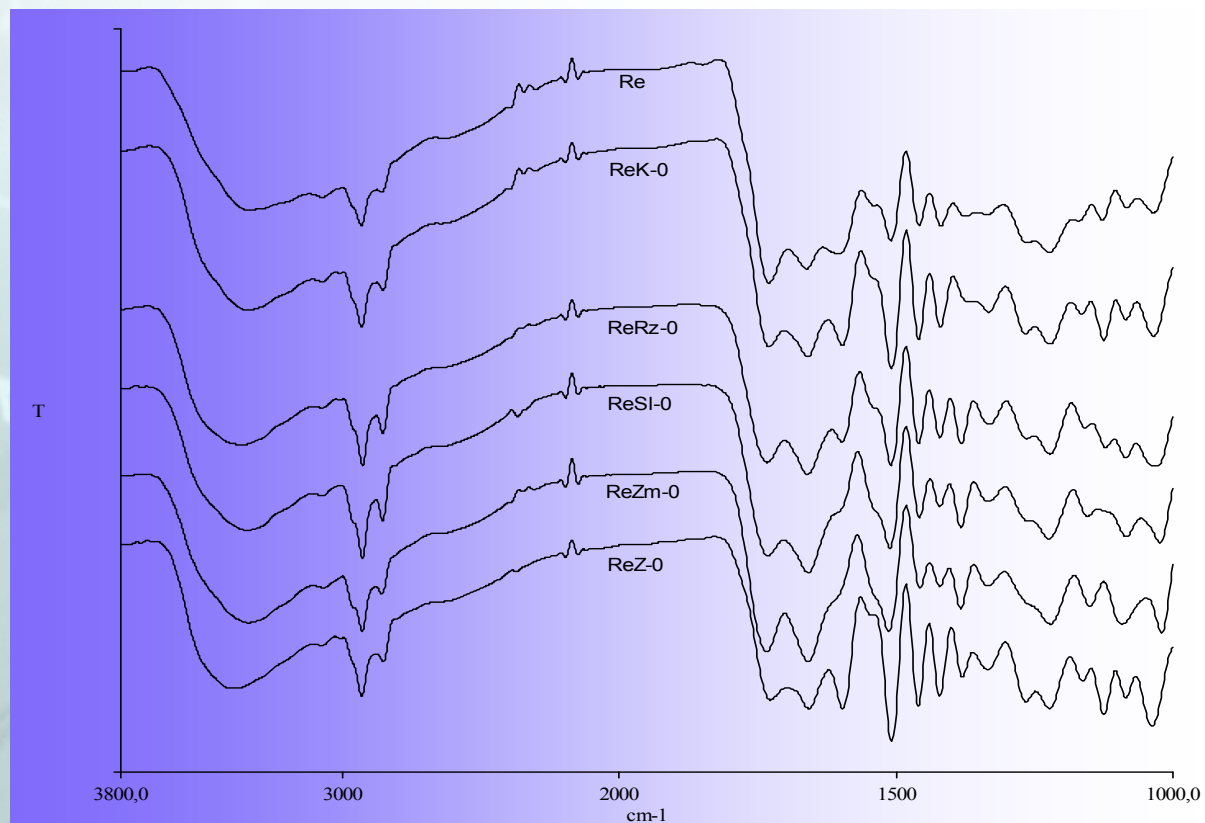
◆ Optical properties in range UV-VIS



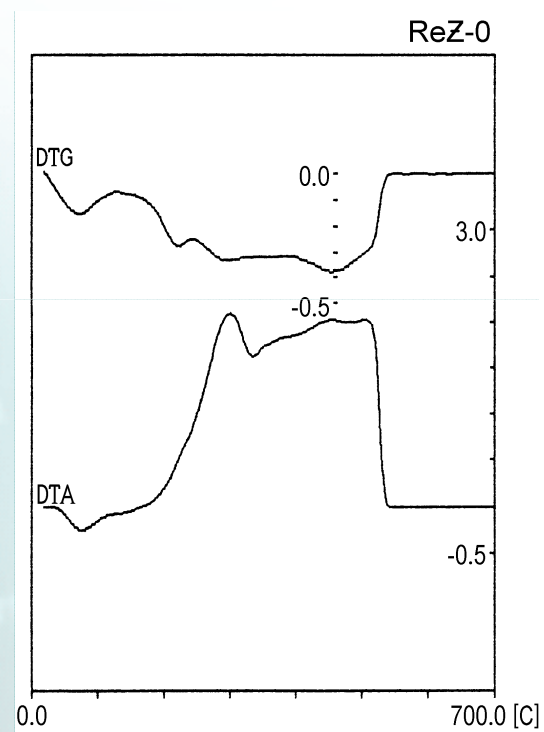
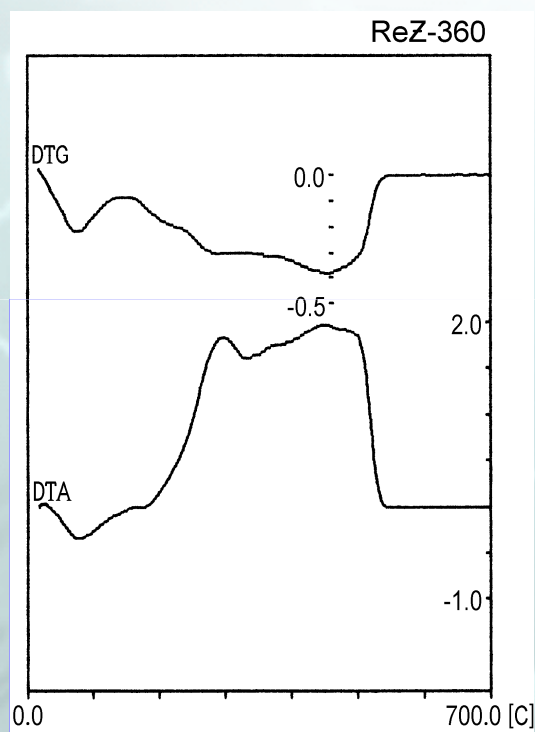
◆ Susceptibility to oxidation



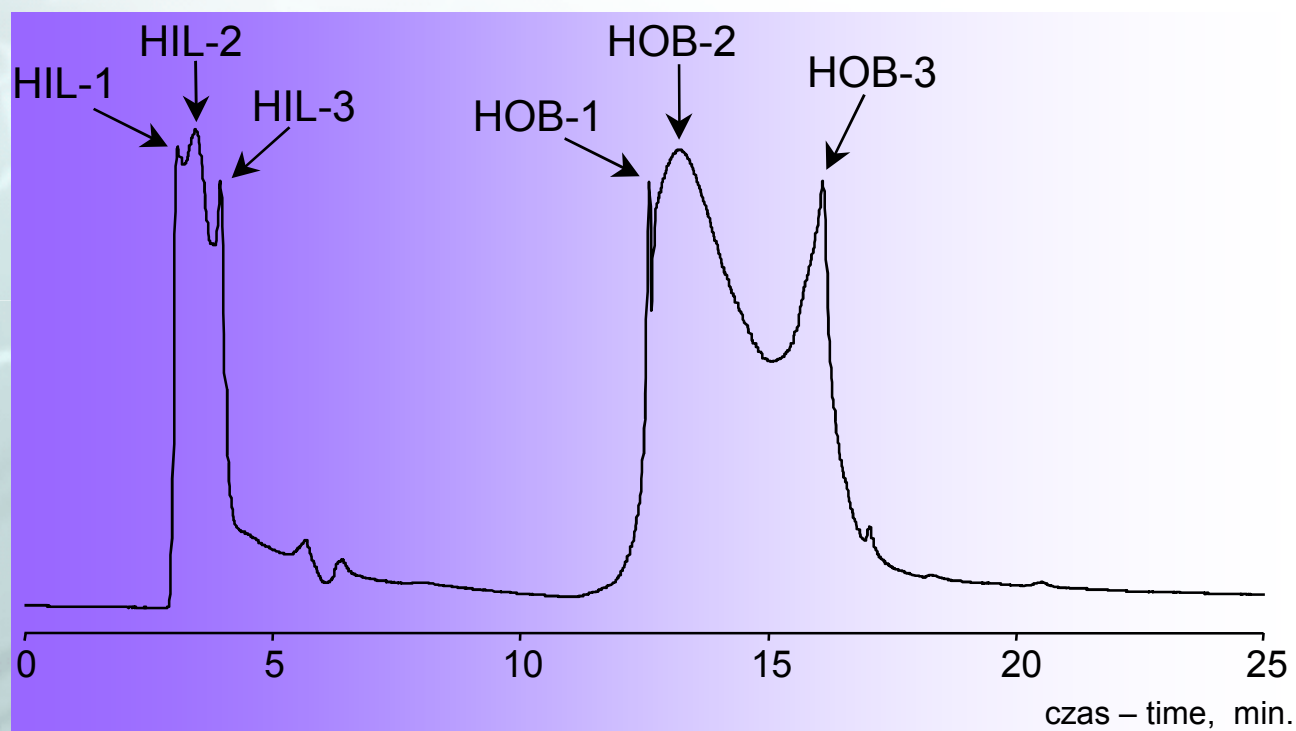
◆ Infrared spectra in range 400 – 4000 cm^{-1}



