PROAGRO LECTORIUM

Responses of an ornamental shrub (*Lonicera japonica* Thunb.) to cadmium stress

Dr. Zhouli Liu

College of Life Science and Engineering
Shenyang University

Shenyang, China

Content

1. Why this topic?
2. How to do?
3. What we get?
4. Summary

Why this topic?

- Cadmium (Cd) contamination is a serious problem in urban areas, especially for Shenyang
- Cd is one of the most toxic heavy metals, which is easily transferred to food chain and threatens human health
- Therefore, it is important and urgent to develop methods to cleanup Cd

Why this topic?

Phytoremediation of Cd-contaminated soil using hyperaccumulators has become a new promising technique.

However, some problems existed:

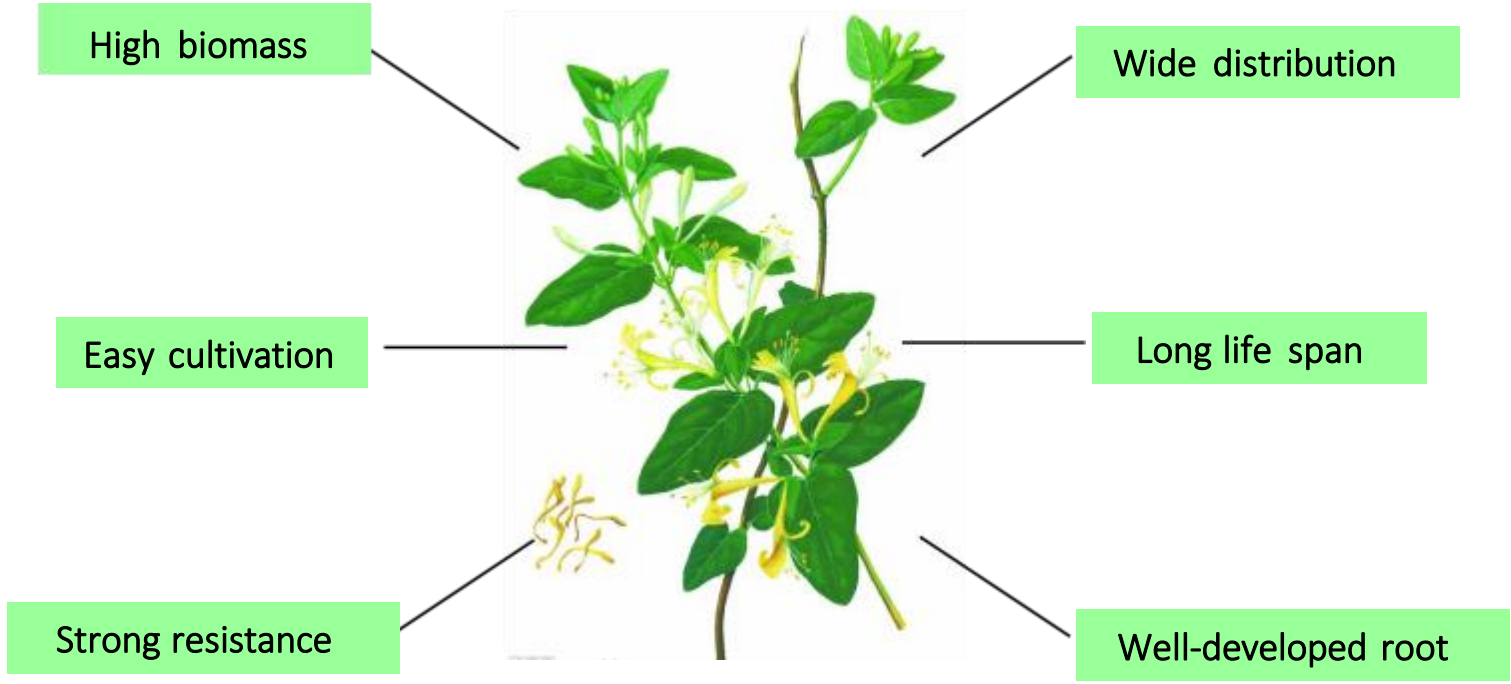
- Small proportion
- Limited growth characteristics
- Single plant species

How to do?

