CHAPTER 6
CONCLUSIONS

My research showed that lead pollution negatively influences seed germination and seedling growth of some agricultural crops, weeds, and tree species.

Lead inhibited both the seed germination rates and early seedling growth rates of six plants tested. *Eleusine indica* was the most vulnerable to lead toxicity for germination, while *Brassica rapa* was the most tolerant one. Shoot elongation of *Brassica rapa* and *Helianthus annuus* were more sensitive to lead than the others, while root elongation of *Brassica rapa, Euphorbia heterophylla,* and *Helianthus annuus* were more sensitive.

Although 1000 μg/ml of lead completely inhibited germination of all plants tested, EC_{50} were <250, >500, >500, 500, >500, and >100 μg/ml for *Eleusine indica, Euphorbia heterophylla, Brassica rapa, Pisum sativum, Helianthus annuus,* and *Lagerstroemia speciosa,* respectively. EC_{50} of root elongation were <250, <100, <100, >100, <100, and >250 μg/ml for *Eleusine indica, Euphorbia heterophylla, Brassica rapa, Pisum sativum, Helianthus annuus,* and *Lagerstroemia speciosa,* respectively.

All seedling growth parameters, *viz.* shoot length, leaf number, leaf length, and biomass were negatively affected by lead. Lead did not completely inhibit all plants tested in all growth parameters. EC_{50} of biomass were <250, >100, >500, >500, 500, >100, and >500 μg/g for *Eleusine indica, Euphorbia heterophylla, Brassica rapa, Pisum sativum, Helianthus annuus,* and *Lagerstroemia speciosa,* and *Shorea roxburghii,* respectively. EC_{50} values reveal that lead inhibits seed germination rather than seedling growth. Agricultural crops grown in contaminated soil with lead 500 μg/g, can not reduce 50 % biomass yield.

Lead can accumulate up to 3,240 μg/g (0.32%) in the shoots of *Euphorbia heterphylla,* while in *Brassica rapa* and *Shorea roxburghi,* it was 0.017 % and 0.011 %, respectively. The K values and TF of *Euphorbia heterphylla* at all lead concentrations were the highest, followed by those of *Brassica rapa* and *Shorea roxburghii.* These values increased with higher lead concentrations in the growth medium, except for

ลิขสิทธิ์มหาวิทยาลัยเชียงใหม่
Copyright © by Chiang Mai University
All rights reserved

Shorea roxiburghii. There was no significant correlation between lead contents in different plant parts and biomass weight. *Euphorbia heterophylla* and *Brassica rapa* are lead indicator species which are able to uptake lead from the growth medium linearly. *Shorea roxburghii* is a lead excluder species which is able to restrict lead uptake from the growth medium.

Three groups of plants based on their lead sensitivity are

1. Sensitive group-- *Euphorbia heterophylla, Lagerstroemia speciosa,*
2. Intermediate group-- *Brassica rapa, Helianthus annuus, Pisum sativum,* and
3. Tolerant group-- *Shorea roxburghii* and *Eleusine indica.*

The most sensitive parameters and indices for biomonitoring of lead pollution were determined. The most sensitive parameters are root elongation and followed by biomass weight. The most sensitive index for seed germination is the percent of root phytotoxicity and for seedling growth, absolute FA. Relative yield index is the most basic and common index to determine plant sensitivity to lead and percent of biomass dry weight is a potential reliable indicator for biomonitoring.

The results are consistent with previous studies showing that lead content in plant tissues is closely connected with its presence in the soil. Lead concentrations in plant tissues are not related to lead tolerance. Lead concentration in shoots can exceed than that in roots.

My experiments demonstrate that lead negatively affected all plants which can accumulate lead in their tissues. This can cause health hazards to humans and animals, especially in agricultural crops grown in lead contaminated soil. *Euphorbia heterophylla* is a potential species for phytoremediation programs and phytotoxicity tests in biomonitoring programs. Plant tolerance can be determined based on percent root phytotoxicity and relative yield indices without chemical analysis. This is very useful for remote experimental conditions. Although phytotoxicity tests are relatively simple, cheap, and less time consuming, reliable results can provide much vital information for biomonitoring programs.

ลิขสิทธิ์มหาวิทยาลัยเชียงใหม่
Copyright © by Chiang Mai University
All rights reserved