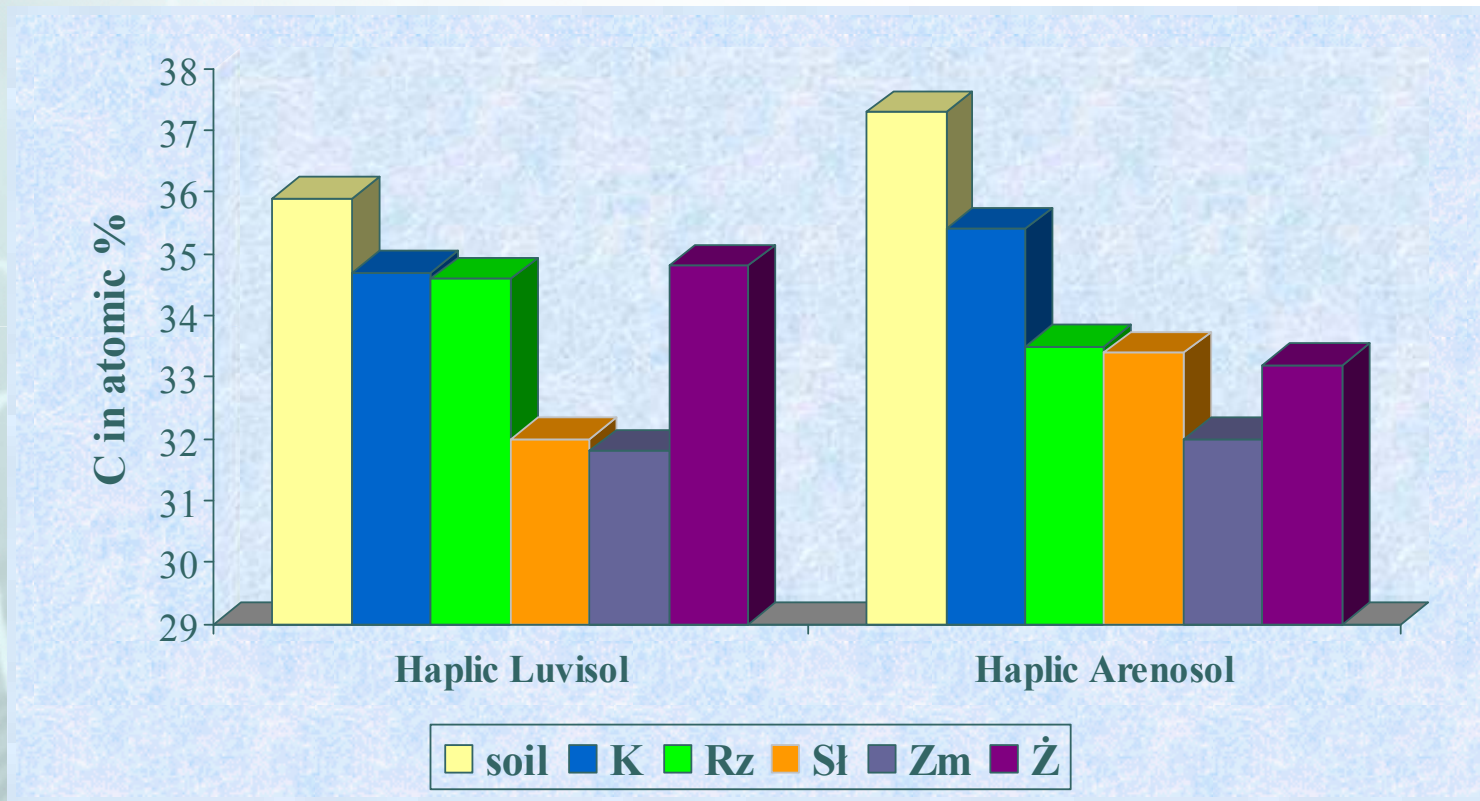
◆ Thermal properties



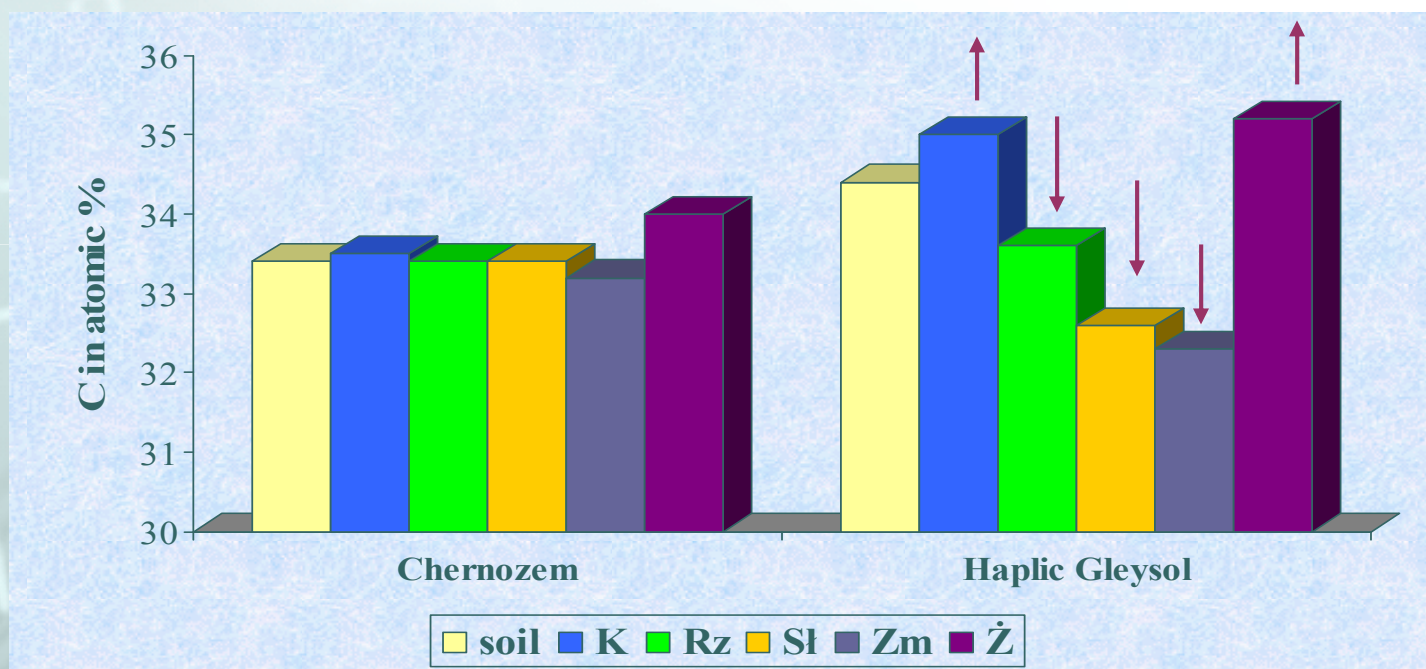
◆ Hydrophilic-hydrophobic properties



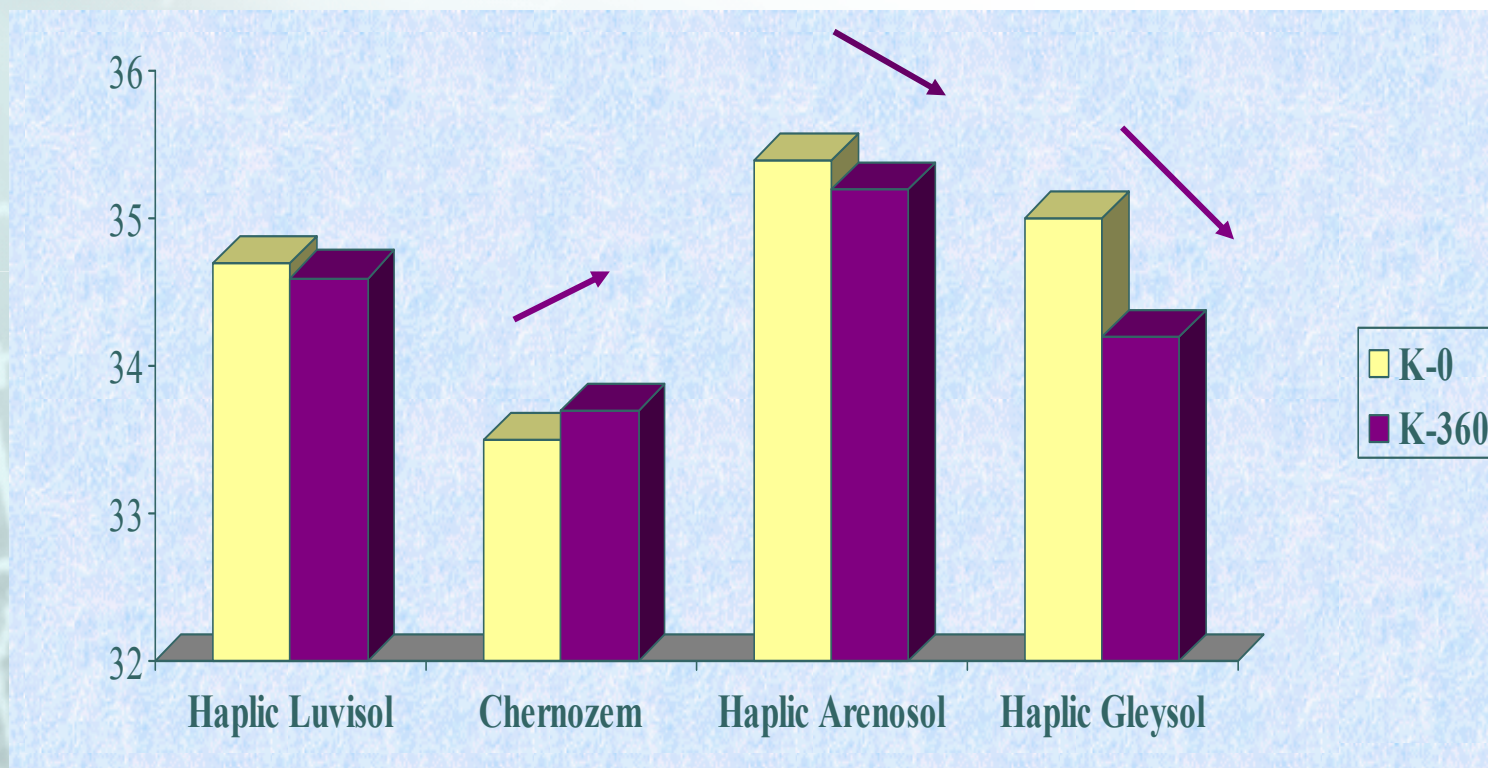
Content of carbon (in atomic %) in humic acids isolated from soil samples without residues and mixed with residues before incubation



