

RESULTS

Artocarpus lakoocha Roxb.

Mean height of seedling at first potting :	8.77 ± 2.31 cm
Mean height of seedling after 10 months :	28.87 ± 13.36 cm
Survival of seedlings after 10 months :	91.67%

RGR of basal diameter (Figure 18 and Table 3) was highest with T12 (135.45 ± 49.92). Interpretation of all factors (Table 7 and Appendix I, Table 19) showed that containers had a significant ($p < 0.01$) effect with plastic bags 3 x 7 in. (122.29 ± 51.11) and 2.5 x 9 in. (112.39 ± 45.26) resulting in a higher mean than REX Trays. The effects of block were also significant ($p < 0.01$) with open (124.20 ± 42.50) and medium exposure (119.64 ± 42.50) having higher means than deep shade.

RGR of height (Figure 18 and Table 3) was highest with T5 (182.45 ± 96.25). Interpretation of all factors (Table 7 and Appendix I, Table 20) showed that containers had a significant ($p < 0.01$) effect, with plastic bags 3x7 in resulting in the highest mean (168.30 ± 77.00). The effects of block was also significant ($p < 0.01$). Medium exposure (186.60 ± 62.60) and open (177.60 ± 64.97) resulted in higher means than deep shade.

Final basal diameter (Figure 19 and Table 3) was highest with T5 (0.531 ± 0.148 cm). Interpretation of all factors (Table 7 and Appendix I, Table 21) showed

that block had a significant effect ($p < 0.01$) with open (0.50 ± 0.13 cm) and medium exposure (0.48 ± 0.14 cm) resulting higher means than deep shade. Container had a significant effect ($p < 0.01$) with plastic bags 3x7 in. (0.50 ± 0.17 cm) resulting in the highest mean.

Final height (Figure 20 and Table 3) was highest with T11 (35.717 ± 19.583 cm). Interpretation of all factors (Table 7 and Appendix I, Table 22) showed that block had a significant ($p < 0.01$) effect with medium exposure (34.46 ± 12.46 cm) and open (34.03 ± 12.11 cm) resulting in higher means than deep shade. Fertilizer also had a significantly effect, with “Osmocote” (30.59 ± 15.20 cm) resulting in a higher mean than soluble fertilizer.

Shoot/root ratio dry weight (Figure 21 and Table 3) was lowest with T7 (1.04 ± 0.428 g). Interpretation of all factors (Table 7 and Appendix I, Table 23) showed that block had a significant ($p < 0.01$) effect with open (1.12 ± 0.59 cm) and medium exposure (1.48 ± 0.81 cm) resulting in lower means than deep shade. Container type also had a significant effect ($p < 0.01$) with REX trays (1.24 ± 0.63 cm) resulting in the lowest mean. Root pruning method had a significant effect ($p < 0.05$) with root pruning by hand (1.43 ± 0.77) resulting in a lower mean than root pruning by air.

***Balakata baccata* (Roxb) Ess.**

Mean height of seedling at first potting : 11.09 ± 4.80 cm

Mean height of seedling after 10 months : 51.49 ± 18.06 cm

Survival of seedlings after 10 months : 68.6%

RGR of basal diameter (Figure 22 and Table 4) was highest T12 (215.10 ± 53.59). Interpretation of all factors (Table 8 and Appendix I, Table 24) showed that block was significant ($p < 0.01$) with medium exposure (198.75 ± 52.69) and open (187.57 ± 53.59) resulting in higher means than deep shade. Container had a significant ($p < 0.01$) effect with plastic bags 3 x 7 in. (193.24 ± 65.91) resulting in the highest mean. Root pruning by hand (190.91 ± 58.88) resulted in a higher mean than root pruning by air.

RGR of height (Figure 22 and Table 4) was highest with T5 (351.93 ± 112.64). Interpretation of all factors (Table 8 and Appendix I, Table 22) showed that block had a significant ($p < 0.01$) effect with medium exposure (301.27 ± 105.12) resulting in the highest mean. Container had a significant ($p < 0.01$) effect with plastic bags 3 x 7 in. (309.99 ± 116.77) resulting in the highest mean and "Osmocote" fertilizer (287.37 ± 106.75) resulted in a higher mean than soluble fertilizer.

Final basal diameter (Figure 23 and Table 4) was highest for 2 treatments, T4 (0.66 ± 0.13 cm) and T10 (0.66 ± 0.16 cm). Interpretation of all factors (Table 8 and Appendix I, Table 26) showed that block had a significant ($p < 0.01$) effect with open (0.60 ± 0.15 cm) and medium exposure (0.59 ± 0.15 cm) resulting in a higher mean than deep shade. Container had significant ($p < 0.05$) effects with plastic bags 2.5 x 9 in. (0.61 ± 0.14 cm) resulting in the highest mean and soluble fertilizer (0.90 ± 0.16 cm) had a higher mean than "Osmocote".

Final height (Figure 24 and Table 4) was highest the with T10 (62.03 ± 8.91 cm). Interpretation of all factors (Table 8 and Appendix I, Table 27) showed

that block was significant ($p < 0.01$) with medium exposure (57.78 ± 19.20 cm) resulting in the highest mean. Container had a significant ($p < 0.01$) effect with plastic bags 2.5 x 9 in. (56.56 ± 18.08 cm) resulting in a higher mean. Root pruning by hand (53.54 ± 18.46 cm) had a higher mean than root pruning by air.

Shoot/root ratio of dry weight (Figure 25 and Table 4) had the lowest mean with T5 (0.72 ± 0.71). Interpretation of all factors (Table 8 and Appendix I, Table 28) showed that block had a significant ($p < 0.01$) effect, with medium exposure (4.12 ± 1.90) resulting in the lowest mean. Container type was also significant ($p < 0.01$) with REX trays (5.23 ± 3.87) resulting in the lowest mean. Fertilizer type was significant ($p < 0.05$), with soluble fertilizer (1.43 ± 0.77) resulting in a lower mean than "Osmocote".

***Horsfieldia thorelii* Lec.**

Mean height of seedling at first potting : 13.39 ± 2.48 cm

Mean height of seedling after 10 months : 30.73 ± 8.98 cm

Survival of seedlings after 10 months : 91.67%

RGR of basal diameter (Figure 26 and Table 5) was highest with T5 (77.5 ± 33.15). Interpretation of all factors (Table 9 and Appendix I, Table 29) showed that block had a significant ($p < 0.01$) effect with medium exposure (65.40 ± 29.59) and open (64.37 ± 34.95) resulting in higher means than deep shade. Root pruning by air (66.59 ± 33.02) resulted in a significantly higher mean than root pruning by hand.

RGR height (Figure 26 and Table 5) was highest with T5 (132.66 ± 54.42). Interpretation of all factors (Table 9 and Appendix I, Table 30) showed that block had a significant ($p < 0.01$) effect with medium exposure (126.03 ± 39.78) and open (115.96 ± 46.96) resulting in having higher means than deep shade. Container had a significant ($p < 0.01$) effect, with plastic bags 3 x 7 in (124.27 ± 45.22) resulting in the highest mean.

Final basal diameter (Figure 27 and Table 5) was highest with T5 (0.71 ± 0.15 cm). Interpretation of all factors (Table 9 and Appendix I, Table 31) showed that block had a significant ($p < 0.01$) effect, with medium exposure (0.67 ± 0.10 cm) and open (0.65 ± 0.12 cm) having higher means than deep shade. Container also had a significant ($p < 0.01$) effect, with plastic bags 3 x 7 in. (0.66 ± 0.13 cm) having the highest mean. Root pruning by air (0.66 ± 0.12 cm) resulted in a significantly higher mean than root pruning by hand.

Final height (Figure 28 and Table 5) was highest with T11 (35.25 ± 9.20 cm). Interpretation of all factors (Table 9 and Appendix I, Table 32) showed that block had a significant ($p < 0.01$) effect, with medium exposure (35.98 ± 8.7 cm) resulting in the highest mean. With regard to container, plastic bags 3 x 7 in. (33.51 ± 9.95 cm) resulted in the highest mean. "Osmocote" (31.78 ± 9.23 cm) resulted in a significantly higher mean than soluble fertilizer.

Shoot / root ratio based on dry weight (Figure 29 and Table 5) was lowest with T8; (1.52 ± 0.45) and T10; (1.52 ± 0.37) Interpretation of all factors (Table 9 and Appendix I, Table 33) showed that a block had a significant ($p < 0.01$) effect with open (1.53 ± 0.39) resulting in the lowest mean. Fertilizer type had a significant ($p < 0.01$) effect with soluble fertilizer (1.62 ± 0.44) resulting in a lower

mean than “Osmocote”. Root pruning had a significant effect ($p < 0.01$) with by hand pruning (1.65 ± 0.56) resulting in a lower mean than root pruning by air.

Seedling Quality Index

The seedling Quality Index (SQI) (Table 14) for *Artocarpus lakoocha* was highest with plastic bags 3 x 7 in. + “Osmocote” + root pruning by hand (0.352). SQI for *Balakata baccata* (Table 15) was highest with plastic bags 2.5 x 9 in. + soluble fertilizer + root pruning by hand (0.376). SQI for *Horsfieldia thorelii* (Table 16) highest with REX tray + “Osmocote” + root pruning by air (0.479).

