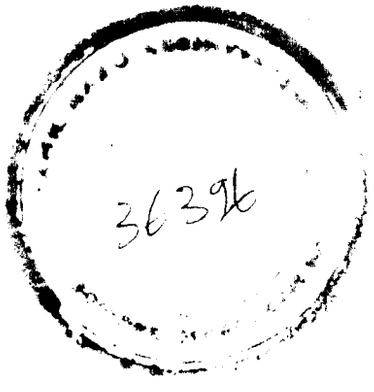
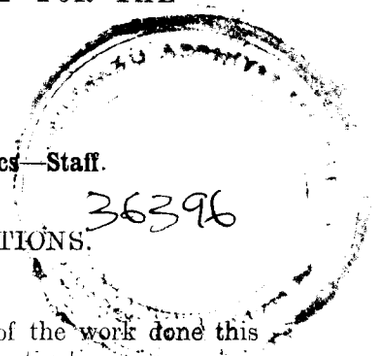
TABLE OF CONTENTS

PART II—EXPERIMENTAL DATA.



ANNUAL REPORT ON SILVICULTURAL RESEARCH IN THE MADRAS PRESIDENCY FOR THE YEAR 1940-41



PART I.

Results—Working Plans—Statistics—Staff.

I. RESULTS AND INDICATIONS.

(i) General.

1. As in previous years, a large amount of the work done this year has been small scale [Stage 1 (*a*)] investigations in experimental gardens. Repetitions of previous years' experiments have been done in all cases where necessary, and routine seed germination and weighment tests were continued.

Some of the most important results obtained during the year are :—

A. Mixed deciduous forest of good quality.

2. (i) Confirmation of earlier indications in methods of improvement of stump production in teak nurseries. Further investigations with the object of still further economy in seed, if possible, have been started.

(ii) We have got further evidence, that the principle of pre-monsoon stump planting is applicable to districts with an East Coast type of climate.

(iii) We have commenced systematic studies on teak soils in the Nilambur division.

(iv) We have successfully established a number of exotic non-thorny bamboos, which if found successful for floating teak, may be better than our own indigenous *Bambusa arundinacea*.

B. High elevation forests.

3. (i) A good start has been made in the raising of *Acacia decurrens* in some districts and one district reports successful plantations by direct sowing.

C. Dry fuel forests.

4. (i) Indications of the effect of the ash and burn, of the interval that elapses between the burn and sowing, and of the field crops, on the forest crops, in Kumri plantations.

(ii) Indications of the successful control of *Lantana* by underplanting with bamboos provided a little help, such as overhead clearing, is given to the bamboos.

D. Spike disease of sandal.

5. Indications that *Jassus indicus* is probably a vector of the spike disease of sandal.

E. Seed indents.

6. During the year the Provincial Silviculturist arranged for the collection and supply of 319 indents for seeds, seedlings and stumps. A large proportion of this stock was collected by the research staff in addition to their ordinary duties.

Climates.

7. A rainfall statement for all research centres is given in paragraph 181 and this gives an idea of the climates in which the experiments mentioned in this report have been done.

In this statement the rainfall for each month is given in inches, and underneath this, is given the number of rainy days in that month thus :—

10·71 (inches of rain in the month)
15 (number of rainy days during the month)

The last column of the statement gives the annual rainfall averaged over as long a period of years as possible for which records are available, with the average number of rainy days per year where it can be ascertained. The rainfall from 1st April 1940 to the 31st March 1941 is totalled for comparison with the average rainfall recorded in the last column, and this coupled with the rainfall from the 1st April 1941 to the 31st of May 1941 covers all the experiments conducted during the year under review.

(ii) Natural Regeneration.

By seed—Attempts to induce natural regeneration under mother trees.

8. *Hopea parviflora.*—In Experimental Plot No. 54, South Coimbatore division started in 1933, 6 *Hopea parviflora* mother trees were selected, and in half the ground projection of the crown of each, weed growth was removed and the soil raked just before seed fall. Every year since the commencement, the existing natural seedlings have been counted, pulled out, and the treatments repeated. Due to poor seeding of the trees till 1939, there has been no appreciable difference in the numbers of seedlings between treated and control plots. In 1939, we had a full seed year, which resulted in our obtaining 2,495 seedlings per tree in the treated plots, and 2,964 seedlings in the control plots. The year under review was a poor seed year, and this year the treated and control plots showed 2,769 seedlings in the treated area, and 2,788 seedlings in the control area per tree. The difference is not significant.

9. *Calophyllum elatum.*—Experimental Plot No. 56, South Coimbatore division, is a similar experiment to the above, but with *Calophyllum elatum*, and was started in 1933. Till 1939 there was little or no seed fall, but in 1939 the seed fall was fair, and the treated plot gave 73 seedlings for 8 trees, while the control plots gave 37 seedlings for 8 trees. This worked out to an average of 9 seedlings per tree for the treated plot, and 4 seedlings for the control plot. During 1940–41 one of the trees was thrown by wind, leaving only 7 trees under observation. There was some seeding of the species this year also, and this has given an average of 14 plants per tree for the treated plots, and 2·7 plants for the control plots. This difference being significant, supports last year's indication that the treatment is successful, but requires further confirmation.

10. *Mesua ferrea.*—Experimental Plot No. 23, Wynaad division is a similar plot, but with *Mesua ferrea*, the projection of the crown spread on the ground receiving three treatments, e.g., (*a*) sectors forming one-third of the crown projection, having all undergrowth cleared by hand pulling weeds and cutting back woody growth, (*b*) sectors having all undergrowth cleared as above and the soil worked with forks to a depth of 5 to 6 inches, and (*c*) sectors where nothing is done, being kept as control.

The A sectors gave 50·3 seedlings per tree, the B sectors 66·0 seedlings, and the C sectors 28·1 seedlings. Though the differences are significant, further confirmation is needed.

11. Experimental Plot No. 55, South Coimbatore division is a similar plot with this species, but with only three trees, and two treatments, i.e., weed growth in half the area under each tree was cut and soil raked before seed fall, while in the control half nothing was done. The treated plots gave 114 seedlings per tree, while the control plots gave 187. Further confirmation of indications is necessary.

12. *Dysoxylum malabaricum.*—Experimental Plot No. 23, Wynaad division, mentioned under the foregoing species, also included this species. No seedlings have been found under any of the trees, under any of the treatments. The species requires further observation, when we have a satisfactory seed fall.

13. *Swietenia macrophylla.*—Experimental Plot No. 142, Nilambur division was started in 1936, to determine whether cutting the undergrowth and burning (either before or after seed fall) under *Swietenia macrophylla* mother trees will increase natural regeneration. The treatments were (*a*) cutting all undergrowth in November each year and burning when dry in December before seed fall, (*b*) cutting all undergrowth in February and burning in March just after seed fall, and (*c*) control no cutting or burning. Counts of seedlings in April and May of each of the years 1937 to 1940 were made. The conclusions drawn were that (1) cutting

and burning either before or after seed fall under *Swietenia macrophylla* mother trees do not increase natural regeneration but diminish it and (2) the decrease is greatest if the cutting is done after seed fall. This experiment has now been closed.

14. In Experimental Plot No. 141, Nilambur division, mature seed bearers which bore normally a fair amount of fruit but which produce little or no regeneration have been selected. In the first year of the experiment the trees produced a normal quantity of normal seed, and this seed germinated, and produced seedlings a normal number of which survived the hot weather (162 per tree average). All this regeneration was pulled up. In the second year the trees flowered, fruited and seeded normally, and produced 281 seedlings per tree. An year later 105 seedlings per tree of this crop were surviving. In the third year the new seedlings average 466 per tree. During the year under review we have again got 122 surviving from the previous years' seedlings, while we have 490 new seedlings per tree. We have yet to discover the reason for the ultimate disappearance of this regeneration.

Canopy manipulation over natural regeneration.

Hopea parviflora.

15. Experimental Plot Nos. 37, 38 and 39, South Coimbatore division, were opened in 1931, in Karian shola, to observe the development and measure the rate of growth of *Hopea parviflora* regeneration in the switch and sapling stages when the canopy is manipulated from time to time as appears desirable. The following three treatments were applied in December 1931 :—

A. In Experimental Plot No. 37, all shrubs were cut, and middle storey trees were girdled. Only top canopy trees were retained. The *Strobilanthes* had been back two years previously.

B. In Experimental Plot No. 38, shrubs and *Strobilanthes* were cut. The middle and top storeys were retained.

C. In Experimental Plot No. 39, which was kept as control, nothing was done. There was dense *Strobilanthes* and shrubs left suppressing the *Hopea* regeneration.

16. The three plots are reported to have been strictly comparable before applying the treatments.

Subsequently the treatment consisted of cutting climbers in the indicator plots and recording the details of observations made. Indicator plots each 1 chain by ½ chain were laid out in the experimental plots. All *Hopea* plants over 3 feet in height were enumerated by 1 foot height classes at the commencement on 3rd December 1931, and thereafter annually; 30 stems over 3 feet high were numbered and their heights were recorded annually. In addition the girths of 10 of these trees all over 9 feet high were measured annually at 4 feet 6 inches high. Damage by browsing was also enumerated and recorded. An analysis of the results

by the Central Silviculturist, Forest Research Institute, Dehra Dun, has shown that (1) all plots have progressed towards establishment, (2) progress has been steadiest in Experimental Plot No. 37 (Treatment A) which escaped browsing, (3) Experimental Plot No. 38 (Treatment B) had a severe set back during the first three years due to browsing, but from the fourth year onwards the regeneration made very rapid progress, (4) Experimental Plot No. 39 suffered a similar set back in the first five years due to the presence of *Strobilanthes*, but after the flowering and dying of the *Strobilanthes* in the fifth year, a rapid development of the plants had taken place.

17. The analysis led to the conclusions that no definite effect of the treatments on progress of regeneration can be established, but there is an indication that removal of all but the top storey accelerates the establishment of *Hopea* regeneration, and that there is some danger of browsing in plots in which the undergrowth is removed. We have a further indication that in this type of regeneration work, the *Strobilanthes* flowering is an important factor to be considered, and that we should anticipate this flowering in our regeneration operations in this type of forest, and take full advantage of the sudden impulse that the death of the *Strobilanthes* gives to other regeneration.

18. Experimental Plot Nos. 42 and 43, South Coimbatore division, were opened in 1932 in Karian shola to study the effect of canopy manipulation on established natural regeneration of *Hopea parviflora*, and also the effect of fencing in addition to the canopy manipulation. Initially the overwood and underwood were of typical evergreen rain forest, with dense *Strobilanthes* 10 feet high. Abundant natural regeneration of *Hopea parviflora*, largely unestablished, existed, while in the eastern part of the control plot No. 42, *Hopea* natural regeneration was somewhat deficient.

19. In Plot No. 43, all *Strobilanthes* and other undergrowth were cut and removed from the plot, and trees whose crowns were not in the uppermost canopy were girdled (excepting undergrowth and *Hopea* and *Mesua* trees). Indicator plots 50 feet by 40 feet were laid out and *Hopea* regeneration in each was counted and classified. Two of the indicator plots were effectively fenced. In plot No. 42 two indicator plots 50 feet by 40 feet were laid out, and *Hopea* regeneration in each counted and classified.

20. Subsequently in Experimental Plot No. 43, some of the girdled trees which did not die were poisoned with "Atlas" poison in April 1933, shrubby growth was cut and removed in 1934, and, as the indicator plots did not provide a sufficient number of squares, additional 6 feet wide strips were laid out giving 300 additional 6 feet by 6 feet squares, for observation.

21. In plot No. 42, additional 6 feet wide strips were laid out as in plot No. 43, and 300 additional 6 feet by 6 feet squares formed for observation. The regeneration was classified and enumerated or measured.

22. The analysis of the results shows that there has been an appreciable increase in the establishment stocking factor in the treated plot No. 43 in comparison with that in the control, plot No. 42, the increase from 1933 to 1940 having been 186·12 per cent in the treated plot against 20·9 per cent in the control plot. It is also seen that the removal of dense *Strobilanthes* and small trees below 3 inches diameter, and the girdling of all trees not in the uppermost canopy has a marked beneficial effect on the progress of regeneration towards establishment, the effect becoming apparent from the second year after cutting out the *Strobilanthes* onwards. Fencing does not appear to have any special advantages.

23. Thus it appears very beneficial to open the canopy to establish young *Hopea parviflora* regeneration.

24. In continuation of this investigation, two more sets of plots were opened in the South Coimbatore division in 1937. In the first set (Experimental Plots Nos. 75 and 76, South Coimbatore division), the progress of established regeneration 3 to 9 feet high is observed under the conditions of (*a*) clear felling and (*b*) top canopy cover. Since applying the treatments these plots have shown an average increment per tree of (*a*) 1·76 feet and (*b*) 1·00 foot. The present average height per tree in the clear felled plot is 10·28 feet against the average height of 7·98 feet in the top canopy plot, and the difference is significant by Fischer's " t " test. The increment during the year under review was 2·08 feet and 0·98 foot respectively. Thus the beneficial effect of opening the canopy has shown itself even in these three years after the operation.

25. In the second set (Experimental Plots Nos. 72, 73 and 74 of South Coimbatore division) opened in 1938, the progress of established regeneration of *Hopea parviflora* 3 feet to 10 feet high is observed under 3 conditions, i.e., (*a*) clear felling, (*b*) top canopy and (*c*) full evergreen cover, constituting the control. In this set of plots the effect of the three treatments on the unestablished regeneration on the ground is also being watched. In the first three years the established regeneration has shown an average annual height increment per plant of (*a*) 1·05 feet, (*b*) 0·85 foot, and (*c*) 0·25 foot. The numerical progress in regeneration is set forth in the following tabular statement :—

Year.	Experimental plot No. 72 Clear felling.				Experimental plot No. 73. Top canopy.				Experimental plot No. 74. Control.			
	Recruitment.	Unestablished.	Established.	Saplings.	Recruitment.	Unestablished.	Established.	Saplings.	Recruitment.	Unestablished.	Established.	Saplings.
1938 ..	352	1,318	2	7	286	1,174	3	0	306	271	0	1
1939 ..	352	1,625	3	6	286	1,268	3	3	306	263	0	1
1940 ..	352	3,248	3	5	278	2,862	4	2	306	374	0	1
1941 ..	321	3,473	2	13	260	4,022	0	3	279	591	0	0

26. This statement also indicates that under full evergreen control the recruitment does not move towards efficient establishment. The choice for *Hopea* appears therefore to be between clear felling and top canopy conditions, and here also we have an indication of the beneficial effect of opening the canopy. Further observation is essential before we can determine between the comparative effects of clear felling and top canopy conditions.

In 1940–41 there has been a slight set back in the number of the recruitment on the ground, but the unestablished regeneration has increased in all cases.

Mesua ferrea.

27. Experimental Plots Nos. 44 and 45 of South Coimbatore division were opened in 1932 to test the effect of canopy opening on natural regeneration of *Mesua ferrea* 5 feet to 10 feet high. In Experimental Plot No. 44 the canopy opening consisted of removing *Strobilanthes* and other undergrowth up to 3 inches diameter, and girdling trees (other than *Mesua ferrea* and *Hopea parviflora)* whose crowns are not in the upper canopy, while Experimental Plot No. 45 was the control in which nothing was done. Indicator plots were laid out, and natural regeneration counted and classified. The two treatments have shown an average annual height increment of 12·35 inches and 5·35 inches respectively, but the small regeneration on the ground has not appreciably increased

28. Experimental Plots Nos. 3 and 4, Wynaad division, were opened in 1932 and two treatments applied (*a*) cutting undergrowth. (*b*) control. As the height development of the plants in 1940–41 has been below the average reported last year, the present calculated average annual height increment for six years is (*a*) 4·36 inches and (*b*) 1·68 inches. The small regeneration on the ground has not developed appreciably.

29. Experimental Plots Nos. 5 and 6, Wynaad division, were similarly opened in 1932, and here also results are similar to the Experimental Plots Nos. 3 and 4 mentioned above, due to a slight decrement in height exhibited by some plants on account of wind break, etc., while other plants have not shown any appreciable height increment.

30. The indications therefore are that at least until the natural regeneration is about 5 feet to 10 feet in height, it is not advantageous to open the canopy or remove the undergrowth, for *Mesua ferrea*.

Palaquium ellipticum.

31. Experimental Plots Nos. 163, 164 and 165, Palghat division, were opened in 1938 to determine the effect of heavy opening of the canopy over established and unestablished natural regeneration

of *Palaquium ellipticum*. The shade conditions are (*a*) Experimental Plot No. 163 clear felling, (*b*) Experimental Plot No. 164, top canopy shade only, (*c*) Experimental Plot No. 165 control—full evergreen cover.

32. Measurements indicate that during the three years that have elapsed since the plots were opened the "Clear felling" treatment has given a mean annual height increment of 1·84 inches, while the "Top canopy" treatment has given 0·52 inch, and the "Control" has given 0·36 inch. Enumerations indicate a tendency for the unestablished regeneration to get established under the clear-felling treatment, while under the top canopy treatment the unestablished regeneration tends to increase, but not to get established. Under the control conditions, there has been a reduction both in the unestablished regeneration and the established regeneration. These indications require confirmation by further observations.

Pterocarpus santalinus.

33. The experiment started in 1936 in the Pitchanur tope of the Chittoor division, to study the effect of a judicious opening of the canopy was continued under observation. The experiment has given the indication that "a patch of natural regeneration of *Pterocarpus santalinus* should be at least 30 feet square, and should contain on an average of not less than three seedlings per square foot. In exceptional cases where a 30-feet square is not for any reason practicable, we may treat down to 20-feet squares. The average height of the seedlings should not be less than 9 inches, with the biggest plants about 18 inches in height. Before a radical opening in the overhead canopy is carried out, the red sanders seedlings should show the broad healthy foliage typical of vigorous seedlings. The opening of the canopy consists firstly in the removal of low cover to about 0·6 density, proceeding by cautious stages to 0·4."

34. Under the conditions of the Pitchanur tope, this experiment has proved that natural red sanders regeneration can be induced to establish itself by a judicious and gradual opening of the overhead canopy.

35. A similar experiment in the bringing on of natural regeneration of *Pterocarpus santalinus* has been started in 1939 in Kodur of the South Cuddapah division. It is too early to report results.

Avicennia officinalis.

36. The District Forest Officer, Lower Godavari division, reports that two experimental plots have been opened in the Coringa Felling series of his division from 1935 to see whether *Acanthus ilicifolius* produces suppression of *Avicennia* regeneration or benefits it. The plots are now five years old, and it has been observed that while the *Avicennia* is shooting up, the *Acanthus* is gradually disappearing. The protection appears attributable to the prevention of other arborescent species appearing and suppressing the *Avicennia*, and against browsing by buffaloes.

By coppice.

37. Experimental Plot No. 11 of Chittoor division, was opened in June 1934 to compare the effect of (1) high cutting with trimming, (2) low cutting with trimming and (3) low cutting without trimming on the mortality of stools of *Acacia sundra*, *Albizzia amara* and *Azadirachta indica* and on the consequent coppice growth. The results up to last year have been reported in paragraph 21 of the annual report for 1939–40. Subsequently only one *Acacia sundra* tree under treatment A, two *Albizzia amara* trees under treatment B, and one *Albizzia amara* tree under treatment C have died. As a total of 1,224 trees are under ordinary consideration, this very small additional casualty does not affect appreciably the percentages already reported. Results 6½ years after applying treatments showed the following mortality of stools :—

Species.	Percentage of stools dead.		
	High cutting with trimming.	Low cutting with trimming.	Low cutting without trimming.
Acacia sundra	8	14	13
Albizzia amara	7	15	9
Azadirachta indica	7	9	Omitted due to insufficient number of stools.
Average for all three species ..	7	13	11

38. This experiment is essentially a long-term experiment, and it will be many years before we can determine the effect of the treatments on the volume of fuel produced.

39. To determine the mortality of stools in a dry deciduous forest in ordinary district work, Experimental Plot No. 18, North Coimbatore division, started in 1938 and reported on in paragraph 22 of last year's annual report has been continued under observation. After two years we have 1·83 per cent stools missing, which may be taken as dead, 8·36 per cent definitely dead, and 0·20 per cent green but without shoots. Including the green plants without shoots the total casualties amount to 10·39 per cent, leaving 89·61 per cent alive with shoots. There has thus been 2·14 per cent casualty during this year in addition to the percentage reported last year. After further observation mortality will be determined by species and by girth classes and the information furnished in detail.

Teak coppice—Mortality of stools.

40. Details of Experimental Plot No. 162, Palghat, started in 1937, for determining the mortality of stools in teak coppice have been given in paragraph 23 of the annual report for the year 1939–40. The treatments were *(a)* low cutting as near the ground as possible, stools not trimmed, *(b)* low cutting as near the ground as possible, stools trimmed, *(c)* high cutting 9 inches to 12 inches above the ground, stools not trimmed, and *(d)* high cutting 9 inches to 12 inches above the ground, stools trimmed. Measurements on 17th February 1941 gave the following results :—

Treatment.	A	B	C	
Initial number	240	240	240	240
Survival number	234	237	236	236
Percentage survival	97·5	98·7	98·3	98·3
Mean height in feet	19·19	18·96	19·33	19·23

The differences in mean height are not significant by the " t " test.

Coppicing of Santalum album.

41. An experiment on this subject, conducted by the District Forest Officer, Vellore West division, is in progress. The District Forest Officer's inspection on 16th February 1941, showed 10 stumps dead, 2 dying, 1 not promising, 2 fair, 8 good, 2 very good, 3 excellent. The dead stumps therefore form about 29 per cent of the total number under observation. Damage by browsing and by insects have been noticeable. The stools that are not yet dead, have produced an average of 13 coppice shoots per stool, with an average height of the best shoot of 4·17 feet. It would appear that on account of the large number of casualties, and the damage to the living plants, the operation of coppicing *Santalum album* to obtain regeneration is not very encouraging.

Coppicing of casuarina.

42. Nellore division reports results of experimentally coppicing *casuarina*. The results are not promising, though coppice shoots are produced initially.

Coppicing of Shorea talura.

43. The Research Ranger, Denkanikota, reports a coppicing experiment on *Shorea talura* in the North Salem division. One hundred and forty-six clumps of trees (mixed with other species) were selected, measured, and grouped into 3-inch girth classes, and felled between 12th December 1940 and 26th December 1940. By the end of March 1941 good coppice regeneration has been obtained, except in the case of some of the bigger stumps. It is too early for enumeration or measurement.

44. A small-scale experiment on this was started in Compartment No. V of Talakona Reserved Forest of the Chittoor division in April 1940. Only 13 trees were coppiced, and the results are watched. Present indications are that stumps of 2 feet to 4 feet basal girth produce a large number of vigorous coppice shoots in this locality, while larger stumps do not coppice satisfactorily.

Coppicing of Canthium didymum and Pleurostylia wightii trees with twisted fibre.

45. An experiment on this has been started in October 1940, in the Talakona Reserved Forest of the Chittoor division. It is too early yet to report any results. The object of the experiment is to find out if the twisted fibre of the parent trees is exhibited by the coppice shoots also.

Regeneration by root suckers—Santalum album.

46. The experiment started on 50 trees in the Vellore West division in August 1939 is in progress. It was observed that the major portion of the roots that on cutting have produced root suckers are within a foot and a half below ground level, and that largest number of root suckers are found on the uphill side of the parent tree, and the tallest root suckers were also produced on this side. An enumeration on 30th November 1940 by the District Forest Officer showed 39 root suckers per tree and 34 of them were within $1\frac{1}{2}$ feet from the surface. Enumeration in March 1941 gave 27·6 suckers per tree, with an average height of 5·03 feet.

47. In 1940–41 a further experiment on the effect of trenching around 20 sandal trees in 3 localities in the West Vellore Division has been started. It is too early to report any results.

Strychnos nux vomica.

48. *Twenty-five Strychnos nux vomica* trees in Sriharikota Reserved Forest of the Nellore Division, had trenches $1\frac{1}{2}$ feet $\times 1\frac{1}{2}$ feet section excavated at a distance of 6 feet to 8 feet (radius) from the plants. In October 1940 it was observed that each tree gave out 5 to 15 root suckers.

Sapindus emarginatus.

49. A similar experiment with *Sapindus emarginatus*, gave similar results in the same locality, but the *sapindus* shoots were badly browsed over by semi wild cattle.

Regeneration by layering—Casuarina equisetifolia.

50. The experiment reported in paragraph 26 of the Annual report for the year 1939–40 is still being observed. No indications have yet been obtained about the suitability of the method or otherwise.

(iii) SEED.

51. *Pre-treatment.*—Routine seed pre-treatment tests were done with a large number of species, the treatments used being, cold, hot and boiling water, with an untreated control in each case. The results are progressively combined with the previous year's results, and results up to date, are indicated in the following paragraphs.

52. The germinative capacity of seed of the following species was not apparently improved by any of the treatments used :—

Acacia auriculiformis, Acacia cyclopis, Acacia ferruginea, Acacia leucophlœa, Acacia melanoxylon, Acacia planifrons Acacia saligna, Acacia sundra, Acrocarpus fraxinifolius Albizzia amara, Albizzia lebbek, Bauhinia racemosa, Bischofia javanica, Commiphora caudata, Eugenia arnottiana, Girotia rottleriformis, Grewia tiliæfolia, Holoptelia integrifolia, Leucaena glauca, Markhamia platycalyx, Poinciana elata, Premna tomentosa, Prosopis juliflora, Prosopis spicigera, Zizyphus glabrata, Zizyphus incurva, Zizyphus jujuba, and Zizyphus xylopyrus.

53. The germinative capacity of seed of the following species has apparently been best when sown without any treatment :—

Anacardium occidentale, Azadirachta indica, Berberis tinctoria, Bombax malabaricum, Cassia siamea, Chorisia speciosa, Cupressus torulosa, Dendrocalamus strictus, Elæocarpus oblongus, Glochidion neilgherrense, Hakea saligna, Ligustrum neilgherrense, Litsea zeylanica, Mahonia leschenaultii, Meliosma wightii, Michelia nilagirica, Quercus incana, Sapindus emarginatus, and Tamarindus indica.

54. The germinative capacity of seed of the following species has apparently been best when they were soaked in cold water for 24 hours prior to sowing :—

Alangium lamarckii, Cassia marginata, Chickrassia tabularis, Harrisonia bennettii, Mangifera indica, Pinus longifolia, Pinus insignis, Pongamia glabra, Soymida febrifuga, Thyrostachys oliveri, and *Pterocarpus santalinus* when sown without removing the seed coat.

55. The germinative capacity of *Juniperus procera* has been slightly better when it was soaked in water as hot as the hand can bear, and sowing the seed after the water had cooled down ; than the other treatments.

56. Treatment with boiling water (water 20 times the volume of the seed used is brought to the boil, is taken off the fire, the seed immediately put in and left till cold) appears to increase the germination of :—

Acacia baileyana, Acacia cyanophylla, Acacia dealbata, Acacia decurrens, Acacia mollissima, and Myrsine wightiana.

57. Treatment with boiling water as described in the previous paragraph appears to decrease appreciably the germination of—

Adenanthera pavoniana, Alangium lamarckii, Azadirachta indica, Balanocarpus utilis, Bauhinia purpurea, Bombax malabaricum, Calophyllum elatum, Canthium didymum, Cassia auriculata, Cassia fistula, Cassia marginata, Cassia siamea, Chickrassia tabularis, Chlorophora excelsa, Chloroxylon swietenia, Dalbergia latifolia, Dalbergia sissoides, Dendrocalamus strictus, Dolichandrone crispa, Dolichandrone falcata, Erythroxylon monogynum, Evodia roxburghiana, Feronia elephantum, Gluta travancorica, Gmelina arborea, Juniperus procera, Lagerstræmia flos reginæ, Lagerstræmia lanceolata, Ligustrum neilgherrense, Litsea zeylanica, Mahonia leschenaultii, Mangifera indica, Neolitsea zeylanica, Palaquium, ellipticum, Pinus insignis, Pithecolobium dulce, Pterocarpus dalbergioides, Pterocarpus marsupium, Schleichera trijuga, Sterculia urens, Strychnos nux vomica, Strychnos potatorum, Tectona grandis, Terminalia chebula, Terminalia crenulata, Terminalia paniculata, Thyrostachys oliveri, Vateria indica, Vitex altissima, Vitex littoralis and *Vitex peduncularis.*

58. The results of pre-treatment tests are summarised in paragraph 483. Generally 100 seeds for each treatment were used in each test though in a few cases 200 or 50 seeds were used. The results of previous years' tests are included.

59. *Seed pre-treatment—Obdudate species.*—The following species which usually give a very low or variable germination per cent were experimented on with special tests to try and increase their germination. The treatments were, (*a*) control, (*b*) soaking in lime water for 24 hours, (*c*) soaking in cold water for 48 hours and then keeping moist in straw out of free circulation of air (fermenting), (*d*) scorching over a fire, (*e*) soaking in concentrated sulphuric acid, and (*f*) exposing to sun and watering on alternate days.

60. Results including those of previous years are seen in the table below :—

Species.	Number of tests.	Percentage germination of seed treated with: Control.	Lime water.	Fermenting.	Scorching.	Sulphuric acid.	Weathering.	Other remarks.
Acacia arabica	1	12·6	X	13·4	X	21·5	X	Seed passed through goats gave 21·9 per cent.
Acacia auriculiformis ..	21	9	X	9	X	6	9	
Acacia leucophlœa ..	43	13	X	13	X	14	8	
Alangium lamarckii ..	1	2	X	3	X	3	6	
Acrocarpus fraxinifolius.	30	9	6	13	4	X	6½	
Calophyllum elatum ..	3	9	X	X	X	2	X	

Species.	Number of years.	Percentage germination of seed treated with: Control	Lime water.	Fermenting.	Scorching.	Sulphuric acid.	Weathering.	Other remarks.
Canthium didymum ..	2	0·3	X	0·4	X	1·2	0·3	
Cassia auriculata ..	10	7	X	8	X	25	7	
Cassia fistula	43	12	9	10	0	28	8	
Cassia marginata ..	12	20	13	9	0	35	1	
Erythroxylon monogynum.	13	6	X	2	X	7	6	
Givotia rottleriformis ..	9	3	X	3	X	·2	·3	
Pterocarpus santalinus ..	43	24	X	21	2	10	13	
Terminalia chebula ..	43	19	9	29	16	9	16	
Trema orientalis ..	24	13	X	X	6	X	X	

61. Concentrated sulphuric acid treatment appears to have appreciably improved the germination per cent of *Acacia arabica* (almost equal to seed passed through goats), *Cassia auriculata*, *Cassia fistula*, and *Cassia marginata* while fermenting has greatly improved the germination per cent of *Terminalia chebula*, and slightly that of *Acrocarpus fraxinifolius*.

62. *Seed—Seasonal collection within fruiting season.*—Tests were made at weekly intervals with some seed and at fortnightly intervals with others, during the fruiting season of the following species:—

Acacia leucophlœa, Cassia fistula, Cassia marginata, Chloroxylon swietenia, Evodia roxburghiana, Pterocarpus santalinus, Terminalia chebula, and *Terminalia paniculata*.

63. For *Acacia leucophlœa* the end of February 1940 appeared to give the best results (third fortnight) and in the case of *Terminalia paniculata*, where seed collection was commenced with obviously immature seed, seed collected in January and February did not germinate at all, while in subsequent collections there was no appreciable difference of germination percentage.

64. *Seed—Locality test—Santalum album.*—Sandal seed collected from both the autumn and spring crops, were tested for germination per cent during the year at the Emmanur Experimental Garden. The results are tabulated below:—

Seed collected from: Range.	Division.	Germination per cent.: Autumn crop.	Spring crop.
Somwarpet ..	Coorg	15	..
Denkanikota.	Salem North ..	13	39
Polur ..	East Vellore ..	1	1
Sigur ..	Nilgiris ..	5	3
Talamalai ..	Coimbatore North	5	6
	Total ..	39	49
Mean per cent of all origins	..	7·8	9·8

65. Thus there was no appreciable difference in the germination per cent of seed obtained from three localities; the seed obtained from the Autumn crop of Somwarpet Range germinated satisfactorily while the seed from the Spring crop was a total failure; and the Spring crop collected from the Pot culture area of Denkanikota gave a very much higher percentage than the Autumn crop from the Noganur Reserved Forest. The total percentage does not differ appreciably.

66. The experiment needs repetition for any conclusions being drawn. It is known that while the trees in the Denkanikota pot culture garden receive attention, and are perhaps provided with a sufficient number of vigorous hosts, the trees in the Noganur Reserved forest under natural forest conditions, do not receive any such special attention. Perhaps this difference may affect partially the germination per cent of seed collected from the two areas. But such an explanation is not possible in the case of seed from Somwarpet (Coorg) for the differences if any between the localities where the seeds have been collected are not on record.

67. *Seed—Locality test—Chloroxylon swietenia—Chloroxylon swietenia* seed collected in June 1940 from (1) the Cumbum Reserved forest of Kurnool East division, (2) Ayyalur Range of the Madura division, and (3) Talamalai Range of the North Coimbatore division were experimented on for germination per cent at Emmanur Experimental garden. They gave 1 per cent, 9 per cent and 8 per cent respectively as the germination per cent. It may be of interest to note that the plant per cents were 0 per cent, 3 per cent and 2 per cent respectively.

68. *Weathering of seed—Teak.*—This experiment was repeated at three centres. The seed was treated in each centre in the following ways:—(A) Weathering by exposing to the sun and showers for six weeks from the date of collection in a dump 4 inches deep turned over weekly, (B) as in A, but watered once a week in dry weather, (C) Burying seed in pits, (D) Control, and (E) Seed weathered as in A, but dried, sorted, and stored in straw for one year, and then sown. In A and B care was taken to treat on a tin, so that seed may not come into contact with the earth. The treatments gave the following germination per cent. (A) 30 per cent, (B) 23 per cent, (C) 29 per cent, (D) 22 per cent and (E) 15 per cent. It would thus appear that there is no appreciable difference between the first four treatments, and that storing weathered seed seems to reduce germination per cent.

69. *Plantation and natural forest teak seed comparison.*—Teak seed was collected from trees of comparable sizes and conditions in the natural forest, and in plantations in each of three centres, i.e., Dhoni, Topslip and Begur. Germination tests with the seed showed that there is no appreciable difference between Natural Forest seed and Plantation seed. In Germination per cent plantation seed gave a mean of 33·1 for all three centres, while Natural

Forest seed gave 32·9 per cent. Even in plant per cent, Plantation seed gave 20·0 per cent, while Natural Forest seed gave 19·3 per cent. This is the second test of the series.

70. To study the effect of planting teak stumps raised from the seeds collected from comparable mother trees in Plantation Teak forests and Natural Teak forests in close vicinity, the following long-term experiments have been started in 1940. The results after one growing season are tabulated below :—

Locality.	Experimental plot number.	Year.	Mean height in feet of plants from seed from		Significance of difference.
			Natural Forest.	Plantations.	
Wynaad	66	1940	22·64	16·22	S
Coimbatore South ..	83	1940	4·79	4·29	S
Palghat	171	1940	3·22	3·96	S

71. It is thus seen that in two experiments Natural Forest seed has given significantly the better height growth, while in one, Plantation seed has given significantly better height growth. The results therefore are inconclusive, and further observations are necessary.

72. *Removal of seed coat—Givotia rottleriformis.*—In an experiment done at Emmanur, three treatments were tried, (*a*) control where nothing is done to the seed, (*b*) the soft outer coat is removed, and (*c*) the soft outer coat and the hard inner coat are both removed. Five hundred seeds per treatment in ten randomized sub-beds of 50 seed each were tried. The germination per cents are (*a*) control 11 per cent, (*b*) outer coat only removed 8 per cent and (*c*) both coats removed 15 per cent. This result supports the observation made in the annual report for 1939–40 that for *Givotia rottleriformis* the two seed coats should be removed before sowing.

73. A slight variation of this experiment has been done at three other centres, enabling a comparison of (*a*) control where nothing was done, and (*b*) where the seed was mixed with double the quantity of sand, and pounded in a mortar till the outer cover was removed. The averaged results gave only (*a*) control 0·8 per cent, and (*b*) treated 1·8 per cent. This indicates that removal even of the outer coat improves germination.

74. *Removal of pulp—Passage through birds—Azadirachta indica.*—An experiment on this subject, has been reported in paragraph 39 of the Annual Report for 1939–40. The experiment has been repeated in the Emmanur Experimental Gardens. Results including those of previous years are :—

—	Number of tests.	Seed with pulp.	Seed without pulp.	Seed passed through birds.
Average ..	5	19	73	57

It appears therefore very beneficial to remove the pulp of *Azadirachta indica* seed before sowing.

If possible seed that has passed through birds should be used.

75. *Removal of pulp—Calophyllum elatum.*—During the course of germination tests with this species we obtained the following results :—

Locality.	Control.	Removal of outer pulp.
	PER CENT.	PER CENT.
Chandanathodo	16·4	8·8
Do.	1·2	10·4
Average ..	8·8	9·6

The indications therefore are that the removal of the outer pulp does not appreciably improve the germination per cent of *Calophyllum elatum.*

76. *Removal of pulp—Aglaia roxburghiana.*—In an experiment done at Karian shola with only 500 seeds per treatment it has been observed that depulped seed gave 62 per cent germination, while seed with pulp gave 36 per cent. This indicates that removal of pulp improves the germination per cent of *Aglaia roxburghiana.*

77. *Covering test—Gluta travancorica.*—This experiment could not be done for want of sufficient seed during the year.

78. *Seed storage.*—Routine storage tests were made with different methods of storage. Results showing the lengths of time that seed of different species remains fertile are given in the table in paragraph 484 in which previous years results are included. It should be noted that the table gives indications of the probable longevity of the seed but many more tests are necessary before reliable results can be obtained.

79. *Seed weighments.*—Routine seed weighments, germination tests, etc., were carried out. The results are given in paragraph 482 in the Form given in " Note on the weight of seed (Revised) " by S. H. Howard and H. G. Champion (Forest Bulletin No. 41—1928).

80. *Supplies of seeds, seedlings and stumps.*—As usual the Provincial Silviculturist was in charge of the supplies of seeds, seedlings, stumps, etc., of the Presidency.

81. During the year, arrangements were made for the supply of 274 indents comprising 110 species and 17½ tons of seed and 45 indents of 25 species, totalling 3½ lakks of seedlings and stumps.

82. A large proportion of this stock was collected by the research staff in addition to their ordinary duties.

83. For the benefit of the indenting officers it is brought to notice that up to date details with regard to seed weighments, storage, germinative capacity, etc., of species in common use are recorded in Part II of this report.

