BIOACCUMULATION AND TRANSLOCATION OF ARSENIC AND CADMIUM IN SOYBEAN

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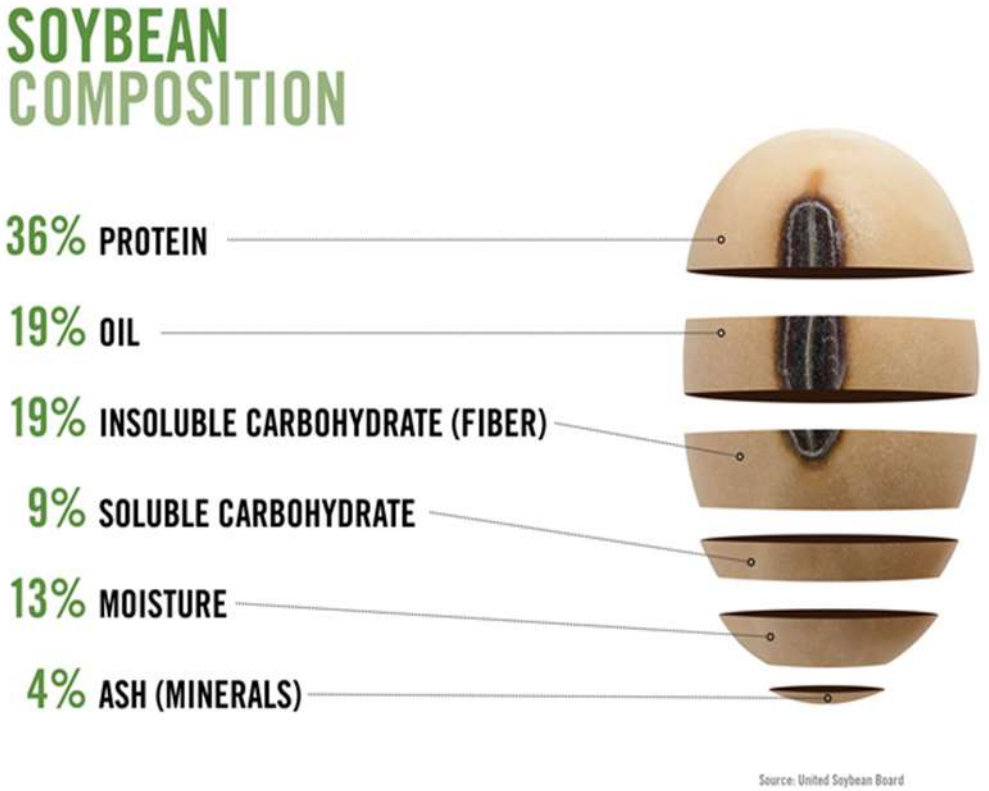
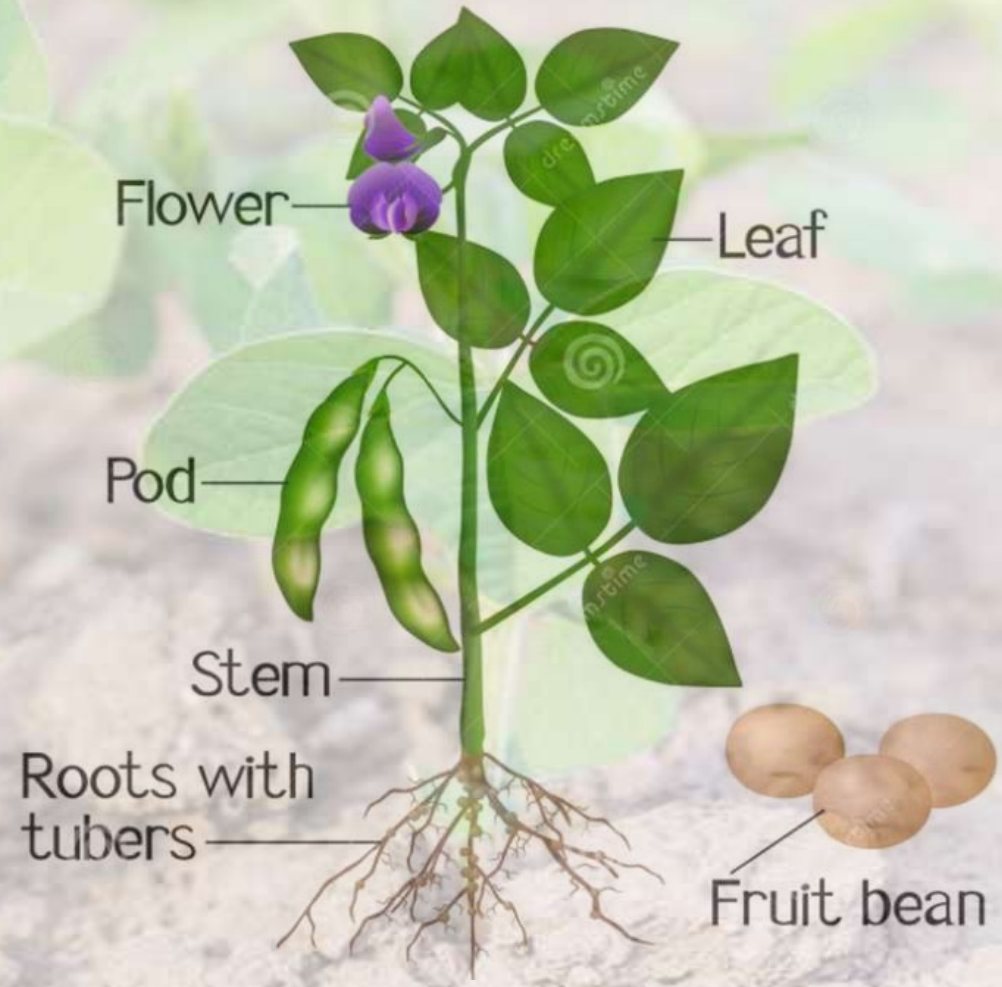
Introduction



