

APPENDICES

Appendix 1. Voucher specimens

FLORA OF THAILAND

CMU Herbarium, Faculty of Science, Chiang Mai University

Chiang Mai, Thailand

Seedling Specimen

Smallest stages in liquid collection

FAMILY: GRAMINEAE

BOTANICAL NAME: *Eleusine indica* (L.) Gaertn.

ENGLISH NAME: goose grass

Province: Chiang Mai

District: Muang

Location: near the Student's Union Building, Chiang Mai University

Elevation: 350 m

Seed Collection Date: 1 July 2003

Habitat: open lawn and roadside weed

Note: Planting Date: 15 July 2003

Germination Date: 18 July 2003

Germination: hypogeal

Harvesting Date: 24 November 2003

130 day-old seedlings are 10-15 cm tall (upper most leaf blade base),

Leaf blade length 20 cm, root length 20-25 cm

Collected by: Nyo Nyo Aung

Number: 1

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FLORA OF THAILAND

CMU Herbarium, Faculty of Science, Chiang Mai University

Chiang Mai, Thailand

Seedling Specimen

Smallest stages in liquid collection

FAMILY: CRUCIFERAE

BOTANICAL NAME: *Brassica rapa* L. cv. group Chinese cabbage

ENGLISH NAME: Chinese cabbage

Province: Chiang Mai

District: Muang

Location: " tsoi sim" cultivar purchased from Vegetable Seed Company, grown in
CMU, Biology Department Nursery.

Elevation: 350 m

Date: 1 July 2003

Habitat: cultivated crop

Note: Planting Date: 26 October 2003

Germination Date: 28 October 2003

Germination: epigeal.

Harvesting Date: 12 December 2003

42 day-old seedlings are 20 cm tall, leaf blade length 10 cm, and root length
8.5 cm

Collected by: Nyo Nyo Aung Number: 2

FLORA OF THAILAND

CMU Herbarium, Faculty of Science, Chiang Mai University

Chiang Mai, Thailand

Seedling Specimen

Smallest stages in liquid collection

FAMILY: EUPHORBIACEAE

BOTANICAL NAME: *Euphorbia heterophylla* L.

ENGLISH NAME: white involucre euphorbia, painted spurge

Province: Chiang Mai

District: Muang

Location: Suthep Road

Elevation: 350 m

Seed Collection Date: 15 April 2003

Habitat: open roadside weed

Note: Planting Date: 10 September 2003

Germination Date: 12 September 2003

Germination: epigeal

Harvesting Date: 23 November 2003

70-day -old seedlings are 35-40 cm tall, leaf blade length 6-8 cm, and root length 7 cm

Collected by: Nyo Nyo Aung

Number: 3

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FLORA OF THAILAND

CMU Herbarium, Faculty of Science, Chiang Mai University

Chiang Mai, Thailand

Seedling Specimen

Smallest stages in liquid collection

FAMILY: LEGUMINOSAE, PAPILIONOIDEAE

BOTANICAL NAME: *Pisum sativum* L.

ENGLISH NAME: garden pea

Province: Chiang Mai

District: Muang

Location: purchased from Vegetable Seed Company, grown in CMU, Biology
Department Nursery

Elevation: 350 m

Date: 20 June 2003

Habitat: cultivated crop

Note: Planting Date: 13 November 2003

Germination Date: 16 November 2003

Germination: hypogeal

Harvesting Date: 30 December 2003

45-day -old seedlings are 35-40 cm tall, leaf blade length 1.5-2 cm, and root
length 15 cm

Collected by: Nyo Nyo Aung

Number: 4

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FLORA OF THAILAND

CMU Herbarium, Faculty of Science, Chiang Mai University

Chiang Mai, Thailand

Seedling Specimen

Smallest stages in liquid collection

FAMILY: COMPOSITAE

BOTANICAL NAME: *Helianthus annuus* L. "Fu Fu"

ENGLISH NAME: sunflower

Province: Chiang Mai

District: Muang

Location: Seeds purchased from (AFM) FLORA PRO CO., LTD, grown in CMU, and
Biology Department Nursery

Elevation: 350 m

Date: 25 September 2003

Habitat: cultivated crop

Note: Planting Date: 26 October 2003

Germination Date: 29 October 2003

Germination: epigeal

Harvesting Date: 6 December 2003

40-day -old seedlings are 6 cm tall, leaf blade length 4-5 cm, and root length 4-
5 cm, Seed (2-2.5) mm in diameter and (5) mm long

Collected by: Nyo Nyo Aung

Number: 5

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FLORA OF THAILAND

CMU Herbarium, Faculty of Science, Chiang Mai University

Chiang Mai, Thailand

Seedling Specimen

Smallest stages in liquid collection

FAMILY: LYTHRACEAE

BOTANICAL NAME: *Lagerstroemia speciosa* (L.) Pers. var. *speciosa*

ENGLISH NAME: queen's crape myrtle

Province: Chiang Mai

District: Muang

Location: In front of UNISERV, Chiang Mai University

Elevation: 350 m

Date: 15 June 2003

Habitat: open roadside ornamental tree

Note: Seed parent tree is 4 m tall; dbh 45 cm; bark thin and light brown

Planting Date: 29 June 2003

Germination Date: 20 July 2003

Germination: epigeal

Harvesting Date: 5 December 2003

150 day - old seedlings are 7 cm tall, leaf blade length 5 cm, and root length 15 cm