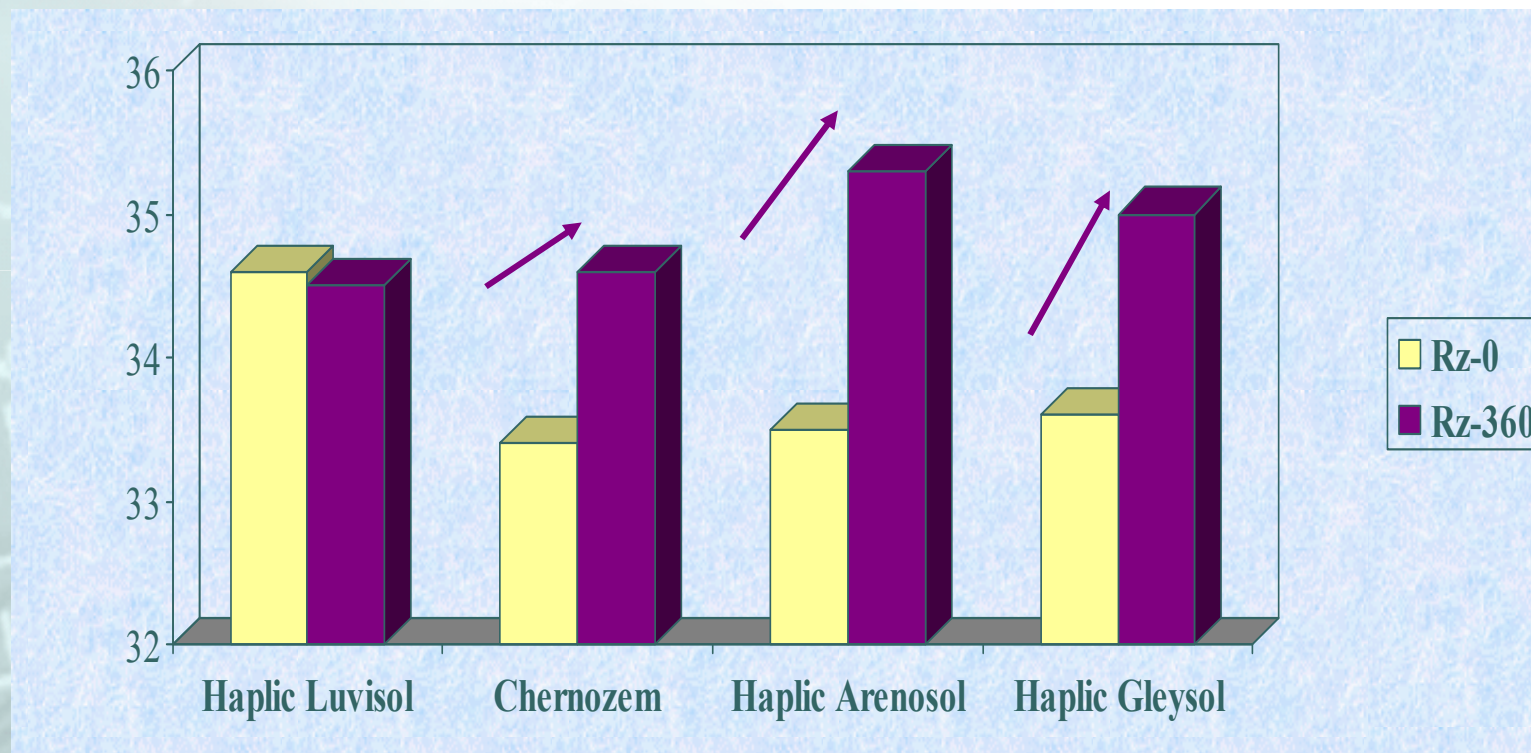
Content of carbon (in atomic %) in humic acids isolated from soil samples without residues and mixed with residues before incubation



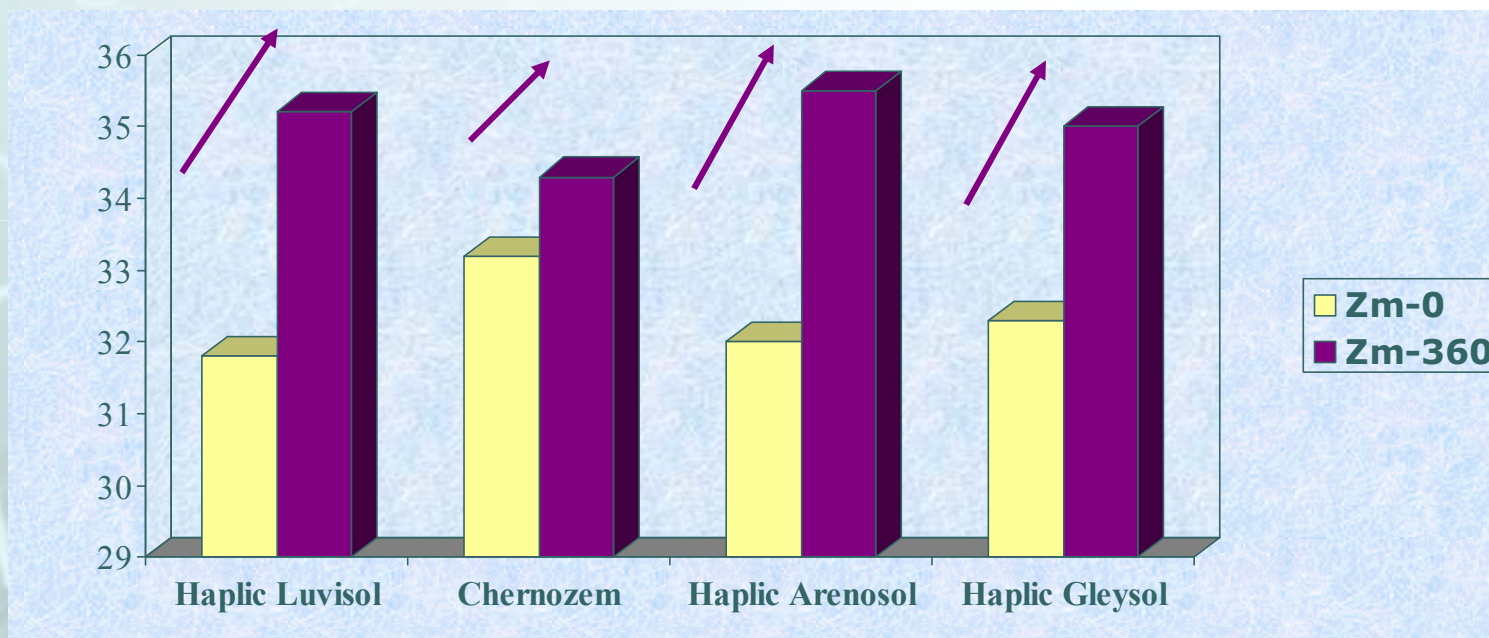
Content of carbon (in atomic %) in humic acids isolated from soil samples mixed with corn residues before and after incubation



