KFRI Research Report No. 502 ISSN 0970- 8103

Seed handling in selected forest tree species and medicinal herbs of Kerala

(Final Report of the project: KFRI **RP-604/10**)

Dr. R.C.Pandalai
Kerala Forest Seed Centre

Kerala Forest Research Institute
(An Institution of Kerala State Council for Science, Technology and Environment)
Peechi - 680 653, Thrissur, Kerala, India

May 2015

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Acknowledgements

The author is thankful to Dr.J.K.Sharma, Dr.R.Gnanaharan, Dr.K.V.Sankaran, Dr.P.S.Easa former Directors and Dr. P. G. Latha, present Director- in- charge for their keen interest, encouragement and for providing all facilities for the implementation and completion of the project. The author wishes to profusely thank Mrs. Omalsree, Mr. Sutheesh, Project fellows, Mrs. Divya, Mrs .Jiji Technical assistants and other staff of Kerala Forest Seed Center for all their inputs without which the completion of the report would not have been possible. I am also thankful to all the field staff and officers of the Kerala Forest Department who helped and cooperated with us during the routine and periodic field visits for gathering the field data and seed collection. I also record my gratitude to Dr. K.C. Chacko, Dr. P. K. Chandrasekhara Pillai and Dr. V. B. Sreekumar for critically going through the manuscript and suggesting modifications.

ABSTRACT OF PROJECT PROPOSAL

1. Project No.	: KFRI 605/2010
2. Title of the project	: **Seed handling in selected forest tree species and medicinal herbs of Kerala**
3. Objectives	: 1. Study the phenology, standardize collection methods and carry out routine tests to assess seed quality. 2. Standardise pre-treatment protocol for seed and evolve methods for optimum seed germination. 3. To study the storage physiology of seeds and arrive at the best storage methods.
4. Date of Commencement	: 1st October 2011
5. Scheduled date of Completion	: 31st March 2014
6. Funding agency and Total amount of Grant sanctioned	: Plan funds, Rs. 20,66,039/-
7. Principal Investigator	: Dr. R.C. Pandalai

Summary

The phenological observations on 14 forest tree species in different parts of kerala reveled that in majority of them the seed maturity(Both orthodox and recalcitrant) and the best seed collection period is from February to May. Flowering and fruiting in different species of selected tree species varied widely. In *Acacia concinna, Ailanthus triphysa, Delonix regia* and *Neolamarkia cadamba* there was only a single flowering and fruiting episode in an year while two peak periods of flowering and fruiting was common in *Cassia fistula* and *Dalbergia latifolia*. Though two peak periods of flowering was noted in *Acacia auriculiformis* , fruiting was observed only once in an year. In *Embelia ribes,* late flowering was observed during May while profuse fruiting was during the following August. *Azadirachta indica* started flowering in March and profuse fruit production is in May and June. In *Oroxylum indicum* flowering started in April and peak fruiting was in February. In *Acacia mangium, Eucalyptus grandis* and *Wrightia tinctoria* peak flowering period was once in a year. However fruiting in all these species occurred twice in a year.

Out of the 60 identified seed sources for tree species in Kerala, only 29 produced good quality seeds with above 50 % germination.

The recalcitrant seeds (*Dysoxylum malabaricum, Syzigium cumini etc.)* had maximum germination when processed within 3 days after collection. Seeds with pulpy seed coats (Gmelina arborea, Melia dubia, Azadirachta indica etc.) are to be depulped by keeping them in cold water for 24 - 48 hours. The seeds were then washed with fresh water and cleaned prior to use in the nursery. However, *Magnolia champaca* seeds after soaking the seeds in cold water for 24 hours, were treated with 0.05% Giberilic acid for 24 hours for enhanced germination up to 80 %.

Majority of the orthodox seeds responds well to pre sowing/ presoaking in cold water t. Whereas Acacia species responded well to hot water treatments.

1. Introduction

Kerala Forest Seed Centre (KFSC) established during 2003 at the campus of Kerala Forest Research Institute (KFRI) in collaboration with the Kerala Forest Department (KFD) is identified for the supply of quality tested superior seeds to KFD for their plantation programmes. While KFD was concentrating on teak for raising plantations, the Social Forestry wing of KFD was interested in a number of miscellaneous forest tree species including medicinal plants, and therefore their demands varied. Accordingly KFSC had identified the seed sources of a number of tree species from which the seed collection and testing was systematically carried out at KFSC.

The present study was mainly intended to standardize the practices to be followed in handling the seeds of a few tree species including teak which are in great demand from KFD, KFSC and other private organizations, entrepreneurs and farmers. The specific objectives of the project were as follows.

