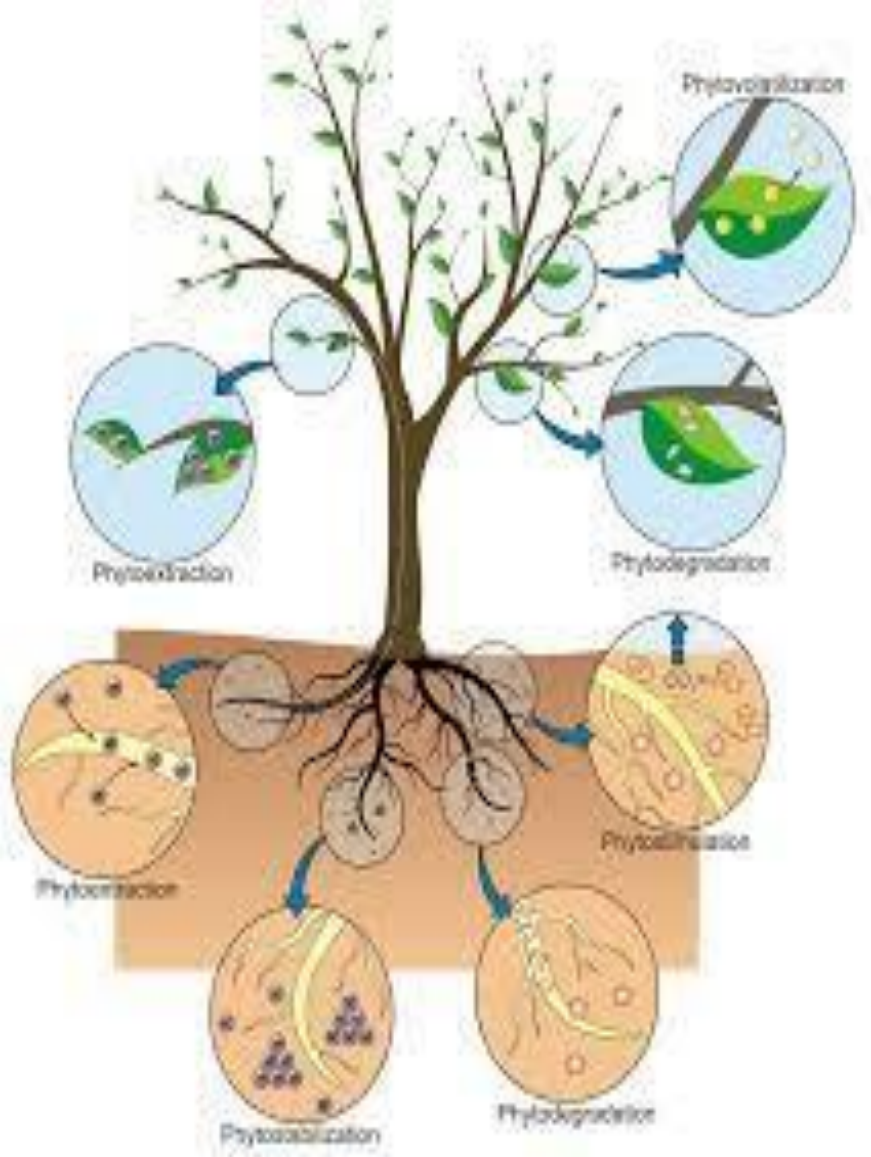
CORFU' 2022

CHROMIUM TOLERANCE AND PHYTOEXTRACTION BY PHYLLOSTACHYS PUBESCENS

Prof. Ing. Ezio Ranieri
University of Bari, Italy

9th International Conference On Sustainable Solid Waste Management



Chromium and Phytoremediation

Chromium (Cr), can cause problems in the ecosystems and human health due to the bioaccumulation in the food chains of plants and animals. Exposure to Cr, may cause toxic, genotoxic, teratogenic, and mutagenic effects.

Phytoremediation is economical and with low environmental impact, that uses plants and their associated microorganisms to remove, degrade or isolate toxic substances from the environment to restore contaminated sites.

- Is Moso Bamboo really effective in Cr removal?
- Is the MB tolerant versus Chromium?
- Is the MB adaptable to Mediterranean conditions?

Objectives

A bamboo species, the Phyllostachys pubescens – Moso Bamboo (MB) -, was selected for its heavy metals accumulation and translocation potential to restore Chromium (Cr)-contaminated soil.