81. *Sorting seed according to size Teak.*—The three large scale planting out experiments, to determine whether a selection of teak seed by size has any effect on later growth and development of resulting trees, and whether such a selection of seed would result in the breeding of any particular strains of teak, reported in paragraph 15 of last year's annual report, were continued. Measurements in January 1941, at the end of the third growing season after planting show the following :—

District.	Year.	Experimental plot number.	District sample.	Selected biggest.	Selected medium.	Selected smallest.
		Survival percentage.				
Wynaad	1938	55	96·75	99·50	97·50	97·50
Palghat	1938	166	97·50	92·50	100·00	95·83
Coimbatore South	1938	80	86·25	81·75	85·25	83·75
		Mean height in feet.				
Wynaad	1938	55	8·27	8·13	8·10	8·95
Palghat	1938	166	15·62	12·93	13·91	14·31
Coimbatore South ..	1938	80	6·32	6·92	7·58	7·78

On an analysis of the measurements, and calculation by the Latin square method, the differences between treatments were in no case significant. The plots are continued under observation.

85. *The effect of size, age and condition of seed bearers on development of plants.*—The effect on germination of seed collected from (*a*) old hollow overmature trees, (*b*) well grown trees approaching maturity, and (*c*) immature trees, at three centres over a period of five years for *Tectona grandis*, *Dalbergia latifolia*, *Pterocarpus marsupium*, and *Terminalia crenulata*, have been reported in paragraph 46 of last year's annual report. The data afford strong evidence that so far as germination is concerned seed from both overmature and undermature trees is just as good as seed from mature trees provided of course that the tree was old enough to produce fertile seed.

86. To test whether this observation holds good in the later development of the plants, large scale experiments have been started for each species in each of three centres, the species being raised by stump planting. We wish to determine in time whether such sorting of seed by size results in our breeding particular strains. The analysis of data up to date is exhibited in the following statement :—

Locality.	Experimental plot number.	Year.	Survival percentage. Overmature.	Mature.	Undermature.	Mean height in feet. Overmature.	Mature.	Undermature.
			Tectona grandis.					
Wynaad	35	1937	97	97	94	11·7	12·1	10·8
Palghat	155	1936	90	92	85	13·9	12·6	14·7
Coimbatore South	81	1938	73	85	81	4·3	4·5	4·4
		Average ..	87	91	87	10·0	9·7	10·0

Locality.	Experimental plot number.	Year.	Survival percentage. Overmature.	Mature.	Undermature.	Mean height in feet. Overmature.	Mature.	Undermature.
			Dalbergia latifolia.					
Wynaad	36	1937	99	99	97	6·3	7·0	6·8
Palghat	157	1936	78	72	78	12·4	10·8	7·4
Coimbatore South	78	1938	98	99	98	3·1	4·8	5·1
		Average ..	92	90	91	7·3	7·5	6·4
			Pterocarpus marsupium.					
Wynaad	31	1936	95	95	96	12·7	10·9	11·9
Palghat	156	1936	80	88	88	21·7	22·9	23·3
Coimbatore South	77	1938	86	88	86	1·1	1·4	1·6
		Average ..	87	90	90	11·8	11·7	12·3
			Terminalia crenulata.					
Wynaad	37	1937	87	82	81	12·6	12·6	11·7
Palghat	158	1936	88	95	85	24·1	22·7	22·6
Coimbatore South	79	1938	96	82	78	6·2	5·7	3·5
		Average ..	90	86	81	14·3	13·7	12·6

87. *Seed origin—All-India teak seed origin plots.*—The two long-term sets of plots in Nilambur and South Coimbatore divisions which were established in 1934 were maintained. These plots cover 14 acres and 6 seed origins, and consist of 24 plots in Nilambur and 16 plots in the South Coimbatore divisions. They are properly randomized. In the course of time we shall be able to collect comparable growth data from them.

(iv) Nursery work.

88. *Effect of shade on germination and on plant per cent (dry fuel forests).*—Previous years' experiments were repeated at Emmanur Experimental gardens with 17 species. Of these *Canthium didymum*, *Premna tomentosa*, *Dendrocalamus strictus*, *Strychnos potatorum*, and *Vitex altissima*, did not germinate under either condition.

89. The following species preferred the open beds :—

Species.	Germination per cent Open beds.	Germination per cent Shaded beds.	Plant per cent Open beds.	Plant per cent Shaded beds.
Feronia elephantum	44	29	41	27
Terminalia chebula	23	6	18	6
Zizyphus xylopyrus	18	11	18	5
Schleichera trijuga	3	1	3	1

90. The following species preferred the shaded beds :—

Species.	Germination per cent		Plant per cent.	
	Open beds.	Shaded beds.	Open beds.	Shaded beds.
Adenanthera pavoniana ..	22	37	16	36
Alangium tamarckii ..	10	19	8	18
Chloroxylon swietenia ..	10	22	5	16
Erythroxylon monogynum ..	6	21	4	19
Mangifera indica	9	18	8	17
Pterocarpus marsupium ..	6	11	6	8
Santalum album	6	32	4	32
Strychnos nux vomica ..	30	59	29	54

91. An experiment in the Karian shola evergreen nursery, with *Dipterocarpus indicus*, gave the following results :—

	Generation per cent.	Plant per cent.
A. Full shade with bamboo thatties	20	12
B. 50 per cent shade with bamboo reepers	20	14
C. Control, open	24	11

This seems to indicate that *Dipterocarpus indicus*, requires in Mount Stuart, initially open beds for germination, followed by a light (50 per cent) shade, for establishment.

92. An experiment done in Chandanathode with *Dysoxylum malabaricum* with 100 per cent shade, 50 per cent shade, and Open Control, indicates that with this species, the differences in shade conditions do not produce a significant difference in mean height growth, while the survival percentage in the open was exceptionally low. Judged by survival percentage 50 per cent shade appears to be the best for this species.

93. *Nursery watering experiment.*—Experiments were repeated at Emmanur Experimental Garden nursery to endeavour to determine the amount and periodicity of watering necessary in a nursery to give the best results in germination and survivals. Three species were experimented with : *Albizzia amara*, *Acacia planifrons*, and *Prosopis juliflora*, and three treatments tried, (*a*) beds watered with 8 to 10 gallons of water per bed every day, (*b*) beds watered with 8 to 10 gallons of water per bed once in two days, and (*c*) beds watered with 4 to 5 gallons of water per bed once in two days.

94. Results including those of previous years are :—

Species.		Treatment. A 10 gallons daily.	B 10 gallons on alternate days.	C 5 gallons on alternate days.
Albizzia amara	Germination per cent ..	30	22	22
	Mean height in inches ..	13	10	9
Prosopis juliflora ..	Germination per cent ..	18	15	16
	Mean height in inches ..	11	10	8
Acacia planifrons ..	Germination per cent ..	43	37	35
	Mean height in inches ..	24	21	20

95. The above figures seem to indicate that watering with 10 gallons daily, appears to result in a slightly better percentage of survivals, and slightly better height growth than watering with 10 or 5 gallons of water on alternate days. But the differences do not appear to be appreciable.

96. *Effect of repeatedly using the same nursery beds.*—In paragraphs 53 to 56 of the Annual report for the year 1939–40 the object of these experiments, and past results have been set out in detail. During 1940–41 only two treatments, namely, (A) beds sown each year with no manuring, and (D) beds sown each year but manured with wood ash and leaf mould, were done in Experimental Plot No. 136/1935 Nilambur division. In the three other Experimental Plots all four treatments were done, i.e., A and D as shown above, (B) beds left fallow in alternate years, and (C) a green manure crop grown in the beds in alternate years and dug in.

97. The results during the year 1940–41 are tabulated below :—

Nilambur Experimental Plot No. 136.

Year.	Number of usable stumps per standard bed. A	B	C	D
First year	1,353	1,353	1,353	1,353
Second year	2,156	..	..	2,593
Third year	925	1,708	2,035	1,509
Fourth year	659	..	..	621
Fifth year	1,107	1,239	1,660	1,049
Sixth year	1,050	..	..	1,099

Year.	Mean diameter of usable stumps. A	B	C	D
First year	0·43	0·43	0·43	0·43
Second year	0·43	..	..	0·42
Third year	0·43	0·44	0·47	0·44
Fourth year	0·42	..	..	0·41
Fifth year	0.40	0·42	0·42	0·41
Sixth year	0·41	..	..	0·43

98. Up to 1940–41 the production of stumps in the fifth year in four experimental plots are tabulated below :—

Locality.	Experimental plot number.	Year.	Number of usable stumps per standard bed. A	B	C	D
Nilambur, ..	136	1935	1,107	1,239	1,660	1,049
Coimbatore, South	68·	1936	1,492	1,417	1,504	1,279
Palghat ..	152	1936	2,578	2,925	2,464	3,094
Wynaad ..	34	1936	620	542	443	490
Total ..	..	..	5,797	6,123	6,071	5,912
Average ..	..	..	1,449	1,531	1,518	1,478

Locality.	Experimental plot number.	Year.	Mean diameter of stumps.			
			A	B	C	D
Nilambur ..	136	1935	0·40	0·42	0·42	0·41
Coimbatore, South	68	1936	0·47	0·47	0·48	0·51
Palghat ..	152	1937	0·44	0·42	0·43	0·42
Wynaad	34	1938	0·40	0·40	0·40	0·42
Average ..	..		0·43	0·43	0·43	0·44

99. This average compared with previous averages is exhibited below :—

Year.	Number of usable stumps.			
	A	B	C	D
1936–37	1,688	1,688	1,688	1,688
1937–38	935	..	..	1,101
1938–39	943	1,092	1,351	1,145
1939–40	708	..	..	632
1940–41	1,449	1,531	1,518	1,478

Year.	Mean diameter of stumps.			
	A	B	C	D
1936–37	0·42	0·42	0·42	0·42
1937–38	0·41	..	..	0·44
1938–39	0·40	0·40	0·41	0·41
1939–40	0·39	..	..	0·41
1940–41	0·43	0·43	0·43	0·44

100. These figures indicate that judged by the number of stumps produced per standard bed, repeated use of the same nursery bed with or without artificial manuring causes a falling off in production. The preliminary indication is therefore that it is not advisable to use the same nursery beds year after year even with manuring in some form, as apart from the liability of pests to come in, production falls off.

101. *Nursery methods for the production of teak stumps—Determination of the quantity of seed required per standard bed.*—The experiments done from 1933 to 1940 have been reviewed in paragraphs 57 to 60 of the Annual Report for the year 1939–40. It has been reported in paragraph 60 of that report that "the indication is that the best procedure is to sow evenly about 20 to 30 lb. of seed per standard bed and do no pricking out of seedlings at all. This is most economical in both cost and quantity of seed." Such a bed produced enough good stumps of usable size to plant 1 acre at an espacement of 6 feet by 6 feet; and undersized plants could be stumped and replanted in the nursery, or left over for the second year when they, supplemented by germinations from dormant seed in the beds, could produce a further quantity of utilizable stumps. As substantial confirmation of previous work had been obtained, this part of the investigation was concluded.

102. To see whether further economy in seed is possible without a corresponding reduction in the number of utilizable stumps per standard bed, the following Experimental Garden Experiments have been opened. Begur Experimental Garden Experiment No. 175/1940, Dhoni Experimental Garden Experiment No. 212/1940, and Topslip Experimental Garden Experiment No. 229/1940. In these experiments the effect of sowing (A) 30 lb., (B) 20 lb. and (C) 10 lb. of teak seed per standard (40 feet by 4 feet) bed on the number, and size of utilizable stumps per bed are being investigated.

103. The results at the end of the first growing season are tabulated below :—

Locality.	Experimental garden Experiment number.	Year.	Number of utilizable stumps.			Average diameter of utilizable stumps inches.		
			A	B	C	A	B	C
Begur ..	175	1940	726	858	584	0·46	0·46	0·47
Dhoni ..	212	1940	1,553	1,567	1,142	0·45	0·49	0·47
Topslip ..	229	1940	371	442	125	0·50	0·54	0·46
Average ..			883	889	617	0·47	0·50	0·47

104. The indications therefore are—

(1) 10 lb. of teak seed is too small a quantity for a standard (40 feet by 4 feet) nursery bed, in the localities where the experiment has been tried;

(2) There seems to be no appreciable difference in the number of utilizable stumps per bed produced by sowing 30 lb. and 20 lb. per bed respectively; but

(3) the lighter sowing appears to produce stumps with slightly better diameter. The experiment requires confirmation by repetition. It may however be noted that 883 utilizable stumps per bed are insufficient to plant one acre at an espacement of 6 feet by 6 feet; and the cost of making extra nursery beds may offset the economy in seed.

105. *Experiments on production of usable stumps in the second year from undersized plants of the first year.*—The necessity for these experiments have been explained in detail in paragraphs 61 to 63 of the Annual report for the year 1939–40.

106. The experiments on the result of putting back into the nursery undersized plants, as transplants, and as stumps, to investigate the possibility of producing from them utilizable stumps, after another year, have been continued.

107. The outturn of these plants in the 1940 experiments at the end of the second year is as follows :—

(i) Plants put back as transplants.

Centre.	Number of transplants put in.	Number of usable stumps.	Percentage.	Average diameter.
Begur	500	396	70	0·49
Dhoni	500	481	96	0·54
Topslip	1,000	667	67	0·54
Total ..	2,000	1,544	*77	* 0·53

(ii) Plants put back as stumps.

Begur	500	432	86	0·50
Dhoni	500	351	70	0·58
Topslip	1,000	750	75	0·58
Total ..	2,000	1,533	*77	* 0·56

108. The results of the last five years recapitulated are—

Year of experiment.	Plants put back as transplants.		Plants put back as stumps.	
	Average percentage of plants that produced usable stumps.	Average diameter of usable stumps.	Average percentage of plants that produced usable stumps.	Average diameter of usable stumps.
		INCHES.		INCHES.
1940	77	0·53	77	0·56
1939	46	0·46	68	0·48
1938	55	0·51	63	0·53
1937	39	0·48	54	0·55
1936	48	0·52	65	0·49
Average ..	53	0·50	65	0·52

109. The above figures indicate that if undersized plants are to be put back in the nursery for a second year, they should be put back as stumps, rather than as entire transplants. If this is done, instead of wasting about 50 per cent of the nursery stock at the end of the first year, only about 18 or 20 per cent is eventually wasted.

110. These usable stumps obtained from material normally wasted have been planted out for the last four years to compare plants produced from them with those produced from normal fresh

* Average.

full sized one-year old stumps. Their growth and survivals after one growing season are given in the following table :—

Locality.	Experimental Garden Experiment number.	Year.	Survival percentage.			Mean height in inches.		
			Fresh.	Plants put back for second year as below and then stumped.		Fresh.	Plants put back for second year as below and then stumped.	
				Transplants.	Stumps.		Transplants.	Stumps.
Anaipadi ..	214	1940	95	96	97	50·4	47·2	49·2
Dhoni ..	196	1940	100	99	100	39·6	35·9	34·2
Begur ..	154	1940	90	98	97	12·6	17·5	16·3
Average of 1940 experiments ..			95	98	98	34·2	33·5	33·2
Average of 1939 experiments ..			96	94	96	25·8	25·5	27·6
Average of 1938 experiments ..			90	91	94	21·9	23·2	21·3
Average of 1937 experiments ..			88	90	96	33·9	40·0	41·5
Average of 1937, 1938, 1939 and 1940 experiments			92	93	96	29·0	28·7	30·9

111. It is thus seen that putting undersized seedlings back in the nursery for a second year produced plants at the end of the second year which when stumped and planted out are in no way inferior in their early development to fresh one year-old stumps. The general adoption of the method of putting back for a second year into the nursery undersized plants, will help us to tide over years of seed shortage, as the last seven years have been. The indications are therefore, that if an endeavour is made to have in district nurseries sufficient plants for two years' planting, we may have sufficient stock not only as a reserve against unforeseen calamities, but also to tide over bad seed years.

(v) Artificial Regeneration.

(a) Mixed deciduous timber forests.

112. *Development of artificial regeneration in gaps.*—For determining whether gaps in which " gap regeneration " of teak was done could be left to themselves after they had been regenerated and intensively tended for two years, Experimental Plot No. 64, South Coimbatore division and Experimental Plot No. 28, Wynaad division were started in September 1935. These plots contained ten and fifteen gaps respectively, each gap being about 30 feet square and containing about 25 teak plants each. No tending at all is done, and their development and ultimate fate is being watched. Each gap will be considered successful, if ultimately one good teak tree in it comes to maturity. Average of the heights of the best plants in each gap, taken for each locality is tabulated below :—

Division.	Experimental Plot number.	Year.	Mean height of best plants in inches.						
			1935.	1936.	1937.	1938.	1939.	1940.	1941.
South Coimbatore ..	64	1935	34·6	36·7	37·9	50·0	69·4	79·4	124·8 *
Wynad	28	1935	..	144·8	200·5	235·2	267·6	230·4 †	277·6

* Average of eight gaps as two gaps are blank.
†.Negative increment due to damage by elephants.

Even the best trees in the gaps are thus growing very much slower than they would have done in a normal plantation.

113. A further experiment on this subject was started in 1938. In this experiment gaps planted in 1935 were intensively tended for two years and then left to themselves. Half of the gaps were at an espacement of 3 feet by 3 feet and the other half at an espacement of 6 feet by 6 feet. The plants in the gaps are liable to serious damage by wild elephants, bison, deer, lantana and bamboos. In 1939 there was an accidental fire through some of these gaps. After careful consideration it was decided that measurements should be done in nine of the 3 feet by 3 feet espacement gaps, and seven of the 6 feet by 6 feet gaps. In 1940 the average height of the best plant per gap of the 3 feet by 3 feet espacement gaps was 18·6 feet while the average height of the best plant per gap of the 6 feet by 6 feet espacement gaps was 21·0 feet considering only the undamaged gaps. In 1941 the average height of the best plants in the undamaged 3 feet by 3 feet espacement gaps is 22·0 feet while the average height of similar plants in the undamaged 6 feet by 6 feet gaps is 24·71. The Mean Annual height increment in the 3 feet by 3 feet gaps is therefore 3·40 feet against a Mean Annual height increment of 3·71 feet in the 6 feet by 6 feet gaps. Valuable silvicultural information such as the relative capacity of the plants in the gaps of the two different espacements to survive invasion by weeds climbers, etc., and the capacity of such gap regeneration to recover from the effects of accidental fires, is being recorded.

114. It appears that in these localities "gap regeneration" with teak has not succeeded. Therefore an investigation was started in 1937 to try and raise a valuable crop under the canopy of a comparatively worthless crop.

115. In Experimental Plot No. 39, Wynaad division, at Begur, an area not fit for teak was selected, and the undergrowth up to 20 feet felled and burned. The following species have been tried, by the methods indicated, and the present survivals, and Mean height are recorded, and compared with the heights of 1939–40 to show development.

Species and method.	Survival percentage. 1941.	Mean height in inches. 1941.	Mean height in inches. 1940.	Increment in inches.
1 *Lagerstræmia flos reginæ*, sowing.	92·5	23·6	13·6	10·0
2 *Lagerstræmia lanceolata* sowing ..	93·0	45·6	21·7	23·9
3 *Terminalia paniculata*, sowing ..	16·5	20·5	10·5	10·0
4 *Artocarpus hirsuta*, stumps ..	89·0	13·9	16·8	—2·9 *
5 *Dalbergia sissoides*, stumps ..	94·5	16·8	15·1	1·7
6 *Pterocarpus marsupium*, stumps ..	92·8	19·3	14·6	5·2
7 *Terminalia crenulata*, stumps ..	78·3	27·5	15·9	11·6
8 *Swietenia macrophylla*, transplants	76·3	72·6	50·3	22·3
9 Ceylon *Chloroxylon swietenia*—				
Transplants	97·0	28·4	29·5	—1·1 *
Stumps	98·5	43·6	19·5	24·1
10 Madras *Chloroxylon swietenia*—				
Transplants	72·0	15·2	16·7	—1·5 *
Stumps	86·5	24·0	10·6	13·4

* Negative increment due to casualties.

116. *Comparison of direct sowing, entire transplanting and stump planting—Artocarpus integrifolia.*—Four experiments were done with this species at four centres, and results are tabulated. For comparison, previous years' results are also given.

In one case shoot cuttings obtained after stumping were tried. It may be noted that some success has been obtained.

Locality.	Experimental Garden Experiment number.	Year.	Survival percentage. Sowing.	Transplanting.	Stump planting.	Cutting planting.	Mean height in inches. Sowing.	Transplanting.	Stump planting.	Cutting planting.
Anaipadi	225	1940	84	85	38	..	27·56	29·18	12 04	..
Dhoni	195	1940	99	98	59	..	30·49	29·07	20·02	..
Begur	161	1940	97	15	20	..	25·67	19 66	16·75	..
Kannoth	95	1940	99	22	62	47	34·06	22·50	14·59	18·32
Average of 1940 experiments	95	..	95	55	45	47	29·4	25·1	16·1	18·3
Average of 1939 experiments	..	..	99	67	69	..	29·1	20·6	18·6	..
Average of 1938 experiments	..	..	100	80	63	..	40·3	25·8	15·9	..
Average of 1938, 1939 and 1940 experiments ..	..	..	98	67	59	47	32·9	23·8	16·9	18·3

117. The indication is that the best method of raising *Artocarpus integrifolia* in the localities mentioned is by direct sowing; and entire transplants are preferable to stump plants.

118. *Bombax malabaricum.*—Three experiments at three centres were done with this species, and results are tabulated below, with those of the prveious year for comparison.

Locality.	Experimental garden experiment number.	Year.	Survival percentage. Sowing.	Transplanting.	Stump planting.	Cutting planting.	Mean height in inches Sowing.	Transplanting.	Stump planting.	Cutting planting.
Begur	165	1940	73	96	75	7	4·23	15·39	5·08	5·29
Dhoni	202	1940	99	88	88	..	6·82	9·21	8·79	..
Kannoth	99	1940	62	93	76	2	4·74	17·89	6·36	3·00
Average of 1940 experiments	..	..	78	92	80	4	5·26	14·16	6·74	4·14
Average of 1939 experiments	..	..	94	94	..	..	8 0	6·9	..	..
Average of all four experiments	..	..	82	93	80	4	5·95	12·35	6·74	4·14

119. The preliminary indications are that the species cannot be successfully raised by planting shoot cuttings, and that it can successfully be raised by sowing, transplanting, and stump planting. It however appears that entire transplanting is preferable to the other two methods, but this result requires confirmation by repetition.

120. *Broussonetia papyrifera (the paper mulberry).*—An experiment was done at Begur with this species comparing planting of entire transplants, stump plants, and shoot cuttings. The

result is given below. No conclusions are drawn as this is the only experiment done so far on the subject.

Locality.	Experimental Garden Experiment number.	Year.	Survival percentage by planting.			Mean height in inches by planting.		
			Entire transplants.	Stump plants.	Shoot cuttings.	Entire transplants.	Stump plants.	Shoot cuttings.
Begur	174	1940	99	100	98	7·54	7·14	7·20

121. The indication is that this species can be successfully raised by all three methods; and if this is confirmed by repetition, regeneration by stump plants and shoot cuttings will be indicated, for, one nursery plant while giving *only* one entire transplant, can give one stump, and one or more shoot cuttings.

122. *Chloroph*ora *excelsa*.—Two experiments were done at two centres with this species, and results are tabulated below :—

Locality.	Experimental Garden Experiment number.	Year.	Survival percentage.				Mean height in inches.			
			Sowing.	Transplanting.	Stump planting.	Cutting planting.	Sowing.	Transplanting.	Stump planting.	Cutting planting.
Begur	162	1940	44	97	86	21	14·95	23·33	18·49	22·33
Kannoth	96	1940	2	76	88	43	6·00	24·35	14·50	17·18
Average of 1940 experiments	..	..	23	87	87	32	10·48	23·84	16·50	19·76

123. This experiment indicates that transplanting entire transplants is the best method of raising this species, while it can also be raised by stump planting. Stump planting appears to have this advantage that while stumps are cut, the shoot cuttings that would normally be wasted could be used to add to the percentage of success with the same number of nursery plants. The indications require confirmation by repetition of the experiment.

124. *Evodia roxburghiana*.—Three experiments at three centres were done with this species, and the results are tabulated below :—

Locality.	Experimental Garden Experiment number.	Year.	Survival percentage.				Mean height in inches.			
			Sowing.	Transplanting.	Stump planting.	Cutting planting.	Sowing.	Transplanting.	Stump planting.	Cutting planting.
Begur	164	1940	0	16	11	..	0	25·00	8·55	..
Dhoni	204	1940	25	62	15	..	10·96	18·73	11·60	..
Kannoth	98	1940	23	85	92	60	5·48	36·36	12·66	16.55
Average of 1940 experiments	..	..	16	54	39	60	5·48	26·69	10·94	16·55

125. The results require confirmation by repetition, but the indications are that the species can be successfully raised by entire transplanting (best) and by planting stumps, and shoot cuttings.

126. *Grewia tiliæfolia*.—Three experiments at three centres have been done with this species and the results are tabulated below :—

Locality.	Experimental Garden Experiment number.	Year.	Survival percentage.				Mean height in inches.			
			Sowing.	Transplanting.	Stump planting.	Cutting planting.	Sowing.	Transplanting.	Stump planting.	Cutting planting.
Begur	163	1940	87	80	99	83	22·57	49.74	56·90	54·38
Dhoni	201	1940	92	88	88	..	27·00	19·68	43·08	..
Kannoth	97	1940	0	92	85	68	0	41·55	22·86	36·88
Average of 1940 experiments	..	..	60	87	91	76	16·52	36·99	40·95	45·63

127. The above results indicate that the species can be successfully raised by transplanting, stump planting and planting shoot cuttings, and as each nursery plant can give only one entire transplant, while it can give one stump, and one or more shoot cuttings, stump planting and planting shoot cuttings may be better. The result requires confirmation by repetition.

128. *Lagerstræmia flos reginæ*.—Four experiments were done with this species at four centres, and results are tabulated below, with those of previous years for comparison.

Locality.	Experimental Garden Experiment number.	Year.	Survival percentage.			Mean height in inches.		
			Sowing.	Transplanting.	Stump planting.	Sowing.	Transplanting.	Stump planting.
Anaipadi	224	1940	28	34	76	11·60	14·18	23·77
Begur	157	1940	93	100	99 73 *	8·81	16·13	18·45 8·68 *
Dhoni	200	1940	61	74	99	9·69	11·63	20·20
Kannoth	91	1940	4	99	71 27 *	6·00	37·05	13·92 20·84 *
Average for 1940 experiments	..	..	47	77	86 50 *	9·02	19·75	19·09 14·76 *
Average for 1939 experiments	..	..	52	72	95	10·0	14·0	21.3
Average for 1938 experiments	..	..	66	72	67	8·5	12·00	20·3
Average of 3 years' experiments	..	..	55	74	83 50 *	9·2	15·3	20·2 14·76 *

129. The results indicate that stump planting is likely to be the best method for raising this species in the localities mentioned.

* These are results of planting shoot cuttings, which would normally be wasted when cutting stumps.

130. *Lagerstramia lanceolata.*—Three experiments were done with this species at three centres, and results are tabulated, with those of previous years for comparison :—

Locality.	Experimental Garden Experiment number.	Year.	Survival percentage. Sowing.	Transplanting.	Stump planting.	Mean height in inches. Sowing.	Transplanting.	Stump planting.
Anaipadi	223	1940	1	38	26	13·00	20·23	19·34
Begur	156	1940	87	92	71	17·28	22·81	25·84
Dhoni	198	1940	10	59	51	15·20	14·00	19·25
Average of 1940 experiments	..	..	33	63	49	15·16	19·01	21·48
Average of 1939 experiments	..	..	24	66	93	8·1	15·1	26·1
Average of 1938 experiments	..	..	72	54	84	16·0	17·4	31·6
Average of 3 years' experiments ..	..	..	43	61	75	13·1	17·2	26·4

131. Judged both by survival per cent and mean height growth, stump planting is indicated as the best method for raising this species in the localities mentioned.

132. *Mangifera indica.*—Four experiments at four centres were done with this species, and results are tabulated below with those of previous years for comparison :—

Locality.	Experimental Garden Experiment number.	Year.	Survival percentage. Sowing.	Transplanting.	Stump planting.	Mean height in inches. Sowing.	Transplanting.	Stump planting.
Anaipadi ..	219	1940	65	55	23	8·63	7·27	5·26
Begur ..	160	1940	100	94	36	18·21	19·24	7·05
Dhoni ..	203	1940	84	78	3	13·65	11·55	4·00
Kannoth ..	93	1940	84	94	7	14·93	21·34	8·14
Average of 1940 experiments			83	80	17	13·86	14·85	6·11
,, 1939 experiments			83	73	12	13·6	10·6	3·7
Average of 2 years' experiments ..			83	77	15	13·7	12·7	4·9

133. The indications are that direct sowing is the best method of raising this species, and that the species cannot be raised satisfactorily by stump planting. But the results require confirmation by repetition.

134. *Pterocarpus dalbergioides* (Andaman Padauk).—Experimental Garden Experiment No. 85 at Kannoth, was done with this species in a ponam crop of hill paddy. The results have been reported in paragraph 70 of the annual report for the year 1939–40.

The conclusions of five years' work with the species is that sowing and stump planting gave very poor results, while transplanting entire transplants gave very fair results, and the bigger sizes of transplants appear to do better than the smaller sizes. As sufficient evidence has been obtained further work on this subject with this species has been discontinued.

135. *Schleichera trijuga.*—Four experiments were done with this species, on this subject at four centres. Results are given below with those of previous years for comparison.

Locality.	Experimental Garden Experiment number.	Year.	Survival percentage. Sowing.	Transplanting.	Stump planting.	Mean height in inches. Sowing.	Transplanting.	Stump planting.
Anaipadi ..	220	1940	4	53	85	24·85	10·59	13·65
Begur ..	159	1940	34	85	91	2·97	10·41	7·76
Dhoni ..	197	1940	92	67	63	5·89	7·13	4·48
Kannoth ..	94	1940	30	95	97	3·13	9·31	4·65
Average of 1940 experiments			40	76	84	9·21	9·36	7·64
,, 1939 ,, ...			80	91	62	5·0	9·0	5·7
,, 1938 ,, ...			86	69	76	10·6	11·2	11·3
,, 1937 ,, ...			40	46	64	23·7	17·8	26·6
,, 1936 ,, ...			40	40	90	8·5	5·4	7·2
Average of 5 years' experiments ..			57	64	75	11·4	10·6	11·7

136. Although results in different localities and in different years differ very much considering the average of five years' experiments, the indication is that the best method of raising this species is by stump planting.

137. *Sterculia urens.*—Only one experiment has been done with this species, and the result is tabulated below. In this experiment, judged both by survival per cent, and significant difference of mean height growth, stump planting has given the best result. But this is only to be taken as an indication, for the experiment requires confirmation by repetition.

Locality.	Experimental Garden Experiment number.	Year.	Survival percentage. Sowing.	Transplanting.	Stump planting	Mean height in inches. Sowing.	Transplanting.	Stump planting.
Anaipadi ..	226	1940	8	60	75	2·75	5·10	5·87

138. *Swietenia macrophylla.*—Three experiments of 1938, and one experiment of 1940 were measured up during the year. The object of these experiments was the comparison of direct sowing,

and planting with three different sizes of transplants, i.e., big, medium and small. The results are tabulated below :—

Locality.	Experimental Garden Experiment number.	Year.	Survival percentage mean height.						
			Transplanting entire.				Transplanting entire.		
			Sowing.	Big.	Medium.	Small.	Sowing.	Big.	Medium.	Small.
Anaipadi	176	1938	1	24	56	53	6·20	6·24	5·99	5·39
Begur ..	122	1938	96	79	81	46	5·38	6·01	5·64	5·35
Dhoni ..	161	1938	89	84	71	50	7·34	8·45	7·71	7·20
Average after 3 growing seasons.			62	62	69	50	6·31	6·90	6·45	5·98
Kannoth ..	72	1940	..	..	..	..	..	..	..	..
After one growing season.		..	46	78	24	71	5·28	5·93	5·31	5·30

139. These results indicate that for raising *Swietenia macrophylla* in these localities, entire transplanting big plants is the best method.

140. *Terminalia paniculata*.—Four experiments were done with this species on this subject at four centres. Results are given below with those of previous years for comparison.

Locality.	Experimental Garden Experiment number.	Year.	Survival percentage.			Mean height in inches.		
			Sowing.	Transplanting.	Stump planting.	Sowing.	Transplanting.	Stump planting.
Anaipadi	218	1940	12	38	62	11·25	17·92	27·96
Begur	155	1940	24	91	84	8·96	23·42	28·04
Dhoni	199	1940	85	85	88	3·77	7·99	8·76
Kannoth	90	1940	2	52	60	3·50	8·79	11·40
Average of 1940 experiments			31	67	74	6·87	14·53	19·04
,, 1939 ,, ...			37	67	75	7·3	9·2	12·9
,, 1938 ,, ...			26	52	73	8·2	9·1	16·6
,, 1937 ,, ...			..	53	87	..	8·8	12·7
Average of 4 years' experiments			29	60	77	5·6	10·4	15·3

141. The above results indicate that judged both by survival percentage and mean height growth of resulting plants, stump planting is the best method for raising this species.

142. *Trema orientalis*.—Four experiments at four centres were one with this species, and results are tabulated below with those f previous years for comparison :—

Locality.	Experimental Garden Experiment number.	Year.	Survival percentage.				Mean height in inches.			
			Sowing.	Transplanting.	Stump planting.	Cutting planting.	Sowing.	Transplanting.	Stump planting.	Cutting planting.
aipad i ..	222	1940	69	14	52	..	65·76	71·52	84·84	..
gur ..	158	1940	78	100	59	60	44·70	66·10	63·32	..
oni ..	205	1940	85	92	..	..	44·64	48·72	..	66·08
unoth ..	92	1940	16	3	3	4	11·75	26·00	..	..
erage of 1940 experiments ..			62	52	29	32	41·71	53·09	10·67	15·00
,, 1939 ,, ..			37	49	30	..	45·2	53·5	39·71	40·54
,, 1938 ,, ..			54	83	53	..	37·9	55·5	40·7	..
rage of 3 years' experiments.			51	61	37	32	41·6	54·0	46·9	..
									42·4	40·54

143. The results indicate that transplanting is likely to be the best method of regenerating this species; and the next best method is probably direct sowing.

144. *Vitex peduncularis*.—Only one experiment has been done with this species at Dhoni (Experimental Garden Experiment No. 206 of 1940) to compare stump planting with transplanting. Stump planting gave 89 per cent survivals with an average height of 1·27 feet (15·24 inches) while planting entire transplants gave a survival percentage of 77 per cent with an average height of 1·63 feet. Entire transplanting has thus given a significantly better height growth, while stump plants have given a better percentage of survivals. The experiment requires repetition.

145. *Pre-monsoon stump planting—Teak—Nilambur division*.—The experiments mentioned in paragraph 82 of the annual report for the year 1939–40 have been continued.

Abbreviated results as measured at the end of the first growing season after planting are as follows :—

Experimental Garden Experiment number.	Year.	Stumps planted on				
		1st April.	15th April.	1st May.	15th May.	1st June.
		Survival percentag .				
16	1940	10	49	98	96	96
12	1939	51	85	71	26	87
10	1938	98	97	98	100	97
Average ..		53	77	89	74	93
		Mean height in inches.				
16	1940	39·90	39·65	45·34	31·99	26·46
12	1939	30·7	38·0	20·1	14·8	16·3
10	1938	48·1	43·2	41·4	47·3	40·4
Average ..		39·6	40·3	35·6	31·4	27·7

146. Abbreviated results as measured at the end of the second growing season after planting are as follows :—

Experimental Garden Experiment number.	Year.	Stumps planted on				
		1st April.	15th April.	1st May.	15th May.	1st June.
		Survival percentage.				
12	1939	50	85	71	25	87
10	1938	90	95	95	100	95
Average ..		70	90	83	63	91
		Mean height in feet.				
12	1939	6·80	7·40	5·34	5·03	4·86
10	1938	13·6	12·8	12·3	13·0	12·1
Average ..		10·2	10·1	8·8	9·0	8·5

147. It would thus be seen that judged after two growing seasons, plants raised by stump planting in the middle of April still retain their lead.

148. Abbreviated results as measured at the end of the third growing season after planting are as follows :-

Experimental Garden Experiment number.	Year.	Stumps planted on 1st April.	15th April.	1st May.	15th May.	1st June.
		Survival percentage.				
10	1938	98	97	98	100	98
		Mean height in feet.				
10	1938	21·10	21·07	20·59	21·25	19·66

149. In the third year, in this experiment, the early differences have shown a tendency to disappear; but this observation requires confirmation by repetition.

150. Similar experiments have been done with teak grown in conjunction with a ponam crop of paddy.

151. Abbreviated results as measured at the end of one growing season after planting are as follows :—

Experimental Garden Experiment number.	Year.	Stumps planted on 1st April.	15th April.	1st May.	15th May.	1st June.
		Survival percentage.				
17	1940	17	63	58	78	84
13	1939	36	85	72	54	95
Average		27	74	85	66	90
		Mean height in inches.				
17	1940	25·77	28·58	34·62	21·26	12·75
13	1939	42·3	44·6	22·0	11·7	14·9
Average		34·1	36·6	28·3	16·5	13·8

152. For Experimental Garden Experiment No. 13 of 1939, abbreviated results at the end of the second growing season are as follows :—

	Stumps planted on 1st April.	15th April.	1st May.	15th May.	1st June.
Survival percentage	35	86	72	53	94
Mean height in inches	13·11	13·48	10·19	7·69	8·80

153. It would thus appear that even when teak is stump planted with a ponam crop in Nilambur, the middle of April is probably the best date. The experiment requires repetition for confirmation of the indications obtained.

(For full experimental data *see* paragraph 186.)

154. *Best date of stump planting—District Work—Godavari Upper Division.*—The results from experiments conducted in the Upper Godavari division have been analysed, and the general indication that the best date for stump planting teak in this division is the middle of June or even a few days earlier has been recorded in paragraph 84 of the Annual Report for 1939–40.

155. *Kurnool West division.*—Experiments in this division have been continued, and abbreviated results at the end of the first growing season after planting are :—

Survival percentage.

Year of experiment.	Stumps planted in Mid April.	Early May.	Mid May.	Early June.	Mid June.	Early July
1935	67	79	1	93	100	95
1936	4	10	9	100	94	81
1937	91	70	90	97	99	89
1938	35	49	67	99	93	92
1939	5	4	11	21	82	72
Average ..	40	60	36	82	94	86
	Mean height growth in inches.					
1935	6·4	5·9	6·1	7·3	9·6	3·9
1936	19·0	22·2	20·4	22·6	12·0	8·8
1937	28·2	17·5	10·7	11·1	16·5	7·2
1938	9·8	12·9	12·2	14·2	7·3	3·0
1939	8·2	7·8	10·3	13·5	15·8	10·2
Average ..	14·32	13·25	11·94	13·74	12·24	6·62

156. The indications are that the best period for stump planting in this division is from early June to about mid June.

157. The results of remeasurement of all these plots in 1940 are exhibited below :—

Survival percentage.