- Research on growth responses of typical ornamentals to Cd stress
- The research was conducted in the Shenyang Botanical Garden of Chinese Academy of Sciences (41º46’ N and 123º26’ E)

How to do?

- By screening typical ornamentals, we found that:
- *Lonicera japonica* Thunb. keeps a good growth at higher Cd concentrations



Lonicera japonica Thunb.

How to do?

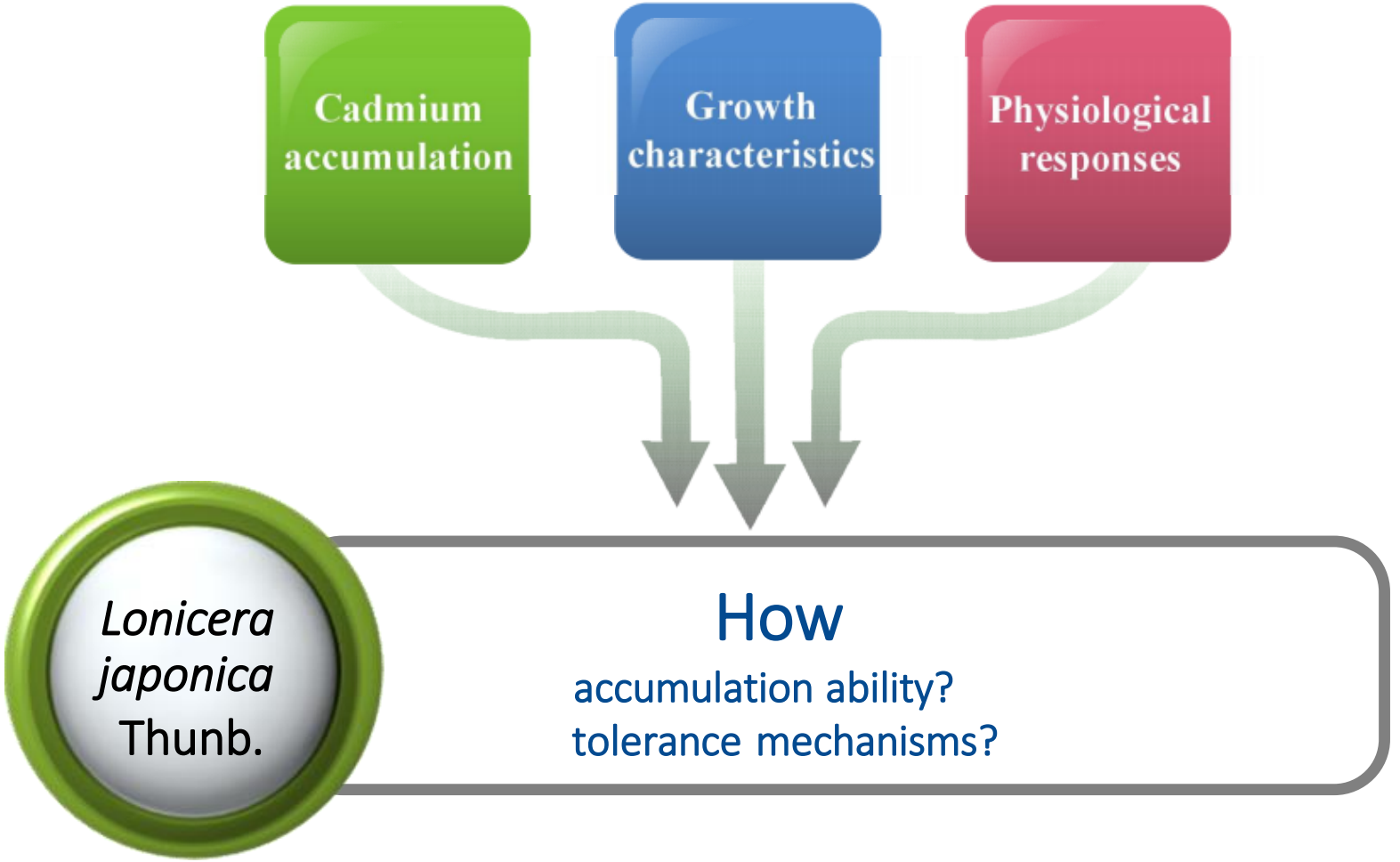
- Hydroponic system: modified Hoagland solution