Highest SQI averaging across all study species (Table 17) was in plastic bags 3 x 7 in + “Osmocote” + root pruning by air (0.577) and plastic bags 3 x 7 in + “Osmocote” + root pruning by hand (0.579).

Benefit value

Benefit value (Table 18), which relates seedling characteristics with production costs per seedling per season, was highest for *Artocarpus lakoocha* with REX trays + “Osmocote” + root pruning by hand (0.408) for *Balakata baccata* with plastic bags 2.5 x 9 in + soluble fertilizer + root pruning by hand (0.560) and for *Horsfieldia thorelii* with REX trays + “Osmocote” + root pruning by hand (0.529).

Highest benefit value averaging across all study species was showed in REX trays + soluble fertilizer + root pruning by hand (0.547).

Root Score (characteristic)

Root score 1: tap root straight and physically strong growing downwards to the bottom of containers (Figure 30).

Root score 2: branching tap root or very sinuous sometime without a tap root, but roots still grow downwards to the bottom of container (Figure 31).

Root score 3: tap root start vertically growing downwards and go down to bottom of container when touch inner surface of container (Figure 32).

Root score 4: tap root twisted upwards, but development straight down to the bottom of container (Figure 33).

Root score 5: tap root straight upward but coiled like container shape at bottom (Figure 34).

Root score 6: tap root hooked at start and coiled shape like bottom of container at bottom (Figure 35).

For *Artocarpus lakoocha* T1 resulted in the lowest mean root score of 2.4 (Table 11).

For *Balakata baccata* T5 resulted in the lowest mean root score of 2.1 (Table 12).

For *Horsfieldia thorelii* T1 resulted in the lowest mean root score of 1.333 (Table 13).

REX trays, the highest root score frequency was root score 1, with plastic bag 2.5 x 9 in, the highest root score frequency was root score 3 and plastic bag 3 x 7 in, the highest root score frequency was root score 2.

The best root characteristics were obtained with REX trays and root pruning by air.

Total Costs

The cheapest treatment (Table 2) was REX trays, with root pruning by hand and soluble fertilizer, 0.646 baht per seedling per season.

Seedlings Description

Artocarpus lakoocha Roxb. (MORACEAE)

The description is based on seedling grown at Forest Restoration Unit nursery. The large seedlings 10 months old, 37 cm tall (CMU Herbarium, voucher Jitlam S129b1), small seedlings 25 - 56 days old, 8 - 14 cm tall (CMU Herbarium, voucher Jitlam S129b2), very small in liquid collection 1-25 days old, 1-10 cm tall. The stage of development are in Figure 15.

- germination: hypogeal (*Horsfieldia* type (de Vogel, 1979))
- testa: thin, brown with darker brown lines
- endosperm: smooth, cream
- cotyledons: plano-convex, cream, 10 -15 x 8 – 10 mm
- cotyledonary petiole: distinct, white, 4 mm long, 2 mm thick
- epicotyl: often paired or branched above the base, one frequently aborting; straight, green; with 4 spirally arranged, scale-like/subulate prophylls, 1 mm long, all parts finely white hispidulous
- cotyledonary leaves: minute, inside the seed
- seedling leaves: spiral, simple, blade ovate, apex acuminate, base obtuse, finely serrulate, midnerve distinct, secondary veins pinnate, subopposite, 5 on each side of the midrib, arching, finer veins reticulate, sparsely and finely hispidulous on both sides, stipules, linear, hispidulous, 1.5 mm long
- hypocotyl: none

roots: radicle straight, thin, sinuous white, 1 mm diameter, after 5 days, becoming yellow, secondary roots, fibrous, white, becoming yellow with age, branching

***Balakata baccata* (Roxb) Ess. (EUPHORBIACEAE)**

The description is based on seedling grown at Forest Restoration Unit nursery. The large seedlings 8 months olds, 28-32 cm tall (CMU Herbarium, Voucher Jitlam S015b1), small seedlings 2-18 days old, 2-6 cm tall, (CMU Herbarium, Voucher Jitlam S015b2), small and very small seedling in liquid collection 1-25 days old, 1-10 cm tall. Stage of development are in Figure 16.

germination: epigeal
 testa: hard, black; tegument firm, soft, white
 cotyledon: cryptocotyledonary, thick, white, disappear after germinate 2-3 days
 epicotyl: initially reflexed and becoming straight 5 days after germination, green and becoming red or pink with age
 cotyledonary leaves: opposite, blades elliptic both ends rounded, entire, main venation, obscure, with 5-6 parallel veins, forking near the tips, finer venation indistinct, 7 x 12 mm, light green or cream becoming green with age, petiole 2-3 mm long
 embryo leaves: opposite, simple, blades ovate; apex acute, base rounded; entire, 9 x 12 mm, in older nodes becoming elliptic; apex acute, base peltate, 17 x 28 mm, midnerve with, primary vein soft 5-6 pairs of opposite, distinct, secondary vein finely, reticulate, above dark green, below light green, petiole light green, 8 mm long, glabrous
 seedling leaves: spiral, morphologically similar to the embryo leaves, but larger
 hypocotyl: base white, middle pink or dark red, apex light green

root: radicle slightly sinuous, cream becoming pale yellow , straight with age, 1 mm diameter after 20 days

***Horsfieldia thorelii* Lac. (MYRISTICACEAE)**

The description is based on seedling grown at Forest Restoration Unit nursery. The large seedlings 10 months olds, 28-35 cm tall (CMU Herbarium, Voucher Jitlam S236b1). Liquid collection age 5 days and 30 days, 8 and 40 cm tall. Stage of development are in Figure 17.

germination: hypogeal (*Horsfieldia* type (de Vogel, 1979))
 testa: hard, mottled brown and gray, 0.5 mm thick
 cotyledons: not seen, microscopic, remaining in the seed
 endosperm: ruminant, white with brown lines
 cotyledonary petiole: stout, 8 mm long, 5 mm thick, brown after 30 days
 epicotyl: straight, stout, green, glabrous; with 3-4 spirally arranged, scale-like/subulate prophylls, lowest one 4 mm long, these becoming green and larger distally
 hypocotyl: hardly distinct, represented by a dark brown ring between the insertion of the cotyledonary petiole and top of the radical
 seedling leaves: spirally arranged, simple, spaced; blades elliptic apex obtuse, base acute, entire; midnerve distinct, flat dorsally, raised ventrally; secondary veins pinnate, subopposite, 6-7 on each side of the midrib; arching; finer veins reticulate; glossy dark green dorsally, glossy green underneath; petioles light green, 4-5 mm long; very immature leaf parts with fine, brown, stellate indumentum, glabrescent
 stipules: none
 roots: radical straight, stout, light brown, 3 mm diameter after 30 days; secondary roots fibrous, 1 mm diameter