- To evaluate MB's tolerance in Cr-contaminated soils
- To assess the phytoextraction capacity versus Chromium
- To evaluate the migration capacity of Cr within MB
- To evaluate the capacity of CO2 sequestration by MB

Materials and Methods 1/2

Preliminary tests were carried out in a laboratory, in a controlled environment, for evaluating MB growth with irrigation in Mediterranean conditions. The experiment was carried out with only one MB plant allocated in a pot with a diameter (D) of 25 cm and a height (h) of 20 cm. The pot had a horizontal surface of 490 cm2 and a volume of 10 l. It was filled with a mixture of blond, brown peat, natural vegetable conditioner and organic substance. pH = 6.9. Total soil mass was 4 kg and soil density was equal to 0.25 kg/l. A given constant watering rate of 1.644 mm/day = 0.0805 l/day was used.

Materials and Methods 2/2

MB tolerance was assessed by measuring its growth with irrigation with a solution of 125 mg Cr/l.

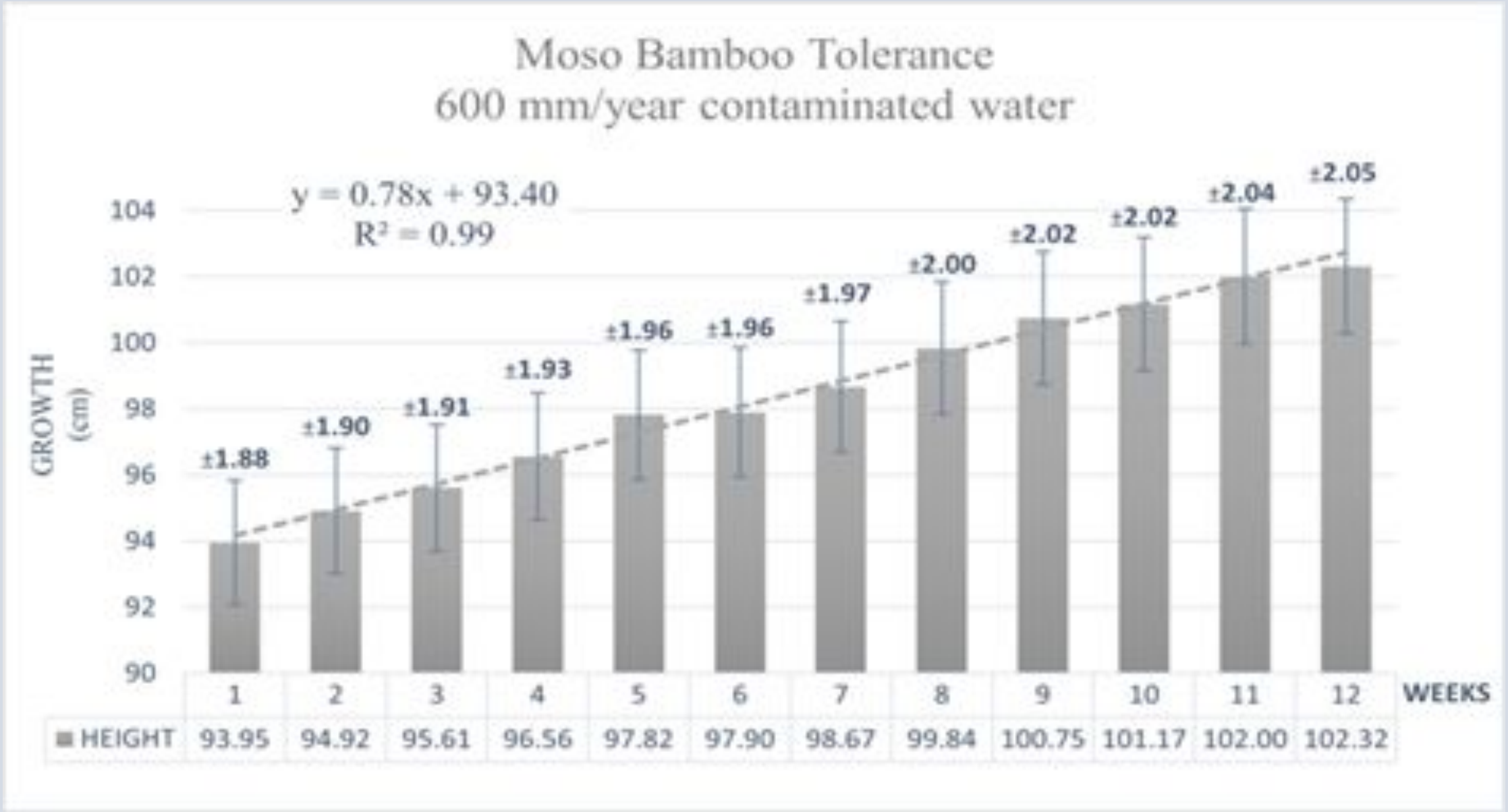
After MB tolerance test, his capacity of Cr phytoextraction has been evaluated in the pot where the Cr concentration in soil was homogenous and equal to 200 mg Cr/kg dw.