1. Study the phenology, standardize collection methods and carry out routine tests to assess seed quality.
2. Standardise pre-treatment protocol for seed and evolve methods for optimum seed germination.
3. To study the storage physiology of seeds and arrive at the best storage methods.

2. Materials and methods

2.1. Phenological observations and seed collection

Phenological studies on selected species were carried out by periodic visits to the seed sources identified both from forest and non-forest areas and homesteads in the state of Kerala. The seeds were collected either after the seed fall from the ground or from the tree when they showed indications of seed ripening. Whenever seeds were collected from the tree either the seed bearing branches were lopped down without causing damage to the parent tree or by shaking the branches so as to allow the ripe seeds to fall down and later handpicked from the ground. Long poles were also used for seed collection depending on the tree size and terrain.

Soon after collection, the seeds were pre cleaned from the field itself by removing the bits and pieces of leaves, bark, twigs and other removable impurities so as to reduce the bulk prior to transportation. Transportation to KFSC was done in a minimum possible time to avoid excess desiccation.

Once the seeds reached Kerala Forest Seed Centre (KFSC) after recording the morphological features and assessing the seed weight a series of routine tests were carried out as prescribed in the seed manual of KFSC (Pandalai and Chacko, 2012).

Test samples were drawn after thoroughly mixing the seed lots. The seed lots were then made in to four sets, containing 100 seeds each. The seeds were then cut open using the seed cutter available at KFSC and visual assessments on the embryo/endosperm colour, seed filling and infections if any were noted.

In order to confirm the viability of seeds, another set of seed samples were soaked in water overnight. The seed coat were then removed and the cotyledons with embryo kept immersed in freshly prepared solution of 2, 3, 5 Tri-phenyl Tetrazolium Chloride for 4 to 12 hours at room temperature away from light, preferably in a dark chamber. (One gram of 2, 3, 5 Tri-phenyl Tetrazolium Chloride was dissolved in one liter of distilled water and was taken in an amber coloured bottle as the solution was highly light sensitive and was kept in darkness to avoid any

possible light penetration.) The cotyledons with embryo were examined for the reddish pink staining of the live tissues thus confirming the viability of the seeds.

2.2. Germination test

Four sets of 100 seeds each were used for the germination test. The details of the germination test was recorded as specified in KFSC manual. The seeds were sown in plastic trays filled with vermiculite. Daily germination count was taken from the second day of sowing in Form, S4. Once the germination was completed as evidenced by no further germinations from any of the trays, the count on number of ungerminated seeds were also noted. The probable reason for seeds not germinating was also recorded.

2.3. Pre-sowing treatments

Seeds of some species showed dormant conditions and required specific pre-treatments for enhanced germination. The mechanical dormancy exhibited by some of the seeds due to thick seed coat was overcome by either nicking or piercing a portion of the seed with a sharp needle.

Another common treatment employed for certain seeds were soaking in hot(*Acacia mangium*) or normal cold water (*Swietenia macrophylla*) for 12 to 48 hours depending on the species. In hot water treatment the seeds were kept in cloth bags and dipped in hot water for a few seconds prior to boiling of water (about 80° C). The seeds were then transferred to cold water and left over night.

Sulphuric acid (98%) was also used for pre treating seeds of a few species (*Cassia fistula, Adenanthera pavonina*)which had very thick seed coat. Seeds were taken in a clean beaker and concentrated sulphuric acid was added very slowly through the sides during which the seeds were gently stirred continuously. When the seed coat turned greyish black in colour water was added to dilute the acid. The seeds were then taken out of water and washed several times in water so that no tinch of the acid remained on the seeds. The seeds were soaked in cold water overnight.

A growth hormone was also tried for enhancing the germination of seeds in certain species (*Santalum album*). Seeds were soaked overnight in 0.05% of Gibberilic acid (GA_3) solution kept

in a beaker. After the treatment the seeds were washed repeatedly in water. Seeds (*Gmelina arborea, Melia dubia, Azadirachta indica* etc.) with pulpy seed coats (mostly recalcitrant) were depulped in water by keeping the fresh clean seeds in cold water for 24 to 48 hours. The seeds were then cleaned by repeated washings with fresh water and were shade dried. The seeds were directly used in the nursery or were covered with moist clean saw dust for storage for 5 to 7 days.

2.4. Storage

Clean seeds were stored either in the ambient condition (Room temperature) or in the cold storage facility (4^0 C and 16^0 C) at KFSC. In ambient storage (usually for short duration storage up to one year) the seeds were either kept in clean gunny bags or in plastic bins specially made for the purpose with air tight lids. The seeds were stored in such a way that they were in a clean, dry and well ventilated place away from moisture.