Year of planting.	Measured after the lapse of	Stumps planted. Mid April.	Early May.	Mid May.	Early June.	Mid June.	Early July.
1939	1 year	5	4	11	21	2	72
1938	2 years	36	49	68	99	92	95
1937	3 ,,	92	71	88	97	100	88
1936	4 ,,	84	100	9	100	95	80
1935	5 ,,	65	78	81	93	97	94
	Mean height growth in inches.						
1939	1 year	8·20	7·75	10·27	13·52	15·80	10·24
1938	2 years	47·22	55·84	56·41	62·18	52·51	39·54
1937	3 ,,	120·04	113·80	104·26	101·11	113·59	91·18
1936	4 ,,	94·30	93·40	98·36	96·98	92·52	87·90
1935	5 ,,	61·4	58·7	58·4	58·7	68·1	60·8

158. In the above table, the maximum percentages, and the maximum heights for each year are underlined. The indication is that even five years after planting, the benefit of early stump planting is still noticeable in the greater percentage of survivals and the greater mean height of the resulting plants. It would thus appear that the initial advantage is still maintained.

159. *Godavari Lower division.*—In 1939, an experiment on the best date of stump planting has been done in the Godavari Lower division, in Teak Coupe No. V, Beddanole R.F. Measurements at the end of the first growing season after planting are tabulated below :—

Year of experiment.	Stumps planted on 15th April.	1st May.	15th May.	1st June.	15th June.	1st July.
Survival per cent	..	..	..	..	14	43
Mean height in inches	..	..	..	..	4·6	3·8

The rainfall in April and May 1939 was nil, and in June it was only 1·2 inches which was abnormally light. Hence no conclusions can be drawn from the above data.

160. In general, it appears that the principle of pre-monsoon stump planting of teak applies not only to localities with a West Coast type of climate, but also to other districts. But as climatic conditions for different districts differ, each district has got to determine for itself its own best date for stump planting teak. It appears however that the advantage of planting teak stumps before the onset of the monsoon has been demonstrated, as of general application.

161. *Stump planting in pits and crowbar holes.*—Experiments in this subject have been continued in the Kurnool West Division. The results of measurements at the end of the first growing season after planting show :—

Year of experiment.	Survival percentage. Pits.	Survival percentage. Crowbar holes.	Mean height in inches. Pits.	Mean height in inches. Crowbar holes.
1935	99	99	15·2	12·4
1936	96	93	18·6	14·8
1937	97	98	11·9	7·9
1938	100	96	14·5	10·9
1939	92	94	22·53	24·27
Average ..	97	96	16·54	14·03

162. Stump planting in pits has thus given about 18 per cent more height growth than stump planting teak in crow bar holes, the actual mean difference being 2·51 inches only. It is therefore for the consideration of districts if this very small increase in height growth is commensurate with the extra expense involved in digging pits.

163. Digging pits, in conjunction with pre-monsoon stump planting may involve the practical question of artificially moistening hard soil to facilitate the digging of pits, and consequent increase in costs, and the question therefore requires very careful consideration.

164. "*Shaving*" *of teak stumps.*—Three experiments in three localities have been done to determine whether it is necessary to carefully cut off strong side roots, and the small rootlets and root hairs of teak stumps.

165. Abbreviated results after one growing season are as follows :—

Survival percentage.

Locality.	Experimental Garden experiment number.	Year.	Date of planting. 1st April 1940. Normal.	1st April 1940. Shaved.	1st June 1940. Normal.	1st June 1940. Shaved.
Anaipady ..	212	1940	98	98	98	97
Begur	167	1940	38	64	76	87
Dhoni	207	1940	100	99	86	90
Average of 1940 experiments ..	..	..	79	87	87	91
„ 1939 „ ..	..	..	95	94	94	95
„ 1938 „ ..	..	..	96	97	98	97
Average of 3 years experiments ..			90	93	93	94

Mean height growth in inches.

Anaipady ..	212	1940	56·40	57·12	22·56	22·56
Begur	167	1940	17·93	15·21	7·75	8·23
Dhoni	207	1940	18·44	16·84	7·92	7·13
Average of 1940 experiments			30·92	29·72	12·74	12·64
„ 1939 „			32·4	30·3	13·1	14·5
„ 1938 „			31·2	32·5	16·1	15·2
Average of 3 years experiments			31·5	30·8	14·0	14·1

166. The above data indicate that judged by survival per cent and Mean height growth at the end of the first growing season, there is no advantage derived by " shaving " teak stumps.

These data again demonstrate the greatly increased height growth obtained by early stump planting of teak.

167. *Teak—Stump-planting teak, effect of depth of planting.*—The experiments in this subject were continued and were done at five centres. Six treatments were applied, as follows :—

(*a*) Stumps planted early (April) normally, i.e., 1 inch shoot above ground.

(*b*) Stumps planted early (April), the entire stump buried below ground level.

(*c*) Stumps planted early (April), as in (*a*) but the shoot covered by a mound of earth.

(*d*) Stumps planted late (June) but normally as in (*a*).

(*e*) Stumps planted late (June) but as in (*b*), i.e., buried below ground level.

(*f*) Stumps planted late (June) but as in (*c*) with a mound of earth covering the shoot.

168. Abbreviated results are as follows :—

Locality.	Experimental Garden Experiment number.	Year.	Survival percentage of stumps planted on 1st April 1939. Normal.	Buried.	Mound.	1st June 1939. Normal.	Buried.	Mound.
Anaipady ..	213	1940	95	93	95	87	96*	89
Begur ..	166	1940	38	69	59	80	87	89
Dhoni ..	208	1940	88	96	95	92	86	84
Kannoth ..	89	1940*	52	79	83	68	75	81
Walayar ..	11	1940	60	82	90	33	37	22
Average of 1940 experiments			67	83	84	72	76	73
Average of 1939 experiments			79	92	..	92	93	..
Average of 1938 experiments			89	96	..	98	98	..
Average of 1937 experiments			70	86	..	92	95	..
Average of 1936 experiments			55	68	..	86	91	..
Average of 5 years experiments.			72	85	84	88	91	73
			Mean height growth in inches.					
Anaipady ..	213	1940	49·56	52·32	48·72	13·68	14·76	14·16
Begur ..	166	1940	19·34	19.76	18·40	7·16	7·19	7·57
Dhoni ..	208	1940	13·80	15·91	17·65	8·32	7·65	7·61
Kannoth ..	89	1940*	34·33	32·75	30·92	7·87*	7·59	9·67
Walayar ..	11	1940	50·40	51·12	49·44	34·68	33·24	32·88
Average of 1940 experiments			33·49	34·37	33·03	14·34	14.09	14·38
Average of 1939 experiments			26·0	26·9	..	14·2	13·0	..
Average of 1938 experiments			23·4	25·6	..	13·6	12·9	..
Average of 1937 experiments			30·1	34·7	..	14·0	14·6	..
Average of 1936 experiments			31·4	32·1	..	17·9	18·4	..
Average of 5 years experiments			28·9	30·7	33·0	14·8	14·6	14·4

169. We have now done 24 experiments on this subject in five centres over five years.

170. Judged both by survival percentage and Mean height growth it appears decidedly beneficial to plant the stumps with the top of the 1 inch shoot flush with the ground, when doing early stump planting. Incidentally this experiment also exhibits the advantage of early stump planting. The practical difficulty, that

* Kannoth Experimental Garden Experiment No. 89 of 1940 was done in a ponam crop of paddy.

stump planting, by burying the shoots to ground level, makes inspection difficult, and consequently there is a risk of some portions of the planting area being inadvertently missed out during stump planting has been mentioned in the Annual Report for 1939–40.

(For full experimental data vide paragraph 485.)

171. *The effect of longitudinally halving teak stumps.*—Indications having previously been obtained at Dhoni in a very small scale experiment, one experiment was done at Begur to get preliminary indications of the effect of cutting teak stumps longitudinally into two halves from the tip of the 1 inch shoot down to the tip of the root, and planting them separately in crow-bar holes, before the break of the monsoon. Fifty stumps thus gave 100 halves, and were planted at 100 stakes; and the result was compared with the planting at 100 stakes of normal stumps. In all other operations normal plantation practice was followed for both treatments. The results after one growing season are—

	Survival percent.	Mean height in inches.
A. Control normal stumps planted on 15th April 1940	78	15·51
B. Longitudinally halved stumps planted on 15th April 1940 ..	91	17·81

172. The difference in Mean height 2·30 inches in favour of the longitudinally halved stumps is not significant; nor is the difference in survival per cent.

173. If splitting of the stump into two halves could be the worst damage that could be expected while digging a nursery for pre-monsoon stump planting, this experiment indicates that teak stumps can stand considerable damage, without affecting appreciably the results in plantation work. A further indication that needs confirmation is that, if it is established that such plants do not develop any defect such as rot, splitting teak stumps may be a valuable method of reducing nursery costs, where there is any difficulty in nursery work.

174. *Teak Plantations—Effect of planting espacement on growth, tending and costs.*—These experiments have been started to determine the comparative merits of a 6 feet by 6 feet and an $8\frac{1}{2}$ feet by $8\frac{1}{2}$ feet espacement on the growth, tending and costs of a teak plantation raised by stump planting teak. A re-examination of the problem of espacement was necessitated by the fact that modern plantation methods (early stump planting) are different from the earlier methods. A bigger espacement, if found satisfactory from the growth of the teak plants, would help to save costs in nursery work, initial planting, tending and thinning at least in first quality localities.

175. Experimental Plots Nos. 149 and 150, Nilambur division, were started in 1938. Results in these two plots at the end of three growing seasons are tabulated below :—

Locality.	Experimental plot numb	Year.	Site quality.	Espacement.	Survival per cent.	Mean height in feet.	Relative costs.
Nilambur ..	149	1938	I	6′ × 6′	100	23·92	1
				8½′ × 8½′	99	24·00	0·72
Nilambur ..	150	1938	II	6′ × 6′	98·5	21·28	1
				8½′ × 8½′	98·5	20·37	0·75

176. The difference in height between the two treatments is not significant in either plot. It remains to be seen how the plots progress.

177. Two more experiments (Experimental Plots Nos. 159 and 160 Nilambur division) were started in 1940 on this subject. Results in these two plots at the end of one growing season are tabulated below. The experiments are in second rotation teak.

Locality.	Experimental plot number.	Year.	Site quality.	Espacement.	Survival per cent.	Mean height in feet.	Relative costs.
Nilambur ..	159	1940	I	6′ × 6′	98	4·92	1·00
				8½′ × 8½′	100	5·86	0·72
Nilambur ..	160	1940	II	6′ × 6′	100	4·14	1·00
				8½′ × 8½′	100	3·14	0·72

178. In this set also the difference in height between the two treatments is not significant in either plot. It remains to be seen how the plots progress.

179. All sub-plots of both treatments of all the four experimental plots have had exactly the same tending throughout, and the same tending as in the surrounding district plantations.

180. *Irrigated teak plantations.*—Work in this subject which was started in 1932 at Hulicaldrug near Mettupalayam was continued.

181. In Coimbatore North Division Experimental Plot No. 6 was started in 1939 to compare the effects of stopping irrigation of a teak plantation (raised in an area of poor scrub forest) after the 4th, 5th and 6th monsoons. In 1940, i.e., after one growing season, there was no significant difference in height growth between the sub-plots. The sub-plots will be allotted to treatments by measurement after the third monsoon.

182. In Experimental Plot No. 1 of Coimbatore North Division (1932 plantation) half of the plantation was clear felled in 1938, and is being regenerated as irrigated coppice (North Coimbatore Experimental Plot No. 5). We have four treatments, as tabulated below. In February 1940, allotment to treatments was done after establishing initial comparability between the four blocks. Measurements in 1941 indicate that there is no difference in survival percentage but judged by mean height growth the block which

was thinned and irrigated weekly has given significantly poorer results than the three other blocks. The remaining three blocks do not differ significantly in Mean height growth. The results are tabulated below. Further observations are required before any conclusions can be drawn.

Irrigated.	Thinning of coppice shoots.	Survival per cent.	Mean height growth in feet.
Fortnightly	Thinned to two shoots per stool.	100	24·32
	Unthinned	100	23·60
Weekly	Thinned to two shoots per stool.	100	21·69
	Unthinned	100	23·70

183. The rest of Experimental Plot No. 1, area 1·4 acres had received a thinning on 2nd April 1940, and a further thinning on 23rd January 1941, as detailed below :—

Date of thinning.	Number of trees removed.	Number of trees retained.	Number of trees retained per acre.
2nd April 1940	130	308	220
23rd January 1941	68+22 (suppressed).	218	156

184. After the thinning on 23rd January 1941 all standing trees have been numbered, their diameters recorded, sufficient sample trees measured, so that volume increment may be calculated in future.

185. Experimental Plot No. 1, North Coimbatore Division, was started on 22nd April 1938 with the object of determining the minimum irrigation required to raise a teak plantation, after clear felling a Mixed dry deciduous forest consisting chiefly of fuel species. The area of 2·2 acres was divided into six blocks, which were allotted to three treatments, Blocks I and VI being unirrigated control, Blocks II and V being irrigated once a fortnight and Blocks III and IV once a week, the duration of irrigation being 3 hours after the water had reached the lower end of the plot. The percentage of survivals and Mean height of resultant plants up to date are given in the following table :—

Measurements in	Survival per cent.			Mean height in feet.		
	Control.	Fortnightly irrigation.	Weekly irrigation.	Control.	Fortnightly irrigation.	Weekly irrigation.
January 1940 (after one growing season)	100	95	96	4·9′	5·5	5·2
February 1941 (after two growing seasons)	91	96	94	15·14′	19·06	18·79

186. It is thus seen that there is no appreciable difference between the percentage survivals from the three treatments. The differences in Mean height growth are not significant.

187. Experimental Plot No. 7, North Coimbatore Division, started on 18th April 1940. was a similar experiment, and had for its object the comparison of the effects of irrigation by percolation

weekly, fortnightly, and monthly, of a teak plantation raised after clear felling a mixed deciduous forest of poor quality. The duration of watering during weekly and fortnightly irrigation was 3 hours, while during the monthly irrigation it was 8 hours each day on three consecutive days once a month.

188. The survival percentage, and Mean height growth after one growing season are tabulated below :—

	A. Irrigated weekly.	B. Irrigated fortnightly.	C. Irrigated monthly.
Survival per cent	92	84·5	89
Mean height in feet	5·81	5·85	6·52

189. Plants irrigated once a month have given a significantly better height growth than plants irrigated fortnightly, or plants irrigated weekly. There is no significant difference in Mean height growth between plants irrigated fortnightly and those irrigated weekly. The experiment needs repetition.

190. An interesting experiment was conducted in Experimental Plot No. 7 North Coimbatore division, in an attempt to measure the quantity in gallons per minute of water absorbed by the soil during irrigation, and thus get an idea of the water required for raising such irrigated teak plantations. Great variations depending on the dryness of the soil on the date of measurement have been observed. The data obtained up to date are tabulated below :—

Measurement on.	18th June 1940.	25th July 1940.	26th September 1940.	22nd January 1941.	15th May 1941.	1st July 1941.
Water absorbed *per acre* : gallons per minute.	37	81	66	101	180	148

191. *West Coast Teak Soils.*—As mentioned in paragraph 98 of the Annual Report for the year 1939–40, the District Forest Officer, Nilambur, had collected very valuable preliminary information on this subject, and had incorporated the information in a note accompanied by pastille sketches of soil profiles examined by him. This preliminary information indicates that though soil conditions are not initially defective when a teak plantation is started, the teak which is a strong light demander subjects the soil to sudden insolation in its youth, and thus under the alternations of very wet and dry periods in Malabar, laterization of the soil takes place. Between the 7th and the 13th of January 1941, the entire subject was carefully examined, and discussed by the following officers :—

P. W. Davis, Esq., District Forest Officer, the Nilgiris (the Officer who had collected all the preliminary information).

A. R. Brand, Esq., District Forest Officer, Nilambur.

A. L. Griffith, Esq., Central Silviculturist, Forest Research Institute, Dehra Dun.

Dr. R. S. Gupta, Soil Chemist, Forest Research Institute, Dehra Dun.

Sri M. S. Raghavan, Provincial Silviculturist, Madras (the writer of this report).

192. The objects of the investigation have been defined as the determination of—

I. What soils, being capable of growing high quality natural mixed forest are liable to alter in the course of forming and maintaining a teak plantation; and the determination if possible of a simple index for the recognition of such soils.

II. The seasonal and other conditions responsible for such changes.

III. Methods for preventing such changes, if such changes are proved to constitute a degrade.

193. The following possible methods of approach to the problem were suggested :—

A. Study of soil profiles to show the complete range of soil conditions likely to be met with (" Profile " to include all its site factors)

(i) In old teak plantation areas of different qualities starting from riverain alluvium, ascending up hill with a north-east aspect, over the hill top and descending down the other side—south-west aspect—if possible down to swamp conditions;

NOTE.—(1) North-east and south-west aspects are chosen as likely to be extremes of conditions.

(2) Replications to be done as indicated as the work progresses.

(ii) in areas similar to (i) but in young teak areas;

(iii) in areas where changes of aspect and slope do not occur but where teak changes seriously in quality; and

(iv) in areas containing extreme conditions where teak is varying from very good on the alluvium to complete failure on laterite hill slope and hill top.

B. Study of typical areas in the conversion working circle from the stage of natural forest to established teak plantations to determine what soil changes, if any, occur. This will be a long term study.

194. The conference agreed that the line of approach (B) mentioned above is urgent, and should be started immediately. It was also agreed that owing to lack of time and staff of the Madras Silviculturist and of the Soil Chemist, item A (ii) above should for the present be postponed, although it is a very desirable investigation.

195. The forms to be used, and details under which information is to be recorded, were discussed in detail, and decided on.

196. For study (A), i.e., study of profiles to show the complete range of soil conditions to be met with, the following localities were selected :—

(1) Walluvasseri Compartment 152 which shows a gradation in about 1½ furlongs all quality classes from All-India quality I through All-India quality II, All-India quality III, All-India quality IV, to failed area. This is in first rotation teak, with a southern aspect, and showing an elevation range of about 80 feet between the extremes.

(2) Walluvasseri Compartment 157–158 boundary. This is a second rotation teak, which shows many sudden and marked changes in quality without appreciable change in slope or aspect.

(3) Walluvasseri Compartment 155 which shows a typical example of a laterite hill slope on which the teak planted in 1888 had failed completely.

(4) Panengode Compartments 135 and 137 which show a gradual change from All-India quality II through All-India quality III and All-India quality IV to failed area in a distance of about 3 furlongs. The rise is roughly 30 feet and the aspect if generally north-east, though, because of the small rise, the aspect is negligible.

(5) Panengode Compartment 121. This compartment contains a laterite hill. It is suggested that this be used to compare the north-east aspect with the south-western aspect. The study to be of soils on the two aspects on the same contours, and of similar qualities on the two aspects. The area contains second rotation teak.

197. For study (B), i.e., study of typical areas in the conversion working circle, an area of natural forest immediately to the east of the Kanhirakadavu 1941 regeneration area in the conversion working circle in Amarampalam range, Nilambur division, was selected. It was suggested that profiles should be examined in the various types on the southern slope, and at corresponding contours on the northern slope, where definite types do not occur so markedly. For this purpose an area of about 40 chains long and 6 chains wide and about 25 acres in extent was selected.

198. After selection of the areas, the Soil Chemist has examined and fully described, the following pits, in the limited time at his disposal :—

Study.	Locality.	Compartment.	Number of pits.
A	Walluvasseri	151, 152, 153	4
	Do.	154, 155	3
	Panengode	134, 135, 137	4
B	Kanhirakadavu	East of R.A. 1941	5

199. Similarly some soil pits were examined by the Soil Chemist at Kanmoth, after a preliminary discussion between the District Forest Officer, Wynaad, the Provincial Silviculturist and the Soil Chemist.

200. The investigation is being continued, and further descriptions of pits have been undertaken by the Provincial Silviculturist, who has learnt by doing it himself (under instructions from the Soil Chemist) how to describe a soil pit, and how to take samples of such soils, for analysis by the Soil Chemist at his laboratory.

201. *Swietenia macrophylla—Planting in the open.*—In paragraph 100 of the annual report for 1939–40, it has been stated that at the end of the first year there were very heavy casualties in Experimental Plot No. 140 of 1936, Nilambur division, indicating that *Swietenia macrophylla* cannot stand exposure in early youth. In consequence a natural shade crop of *Trema orientalis* was allowed to come in. Under the shade crop, the mahogany has done better, and it has been reported that shoot borer attack has almost completely stopped since the shade crop came in, in 1937. At present the *Trema* has attained an average height of about 32 feet and the mahogany which is 96·5 per cent stocked, has got an average height of 11·14 feet. The indications are therefore that mahogany requires a shade crop in its early youth, not only for reducing attack by the shoot borer, but also as a protection against undue exposure to the hot sun.

202. *Swietenia macrophylla—Planting under an artificial shade crop.*—Experimental Plot No. 151, Palghat division, was started in 1936, to determine the effect of underplanting an artificial crop of *Trema* with different sizes of *Swietenia macrophylla* transplants, as judged by percentage survivals, mean height growth and incidence of insect attack. The previous history of this plot has been summarized in paragraph 101 of the annual report for the year 1939–40, and is therefore not repeated here. Measurements in January 1941 showed the plot to be 82 per cent stocked with mahogany of an average height of 8·85 feet. The *Trema* is also a full crop, with an average height of 42 feet. The mahogany is almost entirely free from the shoot borer.

203. *Swietenia macrophylla.*—Experiments on the lines of Bengal practice to raise *Swietenia macrophylla*, as free as possible from the shoot and collar borers after clear felling and burning, have been continued. Details of layout have been described in detail in paragraph 102 of the annual report for the year 1939–40, and are therefore not repeated here.

204. The following is a list of plots that are maintained on this subject :—

Formed in	Wynaad Experimental Plot number.	Nilambur Experimental Plot number.	Palghat Experimental Plot number.
1937	40	143	154
1938	51	147	168
1939	59	157	170
1940	72	..	..

205. Wynaad Experimental Plot No. 72 is too young to warrant any conclusions yet. The other plots are fully stocked, and look promising, in general. No attack of collar borer has been noticed, on any of the plants in these plots. Though we have a few shoot borer attacks near the periphery, where the mahogany plants are not fully protected, the plots are almost completely free from the shoot borer, in the interior.

206. The experience gained up to date indicates that the best method for raising mahogany in such areas is with a shade crop of *Trema*, the *Trema* and mahogany being in lines 6 feet apart and the mahogany being close planted in the lines.

207. *Artificial regeneration of Bambusa arundinacea (in experimental gardens).*—In 1938 experiments were done at Begur and Topslip in which direct sowing, planting of one-year old transplants and planting 1, 2 and 3 year old rhizomes were compared.

208. Abbreviated results together with those of the previous years are as follows :—

Consolidated data after two seasons.

Locality.	Experimental Garden Experiment number.	Year.	Survival per cent.					
			Sowing.	One-year seedlings.	One-year rhizomes.	Two-year rhizomes.	Three-year rhizomes.	Four-year rhizomes.
Begur ..	147	1939	1	3	..	19	84	65
Average of 1938 experiments			1	57	77	90	65	..
Average of 1937 experiments			13	83	61	49	..	..
Average of 1937, 1938 and 1939 experiments.			5	48	69	53	75	65

Locality.	Experimental Garden Experiment number.	Year.	Mean height growth after one season.					
			Sowing.	One-year seedlings.	One-year rhizomes.	Two-year rhizomes.	Three-year rhizomes.	Four-year rhizomes.
Begur ..	147	1939	14·4	14·9	..	9·7	15·0	15·2
Average of 1938 experiments			5·0	11·9	12·9	13·7	16·8	..
Average of 1937 experiments			8·5	13·4	13·2	12·6	..	..
Average of 1937, 1938 and 1939 experiments.			9·3	13·4	13·1	12·0	15·9	15·2

209. The indications of the above data, are that direct sowing cannot be relied on for successful raising of *Bambusa arundinacea*, that judged by survival percentage, rhizome planting appears to be better than planting entire transplants, and that of the rhizomes three-year old rhizomes are probably best for this purpose. It should

however be emphasized that these are only indications, and more work on the subject is necessary before these indications can be taken as proved.

210. Two experiments were done at two centres on this subject in 1940.

Abbreviated results, together with those of previous years, are as follows :—

Survival per cent and mean height growth after one season.

Locality.	Experimental Garden Experiment number.	Year.	Survival per cent.					
			Sowin .	One-year seedlings.	One-year rhizomes.	Two-year rhizomes.	Three-year rhizomes.	Four-year rhizomes.
Anaipady.	217	1940	1	49	73	..	16	..
Begur ..	168	1940	47	99	100	70	83	44
Average of 1940 experiments			24	74	87	70	50	44
Average of 1939 experiments			22	90	88	88	93	78
Average of 1939 and 1940 experiments			23	82	88	79	72	61

Locality.	Experimental Garden Experiment number.	Year.	Mean height growth in inches.					
			Sowing.	One-year seedlings.	One-year rhizomes.	Two-year rhizomes.	Three-year rhizomes.	Four-year rhizomes.
Anaipady.	217	1940	4·2	1·0	3·21	..	2·44	..
Begur ..	168	1940	4·1	50·0	35·8	28·2	32·6	29·1
Average of 1940 experiments			4·2	25·5	19·5	28·2	17·5	29·1
Average of 1939 experiments			28·8	43·2	61·2	61·2	67·2	52·8
Average of 1939 and 1940 experiments			16·5	34·4	40·4	44·7	42·4	41·9

211. Judged by survival percentage and mean height growth after one season, there seems to be no appreciable difference between rhizome planting and planting entire transplants.

212. In addition one experiment at one centre was done comparing multiple or not separated rhizomes with separated rhizomes. Results together with those of previous years were as follows :—

Year.	Multiple rhizomes.		Separated rhizomes.	
	Survival percentage.	Mean height in feet.	Survival percentage.	Mean height in feet.
1940 (Anaipadi Experimental Garden Experiment No. 215) ..	85	3·35	67	2·41
1939 (Begur Experimental Garden Experiment No. 148/39)	88	4·7	84	4·7
1938	66	3·4	78	3·9
1937	48	2·8	68	2·6
Average of four experiments	72	3·6	74	3·4

213. The indications are that there is no appreciable difference between planting multiple rhizomes and planting separated rhizome as judged by survival per cent and mean height growth after one growing season.

214. After two growing seasons, Begur Experimental Garden Experiment No. 148 of 1939 gave the following results :—

	Survival percentage	Mean height in feet.	Difference.
A. Separated rhizomes ..	65	14·93	Control
B. Multiple rhizomes ..	70	15·10	0·17 feet.

The difference of 0·17 feet is not significant, by the " t " test.

215. Therefore, the indications are that judged even after two growing seasons there is no appreciable difference between planting multiple rhizomes and planting separated rhizomes as judged by survival per cent and mean height growth.

216. *Artificial regeneration of Dendrocalamus strictus (in experimental gardens).*—Similar experiments were done with this species as with *Bambusa arundinacea*. Results at the end of the first growing season after planting together with those of previous years are—

Year.	Survival percentage.					Mean height growth in inches.				
			Planting rhizomes.					Planting rhizomes.		
	Sowing.	One year transplants.	One year.	Two years.	Three years.	Sowing.	One year transplants.	One year.	Two years.	Three years.
Locality—Begur Experimental Garden Experiment No. 169.										
1940	99	100	79	92	..	44·05		71·75	67·58	83·48
Locality—Anaipady Experimental Garden Experiment No. 216.										
1940	27	62	87	74	..	19·92	22·92	45·72	55.08	..
Average of 1940 experiments	14	81	94	77	92	9·96	33·49	58·74	61·33	83·48
Average of 1939 experiments	36	85	..	85	..	25·2	54·0	..	76·8	..
Average of 1938 experiments	7	53	85	..	..	38·4	39·6	48·00	..	..
Average of three years experiments ..	19	73	90	81	92	24·5	42·4	53·4	69·1	83·5

217. The indications are that direct sowing cannot be relied on for successfully raising *Dendrocalamus strictus;* that rhizome planting appears to be better than planting entire transplants; and that three-year old rhizomes are probably best for the purpose Repetition is required for confirmation of these indications.

218. Begur Experimental Garden Experimental No. 152 of 1939 was remeasured in 1941. Growth data after two growing seasons are as follows :—

	Survival percentage.	Mean height in feet.
A. Sowing	28	7·73
B. Entire transplants	73	11·93
C. Rhizome planting (two-year old rhizomes).	90	13·32

219. This experiment indicates that judged by survival percentage and mean height of resulting plants, after two growing seasons planting two-year old rhizomes gives better results than direct sowing or sowing entire transplants.

220. Two experiments at two centres were done comparing multiple rhizomes with separated rhizomes. Results at the end of the first year together with those of previous years were—

Locality.	Experimental Garden Experiment number.	Year.	Multiple rhizomes.		Separated rhizomes.	
			Survival percentage.	Mean height in feet.	Survival percentage.	Mean height in feet.
Anaipady	230	1940	66	3·08	90	2·62
Begur	170	1940	78	4·93	89	5·38
Average of 1940 experiment			72	4·01	90	4·00
" 1939 "			84	4·7	89	5·8
" 1938 "			79	4·1	67	3·7
Average of three years' experiments			78	4·3	82	4·5

221. The indications are that there is no appreciable difference in survival percentage, or in mean height growth between plants raised by planting multiple rhizomes, and plants raised by planting separated or single rhizomes, as judged after one growing season.

222. *Dendrocalamus strictus—Raising of artificial plantations for study of intensive working.*—In Experimental Plot No. 160 of 1937 of Palghat division, an area of one half acre has been raised with this species, by planting of one-year old rhizomes. At the end of four growing seasons, the plot is 100 per cent stocked, and the plants have a mean height of 20·6 feet. Including an average of 1·8 new one-year old culms, each clump has an average of 28·2 culms.

223. In Experimental Plot No. 71 of 1937, South Coimbatore division, an area of one acre was raised by planting one-year old rhizomes and seedlings in alternate lines. This attempt to raise the bamboo under the standing dry fuel thorny forest in a dry district, gave only 35 per cent stocking with a mean height growth of 12·1 inches at the end of the second year. As the bamboo was obviously not thriving, the growth on the area was clear felled and

burned in March 1939, and the area planted up with 154 rhizomes and 154 transplants, in alternate lines. The results at the end of one and two growing seasons are tabulated below :—

At the end of	Survival percentage.		Mean height in feet.	
	Rhizomes.	Transplants.	Rhizomes.	Transplants.
One growing season	99	97	4·3	6·6
Two growing seasons	99	99	14·45	12·18
Increase in height during one year ..			10·15	5·58

224. The mean height of plants raised from rhizome planting at the end of two growing seasons is significantly (by " t " test) superior to the mean height of plants raised from entire transplants. It is also seen that during the second growing season the rhizome plants have put on 82 per cent more height increment than the transplant plants.

225. In Experimental Plot No. 84 of 1940, South Coimbatore division, 308 one-year old rhizomes of *Dendrocalamus strictus* were planted in June 1940, in a one acre plot, in a mixed deciduous forest of poor quality, along with a taungya crop of *Eleusine coracana*. In January 1941, we had 97 per cent survivals with a mean height of 5·03 feet.

226. *Artificial regeneration of Auracaria cunninghamii.*—Forty nursery raised transplants of this species were transplanted at Topslip Experimental Garden Experiment No. 142 of 1936, on the 5th July 1936. We have now 27 survivals (67·5 per cent) with a mean height of 5·62 feet the shortest plant being 1·9 feet and the tallest 8·3 feet.

227. *Artificial regeneration of Chlorophora excelsa.*—Experiments on transplanting, stump planting and planting of shoot cuttings of this species have been done for the last three years.

228. In Experimental Plot No. 54 of 1938, Wynaad division (area ¼ acre), 300 *Cholorophora excesla* stumps, 0·4 inches to 0·6 inches diameter, obtained from 9 months old nursery stock, was planted on 2nd June 1938 in crowbar holes, in a ponam crop of hill paddy. The development during the last three years is tabulated below :—

Date.	Percentage of survivals.	Average height.	Remarks.
19th February 1939	78	19·5 inches ..	Filling in of blanks on 17th June 1939, 99 stumps.
22nd February 1940	96	4·2 feet = 50·4 inches..	
8th January 1941	98·7	8·20 feet = 98·4 inches.	Filling in of blanks on 25th June 1940, 52 stumps.

229. The plot is thus fully stocked, and the plants are growing rapidly.

230. In Experimental Plot No. 62 of 1939, Wynaad division (area ½ acre), 308 two-year old stumps ranging from 0·8 inches to 1·6 inches fat diameter, and 300 shoot cuttings, 9 inches in length and 0·4 inches to 0·8 inches diameter (obtained after cutting stumps), were planted in alternate lines. The stumps were planted in crowbar holes, and the cuttings in pits leaving about 2 nodes above ground level. The experiment is done in a ponam crop of hill paddy. The results are tabulated below :—

Date of observation.	Percentage of survivals.	Average height n inches.	Remarks on replacement, etc.
22nd February 1940—Stumps plants.	87	23·3	Casualties due to porcupine or mouse, deer damage.
Cuttings ..	100	27·9	
9th January 1941—Stump plants ..	98	58·14	
Cutting plants ..	100	70·44	

231. Expermiental Plot No. 69 of 1940, Wynaad division (area ½ acre), was similarly planted with 300 stumps of 0·4 inches to 1·0 inches fat diameter and 300 shoot cuttings of 0·3 inches to 0·7 inches diameter, and all 10 inches long, on 20th March 1940. On 6th August 1940 blanks were filled with 40 stumps and 120 cuttings. On 18th January 1941 the plot is stocked as follows :—

Date of observation.	Plants.	Percentage of survivals.	Average height in inches.
18th January 1941 ..	Stump ..	97	22·87
	Cuttings ..	67	19·73

232. These experments indicate that cuttings are inferior to stumps for raising a plantation of this species, but as the percentage of survivals is still high, and as cuttings are normally wasted when stumps are cut, this material normally wasted could be utilized at the very commencement to supplement the regeneration by stumps, and thus reduce the costlier operation of replacement of casualties at a later stage.

233. *Morus indica and alba.*—Experimental Plot No. 144 of 1937, Nilambur division, was opened on 26th March 1937 to try and raise these species, for the establishment of a colony of *Cedria paradoxa*. As we had no previous experience of mulberries under the climatic conditions of Nilambur, various methods were tried. Also, as the plot was in the current district regeneration area it was planted with teak stumps at 6 feet by 6 feet, so that if the mulberry failed, it would carry a teak crop instead of being a blank in a plantation. As the stock of cuttings was obtained from a much higher elevation, it was doubted if the *Morus* would stand the heat of the plains, and so in one plot *Trema orientalis* was transplanted in lines 1½ feet away from the mulberry lines, and in another plot *Tephrosia candida* was similarly sown. Later it was

found that the *Morus* does not need a shade, and the *Trema* and the *Tephrosia* had to be cut out in 1939. The results of enumeration are recorded below :—

Percentage survivals and mean height growth.

Date.	Sub-plot A.				Sub-plot B.			
	Morus indica.		Teak.		Morus indica.		Teak.	
	Per cent.	Height.	Per cent.	Height.	Per cent.	Height.	Per cent.	Height.
		FT.		FT.		FT.		FT.
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
January—								
1940	100	14·8	100	8·3	103	14·2	100	2·5
1941	100	16·6	97	15·8	85	19·0	83	4·2

Date.	Sub-plot C.11				Sub-plot C.2.			
	Morus indica.		Teak.		Morus alba.		Teak.	
	Per cent.	Height.	Per cent.	Height.	Per cent.	Height.	Per cent.	Height.
		FT.		FT.		FT.		FT.
	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)
January—								
1940	100	15·7	100	12·4	100	9·2	100	15·6
1941	99	20·1	99	18·6	98	10·4	100	21·6

234. The indications are that *Morus alba* is a slower growing species than *Morus indica*, and *Morus indica* does not need a shade crop at Nilambur.

235. A further plot of *Morus alba* was raised in Experimental Plot No. 152 of 1938 at Nilambur, in a swampy locality in the current District Regeneration area. At the end of the second year the plot was 97 per cent stocked, with an average height of 5 feet. At the end of the third year the plot was 90 per cent stocked, with an average height of 7·6 feet. The indications are that though *Morus alba* can grow in a swampy locality, the growth is very slow; and the species does better in a better drained locality (cf. results in Plot C. 2 above).

236. *Vitex peduncularis*.—Two long-term experiments to observe the growth and development of *Vitex peduncularis* have been started. These are Experimental Plot No. 68 of 1940 (Begur) Wynaad division, and Experimental Plot No. 74 of 1940 (Kannoth) Wynaad division. Of these Experimental Plot No. 68 is 0·25 acre in extent, and in this 30 seedlings of 1938 sowing, ranging from 18 inches to 58 inches in height, and 45 seedlings of 1939 sowings, ranging from 8 inches to 30 inches in height were planted in pits on 28th June 1940. On 15th April 1941 there were 57 survivals (76 per cent) with an average height of 17·73 inches. Experimental Plot No. 74 of 1940, Wynaad division is 0·50 acre in extent. In this plot 50 seedlings ranging from 9 inches to 18 inches in height, obtained from Vellore, and 100 plants ranging from one foot to four feet raised locally were planted on 19th June 1940.

Survivals on 15th January 1941 were 131 plants (87 per cent) with a mean height of 27·09 inches. Their further development is being watched.

237. The following survivals have been reported by districts which have tried the introduction of the species :—Guntur 6 plants; Chittoor 12 plants; West Vellore 14 plants; North Salem 7 plants. The plants in North Salem are from 5 inches to 4 feet in height.

238. *Aleurites fordii*.—North Coimbatore and North Salem divisions report that there are a few plants of this species in their divisions. These reports confirm remarks made last year that germination is fair, but growth is slow. Plants left in the nursery appear much healthier than transplants, in the North Coimbatore division. In the North Salem division, out of 17 plants reported alive last year, only 9 are alive at present, with a height ranging from 4 inches to 28 inches, with an average height of 13 inches.

239. *Morus species*.—Kollegal division reports further progress in growth in mulberries reported last year, and further successful extension of the planting of the species this year.

240. *Cinnamomum zeylanicum*.—An experiment on the artificial introduction of this valuable species was started in 1939. Seed of both varieties (sandy and laterite) was obtained from Ceylon and distributed to the South Kanara, Wynaad and the Provincial Silviculturist's divisions. Each division raised plants in nurseries. In February 1940, the District Forest Officer, Wynaad and the Provincial Silviculturist, had altogether 327 plants of the sandy variety and 333 plants of the laterite variety. Though the District Forest Officer, South Kanara, had 187 plants of the sandy variety and 193 plants of the laterite variety, it was considered risky transferring this lot elsewhere. Hence the Provincial Silviculturist took over the stock available with the District Forest Officer, Wynaad division, and started two experimental plots at Kannoth; Experimental Plot No. 75 was planted with 298 plants of the sandy variety, and Experimental Plot No. 76 was planted with 293 plants of the laterite variety. The plants were put in as entire transplants in one foot cube pits, at 6 feet by 6 feet espacement, in June 1940. In Experimental Plot No. 75, Wynaad division, containing the sandy variety, *Havea rubber* plants were planted 2 feet apart in lines, between the lines of cinnamon plants to shade the cinnamon plants during the hot weather. In Experimental Plot No. 76 (laterite variety of cinnamon) a thick regeneration of *Havea rubber* came in naturally and it was retained for the beneficial shade it gives the cinnamon. Both plots have received careful attention, including fork weeding and mulching in August 1940, and again in December 1940, draining where necessary to prevent water logging, adjustment of the shade of the *Havea rubber* to prevent drip during monsoon and excessive heat during the hot weather: and artificial shade with coconut palm

leaves in February 1941, when the *Havea rubber* plants were leafless, etc.