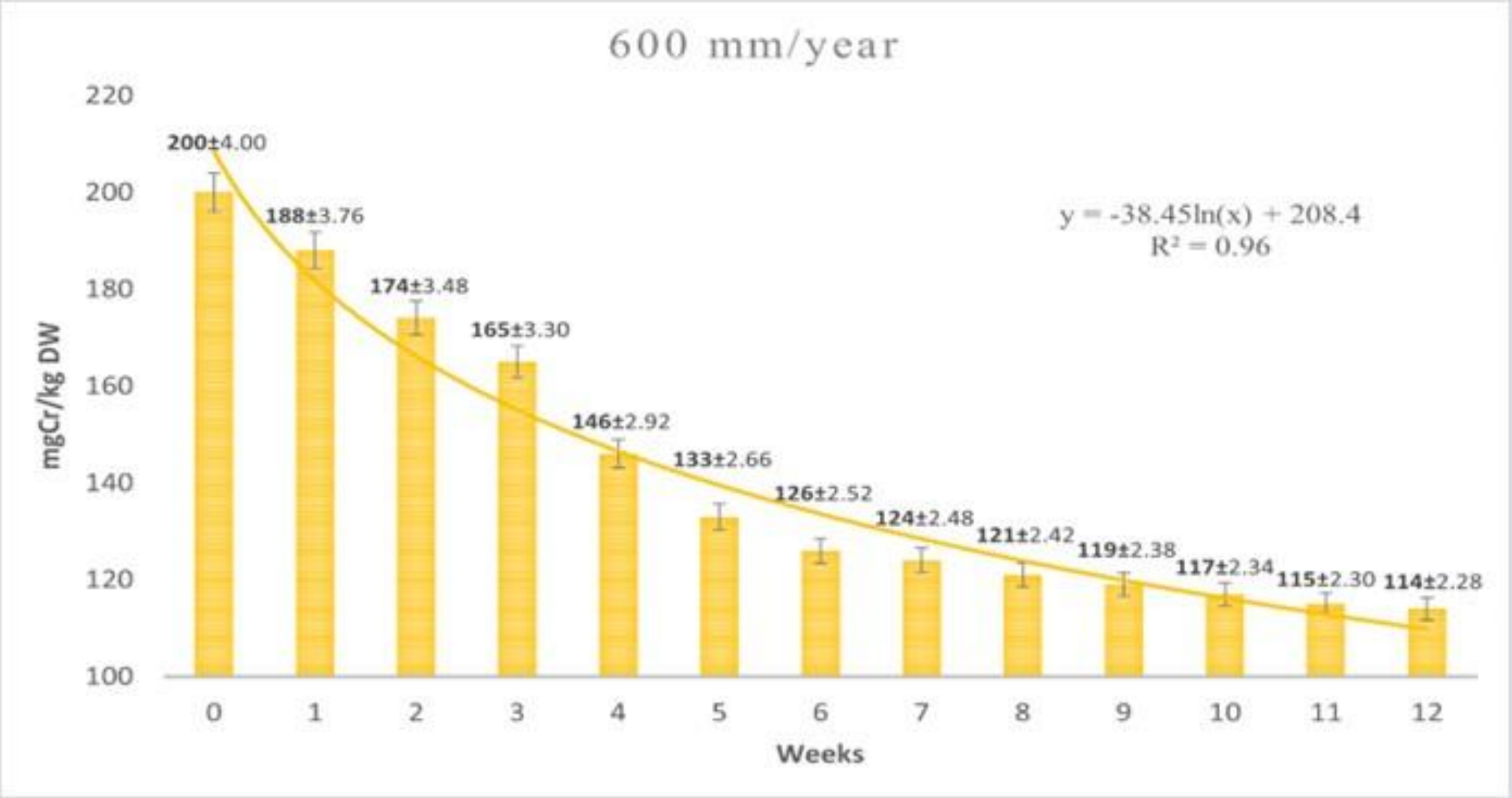
For the analysis, the MB plant was also separated into its components: roots, rhizomes, stems and leaves. The total biomass analyzed was approx. 1.5 kg.