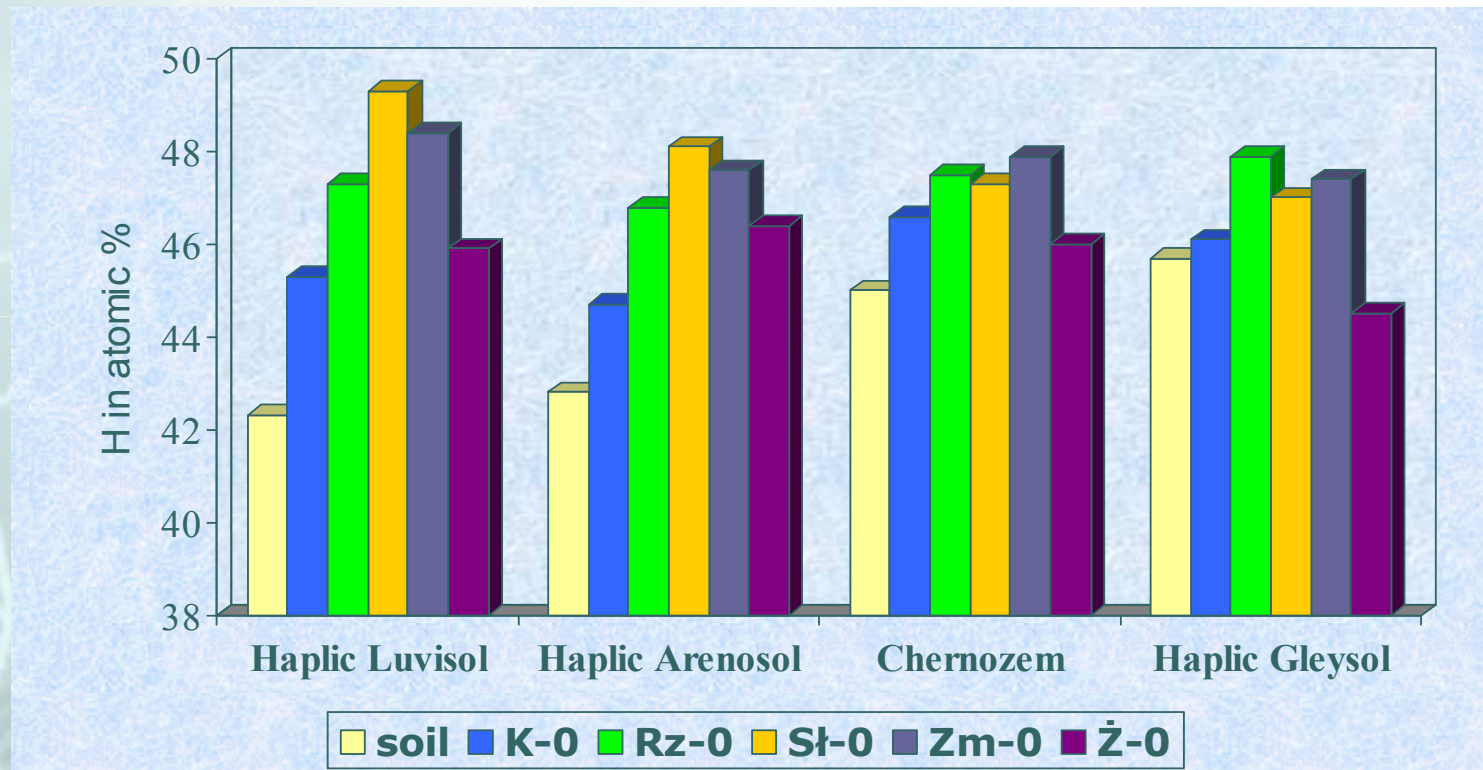
Content of carbon (in atomic %) in humic acids isolated from soil samples mixed with rape residues before and after incubation



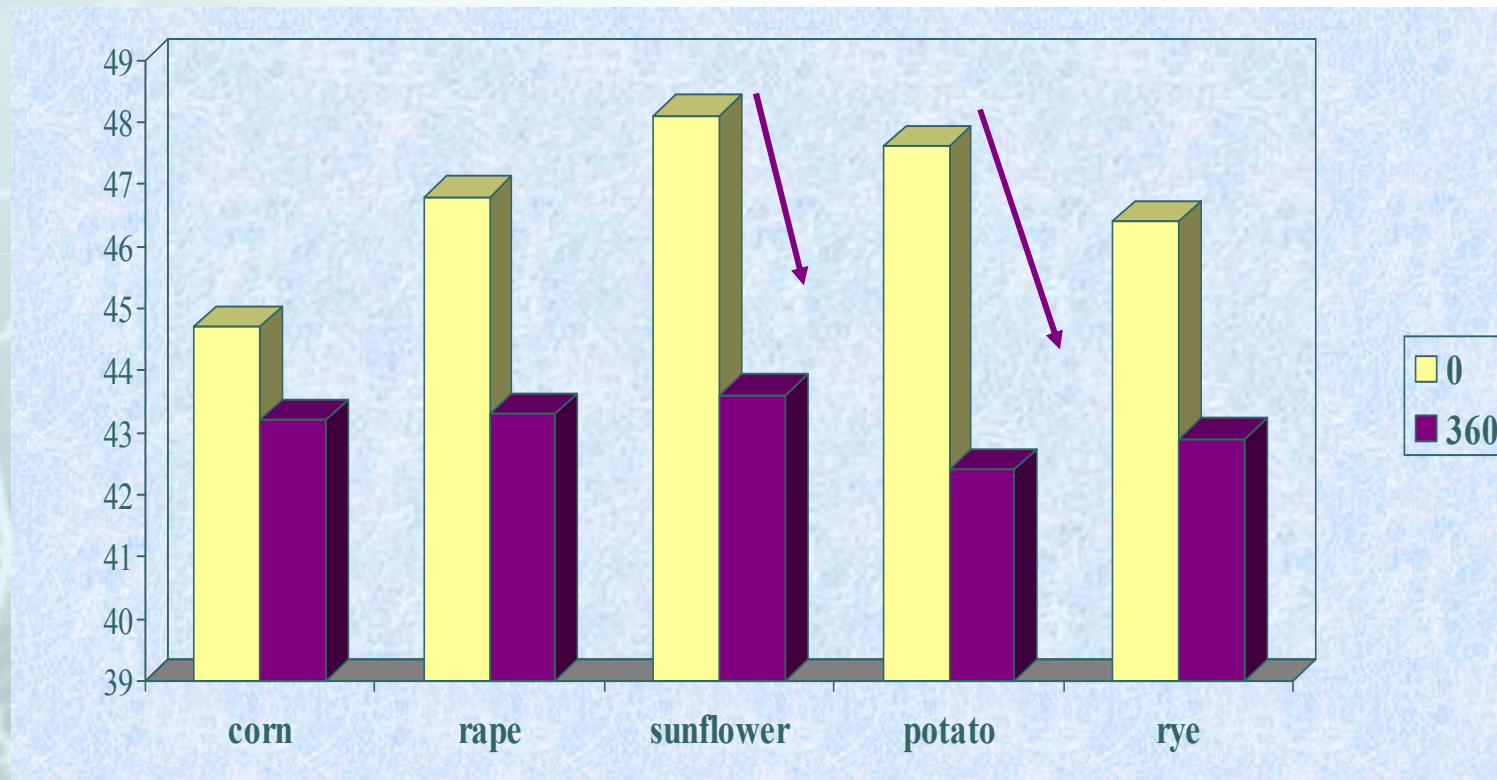
Content of carbon (in atomic %) in humic acids isolated from soil samples mixed with potato residues before and after incubation



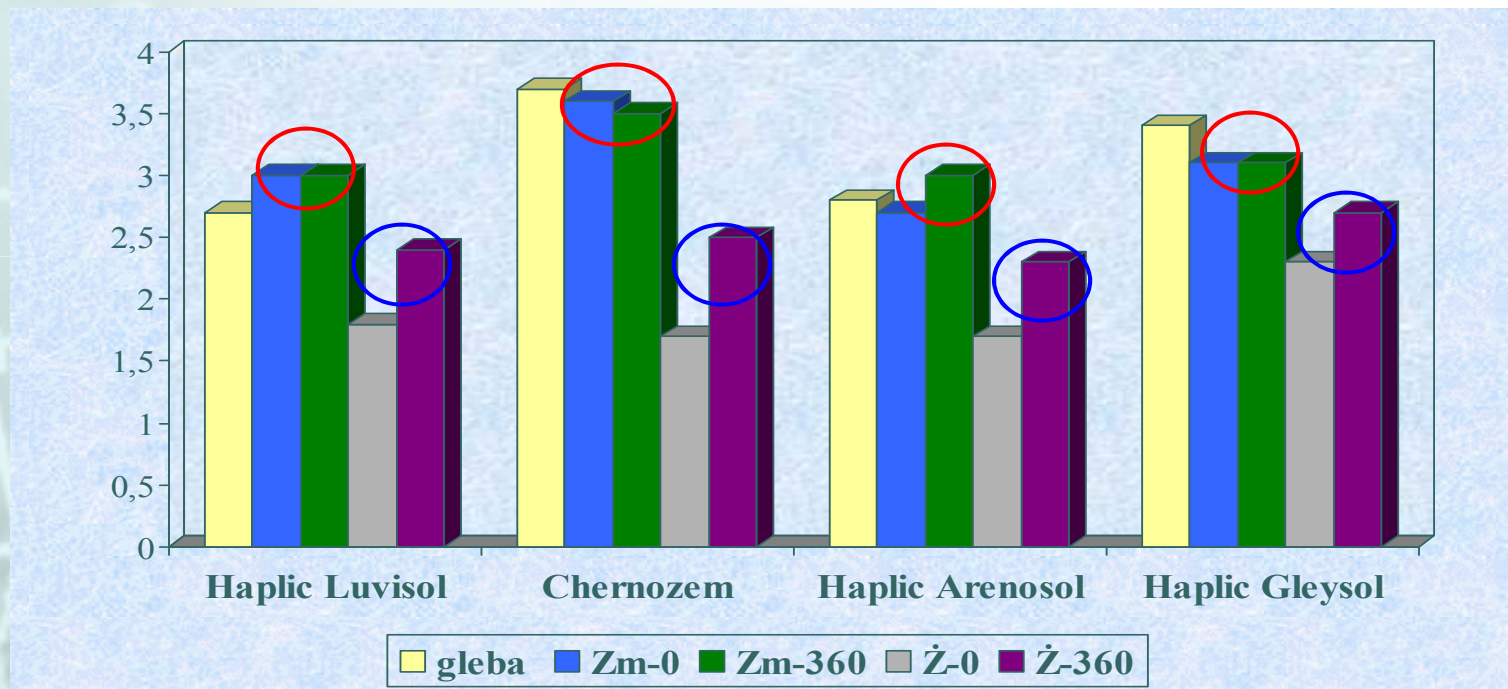
Content of hydrogen (in atomic %) in humic acids isolated from soil samples without residues and mixed with residues before incubation