  Cd levels: 0 (CK), 0.5, 2.5, 5, 10, 25 and 50 (mg L^{-1})

- Pot-culture system: the top soil (0-20 cm, meadow burozem) of the garden

  Cd levels: 0 (CK), 5, 10, 25, 50, 100 and 200 (mg kg^{-1})

How to do?


Cadmium accumulation
Growth characteristics
Physiological responses
Lonicera japonica Thunb.
How
accumulation ability?
tolerance mechanisms?

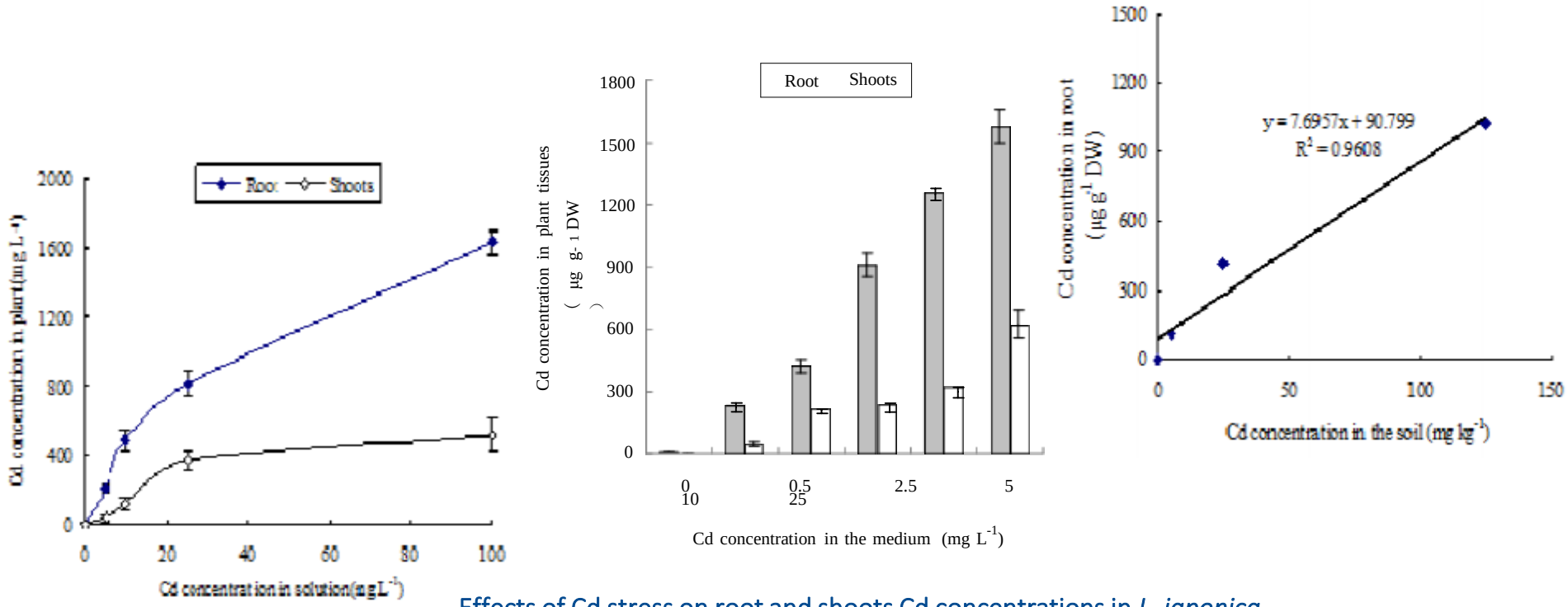
What we get?

what we get?