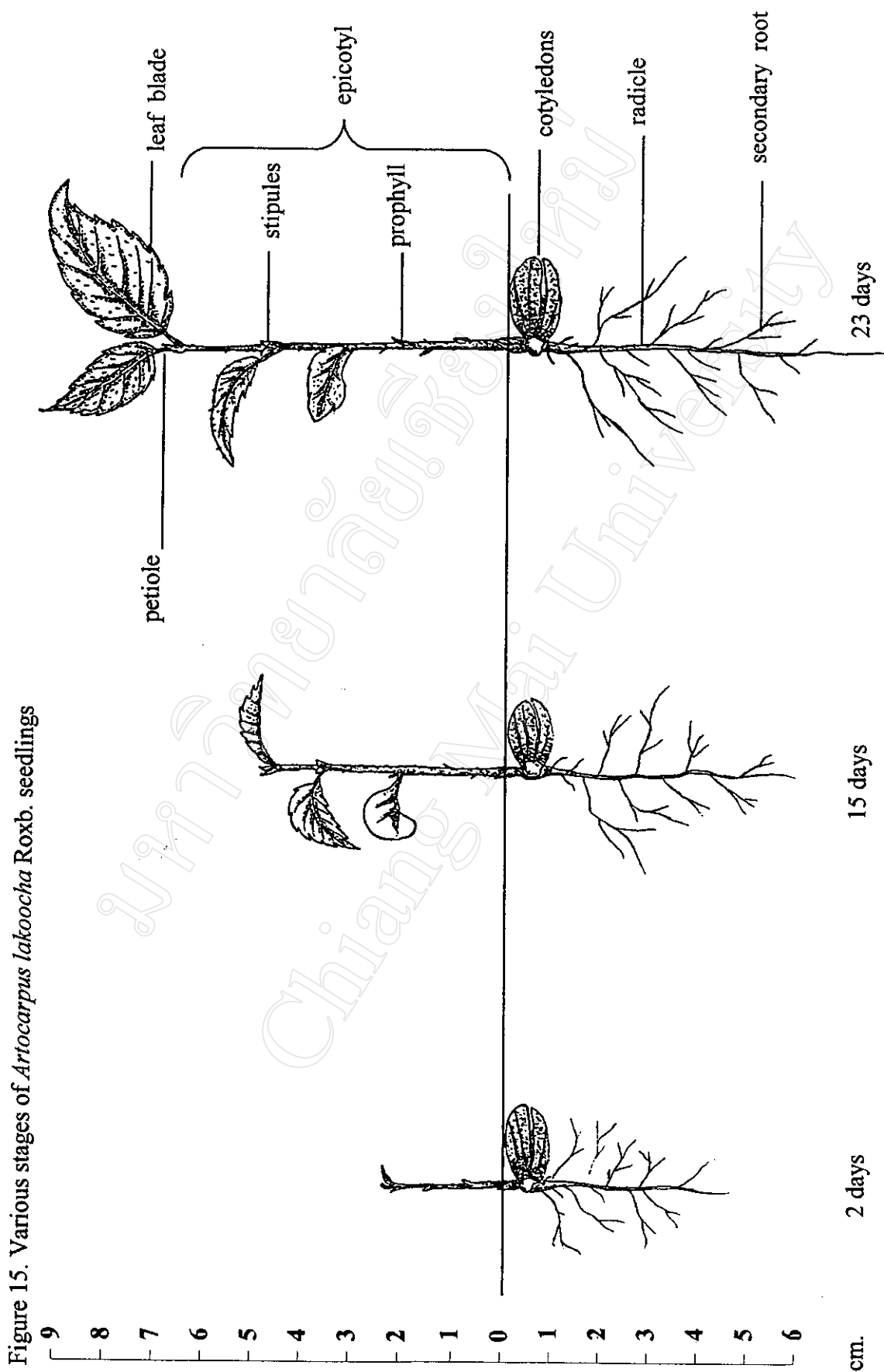


Figure 15. Various stages of *Artocarpus lakoocha* Roxb. seedlings

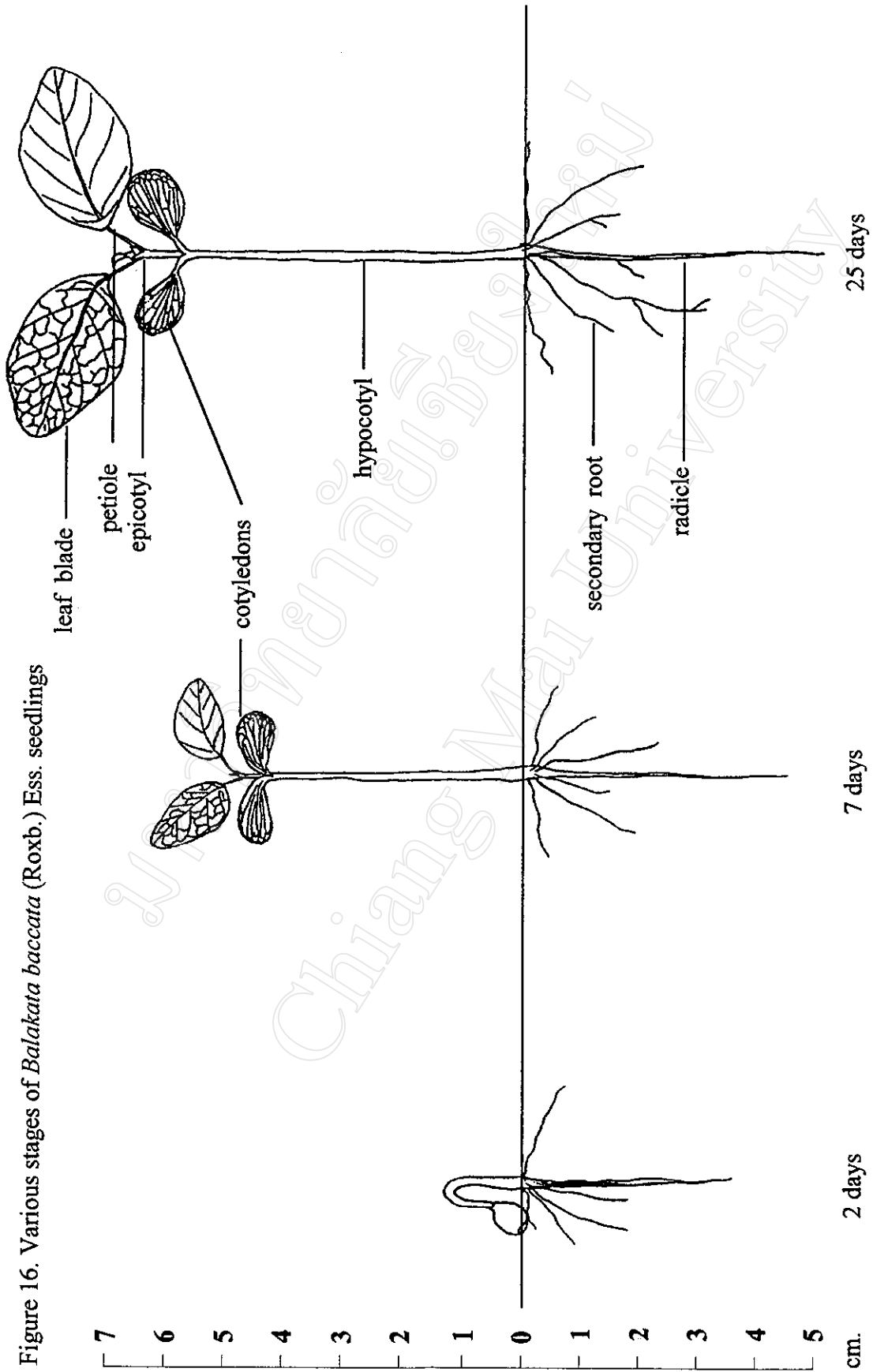


Figure 16. Various stages of *Balakata baccata* (Roxb.) Ess. seedlings

Figure 17. Various stages of *Horsfieldia thorelii* Lec. seedlings

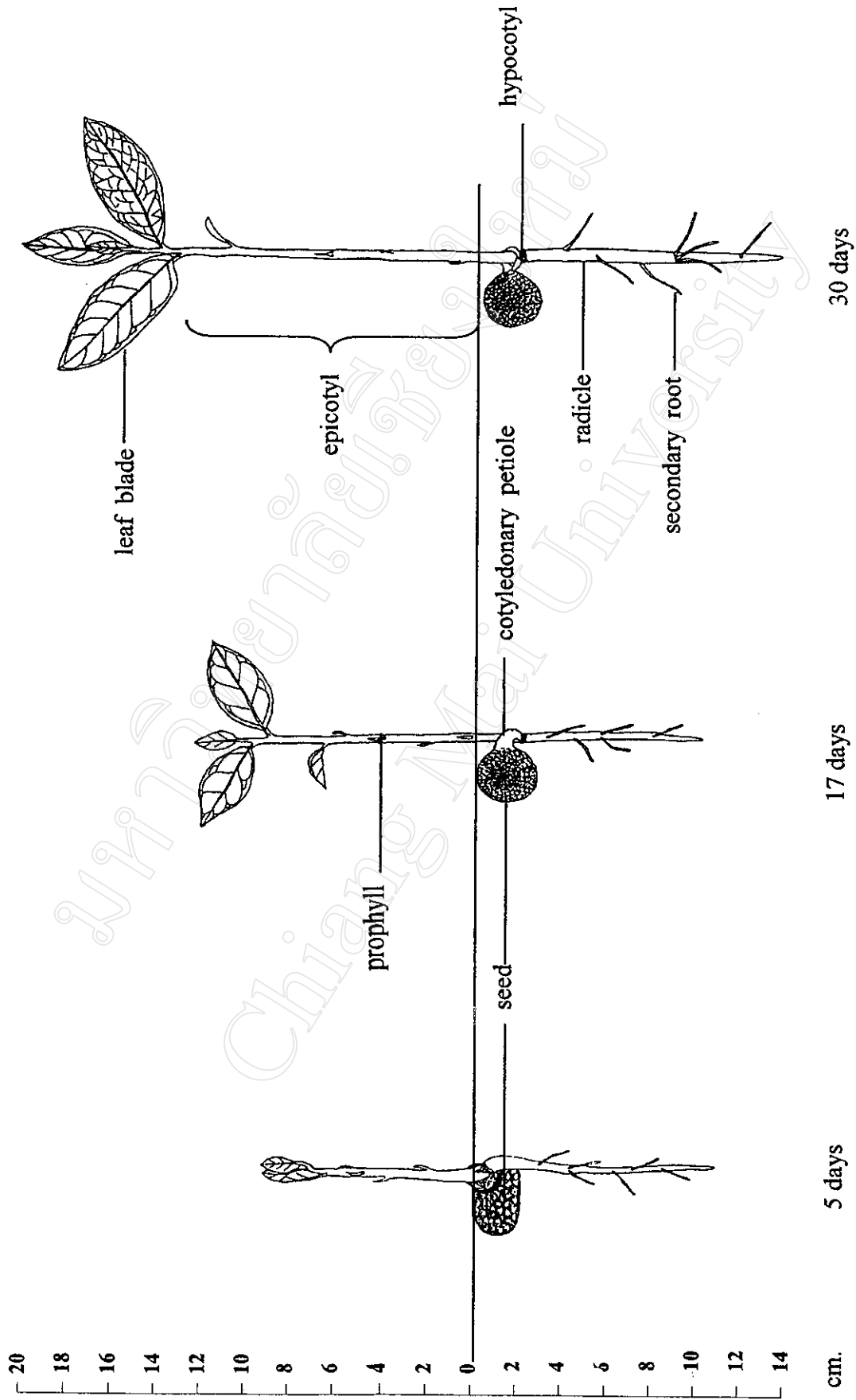


Figure 18. Relative Growth Rate (RGR) of basal diameter and height percent per year of *Artocarpus lakoocha*.