- Soybean (Glycine max), is an annual legume from the family Fabaceae;
- The benefits of soybeans are numerous:
- It is rich in protein and low in price and thus it is considered one of the most economically important beans for food industry;
- Additionally, it contains no starch and, therefore, is a good source of protein for diabetics.
- It is also an important soil-enriching crop, adding nitrogen to the soil by means of nitrogen-fixing bacteria.

Introduction

- Soybean is considered a good biaccumulator of heavy metals from soil;
- Some authors even considered it as a remediation agent.
- In that case, the quality and the HM content in the seed could be an issue.
- Literature results are scattered.
- The purpose of our study was to investigate the ability of soybean to accumulate and translocate Pb in the plant parts (roots, shoots, leaves, pods, and seeds);



Materials and methods

- The experiment was performed in control environment.
- Soil samples were collected from the naturally polluted soil with Pb from the top layer (25 cm depth) near the mining area of „Zletovo“.
- Soil quality was investigated before sawing the plants.
- Two different soybean varieties (Avigea and Ilyndenka) with different vegetation periods were used in this study.
- Microwave digestion followed by the Q-ICP-MS analysis was used for the determination of As and Cd in different plant parts.

Soybean variety	Origin	Mature group	Vegetation period
Avigea	Bulgaria	0	100 days
Ilindenka	Macedonia	II	150 days

•Weit digestion (open system)

SOIL SAMPLES

•Weit digestion(closed system)

PLANT SAMPLES

DETERMINATION OF TOTAL AND AVAILABLE ELEMENTS CONTENT IN SOIL

➢Wet digestion in open system

Determination of total content of elements

***ISO 14869-1:2001**

Dry samples (0,25 g) →   ← **HNO_3**, **HF**, **$HClO_4$**

➢**EXTRACTION** - FOR AVIABLE FORMS OF ELEMENTS

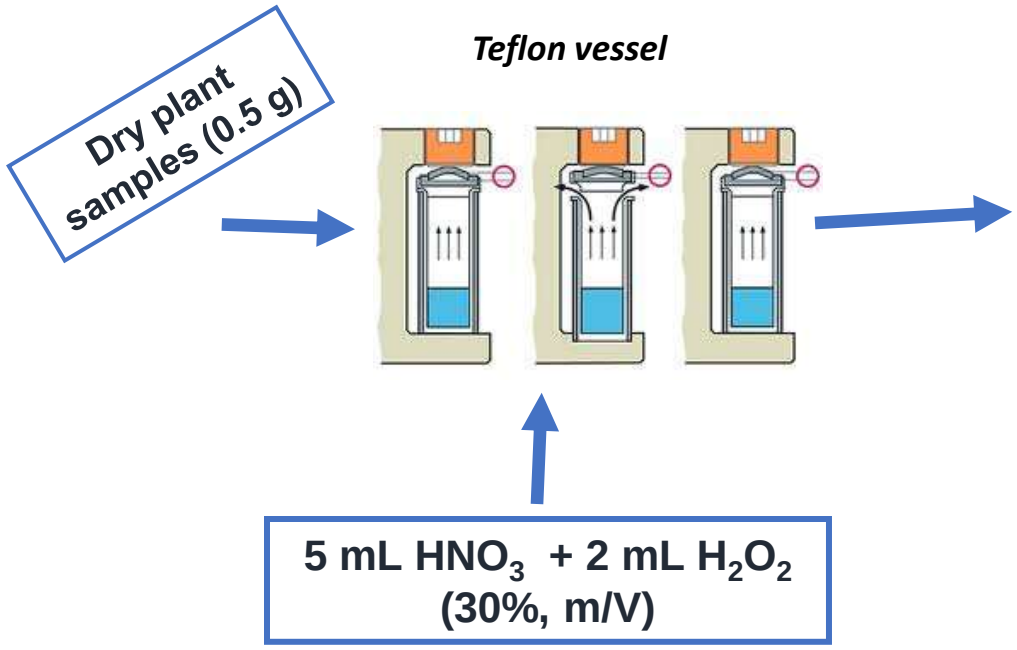
- Extraction H_2O
- Extraction with 1M CH_3COONH_4 (pH = 7.0)
- Extraction with 1M CH_3COONH_4 (pH = 5.0)