Content of hydrogen (in atomic %) in humic acids isolated from Haplic Arenosol mixed with residues before and after incubation



Content of nitrogen in humic acids isolated from soil samples without residues and mixed with selected residues before and after incubation



UV-VIS spectrometry

A280-defines the content of compounds of lignin type

A465-content of the substance at the initial stage of decomposition

A665-reflects the content of substances showing a high degree of humification

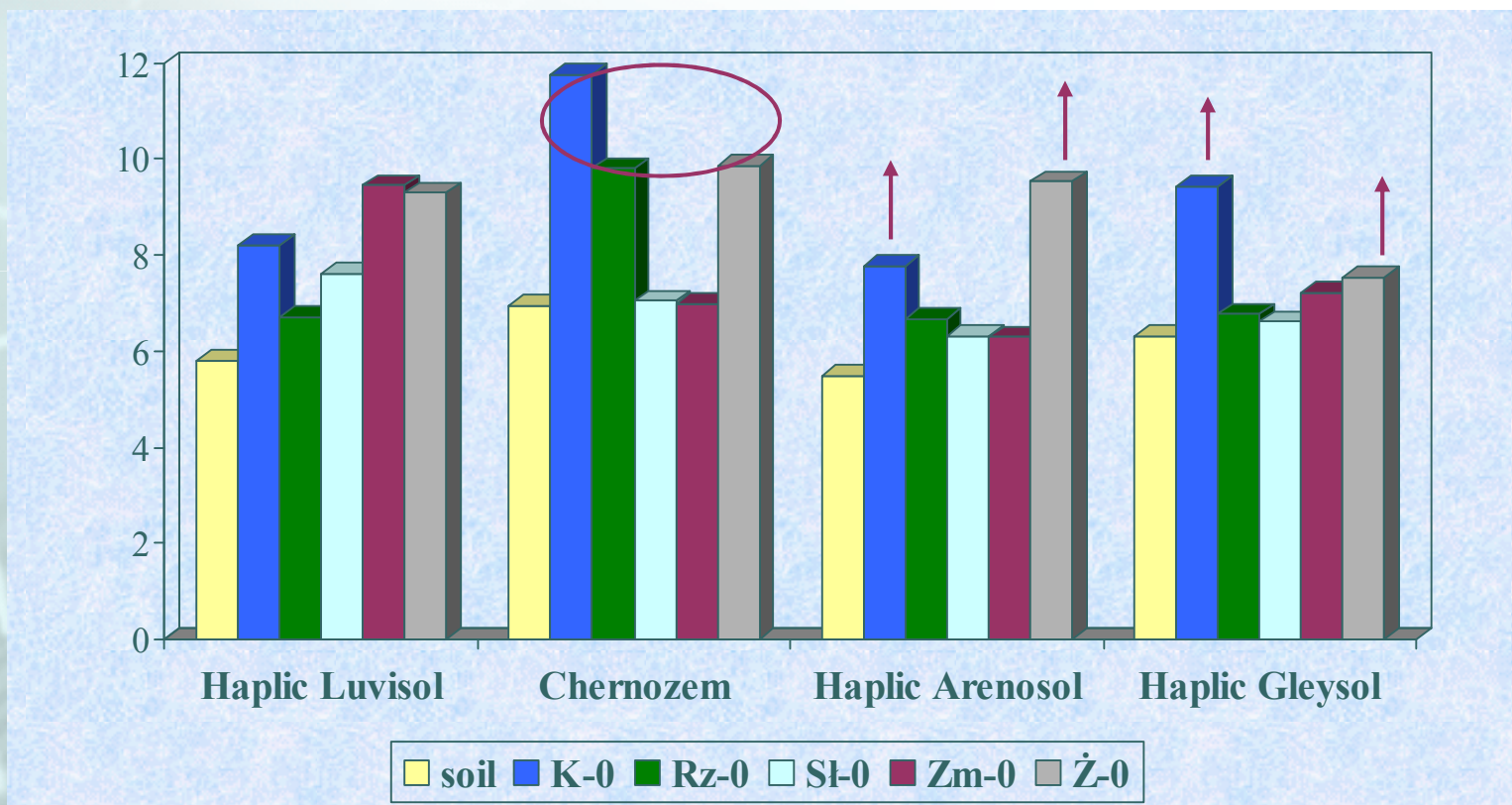
A2/4- 280 nm and 465 nm absorbance ratio

A2/6- 280 nm and 665 nm absorbance ratio

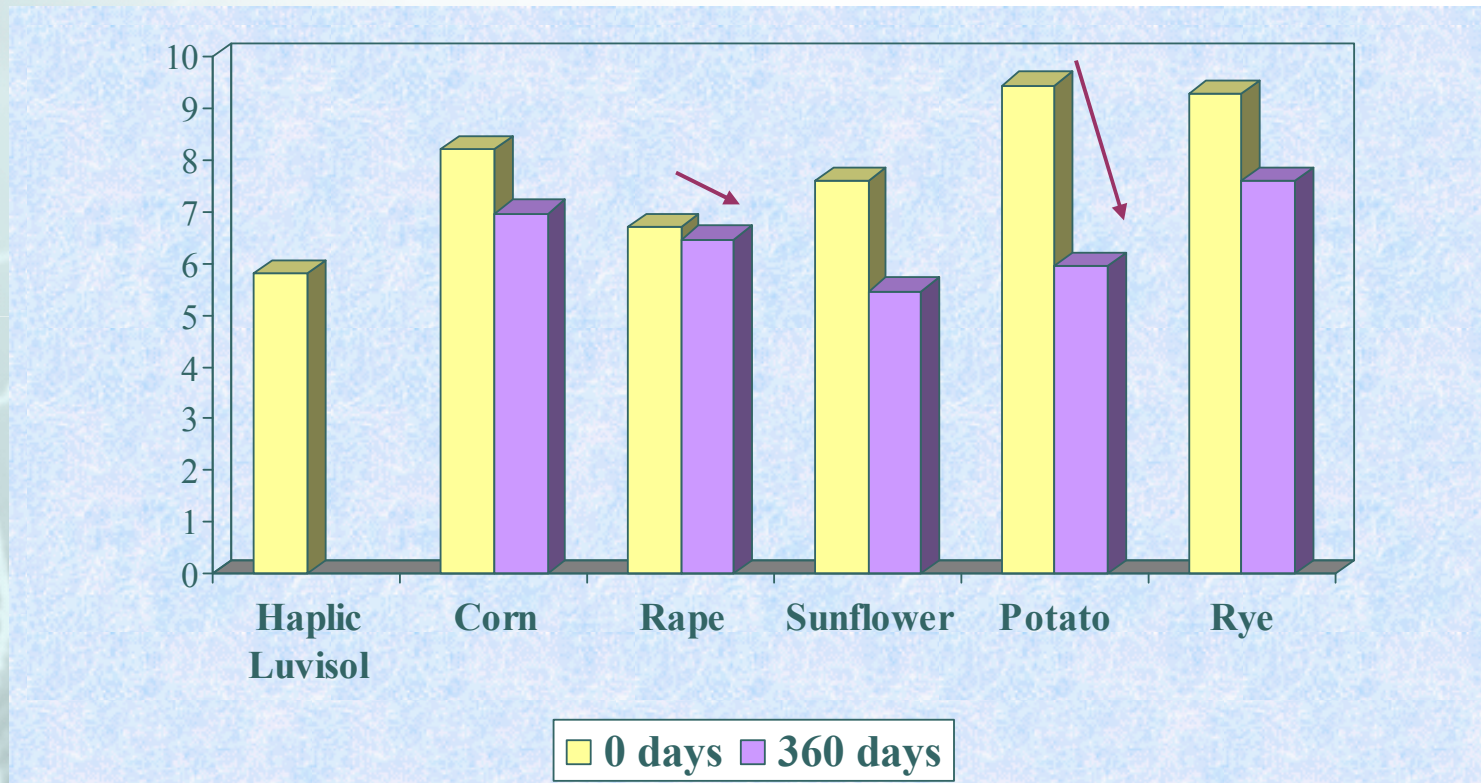
A4/6- 465 nm and 665 nm absorbance ratio