What we get?

Cadmium accumulation

- The normal Cd concentration in leaf (dry weight) of plants is 0.05–0.2 μg g^{-1}
- The threshold value of Cd-hyperaccumulator is **above 0.01% dry tissue (100μg g^{-1})**



Effects of Cd stress on root and shoots Cd concentrations in *L. japonica*

What we get?

- Compared with some found hyperaccumulators and accumulators, *L. japonica* could accumulate a larger amount of Cd more rapidly

Comparison of Cd accumulation in some found hyperaccumulators and accumulators

Species	Cd concentration in roots (mg kg^{-1})	Cd concentration and plant parts (mg kg^{-1})	Treatment time (d)	Culture medium
Lonicera japonica Thunb.	793.6	344.5 (stems) 286.1 (shoots)	21	Nutrient
Solanum nigrum.L.*	—	310 (leaves)	35	Soil
*Echinochloa polystachya**	299	233 (leaves)	58	Nutrient
Iris tectorum	330	171 (shoots)	42	Nutrient
*Arabidopsis halleri**	660	157 (shoots)	30	Nutrient
*I.lactea var.chinensis**	402	120.7 (shoots)	42	Nutrient

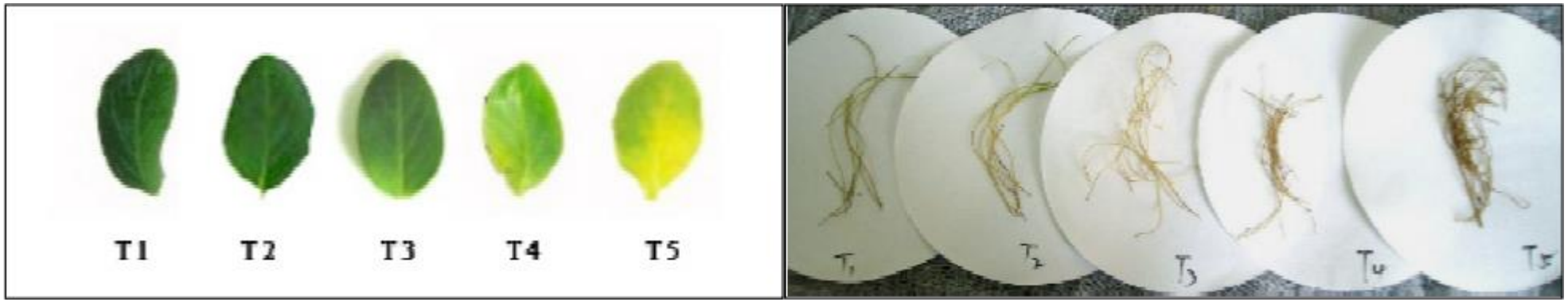
- The results has been reported in Journal of Hazardous Materials

Accumulation and tolerance characteristics of cadmium in a potential hyperaccumulator — *Lonicera japonica* Thunb.

What we get?

Growth characteristics

- Under 5 mg L^{-1} Cd exposure in hydroponic system, root and shoots biomass increased
- With Cd concentrations increasing, chlorosis on leaves and dark brown spots on roots were observed
- However, leaf and root biomass had no significant differences compared with the control