MB GROWTH

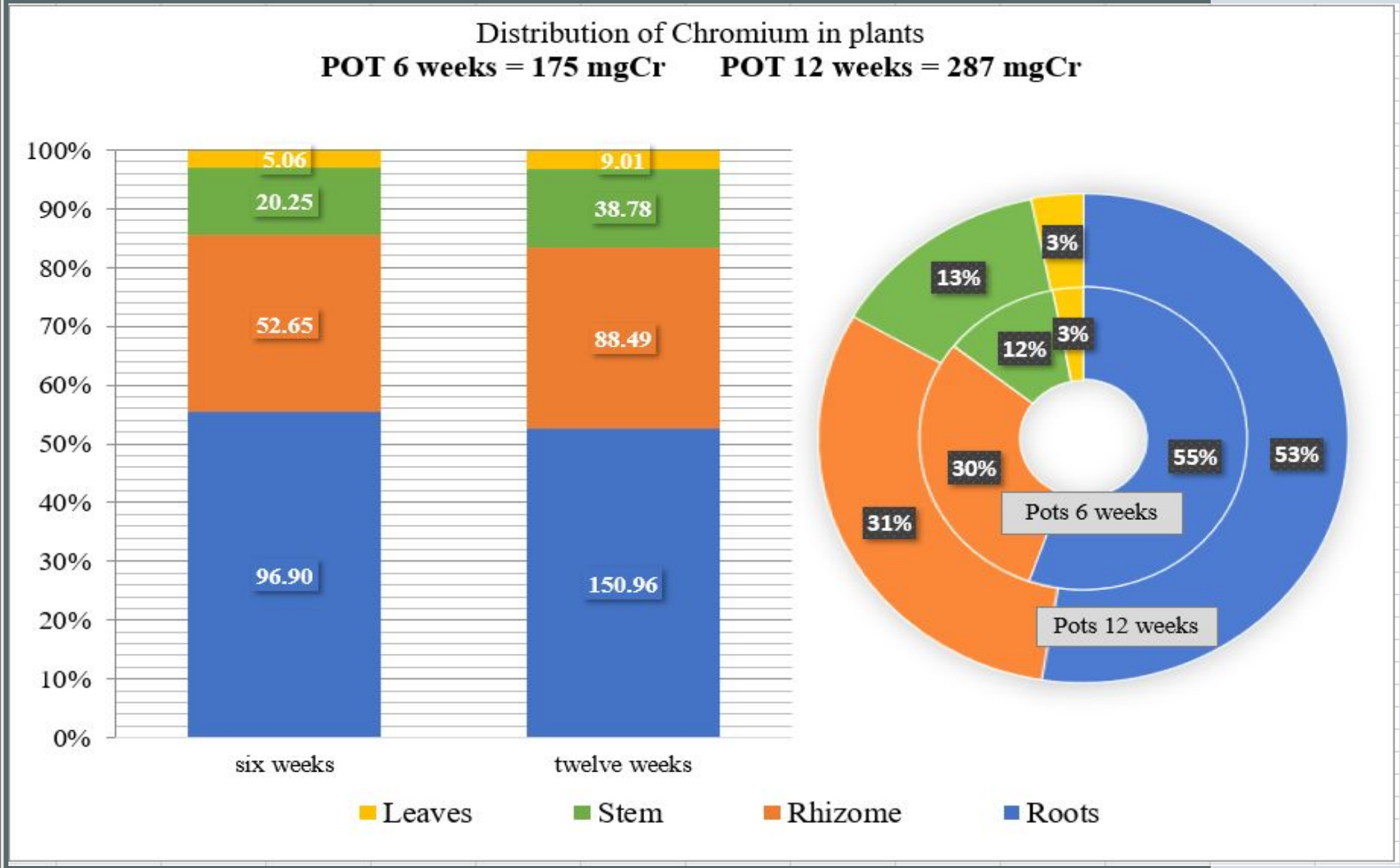

M. bamboo growth 600 mm/y
y = 4.71x + 36.86
R² = 0.99
GROWTH (cm)
100.00
90.00
80.00
70.00
60.00
50.00
40.00
30.00
±0.85
±0.96
±1.04
±1.08
±1.17
±1.27
±1.39
±1.50
±1.58
±1.70
±1.79
±1.88
1 2 3 4 5 6 7 8 9 10 11 12 WEEKS
HEIGHT (cm) 42.54 47.87 52.21 54.12 58.34 63.56 69.40 74.77 78.78 84.98 89.51 93.95

MB tolerance: 600 mm/y water with 125 mg Cr/l.