For long duration storage (more than an year) seeds were kept in cold storages. Out of the two cold rooms one was maintained at 4 degree celsius and another at 16 degree celsius. In both the rooms a relative humidity of 45 % was maintained. In addition to this, seeds of *Gluta travacorica* and *Vateria indica* were stored in a deep freezer maintained at 20^0 C for a very short duration.

3. Results

3.1. Flowering and fruiting

Flowering and fruiting phenology was recorded in fourteen species. (Table, 1). Out of the fourteen species, majority showed flowering and fruiting during the summer months from February to June. Peak period in flowering and fruiting varied in different species. A single peak period of flowering and fruiting was observed in Acacia *concinna* (August/may) *Ailanthus triphysa* (November/February) *Delonix regia* (March/March) and *Neolamarkia cadamba* (May/December) respectively.

Two peak periods of flowering were observed in *Cassia fistula* (March/April) and *Dalbergia latifolia* (April/May). Similarly in both the species fruiting was also observed twice in an year (March/April) in *Cassia fistula* and (February/March) in *Dalbergia latifolia.*

Though two peak periods (June/July) of flowering was noted in *Acacia auriculiformis,* profuse fruiting was noted only once in an year in March. In *Embelia ribes* late flowering was observed during May while profuse fruiting was noted during August. *Azadirachta indica* had an early flowering in March followed by profuse fruit production in May and June. Similarly in *Oroxylum indicum* early flowering in April was followed by peak fruiting in February.

In *Acacia mangium, Eucalyptus grandis* and *Wrightia tinctoria* peak flowering period was during the month of June, May and September respectively. However fruiting in all these species were twice in a year *ie:* March/May; July/November for the first two species and February/March in *Eucalyptus grandis* and *Wrightia tinctoria.*

Caryota urens being a semelparous species characterized by a single, massive,fatal reproductive episode exhibited profuse flowering an fruiting during the month of September.

The variation in season of flowering and fruiting observed in certain species however did not affect seed germination considerably.

Table.1. Phenology of selected forest tree species

	Species		Jan			Feb			Mar			Apr			May			Jun			Jul			Aug			Sep			Oct			Nov			Dec		
			E	P	L	E	P	L	E	P	L	E	P	L	E	P	L	E	P	L	E	P	L	E	P	L	E	P	L	E	P	L	E	P	L	E	P	L
1	*Acacia auriculiformis*	FL																	*			*																
		FR								*																												
2	*Acacia concinna*	FL																							*													
		FR				*										*																						
3	*Acacia mangium*	FL																	*																			
		FR	*							*						*																						
4	*Ailanthus triphysa*	FL						*																										*				
		FR	*				*										*																					
5	*Azadirachta indica*	FL							*								*																					
		FR														*			*							*												
6	*Cassia fistula*	FL								*			*																									
		FR	*							*			*																								*	
7	*Caryota urens*	FL																									*											
		FR																			*																	
8	*Dalbergia latifolia*	FL											*			*																						
		FR					*			*																												
9	*Delonix regia*	FL								*																												
		FR			*					*																								*				
10	*Embelia ribes*	FL															*																					
		FR																*							*													
11	*Eucalyptus grandis*	FL														*																						
		FR					*			*																												
12	*Neolamarkia cadamba*	FL														*																						
		FR																									*						*				*	
13	*Oroxylum indicum*	FL										*																										
		FR					*																														*	
14	*Wrightia tinctoria*	FL																									*											*
		FR					*			*										*																		

FL: Flowering. FR: Fruiting. E – Early, P – Peak, L - late

3.2. Seed sources

Sixty seed sources were identified for 15 selected species of forest trees from forest areas of Kerala and is given in Table 2 along with the month for seed collection. Out of the 60 seed sources only 29 were productive and economical for seed collection with seeds of higher germination percentage of more than 50%. As observed in phenological studies, germination percent of seeds collected during the summer months gave better results. Selected seed sources were maintained through proper labeling and periodic monthly monitoring. The appropriate seed collection period was also determined through the germination studies. (Table 2). Seed germination of seeds collected at different periods from different sources were also studied.