241. There are 243 survivals in Experimental Plot No. 75 (82 per cent) with a mean height of 21·2 inches, and 219 survivals in Experimental Plot No. 76 (75 per cent) with an average height of 17·3 inches. Judged both by survival per cent and mean height growth, the sandy soil variety of cinnamon plants appear to be slightly better than the laterite soil variety at Kannoth.

242. The species grows very slowly in the locality and seems to benefit by the shading given during summer. Weeding, soil working, and mulching appear to be required.

243. It is proposed to look carefully after these two plots, until they are old enough for exploitation. Meantime we shall learn something more of the silviculture of the species, enabling us to raise this species economically; as, for various reasons, it is realized that the cost in this preliminary experiment has been rather high.

244. *Artificial regeneration of Bambusa polymorpha.*—In Anaipadi Experimental Garden Experiment No. 227 of 1940, an experiment to determine the comparative merits of planting rhizomes and entire transplants, both one year old of *Bambusa polymorpha*, gave the following results :—

	Survival percentage.	Mean height in feet.	Difference.	Significance.
(*a*) Transplants ..	52	1·04	Control.	..
(*b*) Rhizomes ..	96	1·74	0·70	S

245. This indicates that one year rhizomes are better than one year entire transplants for the artificial regeneration of *Bambusa polymorpha* at Anaipadi (Mount Stuart).

246. *Cedrela toona.*—Experimental Plot No. 71 of 1940 Wynaad, was started at Begur to watch the growth of *Cedrela toona* in the open, and under a shade crop of *Trema orientalis.* The *Cedrela toona* was raised both by stumps and by cuttings. A higher percentage of survivals (59 per cent) is obtained by stump planting *Cedrela toona* than by planting cuttings (49 per cent). A greater percentage of survivals is obtained by planting *Cedrela toona* under shade (62·5 per cent) than by planting the species in the open (50 per cent). Judged by survival percentage stump planting under shade appears to be the best method. But judged by the mean height of resulting plants, plants in the open have put on greater height than plants in shade. The experiment requires further observation, and repetition.

247. *Terminalia crenulata—Heredity of "figure."*—Experimental Plot No. 38 of 1937 Wynaad division, and Experimental Plot No. 82 of 1938, South Coimbatore division have been started on 6th May 1937 and 16th May 1938 respectively to determine whether the "figure" of *Terminalia crenulata* timber is transmitted to the offspring, through seed, by planting one year old stumps, raised from seed obtained from plants of known "figure."

In 1940 Experimental Plot No. 67 of Wynaad division was started with the same object. The present state of the plots is as follows :—

Experimental plot number and division.	Results in 1941. Survival per cent.	Mean height growth in feet.
38/1937 Wynaad	48	11·7
82/1938 South Coimbatore ..	33	7·0
67/1940 Wynaad	93	2·28

As soon as the *Terminalia crenulata* is reasonably mature, the trees will be felled and the timber examined for figure.

248. *Observational experimental plots of exotics in mixed deciduous forest of fair quality.*—A number of plots have been established to observe the growth and development of some exotics in areas of mixed deciduous forest of fair quality, in general not fit for teak, after clear felling and burning.

(1) *Bambusa polymorpha.*

249. Two experimental plots (Nos. 53 and 56 of 1938 of the Wynaad division) were raised with this species by planting two year old rhizomes at Begur and Kannoth. At the end of the third growing season the state of the plots was as follows :—

	Stocking per cent.	Mean height in feet.	Increment during year.
Kannoth Experimental Plot No. 53—½ acre ..	99	21·52	9·32
Begur Experimental Plot No. 56—½ acre ..	97	15·75	7·15

(2) *Dendrocalamus brandisii.*

250. Experimental Plot No. 57 was started at Begur in 1938 by planting three year old rhizomes, obtained from seed from three clumps which flowered in 1935 at Manantoddy. In January 1941, we had a survival of 95 per cent with a mean height of 19·35 feet.

251. In a portion of Ponam Coupe VI in Kannoth Reserved Forest where the Wynaad division had raised a nursery in 1932, rhizomes of *Dendrocalamus brandisii* were planted at the rate of 2 to 3 per stake in 1934, at an espacement of about 40 feet by 40 feet after removal of the nursery stock. The plot also contains a few plants of *Pterocarpus dalbergioides*, and *Artocarpus hirsuta*, and a few teak. This plot was taken over, and constituted into an Experimental Plot (No. 78 of 1940, Wynaad) for the purpose of watching the growth and development of the species. There are at present 27 clumps, and the mean height of the tallest culms in the clumps, is 38·2 feet.

252. *Dendrocalamus longispathus.*—Experimental Plot No. 61 of 1939 Wynaad division, and Experimental Plot No. 65 of 1939 Wynaad division were maintained. Of these, Experimental Plot

No. 61, is in a ponam crop of hill paddy. These two plots were formed in March 1939. In January 1941, the state of the plots was as follows :—

	Stocked per cent.	Mean height in feet.
Kannoth (Experimental Plot No. 61) ..	100	17·36
Bogur (Experimental Plot No. 65)	75	11·98

253. *Thyrsostachys oliveri.*—Experimental Plot No. 70 of 1940 Wynaad division, at Begur, and Experimental Plot No. 77 of 1940 Wynaad division at Kannoth, each of 0·50 acre, were opened in March 1940, for observing the growth and development of *Thyrsostachys oliveri*, in the localities. Experimental Plot No. 77 is in a ponam crop of paddy. The state of the plots in January 1941 was as follows :—

	Survival per cent.	Mean height in inches.
Experimental Plot No. 70 (Wynaad-Begur).	100	65·04
Experimental Plot No. 77, Wynaad (Kannoth in Ponam crop)	100	5·91

254. *Lagerstræmia flos reginæ.*—Experimental Plot No. 63 of 1939 Wynaad division was raised in 1939 in half an acre of the 1939 ponam regeneration area. The survival percentage on 14th February 1941 was 97 per cent, and the mean height of one hundred labelled plants out of 2,481 was 11·14 feet. The soil in this experiment is red loam with lateritic nodules.

255. *Pterocarpus dalbergioides.*—In Anaipadi Experimental Garden Experiment No. 210 of 1939, 200 one-year old transplants were transplanted in standard pits in June 1939. In January 1940, after one growing season, we had 33 per cent stocking, with a mean height of 16·2 inches. In January 1941 after two growing seasons, the plot is 31·5 per cent stocked with a mean height of 21·6 inches, thus showing a growth of 10 inches in height in one year.

256. This species is doing very well at Kannoth (Wynaad division) and a number of garden experiments have shown that it is probably suited for areas in Nilambur unfit for teak.

257. To determine if the species can be successfully raised in such localities and if so to observe its growth and development Experimental Plot No. 148 of 1938 Nilambur division, was started in 1938, in the 1938 Miscellaneous Regeneration area at Pokkode. The mixed deciduous forest of fair quality was previously clear felled and burnt, and two-thirds of an acre taken over, and stakes put in at an espacement at 12 feet by 12 feet. The soil is sandy loam with lateritic nodules. Two hundred *Pterocarpus dalbergioides* plants were planted at the stakes. In order to stock the area fully and to keep down weeds, the remaining stakes at a

6 feet by 6 feet espacement were dibbled with *Anacardium occidentale*. The survival per cent and mean height of plants are recorded below :—

	Stocking per cent.	Average height in feet.	Increment in feet.
After one growing season	98	5·7	..
After two growing seasons	97	8·3	2·6
After three growing seasons	100	13·5	5·2

258. A similar experiment, Experimental Plot No. 64 of 1939 Wynaad division, was started on an area of 0·75 acre in the 1939 Ponam Regeneration area of Kannoth. Growth data are recorded below :—

	Stocking per cent.	Average height in feet.	Increment in feet.
After one growing season	100	5·6	..
After two growing seasons	99	9·8	4·2

259. *Eucalyptus rostrata.*—Nellore division reports the successful raising by transplanting of *Eucalyptus rostrata*, in a *casuarina* plantation, and states that 262 survivals out of 320 planted are coming up well, and are considerably bigger than *casuarina* of the same (one year) age.

260. *Teak—Coppice forest—Filling in blanks with stumps.*—Observations in Experimental Plot No. 17, Palghat division were continued. In this experiment an attempt was made to fill in fairly small blanks in a teak coppice forest by using teak stumps at the time of felling. This was done in 1926 over 1 acre. In 1941, i.e., 15 years after the replacement the following are the results :—

Percentage of survivals	57	per cent.
Ratio of $\frac{\text{Mean heights of plants grown from stumps}}{\text{Mean heights of plants grown from coppice}}$	44	„
Ratio of Mean girths of $\frac{\text{plants grown from stumps}}{\text{plants grown from coppice}}$	37	„

261. Though it is thus seen that the stump plants have not taken their place in the crop, yet if they survive to the end of the rotation, they can then be coppiced and the object of their introduction will have been achieved. But as the stump plants are not growing reasonably well, and are already heavily suppressed, this does not appear likely.

262. *Regeneration of swampy localities.*—Experimental Plot No. 69 of 1937, South Coimbatore division, for investigating the best method of regenerating swampy areas in the Plantation Working Circle, at Mount Stuart, has been maintained. At the end of the fourth year the plot is 84 per cent stocked with a mean height of 4·2 feet. The species is *Lagerstræmia flos reginæ.*

263. *Regeneration of semi evergreens after clear-felling and burning what is now deciduous forest.*—In Experimental Plot No. 41 of 1937, Wynaad division and Experimental Plot No. 153 of 1937, Palghat division, an attempt was made in 1937 on the lines

of Bengal practice to raise evergreens after clear-felling and burning the secondary regrowth resulting from old shifting cultivation, at Kannoth and Dhoni respectively. In both experiments *Hopea parviflora*, *Swietenia macrophylla*, and *Artocarpus hirsuta* were raised (i) under a cover crop of *Tephrosia candida*, and (ii) under a shade crop of *Trema orientalis*. The tentative conclusions from these experiments at the end of the third year are—

(i) *Artocarpus hirsuta* grows best without any cover or shade crop,

(ii) *Hopea* and possibly *Mesua* (tried during replacement of casualties of *Artocarpus*) can be raised in such localities under a cover crop of *Tephrosia*.

(iii) *Hopea* under *Trema* appears to grow faster than *Hopea* under *Tephrosia* after the first year, though in the first year the shade crop of *Trema orientalis* appears insufficient for *Hopea*,

(iv) In the third year the *Hopea* in the open (where the *Trema* shade trees have been accidentally felled) appears to grow much better than the *Hopea* under Boga cover.

264. In experimental Plot No. 52 of 1938, Wynaad division (Kannoth) and Experimental Plot No. 167 of 1938, Palghat division (Dhoni), the experiment has been repeated. The species tried in Experimental Plot No. 52, Wynaad division were *Hopea parviflora* and *Mesua ferrea* under a cover crop of *Tephrosia candida*, and a shade crop of *Trema orientalis*. The species tried in Experimental Plot No. 167, Palghat division, are *Hopea parviflora* and *Cedrela toona* under a cover crop of *Tephrosia candida* and a shade crop of *Trema orientalis*.

265. The following tentative conclusions are drawn :—

(i) The growth of *Mesua* at Kannoth under the conditions in the plot has not been encouraging.

(ii) *Hopea* under *Tephrosia* appears to do a little better than under *Trema* in the second year of its growth, at Kannoth, though at Dhoni the *Hopea* under the *Trema* is slightly better than the *Hopea* under Boga. The differences however are not appreciable.

(iii) Judged both by survival per cent and by mean height growth of resultant plants the *Cedrela toona* under the *Trema* has done better than the *Cedrela toona* with the *Tephrosia candida*.

266. In 1939 the experiment was repeated in Experimental Plot No. 60 of 1939, Wynaad division at Kannoth. The species tried are *Hopea parviflora*, *Cedrela toona*, and *Balanocarpus utilis*. The *Balanocarpus* and *Hopea parviflora* were tried under (i) a cover crop of *Tephrosia candida* and (ii) a shade crop of *Trema orientalis*. The *Cedrela toona* was tried only under a shady crop of *Thema orientalis*. During the second year it has been observed that there is full

stocking under all treatments for all species, but while the *Hopea* has put on slightly better height growth under the *Trema* shade than under the cover crop of *Tephrosia*, the *Balanocarpus* has put on distinctly better height growth under the *Tephrosia* cover crop than under the shade crop of *Trema orientalis*. The experiment requires to be kept under observation for a further sufficient period, before any conclusions can be drawn.

267. Experimental Plot No. 73 of 1940, Wynaad division, was started at Kannoth with three species, (1) *Vateria indica*, (2) *Cedrela toona*, and (3) *Balanocarpus utilis*. The *Vateria indica* was grown with a cover crop of *Tephrosia candida*, and under a shade crop of *Trema orientalis*. The *Cedrela toona* was grown under a shade crop of *Trema orientalis*, and the *Balanocarpus utilis* was grown under a cover crop of *Tephrosia candida*, and under a shade crop of *Trema orientales*. Judged by the survivals and mean height growth at the end of the first year, there is no appreciable difference in the effect of *Tephrosia candida*, and *Trema orientalis* on the more valuable crops of *Vateria indica* and *Balanocarpus utilis*.

268. Among the valuable crops, *Cedrela toona* has fared best, while both *Vateria indica*, and *Balanocarpus* have been slower grown. *Balanocarpus* has been the slowest of the species. In spite of the cover and shade crops, both *Vateria indica*, and *Balanocarpus* had several casualties. More work on the subject is necessary, before any conclusions can be drawn.

Entomological work—Teak defoliation, determination of loss of increment by defoliation.

269. Experimental Plots Nos. 161 of 1940 and 162 of 1940, Nilambur division, were started to determine the practicability of a method designed for the determination of the loss of increment by defoliation. In Experimental Plot No. 161 of 1940, six comparable trees in a 44-year old teak plantation were selected and allotted to three treatments by roughly randomizing. The treatments are (*a*) sprayed fortnightly with lead arsenate and soft soap in solution, (*b*) complete artificial defoliation by cutting off the leaves, and (*c*) control where nothing is done. Experimental Plot No. 162 is a similar experiment but in a 15-year old crop. In March 1941 it was noticed that some of the sprayed leaves showed signs of scorching, but at the same time some of the leaves from the control trees were drying up prior to natural dropping of leaves. So a number of leaves from the different treatments were taken and examined (by applying a X test) to see whether the number of dried patches may be attributed to the spraying. The difference by the test was not significant. The indications of these preliminary experiments are that treatments are practicable, but on a careful estimate it was found that the proper spraying and defoliation fortnightly during the insect defoliation period of 100 trees would cost Rs. 490 and therefore further investigations are being considered to cheapen costs, before taking up the investigation proper.

Mahagony Borers.

270. Experiments connected with the study of the Life History of and methods of prevention of attack by the Mahagony Collar borer (*Pagiophlaeus longiclavis Mshl*) have been continued during the year, and have now been summarized and closed.

271. Experimental Garden Experiment No. 193 of 1939 Chandanathode, Wynaad, the object of which was to find out (1) whether the stems of Mahagony transplants if enclosed at the time of transplanting in open mouthed bamboo tubes 1 foot to 1½ feet from ground level will protect the plants against the attacks of the collar borer and (ii) whether the injury to the stems at the collar is the predisposing cause of attack by the collar borer has now been closed. Indications have been obtained that the protection of the stem by bamboo tubes as tried in the experiment did not prove effective against the collar borer attack, and that the beetles did not show any preference for plants preliminarily artificially injured.

272. Experimental Garden Experiment No. 190 of 1939, Wynaad division was started for studying under natural conditions in the field (1) the longevity of the beetle, (2) the period of oviposition of the beetle, (3) length of each life cycle of the beetle and (4) number of generations in an year. The following indications have been obtained :—(1) The longevity of beetles of the first generation could not be determined. The longest life recorded for male beetles of the second generation was 211 days, and for female beetles of the second generation it was 219 days. (2) The period of oviposition for the beetles which are on the wing in April is about five months. The beetles bred out from the larvæ of the first generation were kept under observation on mahogany plants in the cages in pairs, in the same manner as for the first generation; but none of the plants showed any signs of attack though in one case two pairs lived for 7 to 8 months; and as many as 10 plants were exposed to the attack one after the other, it appears probable that the beetles require a period of flight before they are able to reproduce successfully. (3) The emergence of the adults of the May-June broods commences in September, and the indication is that the emergence of beetles from the first generation continues till December. (4) The life cycle for the earlier broods of May and June is about 4 months and for the later broods the life cycle tends to be longer. The life cycle was about 5 months in one case where oviposition took place in the beginning of July. (5) There is some indication of a long cycled larva, with a consequent possibility of a single generation in the year. (6) For beetles of earlier broods of short cycled larvæ where emergence of the adult had taken place in September a second generation could not be traced out.

273. During the year, Dr. Beeson, Forest Entomologist, Forest Research Institute, Dehra Dun, kindly summarised the information collected on the percentage incidence data of *Pagiophloeus longiclavis* in our experimental plots at Chandanathode, Kariansola, Kannoth, Nilambur, Topslip and Dhoni. His summary is reproduced below :—

"*Pagiophlaeus longiclavis Mshl.*

Percentage incidence data of attack in Madras Silviculturist's Experimental Plots, Chandanathode, Kariansola, Kannoth, Nilambur, Topslip and Dhoni, 15th November 1936 to 1st April 1940.

The recent data for 1st January 1939 to 1st April 1940 together with the previous data give a sequence of incidences for three biological years 1937, 1938 and 1939 and also sequence of three for the subdivisional periods of "attack" (1·5 to 15·12) and late mortality (15·11 to 15·4).

The recent data are summarized in Table I and the complete data in Table II.

Relative incidence in plots.—The incidence of early attack was greater in 1938 than in 1937 in all 11 plots; and the mortality was greater in 9 out of 11 plots; was the same in the remaining 2.

The incidence of attack and the mortality were less in 1939 than in 1938 in 9 out of 11 plots except 2 (109 B and 38) in which there was an increase. As the plots were of different initial ages and in various environments it must be concluded that the trend of the annual fluctuation of the incidence was primarily due to external factors, probably weather, and not to internal factors. The local incidence at Chandanathode was consistently higher than at Kariansola or Kannoth which indicates that external factors other than weather have a dominant influence. The relative annual percentage incidence for the three biological years may be compared by plot/age/and shade :—

Incidence of attack.

Evergreen clear-felling.

	Years old. 1	2	3
109 A	75	113	63
109 B	41	80	102
109 C	39	39	2

Evergreen Top Canopy shade.

	Years old. 1	2	3	4	5	6
74	4	9	2	..	..	..
76	10	28	0	..	..	..
108	..	33	37	16	..	..
78	..	9	13	4	..	..
75	..	..	13	13	0	..
77	..	..	..	6	7	0

Deciduous clear-felling in the open.

	Years old. 1	2	3	4
38	0	2	5	..
37	..	2	5	2

Nilambur, Topslip, and Dhoni—Nil.

Age.—The present data do not support the deduction previously made that the annual incidence increases from year to year up to an age of five years. The mortality is greatest in the 2-year old crop; but it is not proved that the liability to attack is greatest in crops of that age.

Mortality is greater in the season May-December than in the season November-March of the same biological year in two-thirds of the cases; only in the Karianshola plots was the mortality greater in November-March than in May-December.

Shade.—The local incidence at Chandanathode shows great divergence in 109 B and 109 C, viz., B increased to 102 and C decreased to 2. The superiority of original deep undergrowth over Boga replaced by natural undergrowth is shown in the better height growth and the lower borer incidence of 109 C. The earlier conclusion, that deep undergrowth sheltering mahogany in clear-felled plots prevents increase of borer incidence, is confirmed.

Height.—The considerable decrease or complete disappearance of the borer in the third year in the Karianshola plots is not explicable by the descriptive note "evergreen top canopy shade"; it is presumably connected with the height growth which has reached and exceeded an average of 10 feet. In crops with an average height of 10 feet the borer incidence has ceased to increase and begins to decrease rapidly.

Alternative food-plants.—From what we now know of the biology and the importance of *Cedrela toona* as a normal food-plant it is probable that the collar borer incidence in all these plots has been determined more by the extent of nearby fellings of *C. toona* than by any of the factors that were under test in the experiments. The relative local incidences in Chandanathode Karianshola and Kannoth were influenced by the pre-existing populations of toon *Pagiophlœus;* the superimposed influence of shade conditions in the plots has been relatively slight. The proper way to control the collar borer is to control and clean up the contemporaneous fellings of toon.

TABLE I.

Percentage incidence of the mahogany collar borer (Pagiophlœus longiclavis), 1939–40.

Experiment.		Percentage incidence for the period: 15th November 1939 to 1st April 1940.	1st May 1939 to 15th December 1939.	1st May 1938 to 15th April 1939.	1st May 1939 to 1st April 1940.
Chandanathode	108	7	13	37	16
Do.	109 A	34	50	113	63
Do.	109 B	63	90	80	102
Do.	109 C	1	2	39	2
Karianshola	74	2	1	9	2
Do.	75	..	..	13	..
Do.	76	..	..	28	..
Karianshola	77	..	..	7	..
Do.	78	4	1	13	4
Do.	79	1	0	..	1
Kannoth	37	..	2	5	2
Do.	38	3	4	2	5
	Nilambur	3, 4, 5, 6			Nil.
	Topslip	144			
	Dhoni	124, 125 A, 125 B, 126			

TABLE II.

Percentage incidence of the mahogany collar borer (Pagiophlœus longiclavis), 1936–40.

Summary of complete incidence data for all experimental plots during the period 15th June 1936 to 1st April 1940 grouped by biological year 1·5 to 15·4 and subdivisions 15·11 to 15·4 and 1·5 to 15·12.

Experiment.		Percentage incidence for the period: 15th November 1936 to 15th April 1937.	15th November 1937 to 15th April 1938.	15th November 1938 to 1st April 1939.	15th November 1939 to 1st April 1940.	1st May 1937 to 15th December 1937.	1st May 1938 to 15th December 1938.	1st May 1939 to 15th December 1939.	1st May 1937 to 15th May 1938.	1st May 1938 to 15th May 1939.	1st May 1939 to 1st April 1940.
Chandanathode	108 ..	9	20	10	7	21	33	13	33	37	16
Do.	109 A ..	30	19	56	34	70	97	50	75	113	63
Do.	109 B ..	4	19	32	63	35	80	90	41	80	102
Do.	109 C ..	1	27	13	1	34	39	2	39	39	2
Karianshola	74 ..	0	4	6	2	1	4	1	4	9	2
Do.	75 ..	10	9	8	0	6	9	0	10	28	0
Do.	76 ..	0	9	8	0	3	22	0	13	13	0
Do.	77 ..	14	6	2	0	0	6	0	6	7	0
Do.	78 ..	0	8	5	4	5	10	1	9	13	4
Do.	79 ..	..	..	..	1	..	..	0	..	..	1
Kannoth	37 ..	0	1	4	0	2	3	2	2	5	2
Do.	38 ..	0	0	0	3	0	2	4	0	2	5
	Nilambur	3, 4, 5, 6									Nil"
	Topslip	144									
	Dhoni	124, 125 A, 125 B, 125									

(*b*) *Evergreen rain forests.*—Nil.

(*c*) *Dry fuel forest.*

274. *Best date of sowing—District work.*—The investigation in this subject with *Acacia planifrons* at Ayyalur in Madura district was continued. Remeasurement of the 1938 experiment given in detail in the annual report for 1939–40 showed that the effects of early sowing were still very appreciable.

275. The experiment was repeated in 1940 in two centres, in the Ayyalur and Natham ranges. The first year measurements of the 1940 experiment at Natham only, together with those of the previous years are given below; as some doubts about the Ayyalur measurements are to be cleared, Ayyalur measurements are not included.

Survival percentage of sowings on

Range.	1st April 1940.	1st May 1940.	1st June 1940.	1st July 1940.	1st August 1940.	1st September 1940.	1st October 1940.	1st November 1940.
Natham ..	54	57	55	48	62	54	68	70
Average of 1940 experiments ..	54	57	55	48	62	54	68	70
Average of 1939 experiments ..	75	57	63	63	59	82	91	41
Average of 1938 experiments ..	82	100	60	61	67	73	83	74
Average of three years' work ..	**70**	**71**	**59**	**57**	**63**	**70**	**81**	**62**

Mean height in inches of plants from above sowings.

Range.	1st April 1940.	1st May 1940.	1st June 1940.	1st July 1940.	1st August 1940.	1st September 1940.	1st October 1940.	1st November 1940.
Natham ..	18·00	13·00	7·09	6·02	5·32	5·17	3·46	2·73
Average of 1940 experiments ..	18·00	13·00	7·09	6·02	5·32	5·17	3·46	2·73
Average of 1939 experiments ..	10·8	7·0	7·9	5·9	5·7	5·2	4·3	2·4
Average of 1938 experiments ..	17·4	20·3	15·7	13·0	14·1	6·2	6·3	4·6
Average of three years' work ..	**15·4**	**13·4**	**10·2**	**8·3**	**8·4**	**5·5**	**4·7**	**3·2**

Dry fuel forest.

276. *Comparison of sowing, entire transplanting and stump planting.*—In Experiments Nos. 291 to 296 of 1940 (Emmanur Experimental Gardens), six species were experimented with by these methods of regeneration. Measurements in January 1941 indicate that (i) (*a*) judged by survival percentage, direct sowings give the best results, and stump planting the poorest results for *Azadirachta indica*; and (*b*) judged by mean height growth entire transplants give significantly the best results, and stump plants the poorest, (ii) in the case of *Bauhinia purpurea*, judged both by survival percentage and mean height growth of resulting plants direct sowing has given the best results, and entire transplants significantly the poorest results, (iii) for *Chloroxylon swietenia* there is no appreciable difference in survival percentage between the three treatments, but entire transplanting has given significantly better height growth of resulting plants than either direct sowing, or stump planting, (iv) for *Pterocarpus santalinus* there is no significant difference between the mean height growth of plants raised by the three treatments, but judged by survival percentage, stump planting has given the best results, (v) as for *Terminalia chebula* direct sowing gives the highest percentage of survivals, and stump planting the poorest. Judged by mean height growth, transplanting entire transplants gives significantly the best height growth, while direct sowing gives significantly the poorest result. Tentatively it may be said that direct sowing and entire transplanting appear to be the best methods for this species, judged by both criteria, and (vi) for *Wrightia tinctoria*, judged both by survival percentage and mean height growth of resultant plants, by survival percentage and mean height growth of resultant plants, transplanting entire plants appears to be the best method of artificial regeneration at Emmanur.

277. These are preliminary indications from measurements at the end of the first year. They show that it is not possible to say that any one method will suit all species. Each species has got to be considered independently. But coupling these results with the results of previous years, the general conclusion may be formulated that in this work direct sowing gives the best results for most species that are commonly used in district rab work, as transplanting and stump planting necessarily are more dependent on rainfall.

(For full experimental data, see paragraph 487.)

278. *Comparison of stump planting and transplanting.*—Experimental Garden Experiments Nos. 297 to 301 (Emmanur Experimental Garden) had as their objects (*a*) to find the best season for stump planting, (*b*) to compare stump planting and planting entire transplants, (*c*) to compare transplanting at the commencement of the south-west and north-east monsoons, and (*d*) to compare stumps cut from one-year old plants with stumps from two-year old plants.

279. Measurement in January 1941 showed (i) that two-year old stumps generally give a better survival per cent and a better mean height growth than one-year old stumps of the species tried at Emmanur and (ii) as is to be expected early stump planting generally gives a better height growth of resulting plants than later planting. The comparative merits of transplanting and stump planting naturally differ with the species. The indications of the 1940 experiments at Emmanur are as follows:—

(i) *Azadirachta indica.*—Judged by both criteria transplanting entire plants appears the best method. For best survival percentage transplanting in October, and for significantly the best height transplanting in July are indicated.

(ii) *Chloroxylon swietenia.*—Judged by both criteria, transplanting in the north-east monsoon appears to be the best method of raising this species.

(iii) *Pterocarpus santalinus.*—Judged by both criteria stump planting in early October seems to be the best method and two-year old stumps appear preferable to one-year old stumps for this purpose.

(iv) *Terminalia chebula.*—Judged by both criteria, transplanting in the north-east monsoon appears best suited for this species at Emmanur.

(v) *Wrightia tinctoria.*—Judged by both criteria entire transplanting in the north-east monsoon appears to give the best results.

(For full experimental data, see paragraph 488.)

280. *The effect of the burn and the ash on survivals and development.*—In Emmanur Experimental Garden Experiment No. 266 of 1939, an investigation has been started to study the effect of the burn and the ash in dry fuel regeneration work. The arrangement of the experiment is in randomized blocks and three species *Acacia planifrons*, *Cassia siamea* and *Prosopis juliflora* have been used. Four treatments were applied (A) a normal burn and the ash mixed in with the soil before sowing, (B) a normal burn and the ash removed outside the area, (C) no burn and the ash from (B) mixed into the soil before sowing and (D) no burn and no ash mixed in. Results at the end of the second growing season are tabulated below :—

	Survival percentage.		
	Acacia planifrons.	Cassia siamea.	Prosopis juliflora.
Burn and mix ash	88	72	66
Burn and remove ash ..	79	84	68
No burn but mix ash ..	77	88	61
No burn and no ash ..	77	81	68

	Mean height growth in inches.					
	Acacia planifrons.		Cassia siamea.		Prosopis juliflora.	
Burn and mix ash	42·78	C	43·47	C	70·27	C
Burn and remove ash	44·25	N	55·36	S	64·44	S
No burn but mix ash	49·61	S	52·61	S	78·99	S
No burn and no ash	44·92	N	61·78	S	61·63	S

Note.—C represents control. N indicates that the difference is not significant by a 't' test while S indicates that the difference is significant. The different treatments have behaved in different ways with the different species ; and hence no conclusions can yet be drawn. Repetition of the experiment is essential.

281. In Emmanur Experimental Garden Experiment No. 303 of 1940, a similar experiment has been done, with *Albizzia lebbek*, *Acacia planifrons* and *Prosopis juliflora*. Results at the end of the first growing season, from direct sowing of 10 seeds per patch on 14th July 1940, are tabulated below :—

	Survival percentage.		
	Acacia planifrons.	Albizzia lebbek.	Prosopis juliflora.
Burn and mix ash	64	91	64
Burn and remove ash	70	91	62
No burn but mix ash	80	94	52
No burn and no ash	74	98	52

	Mean height growth in inches.					
	Acacia planifrons.		Albizzia lebbek.		Prosopis juliflora.	
Burn and mix ash	6·78	S	2·55	N	9·63	N
Burn and remove ash	8·70	N	2·25	N	11·73	N
No burn but mix ash	9·22	C	2·70	C	13·25	C
No burn and no ash	7·68	S	2·26	Just S	7·37	S

282. In this experiment, no burn but mixing ash has given the best mean height. This does not differ significantly from burn and remove ash, but gives in every case a significantly better height than the treatment "No burn and no ash." This observation supports the observation made last year on the subject. Several repetitions of the experiment (at least for five years) are essential for obtaining reliable results.

283. *The effect of the period that elapses between burning and sowing on survivals and development.*—Experimental Garden Experiment No. 267 of 1939 was started at Emmanur in 1939 to determine this effect, on the survival and development in the artificial regeneration of dry fuel forests. The treatments were arranged in randomized blocks, for five dates of burning, as detailed below, all the blocks being sown on one date. Three species, *Acacia planifrons*, *Cassia siamea* and *Prosopis juliflora* were tried. The sown patches were at an espacement of 2 feet by 2 feet, 100 patches per treatment, and ten seeds being sown per patch. Results after two growing seasons are tabulated below :—

Species	Burned on	Sown on	Survival per cent.	Mean height in inches.	Difference from mean of control.	Significance by 't' test.
Acacia planifrons ..	15th March 1939 ..	17th July 1939 ..	71	50·54	1·99	N
	15th April 1939 ..	Do. ..	71	47·76	4·77	N
	15th May 1939 ..	Do. ..	74	52·53	Control.	..
	15th June 1939 ..	Do. ..	87	48·59	3·94	N
	15th July 1939 ..	Do. ..	78	49·64	2·89	N
Cassia siamea ..	15th March 1939 ..	17th July 1939 ..	66	65·57	5·74	N
	15th April 1939 ..	Do. ..	78	68·86	2·45	N
	15th May 1939 ..	Do. ..	81	71·31	Control.	..
	15th June 1939 ..	Do. ..	65	74·45	3·16	N
	15th July 1939 ..	Do. ..	80	73·15	1·84	N
Prosopis juliflora ..	15th March 1939 ..	17th July 1939 ..	64	91·55	6·23	N
	15th April 1939 ..	Do. ..	79	85·82	0·49	N
	15th May 1939 ..	Do. ..	78	85·33	Control.	..
	15th June 1939 ..	Do. ..	85	82·36	2·97	N
	15th July 1939 ..	Do. ..	90	76·69	8·64	S

284. It is thus seen that judged by mean height growth of surviving plants at the end of two growing seasons, the time that elapses between the burning and the sowing does not generally

produce any significant difference in mean height growth. The differences in survival percentages also are not high, though if the sowing is done soon after burning, the survival percentage tends to be higher than if some time is allowed to elapse.

285. A further experiment in this subject was started in Experimental Garden Experiment No. 302 of 1940 in the Emmanur Experimental Gardens.

Results after one growing season are tabulated below :—

Species.	Burnt on	Sown on	Survival per cent.	Mean height in inches.	Difference from mean of control.	Significance.
Albizzia lebbek ..	15th March 1940 ..	15th July 1940 ..	84	3·18	5·20	S
	15th April 1940 ..	Do. ..	55	5·71	2·67	N
	15th May 1940 ..	Do. ..	76	7·49	0·89	N
	15th June 1940 ..	Do. ..	86	8·38	Control.	..
	15th July 1940 ..	Do. ..	85	3·56	4·82	S
Acacia planifrons ..	15th March 1940 ..	15th July 1940 ..	69	11·80	12·62	S
	15th April 1940 ..	Do. ..	74	18·20	6·22	S
	15th May 1940 ..	Do. ..	85	24·73	0·31	N
	15th June 1940 ..	Do. ..	88	24·42	Control.	..
	15th July 1940 ..	Do. ..	74	12·50	11·92	S
Prosopis juliflora ..	15th March 1940 ..	15th July 1940 ..	62	29·76	9·86	S
	15th April 1940 ..	Do. ..	66	36·80	2·76	N
	15th May 1940 ..	Do. ..	83	40·62	1·06	N
	15th June 1940 ..	Do. ..	88	39·56	Control.	..
	15th July 1940 ..	Do. ..	84	33·46	6·10	S

286. These measurements at the end of the first growing season indicate that sowing immediately after burning produces a significantly poorer height growth than if sometime is allowed to elapse. If more than three months elapse between burning and sowing the height growth tends to drop to a significant extent. Beyond two months there appears to be a tendency for the percentage of survivals to be reduced. Therefore judged by both criteria burning from one to two months before sowing is indicated as the best method at Emmanur. This observation lends support to the observation recorded in the annual report for 1939–40.

287. *The effect of Kumri crops on the forest crop.*—Experimental Plot No. 19 of 1939, North Coimbatore division, was started in 1939 to study the effect of (A) ragi (*Eleusine coracana*), (B) tenai (*Setaria italica*), (C) cholam (*Andropogon sorghum*), (D) cumbu (*Pennisetum typhoideum*) and (E) control (no crop) on the development of the following forest species :—*Azadirachta indica*, *Acacia planifrons*, *Acacia sundra* and *Prosopis juliflora*). The arrangement of the experiment for each species was a latin square of 25 sub-plots.

288. Judged by the mean height growth after two growing seasons, there was no significant difference attributable to the different field crops in the case of *Acacia sundra*, *Acacia planifrons*, and *Azadirachta indica*. In the case of *Prosopis juliflora* a field crop of *Eleusine coracana* gave significantly the best height growth and a field crop of *Andropogon sorghum* gave significantly the poorest height growth of the forest species. There was however no significant difference in the height growth of the *Prosopis juliflora* grown in combination with the other field crops.

289. Experimental Plot No. 20 of 1940, North Coimbatore division is a similar experiment started in 1940. The forest crops are *Acacia planifrons*, *Albizzia lebbek*, *Azadirachta indica*, and *Prosopis juliflora*. The field crops are (A) ragi (*Eleusine coracana*), (B) tenai (*Setaria italica*), (C) cholam (*Andropogon sorghum*), (D) kollu (*Dolichos biflorus*), and (E) control (no crop).

290. In the case of *Albizzia lebbek*, there is no significant difference in the mean height growth of plants attributable to the different field crops.

291. In the case of *Acacia planifrons* there is no significant difference in the mean height growth of plants associated with *Eleusine coracana*, *Dolichos biflorus*, and control, but these plants have put on significantly better height than plants associated with *Setaria italica* and *Andropogon sorghum*. There is on the other hand no significant difference in mean height growth of plants associated with *Setaria italica* and *Andropogon sorghum*.

292. The same observation holds good in the case of *Azadirachta indica* also. In the case of *Prosopis juliflora*, plants in association with *Dolichos biflorus*, have put on the best height growth, while plants in association with *Andropogon sorghum* have put on significantly the poorest height growth. There is however no significant difference in the height growth of plants in association with *Eleusine coracana*, *Setaria italica*, *Dolichos biflorus* and plants with no field crop.