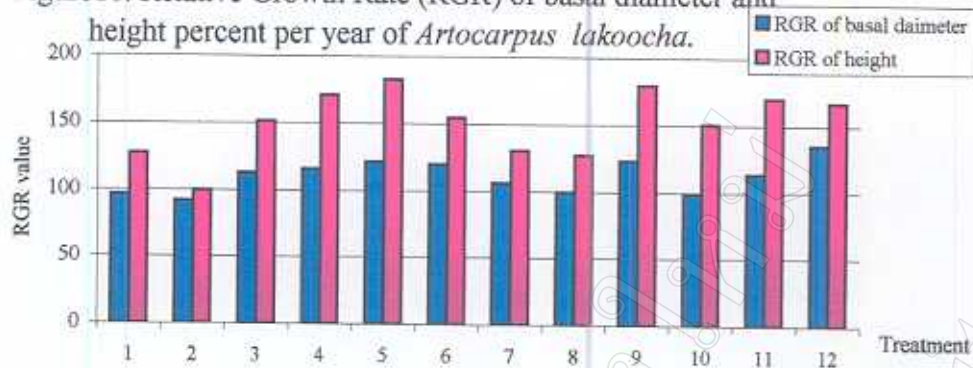


Figure 19. Final basal diameter of *Artocarpus lakoocha*.

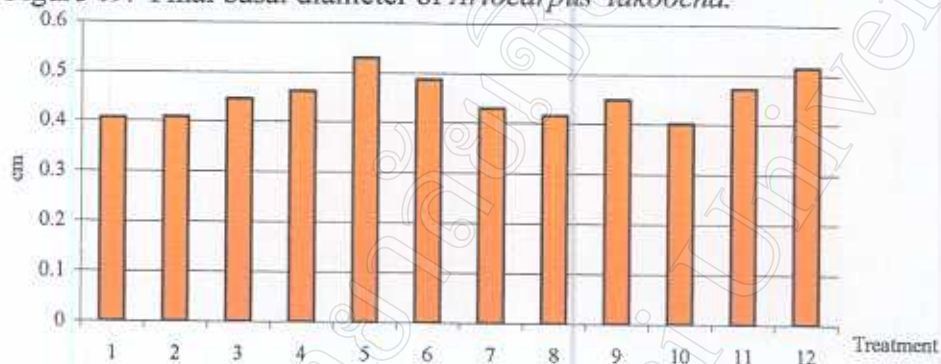


Figure 20. Final height of *Artocarpus lakoocha*.

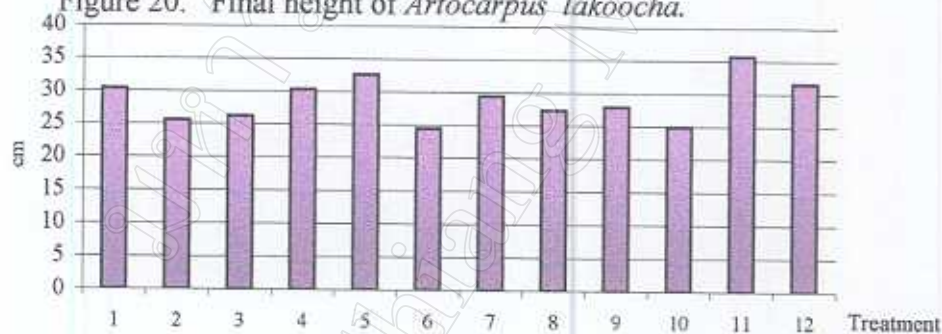


Figure 21. Shoot/root ratio of *Artocarpus lakoocha*.

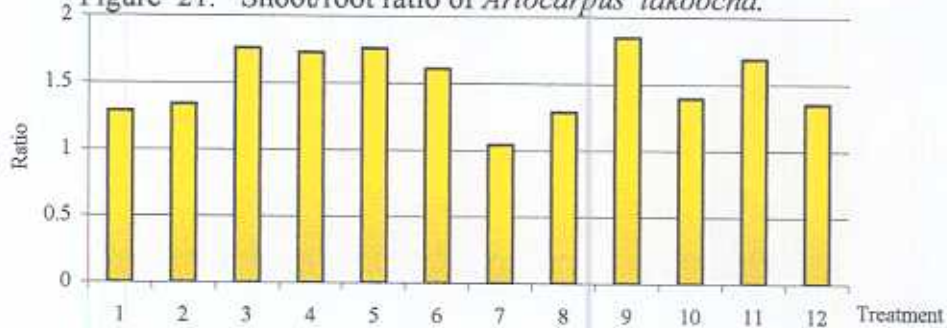


Figure 22. Relative Growth Rate (RGR) of basal diameter and height percent per year of *Balakata baccata*.

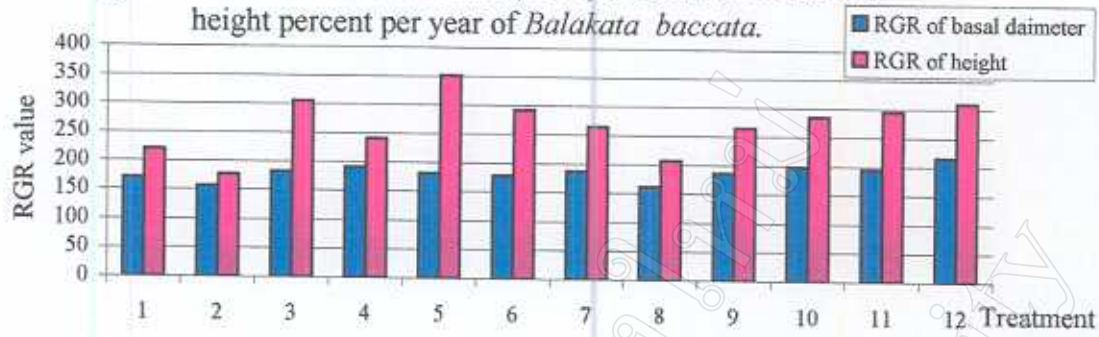


Figure 23. Final basal diameter of *Balakata baccata*.

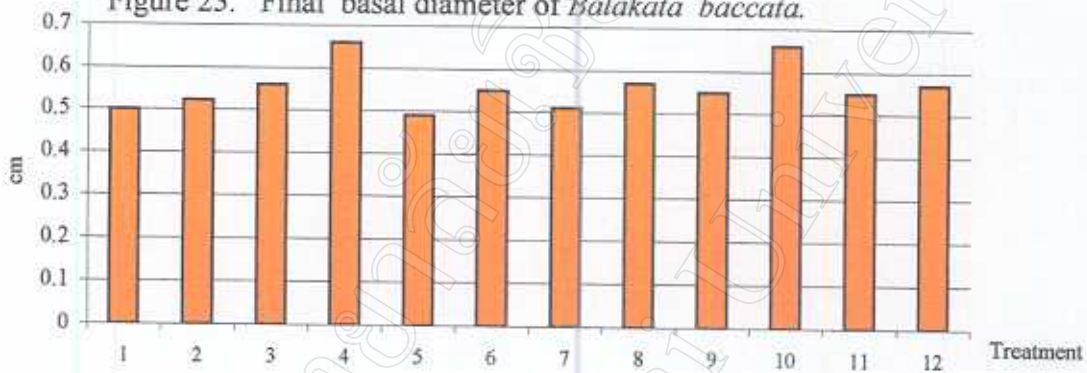


Figure 24. Final height of *Balakata baccata*.

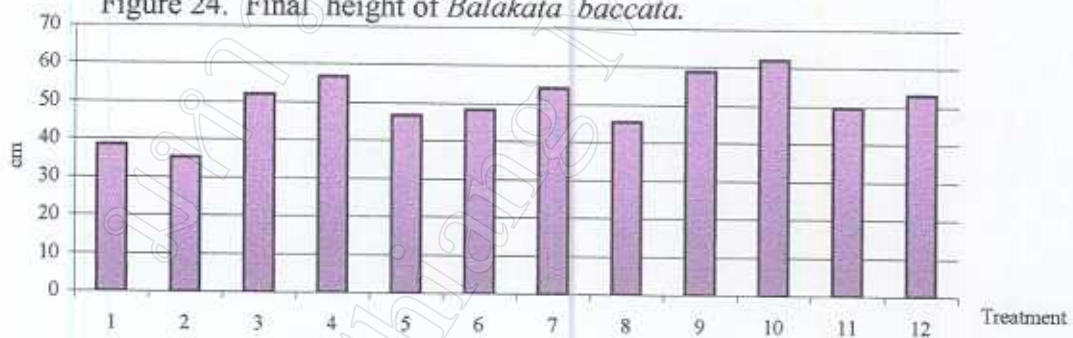


Figure 25. Shoot / root ratio of *Balakata baccata*.