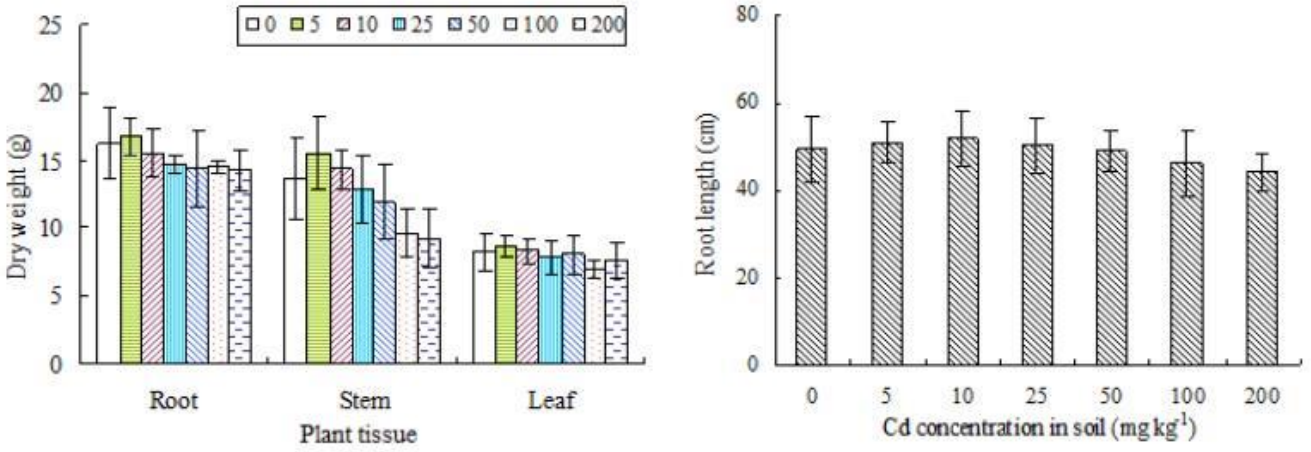
Changes in leaf and root related to different Cd concentrations. T1～T5 means 0, 5, 10, 25 and 50 mg L^{-1}

- The results has been reported in Journal of Plant Growth Regulation

Influence of Cd^{2+} on growth and chlorophyll fluorescence in a hyperaccumulator—*Lonicera japonica* Thunb.

What we get?

- In pot-culture system, 50 mg kg^{-1} Cd did not induce visual symptoms
- The biomass and maximum root length showed no significant differences even though plants exposed to 100 and 200 mg kg^{-1} Cd
- It seemed that low concentrations Cd had stimulating effect on plant growth, and *L. japonica* could maintain normal growth at higher concentration Cd exposure



Effects of Cd stress on dry weight and the maximum root length in *L. japonica*

- The results has been reported in Ecotoxicology

Effects of cadmium hyperaccumulation on the concentrations of four trace elements in *Lonicera japonica* Thunb.

What we get?