Table.2. Seed source and month of seed collection in selected forest tree species

Sl No	Species	Source	ger %	Period of seed collection							
				Jan	Feb	Mar	Apr	May	Sep	Nov	Dec
1	*Acacia auriculiformis*	Nilambur	64		*						
2	*Acacia mangium*	Nilambur	76	*							
		Kottappara	67			*					
		Kulathupuzha	70			*					
3	*Ailanthus triphysa*	Peechi	55			*					
		Walayar	65		*						
		Alathur	81		*						
4	*Bambusa bambos*	Pulpally	76				*				
		Muthanga	81					*			
		Manathavadi	70					*			
		Thekkadi	93				*				
5	*Caesalpinia sappan*	Peechi	61		*						
		Mettupalayam	60							*	
		Thrissur	61	*							
6	*Eucalyptus grandis*	Munnar	58		*						
		Muthanga	81		*						
7	*Neolamarkia cadamba*	Kulathupuzha	80					*			
		Palakkad	63								*
8	*Pongamia pinnata*	Kanjikkod	83		*						
		Walayar	59		*						
		Nilambur	57		*						
		Marayoor	70								*

Sl No	Species	Source	ger %	Period of seed collection							
				Jan	Feb	Mar	Apr	May	Sep	Nov	Dec
9	*Pterocarpus marsupium*	Marayoor	80		*						
10	*Swietenia macrophylla*	Palakkad	64		*						
		Valluvassery	87		*						
		Aryankavu	82	*							
11	*Terminalia bellirica*	KFRI Campus	58	*							
12	*Wrightia tinctoria*	Peechi	68	*							
		Walayar	82	*							

*Optimum period for seed collection

Pretreatment and storage of seeds

Pretreatment, storage physiology and storage temperatures of seeds of 31 forest tree species were studied during the reporting period and is given in Table, 3 & 4. Out of the 31 species, seeds of *Calophyllum calaba, Careya arborea, Diospyros discolor, Embelia ribes, Magnolia champaca, Sterculia guttata, Sterculia villosa, Trewia nudiflora and Vateria indica* belonged to the recalcitrant group and no foolproof method for storage could be arrived at Table 3.

The recalcitrant seeds gave maximum germination when processed quickly when the seeds were still fresh. In case the stored seeds were used, the germination percent went down and hence it is suggested to use the fresh seeds soon after collection for nursery purpose. In *Magnolia champaca* after soaking the seeds in cold water for 24 hours, the seeds were treated with 0.05% Giberilic acid for another 24 hours and then the seeds showed an enhanced germination of 80%.

Table.3. Common pre-treatments and storage temperatures for selected recalcitrant seeds

SI	Botanical Name	Local Name	Pre-treatment	Storage temperature	Germination Period	Ger. (%)
1	*Diospyros discolor*	Velvet apple	Cold water soaking for 24 hours	4^0C	15-30	90
2	*Embelia ribes*	Vizhal	Soak the seeds in Cow dung slurry /GA3 0.05% for 24 hours	4^0C	38-72	84
3	*Sterculia guttata*	Theethondi	Not required	4^0C	7-53	77

SI	Botanical Name	Local Name	Pre-treatment	Storage temperature	Germination Period	Ger. (%)
4	*Sterculia villosa*	Anavakka	Not required	4^0C	10-30	70
5	*Spondias indica*	Ambazham	Clipping of seeds	16^0C	30-229	60
6	*Memecylon edule*	Kayamboo	Not necessary	20^0C	19-82	35
7	*Schleichera oleosa*	Poovam	Not required	20^0C	8-94	58
8	*Carreya arborea*	Pezhu	Not required	20^0C	11-46	90
9	*Trewia nudiflora*	Pambarakumbil	Soaking in cold water for 24 hrs	20^0C	25-240	60

Majority of the orthodox seeds (Table 4) responds well to the simple cold water treatment which involves soaking the seeds in normal cold clean water for 12 to 48 hours depending on the physiology of the species. However in certain Acacia species (*Acacia mangium, Acacia auriculiformis*) where cold water treatment did not work, seeds are tied as bundles in cotton bags and slowly dipped in to almost boiling (80° C) water. The duration for which the seeds are to be dipped in boiling water is species specific and is given in table, 4.

Table. 4. Common Pre-treatments and storage temperatures for orthodox seeds under study

SI No.	Botanical Name	Local Name	Pre-sowing treatment	Storage Temperature	Germination Period (days)	Ger. (%)
1	*Caesalpinia sappan*	Pathimugam	Hot water treatment for 1 minute followed by cold water soaking for 24 hours	Ambient	4 -7	80
2	*Caryota urens*	Anappana	Not required	Ambient	25-110	76
3	*Acacia concinna*	Shikkakai	Hot water treatment for 30 mts	16^0C	8-25	40
4	*Bauhinia racemosa*	Mantharam	Hot water treatment for 1 minute followed by cold water soaking for 24 hours	16^0C	4-10	90
5	*Bauhinia purpurea*	Mantharam	Cold water soaking for 24 hours	16^0C	9-30	50
6	*Bauhinia variegata*	Chuvanna Mantharam	Cold water soaking for 24 hours	16^0C	9-30	80