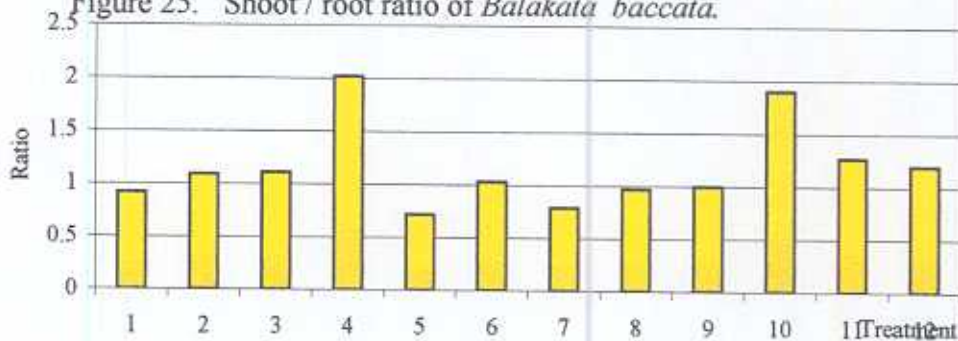


Figure 26. Relative Growth Rate (RGR) of basal diameter and height percent per year of *Horsfieldia thorelii*.

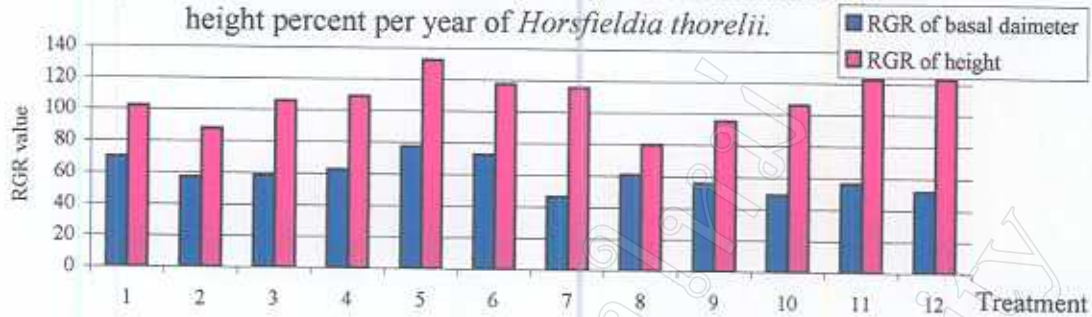


Figure 27. Final basal diameter of *Horsfieldia thorelii*.



Figure 28. Final height of *Horsfieldia thorelii*.

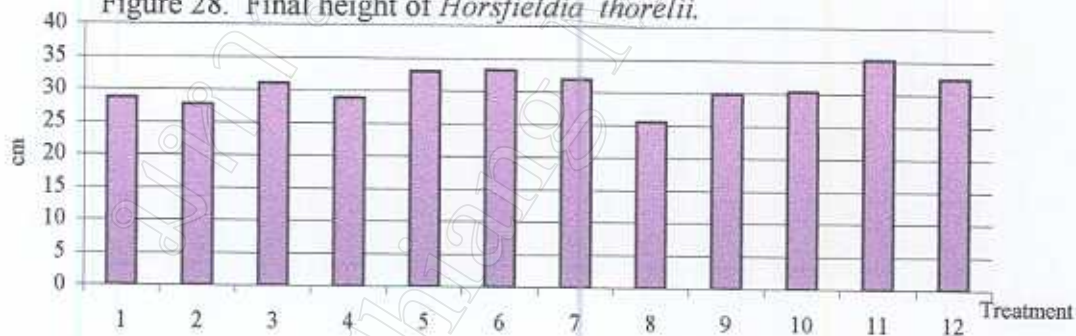


Figure 29. Shoot / root of *Horsfieldia thorelii*.

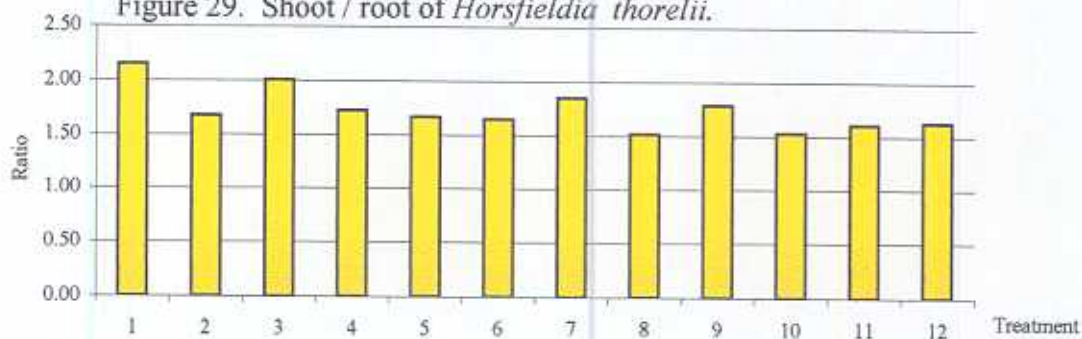




Figure 30. Root score 1

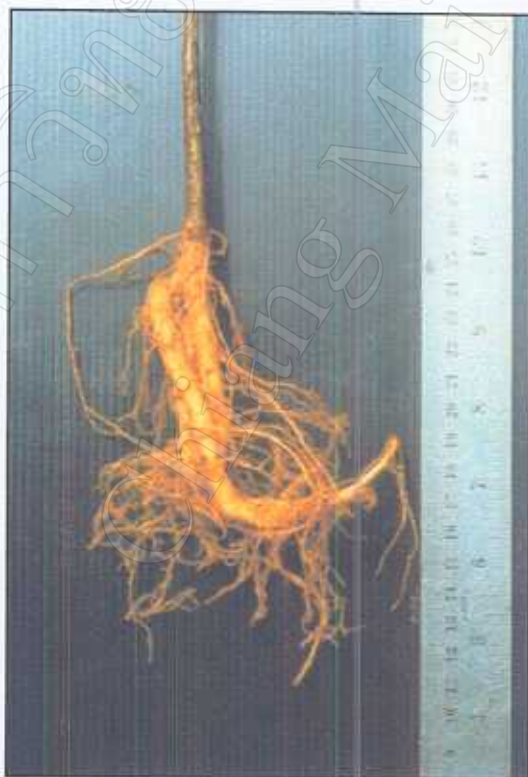


Figure 31. Root score 2



Figure 32. Root score 3



Figure 33. Root score 4

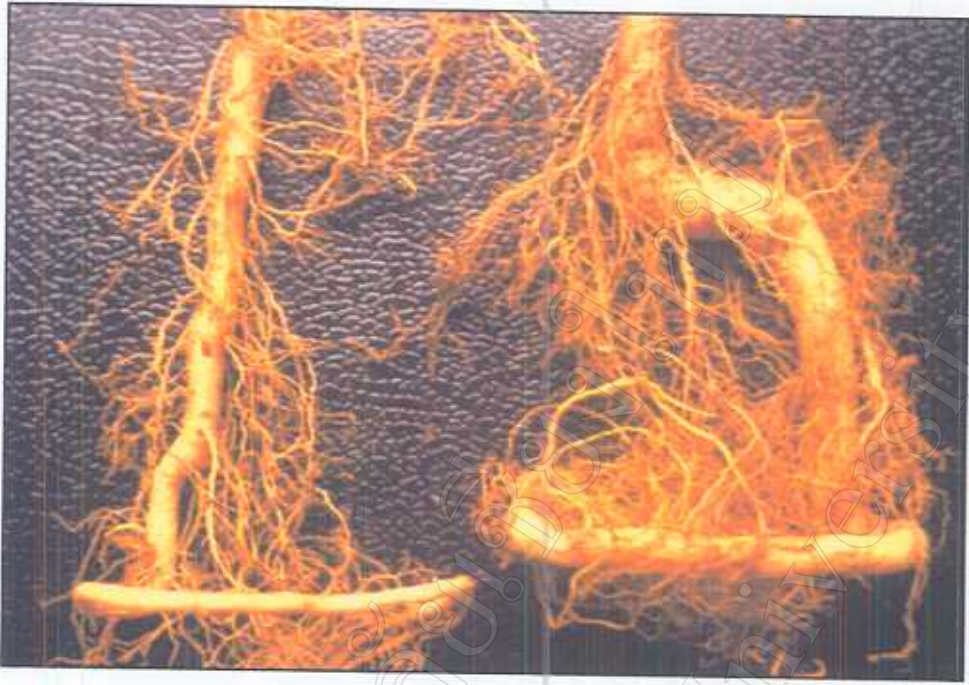


Figure 34. Root score 5



Figure 35. Root score 6

Table 2. Total cost: baht per seedling per season

Treatment	Container	Media	Fertilizer	Root Pruning	Labour Cost	Total
T1: raised + REX tray + osmocote	0.243	0.1671	0.18	0.347	0.1689	1.106
T2: raised + REX tray + soluble fertilizer	0.243	0.1671	0.0375	0.347	0.1928	0.987
T3: raised + plastic bag 2.5x9 in + osmocote	0.127	0.4456	0.18	0.242	0.2404	1.235
T4: raised + plastic bag 2.5x9 in + soluble fertilizer	0.127	0.4456	0.0375	0.242	0.2643	1.116
T5: raised + plastic bag 3x7 in + osmocote	0.144	0.4736	0.18	0.347	0.2404	1.385
T6: raised + plastic bag 3x7 in + soluble fertilizer	0.144	0.4736	0.0375	0.347	0.2643	1.266
T7: ground + REX tray + osmocote	0.243	0.1671	0.18	0.0054	0.1689	0.764
T8: ground + REX tray + soluble fertilizer	0.243	0.1671	0.0375	0.0054	0.1928	0.646
T9: ground + plastic bag 2.5x9 in + osmocote	0.127	0.4456	0.18	0.104	0.2404	1.097
T10: ground + plastic bag 2.5x9 in + soluble fertilizer	0.127	0.4456	0.0375	0.104	0.2643	0.978
T11: ground + plastic bag 3x7 in + osmocote	0.144	0.4736	0.18	0.104	0.2404	1.142
T12: ground + plastic bag 3x7 in + soluble fertilizer	0.144	0.4736	0.0375	0.104	0.2643	1.023