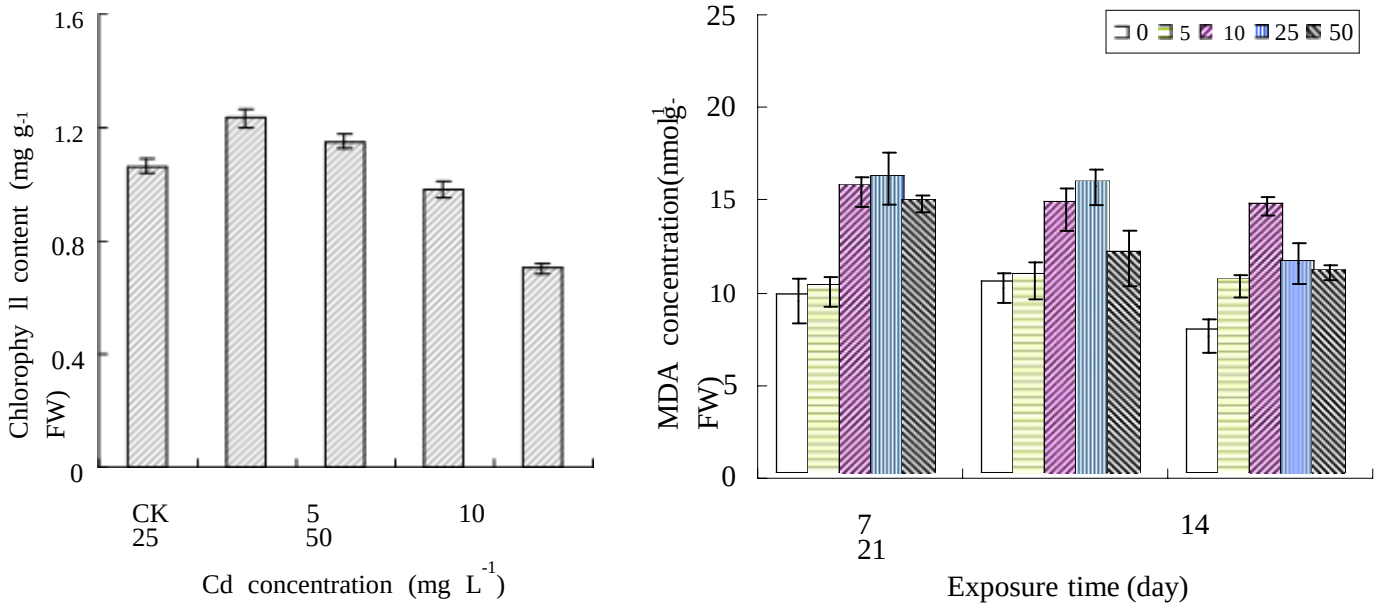
Physiological responses

- Chlorophyll (CHL) content

The increase in CHL contents by exposure to 5 mg L^{-1} Cd may indicate improved growth, which is in agreement with biomass changes

- Malondialdehyde (MDA) content

The elevation in MDA contents showed the plants were subjected to Cd-induced oxidative stress



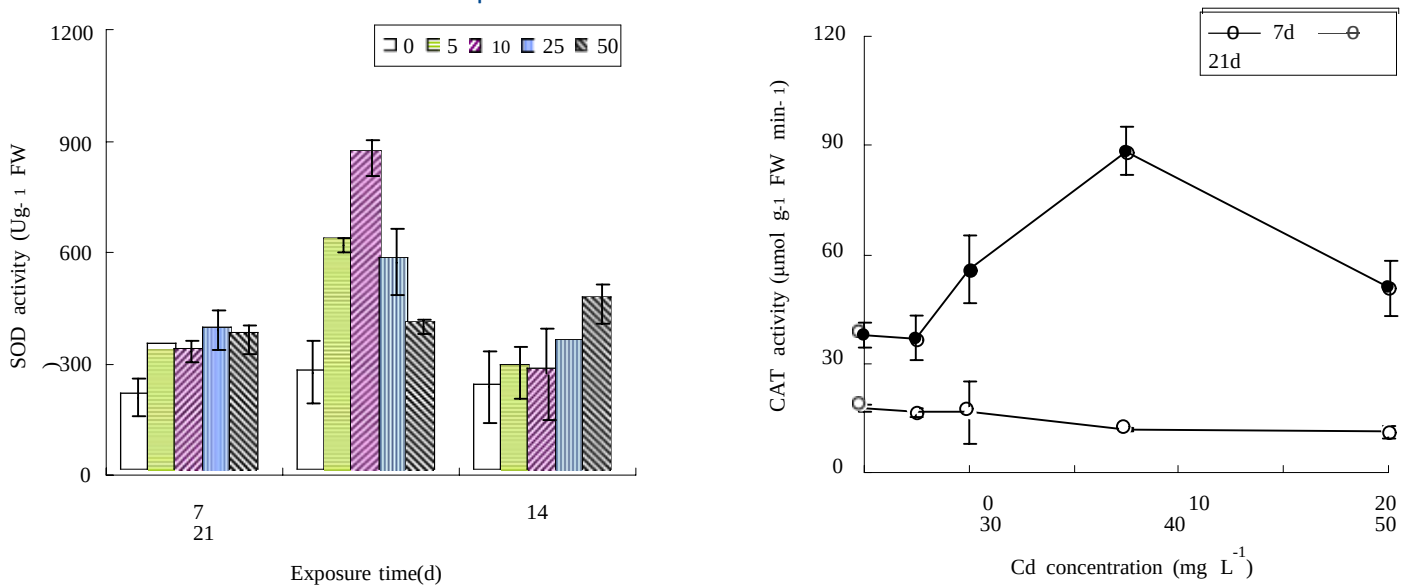
Effects of Cd stress on chlorophyll and MDA contents in *L. japonica*

What we get?