SI	Botanical Name	Local Name	Pre-sowing	Storage temperature	Germination Period	Ger. (%)
7	*Berrya javanica*	Berrya	Hot water treatment for 1 minute followed by cold water soaking for 24 hours	16^0C	12-40	68
8	*Butea monosperma*	Plash	De-winging	16^0C	8 – 14	70
9	*Cassia grandis*	Horse cassia	Scarify the seeds using H_2SO_4 for about 6 mnts & wash thoroughly with water before sowing	16^0C	6-70	45
10	*Cassia nodosa*	Pink cassia	Hot water treatment for 1 minute followed by cold water soaking for 24 hours	16^0C	3-28	20
11	*Cassia siamia*	Manjakonna	Cold water soaking for 24 hours	16^0C	10-56	67
12	*Enterolobium cyclocarpum*	Anacheviyan	Sulphuric acid scarification for about 6 mnts & repeated washes with water prior to sowing	16^0C	2-25	70
13	*Eucalyptus urophylla*	Urophylla	Not required	16^0C	2-20	95
14	*Garcinia gummi-gutta*	Kudampuli	Removal of seed coat	16^0C	25-90	70
15	*Holostemma ada-kodien*	Adapathiyan	Not required	16^0C	6-20	93
16	*Indigofera tinctorea*	Neela amari	Not required	16^0C	3-50	35
17	*Leucaena leucocephala*	Subabul	Hot water treatment for 1 minute followed by cold water soaking for 24 hours	16^0C	7-60	30
18	*Oroxylum indicum*	Palakapayyani	Not required	16^0C	7-30	95
19	*Phyllanthus indo-fischeri*	Nelli	Not required	16^0C	24-50	40
20	*Radermachera xylocarpa*	Vedamkorana	Soak the seeds in cold water for 24 hours	16^0C	7-30	21
21	*Schleichera oleosa*	Poovam	Not required	20^0C	8-94	58

Fig.1. Seed storage in ambient condition

Fig.2. Seed storage in cold room

3.4. Supply of seeds to the Kerala Forest Department

It was one of mandate of the project to collect, process, test and distribute seeds of forest tree species and medicinal herbs along with teak to Kerala Forest Department as and when there was demand from them. The details of seeds collected (kg), processed (kg) and supplied (kg) during the project period are presented in Appendix I, II and III.

4. References

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Appendix I

Details of Teak seeds collected by Kerala Forest Department and processed at KFSC during 2010-2013

SI NO	Name of TSPA	Area (ha)	2010			2011			2012			2013		
			BG (Kg)	AG (Kg)	Ger %	BG (Kg)	AG (Kg)	Ger %	BG (Kg)	AG (Kg)	Ger %	BG (Kg)	AG (Kg)	Ger %
I	**KULATHUPUZHA RESEARCH RANDE**													
1	1968 TP Palaruvi	13.96	-	-	-	-	-	-	-	-	-	755.66	607.40	14
2	1970 TP Palaruvi	9.80	-	-	-	-	-	-	-	-	-	544.78	461.10	13
3	1981 TP Thalappara	13.50	-	-	-	-	-	-	-	-	-	341.70	287.40	12
											TOTAL	**1642.14**	**1355.90**	
II	**MANANTHAWADY RESEARCH RANGE**													
1	1898 TP Alathur RF	-	27.00	23.00	33	-	-	-	-	-	-	-	-	-
2	1934 TP Alathur RF	-	62.00	58.00	32	-	-	-	-	-	-	-	-	-
3	1939 Thetturoad	16.50	55.00	48.00	7	-	-	-	-	-	-	-	-	-
4	1960 TP Begur RF	-	31.00	26.00	37	-	-	-	-	-	-	-	-	-
5	1961 TP Begur RF	-	28.00	24.00	37	-	-	-	-	-	-	-	-	-
6	1966 TP Alathur RF	-	56.00	51.00	27	-	-	-	-	-	-	-	-	-
7	1969 TP Alathur RF	-	47.00	42.50	37	-	-	-	-	-	-	-	-	-
8	1970 TP Begur RF	-	75.00	66.50	32	-	-	-	-	-	-	-	-	-
9	1974 TP Alathur RF	-	62.00	58.00	28	-	-	-	-	-	-	-	-	-
10	1976 TP Mathamangalam	41.20	-	-	-	-	-	-	-	-	-	3068.40	2706.00	27
11	1977 TP Alathur RF	-	50.00	45.20	39	-	-	-	-	-	-	-	-	-
12	1977 TP Mathamangalam	36.70	-	-	-	-	-	-	-	-	-	3210.12	2783.00	25
13	1978 TP Cheeyambam	50.40	-	-	-	-	-	-	1798.76	1349.00	22	2738.66	2375.00	28
14	1981 TP Begur	67.50	-	-	-	-	-	-	870.940	635.00	26			
15	1981 TP Changabam	60.50	-	-	-	-	-	-	-	-	-	3474.70	3022.10	40
16	1981TP Alathur Bit I,II	822.08	-	-	-	-	-	-	2475.00	1811.00	39			
TOTAL		-	**493.00**	**442.70**					**5144.70**	**3795.00**		**12,491.88**	**10,886.10**	