Table 3. Growth parameters of *Artocarpus lakoocha* Roxb. with 12 treatments. Data were analyzed by SNK and Duncan test with significance level 0.05.

Treatment	Number	RGR diameter % per year		RGR height % per year		final diameter (cm)		final height (cm)		shoot/root ratio (dry weight)		
		mean	SD	mean	SD	mean	SD	mean	SD	mean	SD	Number
T1	26	96.64ab	37.10	127.26ab	67.99	0.407a	0.103	30.327	11.455	1.29ab	0.549	30
T2	30	92.06a	35.16	99.77a	39.57	0.409a	0.072	25.600	5.892	1.34ab	0.866	30
T3	23	112.82ab	47.97	151.64ab	81.93	0.446ab	0.131	26.217	12.389	1.76b	0.868	30
T4	26	116.16ab	39.90	170.79b	81.55	0.462ab	0.112	30.327	14.236	1.73b	1.040	30
T5	28	121.68ab	55.42	182.45b	96.25	0.531b	0.184	32.554	17.163	1.76b	0.960	30
T6	30	119.89ab	51.50	154.44ab	50.23	0.487ab	0.159	24.450	7.714	1.61ab	0.941	30
T7	29	105.99ab	37.24	130.53ab	51.25	0.43ab	0.099	29.397	10.384	1.04a	0.428	30
T8	28	99.91ab	31.87	127.44ab	53.84	0.416b	0.068	27.321	9.848	1.29ab	0.586	30
T9	25	123.28ab	44.52	179.67b	93.81	0.449ab	0.133	27.900	16.682	1.85b	0.973	30
T10	28	98.83ab	50.78	150.81ab	82.29	0.401a	0.132	24.893	11.993	1.39ab	0.564	30
T11	30	113.42ab	47.69	170.09b	86.46	0.473ab	0.160	35.717	19.583	1.69b	0.946	30
T12	27	135.45b	49.92	167.04b	69.16	0.516ab	0.163	31.556	14.256	1.35ab	0.718	30

Table 4. Growth parameters of *Balakata baccata* (Roxb.) Ess. with 12 treatments. Data were analyzed by ANOVA and SNK test with significance level 0.05

Treatment	Number	RGR diameter % per year		RGR height % per year		final diameter (cm)		final height (cm)		shoot/root ratio (dry weight)		
		mean	SD	mean	SD	mean	SD	mean	SD	mean	SD	Number
T1	10	170.39ab	36.72	220.33ab	69.70	0.50a	0.05	38.5ab	12.03	0.92ab	0.78	13
T2	9	156.75a	34.86	176.21a	62.12	0.522ab	0.09	35.22a	13.61	1.09ab	0.64	11
T3	26	182.05ab	40.23	306.13bc	103.41	0.56ab	0.13	52.13abc	19.09	1.11ab	0.92	21
T4	23	190.96ab	45.63	240.61ab	109.66	0.66b	0.13	56.91c	18.74	2.02b	1.73	21
T5	27	180.85ab	53.21	351.93c	112.64	0.49a	0.11	46.82abc	16.06	0.72a	0.71	21
T6	19	177.17ab	42.55	291.75bc	127.62	0.55ab	0.15	48.39bc	11.63	1.03ab	0.83	19
T7	24	186.99ab	42.41	264.68abc	86.74	0.51ab	0.11	54.13abc	15.06	0.79a	0.74	20
T8	22	160.90ab	30.93	207.03ab	85.05	0.57ab	0.08	45.57c	10.89	0.97ab	0.76	21
T9	21	185.82ab	69.34	264.18abc	88.00	0.55ab	0.14	58.88c	21.55	1.00ab	1.90	21
T10	18	198.06ab	30.82	284.44bc	122.82	0.66b	0.16	62.03c	8.91	1.90b	1.21	21
T11	25	193.87ab	74.44	294.74bc	129.91	0.55ab	0.19	49.64abc	22.45	1.27ab	0.92	18
T12	23	215.10b	77.20	310.61bc	92.58	0.57ab	0.22	53.26bc	22.19	1.20ab	1.18	19

Table 5. Growth parameters of *Horsfieldia thorelii* Lac. with 12 treatments. Data were analyzed by ANOVA and SNK test with significance level 0.05.

Treatment	Number	RGR diameter % per year		RGR height % per year		final diameter (cm)		final height (cm)		shoot/root ratio (dry weight)		
		mean	SD	mean	SD	mean	SD	mean	SD	mean	SD	Number
1	26	70.01ab	23.94	102.01abc	51.78	0.65abc	0.08	28.71ab	9.65	2.15c	1.05	30
2	27	56.99ab	26.64	88.04ab	36.66	0.62ab	0.06	27.76ab	6.16	1.68ab	0.47	30
3	26	58.61ab	37.06	105.92abc	48.99	0.62ab	0.09	31.06ab	10.21	2.01bc	0.75	30
4	30	62.63ab	38.01	109.14abc	50.80	0.63ab	0.13	28.83ab	7.87	1.73abc	0.40	30
5	30	77.5b	33.15	132.66c	54.42	0.71c	0.15	32.97b	10.18	1.67ab	0.36	30
6	28	72.66ab	33.66	117.77bc	43.91	0.70bc	0.13	33.29b	9.20	1.65ab	0.44	30
7	26	46.34a	23.45	115.82abc	32.33	0.59a	0.10	31.94ab	7.01	1.85abc	0.59	30
8	27	60.81ab	32.05	80.28a	45.35	0.63ab	0.09	25.53a	7.29	1.52a	0.45	30
9	25	55.84ab	27.52	95.46abc	45.79	0.57a	0.10	29.94ab	7.73	1.79abc	0.83	30
10	29	49.11a	32.15	106.24abc	27.91	0.58a	0.11	30.33ab	7.07	1.53a	0.37	30
11	30	56.63ab	26.62	122.83bc	35.16	0.64ab	0.11	35.25b	9.20	1.61ab	0.47	30
12	26	51.65ab	28.83	123.32bc	46.35	0.60a	0.09	32.45ab	11.40	1.63ab	0.47	30

Table 6. Average for all study species in growth parameters of with 12 treatments. Data were analyzed by ANOVA and SNK test with significance level 0.05 .

Treatment	Number	RGR diameter		RGR height		final diameter (cm)		final height (cm)		shoot/root ratio (dry weight)		
		mean	SD	mean	SD	mean	SD	mean	SD	mean	SD	Number
1	62	97.37ab	46.81	131.68a	73.36	0.523ab	0.14	30.97ab	11.18	1.79ab	0.92	73
2	66	86.54a	45.21	105.40a	50.45	0.512a	0.12	27.60a	7.96	1.70a	0.83	71
3	75	118.02b	66.21	189.35c	118.74	0.547ab	0.14	36.88bc	18.25	2.61bc	1.90	81
4	79	117.61bc	66.22	167.71bc	96.81	0.582ab	0.15	37.50bc	18.55	2.28abc	1.80	81
5	75	117.42bc	61.16	200.95c	120.59	0.596b	0.18	35.95bc	15.46	2.82c	2.16	81
6	77	116.85bc	58.96	174.99c	101.42	0.578ab	0.17	33.57abc	13.14	2.42abc	1.80	79
7	79	110.97bc	66.22	166.44bc	88.31	0.506a	0.12	37.747bc	15.53	3.89abc	1.96	80
8	77	103.52ab	50.83	133.64ab	79.48	0.534ab	0.12	31.91abc	12.71	2.00abc	1.28	81
9	71	119.47bc	70.74	175.01c	102.96	0.525ab	0.13	37.78bc	20.95	2.82c	2.04	81
10	75	103.42ab	69.95	165.65bc	105.50	0.533ab	0.17	35.91bc	17.71	2.20abc	1.73	81
11	85	117.04bc	75.35	190.07c	113.35	0.553ab	0.17	39.65c	18.65	2.49abc	1.91	78
12	76	130.89c	85.14	194.18c	105.98	0.560ab	0.16	37.89bc	18.81	2.14abc	1.49	79

Table 7. Growth parameters of *Artocarpus lakoocha* Roxb. in different type of block, container, root pruning and fertilization Analyzed by ANOVA and LSD test with significance level 0.05.