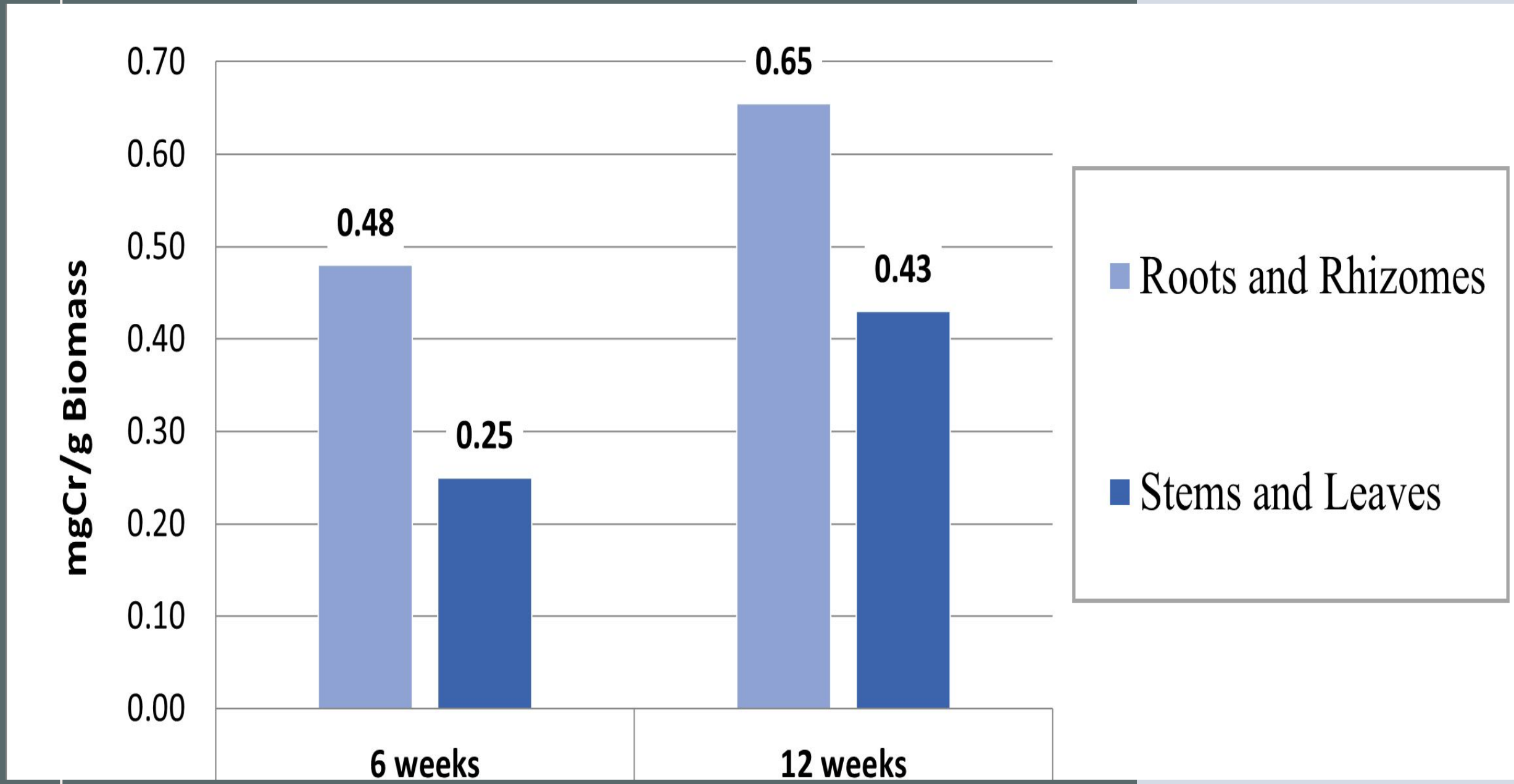




Cr Phytoextraction from The Soil



Cr distribution in the plant



Quantity of Cr per gram of root/rhizome and stem/leaves after 6, 12 weeks mg/g dw

Bioconcentration Factor (BCF) and Translocation Factor (TF) were calculated. Aerial and root-rhizome Cr accumulation, bioconcentration factor (BCF), for 12 weeks .