BG- Before grading, AG- After grading, Ger %- Germination Percentage

Teak seeds collected by Kerala Forest Department and processed at KFSC during 2010-2013 contd...

SI NO	Name of TSPA	Area (ha)	2010			2011			2012			2013		
			BG (Kg)	AG (Kg)	Ger %	BG (Kg)	AG (Kg)	Ger %	BG (Kg)	AG (Kg)	Ger %	BG (Kg)	AG (Kg)	Ger %
III	**NILAMBUR RESEARCH RANGE**													
1	1961 TSPA Sankarankode	79.57	-	-	-	-	-	-	2231.48	1695.20	35	2027.76	1668.60	24
2	1970TSPA Nedunkayam	55.40	-	-	-	-	-	-	1908.26	1486.50	34	822.740	709.70	23
3	1970 TSPA Poolakappara	43.80	-	-	-	-	-	-	1711.14	1368.50	31.7	797.14	693.00	21
4	1973 TSPA Nedunkayam	65.00	-	-	-	-	-	-	1847.42	1413.50	34	1302.16	1097.38	32
5	1974 TSPA Kariammuriam	51.43	-	-	-	-	-	-	-	-	-	1061.56	921.00	12
TOTAL									**7698.30**	**5963.7**		**6011.360**	**5089.68**	
IV	**OLAVAKKODE RESEARCH RANGE**													
	1971 TSPA Elival	41.84	-	-	-	-	-	-	256.200	196.00	13	565.520	502.000	4
TOTAL									**256.200**	**196.00**		**565.520**	**502.000**	
V	**PEERUMEDU RESEARCH RANGE**													
1	1967 TSPA Padayanippara	27.39	-	-	-	-	-	-	-	-	-	313.140	222.600	6
2	1983 TSPA Adukuzhi	30.00	-	-	-	-	-	-	-	-	-	373.260	260.00	6
TOTAL												**686.400**	**482.600**	

BG- Before grading, AG- After grading, Ger %- Germination Percentage

Appendix II

Miscellaneous seeds collected and distributed from KFD during the project period 2010-2013

Sl. No.	Species	Local Name	Quantity Collected(Kg)				Quantity Distributed
			2010-11	2011-12	2012-13	Total quantity	
1	*Acacia auriculiformis*	Acacia	13.000	-	0.370	13.370	3.870
2	*Acacia mangium*	Mangium	5.300	-	-	5.300	-
3	*Acacia peregrina*	Karivelam	7.000	-	-	7.00	-
4	*Adenanthera pavonina*	Manjadi	-	-	0.500	0.500	0.500
5	*Artocarpus hirsutus*	Anjili	-	-	1.800	1.800	-
6	*Bauhinia variegata*	Mantharam	-	-	0.480	0.480	0.480
7	*Caesalpinia sappan*	Pathimugham	8.750	-	-	8.750	8.750
8	*Calamus rotang*	Ari chooral	-	-	44.100	44.100	44.100
9	*Calamus thwaitesii*	Pannichooral	1.200	-	-	1.200	-
10	*Cassia fistula*	Kanikkonna	-	-	10.000	10.000	10.000
11	*Dalbergia latifolia*	Veetti	10.000	-	-	10.000	-
12	*Lagerstroemia microcarpa*	Venthekku	-	-	1.140	1.140	0.750
13	*Melia dubia*	Malaveppu	-	-	17.000	17.000	17.000
14	*Pongamia pinnata*	Ungu	30.000	25.000	25.900	80.900	67.200
15	*Pterocarpus marsupium*	Venga	-	-	17.300	17.300	17.300
16	*Terminalia travancoricum*	Pei kadukka	-	-	10.000	10.000	10.000
17	*Santalum album*	Chandhanam	-	-	77.500	77.500	-
18	*Swietenia macrophylla*	Mahogany	506.500	942.360	223.500	1672.300	997.050
19	*Syzygium cumini*	Njaval	-	-	59.000	59.000	59.000
20	*Tamarindus indica*	ValanPuli	-	-	63.300	63.300	63.300
21	*Terminalia bellirica*	Thanni	190.000	-	518.200	708.200	657.280
22	*Terminalia crenulata*	Karimaruthu	267.000	-	150.600	417.600	464.400