$\Delta\log K = \log A_{400} - \log A_{600}$

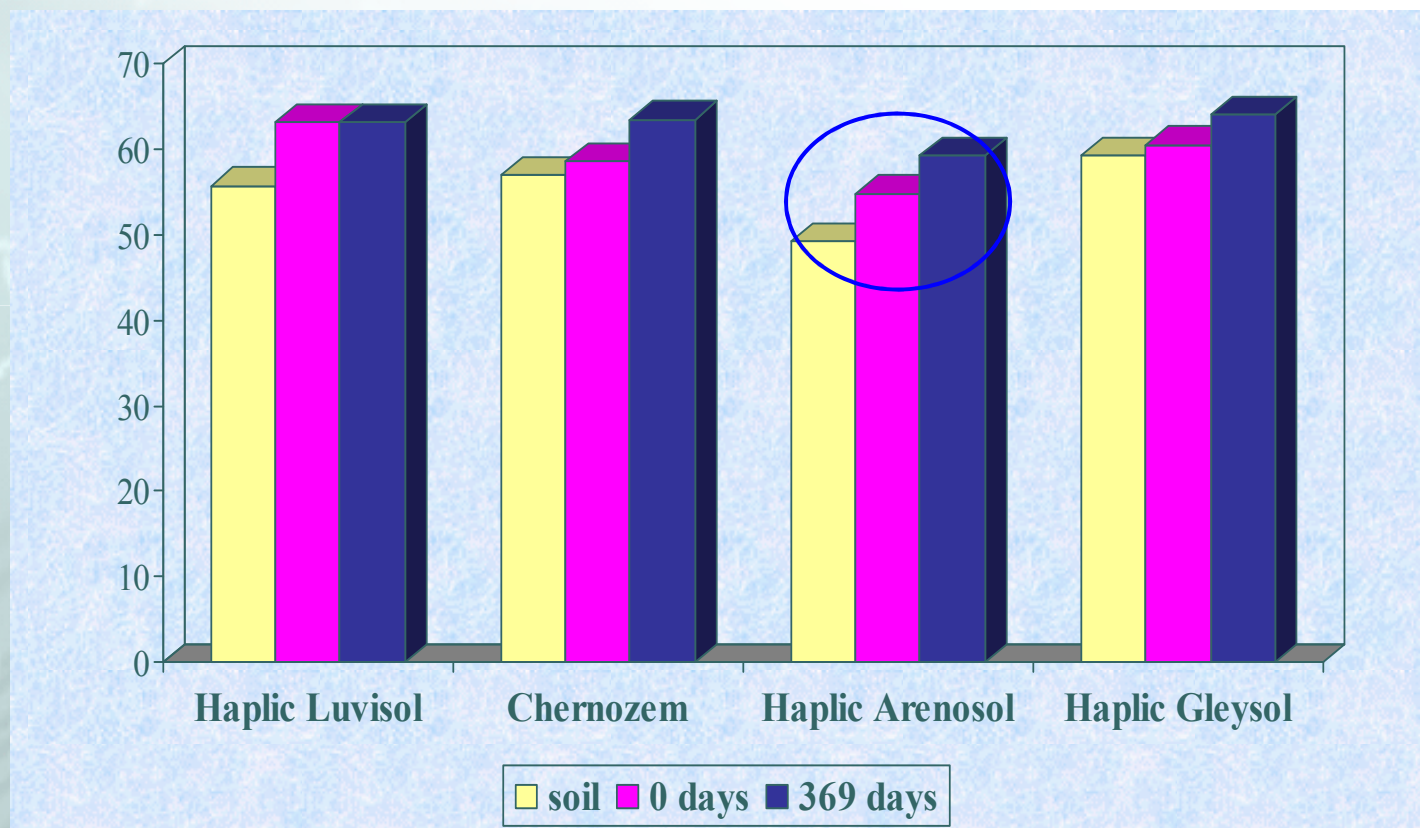
Values of $A_{2/4}$ ratio for soils' HA without residues and mixed with residues before incubation



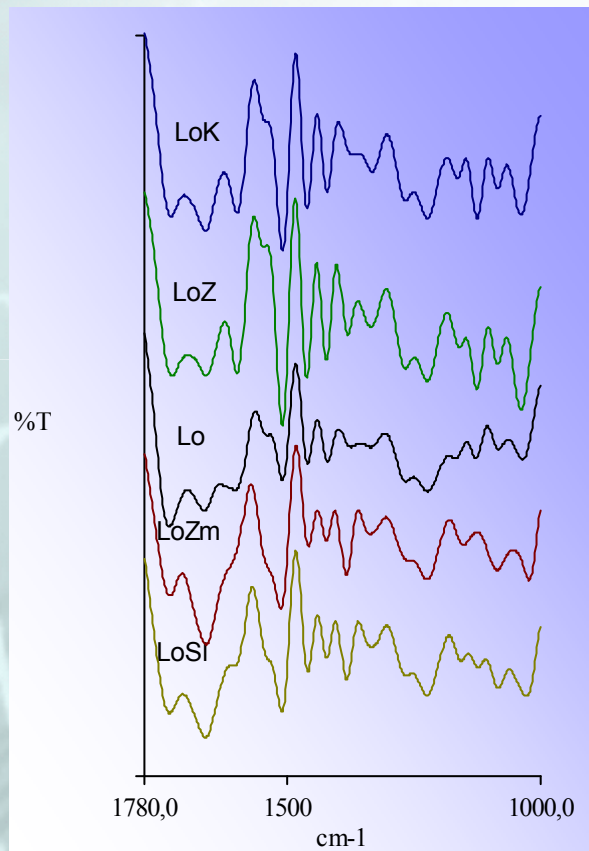
Values of $A_{2/4}$ ratio for HA isolated from Haplic Luvisol without residues and mixed with residues before and after incubation



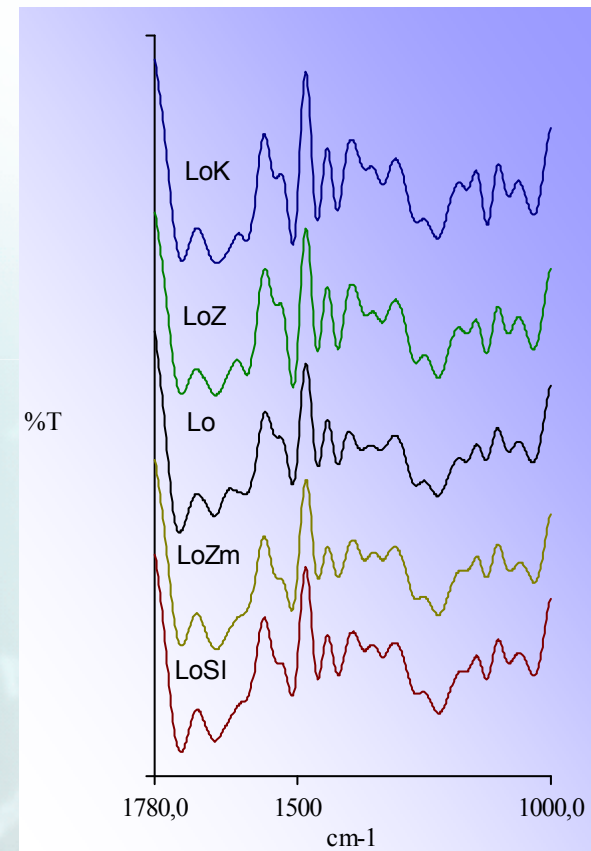
Average values of ΔA_{u465} for soils' HA without residues and before and after incubation with residues



FTIR spectra of HA isolated from Haplic Luvisol without residues and before and after incubation with post-harvest residues