293. *Plantations for manure leaves.*—Experiments on the regeneration of *Poinciana elata* by cuttings were repeated. Consolidated results at the end of the first growing season, including previous years' results are—

I. Best date of planting.

Year and locality.	Survival percentage of cuttings planted on 1st June.	1st July.	1st August.	1st September.	1st October.
1939—					
Emmanur Experimental Garden.	4	14	48	78	82
South Salem division	40	72	100	100	88
1940—					
Emmanur Experimental Garden.	26	2	48	42	40
South Salem division	..	..	100	73	55
Average ..	23	29	74	73	66

II. Best depth of planting.

Year and locality.	Survival percentage of cuttings planted to depths of		
	9 inches.	18 inches.	36 inches.
1939—			
Emmanur Experimental Garden.	48	60	82
South Salem division	82	88	96
1940—			
Emmanur Experimental Garden.	4	26	22
South Salem division	80	84	86
Average ..	54	65	72

III. Best size of cutting.

Year and locality.	Survival percentage of cuttings of the following sizes.		
	Big.	Medium.	Small.
1939—			
Emmanur Experimental Garden.	40	18	8
South Salem division	84	78	28
1940—			
Emmanur Experimental Garden.	24	4	0
South Salem division	62	60	36
Average ..	53	40	18

294. Consolidated results at the end of the second growing seasons are tabulated below :—

I. Best date of planting.

Year and locality.	Survival percentage of cuttings planted on				
	1st June.	1st July.	1st August.	1st September.	1st October.
1939—					
Emmanur Experimental Garden.	4	10	24	40	46
South Salem division	38	64	94	92	50
Average of 1939 experiments ..	21	37	59	66	48
Average of 1938 experiments ..	34	30	29	71	63
Average of 1937 experiments ..	43	21	28	29	53
Average of three years' experiments	33	29	39	55	55

II. Best depth of planting.

Year and locality.	Survival percentage of cuttings planted to depths of		
	9 inches.	18 inches.	36 inches.
1939—			
Emmanur Experimental Garden.	40	52	68
South Salem division	64	80	74
Average of 1939 experiments ..	52	66	71
Average of 1938 experiments ..	40	58	45
Average of 1937 experiments ..	10	31	47
Average of three years' experiments	34	52	54

III. Best size of cutting.

Year and locality.	Survival percentage of cuttings of the following sizes.		
	Big.	Medium.	Small.
1939—			
Emmanur Experimental Garden.	28	16	2
South Salem division	64	66	12
Average of 1939 experiments ..	46	41	7
Average of 1938 experiments ..	66	38	7
Average of 1937 experiments ..	63	10	1
Average of three years' work ..	58	30	5

295. Results at the end of three growing seasons are as below :—

I. Best date of planting.

Year and locality.	Survival percentage of cuttings planted on				
	1st June.	1st July.	1st August.	1st September.	1st October.
1938—					
Emmanur Experimental Garden.	24	30	16	66	42

II. Best depth of planting.

Year and locality.	Survival percentage of cuttings planted to depths of		
	9 inches.	18 inches.	36 inches.
1938—			
Emmanur Experimental Garden ..	34	62	44

III. Best size of cutting.

Year and locality.	Survival percentage of cuttings of the following sizes.		
	Big.	Medium.	Small.
1938—			
Emmanur Experimental Garden ..	64	26	6

296. Judged by results at the end of one, two and three growing seasons, we have the indication that in these localities it is probably best to plant large cuttings of *Poinciana elata* deep in the ground in the North East monsoon.

297. *Santalum album—Comparison of sowing, transplanting and stump planting.*—Experiments in this subject have been done at Emmanur for the past three years, and the following table shows the consolidated results up to date :—

Year.	Survival percentage from		
	Sowing.	Transplanting.	Stump planting.
1938	17	33	19
1939	12	9	25
1940	55	75	80
Average of three years' work ..	28	39	41

These experiments indicate that stump planting is the best method of raising sandal, at Emmanur.

298. *Introduction of bamboos in dry districts.*—A great deal of work has been done on this subject in Nellore, Guntur, Chittoor, North Salem, East and West Vellore divisions. Nellore and Guntur divisions report fair results by stump planting, or rhizome planting of *Dendrocalamus strictus*. West Vellore division reports successful small scale regeneration of bamboos by direct sowing, and by transplanting entire plants. Very successful results have been achieved by the Chittoor division in establishing nurseries of both *Dendrocalamus strictus* and *Bambusa arundinacea*, and in the formation of small bamboo plantations by planting offsets, planting rhizomes and direct sowing. In nursery technique an improvement is reported that seeds are sown in drills at an espacement of 9″ × 6″ instead of the previous closer espacement of 6″ × 4″ thus reducing cost of transplanting, or thinning out seedlings for production of a good root system. Other interesting observations are that (1) Bamboo seed keeps well in sealed Kerosene oil tins for one year, and (2) seed mixed with *Acorus Calamus* is less liable to damage by rats, though there is no difference in the stocking or height growth of plants in the nursery beds.

299. Experimental Garden Experiments Nos. 286, 287, 305, 306, 308 and 309 all of 1940 were conducted in the Emmanur Research Gardens, with the object of determining (1) *Dendrocalamus strictus* could be successfully raised by rhizomes in dry fuel forests, (2) to compare the results of planting one and two-year old rhizomes, and (3) to compare the results of planting such rhizomes in the open and in shaded beds, in the nursery.

300. The following general conclusions are drawn from all these experiments :—(1) Survival percentage in a dry locality like Emmanur is liable to vary according to the prevailing

climatic conditions at the time of planting and after, (2) there is no significant difference in the survival percentage from planting one and two year old rhizomes, and (3) there is no significant difference in survival percentage nor in mean height growth between plants raised by rhizome-planting in the open and those raised in shaded beds. It is realized that these results need confirmation by repetition.

301. *Grass introduction.*—Several divisions report the successful introduction of important fodder grasses.

302. Chittoor division reports successful establishment of *Pennisetum cenchroides* by broadcast sowing, in the Chendragiri range.

303. Guntur division reports that a plot in Bezwada range in which *Pennisetum cenchroides* and *Ischæmum laxum* were introduced in 1933–34 may now be considered established, and the grass is coming up satisfactorily. The division also reports moderate success with these two species in Vinukonda Range, the *Pennisetum cenchroides* having come up better than the *Ischæmum laxum*.

304. North Coimbatore division reports very successful introduction of *Cenchrus ciliaris*, and *Pennisetum clandestinum*. It has also been observed that *Pennisetum clandestinum* cannot be successfully raised under swampy soil conditions. An attempt to introduce *Pennisetum clandestinum* in fire lines after late burning the *Themeda cymbria* and *Cympopogon* spp. with which they were previously covered also failed, the regrowth of the indigenous species being altogether too fast for the *Pennisetum clandestinum*.

305. Of the indigenous grasses, success from direct sowings are reported in the North Coimbatore division from *Andropogon pumilis*, *Eremopogon foveolatus*, and *Cenchrus seligerus*. *Chloris bournei* and *Chionachne koenigii* have been disappointing. *Schima nervosum Enteropogon monostachyos*, *Iseilema anthephoroides*, *Dicanthium annulatum*, and *Panicum antidotale* have shown poor germination.

306. *Live fences.*—Experiments on the raising of Live fences have been started at the Emmanur Experimental Gardens in 1940. It is too early to draw any conclusion about the suitability of the species for the purpose, nor about the success achieved. At present it appears that 80 to 100 per cent success in establishment may be expected from *Acacia arabica*, *Acacia planifrons*, *Agava americana*, *Azadirachta indica*, *Balsamodendron berryi*, *Bauhinia purpurea*, *Euphorbia quadrangularis*, *Euphorbia antiquorum*, *Prosopis juliflora*, and *Zizyphus jujuba*. 60 to 80 per cent survival per cent may be expected from *Pithocolobium dulce*, 40 to 60 per cent from *Dendrocalamus strictus*, 20 to 40 per cent from

Prolcum caudatum, and *Cissus quadrangularis*, and 0 to 20 per cent from *Poinciana elata* and *Euphorbia antiquorum*. The best height growth has been exhibited by *Balsamodendron berryi*, *Agava americana*, *Bauhinia purpurea*, *Cissus quandrangularis* and *Euphorbia antiquorum*.

307. Chittoor division reports experiments on *Agava americana*, *Prosopis juliflora*, *Euphorbia neriifolia*, and *Euphorbia trigona*, for live fences. The tender shoots of *Agava americana* have been observed to be eaten by cattle, chiefly buffaloes, and hence it does not appear desirable to concentrate on this species, in such localities. *Prosopis juliflora* is promising. *Euphorbia neriifolia* has not done well, and the local *Euphorbia trigona* cuttings that were planted in July 1940 are reported to have struck root and doing well; but as the species tends to form a distinct stem in later life, with intervening spaces it is feared that the species may not form a suitable live fence.

308. North Coimbatore division reports introduction of *Balsamodendron berryi* by cuttings, *Agava americana*, *Euphorbia antiquorum* (two varieties, the square chadurakalli variety, and the twisted tirugukalli variety). The *Balsamodendron* sprouted satisfactorily initially, but there have been several casualties later. Local opinion is reported to be that 1½ feet length and 3 inches diameter gives cuttings too large for success and that the cuttings should be stored from 10 days to a fortnight before being put in, and their results are said to be better than ours. *Agava americana* has been very successful, but has been badly damaged in places by elephants, and subsequently by porcupines. Where there have been no damage by these causes, complete success has been achieved. But the species appears to take about two years to make a cattle-proof fence. Of the *Euphorbia antiquorum* the tirugukalli variety though slower grown is reported to give a better percentage of survivals than the Chadurakalli variety.

309. *Teak in dry districts.*—Guntur and West Vellore divisions have reported small scale and satisfactory experimental regeneration by Teak Stump planting.

310. *Soil working.*—Experiments have been continued for testing the merits of soil working in the regeneration of dry fuel forests. This soil working is done in lines between the plants care being taken that the soil within 3 inches of each plant is not disturbed. The first operation is a scratching of the soil to a depth of about 1 inch to 2 inches and each further soil working proceeds deeper and slightly farther away from the plant line until a depth of about 9 inches has been reached. The treatment was applied once a month from about July to the middle of the following January. Measurements at the end of the first growing season were taken in January. The soil working was repeated before the South West monsoon, between the monsoons, after the North East monsoon and the plots measured in January 1941.

311. The abbreviated results of these experiments are given in the tables below :—

Measurements at the end of the second growing season after sowing.

Year of experiment.	Control.		Soil worked.		Remarks.	
	Survival percentage.	Mean height in inches.	Survival percentage.	Mean height in inches.	Number of experiments.	Number of species.
1935	29	15·7	48	31·5	7	7
1936	70	48·3	88	66·0	2	2
1937	59	31·8	71	34·6	3	3
1938	97	49·2	98	64·0	4	4
1939	93	55·4	97	62·8	4	4
Average of five years' work.	70	40·1	80	51·8		

II. Measurements at the end of second growing season after sowing (1939 experiments).

Species.	Control.		Soil worked.		Remarks.
	Survival percentage.	Mean height in inches.	Survival percentage.	Mean height in inches.	
Acacia arabica	90	58·8	100	63·1	N
Acacia ferruginea	93	43·7	93	48·2	N
Cassia siamea	90	58·7	94	64·1	S
Azadirachta indica	100	60·3	100	75·8	S
Average of all species ..	93	55·4	97	62·8	

Measurements at the end of the first growing season after sowing (1940 experiments).

Species.	Control.		Soil worked.	
	Survival percentage.	Mean height in inches.	Survival percentage.	Mean height in inches.
Acacia arabica	98	20·9	100	24·4
Acacia ferruginea	94	21·0	97	18·1
Azadirachta indica	97	8·1	97	9·4
Bauhinia purpurea	100	40·4	100	47·1
Cassia siamea	99	23·3	100	31·1
Average of all species ..	98	22·7	99	26·0

312. These figures show that soil working averaged over the five years of the experiments has produced by the end of the second growing season after sowing, an increase in survival percentage of about 11½ per cent, and in mean height growth of about 30 per cent.

313. The indications recorded in paragraph 173 of the Annual Report for 1939–40, on the beneficial effects of soil working have thus received further confirmation.

(vi) Afforestation.

311. *Grassland catchment areas.* The objects of these experiments in the Nilgiris have been explained in paragraph 174 of the Annual Report for 1939–40. In addition to maintaining the Experimental Gardens mentioned in that report we have taken half an acre from the District Experimental Plot in Jacko's Nulla to see whether we can practically apply indications obtained so far on the re-afforestation of these grassland catchment areas.

315. The climatic conditions of the two gardens during 1940–41 are as follows :—

Particulars.	Experimental gardens at Brooklands.	Experimental Gardens at Jacko's Nulla.
Rainfall from 1st April 1940 to 31st March 1941 ..	58·13″	48·40″
Number of rainy days	13	128
First frosty night	*	8th December 1940.
Last frosty night	4th March 1941.	27th Feb-1941.
Lowest temperature on above date	32°	30 °
Total number of frosty nights during the period ..	24	28
Lowest temperature recorded	20°	26°
Date of above reading	16 February 1941.	15 January 1941.

* Not known as the thermometer was out of order and was refitted only on 25th January 1941.

316. *Jacko's Nulla Experimental Gardens.*—Works done in the Jacko's Nulla Experimental Gardens in previous years have been detailed in the corresponding annual reports. During the year under review casualties were filled up where they existed. New beds were formed and sowing, transplanting, planting natural forest and nursery raised stumps, and planting cuttings, of indigenous shola species, and exotics, were done.

317. We have in this garden patches of *Cytisus scoparius* *Acacia dealbata*, and *Hakea saligna*, which we have established to test their suitability as nurses for frost tender species.

318. *Cytisus scoparius* is satisfactory as a nurse, and we have established under its protection (with no other frost protection) *Eucalyptus maculata*, and *Hakea saligna*.

319. *Hakea saligna planted* out at a wide espacement, suffers from frost rather seriously, and requires protection, such as that afforded by *Citysus scoparius*. But when planted dense in a plot, and given protection in the first year, it resists further frost, and serves as a nurse for other species. We have used a dense patch of *Hakea saligna* as a nurse for frost tender shola species. One of the species for which the *Hakea* has served as a nurse,

and which is of economic importance is *Cinnamomum camphora*, raised by transplanting nursery raised plants. We have had 72 per cent success.

320. Under *Acacia dealbata* cover we have 50 to 60 per cent survivals, with several shola species, which were raised in the nursery, mossed, and transplanted. It is however to be noted that for success, if the *Acacia dealbata* is very dense, a cautious initial thinning should be done in such a way that the canopy is not broken. Then there is always the possibility of profuse regeneration by root suckers. These have to be judiciously cut out if they interfere with the growth of the underplanted species.

321. As a result of our work in the past, we have now the following stock in this garden :—

Species.	Sowing number of plants.	Transplants survival per cent.	Stump plants survival per cent.
Acacia decurrens (South African)	258	50	72
Acacia decurrens (Naduvattam) ..	..	63	..
Acacia mollissima (South African) ..	143	62	68
Acacia melanoxylon	329	31	42
Acacia dealbata	62	51	52
Acacia baileyana	..	60	..
Buddleiya variegata	..	..	52
Berberis tinctoria	270	60	..
Cinnamomum wightii	..	20	34
Cupressus torulosa	634	51	..
Cupressus macrocarpa	151	43	..
Callitris rhomboidea	50	40	4*
Casuarina montana	72	29	14
Eucalyptus maculata	..	100	..
Eucalyptus ficifolia	18	..	..
Eurya japonica	..	..	17
Eugenia arnottiana	130	4	15
Evodia roxburghiana	..	12	..
Glochidion neilgherrense	1	53	62
Hakea saligna	68	80	..
Juniperus procera	5	15	..
Ligustrum neilgherrense	29	60	..
Litsea wightiana	..	20	12
Mahonia leschenaultii	424	8	45
Morus indica	..	..	51
Neolitsea zeylanica	..	25	18
Pinus massoniana	1	..	..
Pinus longifolia	36	26	..
Pinus insignis	53	13	..
Photinia notoniana	..	43	40
Quercus incana	12	42	..
Rapanea wightiana	36	53	81
Rhododendron arboreum	..	8	14
Rhodomyrtus tomentosa	..	12	16
Symplocos foliosa	..	10	35
Tithonia tagitiflora	..	..	35†
Viburnum erubescens	..	37	16
Zizyphus incurva	2	..	..

* It is noted that a conifer *Callitris rhomboidea* has given 4 per cent by stump planting. This information has no silvicultural value, the result was obtained by a mistaken planting of 25 stumps of the species, but may be of interest on an analogy with *Pinus longifolia* which when very young has sometimes been known to coppice.

† Cuttings.

322. This garden is now about 70 per cent stocked, and further attempts are made in our experiments to get the entire area fully stocked.

323. In an extension of this garden made in 1939, we have the stock tabulated below. One of the most important results obtained in this garden is that if *Acacia decurrens* and *Acacia mollissima* both of South African origin can be protected from browsing, fully stocked plantations can be raised by transplanting mossed transplants in soil worked areas, where grass root competition is eliminated. Further experiments on how to achieve these objects at a cheap cost are under way.

324. *Survivals in Jacko's Nulla Experimental Garden Extension*—

Species.	Sowing number.	Transplants per cent.	Stump plants per cent.
Acacia decurrens (South African)	..	81	..
Acacia mollissima (South African)	Profuse in 4 beds and 338 in pits.	89 and 23 in small beds.	63
Acacia dealbata	..	..	29
Acacia melanoxylon	..	..	78
Cinnamomum wightii	..	..	22
Cupressus macrocarpa	..	47	..
Cupressus torulosa	..	32	..
Casuarina montana	..	80	..
Callitris rhomboidea	..	32	..
Eugenia arnottiana	..	14	8
Glochidion neilgherrense	..	..	63
Hakea saligna	..	36	..
Ilex wightiana	..	..	25
Ligustrum neilgherrense	..	11	..
Litsea wightiana	..	..	14
Meliosma wightii	..	..	13
Morus indica (by cuttings)	..	..	55
Mahonia leschenaultii	..	..	21
Neolitsea zeylanica	..	..	21
Pinus longifolia	8	15	..
Photinia notoniana	..	15	17
Quercus incana	15	72	..
Rapanea wightiana	..	..	44
Rhodomyrtus tomentosa	..	..	8
Rhododendron arboreum	..	33	13
Symplocos foliosa	..	..	12
Viburnum erubescens	..	..	16

325. *Jacko's Nulla Experimental Garden No. 2.*—The fifteen patches reported in the Annual Report for 1939–40 have been maintained. These patches are fully stocked now with a mixture of *Cupressus macrocarpa*, *Hakea saligna*, *Acacia dealbata*, *Acacia melanoxylon*, *Mahonia leschenaultii Eugenia arnottiana*, *Cytisus scoparius*, *Buddleia variegata*, and *Hypericum mysorense*.

326. During 1940 an additional half acre was taken over from the charge of the Nilgiri division. At the time of taking over, we had a few *Cytisus scoparius*, and a very few *Ligustrum* plants in this area. We have formed 26 beds each 22′ × 15′ and 90 beds 6′ × 6′ and we are trying various species in these beds. Though we have protected the area fairly successfully against the effects of the first frosty season, it is too early to report results. The area should be under observation for at least one more season, before we can report any success.

327. *The Brooklands Experimental Gardens.*—Work in this garden was also continued. In the past we had a corner of this plot a blank, due to the severe frost killing every species tried so far. But during the year under review we have succeeded in raising a good patch of *Buddleiya variegata*. The *Buddleiya* is now utilised as a nurse for other species. It is too early to report results, though indications are that about 50 per cent of the transplants put in can be saved under *Buddleiya*.

328. In this garden we have successfully protected against frost *Neolitsea zeylanica*, *Meliosma wightii*, *Cinnamomum wightii* and *Symplocos foliosa*, with no other protection than the artificially raised broom.

329. *Acacia dealbata* is also proving itself useful, and under this we have established some *Neolitsea zeylanica*, *Symplocos foliosa*, and *Mahonia leschenaultii*.

330. The following statement indicates the stocking and success in the Brooklands Experimental garden :—

Species.	Number of seedlings from sowings.	Survival per cent. Transplants.	Survival per cent. Stump plants.
(i) *In 1941 open beds*—			
Acacia baileyana	29	40	..
Acacia decurrens (South African)	Profuse.	44	27
Acacia dealbata	32	46	..
Acacia melanoxylon	76	39	25
Acacia mollissima (South African)	75	38	14
Buddleiya (cuttings)	..	..	43
Berberis tinctoria	..	48	..
Callitris rhomboidia	92	27	..
Casuarina montana	..	20	5
Cupressus macrocarpa	27	21	..
Cupressus torulosa	39	31	..
Celtis tetrandra	..	8	..
Cinnamomum wightii	..	40	19
Daphniphyllum glaucescens	..	..	6
Eugenia arnottiana	..	28	13
Eurya japonica	..	..	5
Glochidion neilgherrense	..	..	44
Hakea saligna	43	55	..
Juniperus procera	9	..	..
Ligustrum neilgherrense	..	18	..
Litsea wightiana	..	11	16
Mahonia leschenaultii	46	16	22
Myrsine Rapanea wightiana	..	11	14
Morus indica (cuttings)	..	..	69
Meliosma wightii	..	8	..
Neolitsaea wightiana	..	29	30
Pinus insignis	..	15	..
Pinus longifolia	64	16	..
Photinia notoniana	..	36	24
Quercus incana	..	80	..
Rhododendron arboreum	..	21	8
Rhodomyrtus tomentosa	..	20	..
Symplocos foliosa	..	13	14
Viburnum erubescens	..	..	15

Species.	Number of seedlings from sowings.	Survival per cent. Transplants.	Survival per cent. Stump plants.
(ii) *Survivals under broom*			
Acacia mollissima	..	45	..
Buddleiga (cuttings)	..	..	16
Cinnamomum wightii	..	29	76
Cupressus toralosa	..	44	..
Eugenia arnottiana	17	..	..
Erodia rachurghiana	..	32	..
Litsea wightiana	..	27	24
Mahonia leschenaultii	..	75	64
Meliosma wightii	..	25	..
Neolitsea zeylanica	..	51	..
Pinus insignis	..	12	..
Pinus longifolia	..	28	..
Rapanea wightiana (Myrsino)	..	22	65
Rhamnus wightii	..	17	..
Rhododendron arboreum	..	4	..
Symplocos foliosa	..	32	25
Viburnum erubescens	..	..	4
(iii) *Survivals under* Acacia dealbata *cover*			
Buddleiga (cuttings)	..	..	21
Cinnamomum wightii	..	46	62
Hakea saligna	..	39	..
Litsea wightiana	..	88	..
Mahonia leschenaultii	..	16	..
Neolitsea zeylanica	..	52	..
Pinus longifolia	..	13	..
Rapanea wightiana	..	..	55
Symplocos foliosa	..	26	55

331. *Regeneration of tree species in patches of natural gorse.*—The reason for starting experiments under gorse (*Ulex europeus*) has been explained in paragraph 178 of the Annual Report for 1939–40.

332. We have now three patches under observation—

In the first patch we have the following survivals :—*Symplocos foliosa* 45 per cent, *Neolitsea zeylanica* 16 per cent, *Cupressus macrocarpa* 18 per cent, *Cinnamomum wightii* 7 per cent, *Hakea saligna* 5 per cent, *Eugenia arnottiana* 53 per cent, *Photinia notoniana* 47 per cent.

In the second patch we have 70 per cent survivals of *Photinia notoniana*, and the plants appear to be growing very healthily.

In the third patch we have 18 per cent survivals of *Neolitsea zeylanica*. In this patch the density of gorse was low, and hence the casualties in the plants have been high. But after

frost, some of them are recovering. There is reason to believe that they would have grown to such an extent before the next frost, that this light protection may prove sufficient.

333. The indications of this experiment, are that gorse appears to give sufficient protection for the plants under it, against frost; that after the frosty season the underplanted species may be encouraged to put on height growth by clearing funnels through the gorse directly over them, that we may thus succeed in gradually establishing tree species in the gorse patches; but that rigorous fire protection is necessary as the gorse burns even when green.

334. *Willows.*—Three species of willows have been tried up to date, *Salix alba* var. *coerulea*, *Salix babylonica*, and *Salix tetrasperma*.

335. *Salix alba* var. *coerulea.*—In previous reports, we have mentioned that the sets imported from England suffered for various reasons. The species has therefore not had a fair trail. The experiment has therefore failed, and we have now got not even one plant alive, in spite of all the care taken of them. But it cannot be said that the species is not suited for growth on the Nilgiris. It is yet to be investigated if large sets imported at the proper time by Mail steamer or by air and planted without any fumigation will succeed.

336. *Salix babylonica.*—Experiments with this species were commenced in 1936 primarily with the object of replacing casualties in the *Salix alba* var. *coerulea* plots. *Salix babylonica* is generally doing well in suitable localities, but it has been observed that the species is rather particular with regard to soil conditions, and seems to do well in places, which though subject to periodic flooding are well drained. It is fairly frost hardy. We have now 61 promising plants in double crossing; and we have also got 137 plants in Rees Corner, 75 in Aramby shola, and 69 in the Brooklands Experimental Garden.

337. *Salix tetrasperma.*—This species has in its turn been tried in replacing casualties in the above two species. It is tolerant of soil and moisture conditions and is also frost hardy. We have 279 plants in Rees Corner of this species.

338. Indications are that *Salix babylonica* and *Salix tetrasperma* can be successfully raised by planting cuttings 2 feet long and about $\frac{1}{2}$ to $\frac{3}{4}$ inch mean diameter, the sets being planted with about 2/3 of their length under ground.

339. *Mulberries.*—Experiments with *Morus alba* and *Morus indica were continued.* Though the above ground portion of these plants suffers from frost the portion below ground survives and sends up new shoots after the cold season. The plants do better and resist frost better with the lateral protection of *Cytisus*

scoparius which we have provided for some of them during the year under review. Further development of these plants is being watched.

340. *Andy Corner Rhododendron Plot.* This experimental plot, to study the effect of protection of Rhodendron from fire and grazing where it occurs scattered in grass land, was continued. Unfortunately an accidental fire from the surrounding grass land was carried by wind into the plot, in spite of cleared and properly maintained fire lines all round. The damage has since been repaired and the plot is continued under observation.

341. *Tan barks.*—Experiments on methods of growing *Acacia decurrens* and *Acacia mollissima* both of South African origin were continued. Experiments on stump planting both species have given 72 per cent and 68 per cent survivals in the Jacko's Nulla No. 1 Extension Experimental Garden. In the Jacko's Nulla No. 2 Garden *Acacia mollissima* stumps have given 63 per cent survivals. The further development of these plants is observed, and it is therefore too early to draw any conclusions. Some plants of both these species flowered during the year.

342. Kollegal, Nilgiri and Madura divisions have tried raising *Acacia decurrens* plantations. In the Kollegal division, insect damage has been reported. In the Nilgiri division Sambhur damage the plants.

343. Madura division reports that the result of sowings of *Acacia decurrens* seed has been quite satisfactory and that it is proposed to do the bulk if not all of future regeneration work by direct sowing.

344. It might however be mentioned that the indications of past work are that localities below 5,000 feet are probably not suited to the species, and that protection against browsing by sambhur by wire fencing or some live fencing may be necessary. Perhaps also when areas are brought under *Acacia decurrens* damage per acre by sambhur may tend to be less than when small areas are tried.

(vii) Tending, thinning, cleaning, etc.

345. *Effect of Thinning Teak Coppice shoots.*—Experimental Plot No. 142/1935, Palghat division, was started to determine whether it is advisable to thin out teak coppice when grown for the purpose of producing poles. When the coppice shoots were 18 months old, the following four treatments were applied :—

(A) reduction to one shoot per stool,

(B) reduction to two shoots per stool,

(C) reduction to four shoots per stool, and

(D) control, unthinned.

346. As 18 months was too early for this operation, the thinned stools produced secondary shoots, which persisted. These secondary shoots were removed when the coppice was four years old, and shoots of miscellaneous species interfering with the teak coppice were felled, stacked, and sold as fuel.

347. The growth of the coppice can be judged by the table below which is a summary of enumeration and measurement on 31st January 1941 :—

Treatment.	Number of shoots left per stool.	Type of shoot considered.	Number of stems.	Mortality per cent of shoots.	Average height in feet.	Average diameter in inches.
			PER CENT			
A						
B	1	Biggest	31	3	31·0	4·8
	2	Biggest	31	9	28·4	4·7
		Second biggest	30		22·4	3·1
C	4	Biggest	33	18	30·6	4·6
		Second biggest	32		25·3	3·4
		Remainder	49		19·3	2·3
D	Unthinned	Biggest	33	27	31·7	5·1
		Second biggest	32		25·6	3·4
		Remainder	110		16·6	1·8

348. As the mortality per cent in treatments C and D are high, it seems advisable to thin down to two shoots per stool, but it is only at the end of the rotation (of thirty years) that we can determine which treatment has produced the greatest money yield.

349. *Pruning in Teak Plantations.*—Experimental Plot No. 151, Nilambur Division, was started in 1938 to determine whether pruning each year up to the height a man can reach till the first thinning in a one-year old crop is beneficial. The assessment of the result is to be by height measurements annually (until growth stops), Diameter measurements, counting of production of epicormic branches and observation of natural cleaning of unpruned branches.

350. In March 1941, at the end of three growing seasons, it was found that the control trees had attained a mean height of 19·32 feet as compared with 16·42 feet per tree in the treated plots. The difference in height is significant. An enumeration of branches showed 4·06 branches per tree in the control unpruned plot against 0·21 branches per tree in the pruned plot.

351. Experimental Plot No. 158, Nilambur division, was started in 1939 with the same object. At the end of the second growing season, trees in the control plot have attained a mean height of 17·74 feet, as compared with 15·69 feet attained by trees in the pruned plot. The difference in height growth is significant. An

enumeration of branches showed that there are 08 epicormic branches in the treated plots against 11·90 epicormic branches in control plot.

352. Pruning in these two experiments has definitely retarded height growth to a significant extent, though there is no appreciable difference in survival percentage, and the usefulness of the operation if any has to be sought in other aspects of growth.

353. Experimental Plot No. 154 of Nilambur which was laid out in 1939 in a Plantation of 1934, with the object of determining the efficacy or otherwise of pruning in older teak plantations right up to the crown, and of comparing the effects of pruning at the first thinning with pruning at first and third thinnings, was maintained.

354. *Loranthus in Teak Plantations.*—In Experimental Garden Experiment No. 211/1940 Dhoni and Experimental Garden Experiment No. 18, Nilambur, Phenological observations were continued to determine the fruiting season of *Loranthus longiflorus* var *falcatus*, and to attempt to determine the best way of eradicating the parasite from teak plantations. The species has not been observed to flower or fruit in Dhoni between April 1940 and February 1941, but in Nilambur it has been observed that flowering commenced at the end of September 1940, fruit just began to form in February 1941, they ripened in early March 1941, and began to fall before the end of March 1941.

355. The branches affected by the pest (which were under observation) were cut one foot above the pest in April 1940, and laid in an open space, and observed. The *Loranthus* on the cut branches dried up in about ten days, without producing flowers or fruit. On the cut ends of the teak trees the *Loranthus* has not appeared again.

356. Hence this method of dealing with the pest appears satisfactory.

357. *Thinning research—Teak.*—The plots in the Nilambur and Wynaad divisions the objects of which are to determine (*a*) the best date of first thinning, (*b*) the best intensity of thinning, and (*c*) the best periodicity of thinning in teak plantations of different qualities, including the set of plots established to test whether Dr. Craib's theory of thinning is applicable to teak plantations, have been maintained.

358. *Tending to increase the sandal/host ratio and to introduce "spike-resistant" hosts—Santalum album.*—Chittoor and North Salem divisions report successful Sandal kumries in association with *Cassia siamea*, Chittoor division reports that a judicial thinning and pollarding of *Cassia siamea* in the 1·90 acre plot of 1939–40 (which was rekumried in 1940–41) gave 24 headloads of manure leaves; and this was sold for Rs. 3.

359. North Salem division reports that the 1939–40 kumries in Gulhatti contain an excellent stock of *Cassia siamea*, *Acacia ferruginea*, and *Azadirachta indica*, (2) the 1939–40 Kumri in Javalagiri contains a good stock of *Cassia siamea*, but *Azadirachta indica*, and *Zizyphus* introduced in 1940–41 failed; (3) in the 1940–41 Kumaries only *Cassia siamea* has come up; and (4) Resowing and restocking with nursery transplants will be necessary in 1941–42.

(viii) MIXTURES.—*Nil.*

(ix) UNDERPLANTING.

(*a*) *Teak plantations.*

360. *Underplanting in teak plantations.*—Of the Experimental Plots mentioned under paragraph 192 of the Annual Report for 1939–40, four plots, i.e., Experimental Plots Nos. 98, 99, 102 and 103, Nilambur division, were closed during the year, after writing up final summaries.

361. The conclusions drawn from Experimental Plots Nos. 98 and 102 were as follows:—

From the growth and development of the survivals in spite of continual browsing it is seen that *Swietenia macrophylla* can be successfully underplanted under II and III quality teak, at about half rotation age (37 years) provided that deer and other browsing animals are excluded. If browsers are common and allowed in the area, such underplanting becomes impossible. Later experiments have shown that the open spacing of 6′ × 6′ renders the Mahagony very susceptible to browsing attack. If the Mahagony is introduced in dense lines, liability to heavy mortality due to browsers is greatly diminished. It should also be noted that later experiments have shown that the mahogany introduction by transplanting is much more reliable than by direct sowing.

362. Experimental Plots Nos. 99 and 103/Nilambur division are similar experiments with *Cedrela toona*.

The conclusions drawn from these experiments are as follows:—

From the growth and development of the survivals in spite of continual browsing and bark stripping by deer, *Cedrela toona* can be successfully underplanted under teak (II and III quality) at about half rotation age (37 years) provided that deer and other browsing animals are excluded. If browsers are numerous and allowed in the area casualties are very numerous. It should be noted that later experiments in this subject have shown that the open spacing 6′ × 6′ renders the *Cedrela* very susceptible to browsing attack. If the *Cedrela* is introduced in dense lines liability to heavy mortality due to browsers is greatly diminished. It should also be noted that later experience has shown that *Cedrela* introduction by stump planting is much more reliable than by direct sowing.

363. During the year the remaining old plots were maintained and one new plot was opened in 1940. The following table shows the progress made by the plots during the year :—

Experimental plot number.	Underplanted species.	Date of under planting.	Age of teak at time of underplanting.	Survival per cent of underplanted crop.	Mean height growth in 1941.	Increment during the year.
			YEARS.	PER CENT.	FEET.	FEET.
	NILAMBUR DIVISION.					
101	*Bambusa arundinacea* ..	1930	37	80	26·0	+ 0·7
145	*Bambusa polymorpha* ..	1937	6	98	19·1	+ 6·6
100	*Cephalostachyum pergracile* ..	1930	37	74	56·4	+11·4
104	*Do.* ..	1930	37	58	46·3	+ 3·7
105	*Do.* ..	1931	38	100	51·9	+ 5·5
106	*Do.* ..	1931	38	71	56·1	+12·3
146	*Do.*	1937	35	100	54·4	— 0·6
155	*Dendrocalamus Longispathus* ..	1939	8	99	12·5	+ 9·3
163	*Melocanna bambusoides* ..	1940	9	28	4·3	+ 4·3
138	*Hopea parviflora*	1936	Failed.	67	14·5	+ 3·4
156	*Swietenia macrophylla* ..	1939	8	100	6·5	+ 1·0
	WYNAAD DIVISION.					
8	*Cephalostachyum pergracile* ..	1932	33	83	25·0	+ 4·8
	PALGHAT DIVISION.					
159	*Bambusa polymorpha* ..	1937	7	100	11·4	+ 6·7

364. The data tabulated above shows that the species mentioned, can all be successfully established by underplanting under teak. The percentage of success from *Melocanna bambusoides* has been very low, but it is to be seen how the species develops. One of the difficulties in importing the species from Bengal was that by mistake it was despatched by goods train, and on arrival, it was found that germination had already begun in the majority of cases.

In Experimental Plot No. 146, Nilambur division, a negative increment during the year has been recorded and this was partly due to accidental breakage of some bamboo and partly to the impossibility of correctly measuring the heights of standing bamboos when they are over about 30 feet.

It will be seen that the indigenous *Bambusa arundinacea* is comparatively slower grown than the *Cephalostachyum pergracile* of the same age.

365. In Experimental Plot No. 146 of 1937, Nilambur division, *Cephalostachyum pergracile* was raised by direct sowing in 1929 under teak which was then 27 years of age. In addition to watching the development of the bamboo, this plot also serves for determining the effect of a judicious thinning in the bamboo clumps. The plot was divided into four blocks, initial comparability between the blocks tested, two blocks left as control with

nothing done and in two blocks (i) all broken diseased or whippy culms were removed, (ii) all dead or moribund culms removed, (iii) all culms of the current year left behind, and (iv) also half as many old culms as there are new culms left behind subject to a minimum total of 20 culms per clump. These culms are left well spaced out in the clump. Side branches of all culms both in the treated and control blocks up to about 5 feet from the ground were cleared, and the entire plot cleared of all debris. Treatments are repeated every year. Four years after treatment, there is no difference in survival percentage between the treated plots and the untreated control, but the height growth of tallest culms in the treated plots is significantly poorer than the height growth of tallest culms in the control plots. This result has to be taken with caution, because of the inherent difficulty of correct height measurement of standing bamboo culms.

(b) Evergreen rain forests.

366. *Underplanting under shade.*—Palghat Division Experimental Plots Nos. 147 and 148/1935 were remeasured. These plots have been established to watch the development of *Mesua ferra* and *Calophyllum elatum* respectively of known age from the sapling to the pole stage. The species were raised by transplanting under evergreen forest shade in 1924. These plots are now seventeen years old, and the results of 1941 measurements are tabulated below :—

Experimental plot number.	Species.	Survival percentage.	Mean height in feet.	increment during the year.
147	*Mesua ferrea* ..	100	6·88	0·63
148	*Calophyllum elatum* ..	100	7·91	0·96

367. Experimental Plots Nos. 42 to 50, Wynaad division, were laid out similarly in Chandanathode (Wynaad division) in old experimental gardens, in 1937. Results of remeasurement in 1941 are recorded below :—

Experimental plot number.	Species.	Canopy.	Age.	Survival percentage.	Mean height in inches.	Increment during the year.
			YRS.	PER CENT.		INCHES.
42	*Mesua ferrea* ..	Full evergreen cover	9	97	35·6	+ 2·6
43	*Artocarpus hirsuta* ..	Do.	9	96	41·9	+ 3·4
44	*Gluta travancorica* ..	Do.	8	99	77·1	+17·4
45	*Hopea parviflora* ..	Top canopy only ..	7	100	137·3	+18·6
46	*Artocarpus hirsuta* ..	Do. ..	7	99	114·6	+19·9
47	*Cedrela toona* ..	Do. ..	7	89	55·9	— 7·7*
48	*Gluta travancorica* ..	Do. ..	7	64	112·3	+18·9
49	*Swietenia macrophylla.*	Do. ..	6	32	101·8	+20·8
50	*Dipterocarpus indicus.*	Do. ..	7	100	77·2	+16·6

* NOTES.—1. *Cedrela toona* has shewn a decrease in height due to attack by the shoot borer.
2. The low percentage of survivals of *Swietenia macrophylla* is due to attack by the Collar borer.

368. *Regeneration of evergreens after clear-felling.*—Experimental Plot No. 27, Wynaad division, started in 1935, and regenerated in 1936 to complete the series of degrees of shade requisite for the regeneration of evergreen species, was maintained. It has the following treatments, for the regeneration of evergreens :—

(A) Clear-felling and burning—no cover crop.

(B) Clear-felling and burning with cover crop.