	RGR diameter		RGR height		final diameter		final height		shoot/root ratio	
	% per year		% per year		(cm)		(cm)		(dry weight)	
	mean	SD	mean	SD	mean	SD	mean	SD	mean	SD
Block	1	87.52b	39.50	49.63	0.38b	0.10	17.20b	5.51	1.92b	0.89
	2	124.20a	42.50	64.98	0.50a	0.13	34.03a	12.11	1.12a	0.59
	3	119.67a	46.05	62.35	0.48a	0.14	34.46a	15.84	1.48b	0.81
Container	1	98.56b	35.29	54.37	0.46b	0.09	28.09	9.59	1.24a	0.63
	2	112.39a	46.26	84.64	0.44b	0.13	27.31	13.87	1.69b	0.89
	3	122.29a	51.11	77.00	0.50a	0.17	31.03	15.70	1.60b	0.90
Root pruning	1	109.77	46.00	75.66	0.46	0.14	28.18	12.14	1.58b	0.89
	2	112.41	45.42	75.72	0.45	0.14	28.55	14.45	1.43a	0.77
Fertilization	1	112.25	45.65	82.73	0.46	0.14	30.59a	15.20	1.57	0.86
	2	110.01	65.78	67.88	0.45	0.13	27.24b	11.13	1.45	0.81

Remarks: Block 1 = deep shade 2 = open 3 = medium
 Container 1 = REX tray 2 = plastic bag 2.5 x 9 in. 3 = plastic bag 3 x 7
 Root pruning 1 = by air 2 = by hand
 Fertilization 1 = "Osmocote" 2 = soluble fertilizer

Table 8. Growth parameters of Balakata baccata (Roxb.) Ess. in different type of block, container, root pruning and fertilization Analyzed by ANOVA and LSD test with significance level 0.05.

	RGR diameter		RGR height		final diameter		final height		shoot/root ratio	
	% per year		% per year		(cm)		(cm)		(dry weight)	
	mean	SD	mean	SD	mean	SD	mean	SD	mean	SD
Block	1	164.12b	44.69	240.75b	117.76	0.11	43.83b	17.30	6.82b	4.08
	2	187.57a	53.59	265.85b	101.73	0.15	49.73b	17.08	4.16a	2.02
	3	198.75a	52.69	301.27a	105.12	0.15	57.78a	19.20	4.12a	1.90
Container	1	171.99b	279.74	226.52b	85.37	0.10	46.82b	15.15	3.84a	2.20
	2	188.13a	338.22	274.24b	107.31	0.14	56.56a	18.08	5.43b	3.87
	3	193.27a	439.00	309.99a	116.77	0.18	52.42b	17.52	4.95	2.08
Root pruning	1	0.10a	6.87	277.01	115.68	0.13	48.87b	17.28	5.94	3.67
	2	0.09b	6.63	571.33	105.72	0.16	53.54a	18.46	4.86	2.19
Fertilization	1	185.7	53.63	287.37a	106.75	0.14	51.23	19.07	5.29b	2.41
	2	186.24	51.85	258.95b	112.05	0.16	51.77	16.96	4.51a	3.42

Remarks:

Block 1 = deep shade

Container 1 = REX tray

Root pruning 1 = by air

Fertilization 1 = "Osmocote"

2 = open

2 = plastic bag 2.5 x 9 in.

2 = by hand

2 = soluble fertilizer

3 = medium

3 = plastic bag 3 x 7

Table 9. Growth parameters of *Horsfieldia thorelii* Lac. in different type of block, container, root pruning and fertilization. Analyzed by ANOVA and LSD test with significance level 0.05.

	Block	RGR diameter % per year		RGR height % per year		final diameter (cm)		final height (cm)		shoot/root ratio (dry weight)	
		mean	SD	mean	SD	mean	SD	mean	SD	mean	SD
Block	1	49.96b	27.47	82.77b	38.68	0.57b	0.09	24.85b	5.62	1.89b	0.76
	2	64.37a	34.95	115.96a	46.96	0.65a	0.12	31.00b	8.50	1.53a	0.39
	3	65.41a	29.59	126.03a	39.78	0.67a	0.10	35.98a	8.70	1.80b	0.57
Container	1	58.25	27.73	96.30b	43.77	0.62b	0.09	28.45	7.86	1.80	0.72
	2	56.57	34.08	104.50b	43.87	0.60b	0.11	30.00	8.19	1.77	0.64
	3	64.92	32.16	124.27a	45.22	0.66a	0.13	33.51	9.95	1.64	0.43
Root pruning	1	66.59a	33.02	109.79	49.52	0.66a	0.12	30.48	9.11	1.82b	0.65
	2	53.43b	28.67	107.78	41.69	0.60b	0.10	30.99	9.96	1.65a	0.56
Fertilization	1	61.16	30.50	113.30	46.62	0.63	0.12	31.78a	9.23	1.85b	0.73
	2	59.05	35.69	104.44	44.58	0.63	0.11	29.73b	8.64	1.62a	0.44

Remarks:

Block

1 = deep shade

2 = open

3 = medium

Container

1 = REX tray

2 = plastic bag 2.5 x 9 in.

3 = plastic bag 3 x 7

Root pruning

1 = by air

2 = by hand

Fertilization

1 = "Osmocote"

2 = soluble fertilizer

Table 10. Average growth parameter of all species in different types of block, container, root pruning and fertilization.

	RGR diameter		RGR height		final diameter		final height		shoot/root ratio	
	% per year		% per year		(cm)		(cm)		(dry weight)	
	mean	SD	mean	SD	mean	SD	mean	SD	mean	SD
Block	1	90.92b	57.02	119.22c	95.65	0.15	26.36c	13.98	2.70b	2.03
	2	118.02a	64.46	177.16b	91.44	0.62a	36.96b	13.81	2.00a	1.56
	3	124.68a	69.24	200.02a	102.09	0.59a	41.94a	17.43	2.26a	1.53
Container	1	100.03b	53.99	135.48b	77.91	0.16	32.35b	12.85	1.98a	1.36
	2	114.81b	68.19	174.48a	105.96	0.55a	37.02a	18.76	2.48b	1.88
	3	120.45a	70.99	189.97a	110.46	0.57a	36.84a	16.81	2.47b	1.86
Root pruning	1	109.90	59.59	163.86	102.83	0.56	34.02b	15.12	2.30	1.70
	2	114.19	70.76	171.06	101.50	0.54	36.86a	17.63	2.34	1.77
Fertilization	1	113.99	65.72	177.20a	106.65	0.54	36.73a	17.16	2.50b	1.89
	2	110.24	65.48	157.98b	96.62	0.55	34.24b	15.76	2.13a	1.54
Species	1	111.10b	45.66	150.46b	75.65	0.45c	28.87b	13.36	1.50a	0.84
	2	185.96a	52.67	273.82a	110.00	0.56b	51.49a	18.06	1.74b	0.61
	3	60.09c	31.6	108.39c	45.59	0.64a	31.60b	8.84	4.53c	1.10

Remarks:

Block

1 = deep shade

2 = open

3 = medium

Container

1 = REX tray

2 = plastic bag 2.5 x 9 in.

3 = plastic bag 3 x 7

Root pruning

1 = by air

2 = by hand

Fertilization

1 = "Osmocote"

2 = soluble fertilizer

Table 11. Mean of root scores (characteristic) in different treatment of *Artocarpus lakoocha* Roxb. data were analyzed by Chi-square test.

treatment	root pruning	container	fertilizer	number	mean	Standard deviation	Chi-square	Degree of Freedom	Sig	
T1	by air	root trainer	osmocote	30	2.4	1.4527	7.8	2	0.0202	
T2			soluble	30	2.8667	1.33218	15.333	3	0.0016	
T3		2.5 x 9 in	osmocote	30	2.8333	0.91287	28.333	4	0	
T4			soluble	30	2.8	0.76112	20.667	3	0.0001	
T5		3 x 7 in.	osmocote	30	3.3	1.08755	29.2	5	0	
T6			soluble	30	3.2333	1.19434	23.2	5	0.0003	
T7		root trainer	osmocote	30	2.7333	1.41259	17.467	3	0.0006	
T8			soluble	30	2.6667	1.49328	12.6	2	0.0018	
T9		by hand	2.5 x 9 in	osmocote	30	2.6667	0.88409	23.867	3	0
T10				soluble	30	3.2333	1.04	69.6	5	0
T11			3 x 7 in.	osmocote	30	3.733	1.65952	4.4	5	0.4934
T12				soluble	30	3.8333	1.46413	4.33	4	0.3628

Table 12. Mean of root scores (characteristic) in different treatment of *Balakata baccata* (Roxb.) Ess. data were analyzed by Chi-square test.