$$BCF = \frac{Cr\ content\ in\ plant\ organ}{Cr\ content\ in\ treated\ soil}$$

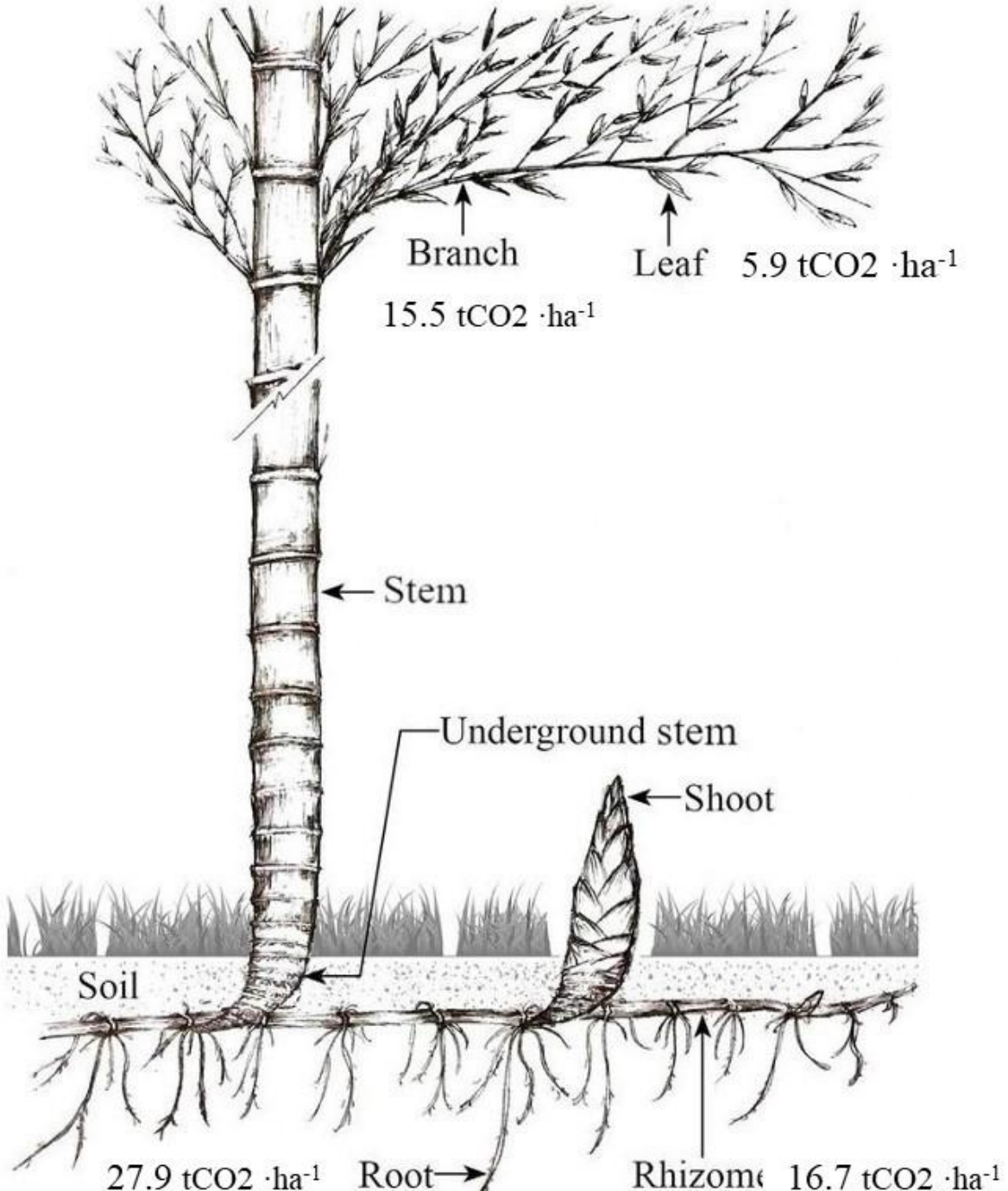
$$TF = \frac{Cr\ concentration\ in\ aerial\ parts}{Cr\ concentration\ in\ roots}$$

