

Effects of Organic Matter Application on the Absorption and Behavior of cadmium in a Volcanic ash Soil

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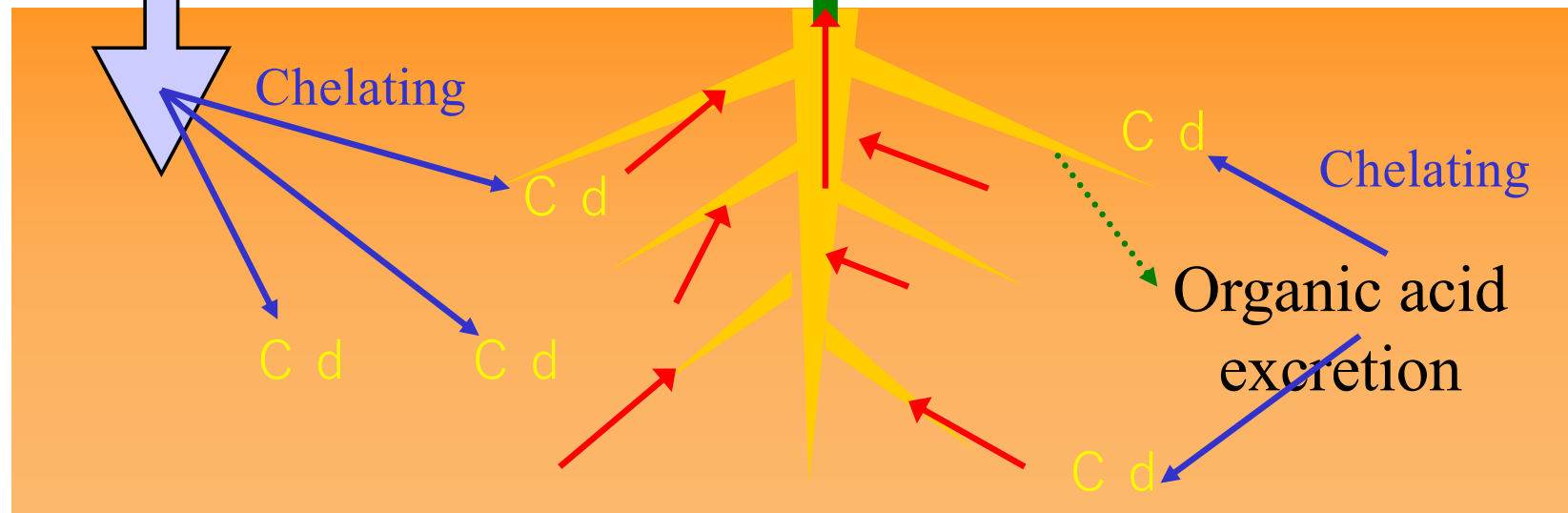
Phytoextraction

Industrial use of plant biomass other than food or feed

Insolubilization, Isolation of Cd

SOM • Applied Organic Matter

Incineration



Effect of Humic Acid on Phytoextraction (Previous studies)

- Evangelou, Daghan, Schaeffer (Chemosphere 57, 207-213, 2004)

Adding HA at 2000ppm increased Cd absorption by tobacco 30-40 %.

- Halim, Conte, Piccolo (Chemosphere 52, 265-272, 2003)

Adding HA at 1 ~ 2% level increased the content of DTPA soluble Cd (Plant available) in soil.

Outline of this study

- Effect of adding HA and FA from volcanic ash soil, and HA from peat soil on the absorption of Cd was examined.
- Effects of EDTA application, and that of anaerobic digested cow slurry were also studied for comparison.