Collected by: Nyo Nyo Aung

Number: 6

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FLORA OF THAILAND

CMU Herbarium, Faculty of Science, Chiang Mai University

Chiang Mai, Thailand

Seedling Specimen

Smallest stages in liquid collection

FAMILY: DIPTEROCARPACEAE

BOTANICAL NAME: *Shorea roxburghii* G. Don

THAI NAME: pah yawm

Province: Chiang Mai

District: Muang

Location: In front of the CMU Herbarium, Biology Department, and Faculty of
Science, Chiang Mai University

Elevation: 350 m

Date: 25 June 2003

Habitat: deciduous tree in seasonal forest

Note: Seed parent tree is 15 m tall; dbh 120 cm; bark thick, cracked and graybrown
Seed (9-10) mm in diameter and 2 -2.5 cm long

Planting Date: 4 July 2003

Germination Date: 14 July 2003

Germination: hypogeal

Harvesting Date: 12 December 2003

160-day -old seedlings are 15 cm tall, leaf blade length 5.5 cm, and root length
13 cm

Collected by: Nyo Nyo Aung

Number: 7

Appendix 2. Results of repeated measurements for analyses of variance on shoot height and leaf number to identify the effects of treatments over time

A. *Eleusine indica*

	df	MS	F	P
Shoot length				
Between subjects				
Treatment	3	36.43	0.87	0.484
Error	12	41.95		
Within subjects				
Time	4	4.68	15.70	0.000
Treatment x time	12	0.49	1.64	0.112
Error	48	0.30		
Leaf number				
Between subjects				
Treatment	3	41.30	9.51	0.002
Error	12	4.34		
Within subjects				
Time	4	21.48	36.96	0.000
Treatment x time	12	4.58	7.9	0.000
Error	48	0.58		

B. *Euphorbia heterophylla*

	df	MS	F	P
Shoot length				
Between subjects				
Treatment	3	417.62	5.15	0.016
Error	12	81.11		
Within subjects				
Time	4	506.08	60.35	0.000
Treatment x time	12	48.23	5.75	0.000
Error	48	8.39		
Leaf number				
Between subjects				
Treatment	3	63.11	6.07	0.009
Error	12	10.40		
Within subjects				
Time	4	4.73	2.44	0.059
Treatment x time	12	6.21	3.20	0.002
Error	48	1.94		

C. Brassica rapa

	df	MS	F	P
Shoot length				
Between subjects				
Treatment	3	23.92	8.11	0.003
Error	12	2.95		
Within subjects				
Time	3	41.71	72.05	0.000
Treatment x time	9	7.30	12.31	0.000
Error	36	0.59		
Leaf number				
Between subjects				
Treatment	3	5.53	9.28	0.002
Error	12	0.60		
Within subjects				
Time	3	6.46	10.88	0.000
Treatment x time	9	1.81	3.04	0.008
Error	36	0.59		

D. Pisum sativum

	df	MS	F	P
Shoot length				
Between subjects				
Treatment	3	72.4	1.96	0.173
Error	12	36.9		
Within subjects				
Time	3	382.8	102.9	0.000
Treatment x time	9	13.04	3.50	0.003
Error	36	3.72		
Leaf number				
Between subjects				
Treatment	3	3.75	0.87	0.482
Error	12	4.3		
Within subjects				
Time	3	91.7	66.03	0.000
Treatment x time	9	3.32	2.39	0.031
Error	36	1.39		

E. Helianthus annuus

	df	MS	F	P
Shoot length				
Between subjects				
Treatment	3	10.5	5.7	0.012
Error	12	1.9		
Within subjects				
Time	3	13.85	67.47	0.000
Treatment x time	9	1.24	6.04	0.000
Error	36	0.21		
Leaf number				
Between subjects				
Treatment	3	4.27	1.54	0.254
Error	12	2.76		
Within subjects				
Time	3	3.02	5.28	0.004
Treatment x time	9	4.29	7.52	0.000
Error	36	0.57		

G. Lagerstroemia speciosa

	df	MS	F	P
Shoot length				
Between subjects				
Treatment	3	3.83	0.27	0.848
Error	12	14.38		
Within subjects				
Time	7	0.38	48.28	0.000
Treatment x time	21	0.03	3.88	0.000
Error	84	0.01		
Leaf number				
Between subjects				
Treatment	3	96.96	5.5	0.016
Error	12	18.83		
Within subjects				
Time	7	11.61	13.47	0.000
Treatment x time	21	1.95	2.26	0.008
Error	84	0.58		