*ISO 14869-1:2001, Soil quality-Dissolution for the determination of total element content-Part 1: Dissolution with hydrofluoric and perchloric acids.

SAMPLE PREPARATION –PLANT SAMPLES

Wet digestion in closed microwave system

For total elements content



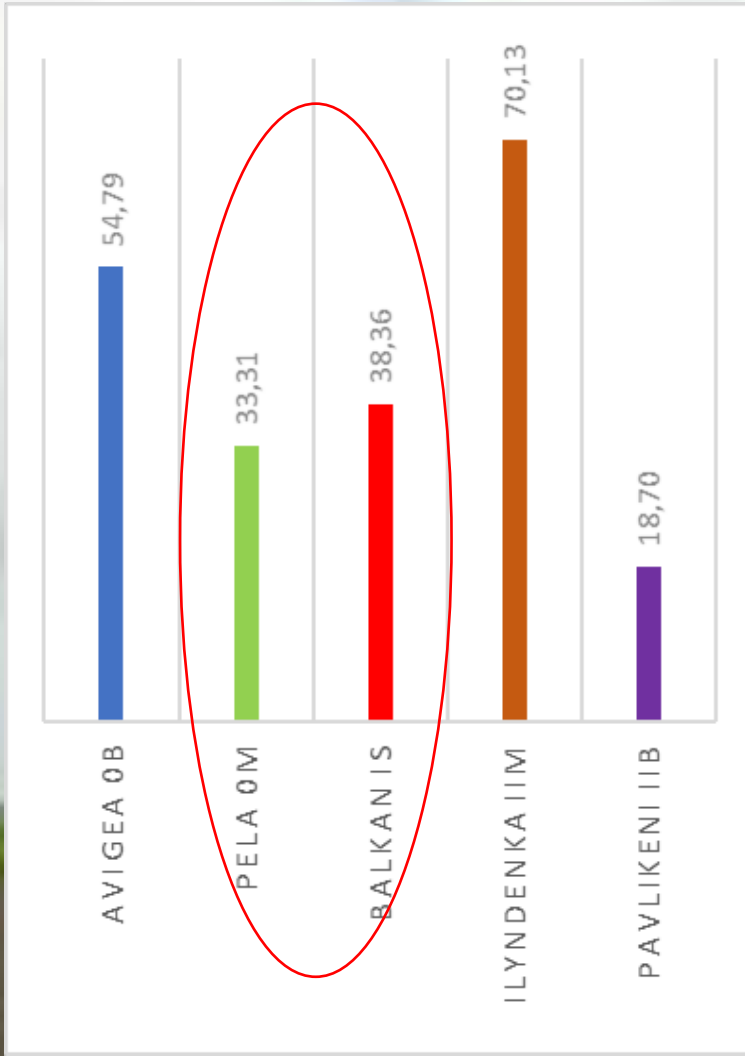
Microwawe system for digestion
model Mars 4, CEM Corporation, USA,

Results

Table2. Soil quality from the Zletovo minning area

	As total ppm	As bioavailable ppm	Cd Total ppm	Cd Bioavailable ppm	pH	CEC cm/mol	EC mS/cm	OM%	K2O mg/100g	P2O5 mg/100g	Loam %
soil	39	83.5			6.9	9.0	0.41	1.47	13.7	12.0	10.2
Igeo		4.6									