Characteristics of used plant

White mustard (*Sinapis alba*)



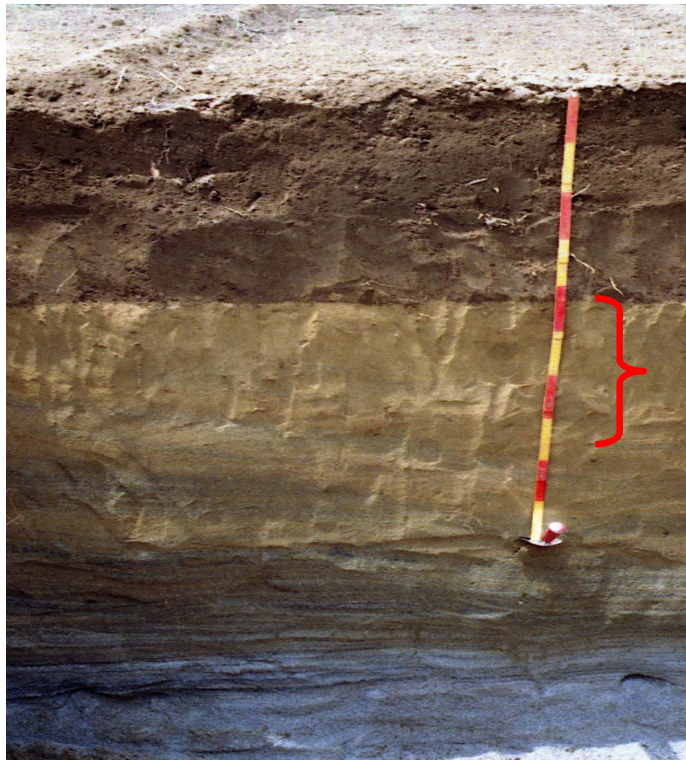
- **belongs to Brassica**
- **Vigorous initial growth**
- **High yield in short time**
- **Used widely as green manure, and amenity plants.**
- **Efficient absorption of Cd**

Used Soil

Soil from Obihiro Uni.

Lower layer of light colored andosoil

50-60 cm Eniwa loam layer



Chemical Characteristics

pH (H ₂ O)	6.92
pH (KCl)	5.37
EC ($\mu\text{S cm}^{-1}$)	54.9
N _{Total} (%)	0.04
C _{Total} (%)	<u>0.42</u>
C/N	9.72
CEC ($\text{cmol}_c\text{kg}^{-1}$)	5.21

Particle Size Distribution %

Coarse Sand	43.7
Fine sand	33.1
Silt	14.6
Clay	8.64

Soil Texture: Sandy loam

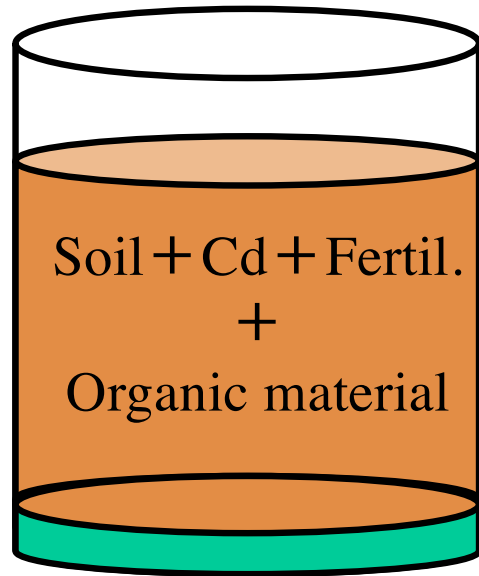
Experimental Design

control	Humic S.	Slurry	EDTA
No addition	Volcanic Ash Soil HA-Low	Digested Slurry Low	EDTA-L
	Volcanic ash Soil HA-High	Digested Slurry-High	EDTA-H
	Peat HA- High		
	Volcanic Ash Soil FA-Low		

- HA and EDTA : L 500 ppm, H 1000 ppm, FA: 500 ppm
Slurry : L 2.5%, H 5.0%
- Cd concentration : 0ppm, 10ppm, 50ppm
- Repetition : 3 times
- N, P, K concentrations were same (equivalent to N 200kg/ha)

