CHAPTER 6

CONCLUSION AND RECOMMENDATION

6.1 Conclusion

Similar physiological responses of four plant species under Cd stress were obtained though each species may differ in the intensity of expression. Responses after plants were subjected to Cd stress are summarized as follows.

1. Cadmium uptake in root: Plants took up the metal rapidly during the onset of stress. Rate of uptake declined with increaseing root damage.

2. Root damage: Roots are the first target of Cd. Cadmium intensely reduced root growth and cause root rot later. Injured roots were earlier observed before plants showed other symptoms of stress injury.

3. Decreased growth: Plants lowered their number of leaves, leaf area and biomass in response to Cd stress.

4. Chlorophyll contents reduction: Reduction of chlorophyll contents was accompanied by decreased RWC and increased leaf Cd content. This reduction would be noticeable when the stress proceeded.

5. Proline accumulation: There was a time lag between proline accumulation and Cd exposure. However, the accumulation was not clearly observed in all plant species.

6. Shoot Cd accumulation: Minor amount of Cd was translocated from roots to stems and leaves. Lower leaves were likely to accumulate more Cd. Only *E. prostrata* showed relatively high shoot Cd content relative to root Cd content.

Visual symptoms also indicate the intensity of stress. Wilting of leaves and reduced shoot growth were another symptoms after root had damaged to some extent. These were clearly seen in the 20 ppm treatment. Then the death of leaves prevailed over the development of the new ones. Finally, chlorosis was apparent and continued even after plants were transferred to Cd-

free solution. It should be noted that during stress plants may survive the toxic effects by producing roots above the level of Cd-containing solution.

Proline accumulation in metal stressed plants is a result of two major factors, the metal-induced water deficit and the metal accumulation. However, the former is predominated. The role of proline accumulation in metal tolerance is less clear. Proline is insensitive and not specific to Cd stress based on the results of this study. Evaluation of metal stress under field conditions by determining only proline accumulation is not suggested.

Although *B. oleracea* could accumulate much more Cd than other species, *E. prostrata* responded the Cd stress differently from the others. Obviously, chlorosis and necrosis were observed in stressed plant. Moreover, the plant effectively translocated metal to the above ground parts.

6.2 Recommendation

1. The heavy metal concentration used for plant uptake investigation should be sufficiently low. This is necessary for screening metal accumulators of which active process is an important uptake mechanism under low metal concentration.

2. Care should be taken when determining chlorophyll contents. As for this study, the chlorophyll contents revealed only the extractable chlorophyll by the method described in chapter 3, not an exact content in plant tissue.

3. The ions contained in nutrient solution may affect the uptake of studied metal. Therefore, when comparing the effects of metal, one should be aware of the nutrient background.

4. Field experiment is needed after study has been performed in controlled environment.

5. Further study should focus on the determination whether *E. prostrata* is possible to be used as a Cd stress indicator and/or for phytoremediation purpose or not.

6. Further investigation on the role of proline under metal stress is necessary. If proline could solely be used to assess the environmental impacts from toxic contaminants, it would be great because proline determination by colorimetric method is simple rapid and effective.