(C) Clear-felling—no burning—no cover crop.

(D) Clear-felling—no burning—with cover crop

(E) Felling all but the undergrowth—no burning.

369. Measurements in March 1941, at the end of the fifth growing season after planting, are recorded below :—

Number and species.	Stock used.	C: No burn—no cover crop. Survival per cent.	C: Mean height.	A: Burn—no cover crop. Survival per cent.	A: Mean height.	D: No burn—cover crop. Survival per cent.	D: Mean height.	B: Burn—cover crop. Survival per cent.	B: Mean height.	E: Natural undergrowth. Survival per cent.	E: Mean height.
		PER CENT.	INCS.	PER CENT.	INCS.	PER CENT.	INCS.	PER CENT.	INCS.	PER CENT.	INCS.
1 *Artocarpus hirsuta.*	Stumps, 0·3″/0·4″ ..	28	26·3	22	31·0	22	31·9	16	34·9	38	18·3
2 *Swietenia macrophylla.*	Transplants, 22″ ..	4	69·5	..	..	..	..	2	31·5	71	46·0
3 *Hopea parviflora.*	Direct Sowing ..	93	48·2	95	29·1	88	17·6	94	12·6	89	19·0
4 Do.	Transplants, 22″ ..	89	57·0	95	53·0	92	40·6	98	40·0	85	58·0
5 *Cedrela toona* ..	Shoot Cuttings, 18″ ..	9	47·5	24	41·4	5	46·4	12	34·9	17	73·8
6 Do. ..	Stumps, 0·2″/0·3″ ..	5	55·0	12	19·0	3	61·3	6	28·9	12	69·9
7 *Chikrassia tabularis.*	Stumps	8	30·0	6	35·5	1	34·0	8	21·8	7	36·3
8 *Dipterocarpus indicus.*	Transplants, 3½″ ..	12	112·8	12	8·7	3	93·0	5	55·9	8	68·7
9 *Dysoxylum malabaricum.*	Transplants, 13″ ..	2	63·7	2	69·3	1	71·0	1	27·0	11	38·8
10 *Mesua ferrea* ..	Transplants, 14″ ..	12	76·0	3	230·8	5	55·0	5	63·4	17	41·7
Average of all species together	..	27	53·4	28	45·1	23	31·4	26	28·8	34	40·7

370. It is seen from the above figures that the requirements of different species are different. In the case of *Hopea parviflora* (both direct sowing and entire transplanting) and *Cedrela toona* (cuttings), burning has given a higher percentage than no burn, and in the case of *Artocarpus hirsuta* (stumps) the treatment of "Burn—cover crop" has given maximum height, but a very low percentage. In all other cases, burn has had no effect. It would appear that for the remaining species selected, no burn, no cover crop, or natural undergrowth, have produced the best results judged by percentage survivals or mean height growth.

371. A similar experiment (Experimental Plot No. 70, South Coimbatore division) was started in 1937 in Kariaushola and promises to be successful. Results at the end of the fourth growing season are recorded in the following table. Though individual species naturally differ in their requirements it would appear that in general, in Kariaushola, the treatment of "Burn—Cover crop of Boga" has given the best results so far.

Number and species.	Stock used.	No burn—no Boga. Survival per cent.	No burn—no Boga. Mean height.	Burn—no Boga. Survival per cent.	Burn—no Boga. Mean height.	No burn—Boga. Survival per cent.	No burn—Boga. Mean height.	Burn—Boga. Survival per cent.	Burn—Boga. Mean height.	Natural undergrowth. Survival per cent.	Natural undergrowth. Mean height.
		PER CENT.		PER CENT.		PER CENT.		PER CENT.		PER CENT.	
1 *Hopea parviflora.*	Transplants, 3½″.	82	21·86″	81	13·64″	92	21·01″	92	15·56″	89	16·00″
2 *Swietenia macrophylla.*	Transplants, 30″.	83	8·16′	84	9·59′	83	8·41′	88	8·30′	93	10·28′
3 *Mesua ferrea* ..	Transplants, 6½″.	65	7·36″	71	7·48″	65	7·36″	86	12·96″	62	7·37″
4 *Palaquium ellipticum.*	Transplants, 5½″.	12	11·08″	10	12·00″	12	11·08″	87	13·95″	46	10·00″
5 *Artocarpus hirsuta.*	Stumps, 0·4″/0·8″.	97	7·97′	98	7·42′	97	7·98′	97	5·90′	86	4·6′
6 *Hopea parviflora.*	Sowing	97	4·82″	90	4·85″	93	5·03″	98	8·89″	97	7·56″
7 *Cedrela toona* ..	Cuttings 10″ ..	85	9·04′	83	9·54′	85	9·03′	49	9·80″	46	8·21′
	Average	74	10·1	74	7·7	75	10·0	85	10·7	74	9·02

Burn and Boga best both by survival percentage and mean height growth as an average.

Burn—No Boga has given poorest average mean height girth.

372. In Experimental Plot No. 169/1939 Palghat Division, an attempt is made to raise *Hopea parviflora*, *Cedrela toona* and *Balanocarpus utilis* in a *deciduous* clear felled and burnt area with artificially raised cover crop of Boga (*Tephrosia candida*) and with a shade crop of *Trema orientalis*.

Results in January 1941 are tabulated below :—

Species.	Percentage survival of main tree species.	Average height of main tree species.
		INCHES.
Hopea under *Trema*	81	19·2
Hopea under Boga	87	20·3
Cedrela toona under *Trema*	73	40·4
Balanocarpus utilis under Boga (replaced by *Hopea* due to casualties)	96*	10·7*
Balanocarpus under *Trema* (but replaced by Hopea due to casualties)	100*	10·6*

* These measurements relate to the replaced *Hopea* and not to the *Balanocarpus*.

373. In a similar experiment Experimental Plot No. 172/1940 Palghat division an attempt is made to raise *Vateria indica*, *Cedrela toona* and *Mesua ferrea*, after clear felling in a *deciduous*

forest which was originally evergreen. The species have been tried under a cover crop of *Tephrosia candida*, and a shade crop of *Trema orientalis*. Results in January 1941, are summarized below :—

Species.	Percentage survival of main tree species.	Average height of main tree species.
		INCHES.
Vateria under *Trema*	64	8·3
Vateria under *Tephrosia*	85	7·5
Cedrela toona under *Trema*	87	27·5
Mesua under *Tephrosia*	96	5·7
Mesua under *Trema*	61	5·1

374. It is too early to draw any conclusions, but it would appear that during the first year the heavier shade of *Tephrosia* is more desirable for *Vateria indica* and *Mesua ferrea*, from the point of view of survival percentage. *Cedrela toona* appears to do quite well under the higher and comparatively lighter shade of *Trema orientalis*. *Hopea parviflora* appears to do equally well judged by results at the end of the second year under the shade of *Tephrosia*, and under the shade of *Trema orientalis*. These tentative indications require further confirmation by repetition.

375. *Direct sowing—Best date (under top canopy only).*—In the Chandanathode Experimental Garden Experiments Nos. 210 to 213 and in the Kariandshola Experimental Garden Experiments Nos. 174 to 178 experiments were done during the year on this subject.

376. *Mesua ferrea*, *Evodia roxburghiana*, and *Chikrassia tabularis* showed the third week of April as probably the best period of sowing, judged by survival per cent and mean height growth of resulting plants.

377. For *Acrocarpus fraxinifolius* the best time appears to be from the third week of July to the third week of August.

378. As there were no survivals at the time of remeasurement of *Bischofia javanica*, *Chikrassia tabularis* and *Swietenia macrophylla*, no conclusions can be drawn.

(For full experimental data see paragraph 189.)

379. *Entire transplanting—Best date (under top canopy only).*—Eight experiments with six species were done with the object of finding out the best date for entire transplanting under top canopy only. Transplanting was done once a fortnight from the middle of June to the middle of September, in four experiments, and till the middle of October in four experiments.

380. Results indicate that at Chandanathode Early September is the best time for transplanting. *Chickrassia tabularis*, and *Mesua ferrea*. *Bischofia javanica* can be transplanted any time from mid June to early September judged by survival percentage, and the earlier the better because of the improved height growth obtained. In Kariandshola and Chandanathode, it appears that

a very good percentage of survivals is obtained with *Hopea parviflora* planting on any of the dates tested, but the earlier the planting, the better is the height growth of the resulting plants. Transplanting *Aglaia roxburghiana* from early June to early August has given the best results judged by both criteria. Judged both by survival per cent and mean height growth of resulting plants early July is the best date for *Calophyllum clatum*. For *Mesua ferrea* transplanting in the middle of June and in the middle of October have both done almost equally well, though mid-June transplanting is slightly the better of the two.

Chandanathode Experimental Garden Experiments Nos. 214 to 217. Kariandshola Experimental Garden Experiments Nos. 180 to 183.

(For full experimental data see paragraph 190.)

381. *Stump planting—Best date top canopy only.*—Two experiments were done at Kariandshola (Experimental Garden Experiments Nos. 184 and 185 of 1940) and one Experiment at Chandanathode (Experimental Garden Experiment No. 218 of 1940) to find the best date for stump planting *Cedrela odorata* and *Chickrassia tabularis*. The experiment with *Cedrela odorata* has failed as there were no survivals in January 1941. Judged by percentage survivals and by mean height growth early June has given the best results in Kariandshola and mid-May has given the best results in Chandanathode. But the *Chickrassia tabularis* has done reasonably well even as late as mid-July in both gardens.

(For full experimental data see paragraph 191.)

382. *Comparison of sowing, transplanting and stump planting.*—Nine experiments with nine species in two localities have been done on this subject. The survival per cent and mean height at the end of one growing season, are tabulated below. In the case of *Aglaia roxburghiana*, direct sowing appears to be the best method of regeneration. In the case of *Bischofia javanica* Stump planting appears to be the best method. In the case of the other species, i.e., *Acrocarpus fraxinifolius*. *Evodia roxburghiana Mangifera indica*, *Balanocarpus utilis*, *Pericopsis indicum*, *Vateria indica* and *Calophyllum clatum*, transplanting appears to be the best method.

Results at the end of one growing season.

Locality.	Experimental garden experiment number.	Year.	Species.	Survivals per cent.			Mean height in inches.		
				Sowing.	Transplanting.	Stump planting.	Sowing.	Transplanting.	Stump planting.
Kariandshola ..	167	1940 ..	*Evodia roxburghiana.*	15	89	81	6·5	17·7	7·6
Chandanathode.	198	Do. ..	*Acrocarpus fraxifolius.*	0	36	12	0	9·1	3·1
"	203	Do. ..	*Mangifera indica.*	96	97	11	7·4	12·0	2·6
"	204	Do. ..	*Bischofia javanica.*	7	95	89	1·1	7·7	26·3

Locality.	Experimental garden experiment number.	Year.	Species.	Survivals per cent.			Mean height in inches.		
				Sowing.	Transplanting.	Stump planting.	Sowing.	Transplanting.	Stump planting.
Chandanathode.	205	1940 ..	*Aglaia barberi-ghiana.*	86	84	38	2·8	2·4	1·5
,,	206	Do. ..	*Balanocarpus utilis.*	..	72	2	..	4·9	1·0
,,	207	Do. ..	*Percibraeria indicum.*	0	100	80	0	11·1	2·5
,,	208	Do. ..	*Valeria indica.*	20	74	2	4·5	3·9	1·0
,,	209	Do. ..	*Calophyllum elatum.*	66	78	10	5·4	5·2	0·7

3·3. *Comparison of sowing, transplanting small, medium and large transplants, and planting small and large stumps, under top canopy cover.*—Chandanathode Experimental Garden Experiments Nos. 166, 171 and 172, and Kariandshola Experimental Garden Experiments Nos. 138, 145 and 148, all of 1939, were remeasured during the year. The results indicate that judged by survival percentage and mean height growth after two growing seasons, direct sowing is the best method of raising *Artocarpus integrifolia*, planting large transplants is the best method for *Artocarpus hirsuta*, while for *Acrocarpus fraxinifolius*, *Chickrassia tabularis* and *Cedrela odorata*, small transplants give the highest survival per cent, but large transplants result in best height growth. *Cedrela odorata* can also be raised by cuttings, but the percentage of survivals (2 per cent) is disappointingly small.

384. Chandanathode Experimental Garden Experiments Nos. 196 and 202 and Kariandshola Experimental Garden Experiments Nos. 164, 165 and 166 were started during 1940, and they were measured after one growing season in 1941. The following are the indications obtained. *Artocarpus integrifolia* can best be raised both by direct sowing, and by large entire transplants. *Bischofia javanica* gives a very high percentage of survivals by large entire transplanting, and by stump planting but judged by the height growth of resulting plants, large transplants appear best for the species; *Chickrassia tabularis* and *Acrocarpus fraxinifolius* do best when raised by large entire transplants.

385. In Chandanathode Experimental Garden Experiment No. 140 of 1938 and Kariandshola Experimental Garden Experiment No. 106 of 1938, there was no stump planting done. The comparison was therefore between direct sowing, and planting entire large, medium and small transplants of *Swietenia macrophylla*. The indications are that judged by survival per cent and Mean height growth after three growing seasons, the best method of raising the species is by planting entire large transplants.

386. Similar investigations were conducted in Kariandshola Experimental Garden Experiments Nos. 150 to 153, 161, and Chandanathode Experimental Garden Experiment No. 170 of 1939

Results after two growing seasons indicate that judged both by survival percentage and mean height growth planting entire large transplants is the best method of raising *Swietenia macrophylla*, *Bischofia javanica* and *Chickrassia tabularis*; while medium transplants appear best for *Hopea parviflora*. For *Mesua ferrea*, while small transplants have done best in Kariandshola, large transplants have done best in Chandanathode. In neither centre were medium transplants of *Mesua ferrea* tried.

387. Similar investigations were conducted in Kariandshola Experimental Garden Experiments Nos. 171 to 173 and Chandanathode Experimental Garden Experiments Nos. 200 and 201 of 1940. Results after one growing season indicate that judged both by survival percentage and Mean height growth the best method of raising *Chickrassia tabularis*, *Hopea parviflora*, *Dipterocarpus indicus* and *Mesua ferrea* is by large transplants, while the best method of raising *Valeria indica* is by direct sowing.

388. It is observed that one species has in cases behaved differently in different localities, or in different years; and hence these results have to be taken with considerable caution. More experimental work is needed before any of the above indications can be considered as reasonable conclusions.

(For full experimental data see paragraph 492.)

389. *Transplanting (under top canopy cover)—Comparison of natural forest seedlings and nursery transplants.*—Experiments Nos. 158 to 160 and 189 of 1939 in the Karian shola Experimental Garden were remeasured. Judged by survival percentage and Mean height growth of resultant plants, nursery transplants have fared better than forest transplants in the case of *Aglaia roxburghiana, and Palaquium ellipticum*, while in the *Calophyllum elatum* forest transplants have done better.

390. In 1940 five experiments have been done in Kariandshola and Chandanathode, with the following four species on this subject:—

Mesua ferrea, *Calophyllum elatum*, *Palaquium ellipticum* and *Hopea parviflora*.

391. In the case of *Palaquium ellipticum* natural forest transplants have given significantly better height growth and a better percentage of survivals than nursery raised transplants. In the case of *Hopea parviflora* there is no appreciable difference in survival percentage, but natural forest transplants have given significantly better height growth than nursery transplants. In these cases it has to be remembered that though the sizes of the natural forest transplants are comparable with nursery transplants, they are of uncertain age.

392. In the case of *Mesua ferrea* on the other hand, nursery transplants have done significantly better than natural forest transplants.

(detected on 8th November 1939, 17th November 1939 and 13th August 1939, respectively) on the Javadi hills of Vellore East and Vellore West Divisions were carefully examined during the year. The exact dates of their infection could not be gauged. The numbers of trees reported spiked at the time of their detection are high in the Nadukuppam, Puliyur and Nachamalai areas being 16, 65 and 256, respectively. Taking these as the outbreaks of the years in which they were detected the number of annual infections reported last year stand as follows :—

1931	1	1933	0	1935	3	1937	3	1939	8
1932	3	1934	3	1936	14	1938	3	1940	3

405. The analysis of the locality factors of all these new outbreaks confirms the previously recorded facts of :—

(*a*) proximity of cultivated areas and diseased field crops;
(*b*) presence of susceptibility conferring host plants;
(*c*) presence of virus diseases in associated plants both wild and cultivated; and
(*d*) nearness to paths and rights of way.

406. *Transmission of the disease—Experiments to determine the size of the vector.*—Wire gauze cages of different meshes were constructed over tested healthy sandal plants in a virulently spiked sandal area since 1933 and the results obtained till 1939–40 showed that the infective vector should be above 1/10 of an inch and below $\frac{1}{4}$ of an inch in size. The period of the experiments was fixed at 5 years and so all cages of 10 meshes to an inch were abolished. Ten of the remaining 35 cages, size 6 meshes to an inch were enlarged to 4 feet cube size to allow more space for the plants to grow. The total incidence of spike obtained till the end of March 1941 is as follows :—

Date of start of experiment—1933 March.

Serial number and size of meshes.	Date of caging.	Number of plants caged.	Number of plants spiked.	Percentage of plants spiked.	Date of abandoning cages.
1 Twenty meshes to an inch.	Nine in March 1933 .. One in December 1933 ..	10	0	0	4th October 1936.
2 Ten meshes to an inch ..	Two in March 1933 .. Seven in December 1933 .. One in September 1933 ..	10	0	0	10th November 1940.
3 Six meshes to an inch ..	June and July 1938. Expanded in January 1941.	10	0	0	..
4 Four meshes to an inch ..	Three in March 1933 .. Six in September 1935 .. Do. 1936 ..	15	6	40	..
Three-eighth inch mesh ..	Four in August 1937 .. Six in September 1937 ..	10	3	30	..
6 Two meshes to an inch ..	Six in September 1934 .. Four in November 1934 ..	10	10	100	November 1938.
7 One mesh to an inch ..	Ten in September 1934..	10	9	90	August 1940.
8 Controls not caged ..	.. ..	1040	944	87·3	..

The last case of spike noticed in these cages was in $\frac{3}{8}$ inch mesh cage on 25th July 1940.

407. *Sticky paper experiments.*—The experiments described last year were continued during the year in both the infective seasons. As a result of this, we have added to our list of suspects in addition to those mentioned in the last year's report the following :—

Jassidæ—

Leofa sp.
Nehala sp.
Kristna sp.
Divus bipunctatus.
Cicadula sp. No. 2.
Scaphoideus sp.
Pediopsis sp.
Chiasmus sp.
Monobazus grandis and
Bitnitus sp.

408. *Platform experiments.*—During this year the platforms were shifted to a new site in the interior and the experiments continued. No incidence has been obtained so far among the plants exposed during the year.

409. *Insect group transmission cages at Kenilworth Castle area.*—This experiment was discontinued during the year for want of a suitable trained fieldman.

410. *Transmission experiments with individual species of insects.*—In *Jassidæ* 18 species, viz., *Nirvana suturalis*, *Nirvana longitudinals*, *Eutettix* sp., *Nephotettix* sp., *Neodartus* sp., *Selanocephalus* sp., *Selanocephalus disparatus*, *Moonia albimaculata*, *Parabolacratus porrectus*, *Jassus indicus*, *Paralimnus confuscus*, *Deltocephalus* sp., *Tettigoniella* sp., *Tettigoniella spectra*, *Divus bipunctatus*, *Neodartus scutellatus*, *Ledropsis* sp., *Kolla unimaculata* have been tested in 52 experiments, 29 at Denkanikota utilizing 2,270 insects from 19 in *Nephotettix* sp., to 543 in *Nirvana suturalis* and 23 experiments at Javalagiri utilizing 2,201 insects from 52 in *Neodartus scutellatus* to 1017 in *Tettigoniella spectra*. The number of experiments has varied from 1 to 9 comprising in all 4,471 individuals of *Jassidæ*, 2,270 at Denkanikota and 2,201 at Javalagiri. Nine experiments with *Moonia albimaculata* and 8 with *Jassus indicus* (both of which species gave us suspicious symptoms previously) were carried out. Of these one of the experiments with *Jassus indicus* gave us positive results detailed elsewhere and another experiment gave us very suspicious symptoms.

411. In *Pentatomidae*, 7 species, viz., *Nezara viridula*, *Sastragala heterospila*, *Menida labecula*, *Pentatomid* sp., *Plautia* sp., *Hotea* sp., *Dolycoris indicus* have been tested in 23 experiments, 11 at Denkanikota utilizing 1,439 insects from one in *Sastragala heterospila* to 632 in *Hotea* sp., and 11 at Javalagiri utilizing 343 insects from 6 to 206 in *Nezara viridula*. The number of experiments has varied from 1 to 7 comprising in all 1,096 individuals of *Pentatomidæ* at Denkanikota and 343 at Javalagiri, *Nezara viridula* which gave suspicious symptoms previously has been given a fair trial in both the centres and at both the infective seasons.

412. In *Fulgoridæ*, 6 species viz., *Brahmaloka fletcheri*, *Fulgorid* sp., *Saliza* near *partitile*, *Centromeria* sp., *Saturnus marginellus* and *Tambinia verticalis* have been tested in 12 experiments, 2 at Denkanikota one with 29 insects of *Brahmaloka fletcheri* and the other with 11 insects of *Saliza* near *partite* and 10 experiments at Javalagiri utilizing 377 insects from 4 in *Fulgorid* sp., to 249 in *Tambinia verticalis*.

413. In *Cercopidæ*, 3 species, viz., *Poophilus costalis*, *Aprophara* sp. and *Machoerota* sp. have been tested in 10 experiments, 6 at Denkanikota utilizing 13 individuals in *Aphrophora* sp. in one experiment, 387 in *Poophilus costalis* in 4 experiments and 339 insects in one experiment with *Machoerota* sp., and 4 experiments at Javalagiri with 67 insects in one experiment in *Poophilus costalis*, 126 insects in 2 experiments with *Aphrophora* sp. and 18 insects on one experiment with *Machoerota* sp.

414. In *Membracidæ*, 3 species, viz., *Tricentrus transversus*, *Leptocentrus taurus*, and *Cocosterphus tuberculatus* have been tested in 14 experiments, 8 at Denkanikota utilizing 676 insects with 221 of *Tricentrus transversus*, 42 insects of *Leptocentrus taurus* and 413 insects of *Cocosterphus tuberculatus* and 6 experiments at Javalagiri, 2 with 83 and 16 insects of *Leptocentrus taurus* and with 108 insects of *Tricentrus transversus*.

415. In *Lygæidæ*, only *Aphanus sordidus* has been tried in 2 experiments at Denkanikota with 34 and 25 insects and 3 experiments at Javalagiri with 22, 54 and 13 insects respectively.

416. In *Capsidæ*, *Lucinatus punctatus* has been tried in 2 experiments at Denkanikota with 76 and 107 insects and 3 experiments at Javalagiri with 87, 11 and 9 insects respectively.

417. In *Coreidæ*, *Cletus bipunctatus* has been tried in one experiment at Denkanikota with 27 individuals and in two experiments at Javalagiri with 12 and 36 insects respectively.

418. No positive results were obtained in all these experiments except in one with *Jassus indicus* which is indicated as the most outstanding result for the year. In one of the compartment cage No. 36 at Javalagiri measuring 6′ × 6′ × 7′ eight healthy sandal plants Nos. 8158, 8457, 10375, 4465, 7575, 3115, 10170 and 6255 taken from the Denkanikota Potculture Plot (a healthy locality) were kept in the cage along with a grafted plant No. 8320 (which showed spike after removal from the cage and then died) from 30th June 1940 to 1st September 1940. Twenty-nine insects of *Jassus indicus* were released into the cage, 14 on 30th June 1940, 2 on 6th July 1940, 3 on 10th July 1940, 2 on 11th July 1940, 2 on 12th July 1940, 1 on 14th July 1940, 3 on 18th July 1940, 1 on 19th July 1940 and 1 on 16th August 1940. All the 8 healthy sandal plants were removed from the cage and kept in the Potculture plot at Denkanikota along with the control plants. On 19th October 1940 one of the plants No. 10375 looked

suspicious and on 22nd October 1940 suspicious symptoms looked definite. Except plant No. 10375 the remaining 7 plants were defoliated to see if any more plants were infected and if so if any of them would manifest the disease. On 14th November 1940, plant No. 8457 manifested the disease. Plant Nos. 8158 and 7575 showed the disease on 2nd December 1940 and 4th December 1940 respectively. In order to prove that the disease manifested was " Spike " leaf-material taken from the sandal plants were grafted on to healthy sandal plant as detailed below :—

Plant number	Date of graft.	Leaf material taken from the plant number.	Kind of leaf.	Number of grafts.	Date of manifestation of the disease.
16295	14th November 1940.	10375	Diseased.	5	
Do.	.. 30th November 1940.	Do.	Do.	5	
Do.	.. 7th December 1940.	Do.	Do.	5	
16296	.. 14th November 1940.	10375	Apparently healthy.	10	
Do.	.. 23rd January 1941.	Do.	Do.	3	
Do.	.. 23rd February 1941.	Do.	Do.	4	
16508	.. 7th December 1940.	8158	Diseased	18	
16510	.. 24th December 1940.	Do.	Do.	18	
	23rd February 1941.	Do.	Do.	4	
16511	.. 23rd December 1940.	Do.	Do.	15	
16512	.. Do.	7575	Do.	10	
16513	.. 17th January 1941.	Do.	Do.	9	
16514	.. Do.	8158	Do.	9	
16515	.. 23rd January 1941.	10375	Apparently healthy leaves.	6	28th April 1941.
Do.	.. 23rd February 1941.	Do.	Do.	4	
16516	.. Do.	7575	Diseased	6	
16520	.. 26th February 1941.	8158	Do.	9	
16521	.. Do.	Do.	Do.	9	
16522	.. Do.	7575	Do.	9	
16523	.. 8th March 1941.	8158	Do.	12	
16524	.. Do.	7575	Do.	12	
16525	.. 14th March 1941.	Do.	Do.	7	
16526	.. Do.	8158	Do.	9	
16527	.. 22nd March 1941.	7575	Do.	8	
16528	.. Do.	Do.	Do.	8	
16529	.. 23rd March 1941.	Do.	Do.	8	
16530	.. Do.	Do.	Do.		

REMARKS.—Total number of leafgrafts done to Plant No. 16295 was 15.

419. The object of doing these grafts was to see whether the disease produced was genuine " Spike disease " communicable by grafting. Hence each plant was grafted with as many leaves as

were available. Grafting was done at intervals from November to March because the season for grafting was not suitable being the cold weather. The diseased leaves available on the plants were not quite suitable for grafting being too narrow, thin, pale or copper coloured (proper leaf for grafting should be dark green, thick and sufficiently wide to allow trimming on all sides). As the diseased leaves were thought to be not quite suitable apparently healthy leaves from a partially spiked plant were also used for grafting as disease-masking leaves were known to carry infection.

420. The result of these tests was that plant No. 16515 grafted with the disease-masking leaves showed spike like symptoms on 28th April 1941 and this indicated that the disease produced on these plants was genuine spike.

421. By 25th May 1940, the diseased plant No. 8158 died in spite of its having a good flourishing host and getting a good supply of water.

422. Thus the diseased plants had the usual morphological symptoms characteristic of "Spike" disease; the transmission of the disease to healthy plant was obtained and the death of one of the diseased plants took place in seven months' time, a reasonable period for such sized plants. The non-infection of numerous control plants kept at Denkanikota Potculture plot where these plants were kept under observation after exposure in the transmission cage and the non-infection of plants kept exposed to other species of insects in the transmission cages indicate that *Jassus indicus* introduced into the cage in which these plants were exposed was most probably responsible for this transmission.

423. In cage No. 27, measuring 6 feet by 6 feet by 7 feet another set of 8 healthy sandal plants Nos. 12967, 1564, 9695, 25, 7143, 13181, 13121 and 12882 associated with the host of *Mundulea suberosa* and one grafted and disease-masking sandal plant No. 384 (which showed spike on 14th April 1941) associated with *Acacia farnesiana* taken from the Denkanikota Potculture plot (a healthy locality) were kept in the cage from 26th November 1940 to 25th January 1941 and insects of *Jassus indicus* were released as follows:—

> 26th November 1940—2; 27th November 1940—1; 6th December 1940—1; 17th December 1940—3; 21st December 1940—1; 31st December 1940—1; 3rd January 1941—2=11 insects.

424. All the healthy sandal plants and the grafted plant were removed from the cage on 27th January 1941, transported to Denkanikota and kept in the Potculture plot along with the control plants. On 11th June 1941, plant No. 13181 looked suspicious. On 20th June 1941, 2 plant Nos. 25 and 13181 exhibited spike like morphological symptoms. Plants Nos. 9695 and 12967 look

suspicious. Though the plants have to be watched and all tests to be carried out before pronouncing them as definitely spiked, yet these results appear to corroborate the results obtained in the experiments detailed above.

425. This species of insect has been experimented with several times both at Javalagiri and at Denkanikota centres as detailed in the statement enclosed and no definite transmission was obtained except in the cases detailed above. This indicates that all individuals of *Jassus indicus* may not be the carriers.

426. The other factors peculiar to these cages are:—

(1) These are two of the five experiments carried out in big sized cages, one at Denkanikota and four at Javalagiri out of a total number of 24. Of these 5, in two experiments only 9 insects each have been released for the whole period on 8 and 9 days (out of 20 and 62 days respectively) at 1 per day. In the remaining three experiments, 50 insects were released on 25 out of 67 days in one and 29 on 9 out of 64 days in another and 11 on 7 out of 61 days in the third. The last two experiments have given [illegible] mentioned above.

(2) Another important factor, associated with these experiments which have given the positive results, is the introduction of a *disease-masking* plant, i.e., a plant on which the organic fusion of the [illegible] had taken place but which manifested the disease only after removal from the cage.

427. *Insect collections at Denkanikota Potculture plot.*—As detailed in the report for 1939–40, the Potculture plot continues to remain healthy todate, indicating the absence of the vectors. The species of insects found are the same as those detailed in 1939–40 and *Jassus indicus* has been absent in the collections.

No special trap collections were made during the year.

428. *Control of spike disease.*—This is dealt with under two main headings, (*a*) prevention and (*b*) cure. These methods have been discussed in detail in 1939–40 report. No new experiments on these lines were carried out during the year.

429. *Autogeni resistance.*—Sixteen plants granted four times were planted in Javalagiri Reserved Forest.

430. *Peculiar strain of sandal.*—One peculiar looking sandal and one normal plant obtained from the seeds of the same parent tree in Noganur Reserved Forest were planted out in the Potculture garden. They have grown quite well and were 4 feet 6 inches and 5 feet respectively on 1st April 1941. One peculiar looking plant which was suitable for grafting shed its leaves completely and so no grafting was done during the year. Two more peculiar looking plants from under the old dead parent tree were potted during the year and they are not yet suitable for grafting.

431. *Attempts to build up resistance by sub-lethal doses.*—None of the plants including the controls in the experiment carried out in 1939–40 manifested spike on defoliation. The experiment requires repetition and duplication after standardization of the normality of solutions employed.

432. *Cure and control of spike.*—Spike control operations were continued in the Denkanikota Main Spike control area. Practical difficulties in the successful control of spike in such large areas are many, among which may be mentioned the lack of sufficient trained staff to tackle the entire area within the period of fifteen days prescribed, the existence of spiked areas all round and in the vicinity, which make spread into the area from outside highly probable, the insufficiency of the 100 yards to 2 furlongs belt for control operations on such large areas and the probability that even if we kill by poison all the spiked trees, the lopped spike masking trees are themselves potent sources of infection, specially when the first flush of leaves come on. The entire question has been carefully considered, and recommendations for discontinuance of control operations in this area have been submitted. It might at this stage be said that the control operations if they are to be successful on large areas require modification based on further knowledge of the mechanism of spike transmission, though it would appear from records that, in the past, small (about 10 acres or less) spike attacks have been successfully tackled by the methods now in vogue, provided also that there were no other spiked areas in the vicinity of such control areas.

433. It is of interest here to note that the Chief Forest Officer, Coorg, in his note on Sandal Spike Disease, dated 17th September 1940, records as follows :—

> "From 1936 rigid control measures were carried out to check the spread of the disease and all instructions laid out in the Madras Standing Orders for the detection of spike and its control issued in 1936 and subsequent dates were implicitly carried out. During this period intensive tending operations were carried out over all sandal bearing areas on a cycle of four years. This tending coupled with spike control measures appears to have produced a very salutary effect in checking the spread of the disease.
>
> Further in the last six years the incidence of fire in the sandal bearing areas was considerably less, as a result of strict control measures. This also appears as a salient contributory factor for the reduction in the incidence of spike disease.
>
> From 1934, in all cases of spike, rigid control measures have been applied and its spread controlled. In all individual cases of spike attack, control measures applied have been effective, and there has been no spread from such nucleus."

434. *Annual spike infection.*—Annual spike infection was found to be 25 per cent in Noganur Reserved Forest, 12 per cent in Aiyur Reserved Forest and 38 per cent in Javalagiri Reserved Forest.

List of Experiments done in Salem North division with Type No. 21 Jassus indicus (A. jassid).

Experiment number.	Date of start of insect release.	Date of closing of exposure to insect feed.	Last date of insect release.	Number of insects released.	Days of release. / Days of experiment.	Size of cages.
(1) DENKANIKOTA CENTRE.						
1	2nd September 1937.	2nd November 1937.	2nd November 1937.	84	32-62	3′ cube cage top wire gauze sides with cloth.
2	9th November 1937.	16th January 1938 *	16th January 1938.	26	10-69	
3	20th January 1938.	22nd February 1938.	22nd February 1938.	25	9-34	
4	7th July 1938.	30th August 1938.	30th August 1938.	77	32-55	3′ cube cages all wire gauze.
5	8th March 1938.	8th May 1938.	5th April 1938.	10	9-29	cube cage top wire guaze sides with cloth.
6	17th May 1938.	4th June 1938.	4th June 1938.	9	8-20	Compartment cage—12½′ × 10½′ × 7′ all wire guaze.
7	8th September 1938.	8th November 1938.	26th October 1938.	23	15-62	3′ cube cage—top wire guaze sides with cloth.
8	11th November 1938.	11th January 1939.	4th January 1939.	32	13-62	Do. all wire gauze.
9	4th June 1939.	4th August 1939.	22nd June 1939.	13	9-62	Do.
10	18th June 1940.	14th August 1940.	14th August 1940.	45	27-68	Do.
11	15th January 1941.	15th March 1941.	9th March 1941.	57	27-60	3′ cube.
(2) JAVALAGIRI CENTRE.						
1	24th June 1937.	18th August 1937.	18th August 1937.	280	48-46	3′ cube cage—top wire gauze sides cloth.
2	19th September 1937.	19th November 1937.	19th November 1937.	104	28-62	
3	15th June 1938.	15th August 1938.	11th August 1938.	121	45-62	
4	30th August 1938.	31st October 1938.	29th October 1938.	13	11-62	
5	3rd November 1938.	7th January 1939.	6th January 1939.	26	17-66	
6	9th January 1939.	9th March 1939.	7th February 1939.	10	10-6	
7	9th March 1939.	9th May 1939.	5th April 1939.	9	9-62	Compartment cage 6′ × 6′ × 6′ 9″ all wire gauze.
8	30th May 1939.	4th August 1939.	29th July 1939.	50	25-67	
9	8th August 1939.	7th October 1939.	6th October 1939.	36	19-67	3′ cube cage—top wire gauze sides with cloth.
10	7th October 1939.	7th December 1939.	14th November 1939.	42	20-62	
11	9th December 1939.	6th February 1940.	4th February 1940.	15	11-60	
12	30th June 1940.	1st September 1940.	16th August 1940.	29	9-64	Compartment cage 6′ × 6′ × 6′ 3″. 4/8 plants are spike-like. Grafting with leaves of the plants done to healthy plants to conclude results.
13	26th November 1940.	26th January 1941.	3rd January 1941.	11	7-61	Do. Compartment.
14	5th February 1941.	31st March 1941.	13th March 1941.	141	22-54	Do.

* Produced spike-like symptoms.

(b) Periodicity of height growth.

435. *General.*—Weekly measurements at all centres for a number of species were continued, with the object of determining the active growing and resting periods of young trees. Sufficient information has now been gathered with regard to important species in our various research centres, and these measurements will be discontinued.

Results during the year show the following :—

A. Evergreen Forests.

(i) Chandanathode.

436. All species exhibited three active periods of growth : (*a*) the middle of April 1940 to the end of June, (*b*) early August to end of November 1940 and (*c*) the end of December 1940 to the middle of January 1941. Except in the case of *Swietenia macrophylla* which was growing vigorously in April 1940, all species exhibited the following resting periods : (*a*) beginning to middle of April, (*b*) end of June to early August, (*c*) end of November to end of December 1940 and (4) middle of January 1941 to early February when the experiments were concluded. Growth trends of *Swietenia macrophylla* were obscured by *casualties* and attack by the shoot borer.

Species.—*Cedrela toona*, *Dipterocarpus indicus*, *Dysoxylum malabaricum*, *Hopea parviflora* and *Swietenia macrophylla*.

437. In a further set of periodicity measurements, the following species were observed :—

Acrocarpus fraxinifolius, *Aglaia roxburghiana*, *Artocarpus hirsuta*, *Balanicarpus utilis*, *Bischofia javanica*, *Cedrela odorata Chickrassia tabularis*, *Gluta travancorica*, *Hardwickia pinnata*, *Mangifera indica*, *Mesua ferrea* and *Palaquiuma ellipticum*.

438. Of these *Balanocarpus utilis*, *Hardwickia pinnata*, *Mangifera indica*, *Mesua ferrea* and *Palaquium* exhibited exceedingly slow growth. *Mesua ferrea*, *Acrocarpus fraxinifolius*, *Chickrassia tabularis* and *Cedrela odorata*, had their growth trends somewhat obscured due to casualties which had to be replaced. *Acrocarpus fraxinifolius*, *Chickrassia tabularis*, *Artocarpus integrifolia*, *Bischofia javanica* and *Cedrela odorata* exhibited comparatively more rapid growth than the other species. It has been exceedingly difficult to analyse the periods of growth and rest for these species, but the following gives an idea of trends. There have been three growth periods, i.e., (*a*) early April to middle of July 1940, (*b*) middle of September to the end of November 1940 and (*c*) end of December 1940 to the middle of January 1941. There have been

three rest periods, (*a*) middle of July 1940 to middle of September 1940, (*b*) end of November 1940 to end of December 1940 and (*c*) middle of January 1941 to the end of the year under review.

(ii) Karianshola.

439. In Karianshola Experimental Garden No. 2 all species were quiescent up to the beginning of April 1940, when growth began. Growth was in general very active from early May to the end of June, and again from the middle of July to the end of November : and a third period of growth though not so pronounced was exhibited in early January, February and March 1940 were periods of comparative rest; while early July, end of November and early December were periods of very slow growth. Height measurement of *Artocarpus hirsuta* reported last year has been discontinued, as the plants have generally exceeded 14 feet in height, and further accurate measurements are not possible.