Pot experiment

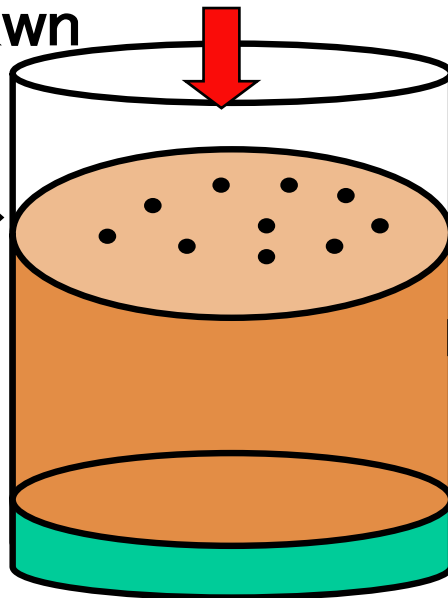
300g soil in a plastic bottle (1L)



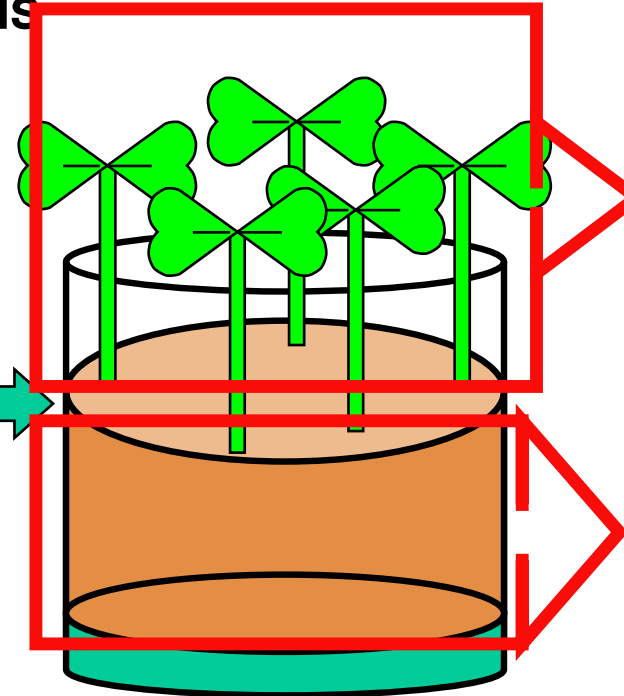
Glass beads : 100 g

60 % of Maximum Water Holding Capacity

Sinapis alba: 10 seeds
sawn