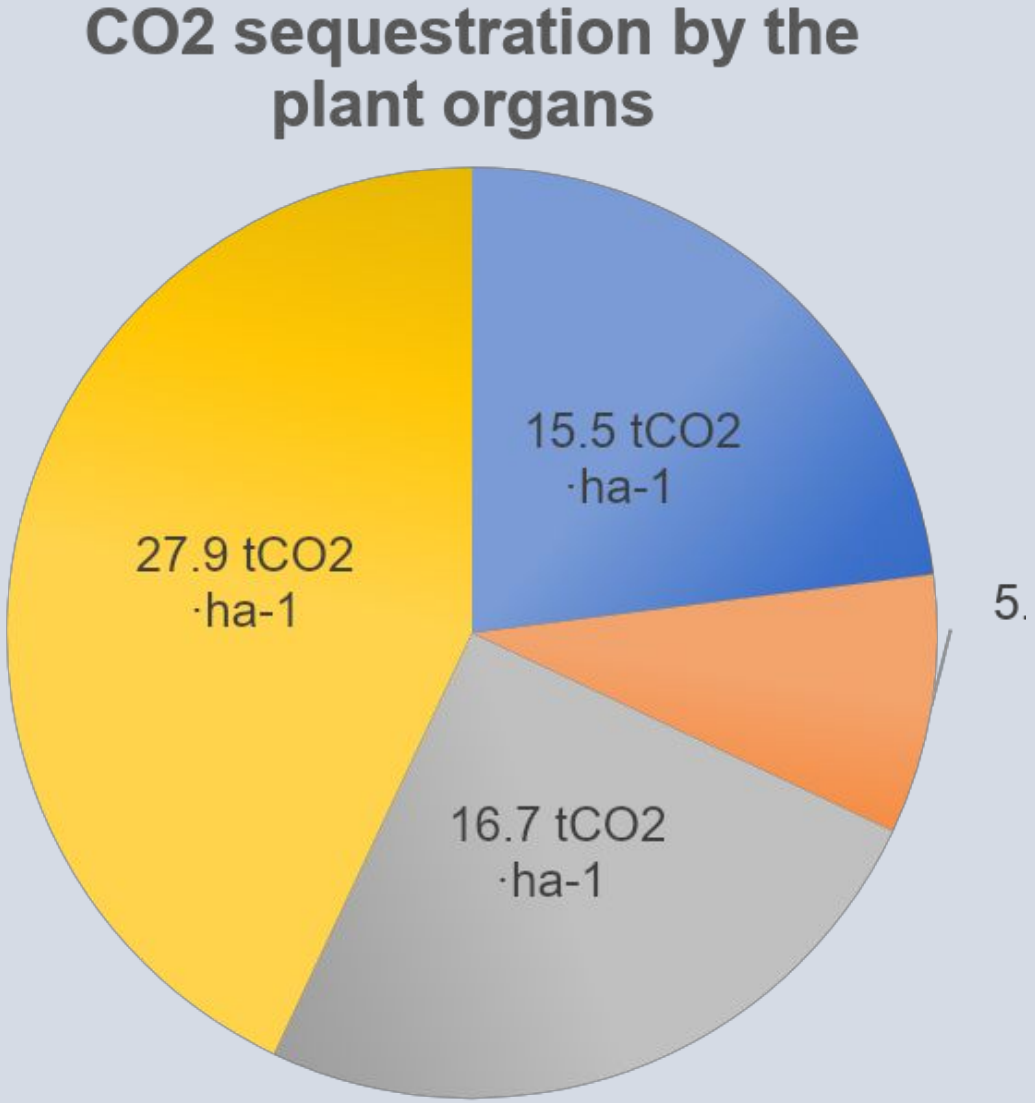
BCF = Cr contents in plant organs / Cr contents in treated soil = 287/456 = 0.63

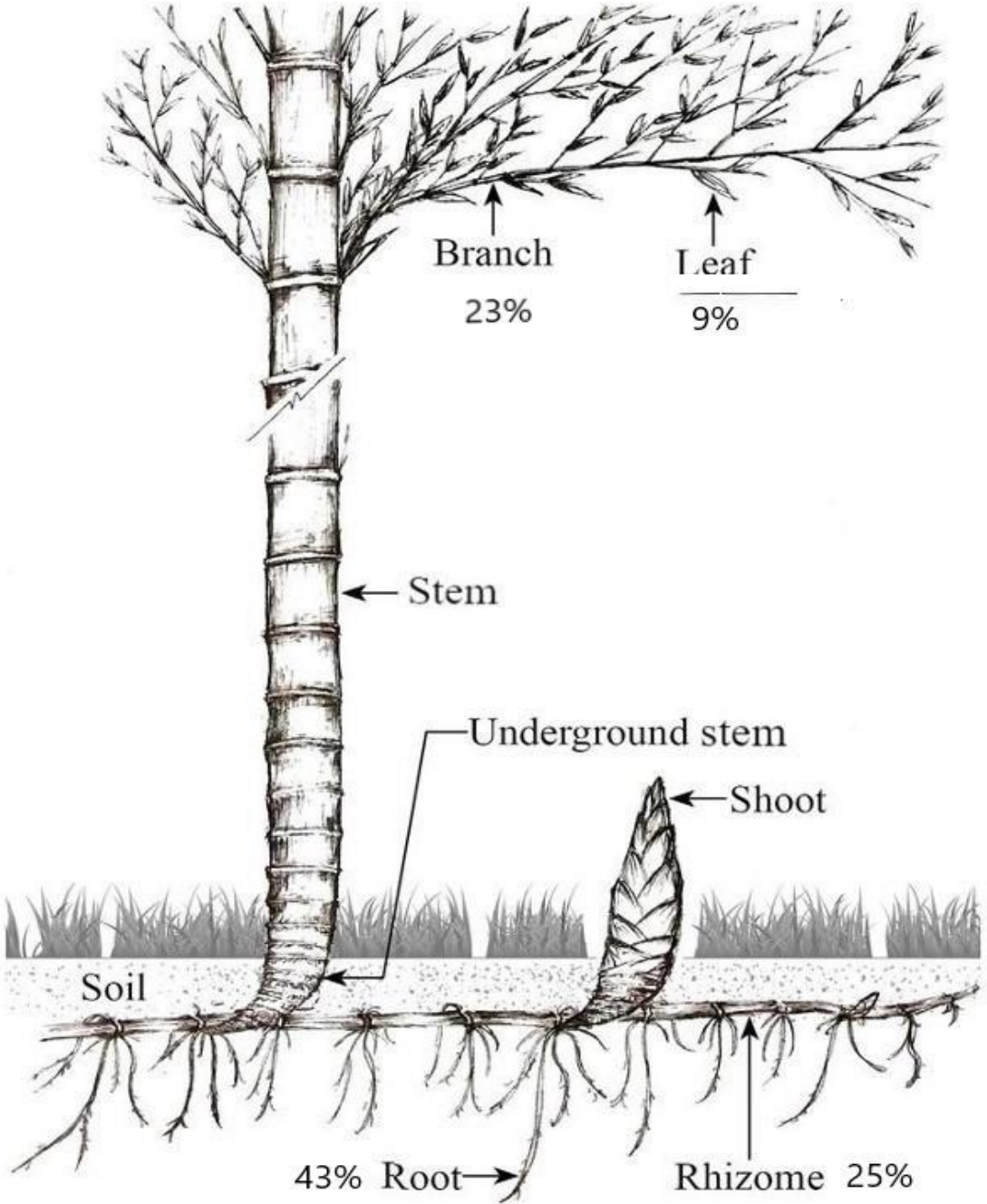
TF = Cr concentration in aerial parts / Cr concentration in root-rhizome = 48/240 = 0.20