Species.—*Cedrela toona*, *Dipterocarpus indicus*, *Hopea parviflora* and *Swietenia macrophylla*.

440. In Karianshola Experimental Garden Experiments Nos. 131 to 136 all species grew fairly steadily from the middle of April to the end of December 1940. Particularly rapid growth was noticeable between the middle and end of May 1940, and again between the end of July and the end of December 1940. There has been no pronounced period of rest except in early April 1940. *Bischofia javanica*, *Artocarpus hirsuta and Vateria indica* have shown the most rapid growth.

Species.—*Acrocarpus fraxinifolius*, *Artocarpus hirsuta*, *Bischofia javanica*, *Gluta travancorica*, *Mesua ferrea* and *Vateria indica*.

B. Mixed Deciduous forests.

(i) Nilambur.

441. Experimental Garden Experiment No. 8 Nilambur Division has been closed as the teak trees have attained a height of over 17 feet in 1940.

Swietenia macrophylla exhibited growth from early April to the end of December 1940, though the most rapid growth was noticeable in the months of May, August and November 1940. Plants in the 3 feet by 3 feet espacement have given the greatest increment in May, while the plants in the 6 feet by 6 feet espacement have given greatest increment in November. In general the 6 feet by 6 feet espacement has given a more uniform height increment during the period than the 3 feet by 3 feet or 9 feet by 9 feet espacements.

Pterocarpus dalbergioides has shown very active growth from early May to the third week of July, and steady growth from the first week of August to the first week of December 1940.

Bambusa polymorpha has grown very rapidly from the middle of June to early October and fairly rapidly from the middle of November to the end of December, with a short spurt of growth in early January.

Species.—*Swietenia macrophylla*, *Pterocarpus dalbergioides* and *Bambusa polymorpha*.

442. In addition to the above the following indications are obtained from a new series of experiments, commenced in 1939.

Observations on periodic height measurements on *Tectona grandis* in taungya and non-taungya areas indicate that teak in taungya areas grows much more rapidly than teak in non-taungya areas, which is slower grown. The growth in both cases indicates particularly rapid growth during July and August, and the latter part of November 1940.

Swietenia macrophylla exhibited steady growth between the end of April 1940 and early December 1940. During this period, particularly rapid growth was observed towards the end of April 1940, and the end of November 1940.

Dendrocalamus longispathus exhibited rapid growth between the end of April 1940 and the middle of January 1941. Particularly rapid growth was observed between the end of June 1940 and the middle of November 1940.

Species.—*Dendrocalamus longispathus*, *Swietenia macrophylla* and *Tectona grandis*.

(ii) Kanmoth.

443. Periodic height measurements in Experimental Garden Experiment No. 56 of 1937 and Experimental Plot No. 53 of 1938 have been closed as the plants have grown too tall for height measurement.

444. In Experimental Garden Experiment No. 88 of 1939 all species grew throughout the period from early April 1940 to the end of January 1941, and very vigorous growth was exhibited from early June to early August, and the middle of September to early December. By the end of January 1941 all species had come to rest.

Species.—*Artocarpus integrifolia*, *Balanocarpus utilis*, *Cassia siamea*, *Cedrela toona*, *Chlorophora excelsa*, *Dendrocalamus longispathus*, *Hopea parviflora*, *Lagerstræmia flos reginæ*, *Lagerstæmia lanceolata*, *Mangifera indica*, *Pterocarpus dalbergioides*, *Swietenia macrophylla*, *Tectona grandis* and *Terminalia crenulata*.

(iii) Begur.

445. Periodic height measurements of both series reported in the Annual Report for 1939–40 were continued. Practically all the species exhibited growth from early March to the middle of December. In general *Dendrocalamus longispathus*, *Dendrocalamus strictus*, *Bambusa polymorpha* and *Bambusa arundinacea* exhibited particularly rapid growth between early July and the middle of September. Other species that have exhibited rapid growth are *Swietenia macrophylla*, *Schleichera trijuga*, *Artocarpus hirsuta*, *Artocarpus integrifolia* and *Trema orientalis*.

Tree species.—*Artocarpus hirsuta*, *Artocarpus integrifolia*, *Chlorophora excelsa*, *Lagerstræmia flos reginæ*, *Lagerstræmia lanceolata*, *Mangifera indica*, *Schleichera trijuga*, *Swietenia macrophylla*, *Tectona grandis*, *Terminalia paniculata* and *Trema orientalis*.

Bamboos.—*Bambusa arundinacea*, *Bambusa polymorpha*, *Dendrocalamus longispathus* and *Dendrocalamus strictus*.

(iv) Dhoni.

446. Of the species reported in paragraph 243 of the Annual Report for 1939–40, periodic height measurement of *Trema orientalis* has been discontinued as the plants had already attained a mean height of over 21 feet and further height measurements correct to ·1 foot or 1 inch are not possible. Height measurements of the other species have been continued. All these species exhibited growth from early April 1940 to about the end of December 1940. In general, the best height growth was observed in May and early June 1940. There were short periods of arrested growth in the middle of June, the latter half of September, and early November. The species exhibiting fastest growth were *Lagerstræmia lanceolata*, *Lagerstræmia flos reginæ*, *Terminalia paniculata* and *Artocarpus hirsuta*.

Species.—*Artocarpus hirsuta*, *Logerstræmia flos reginæ*, *Lagerstræmia lanceolata*, *Swietenia macrophylla*, *Tectona grandis* and *Terminalia paniculata*.

(v) Topslip

447. Experimental Garden Experiments Nos. 114 to 116 of 1935 for periodic height measurements of *Pterocarpus marsupium*, *Dalbergia latifolia* and *Terminalia crenulata* have been closed in June 1941 as the plants have grown too big for further accurate measurements.

(vi) Anaipadi.

448. All species exhibited growth from about the middle of March to the end of December. Rapid growth was noticeable in early June, late July and the middle of August. Growth which had slowed down in December recommenced in January 1941. *Tectona grandis* was the fastest growing species during the period.

Species.—*Lagerstræmia flos reginæ*, *Lagerstræmia lanceolata*, *Dalbergia latifolia*, *Swietenia macrophylla*. *Pterocarpus marsupium*, *Terminalia crenulata*, *Terminalia paniculata* and *Tectona grandis*.

C. Dry fuel forests.

449. *Emmanur.*—The series of periodic height measurements started in July 1938 were continued. The most rapid growth was exhibited by *Prosopis juliflora*, *Acacia ferruginea*, *Azadirachta indica* and *Acacia auriculiformis*. All species exhibited growth from early April to mid July, and from end of October to the end of January 1941. From mid July to the end of October was a period of comparative rest.

Species.—*Acacia auriculiformis*, *Acacia ferruginea*, *Acacia sundra*, *Albizzia amara*, *Albizzia lebbek*, *Azadirachta indica*, *Cassia siamea* and *Prosopis juliflora*.

450. A new series of periodic height measurements was started in October 1939. In the Annual Report for 1939–40, it was too early to report any results. So we include observations in this report on growth between October 1939, and April 1940. All species exhibited growth during November, December 1939 and January 1940. There was a brief rest varying with the species between the end of January 1940 and the middle of February 1940, when growth again started. Growth continued through March, April, May and June 1940, followed by a period of comparatively slow growth during the latter half of July 1940 and through August September 1940. Growth recommenced in November 1940, and was very active during December 1940, gradually slowing down in January 1941.

Species.—*Acacia arabica*, *Acacia auriculiformis*, *Acacia ferruginea*, *Acacia sundra*, *Albizzia amara*, *Albizzia lebbek*, *Azadirachta indica*, *Cassia siamea*, *Prosopis juliflora*, *Pterocarpus santalinus* and *Wrightia tinctoria*.

(c) *Weeds.*

451. *Lantana control.*—Two divisions report work on the silvicultural control of *Lantana* by the introduction of bamboos. In the Alangayam range of Vellore West division, it is reported that results so far obtained are encouraging. It is observed that the best way of eradicating lantana is to raise teak plantations, where the soil, situation, slope and other factors are suitable for teak, and by introducing bamboos wherever lantana is found on steep slopes. The introduction of bamboos under lantana has also been undertaken in small plots in Chengam, Tiruppattur and Harur Ranges of the West Vellore division, but it is too early to report results.

452. It is also reported, that in the Experimental Plots Nos. I to VII of Salem North division, where bamboo has been introduced from 1933 to 1938, the bamboo plants reported in paragraph 249 of the Annual Report for 1939/1940, are all alive, and are growing well. Many have emerged above the lantana. During the year 100 one year old rhizomes of *Dendrocalamus strictus* were planted on a 2-acre plot at Javalagiri. The survival per cent at the

end of the year was 22. It is also reported that 1,600 eighteen months old *Bambusa arundinacea* rhizomes have been planted in two plots, one of two acres and the other of three acres, in Nyama sandiram agraharam, at an espacement of 16 feet by 16 feet. Nine hundred and twenty-seven of these were alive in March 1941.

453. In order to test the capability of *Bambusa arundinacea* to suppress *Lantana* in mixed deciduous forest of good quality, four experiments are in progress. These are Experimental Plot No. 32 Wynaad division, Experimental Plot No. 67 South Coimbatore division, and Experimental Plots Nos. 150-A and 150-B Palghat division. In each of these plots *Bambusa arundinacea* was introduced in about one acre of dense lantana, by coolies crawling under the lantana, and planting one year old transplants and rhizomes at 15 feet by 15 feet in alternate lines. No cutting of lantana at all was done, and it was as little disturbed as possible.

454. By the end of the second year it was observed that the lantana had to be cleared to some extent, to help the bamboo to establish itself, and in the third year a little clearing was done over each bamboo plant. This clearing had the desired effect.

455. The growth data of the bamboos at the end of the fifth year are as follows :—

Division.	Experimental plot number.	Survival percentage.			Mean height in feet.		
		Rhizomes.	Transplants.	Both.	Rhizomes.	Transplants.	Both.
Wynaad	32/1936	99	97	98	4·5	5·4	4·9
South Coimbatore ..	67/1936	97	99	98	21·6	27·4	24·6
Palghat	150–A/1936	88	81	84	8·7	7·7	8.2
	150–B/1936	76	82	79	5·4	4·8	5·1
	Average ..	90	90	90	10·1	11·3	10·7

456. *Attempted suppression of Eupatorium in the Nilgiris.*—Experiments started with the object of determining whether the artificial introduction of Kikiyu grass, in Eupatorium areas, after pulling up the Eupatorium, will keep out the weed, have been continued under observation. The indications are that the Eupatorium is unable to establish itself profusely in the plot once the Kikiyu is established; the Kikiyu is unable to extend marginally under the Eupatorium, unless some further help such as pulling up or opening of the Eupatorium is done; the Kikiyu is subject to browsing especially by buffaloes, and though it is not killed by such browsing, it has, because of this, a slight set back, from which the Eupatorium is immune.

457. Chemical control of Eupatorium has not been attempted for want of the necessary chemicals, which cannot at present be obtained except at prohibitive cost.

II. WORKING PLANS AND STATISTICS.

(i) Working Plans.

458. The Provincial Silviculturist continued to be in touch, through the Working Plans Personal Assistant to the Chief Conservator of Forests, with the Working Plans Officers in the various districts. He was consulted with regard to proposed prescriptions on silvicultural matters and statistical work.

459. The following statement shows the working plans under preparation at the beginning of the year, and new ones undertaken :—

Number of division.	Working plan under preparation at the beginning of the year.	Working plans completed during the year.	New working plans commenced during the year.	Remarks.
I	(1) Harur Range of Vellore West division.	Harur Range.	..	..
	(2) Salem South..	..	..	..
II	(1) Anantapur ..	Anantapur ..	..	..
	(2) Kollegal ..	..	..	..
III	Coimbatore South.	Coimbatore South.	..	This division was abolished with effect from 31st December 1940.
IV	Kurnool East ..	Kurnool East.	1. Kurnool West. 2. Nellore ..	..
V	Vizagapatam ..	..	..	..

Working Plans for the Chittoor and Nilambur divisions were sanctioned during the year. The cost of preparation of these plans is 3 annas and Re. 0-11-2 per acre respectively.

(ii) Yield, Volume and Form Factor Tables.

460. *Sample plots.*—Seven new sample plots were opened during the year. Six teak sample plots in Nilambur division were closed. We thus have now 184 sample plots representing 17 species in seven forest divisions. All sample plots due for remeasurement were remeasured.

461. The standing sample tree measurement apparatus including the swing seat apparatus and the sectional ladder have again been successfully used for the measurement of a number of standing sample trees.

462. Based on recent experience the ladder is being further improved.

463. *Permanent preservation plots.*—Two new plots were opened during the year. We thus now have 25 plots representing 27 species in 13 divisions. The four linear tree increment plots for evergreen species and five protected trees of specially large dimensions reported last year were maintained.

464. *Tree increment plots.*—Six new tree increment plots were opened during the year and we have now 44 plots in all. Five of these plots have a total base line length of five miles and the remaining 39 plots aggregate an area of 684 acres.

III. MISCELLANEOUS.

465. *Tours, records and staff.*—The Provincial Silviculturist and the Assistant Silviculturist toured for 193 days and 37 days respectively during the year.

466. The sandal spike research works in Salem North division were inspected by the Provincial Silviculturist as usual during the year. The Provincial Silviculturist visited also the Chittoor forest division and inspected the district experiments and *Santalum album* tree increment plots. The Assistant Silviculturist (now Provincial Silviculturist) learnt something of the elements of the sciences of genetics and cytology in the sugarcane breeding station at Coimbatore.

467. The Central Silviculturist and the Assistant Soils Chemist, Dehra Dun, visited Nilambur to start investigation on the soil changes if any that occur by clear felling and burning forests on lateritic soils preparatory to planting teak. The subject was discussed in detail by the Central Silviculturist, District Forest Officers, Nilgiris and Nilambur the Assistant Soils Chemist and the Provincial Silviculturist; and subsequently by the Conservator of Forests, Ootacamund Circle, the Provincial Silviculturist and the District Forest Officer, Nilambur.

On his way back from this Province the Central Silviculturist inspected the spike works at Denkanikota.

468. *Books and publications.*—" A note on the possibilities of Camphor cultivation in South India" by Sri Rao Bahadur M. S. Raghavan, B.A., the present Provincial Silviculturist was published during the year.

469. *Records.*—The specific and general ledger files now number 549 and 241 respectively.

470. Twenty-five experimental plots and 155 experimental garden experiments were opened and 10 experimental plots and 240 experimental garden experiments were closed during the year. In consequence 154 experimental plots and 273 experimental garden experiments were open at the close of the year.

471. Seventy-eight photographs were added to the collection during the year. The total number of photographs now ledgered is 747 under specific and 469 under general ledger files.

472. *Office inspection.*—The three research range offices of this division were inspected by the Provincial Silviculturist during the year. The annual inspection of this office and its ledger files was made by the Conservator of Forests, Ootacamund Circle, Ootacamund.

473. *Administration.*—Mr. A. L. Griffith, I.F.S., Deputy Conservator of Forests continued to hold charge of this division till 5th December 1940 when he was transferred to the Forest Research Institute, Dehra Dun, as Central Silviculturist. Sri Rao Bahadur M. Srinivasa Raghava Acharya, B.A., took charge of the division on 6th December 1940 and held charge of the division for the remaining portion of the year.

474. The post of Assistant Silviculturist was held by Sri Rao Bahadur M. S. Raghavan, B.A., till 5th December 1940 and the post has been vacant since then.

475. *Staff.*—The subordinate staff consisted of 3 research rangers, 11 foresters and 1 forest guard.

476. One ranger and one forester continued to be in foreign service throughout the year.

477. The office establishment consisted of 1 head clerk, 2 clerks and 1 typist. For typing the annual report a temporary typist for six weeks was also employed.

478. *Discipline.*—The general discipline of the staff was satisfactory.

479. *General.*—Photographic stores and other important articles were transferred to this office from the old Madras Forest College, Coimbatore, during the year. It is proposed to use these for elementary soil analysis and for processing our own photographs.

480. With a general increase of work in this division, and the mass of information that is furnished in reply to various silvicultural enquiries, the work of the office gets more and more difficult every year and to cope with the situation an increase of office staff is essential.

OFFICE OF THE PROVINCIAL SILVICULTURIST, OOTACAMUND.
2nd September 1941.

M. S. RAGHAVAN,
Silviculturist.

PART II.

Experimental Data.

481. ***Rainfall in inches and number of rainy days*** (vide paragraph 7)—

Locality.	April 1940.	May 1940.	June 1940.	July 1940.	August 1940.	September 1940.	October 1940.	November 1940.	December 1940.	January 1941.	February 1941.	March 1941.	April 1941.	May 1941.	Total for year 1st April 1940 to 1st April 1941.	Average of years	
																INCHES.	YEARS.
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)
							Evergreen forests.										
Topslip (Karian shola).	5·50	10·80	10·50	16·20	13·25	1·70	5·20	19·40	3·00			0·20	1·50	13·40	85·75	63·27	15
	5	10	17	26	21	5	9	18	5	..	..	1	2	6	117	104	
Chandanathode ..	5·10	11·85	50·35	99·00	73·10	12·05	5·40	13·20	0·80				5·45	14·00	270·85	161·65	22
	5	20	27	31	30	21	15	17	1	..	..	..	8	17	167	145	
							Mixed deciduous forests.										
Nilambur	2·66	4·79	29·01	34·97	18·44	1·62	6·12	12·45	2·55				0·65	7·65	112·61	112·22	64
	7	14	19	31	29	9	13	19	5	..	..	..	3	15	146	113	
Begur	7·09	2·35	9·47	14·79	13·54	2·80	1·95	5·96	0·15				2·83	5·77	58·10	70·88	22
	9	8	15	30	28	12	9	16	1	..	..	..	7	14	128	79	
Kannoth	3·73	5·48	30·50	53·91	39·89	6·78	3·74	9·48	0·28				0·85	11·29	153·79	165·84	23
	5	16	23	31	31	19	16	16	1	0·40	..	..	4	18	158	137	
Dhoni	6·15	10·18	23·52	43·27	23·07	1·03	8·49	10·18	1·47		..	..	4·28	10·50	127·76	106·64	12
	7	14	23	29	28	3	16	18	2	1			6	13	141·	136*	
Walayar	5·90	5·90	10·60	14·40	9·20	2·20	6·90	7·60	1·60	0·40			1·00	2·90	64·70	53·38	19
	6	7	11	25	17	2	7	10	1	2	..	..	2	3	88	82	

* Average of six years only for number of rainy days.

Locality.	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	Total for year, 1941	Average of years.	
		April 1940.	May 1940.	June 1940.	July 1940.	August 1940.	September 1940.	October 1940.	November 1940.	December 1940.	January 1941.	February 1941.	March 1941.	April 1941.	May 1941.	April 1940 to April 1941.	INCHES.	YEARS.
																(16)	(17)	(18)
								Dry deciduous forests.										
Emmanur		4·45	7·45	4·02	1·55	1·77	2·48	4·40	16·29	4·40	0·20	1·04	..	2·34	2·92	48·05	33·12	6
		6	18	6	8	9	12	14	23	5	5	1		8	3	107	81	
		4·95	9·23	3·89	2·65	1·32	2·13	3·45	12·53	2·18		1·73		4·45	3·25	44·11	30·06	
Satyamangalam ..		7	16	5	5	7	5	15	18	3	..	1	..	4	8	82	56	45
		5·76	6·53	0·65	1·90	3·17	3·74	6·13	9·36	0·72	0·64			0·27	3·37	38·60	34·70	
Denkanikota		5	9	3	6	7	11	8	14	3	2	..	..	4	7	68	70	1
								High elevation forests.										
Jacko's nullah		4·30	3·85	3·20	3·30	4·60	3·00	5·85	12·40	1·30	0·60	..	..	2·40	6·50	48·40	44·89	4
		7	12	16	17	17	11	20	20	5	3			6	7	128	108	
		5·30	5·20	9·63	6·30	6·15	1·95	8·40	12·80	1·50	0·90			1·90	7·20	58·13	58·20	
Brooklands		7	11	17	22	20	7	18	21	5	3	..	..	6	7	131	115	4
		3·69	5·18	11·36	6·64	6·47	2·83	4·13	10·50	1·40	0·58	0·05	0·36	1·96	6·20	53·19	44·23	
Windy corner (Yemakkal).		9	16	21	29	25	16	17	23	12	12	3	1	10	13	184	177	5

482. *Seed weighments* (vide paragraph 79).—For germinative capacity and plant per cent the maximum are given and therefore plants per lb. of seed are also to be taken as the maximum expected.

Species.	Month in which to collect seed.	Number of seeds per		Number of weighments.	Plant per cent.	Germinative capacity.	Number of tests.	Number of seeds tested.	Plants per pound of seed.
		Ounce.	Pound.						
Acacia arabica ..	XII–III	155	2,480	11	75	75	11	7,000	*1,860
Acacia auriculiformis.	III–IV	1,213	19,408	16	65	80	31	14,100	12,615
Acacia baileyana ..	VIII	966	15,456	5	14	53	5	2,000	2,164
Acacia cyanophylla ..	IV	2,010	32,160	5	93	94	12	4,300	29,909
Acacia cyclopsis ..	XII–I	1,431	22,896	1	1	1	1	500	229
Acacia dealbata ..	XII–IV	2,340	37,440	6	33	45	15	3,700	12,355
Acacia decurrens ..	XII–I	1,737	27,792	6	14	53	7	5,000	3,891
Acacia ferruginea ..	XII–IV	167	2,672	27	80	90	37	19,000	2,138
Acacia leucophlœa ..	XII–IV	1,076	17,216	36	30	42	43	23,000	5,165
Acacia melanoxylon	IV	2,034	32,544	5	78	83	14	3,000	26,184
Acacia mollissima ..	XII–II	1,785	28,560	6	15	57	6	4,000	4,284
Acacia planifrons ..	VI–VIII	722	11,552	11	35	42	20	22,000	4,043
Acacia saligna ..	XII–I	766	12,256	1	3	3	1	500	368
Acacia sundra ..	XI–V	748	11,968	17	90	90	46	20,100	10,771
Acrocarpus fraxinifolius.	III–VI	876	14,016	81	21	25	81	76,500	2,943
Adenanthera pavonina.	VII	103	1,648	5	70	72	3	2,050	1,154
Aglaia roxburghiana.	IX	57	912	4	56	57	2	7,000	511
Alangium lamarckii.	V & XII	46	736	5	12	12	5	3,100	88
Albizzia amara ..	XII–II & V	400	6,400	33	74	83	53	74,100	4,736
Albizzia lebbek ..	XII–I & VI	315	5,040	33	49	65	15	10,100	2,470
Albizzia stipulata ..	II–IV	1,997	31,952	2	1	8	10	1,000	320
Anacardium occidentale.	III–V	5·3	85	14	98	98	60	20,000	83
Antiaris toxicaria ..	..	18	288	1	35	39	1	500	101
Araucaria excelsa ..	..	16	256	1	0	0	1	1,000	0
Artocarpus hirsuta ..	IV–VI	61	976	100	81	97	80	65,000	791
Azadirachta indica ..	V–X	132	2,112	18	89	90	22	23,100	1,880
Balanocarpus utilis ..	X	7	112	4	69	72	4	4,000	77
Bambusa arundinacea.	II–IV	2,277	36,432	19	37	38	10	4,500	13,480
Bambusa polymorpha.	III	1,396	22,336	5	32	40	22	7,000	7,148
Bambusa tulda ..	..	455	7,280	2	1	2	3	3,000	73
Bauhinia purpurea ..	II–III	48	768	5	95	98	5	4,100	730
Bauhinia racemosa ..	II–IV	228	3,648	6	12	17	9	8,000	438
Bauhinia variegata ..	IV	44	704	2	45	50	2	3,000	317
Berberis tinctoria ..	V	2,880	46,080	2	23	56	2	2,000	10,598
Bischofia javanica ..	X–II	1,655	26,480	24	75	79	8	7,000	19,860
Bombax insigne ..	IV	332	5,312	1	0·4	0·4	1	500	21
Bombax malabaricum.	III–V	963	15,408	44	16	22	7	7,500	1,094
Broussenetia papyrifera.	VI	16,900	270,400	5	28	47	4	5,000	75,712
Callitris rhomboidea.	IV–VI	4,856	77,696	4	18	45	7	1,500	13,985
Calophyllum elatum.	V–IX	4	64	35	67	89	30	12,900	43
Canthium didymum.	III–VII	304	4,864	17	12	42	10	9,100	584
Cassia auriculata ..	I–III	908	14,528	7	51	59	11	10,100	7,409
Cassia fistula ..	II–VI	176	2,816	34	47	55	69	38,100	1,324
Cassia marginata ..	II–VI	129	2,064	25	47	65	33	20,100	970
Cassia siamea ..	II–VI	1,036	16,576	31	87	98	45	23,100	14,421
Cassia tomentosa ..	II–IV	1,033	16,528	4	8	13	15	1,500	1,322

* Best results are with seed passed through goats.

Species.	Month in which to collect seed.	Number of seeds per Ounce.	Number of seeds per Pound.	Number of weighments.	Plant per cent.	Germinative capacity.	Number of tests.	Number of seeds tested.	Plants per pound of seed.
Castanospermum australe.	IV	1	16	3	53	56	4	350	8
Casuarina montana.	I	32,778	524,448	4	5	15	4	3,000	26,222
Cedrela odorata ..	III	2,104	33,664	2	15	27	2	10,000	5,050
Cedrela toona ..	IV–VIII	4,465	71,440	42	62	82	34	33,000	44,293
Celtis tetrandra ..	VI	420	6,720	1	5	5	1	400	336
Chickrassia tabularis.	XII	2,231	35,696	13	21	23	4	3,000	1,076
Chlorophora excelsa ..	..	12,625	202,000	30	29	33	11	89,950	58,580
Chloroxylon swietenia.	III–VIII	2,250	36,000	69	64	69	77	62,900	23,040
Chloroxylon swietenia (Ceylon).	III–X	1,406	22,496	50	58	73	38	38,000	13,048
Chorisia speciosa ..	..	..	..	..	0	46	1	2,000	0
Cinnamomum camphora.	..	220	3,520	4	47	69	4	1,250	1,654
Cinnamomum zeylanicum.	..	105	1,680	2	1	1	2	2,000	17
Cytisus scoparius ..	III–IV	3,188	51,008	2	24	30	5	5,000	12,242
Commiphora caudata.	I	350	5,600	3	11	18	3	650	96
Cryptomeria japonica.	IV	9,774	156,384	5	..	0·2	3	3,000	..
Cupressus macrocarpa.	IV–VI	4,388	70,208	6	12	13	8	2,500	8,425
Cupressus torulosa ..	V–VI	4,840	77,440	5	5	9	10	2,000	3,872
Dalbergia latifolia ..	I–VI	525	8,400	30	55	65	68	52,000	4,620
Dalbergia sissoides ..	XII–III	454	7,264	90	51	70	75	50,000	3,705
Daphniphyllum glaucuscens.	V–VI	136	2,176	6	5	10	12	3,000	109
Dendrocalamus brandisii.	II	3,475	55,600	1	1	2	2	1,000	556
Dendrocalamus longispathus.	III–IV	2,367	37,872	8	1	2	4	4,000	379
Dendrocalamus strictus.	III–IV	1,239	19,824	20	47	48	8	3,100	9,917
Dipterocarpus indicus.	III–VIII	5	78	17	26	41	13	1,650	20
Dodonea viscosa ..	I–IV	3,220	51,520	2	12	12	5	500	6,182
Dolichandrone crispa.	I–IV	852	13,632	16	48	54	16	11,100	6,543
Dolichandrone falcata.	III–V	727	11,632	4	1	13	4	4,000	814
Dysoxylum malabaricum.	VII–VIII	65	96	17	85	85	36	4,500	82
Eleocarpus oblongus.	II–V	9·6	154	5	6	7	5	2,100	9
Erythroxylon monogynum.	IX–III	910	1,456	22	34	46	18	13,200	4,950
Eucalyptus eugenioides.	VI	76,800	12,28,800	1	..	..	1	2,500	..
Eucalyptus ficifolia ..	V	2,170	34,720	1	4	53	1	1,000	1,389
Eucalyptus globulus.	III	8,676	138,816	1	20	32	1	250	27,763
Eucalyptus maculata.	..	6,112	97,792	2	12	13	2	200	11,735
Eucalyptus pilularis	..	35,200	563,200	1	0·1	0·1	1	2,500	..
Eucalyptus propinqua.	..	26,176	418,816	1	0·6	0·7	1	1,000	2,513
Eugenia arnottiana ..	V–VII	* 110	1,760	10	71	73	26	6,000	1,250
Eugenia calophyllifolia.	V	146	2,336	1	16	20	1	1,000	374
Eurya japonica ..	IV	25,600	409,600	2	0	0	2	10,000	0
Evodia roxburghiana.	IV, V, XI & XII.	3,034	48,544	52	21	66	11	13,000	10,194
Feronia elephantum.	X–IV	1,397	22,352	10	63	66	12	11,100	14,082
Givotia rottleriformis.	X–V	† 11	176	34	40	43	18	13,700	70
Glochidion neilgherrense.	III–IV	1,298	20,768	4	4	29	4	2,100	881

* With pulp ; without pulp 173 to the ounce.
† With corky layer ; without corky layer 43 per ounce.

Species.	Month in which to collect seed.	Number of seeds per Ounce.	Number of seeds per Pound.	Number of weighments.	Plant per cent.	Germinative capacity.	Number of tests.	Number of seeds tested.	Plants per pound of seed.
Gluta travancorica ..	IV–VIII	2	32	13	90	96	39	12,150	29
Gmelina arborea ..	III–VI	42	672	3	56	64	25	8,500	376
Grewia tiliaefolia ..	V–VI	267	4,272	32	76	84	6	9,500	3,247
Hakea saligna ..	IX–XII	2,276	36,416	10	68	78	20	4,000	24,763
Hardwickia binata ..	III–VII	* 143	2,288	9	0·1	0·2	7	6,100	2
Hardwickia pinnata.	V–VI	8	128	5	80	85	6	1,000	102
Harrisonia bennettii.	I	269	4,304	5	8	12	3	300	344
Holoptelia integrifolia.	III–IV	1,276	20,416	6	15	17	5	1,800	3,062
Hopea parviflora ..	V–VII	82	1,312	30	54	68	60	65,000	708
Jacarandus mimosifolia.	V	3,685	58,960	3	6	18	3	2,000	3,538
Juniperus procera ..	XII–I	1,346	21,536	11	5	12	19	3,000	1,077
Lagerstroemia flos reginae.	XII–II	4,334	69,344	68	55	60	23	54,800	38,139
Lagerstroemia lanceolata.	XII–III	5,538	88,608	60	13	20	31	73,600	11,519
Lantana camara ..	VIII	† 1,302	20,832	5	2	3	2	2,000	417
Leucaena glauca ..	I	869	13,904	10	33	38	7	10,500	4,588
Ligustrum neilgherrense.	XII–III	‡ 851	13,616	6	66	74	13	2,000	8,987
Litsea wightiana ..	IV–VI	150	2,400	3	18	18	3	3,000	432
Maba buxifolia .	XI–I	286	4,576	3	88	92	2	300	4,027
Mahonia leschenaultii.	II–IV	1,766	28,256	9	48	53	8	4,500	13,562
Mangifera indica ..	V–VI	3	48	6	79	83	6	3,200	38
Markhamia platycalyx	..	1,140	18,240	4	1	1	4	4,000	182
Melioema wightii ..	III–V	140	2,240	3	10	14	4	350	224
Melocanna bambusoides.	..	2	32	1	5	56	2	500	2
Memycylon umbellatum.	XI–XII	216	3,456	2	90	94	2	300	3,110
Mesua ferrea ..	XI–III	28	448	61	68	80	30	11,500	305
Michelia nilagirica ..	IV–VI	367	5,872	6	23	24	14	4,250	1,351
Morus alba	..	26,015	416,240	4	5	13	4	5,000	20,812
Mundulea suberosa ..	IV	958	15,328	2	35	54	2	2,000	5,365
Myrsine wightiana (*Rapanea*).	IV–VI	1,353	21,648	6	20	20	6	4,500	4,330
Neolitsea zeylanica ..	V–VII	200	3,200	6	53	53	6	3,000	1,696
Oehroma lagopus ..	..	4,240	67,840	1	0·1	0·7	1	340	..
Palaquium ellipticum.	V–VIII	7	112	35	68	69	36	11,500	76
Photinia notoniana ..	V–VII	10,830	173,280	3	0	21	3	7,000	0
Pinus insignis ..	V–VI	1,807	28,912	3	4	8	5	5,000	1,156
Pinus insularis ..	II	3,680	58,880	1	1	3	1	500	589
Pinus longifolia ..	IV	236	3,776	5	46	80	5	3,000	1,737
Pithecolobium dulce.	II–V	183	2,928	8	50	79	13	2,200	1,464
Poeciloneuron indicum.	V	1	12	1	29	31	1	500	8
Poinciana elata ..	XII	243	3,888	3	7	65	4	3,100	272
Poinciana regia ..	IV	80	1,280	2	5	5	2	2,000	64
Polyalthia fragrans .	V	12	192	2	0·9	1·0	2	1,500	2
Polyalthia longifolia.	IV–IX	21	336	2	2	3	2	2,000	7
Pongamia glabra ..	III–V & X	19	304	4	12	15	4	3,400	36
Premna tomentosa	IV	1,759	28,144	2	1	1	1	1,100	281
Prosopis juliflora ..	V	924	14,784	28	78	89	42	11,600	11,532
Prosopis spicigera ..	II–VII	753	12,048	15	88	88	11	8,000	10,602
Pterocarpus dalbergioides.	II–IV	52	832	50	29	49	54	18,000	§ 241

* Kernel only. Pods 83 per ounce.
† With pulp ; 2092 per ounce without pulp.
‡ Without pulp ; with pulp 500 to the ounce.
§ Seed from the Andamans.

Species.	Month in which to collect seed.	Number of seeds per Ounce.	Number of seeds per Pound.	Number of weighments.	Plant per cent.	Germinative capacity.	Number of tests.	Number of seeds tested.	Plants per pound of seed.
Pterocarpus marsupium.	I–VI	60	960	96	90	97	107	52,500	864
Pterocarpus santalinus.	II–VII	30	475	27	65	88	73	50,000	309
Quercus incana ..	II	14	228	4	51	80	6	3,050	116
Rapanea (see *Myrsine*).	..	..	..	..	..	..	..	..	..
Rhodomyrtus tomentosa.	IV	4,152	66,432	1	1	9	1	1,000	664
Sapindus emarginatus.	II–IV	73	1,168	5	62	67	5	5,000	724
Sapindus trifoliatus.	IV–VI	55	880	3	60	72	3	400	528
Santalum album ..	X–XI & III–IV	* 148	2,368	81	58	85	81	81,000	1,373
Schleichera trijuga ..	II–VIII	62	992	63	72	76	35	20,650	714
Semecarpus anacardium.	II–IV	13	208	2	53	57	2	2,000	110
Shorea talura ..	V	† 29	464	25	55	64	10	6,500	255
Sideroxylon tomentosum.	VI	85	1,360	3	16	18	3	1,100	218
Soymida febrifuga ..	II–VII	378	6,048	12	25	28	12	11,000	1,512
Sterculia urens ..	V	196	3,136	33	18	32	9	5,650	564
Stipa tenassima ..	..	13,200	211,200	2	2	3	2	5,000	4,224
Strychnos nux vomica.	XII–V	17	272	8	52	52	11	9,300	141
Strychnos potatorum.	III–VII	47	752	5	10	14	5	4,700	75
Swietenia macrophylla.	XII–III	63	1,008	67	71	78	78	76,500	716
Swietenia mahogoni ..	..	95	1,520	5	73	74	1	500	1,110
Symplocos foliosa ..	III–VII	‡ 80	1,280	2	0	0	2	2,000	0
Tamarindus indica ..	II–V	41	656	14	80	95	9	13,100	525
Tectona grandis ..	XI–V	50	800	128	58	68	79	97,800	464
Tephrosia candida ..	XI–I	1,300	20,800	1	45	53	1	1,000	9,360
Terminalia arjuna ..	XI–XII & IV–VI	22	352	2	17	19	2	2,000	60
Terminalia belerica ..	II	6	96	1	53	62	1	500	51
Terminalia chebula ..	XI–IV	17	270	28	50	60	62	36,100	§ 135
Terminalia crenulata.	I–VI	22	352	76	58	72	91	85,500	204
Terminalia paniculata.	XI–IV	1,106	17,696	149	9	16	114	194,100	1,592
Ternstroemia japonica.	II–VII	200	3,200	3	0	4	4	4,000	0
Thyrsotachys oliveri.	V	1,890	30,240	4	22	25	4	4,000	6,653
Trema orientalis ..	I–VI	5,324	85,184	78	5	8	27	57,000	4,259
Tsuga brunoniana ..	..	10,000	160,000	1	4	4	1	1,000	6,400
Vateria indica ..	VII–VIII	● 1·6	26	15	76	80	10	4,250	20
Viburnum coriaceum.	VII	566	9,056	2	4	4	2	2,000	362
Viburnum erubescens.	VII	1,005	16,080	5	7	7	5	3,000	1,126
Vitex altissima ..	XII–IV	349	5,584	9	2	4	9	9,100	112
Vitex littoralis ..	V–VII	88	1,408	2	0	30	3	230	0
Vitex peduncularis ..	VII–VIII	273	4,368	14	15	28	12	12,000	655
Wrightia tinctoria ..	II–V	813	13,008	12	26	42	6	5,100	3,382
Xylia xylocarpa ..	I–V	95	1,520	28	80	99	65	53,000	1,216
Zizyphus glabrata ..	X–II	225	3,600	5	12	19	5	5,000	432
Zizyphus incurva ..	I	‖ 114	1,824	9	38	69	8	4,400	693
Zizyphus jujuba ..	I–VII	51	816	13	82	95	11	12,100	669
Zizyphus xylopyrus ..	III	612	9,792	1	40	52	2	2,000	3,917

* With pulp; without pulp 195 per ounce.
† Without wings; with wings 15 per ounce.
‡ With pulp; without pulp 132 per ounce.
§ Kernel. Best results are obtained with fermented seed.
‖ Without pulp; with pulp 80 to the ounce.

NOTE.—Seeds of *Acrocarpus fraxinifolius*, *Calophyllum elatum*, *Mesua ferrea* and *Dysoxylum malabaricum* very often only germinate to a small extent in the first year, the main germination often being in the second year.