Thinned to 5 seedlings after 4 days

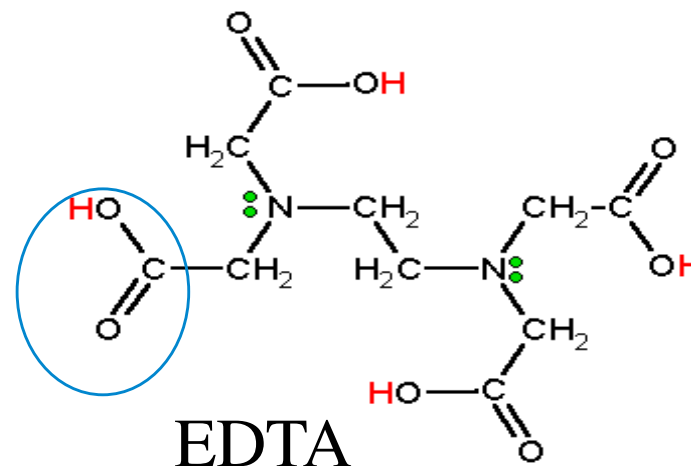


Grown for 30 days in a greenhouse At 20°C

Cd in Shoot & root

Soil Cd in different forms

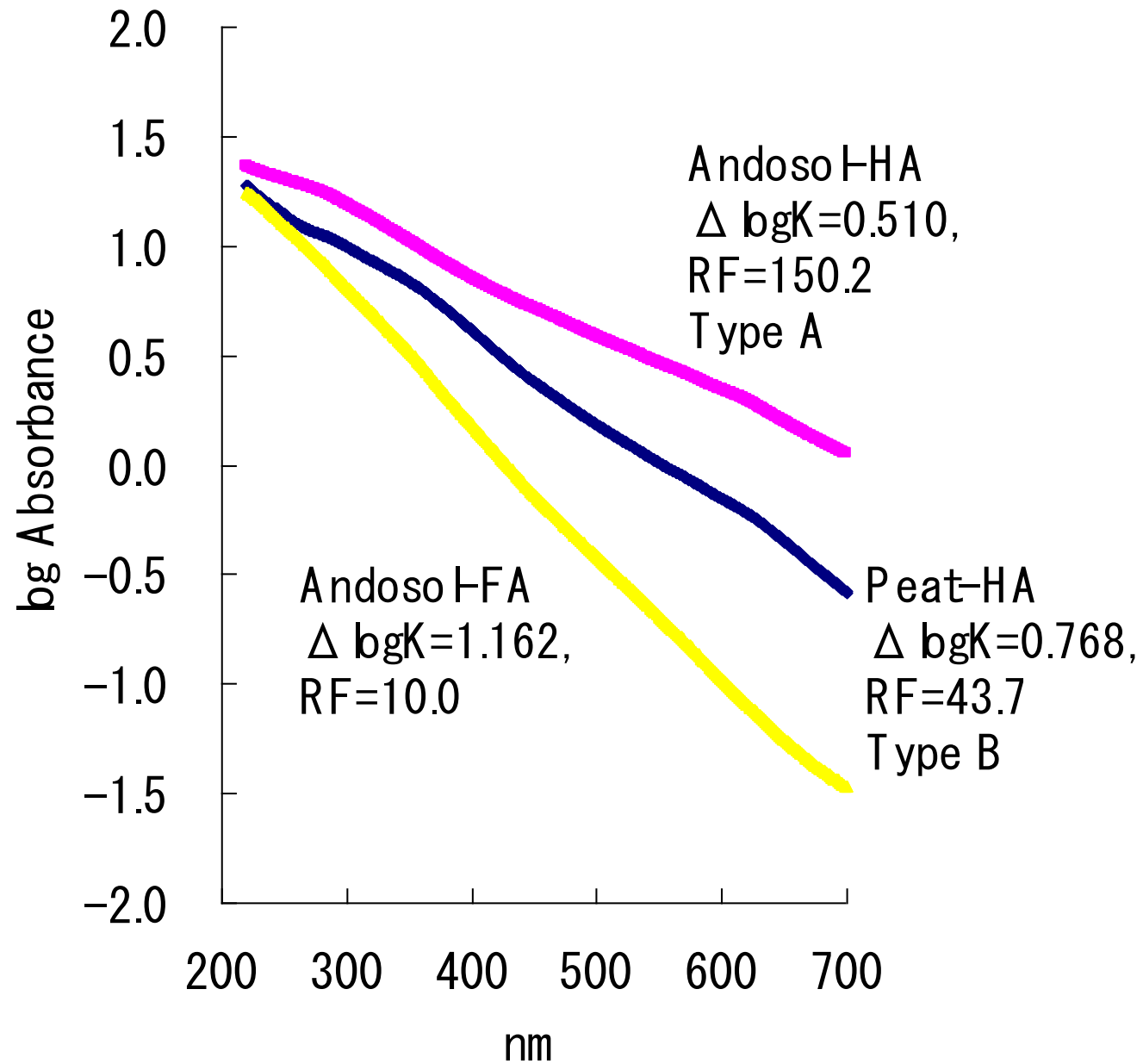
Functional Group Composition of HS