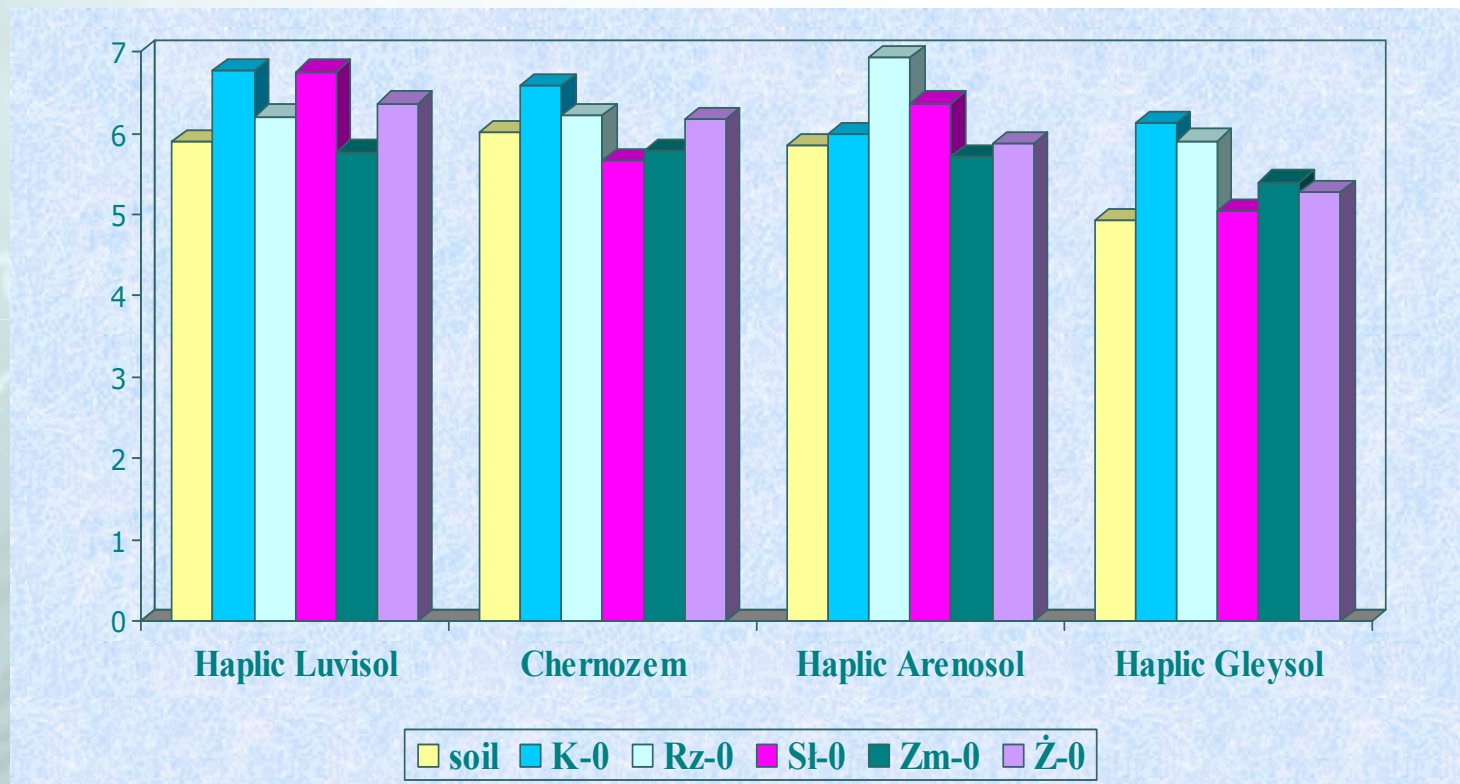


Before incubation

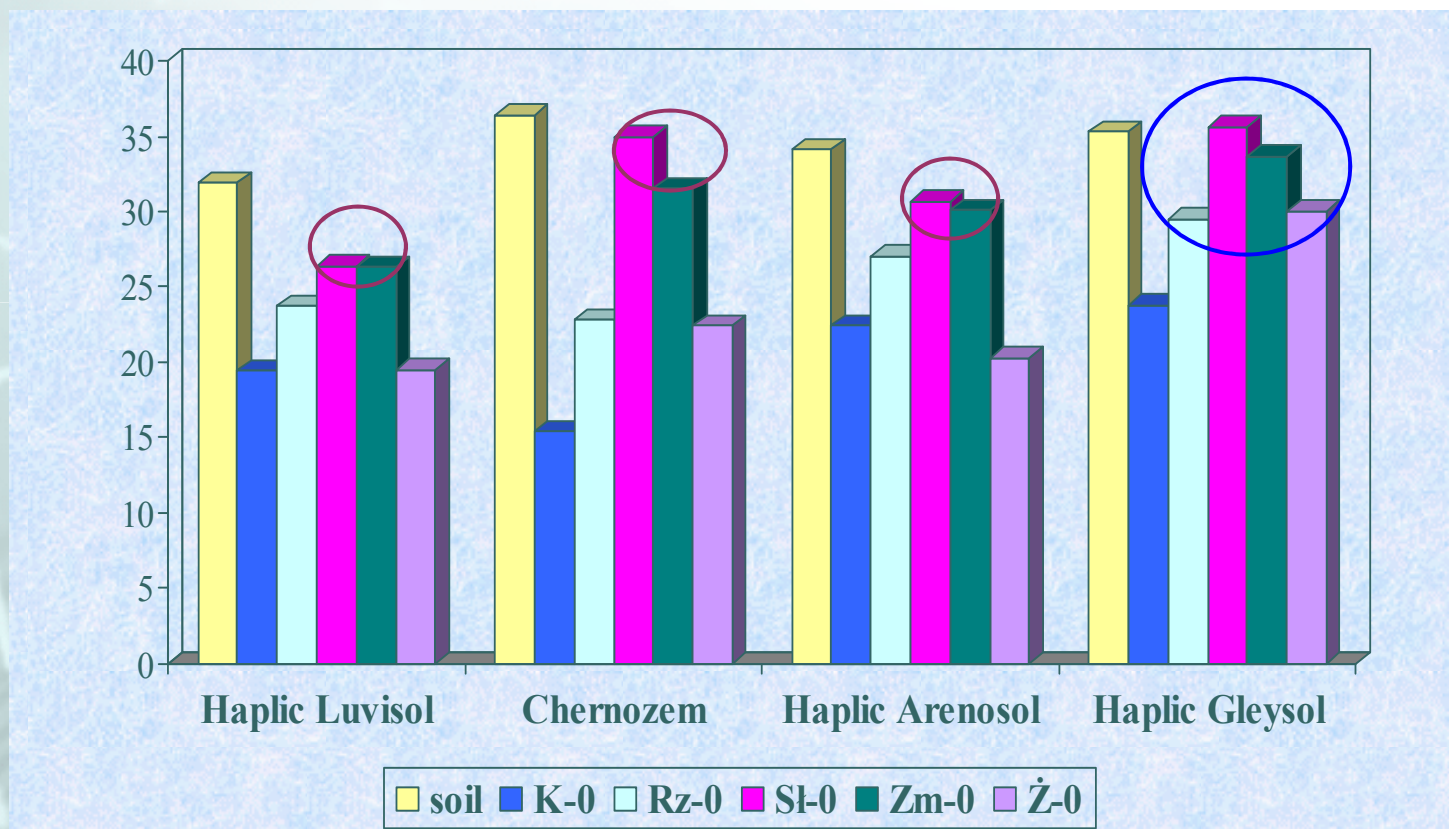


After incubation

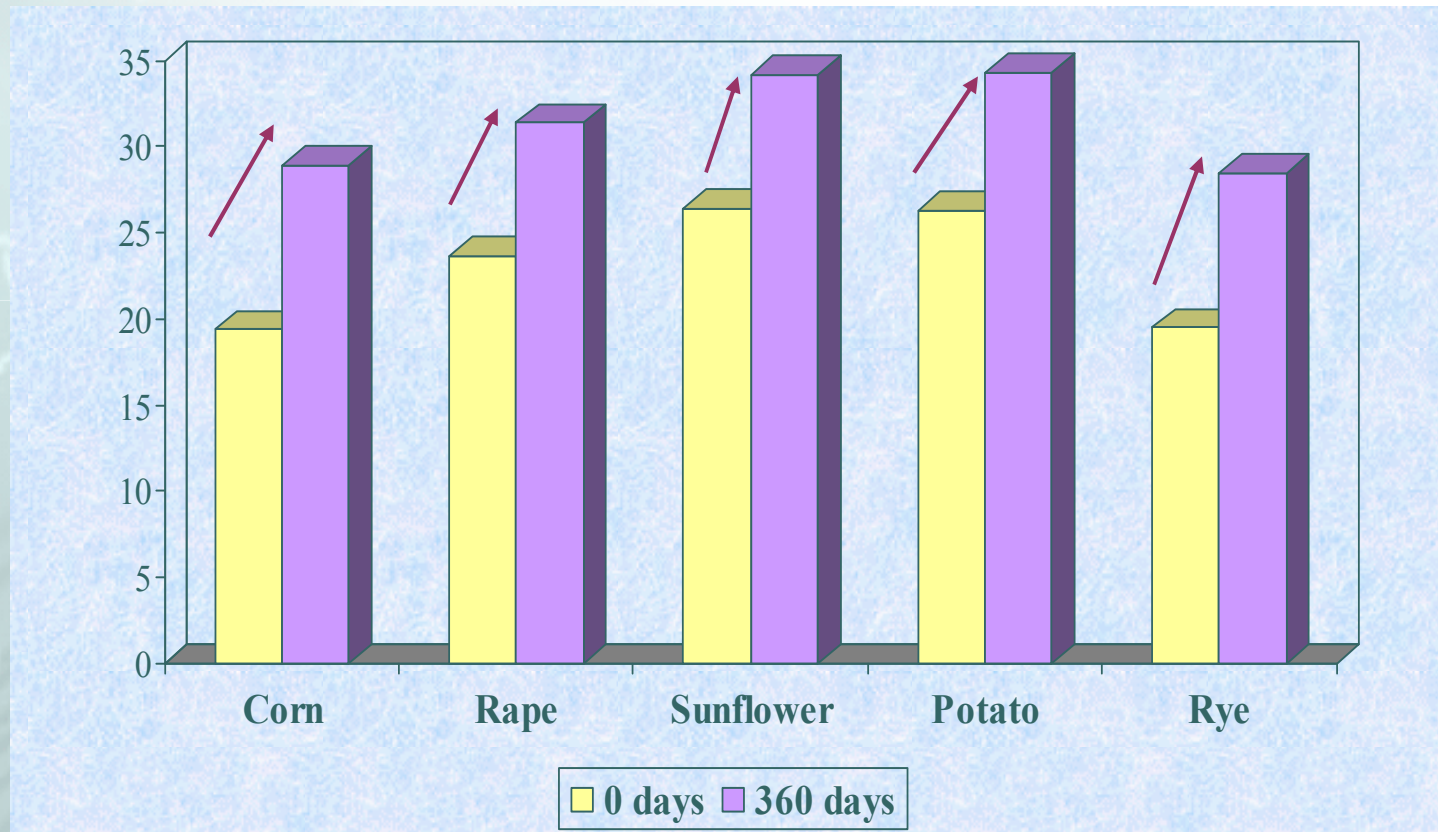
Values of DTA_{egzo2}/DTG_{egzo2} parameter in soils'HA without any additions and mixed with residues before incubation



