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Experimental Planting of Open-Rooted Seedlings in Same Lowlands

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Silviculture Section

Kilimanjaro Village Forestry Project

1. Introduction

There are two popular ways to raise tree seedlings. Potted seedlings are raised in polythene tubes. Polythene tubes are commonly used in semi-arid areas. The Kilimanjaro Village Forestry Project (KVFP) has also used them to plant in demonstration and experimental plots in Mkonga site, and provided them to villagers in Same district for their own tree planting activities. Another type of seedlings, open-rooted seedlings are raised directly on nursery beds without any tubes/pots. Soil is removed from their roots before they are transported from nurseries to plantation sites (Yamate, 1993).

In Tanzania, there seems to be no documented experience on raising open-rooted seedlings in semi-arid areas like Mkonga site. Generally, the silvicultural methods to use open-rooted seedlings are employed in more humid areas to establish soft wood plantations such as cypresses and pines. However, according to Weber and Stoney (1986), both open-rooted seedlings and potted seedlings have advantages and disadvantages in semi-arid areas.

Table 1: Advantages and disadvantages of open-rooted seedlings

Advantages	Disadvantages
1) Seedlings are lighter and can be easily transported from nurseries to plantation sites.	1) Raising open-rooted seedlings require larger space compared to raising potted seedlings.
2) Production of open-rooted seedlings does not require pots and pot-filling process, therefore they are usually cheaper to raise.	2) Open-rooted seedlings need longer period to raise.
3) Open-rooted seedlings are normally bigger and require less tending, therefore they are cheaper to tend.	3) Nurseries need a large amount of good soil.
	4) It may be possible that their roots are easily damaged due to exposure to the air during the transportation to planting sites.

Table 2: Advantages and disadvantages of potted seedlings

Advantages	Disadvantages
1) Nursery beds do not require additional soil. 2) Seedlings can be placed closer to each other thus require less space. 3) Seedlings require shorter period to reach to plantable sizes. 4) Seedlings can be easily handled and transported without exposing their hair roots to the air.	1) Seedlings require frequent root pruning. 2) It is difficult to transport many seedlings at once because they are heavier and cannot be piled. 3) It incurs additional costs to purchase and fill pots. 4) When planted, seedlings are normally smaller and require extra tending period.

Among the advantages of open-rooted seedlings mentioned above, particularly requiring less cost or less labour force is beneficial to farmers since ordinary farmers can seldom divert resources from producing immediate needs for food and income to tree planting (Arnold, 1984). The KVFP had, therefore, established an experimental plot to find out a possibility of tree-growing by using open-rooted seedlings in semi-arid areas. The results of the experiment are reported here.

2. Methodology

This experiment of open-rooted seedlings was carried out as a preliminary trial to find out a possibility of tree-growing by using open-rooted seedlings in dry areas like Mkonga site. Since it was a preliminary trial the KVFP needs to avoid spending extra costs. For this reason, the open-rooted seedlings used in this experiment were the ones raised as potted seedlings, from which pots and soil were removed before transported from the nursery to the plantation site.

The design and assessment method of the experiment were as follows:

1) A total of 16 species, *Grevillea robsta, Acacia polyacantha, Albizia anthelmintica, Cassia siamea, Dalbergia melanoxylon, Delonix regia, Faidherbia albida, Leucaena leucocephala, Parkinsonia aculeata, Peltophorum pterocarpum, Pithecelobium dulce, Tamarindus indica, Azadirachta indica, Melia azedarach, Eucalyptus saligna* and *Vitex keniensis* were tested. 150 seedlings of each species were planted except three species which had only 100 seedlings each due to the limited stock availability at that time. A total of 2,250 seedlings were planted (Table 3).

Table 3: Species and quantity of experimental planting

	Species	Quantity		
		Number of seedlings in each compartment	Number of compartments	Total number of seedlings
1	*F. albida*	50	3	150
2	*L. leucocephala*	50	3	150
3	*A. polyacantha*	50	3	150
4	*P. aculeata*	50	3	150
5	*T. indica*	50	3	150
6	*V. keniensis*	50	3	150
7	*P. dulce*	50	3	150
8	*C. siamea*	50	3	150
9	*M. azedarach*	50	3	150
10	*P. pterocarpum*	50	3	150
11	*G. robsta*	50	3	150
12	*A. anthelmintica*	50	2	100
13	*E. saligna*	50	3	150
14	*D. melanoxylon*	50	2	100
15	*D. regia*	50	2	100
16	*A. indica*	50	3	150
Total		800	45	2,250

2) The experimental plot was divided into three blocks. Each block contained 15 compartments to which each 15 species was allocated. In each compartment, 50 seedlings had been planted. Compartments were laid out at random and duplicated two to three times (Figure 1).