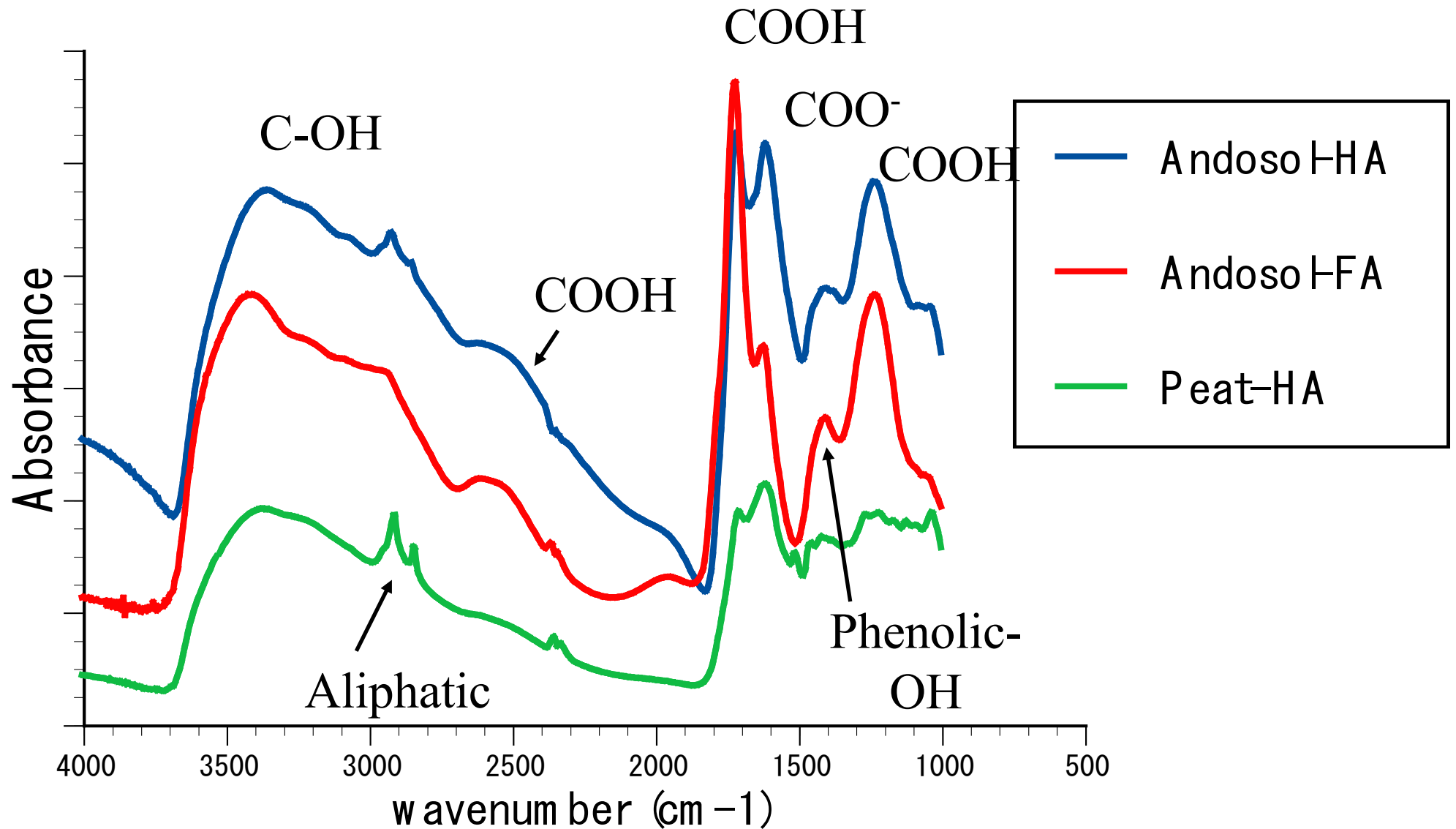
HS	Soil	Functional Gp (me/g)	
		Carboxyl	Phenolic OH
HA-Andosol	Andosol	4.27	2.14
FA-Andosol	Andosol	8.10	0.90
HA-PEAT	Peat	2.74	2.31

* Carboxyl group content of EDTA: 10.8(me/g)