Treatment	Root pruning	Container	Fertilizer	Number	Mean	Standard deviation	Chi-square	Degree of Freedom	Sig
T1		root trainer	osmocote	13	2.76923	1.01274	0.6923	1	0.4054
T2			soluble	11	2.36364	1.43337	4.6364	3	0.2004
T3	by air	2.5 x 9 in	osmocote	21	2.57143	0.50709	0.4286	1	0.5127
T4			soluble	21	2.80952	0.87287	10.2857	2	0.0058
T5		3 x 7 in.	osmocote	21	2.19048	0.98077	29.4762	3	0
T6			soluble	19	2.31579	0.47757	2.5789	1	0.1083
T7		root trainer	osmocote	21	2.61905	1.07127	25.9048	4	0
T8			soluble	21	3.28571	1.00712	16.9048	3	0.0007
T9	by hand	2.5 x 9 in	osmocote	21	2.38095	0.86465	6.2381	3	0.1006
T10			soluble	21	2.71429	0.56061	10.2857	2	0.0058
T11		3 x 7 in.	osmocote	18	2.27778	0.57451	8.333	2	0.0155
T12			soluble	19	2.21053	0.41885	6.3684	1	0.0116

Table 13. Mean of root scores (characteristic) in different treatment of *Horsfieldia thorelii* Lac. data were analyzed by Chi-square test.

treatment	root pruning	container	fertilizer	number	mean	Standard deviation	Chi-square	Degree of Freedom	Sig
T1		root trainer	osmocote	30	1.333	0.5467	20.6	2	0
T2			soluble	30	1.4	0.6146	16.8	2	0.0002
T3	by air	2.5 x 9 in	osmocote	30	2.033	0.96431	6	3	0.116
T4			soluble	30	1.8	0.71438	4.2	2	0.1225
T5		3 x 7 in.	osmocote	30	2.667	0.99424	13.467	3	0.0037
T6			soluble	30	2.033	0.96431	6	3	0.116
T7		root trainer	osmocote	30	1.667	0.7581	5	2	0.0821
T8			soluble	30	1.533	0.57135	12.2	2	0.0022
T9	by hand	2.5 x 9 in	osmocote	30	2.033	0.80872	17.733	3	0.0005
T10			soluble	30	2.233	1.19434	3.33	3	0.343
T11		3 x 7 in.	osmocote	30	3.533	0.68145	13.4	2	0.0012
T12			soluble	30	2.933	1.31131	18.533	3	0.0003

Table 14. Seedling Quality Index (SQI) of *Artocarpus lakoocha* Roxb.

Treatment	Root pruning	Container	Fertilizer	Standardised value					SQI
				Height	Diameter	Root dry weight	Shoot/root	Root degree	
T1		REX trays	osmocote	0.849	0.766	0.397	0.806	1.000	0.208
T2			soluble	0.716	0.770	0.448	0.773	0.837	0.160
T3	by air	2.5 x 9 in	osmocote	0.734	0.840	0.546	0.596	0.847	0.170
T4			soluble	0.849	0.870	0.512	0.601	0.857	0.195
T5		3 x 7 in.	osmocote	0.911	1.000	0.781	0.591	0.727	0.306
T6			soluble	0.685	0.917	0.611	0.645	0.742	0.184
T7		REX trays	osmocote	0.823	0.810	0.544	1.000	0.878	0.318
T8			soluble	0.765	0.783	0.430	0.806	0.900	0.187
T9	by hand	2.5 x 9 in	osmocote	0.781	0.940	0.469	0.562	0.900	0.174
T10			soluble	0.697	0.756	0.529	0.962	0.742	0.199
T11		3 x 7 in.	osmocote	1.000	0.891	1.000	0.615	0.643	0.352
T12			soluble	0.884	0.972	0.801	0.770	0.626	0.332

Table 15. Seedling Quality Index (SQI) of *Balakata baccata* (Roxb.) Ess.

Treatment	Root pruning	Container	Fertilizer	Standardised value					SQI
				Height	Diameter	Root dry weight	Shoot/root	Root degree	
T1		REX trays	osmocote	0.621	0.758	0.456	1.000	0.791	0.169
T2			soluble	0.568	0.791	0.541	0.780	0.927	0.176
T3	by air	2.5 x 9 in	osmocote	0.840	0.848	0.548	0.398	0.852	0.132
T4			soluble	0.917	1.000	1.000	0.344	0.780	0.246
T5		3 x 7 in.	osmocote	0.755	0.742	0.354	0.343	1.000	0.068
T6			soluble	0.780	0.833	0.504	0.431	0.946	0.134
T7		REX trays	osmocote	0.873	0.773	0.391	0.372	0.836	0.082
T8			soluble	0.735	0.864	0.481	0.577	0.667	0.118
T9	by hand	2.5 x 9 in	osmocote	0.949	0.833	0.497	0.365	0.920	0.132
T10			soluble	1.000	1.000	0.943	0.494	0.807	0.376
T11		3 x 7 in.	osmocote	0.800	0.833	0.628	0.400	0.962	0.161
T12			soluble	0.859	0.864	0.610	0.489	0.991	0.219

Table 16. Seedling Quality Index (SQI) of *Horsfieldia thorelii* Lec.

Treatment	Root pruning	Container	Fertilizer	Standardised value					SQI
				Height	Diameter	Root dry weight	Shoot/root	Root degree	
T1		REX trays	osmocote	0.742	0.908	1.000	0.710	1.000	0.479
T2			soluble	0.738	0.878	0.782	0.900	0.952	0.434
T3	by air	2.5 x 9 in	osmocote	0.828	0.882	0.934	0.760	0.656	0.340
T4			soluble	0.775	0.952	0.808	0.880	0.741	0.389
T5		3 x 7 in.	osmocote	0.882	1.000	0.777	0.910	0.500	0.312
T6			soluble	0.878	0.958	0.765	0.660	0.656	0.279
T7		REX trays	osmocote	0.812	0.817	0.860	0.820	0.667	0.312
T8			soluble	0.657	0.871	0.704	1.000	0.870	0.350
T9	by hand	2.5 x 9 in	osmocote	0.832	0.784	0.832	0.850	0.656	0.302
T10			soluble	0.847	0.814	0.709	0.990	0.597	0.289
T11		3 x 7 in.	osmocote	1.000	0.904	0.746	0.940	0.377	0.239
T12			soluble	0.770	0.810	0.759	0.930	0.455	0.200

Table 17. Total Seedling Quality Index (SQI) for these three species.

Treatment	Root pruning	Container	Fertilizer	Standardised value					SQI
				Height	Diameter	Root dry weight	Shoot/root	Root score	
T1		REX trays	osmocote	0.690	0.881	0.466	0.813	1.000	0.230
T2			soluble	0.746	0.883	0.548	0.886	0.884	0.283
T3	by air	2.5 x 9 in	osmocote	0.868	0.913	0.719	0.761	0.892	0.387
T4			soluble	0.889	0.996	0.822	0.709	0.880	0.454
T5		3 x 7 in.	osmocote	0.908	1.000	0.883	0.879	0.819	0.577
T6			soluble	0.829	0.969	0.849	0.864	0.818	0.483
T7		REX trays	osmocote	0.878	0.866	0.600	1.000	0.905	0.413
T8			soluble	0.776	0.890	0.604	0.997	0.872	0.362
T9	by hand	2.5 x 9 in	osmocote	0.940	0.871	0.692	0.797	0.916	0.413
T10			soluble	0.948	0.910	0.827	0.815	0.796	0.462
T11		3 x 7 in.	osmocote	1.000	0.970	1.000	0.822	0.726	0.579
T12			soluble	0.861	0.930	0.783	0.903	0.716	0.405

Table 18. Benefit value (Seedling Quality Index (SQI)/Cost) of *Artocarpus lakoocha*, *Balakata baccata* and *Horsfieldia thorelii*.

Treatment	Cost	<i>Artocarpus lakoocha</i>		<i>Balakata baccakata</i>		<i>Horsfieldia thorelii</i>		Total	
		SQI	benefit value	SQI	benefit value	SQI	benefit value	SQI	benefit value
T1	1.1059	0.208	0.188	0.060	0.054	0.479	0.433	0.230	0.208
T2	0.9873	0.160	0.162	0.103	0.104	0.434	0.440	0.283	0.286
T3	1.2354	0.170	0.138	0.268	0.217	0.340	0.275	0.387	0.313
T4	1.1168	0.195	0.175	0.460	0.411	0.389	0.348	0.454	0.407
T5	1.3854	0.306	0.221	0.198	0.143	0.312	0.225	0.577	0.416
T6	1.2668	0.184	0.145	0.256	0.202	0.279	0.220	0.483	0.381
T7	0.7809	0.318	0.408	0.192	0.246	0.312	0.399	0.413	0.529
T8	0.6623	0.187	0.282	0.125	0.189	0.350	0.529	0.362	0.547
T9	1.0974	0.174	0.159	0.343	0.312	0.302	0.276	0.413	0.377
T10	0.9788	0.199	0.203	0.548	0.560	0.289	0.295	0.462	0.472
T11	1.1424	0.352	0.308	0.358	0.313	0.239	0.209	0.579	0.506
T12	1.0238	0.332	0.324	0.286	0.279	0.200	0.195	0.405	0.396