CO2 levels in the plant organs

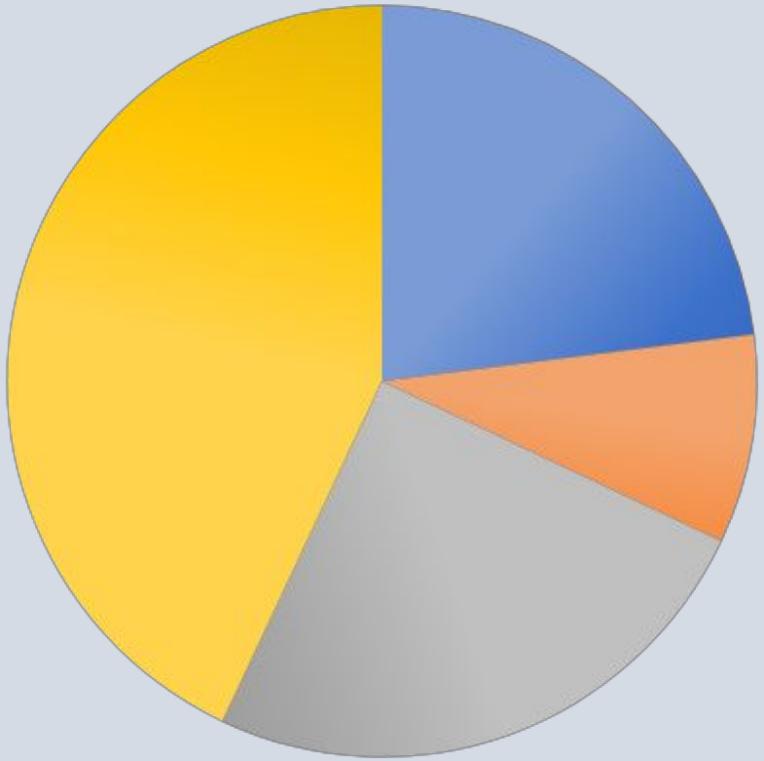
Plant Part	CO2 content in plant organ ($tCO2 \cdot ha^{-1}$)	CO2 distributiion in plant organs %
Branches	15.5	23
Leaves	5.9	9
Rhizomes	16.7	25
Roots	27.9	43
Total	66	100


Branch
Leaf
5.9 tCO2 ·ha-1
15.5 tCO2 ·ha-1
Stem
Underground stem
Shoot
Soil
27.9 tCO2 ·ha-1
Root
Rhizome
16.7 tCO2 ·ha-1


CO2 sequestration by the plant organs
15.5 tCO2 ·ha-1
27.9 tCO2 ·ha-1
16.7 tCO2 ·ha-1
5.



CO2 distribution in the plant organs



Conclusions

- *Tolerance test results have showed a good response of the plant up to 125 mg Cr/l solution utilized*
- *Cr accumulation was found to be significant and to concentrate the most in the roots/rhizomes indicating an overall phytoextraction potential of the plant*
- *Pot experiments show that phytoremediation using MB provides an alternative approach for handling Cr contaminated soil.*

Future experimentations under contaminated field conditions are demanded to further verify the findings of this study

Thank you

Prof.Ing. Ezio Ranieri

ezio.ranieri@uniba.it;