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H. Shorea roxburghii

	df	MS	F	P
Shoot length				
Between subjects				
Treatment	3	0.39	0.01	0.999
Error	12	38.43		
Within subjects				
Time	7	0.67	27.34	0.000
Treatment x time	21	0.01	0.40	0.991
Error	84	0.02		
Leaf number				
Between subjects				
Treatment	3	4.45	0.28	0.838
Error	12	15.85		
Within subjects				
Time	7	0.08	0.38	0.913
Treatment x time	21	0.19	0.90	0.586
Error	84	0.21		

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Appendix 3. Lead content in plant tissues

Plants parts/ Pb treatments	<i>Euphorbia heterophylla</i>			
	10 times		Pb amount in 0.5 g plant tissues	µg/g
	absorbance	concentration		
Shoots				
0 µg/g	0	0	0	0
	0	0	0	0
100 µg/g	0.068	6.1338	61.34	122.68
	0.059	5.018	50.18	100.36
250 µg/g	0.478	56.94	569.4	1138.8
	0.482	57.43	574.3	1148.6
500 µg/g	0.27*	31.164	1558.2	3116.4
	0.29*	33.643	1682.15	3364.3
Roots				
0 µg/g	0	0	0	0
	0	0	0	0
100 µg/g	0.156	17.038	170.38	340.76
	0.136	14.56	145.6	291.2
250 µg/g	0.179*	19.89	994.5	1989
	0.197*	22.12	1106	2212
500 µg/g	0.236*	26.95	1347.5	2695
	0.265*	30.55	1527.5	3055
Plants parts/ Pb treatments	<i>Brassica rapa</i>			
	10 times		Pb amount in 0.5 g plant tissues	µg/g
	absorbance	concentration		
Shoots				
0 µg/g	0	0	0	0
	0	0	0	0
100 µg/g	0	0	0	0
	0	0	0	0
250 µg/g	0.034	1.92	19.2	38.4
	0.028	1.18	11.8	23.6
500 µg/g	0.081	7.74	77.4	154.8
	0.09	8.85	88.5	177
Roots				
0 µg/g	0	0	0	0
	0	0	0	0
100 µg/g	0.067	6.01	60.1	120.2
	0.062	5.27	52.7	105.4
250 µg/g	0.299	34.76	347.6	695.2
	0.274	31.66	316.6	633.2
500 µg/g	0.367	43.18	431.8	863.6
	0.374	44.05	440.5	881

Plants parts/ Pb treatments	<i>Shorea roxburghii</i>			
	10 times		Pb amount in 0.5 g plant tissues	µg/g
	absorbance	concentration		
Shoots				
0 µg/g	0	0	0	0
	0	0	0	0
100 µg/g	0.019	0.06	0.6	1.2
	0.022	0.433	4.3	8.6
250 µg/g	0.023	0.558	5.58	11.16
	0.017	0.185	1.85	3.7
500 µg/g	0.065	5.76	57.6	115.2
	0.059	5.02	50.2	100.4
Roots				
0 µg/g	0	0	0	0
	0	0	0	0
100 µg/g	0.037	2.29	22.9	45.8
	0.042	2.91	29.1	58.2
250 µg/g	0.109	11.21	112.1	224.2
	0.116	12.08	120.8	241.6
500 µg/g	0.389	45.91	459.1	918.2
	0.399	47.15	471.5	943

Note: * 50 times.

Appendix 4. Correlation of lead in plant tissue and biomass weight

A. *Euphorbia heterophylla*

		Pb in shoot	Shoot biomass weight
Pb in shoot	Pearson Correlation	1000	-0.537
	Sig. (2-tailed)	0	0.170
	N	8	8
Shoot biomass weight	Pearson Correlation	-0.537	1000
	Sig. (2-tailed)	0.170	0
	N	8	8
		Pb in root	Root biomass weight
Pb in root	Pearson Correlation	1000	-0.623
	Sig. (2-tailed)	0	0.099
	N	8	8
Root biomass weight	Pearson Correlation	-0.623	1000
	Sig. (2-tailed)	0.099	0
	N	8	8

B. *Brassica rapa*

		Pb in shoot	Shoot biomass weight
Pb in shoot	Pearson Correlation	1000	-0.098
	Sig. (2-tailed)	0	0.817
	N	8	8
Shoot biomass weight	Pearson Correlation	-0.098	1000
	Sig. (2-tailed)	0.817	0
	N	8	8
		Pb in root	Root biomass weight
Pb in root	Pearson Correlation	1000	-0.591
	Sig. (2-tailed)	0	0.123
	N	8	8
Root biomass weight	Pearson Correlation	-0.591	1000
	Sig. (2-tailed)	0.123	0
	N	8	8

C. Shorea roxburghii

		Pb in shoot	Shoot biomass weight
Pb in shoot	Pearson Correlation Sig. (2-tailed) N	1000 0 8	-0.172 0.684 8
Shoot biomass weight	Pearson Correlation Sig. (2-tailed) N	-0.172 0.684 8	1000 0 8
		Pb in root	Root biomass weight
Pb in root	Pearson Correlation Sig. (2-tailed) N	1000 0 8	-0.263 0.530 8
Root biomass weight	Pearson Correlation Sig. (2-tailed) N	-0.263 0.530 8	1000 0 8

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