Total Pb



One-way ANOVA between groups

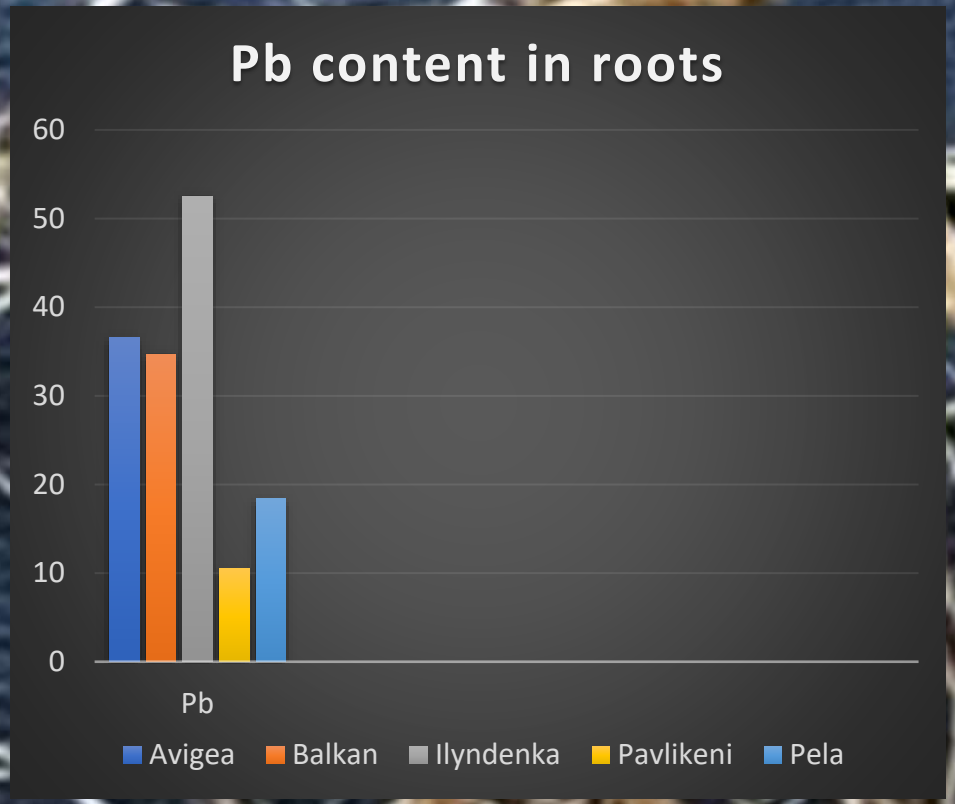
ANOVA						
ce of Varic	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between (	4742,668	4	1185,667	103,7500866	4,24233E-08	3,47805
Within Gr	114,2811	10	11,42811			
Total	4856,949	14				

Bonferroni-Adjusement α-crit = 0.01

t-Test	p
Avigea 0B/Pela 0M	0,002196
Avigea 0B/Balkan IS	0,006923
Avigea oB/Ilyndenka IIM	0,010439
Avigea 0B/Pavlikeni IIB	0,000263
Pela 0M/Balkan IS	0,104192
Pela 0M/Ilyndenka IIM	0,000149
Pela 0M/Pavlikeni IIB	0,002154
Balkan IS/Ilyndenka IIM	0,000338
Balkan IS/Pavlikeni IIB	0,000998
Ilyndenka IIM/Pavlikeni IIB	3,3E-05

	Avigea	***Balkan***	***Ilyndenka***	***Pavlikeni***	***Pela***
BAF	0.66	0.46	0.84	0.22	0.40

Roots



ANOVA single-factor analysis

ANOVA						
Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Groups	3254,77	4	813,6925	63,83224	4,42E-07	3,47805
Within Groups	127,4736	10	12,74736			
Total	3382,244	14				

Post-Hoc T-test for equal variances

t-Test	p
Avigea 0B/Pela 0M	6,19E-04
Avigea 0B/Balkan IS	0,2647
Avigea oB/Ilyndenka IIM	0,0200
Avigea 0B/Pavlikeni IIB	4,59E-05
Pela 0M/Balkan IS	5,72E-04
Pela 0M/Ilyndenka IIM	0,0014
Pela 0M/Pavlikeni IIB	0,0074
Balkan IS/Ilyndenka IIM	0,0128
Balkan IS/Pavlikeni IIB	2,11E-05
Ilyndenka IIM/Pavlikeni IIB	5,30E-04

Table 3. The content of Pb (ppm) found in the roots of the investigated soybean varieties

Soybean variety	Avigea	Balkan	Ilyndenka	Pavlikeni	Pela
Pb roots	36.56±4.77	34.68±7.81	52.50±6.64	10.50±1.2	18.39±2.23
TA %	66,72	55,21	90,39	74,87	56,14