Appendix III

Miscellaneous seeds collected and distributed from KFSC during 2010-2013

Sl. No.	Species	Local Name	Quantity Collected (Kg)				Qty. Distributed
			2010-11	2011-12	2012-13	Total qty.	
1	*Acacia auriculiformis*	Acacia	6.000	7.300	-	13.300	10.159
2	*Acacia catechu*	Karinjali	-	-	1.000	1.000	0.110
3	*Acacia concinna*	Shikkakai	-	0.160	-	-	0.160
4	*Acacia mangium*	Mangium	5.354	2.450	14.100	16.550	38.454
5	*Adenathera pavonina*	Manjadi	3.500	3.760	4.600	11.860	4.800
6	*Aegle marmelos*	Koovalam	0.350	0.850	-	1.200	1.200
7	*Anamirta cocculus*	Anamruthu	-	0.280	-	0.280	-
8	*Ailanthus triphysa*	Matti	-	6.020	17.430	23.450	17.950
9	*Azadirachta indica*	Aryaveppu	-	19.720	23.000	42.720	13.900
10	*Bambusa bambos*	Mullumula	116.000	136.500	-	252.500	36.818
11	*Bambus pallida*	Pallida	15.800	-	-	15.800	15.800
12	*Bauhinia malabarica*	Arampuli	-	7.000	13.670	20.670	9.500
13	*Bauhinia purpurea*	Mantharam	-	1.000		1.000	1.000
14	*Bauhinia variegata*	Mantharam	-	1.750	11.800	13.550	3.850
15	*Berrya javanica*	Berrya	-	0.410	-	0.410	0.400
16	*Butea monosperma*	Plashu	0.790	-	-	0.790	-
17	*Caesalpinia coriaria*	Dividivi	-	54.500	-	54.500	14.930
18	*Caesalpinia sappan*	Pathimugham	-	21.000	26.000	47.000	22.219
19	*Calamus longisetus*	Calamus	7.600	-	-	7.600	-
20	*Calamus thwaitesii*	Pannichooral	56.100	-	-	56.100	-
21	*Calophyllum calaba*	Chrupunna	-	-	1.740	1.740	1.700
22	*Careya arborea*	Pezhu	-	2.200	-	2.200	-
23	*Caryota urens*	Anapana	-	11.060	-	11.060	7.600
24	*Cassia fistula*	Kanikkonna	-	28.800	11.300	40.100	27.810
25	*Cassia grandis*	Horse cassia	-	2.240	2.600	4.840	15.500
26	*Cassia nodosa*	Pink cassia	-	3.440	-	3.440	2.600
27	*Cassia siamia*	Manjakonna	-	0.200	-	0.200	0.200
28	*Casuarina equisetifolia*	Kattadi	-	-	2.700	2.700	2.250
29	*Chrysophyllum roxbourgii*	Pulichakka	-	5.000	-	5.000	0.500
30	*Cleistanthus collinus*	Oduku	-	0.500	-	0.500	-
31	*Couropita guianensis*	Nagalingam	-	1.260	-	1.260	1.300