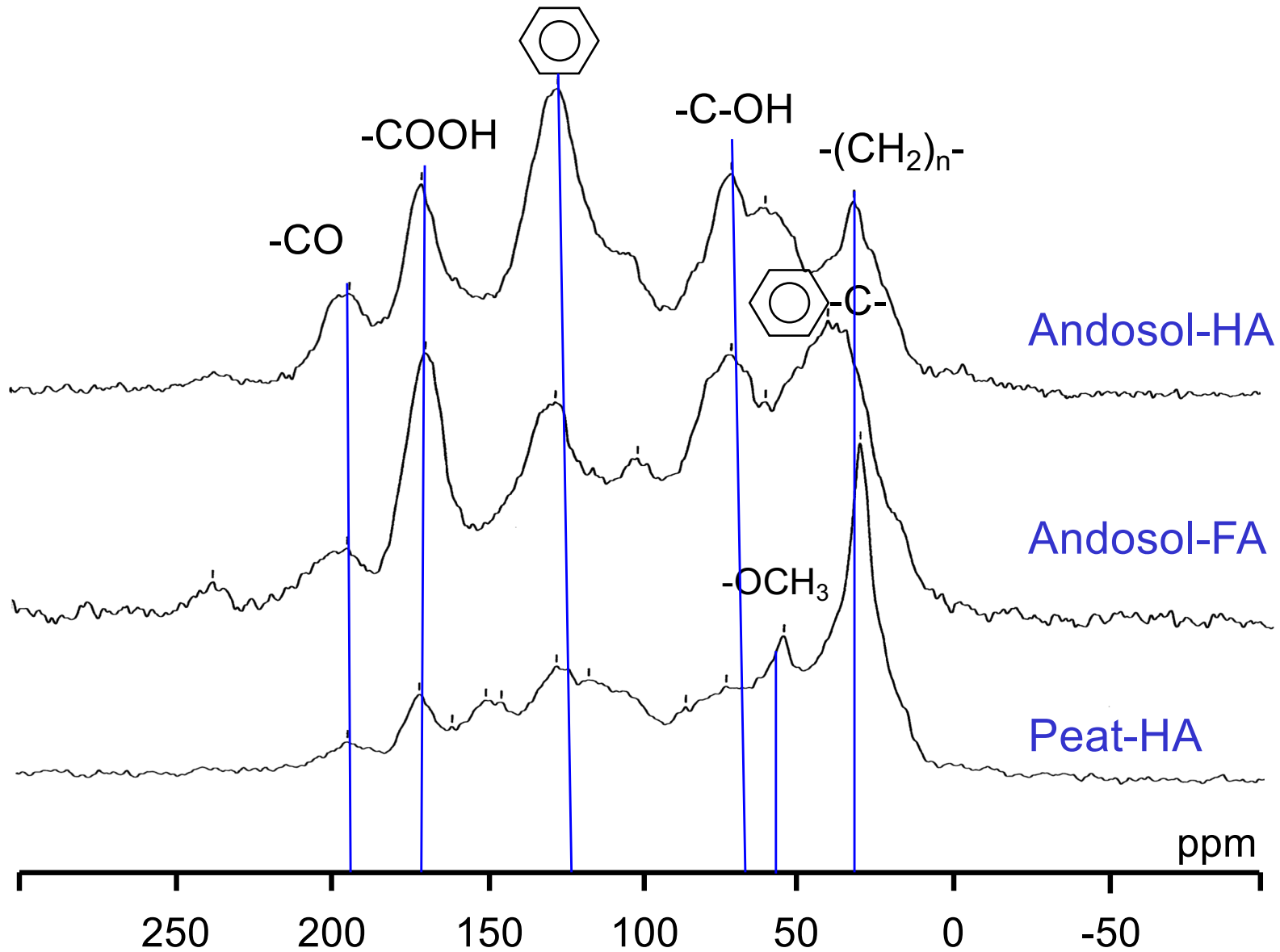
UV-Vis spectra of humic substances



FT-IR spectra of humic substances



^{13}C -NMR spectra of humic substances



Charadterisitics of Digested Slurry

Collected from the slurry store tank of a biogas plant (high temperature, 55 C) in Obihiro University