- Antioxidative enzymes activity

As defensive mechanism, superoxide dismutases (SOD) and catalases (CAT) play an important role in scavenging active oxygen species (AOS)

The maintenance of high SOD and CAT activities were observed along with Cd concentration increasing, suggesting strong internal detoxification mechanisms inside plant cells



Effects of Cd stress on SOD and CAT activities in *L. japonica*

- The results has been reported in Clean-Soil, Air, Water

Cadmium-induced physiological response in *Lonicera japonica* Thunb.

Summary

Summary

Cadmium accumulation
Hormetic effect

L. japonica could accumulate a larger amount of Cd more rapidly

The increase in biomass and CHL contents under 5 mg L^{-1} Cd exposure indicated improved growth

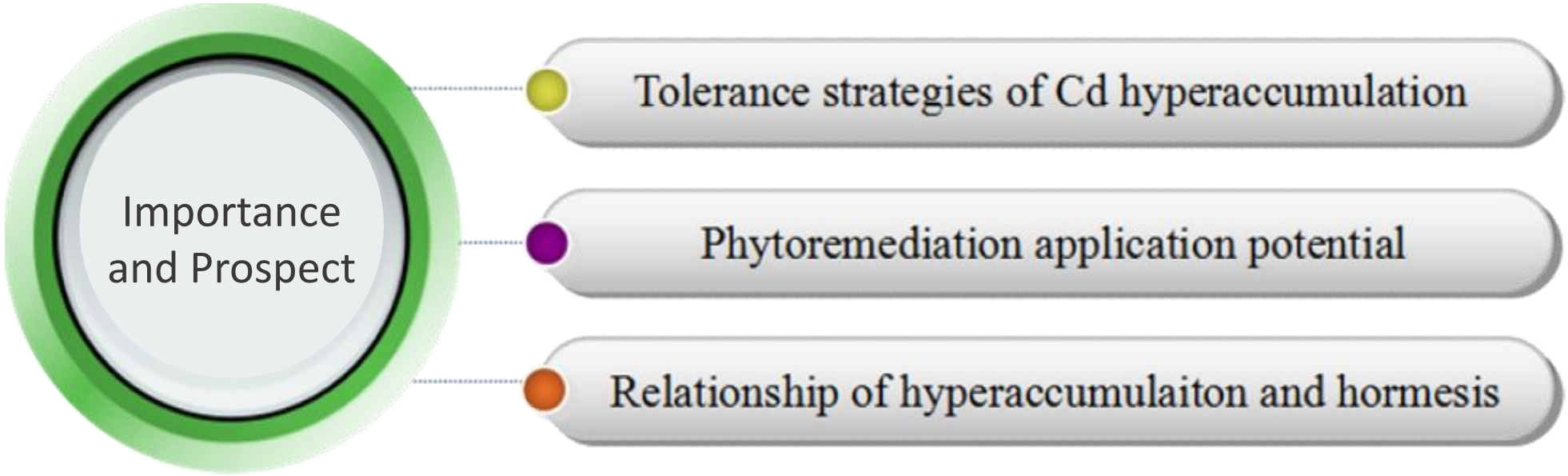
Growth characteristics

L. japonica could maintain normal growth at higher concentration Cd exposure

Physiological responses

The maintenance of high SOD and CAT activities were observed

Summary


Importance and Prospect
Tolerance strategies of Cd hyperaccumulation
Phytoremediation application potential
Relationship of hyperaccumulaiton and hormesis

Thanks for my research group

PROAGRO
LECTORIUM

E-mail: zlliu@syu.edu.cn
Phone: +86 139 4059 8126