Sl. No.	Species	Local Name	Quantity Collected (Kg)				Qty. Distributed
			2010-11	2011-12	2012-13	Total qty.	
32	*Croton malabaricus*	Kolavanchi	-	5.300	-	5.300	0.500
33	*Dalbergia latifolia*	Veetti	-	11.000	21.280	32.280	15.925
34	*Delonix regia*	Gulmohar	4.000	4.250	-	8.250	5.405
35	*Dendrocalamus strictus*	Kallanmula	-	40.000	-	40.000	29.370
36	*Dillenia pentagyna*	Vazhapunna	-	1.460	-	1.460	1.000
37	*Diospyros discolor*	Velvet apple	-	3.200	-	3.200	3.000
38	*Elaeocarpus tuberculatus*	Kara	-	3.330	-	3.330	0.700
39	*Embelia ribes*	Vizhal	-	7.420	0.714	8.134	-
40	*Entada rheedi*	Kakkum kaya	2.800	-	-	2.800	-
41	*Enterolobium cyclocarpum*	Anacheviyan	2.300	1.900	0.600	4.200	4.800
42	*Eucalyptus grandis*	Eucaly	-	2.470		2.470	4.304
43	*Eucalyptus urophylla*	Urophylla	-	3.818	2.050	5.868	3.900
44	*Ficus dalhousiae*	Kallal	-	0.400	-	0.400	-
45	*Garcinia gummi-gutta*	Kudampuli	1.000	1.250	-	1.000	2.250
46	*Gmelina arborea*	Kumizhu	4.500	-	16.550	21.050	5.450
47	*Grewia tilifolia*	Chadachi		0.220	0.480	0.700	0.150
48	*Gluta travancorica*	Chenkurinji	58.020			58.020	-
49	*Holoptelia integrifolia*	Aaval	-	1.400	9.000	10.400	4.220
50	*Holostemma ada-kodien*	Adapathiyan	-	0.200	-	0.200	0.200
51	*Hydnocarpus pentandra*	Marotti	-	5.800	-	5.800	3.010
52	*Indigofera tinctorea*	Neelaamari	-	-	5.000	5.00	3.200
53	*Knema attenuata*	Chorapali	1.000	-	-	1.000	-
54	*Lagerstroemia flos-reginae*	Manimaruthu	-	3.815	-	3.815	3.815
55	*Leucaena leucocephala*	Subabul	2.000	-	-	2.000	01.000
56	*Magnolia chembaka*	Chembakam	-	-	2.000	2.000	-
57	*Melia azadirach*	Kaattuveppu	-	-	1.080	1.080	1.080
58	*Melia dubia*	Malaveppu	32.500	-	18.650	51.150	21.710
59	*Memecylon edule*	Kayamboo	-	0.390	-	0.390	0.200
60	*Mimusops elengi*	Elenji	-	6.500	-	6.500	-
61	*Neolamarkia cadamba*	Neelakadamba	-	4.244	-	4.244	4.190
62	*Oroxylum indicum*	Palakapayyani	-	4.110	4.960	9.070	4.290
63	*Phyllanthus indo-fischeri*	Nelli	-	3.000	-	3.000	0.680
64	*Phyllanthus emblica*	Nelli	-	-	5.000	5.000	4.200
65	*Pongamia pinnata*	Ungu	-	8.100	26.800	34.900	14.600
66	*Pterocarpus marsupium*	Venga	-	4.100	41.000	45.100	16.570
67	*Prunus ceylanica*	Attanaripongu	-	2.900	-	2.900	2.100
68	*Radermarchera xylocarpa*	Edankorana	-	0.430	1.000	1.430	0.250
69	*Sapindus emarginatus*	Soap nut	-	3.960	-	3.960	1.350
70	*Santalum album*	Chandhanam	203.000	460.340	98.000	761.340	521.737
71	*Saraca asoca*	Asokam	4.100	6.500	24.000	34.600	26.500
72	*Schlechera oleosa*	Poovam	-	0.340		0.340	-

Sl. No.	Species	Local Name	Quantity Collected (Kg)				Qty. Distributed
			2010-11	2011-12	2012-13	Total qty.	
73	*Simarouba glauca*	Lakshmitharu	-	2.920	11.000	13.920	9.980
74	*Spatholobus parviflorus*	Valliplasu	-	0.650		0.650	0.350
75	*Spondias indica*	Kattambazham	-	4.500	2.156	6.656	1.450
76	*Sterculia guttata*	Theethondi	-	0.730	1.200	1.550	3.250
77	*Sterculia villosa*	Aana vakka	-	-	4.000	4.000	-
78	*Stereospermum colais*	Pathiri	0.700	0.410	0.250	1.360	-
79	*Strychnos nux-vomica*	Kaanjiram	-	25.500	0.500	26.000	24.540
80	*Swietenia macrophylla*	Mahogany	14.920	35.700	126.220	161.920	176.840
81	*Syzygium cumini*	Njaval	13.820	7.000	-	20.820	5.000
82	*Tectona grandis*	Thekku	85.000	253.000	689.000	1027.000	774.845
83	*Terminalia arjuna*	Neermaruthu	-	15.800	36.650	52.450	9.635
84	*Terminalia bellirica*	Thanni	-	132.00	53.000	185.00	54.995
85	*Terminalia chebula*	Kadukka	-	13.310	22.800	36.110	8.820
86	*Terminalia crenulata*	Karimaruthu	0.650	47.880	20.200	68.730	13.860
87	*Terminalia paniculata*	Pullamaruthu	-	0.750	1.600	2.350	2.255
88	*Trewia nudiflora*	Pambarakumbil	-	-	0.390	0.390	-
89	*Vateria indica*	Payin	-	20.000	7.000	27.000	2.100
90	*Vitex altissima*	Mayilellu	-	2.700	-	2.700	2.500
91	*Wrightia tinctoria*	Dhandhapala	-	6.930	18.400	25.330	13.893
92	*Xylia xylocarpa*	Irul	-	0.900	-	0.900	0.900