total C (%)	1.87
total N (%)	0.35
C/N	5.36

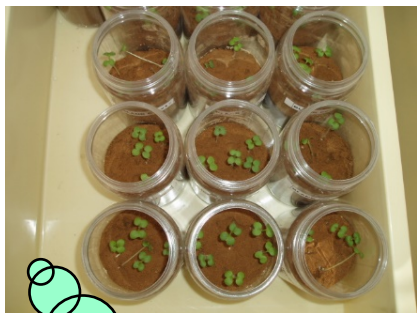
Result of Pot Experiment

Treatment **BLANK**

Cd Lv2
50 ppm

Cd Lv1
10 ppm

Cd Lv0
0 ppm



Germination rates were 100% in all levels

Cd50ppm caused chlorosis

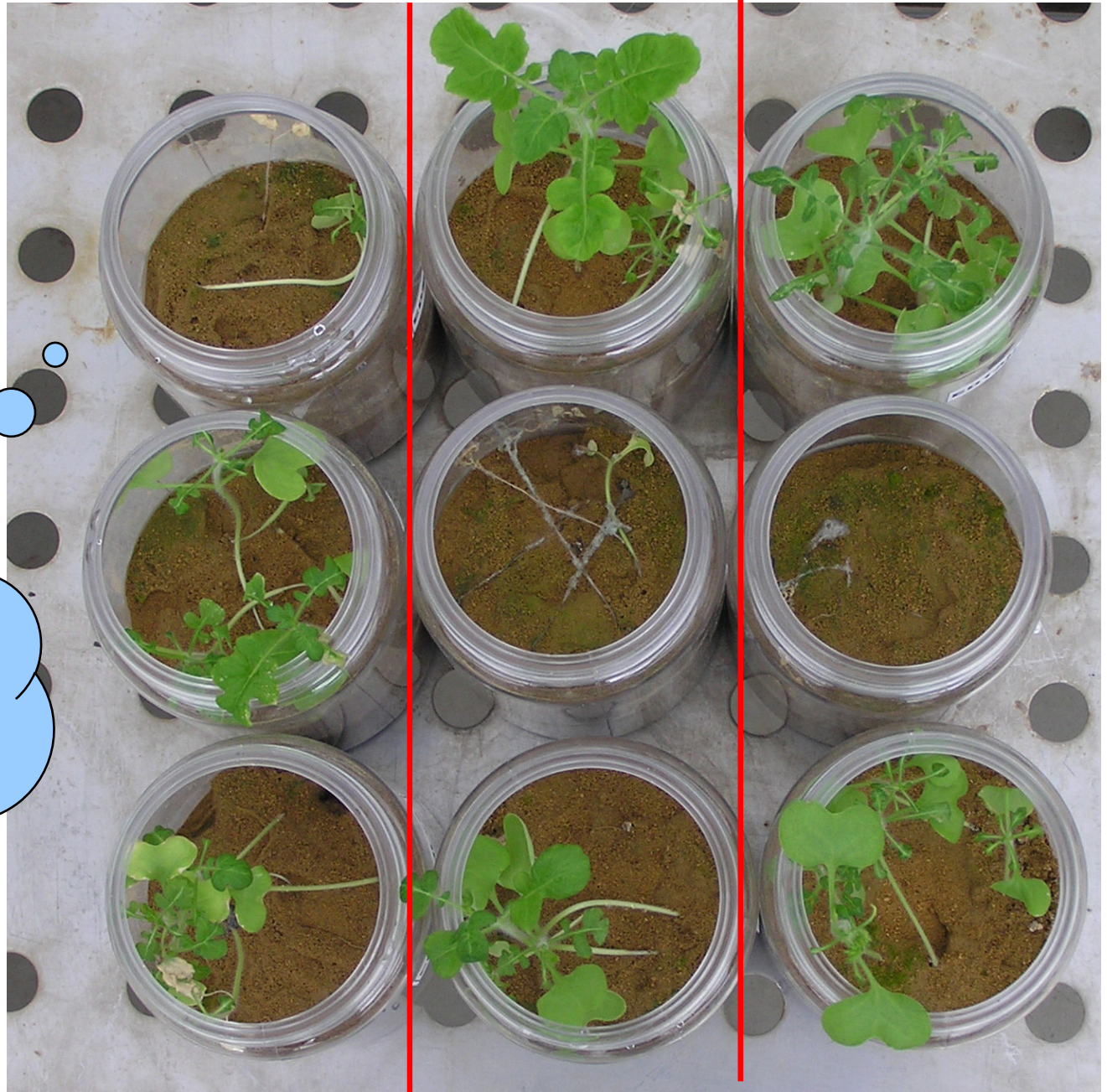
Treatment with EDTA



Cd Lv2
50 ppm

Cd Lv1
10 ppm

Cd Lv0
0 ppm



EDTA
inhibited the
growth of
plant