Figure 1: Design of the experimental plot

Block I			Block II			Block III		
7	11	16	6	4	3	8	9	5
1	8	9	12	15	13	10	4	7
10	15	4	2	7	9	6	14	11
13	12	3	11	14	10	1	2	16
14	2	5	1	16	8	15	12	13

Each compartment has 50 seedlings planted in 10 lines x 5 rows.

Species
1 *G. robusta*
2 *A. polyacantha*
3 *A. anthelmintica*
4 *C. siamea*
5 *D. melanoxylon*
6 *D. regia*
7 *F. albida*
8 *L. leucocephala*
9 *P. aculeata*
10 *P. pterocarpum*
11 *P. dulce*
12 *T. indica*
13 *A. indica*
14 *M. azedarach*
15 *E. saligna*
16 *V. keniensis*

3) The experimental plot was established in late November 1993 and trees were watered regularly during the following dry season.

4) The experimental plot had been abandoned after the last survival assessment because its aim had been accomplished.

3. Result

Only one month after they were planted, seedlings of five species, *F. albida*, *L. leucocephala*, *A. polyacantha*, *T. indica* and *M. azedarach* had died out almost completely. By the beginning of the long rain season in 1994, three months after they were planted, there were only four species, *P. dulce*, *P. pterocarpum*, *G. robusta* and *D. regia* which showed 10 % or higher survival rates, in spite of that the long rain season in 1994 recorded the highest rainfall during last four years (see Annex 1 for rainfall data). Eventually most seedlings of all species had died by the last assessment on 28th July 1994, just after the long rain season.

It is interesting that the seedlings of *A. indica*, *A. polyacantha* and *T. indica*, which are now widely planted in Mkonga site and showing good performance, had completely died before the beginning of the long rain season. On the other hand, *G. robusta* which is normally planted in semi-humid areas, had shown better survival than most of other species. However, only by the result of this experiment, it is difficult to find out what had caused these differences.

Table 4: Results of the Experimental planting of open-rooted seedlings

Date of planted : late November 1993

	Species	number of seedlings planted	number of seedlings survived							
			1993 21-Dec	1994 21-Jan	25-Feb	22-Mar	22-Apr	19-May	28-Jun	28-Jul
1	*F. albida*	150	0							
2	*L. leucocephala*	150	1	1	1	0				
3	*A. polyacantha*	150	1	0						
4	*P. aculeata*	150	24	3	1	1	0			
5	*T. indica*	150	0							
6	*V. keniensis*	150	148	4	3	1	0			
7	*P. dulce*	150	143	96	68	35	6	2	2	1
8	*C. siamea*	150	131	7	6	3	1	1	1	1
9	*M. azedarach*	150	1	0						
10	*P. pterocarpum*	150	150	101	72	26	1	1	0	
11	*G. robusta*	150	149	38	22	6	3	2	2	2
12	*A. anthelmintica*	100	97	19	2	2	2	2	2	2
13	*E. saligna*	150	74	0						
14	*D. melanoxylon*	100	98	11	9	8	4	2	2	2
15	*D. regia*	100	97	64	36	12	2	1	0	
16	*A. indica*	150	70	1	0					
	Total	2,250	1,184	345	220	94	19	11	9	8

4. Conclusion

The result of this experiment, although it was preliminary, indicates that it is very difficult to grow trees from open-rooted seedlings in Mkonga site where only 200 to 400 mm rainfall (often less than 200 mm) can be expected in a year.

Open-rooted seedlings are not suitable for areas like Mkonga. According to Weber and Stoney (1986), however, most of *A. indica* trees are raised by using the open-rooted method in Africa. It is also used for raising *C. siamea*, *Khaya senegalensis*, *Sclerocarya birrea*, and some species of *Prosopis*. Therefore, it still might be possible for open-rooted seedlings to survive in some semi-arid areas of Same district, where site conditions are more preferable than ones in Mkonga site. There is also a report that people in Njoro village (a village located in semi-arid area) have successfully transplanted *C. siamea* wildlings, which are of course growing without pots. Therefore, it is still necessary to study, whether open-rooted seedlings can be used on farmer's plots, which usually have better environmental conditions compared to savannah bushlands.

5. References

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Annex 1: Rainfall in Mkonga site