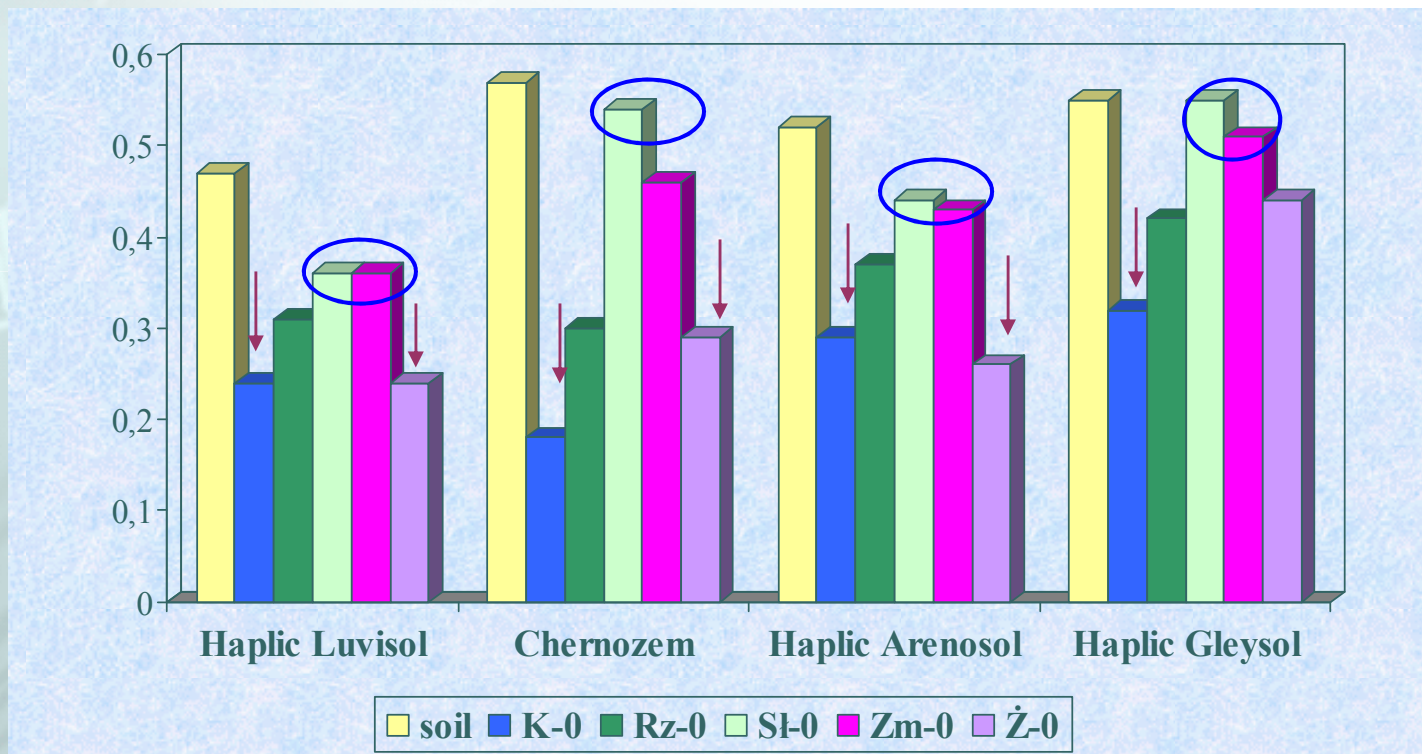
Share of HIL fraction in soils'HA without any additions and mixed with residues before incubation



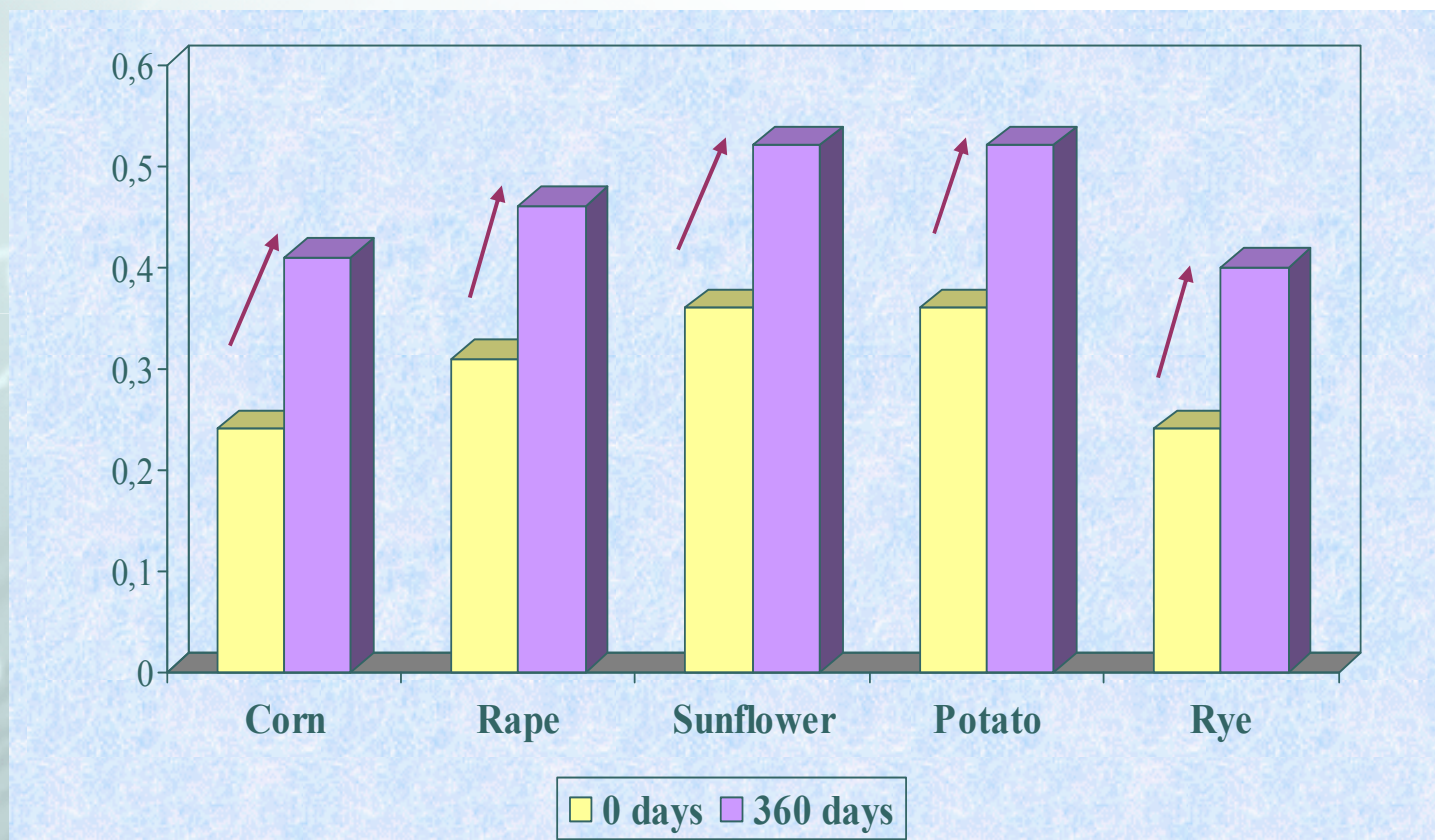
Share of HIL fraction in HA isolated from Haplic Luvisol without residues and mixed with residues before and after incubation



Values of HIL/HOB ratio for soils' HA without residues and mixed with residues before incubation



Values of HIL/HOB ratio for HA isolated from Haplic Luvisol mixed with residues before and after incubation



CONCLUSIONS

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13.-17.9.2009 Slovakia



1.

The introduction of post-harvest residues into the soils caused in molecules of humic acids – irrespective from type of soil and chemical composition of residues:

- increase content of hydrogen**
- decrease value of internal oxidation degree**
- increase values of coefficients $A_{2/4}$ and $\Delta \log K$**
- decrease share of hydrophilic fraction as well as the share HIL/HOB**

The changes others parameters were not so unambiguous and they were determined both the type of soil as well as the kind of post-harvest residues.



2.

The growth of 'maturity' degree of humic acids molecules was related in general with:

- decrease of the hydrogen contents
- increase of the nitrogen and oxygen contents
- increase of internal oxidation degree
- decrease of the values of the absorbance coefficients ($A_{2/4}$, $A_{2/6}$ i $\Delta\log K$)
- increase of the share hydrophilic fraction and the share i HIL/HOB



3.

The pattern of FTIR spectra of the soils HA without residues and mixed with residues before and after incubation permits to arrange plant residues in dependence on their intensity of decomposition in the following order:

potato \geq sunflower $>$ rape $>$ corn \geq rye



4.

Humic acids of soils mixed with post-harvest residue showed, in general, higher values of parameter DTA_{exo2}/DTG_{exo2} than the humic acids of soils without additives. The process of post-harvest residue decomposition was connected with a decrease in the value of the parameter corresponding to the burning heat of humic acids.



**THANK YOU FOR
ATTENTION**