483. *Seed pre-treatment* (vide paragraph 58)—

Species.	Number of tests made.	Average germinative capacity with Untreated.	Cold water.	Hot water.	Boiling water.
Acacia auriculiformis	8	14	14	16	17
Acacia baileyana	4	2	3	19	42
Acacia cyanophylla	9	11	14	17	35
Acacia cyclopsis	1	1	1	1	0
Acacia dealbata	6	45	68	60	87
Acacia decurrens	4	1	1	8	24
Acacia ferruginea	10	50	43	49	36
Acacia leucophloea	14	21	12	17	23
Acacia melanoxylon	1	83	81	91	90
Acacia mollissima	5	5	2	11	29
Acacia planifrons	5	17	15	15	12
Acacia saligna	1	3	4	4	2
Acacia sundra	10	34	28	30	25
Acrocarpus fraxinifolius	25	8	8	9	6
Adenanthera pavoniana	3	21	21	22	1
Alangium lamarckii	1	12	22	19	0
Albizzia amara	22	41	35	30	34
Albizzia lebbek	3	18	13	17	15
Anacardium occidentale	6	70	58	54	24
Azadirachta indica	9	43	38	32	7
Balanocarpus utilis	2	42	35	39	20
Bauhinia purpurea	11	23	25	27	13
Bauhinia racemosa	4	14	16	16	13
Bischofia javanica	1	2	2	1	..
Berberis tinctoria	2	56	0	0	0
Bombax malabaricum	3	13	10	8	6
Calophyllum elatum	7	15	14	13	0
Canthium didymum	1	4	6	6	0
Cassia auriculata	14	12	9	11	5
Cassia fistula	16	12	11	8	7
Cassia marginata	12	17	22	13	5
Cassia siamea	16	50	37	47	5
Chickrassia tabularis	1	23	35	..	..
Chlorophora excelsa	16	18	15	12	0
Chloroxylon swietenia	14	16	14	14	1
Chorisia speciosa	2	46	0	0	0
Commiphora caudata	1	3	1	2	0
Cupressus torulosa	2	7	0	0	0
Dalbergia latifolia	22	31	26	29	5
Dalbergia sissoides	30	26	26	32	5
Dendrocalamus strictus	6	28	18	18	0
Dolichandrone crispa	5	15	12	13	1
Dolichandrone falcata	4	8	6	5	1
Elaeocarpus oblongus	2	5	0	0	0
Erythroxylon monogynum	2	20	21	16	1

Species.	Number of tests made.	Average germinative capacity with			
		Untreated.	Cold water.	Hot water.	Boiling water.
Eugenia arnottiana	3	53	51	40	42
Evodia roxburghiana	5	8	7	2	0
Feronia elephantum	4	15	16	15	2
Givotia rottleriformis	6	5	4	4	2
Glochidion neilgherrense	2	3	0	0	0
Gluta travancorica	10	44	48	42	21
Gmelina arborea	25	20	19	18	6
Grewia tiliæfolia	2	10	6	10	5
Hakea saligna	2	45	0	0	0
Harrisonia bennetii	4	10	14	7	2
Holoptelia integrifolia	1	1	0	1	0
Juniperus procera	4	2	4	5	1
Lagerstroemia flos reginae	1	5	3	3	..
Lagerstroemia lanceolata.	31	5	4	4	0
Leucaena glauca	12	24	26	31	32
Ligustrum neilgherrense	2	66	21	13	2
Litsea zeylanica	2	15	9	7	0
Mahonia leschenaultii	4	51	6	2	0
Mangifera indica	2	49	63	61	3
Markhamia platycalyx	1	1	1	0	0
Meliosma wightii	1	14	8	0	0
Michelia neilgherrense	1	5	0	0	0
Myrsine wightiana (*Rapanae*)	2	10	14	11	20
Neolitsea zeylanica	2	16	18	0	0
Palaquium ellipticum	14	40	50	40	0
Pinus longifolia	4	34	54	27	49
Pinus insignis	3	4	9	2	0
Pithecolobium dulce	9	47	20	42	5
Poinciana elata	2	19	28	24	31
Pongamia glabra	4	10	14	8	6
Premna tomentosa	1	1	1	1	1
Prosopis juliflora	6	61	62	53	46
Prosopis spicigera	1	10	12	8	9
Pterocarpus dalbergioides	6	13	16	11	5
Pterocarpus santalinus	14	22	62	30	17
Pterocarpus santalinus *	3	14	18	17	4
Pterocarpus marsupium	95	40	31	32	12
Quercus incana	2	81	0	0	0
Sapindus emarginata	4	20	9	13	12
Schleichera trijuga	19	29	27	25	0
Soymida febrifuga	10	1	3	1	0
Sterculia urens	5	18	15	16	0
Strychnos nux vomica	4	15	21	21	4
Strychnos potatorum	2	2	3	2	0
Tamarindus indica	2	64	56	48	22
Tectona grandis	40	28	27	24	8

* Seed coat removed.

Species.	Number of tests made.	Average germinative capacity with			
		Untreated.	Cold water.	Hot water.	Boiling water.
Terminalia chebula—	14	21	16	23	8
(1) (Whole fruit)	3	4	6	5	7
(2) (Fleshy covering removed)	4	6	1	2	0
(3) (Kernel)					0
Terminalia crenulata—	83	28	30	24	0
(1) Fresh seed	10	9	8	7	8
(2) Stored 14 months	28	10	8	9	0
Terminalia paniculata	1	10	11	4	2
Thyrsostachys oliveri	5	2	2	2	1
Trema orientalis	3	58	57	58	0
Vateria indica	1	4	5	5	0
Vitex altissima	2	30	38	11	0
Vitex littoralis	3	7	8	3	0
Vitex peduncularis	3	13	20	10	2
Wrightia tinctoria	42	20	26	25	13
Xylia xylocarpa	2	8	5	6	5
Zizyphus glabrata	5	31	24	24	22
Zizyphus incurva	13	21	25	16	17
Zizyphus jujuba	2	9	9	12	11
Zizyphus xylopyrus					

484. *Seed storage* (vide paragraph 78).—Tests made at intervals with seed from the same sample gave the following indications of the length of time the seed remains fertile. Previous years' results are included in the table.

Species.	Method of storage.	Number of individual tests.	Number of series of the same sample of seed.	Remarks.
(1)	(2)	(3)	(4)	(5)
Acacia auriculiformis.	(1) Stoppered bottle.	32	12	No falling off up to one year.
	(2) Earthen pot	36	12	
	(3) Gunny bag	42	12	
	(4) Air-tight tins	60	13	
Acacia cyanophylla	(1) Stoppered bottle.	21	6	No falling off up to eight months.
	(2) Earthen pot	21	6	
	(3) Gunny bag	21	6	
	(4) Air-tight tins	28	8	Seed ten months old only slightly less fertile than fresh seed.
Acacia ferruginea	(1) Stoppered bottle.	34	24	Seed good up to sixteen months and then rapidly deteriorates; keeps best in (2).
	(2) Earthen pot	50	24	
	(3) Gunny bag	50	24	
	(4) Air-tight tins	48	24	
Acacia leucophloea	(1) Air-tight tins	20	12	Seed good after ten months.
	(2) Earthen pot	12	12	
	(3) Gunny bags	12	12	
Acacia planifrons	(1) Air-tight tins	24	12	Seed good after one year keeps best in (3).
	(2) Earthen pot	24	12	
	(3) Gunny bag	24	12	
Acacia sundra	(1) Stoppered bottle.	45	24	Seed good after fifteen months; does not keep in (1).
	(2) Earthen pot	55	24	
	(3) Gunny bag	61	25	Seed good after eight months; falling off slightly by twelve months.
	(4) Mud pot with wood ash.	61	25	
	(5) Air-tight tins	6	1	Seed after nineteen months as good as fresh seed.
Acrocarpus fraxinifolius.	(1) Gunny bags	129	27	
	(2) Air-tight tins	30	18	Seed good up to two months; keeps best in (1).
Aglaia roxburghiana.	(1) Air-tight tins	2	6	
	(2) Gunny bags	2	6	

Species.	Method of storage.	Number of individual tests.	Number of series of the same sample of seed.	Remarks.
(1)	(2)	(3)	(4)	(5)
Albizzia amara ..	(1) Air-tight tins ..	41	13	Seed good up to two and a half years ; keeps best in (2).
	(2) Mud pot with wood ash.	71	21	
	(3) Gunny bag ..	41	13	
Albizzia lebbek ..	(1) Air-tight tins ..	12	1	Seed good up to two months in all cases.
	(2) Mud pot with wood ash.	12	1	
	(3) Gunny bag ..	12	1	
Anacardium occidentale.	(1) Air-tight tins ..	55	24	Seed good up to eighteen months ; keeps best in (1) or (3).
	(2) Gunny bag ..	75	24	
	(3) Earthen pot ..	55	24	
Artocarpus hirsuta ..	(1) Gunny bag ..	55	12	Seed good up to three months and then rapidly deteriorates; keeps best if in pit covered with 2 inches of dry earth.
	(2) Dry earth ..	30	12	
	(3) Puddled mud ..	30	12	
Azadirachta indica.	(1) Air tight tins ..	12	1	Seed good up to two months.
	(2) Mud pot with wood ash.	12	1	
	(3) Gunny bag ..	12	1	
Bischofia javanica ..	(1) Gunny bag ..	4	7	Keeps for three months and then rapidly deteriorates.
Bombax malabaricum.	(1) Air-tight tin ..	2	2	Seed keeps for three months.
	(2) Mud pot with wood ash.	2	2	
	(3) Air-tight tin ..	3	3	
Bauhinia purpurea.	(1) Air-tight tin ..	12	1	Seed good up to eight months ; keeps best in (1).
	(2) Mud pot with wood ash.	12	1	
	(3) Gunny bag ..	12	1	
alophyllum elatum.	(1) Gunny bag ..	5	8	Keeps for at least one year. In the seed bed it often only germinates in the second year.
Cassia auriculata.	(1) Air-tight tin ..	12	1	Seed good up to 10 months under all treatments.
	(2) Mud pot with wood ash.	12	1	
	(3) Gunny bag ..	12	1	
Cassia fistula ..	(1) Air-tight tins ..	7	25	Seed good up to two years except in (1); keeps best in (3).
	(2) Earthen pots ..	55	24	
	(3) Gunny bag ..	61	25	
	(4) Earthen pot with wood ash mixed.	6	1	
Cassia marginata ..	(1) Air-tight tins ..	28	12	Seed good after ten months.
	(2) Gunny bag ..	12	..	
Cassia siamea ..	(1) Air-tight tins ..	42	13	Seed good after three years; keeps best in (1).
	(2) Mud pots with wood ash.	62	13	
	(3) Gunny bag ..	42	13	
Cedrela toona ..	(1) Gunny bag ..	32	6	Seed good up to three months ; falling to 50 per cent at five months.
Chickrassia tabularis.	(1) Air-tight tins ..	1	1	Keep for about five months.
	(2) Gunny bag ..	2	2	
	(3) Gunny with wood ash.	1	1	
Chloroxylon swietenia.	(1) Air-tight tins ..	110	15	Good up to about three months and then rapidly deteriorates. No difference between Ceylon and Madras seed.
	(2) Earthen pots ..	51	13	
	(3) Gunny bags ..	92	14	
	(4) Earthen pot with wood ash.	18	1	
Dalbergia latifolia ..	(1) Gunny bags ..	144	20	Good up to six months.
	(2) Air-tight tins ..	62	15	No seed has given any result after one year.
	(3) Earthen pot ..	14	12	Good up to six months.
Dalbergia sissoides ..	(1) Gunny bag ..	15	12	Good up to six months and then rapidly deteriorates ; keeps best in (1).
	(2) Air-tight tins ..	15	12	
	(3) Wood ash ..	15	12	
Dendrocalamus strictus.	(1) Air-tight tins ..	3	6	Good up to three months and then rapidly deteriorates.
Dipterocarpus indicus.	(1) Gunny bag ..	3	6	Good up to one month and then rapidly deteriorates.
Dolichandrone crispa.	(1) Air-tight tin ..	12	1	Seed good up to eight months best in (1).
	(2) Gunny bag ..	12	1	
	(3) Gunny bag with wood ash.	12	1	
Dysoxylum malabaricum.	(1) Dry gunny bag.	11	7	Seed good up to six weeks ; keeps in wet gunny bag but not in dry gunny bag.
	(2) Wet gunny bag.	11	7	
Erythroxylon monogynum.	(1) Air-tight tins.	15	13	Seed good after one year; keeps best in (2).
	(2) Earthen pot ..	3	12	
	(3) Gunny bag ..	15	13	
	(4) Gunny bag with wood ash.	12	1	

Species.	Method of storage.	Number of individual tests.	Number of series of the same sample of seed.	Remarks.
(1)	(2)	(3)	(4)	(5)
Evodia roxburghiana.	(1) Air-tight tin ..	10	4	Does not keep. Should be sown immediately on collection.
	(2) Do. with wood ash mixed.	8	2	
	(3) Gunny bag	3	2	
	(5) Gunny bag with wood ash mixed.	2	2	
Gluta travancorica ..	(1) Gunny bag ..	44	6	Seed good up to four months dropping to 50 per cent at six months.
Gmelina arborea ..	(1) Gunny bag ..	75	15	Variable seed usually good up to six or eight weeks.
Grewia tiliaefolia ..	(1) Air-tight tins ..	5	9	Seed good up to four months.
	(2) Gunny bag ..	4	8	
	(3) Gunny bag with wood ash mixed.	2	2	
Hopea parviflora ..	(1) Gunny bags ..	54	6	Seed good after twenty days; falling to 0 after forty days.
Lagerstroemia flos reginae.	(1) Gunny bags	64	14	Seed good up to eight months ; by all three methods and then rapidly deteriorates.
	(2) Gunny bags with wood ash.	63	13	
Lagerstroemia lanceolata.	(3) Air-tight tins ..	63	13	Seed good up to six months ; keeps best in (1).
	(1) Gunny bags ..	41	9	
	(2) Air-tight tins ..	41	9	
	(3) Gunny bags with wood ash.	3	3	
Leucaena glauca ..	(4) Wood ash ..	14	6	Seed good up to three months. Seed good up to ten months.
	(1) Air-tight tins ..	12	1	
	(2) Gunny bag ..	12	1	
	(3) Gunny bag with wood ash mixed.	12	1	
Mesua ferrea ..	(1) Gunny bags ..	21	8	Seed good up to five months ; dropping to 30 per cent at six months.
Palaquium ellipticum.	(1) Gunny bags ..	28	8	Variable—usually good up to about one month.
Poinciana elata ..	(1) Gunny bag	12	1	Seed good up to nine months.
	(2) Gunny bag with wood ash mixed.	12	1	
	(3) Air-tight tin ..	66	12	Seed good after one year; keeps best in (2).
Prosopis juliflora ..	(1) Stoppered bottle.	70	12	
	(2) Earthen pot ..	70	12	
	(3) Gunny bag ..	70	12	
	(4) Air-tight tin ..	19	18	Seed good up to four months.
Pterocarpus dalbergioides.	(1) Gunny bags ..	1	1	
	(2) Air-tight tins .	156	20	Variable—usually good up to nine months ; sometimes good up to one year.
Pterocarpus marsupium.	(1) Gunny bag ..	67	13	
	(2) Air-tight tins ..	12	1	
	(3) Gunny with wood ash.	66	12	Good up to eight months.
Pterocarpus santalinus.	(1) Gunny bags ..	50	12	
	(2) Earthen pot ..	50	12	Good about two months.
	(3) Stoppered bottle.	1	1	
Samadera indica ..	(1) Gunny bags ..	50	24	Seed good up to two years ; keeps best in gunny.
Santalum album ..	(1) Air-tight tins ..	40	24	Seed kept by all methods for six months without any deterioration.
	(2) Gunny bags ..	14	16	
Schleichera trijuga ..	(1) Gunny bags ..	13	15	
	(2) Gunny with wood ash.	13	15	Keeps for two months.
Sterculia urens ..	(3) Air-tight tins ..	1	1	
	(1) Gunny bags ..	1	1	
	(2) Gunny bags mixed with wood ash.	2	2	Seed good up to ten months ; keeps best in (3).
Strychnos nux vomica.	(3) Air-tight tins ..	2	12	
	(1) Air-tight tins ..	2	12	
	(2) Earthen pots ..	2	12	
	(3) Gunny bags ..	66	12	Seed good up to five months; falling to 0 at seven months.
Swietenia macrophylla.	(1) Gunny bags ..	1	1	Seed good up to two months ; falls to thirty per cent after two months.
Swietenia mahagoni.	(1) Gunny bags ..	214	30	Seed good up to one year but falls to 30 per cent after two years. It keeps much better in (1) than in (2).
Tectona grandis ..	(1) Gunny bags ..	101	17	
	(2) Air-tight tins ..			

Species.	Method of storage.	Number of individual tests.	Number of series of the same sample of seed.	Remarks.
(1)	(2)	(3)	(4)	(5)
Terminalia chebula ..	(1) Gunny bags ..	52	12	Seed good up to two years; keeps best in (1).
	(2) Stoppered bottle.	28	12	
	(3) Earthen pot ..	28	12	
Terminalia crenulata (*tomentosa*).	(1) Gunny bags ..	171	23	Seed good up to one year.
	(2) Stoppered bottle.	45	12	
	(3) Air-tight tins ..	41	13	
Terminalia paniculata.	(1) Gunny bags ..	54	16	Seed often good up to five months but very variable.
	(2) Stoppered bottle.	40	12	
	(3) Air-tight tins ..	54	16	
Trema orientalis ..	(1) Gunny bags ..	76	16	Seed kept by all methods for six months and then rapidly deteriorated.
	(2) Gunny bags with wood ash.	73	15	
	(3) Air-tight tins ..	73	15	
Vateria indica ..	(1) Gunny bags ..	11	7	Seed kept for about one month and then rapidly deteriorated.
Tamarindus indica.	(1) Gunny bag ..	12	1	Good up to six months; falls off after eight months.
	(2) Gunny bag with wood ash mixed.	12	1	
	(3) Air-tight tin ..	12	1	
Wrightia tinctoria ..	(1) Gunny bags ..	12	1	Seed good up to about six months.
	(2) Gunny bag with wood ash mixed.	12	1	
	(3) Air tight tins ..	12	1	
Vitex peduncularis ..	(1) Gunny bags ..	8	6	We have not been able to keep this seed longer than six weeks. Its germination is very poor and it must be sown at once.
	(2) Air-tight tins ..	8	6	
Xylia xylocarpa ..	(1) Gunny bags ..	168	20	
	(2) Stoppered bottle.	55	12	Very variable, usually good up to three months.
	(3) Air-tight tins ..	55	12	
Zizyphus jujuba ..	(1) Gunny bag ..	12	1	Good up to eight months.
	(2) Gunny bag with wood ash mixed.	12	1	
	(3) Air-tight tins ..	12	1	

NOTES.—(1) The above results are indications of the probable longevity of the seed. Many more tests are necessary in most cases before reliable results can be obtained.

(2) The periods in column (5) are the times between collection and sowing and *not* between collection and germination which are often much longer.

(3) Generally 100 seeds were used for each treatment, date and test.

(4) In many cases the remark is given as "Seed good up to ten months." Often this is the maximum period tested and not necessarily the maximum period the seed remains fertile.

485. *Effect of depth of stump planting—Teak* (vide paragraphs 167 to 170)—

Locality—Anaipady, Experimental Garden Experiment No. 213 of 1940. *Species—Tectona grandis. Arrangement*—ABCDEF FEDCBA repeated 10 times in lines of 10 plants, i.e., 100 plants per treatment. *Espacement*—6′ × 6′. *Soil preparation*—Crowbar holes. *Stock used*—Seed sown in nursery bed on 20th April 1939, 85 stumps of 0·6″ diameter and 15 stumps of 0·5″ diameter used for each of the treatments. *Date of planting*—ABC on 1st April 1940, DEF on 1st June 1940. *Number of plants per stake*—One plant per stake. *Size of stumps*—See stock used. *Tending*—Weeding as in a normal district plantation.

Growth data after one season.

Date of measurement, 10th January 1941.

	Detail of treatment.	Survival percentage.	Mean height in feet.	Difference from mean.	Significance.
A	For details see paragraphs 167 and 168.	95	4·13	Control.	..
B		93	4·36	0·23	N
C		95	4·06	0·07	N
D		87	1·14	2·99	S
E		96	1·23	2·90	S
F		89	1·18	2·95	S

Locality—Begur Experimental Garden Experiment No. 166 of 1940. *Species—Tectona grandis. Arrangement*—ABCDEF FEDCBA repeated 10 times in lines of 10 plants, i.e., 100 plants per treatment. *Espacement*—6′ × 6′. *Soil preparation*—Crowbar holes. *Stock used*—Seed sown in the nursery on 8th May 1939. *Date of planting*—A to C planted on 1st April 1940, D to F on 1st June 1940, A and D normal, B and E shoot buried, C and F with mound covering shoot. *Number of plants per stake*—One per stake. *Size of stumps*—All stumps 0·5″ to 0·6″ diameter, 9″ root and 1″ shoot. *Tending*—Normal plantation practice.

Growth data after one season.

Date of measurement, 18th January 1941.

	Detail of treatment.	Survival percentage.	Mean height in inches.	Difference from mean.	Significance.
A	For details see paragraphs 167 and 168.	38	19·34	Control.	..
B		69	19·76	0·42	N
C		59	18·40	0·94	N
D		80	7·16	12·18	S
E		87	7·19	12·15	S
F		89	7·57	11·77	S

Locality—Dhoni Experimental Garden Experiment No. 208 of 1940. *Species—Tectona grandis. Arrangement*—ABCDEF FEDCBA repeated 10 times in lines of 10 plants, i.e., 100 plants per treatment. *Espacement*—6′ × 6′. *Soil preparation*—Crowbar holes. *Stock used*—Seed sown on 16th April 1939. *Date of planting*—ABC on 1st April 1940, DEF on 1st June 1940. *Number of plants*

per stake—One stump per stake. *Size of stumps*—Diameter 0·6″ —50, 0·7″ — 50 well mixed and used in each case. *Tending*—Normal plantation practice.

Growth data after one season.

Date of measurement, 29th January 1941.

	Detail of treatment.	Survival per-centage.	Mean height in inches.	Difference from mean.	Signifi-cance.
A	For details see paragraphs 167 and 168.	88	13·80	Control.	..
B		96	15·91	2·11	S
C		95	17·65	3·85	S
D		92	8·32	5·48	S
E		86	7·65	6·15	S
F		84	7·61	6·19	S

Locality—Kannoth Experimental Garden Experiment No. 89 of 1940. *Species*—Teak. *Arrangement*—ABCDEF FEDCBA repeated 10 times in lines of 10 plants, i.e., 100 plants per treatment. *Espacement*—6′ × 6′. *Soil preparation*—Crowbar holes. *Stock used*—Sown in nursery bed on 18th May 1939. *Date of planting*—ABC stumps planted on 1st April 1940, DEF stumps planted on 1st June 1940. *Number of plants per stake*—One stump per stake. *Size of stumps*—Stumps 0·5″ to 0·6″ diameter, 9″ root 1″ shoot. *Tending*—Weeding and tending according to district practice.

Growth data after one season.

Date of measurement, 15th January 1941.

	Detail of treatment.	Survival per-centage.	Mean height in inches.	Difference from mean.	Signifi-cance.
A	For details please see paragraphs 167 and 168.	52	34·33	26·46	S
B		79	32·75	24·88	S
C		83	30·92	23·05	S
D		68	7·87	Control.	..
E		75	7·59	0·28	N
F		81	9·67	1·80	N

This experiment was done with a Ponam crop of paddy—

Locality—Walayar Experimental Garden Experiment No. 11 of 1940. *Species—Teak.* *Arrangement*—ABCDEF FEDCBA repeated 10 times in lines of 10 plants, i.e., 100 plants per treatment. *Espacement*—6′ × 6′. *Soil preparation*—Crowbar holes. *Stock used*—Stumps (seed sown on 16th April 1939). *Date of planting*—Planted ABC on 2nd April 1940, DEF on 2nd June 1940. *Number of seed or plants per stake*—One stump at each stake. *Size of stumps*—0·7″—50; 0·8″—50 for each treatment well mixed. *Tending*—Normal district weeding.

Growth data after one season.

Date of measurement, 23rd January 1941.

	Detail of treatment.	Survival per-centage.	Mean height in feet.	Difference from mean.	Signifi-cance by Fischer's "t" test.
A	For details please see paragraphs 167 and 168.	60	4·20	1·81	S
B		82	4·26	1·37	S
C		90	4·12	1·23	S
D		33	2·89	Control.	..
E		37	2·77	0·12	N
F		22	2·74	0·15	N

486. *Pre-monsoon stump planting* (vide paragraphs 145 to 153)—

Locality—Nilambur Experimental Garden Experiment No. 16 of 1940. *Species—Tectona grandis.* *Arrangement*—ABCDE EDCBA repeated 10 times in lines of 10 plants, i.e., 100 plants per treatment. *Espacement*—6′ × 6′. *Soil preparation*—Crowbar holes for all treatments. *Stock used*—Sown in nursery bed, middle of April 1939. *Date of stump planting*—(A) 1st April 1940, (B) 15th April 1940, (C) 1st May 1940, (D) 15th May 1940 and (E) 1st June 1940 (stumps planted). *Number of plants per stake*—One per stake. *Size of stumps*—Stumps 0·5″ to 0·7″ diameter, 9″ root and 1″ shoot from one year old nursery plants. *Tending*—Weeding and tending according to the normal district practice.

Growth data after one season.

Date of measurement, 24th January 1941.

	Detail of treatment.	Survival per-centage.	Mean height in inches.	Difference from mean of control.	Signifi-cance by the "t" test.
A	1st April 1940	10	39·90	Control.	..
B	15th April 1940	49	39·65	0·25	N
C	1st May 1940	98	45·34	5·44	N
D	15th May 1940	96	31·99	7·91	N
E	1st June 1940	96	26·46	13·44	S

Locality—Nilambur Experimental Garden Experiment No. 12 of 1939. *Species—Tectona grandis.* *Arrangement*—ABCDE EDCBA repeated 10 times in lines of 10 plants, i.e., 100 plants per treatment. *Espacement*—6′ × 6′. *Soil preparation*—Crowbar holes for all treatments. *Stock used*—Seed sown on 7th May 1938 in

nursery. *Date of stump planting*—(A) 1st April 1939, (B) 15th April 1939, (C) 1st May 1939, (D) 15th May 1939 and (E) 1st June 1939. *Number of plants per stake*—One only. *Size of stumps*.—0·5″ to 0·6″ diameter, 9″ root and 1″ shoot from one year old nursery plants. *Tending*—According to normal district practice.

Growth data after two seasons.

Date of measurement, 24th January 1941.

	Detail of treatment.	Survival per-centage.	Mean height in feet.	Difference from mean of control.	Signifi-cance by the "t" test.
A	1st April 1939	50	6·80	Control.	..
B	15th April 1939	85	7·49	0·69	N
C	1st May 1939	71	5·34	1·46	S
D	15th May 1939	25	5·03	1·77	S
E	1st June 1939	87	4·86	1·94	S

Locality—Nilambur Experimental Garden Experiment No. 10 of 1938. *Species—Tectona grandis. Arrangement*—ABCDE EDCBA repeated 10 times in lines of 10 plants, i.e., 100 plants per treatment. *Espacement*—6′ × 6′. *Soil preparation*—Crowbar holes for all treatments. *Stock used*—Sown in nursery on 30th April 1937. *Date of planting*—All stump planted (A) 1st April 1938, (B) 15th April 1938, (C) 1st May 1938, (D) 15th May 1938 and (E) 1st June 1938. *Number of plants per stake*—One per stake. *Size of stumps*—Stumps 0·5″ to 0·6″ diameter, 9″ root and 1″ shoot from one year old nursery plants. *Tending*—Weeding and tending according to district practice.

Growth data after three seasons.

Date of measurement, 25th January 1941.

	Detail of treatment.	Survival per-centage.	Mean height in feet.	Difference from mean of control.	Signifi-cance by the "t" test.
A	1st April 1938	98	21·10	1·44	S
B	15th April 1938	97	21·07	1·41	S
C	1st May 1938	98	20·59	0·93	N
D	15th May 1938	100	21·29	1·63	S
E	1st June 1938	98	19·66	Control.	..

Pre-monsoon stump planting with a Ponam crop of paddy—

Locality—Nilambur Experimental Garden Experiment No. 13 of 1939. *Species—Tectona grandis. Arrangement*—ABCDE EDCBA repeated 10 times in lines of 10 plants, i.e., 100 plants per treatment. *Espacement*—

6′ × 6′. *Soil preparation*—Crowbar holes. *Stock used*—Seed sown in the nursery on 7th May 1938. *Date of stump planting*—(A) 1st April 1939, (B) 15th April 1939, (C) 1st May 1939, (D) 15th May 1939, and (E) 1st June 1939. *Number of plants per stake*—One per stake. *Size of stumps*—All of 0·5″ to 0·6″ diameter, 9″ root and 1″ shoot from one year old nursery plants. *Tending*—Normal district practice.

Growth data after two seasons.

Date of measurement, 24th January 1941.

	Detail of treatment.	Survival per-centage.	Mean height in feet.	Difference from mean of control.	Signifi-cance by the "t" test.
A	1st April 1939	85	13·11	Control.	..
B	15th April 1939	86	13·48	0·37	S
C	1st May 1939	72	10·19	2·92	S
D	15th May 1939	53	7·69	5·42	S
E	1st June 1939	94	8·80	4·31	S

Locality—Nilambur Experimental Garden Experiment No. 17 of 1940. *Species—Tectona grandis. Arrangement*—ABCDE EDCBA repeated 10 times in lines of 10 plants, i.e., 100 plants per treatment. *Espacement*—6′ × 6′. *Soil preparation*—Crowbar holes for all the treatments. *Stock used*—Seed sown in nursery bed, middle of April 1939. *Date of planting*—Stumps planted on (A) 1st April 1940, (B) 15th April 1940, (C) 1st May 1940, (D) 15th May 1940, and (E) 1st June 1940. *Number of stumps per stake*—One per stake. *Size of stumps*—Stumps 0·5″ to 0·7″ diameter, 9″ root and 1″ shoot from one year old nursery plants. *Tending*—Weeding and tending according to normal district practice.

Growth data after one season.

Date of measurement, 24th January 1941.

	Detail of treatment.	Survival per-centage.	Mean height in inches.	Difference from mean of control.	Signifi-cance by the "t" test.
A	1st April 1940	17	25·77	13·02	S
B	15th April 1940	63	28·58	15·83	S
C	1st May 1940	98	34·62	21·87	S
D	15th May 1940	78	21·26	8·51	N
E	1st June 1940	84	12·75	Control.	..

487. *Comparison of sowing, entire transplanting and stump planting* (vide paragraphs 276 and 277)—

Experiments Nos. 291 *to* 296, *Emmanur Experimental Garden Species*—As in the table below. *Arrangement*—ABC CBA repeated 10 times in single lines of 10 plants each, i.e., 100 per treatment. *Espacement*—2′ × 2′. *Soil working*—For direct sowing and transplanting soil worked 9″ × 9″ × 9″ at each stake and ash worked into the soil. For treatment C (stump planting) stumps planted into 9″ deep crowbar holes. *Stock used*—Transplanting and stump planting one year old plants from nursery stock. *Date of sowing*—*Azadirachta indica* 19th July 1940, the remaining species on 1st July 1940. *Date of entire transplanting*—13th October 1940. *Date of stump planting*—2nd October 1940. *Treatment*—6″ radius round each stake kept free of weeds, and normal soil working.

Measurements in January 1941.

Experiment number. 1940.	Species.	Survival percentage.			Mean height in inches.		
		Sowing.	Transplanting.	Stump planting.	Sowing.	Transplanting.	Stump planting.
291	*Azadirachta indica* ..	100	55	30	4·94	7·55	2·93
292	*Bauhinia purpurea* ..	82	36	87	15·23	7·86	11·64
293	*Chloroxylon swietenia.*	62	54	44	1·67	10·13	2·68
294	*Pterocarpus santalinus.*	43	24	69	5·86	7·25	6·15
295	*Terminalia chebula* ..	67	28	9	6·27	9·67	8·33
296	*Wrightia tinctoria* ..	95	97	75	3·86	12·24	3·96

488. (*i*) *Stump planting best date*—(*ii*) *Comparison of stump planting and transplanting*—(*iii*) *Comparison of transplanting at the commencement of the south-west monsoon and north-east monsoon* (vide paragraphs 278 and 279)—

Experiments Nos. 297 *to* 301, *Emmanur Experimental Garden Species*—As in the table below. *Arrangement*—A-1, A-2, B, C-1, C-2, D-1, D-2, E-1, E-2, F, F, E-2, E-1, D-2, D-1, C-2, C-1, B, A-2 and A-1 in single lines of 10 plants repeated 10 times, i.e., 100 plants per treatment. *Espacement*—2′ × 2′. *Soil preparation*—Crowbar holes for stumps, pits 6″ × 6″ × 12″ for transplants, the area burned and the ash worked in. *Stock used*—A-1, C-1, D-1, E-1, one year old stumps, the diameter varying with the species. A-2, C-2, D-2, E-2, two-year old stumps the diameter varying with the species. B and F are one year old transplants. *Treatment*—Kept clean weeded. *Dates of stump planting*—A-1 and A-2 on 1st July 1940, C-1 and C-2 on 1st August 1940, D-1 and D-2 on 1st September 1940, E-1 and E-2 on 1st October 1940. *Dates of transplanting*—B on 13th July 1940 and F on 12th October 1940.

Experimental Garden Experiment number.	Year.	Species.		Stumps planted on 1st July 1940. A-1.	Stumps planted on 1st July 1940. A-2.	Stumps planted on 1st August 1940. C-1.	Stumps planted on 1st August 1940. C-2.	Stumps planted on 1st September 1940. D-1.	Stumps planted on 1st September 1940. D-2.	Stumps planted on 1st October 1940. E-1.	Stumps planted on 1st October 1940. E-2.	Transplanting on 13th July 1940. B.	Transplanting on 12th October 1940. F.
297	1940	*Azadirachta indica* ..	Survival percentage	27	27	41	46	35	29	50	66	31	70
			Mean height in inches	5·33	6·44	5·37	6·67	4·43	3·79	2·72	3·83	12·03	8·40
298	1940	*Chloroxylon swietenia.*	Survival percentage	21	35	11	44	7	6	22	47	19	46
			Mean height in inches	2·76	2·87	1·90	2·43	4·43	2·83	1·54	2·10	5·26	8·43
299	1940	*Pterocarpus santalinus.*	Survival percentage	25	29	42	41	23	39	38	83	28	16
			Mean height in inches	4·40	5·48	3·29	3·73	4·25	5·13	4·83	6·06	5·00	4·50
300	1940	*Terminalia chebula* ..	Survival percentage	14	16	15	22	14	16	30	48	29	54
			Mean height in inches	6·22	4·78	4·00	5·14	3·79	4·19	3·50	3·77	4·13	8·46
301	1940	*Wrightia tinctoria* ..	Survival percentage	21	24	52	64	36	47	93	86	80	100
			Mean height in inches	2·86	5·67	6·80	6·26	6·02	5·96	4·45	4·78	7·44	10·87
		For all species ..	Average percentage		21·6	26·2	32·2	43·4	24·0	27·4	56·6	37·4	57·2
			Average height in inches		4·31	5·07	4·27	4·25	4·58	3·41	4·11	6·77	8·13

489. *Direct sowing—Best date* (*under top canopy only*) (vide paragraphs 375-378).—*Arrangement*—ABCDEEDCBA repeated 10 times in single lines of 10 stakes, i.e., 100 stakes per treatment. *Espacement*—3 feet × 1½ feet. *Soil preparation*—Patches worked at each stake, 6 inches deep before sowing. *Weeding*—Normal district practice.

Locality.	Experimental Garden Experiment number.	Year.	Species.	Number of seeds per patch.	Date of sowing. A	B	C	D	E
Chandanathode.	210	1940	*Soriemia macrophylla* ..	10	1st April 1940.	1st May 1940.	1st June 1940.	1st July 1940.	1st August 1940.
	211	1940	*Artocarpus fraxinifolius.*	A handful of seed.	21st April 1940.	21st May 1940.	21st June 1940.	21st July 1940.	21st August 1940.
	212	1940	*Mesua ferrea* ..	10	Do.	Do.	Do.	Do.	Do.
	213	1940	*Chickrassia tabularis* ..	A handful.	Do.	Do.	Do.	Do.	Do.
Kottamalai ..	174	1940	*Mesua ferrea* ..	10	20th April 1940.	20th May 1940.	20th June 1940.	20th July 1940.	20th August 1940.
	175	1940	*Artocarpus fraxinifolius.*	10	Do.	Do.	Do.	Do.	Do.
	176	1940	*Evodia roxburghiana* ..	10	Do.	Do.	Do.	Do.	Do.
	177	1940	*Bischofia javanica* ..	10	Do.	Do.	Do.	Do.	Do.
	178	1940	*Chickrassia tabularis* ..	10	Do.	Do.	Do.	Do.	Do.

Locality.	Experimental Garden Experiment number.	Year.	Species.	Survival percentage in January 1941. 20th and 21st April 1940.	20th and 21st May 1940.	20th and 21st June 1940.	20th and 21st July 1940.	20th and 21st August 1940.	Mean height growth in inches in January 1941. 20th and 21st April 1940.	20th and 21st May 1940.	20th and 21st June 1940.	20th and 21st July 1940.	20th and 21st August 1940.
Chandanathode.	211	1940	*Acrocarpus fraxinifolius.*	13	28	10	28	42	2·9	2·5	3·2	2·7	3·5
	212	1940	*Mesua ferrea*	89	72	20	29	6	6·2	5·7	5·3	5·1	5·0
	213	1940	*Chickrassia tabularis* ..	0	0	0	0	0	0	0	0	0	0
Karianshola ..	174	1940	*Mesua ferrea*	84	79	44	79	2	7·9	7·0	6·0	6·3	8·5
	175	1940	*Acrocarpus fraxinifolius.*	4	3	19	54	11	13·3	16·3	10·3	13·5	8·1
	176	1940	*Evodia roxburghiana* ..	13	5	4	2	3	11·2	7·3	4·8	3·0	2·3
	177	1940	*Bischofia javanica* ..	..	..	..	..	..	..	..	..	..	..
	178	1940	*Chickrassia tabularis* ..	78	51	30	32	2	15·6	9·6	9·6	8·3	4·5

				1st April 1940.	1st May 1940.	1st June 1940.	1st July 1940.	1st August 1940.
Chandanathode ..	*Swietenia macrophylla* ..	210	Survival percentage ..	0	0	0	0	0
			Mean height in inches ..	0	0	0	0	0

490. *Transplanting—Best date (under top canopy only)* (vide paragraphs 379–380).—*Arrangement*—ABCDEFGGFEDCBA repeated 10 times in lines of 10 plants, i.e., 100 plants per treatment. *Espacement*—3 feet × 1½ feet. *Soil preparation*—Standard pits for all treatments. *Tending*—Normal district practice.

Locality.	Experimental Garden Experiment number.	Year.	Species.	Number of transplants per stake.	Dates of transplanting. A	B	C	D	E	F	G
Chandanathode	214	1940	*Hopea parviflora*	1	15th June 1940.	1st July 1940.	15th July 1940.	1st August 1940.	15th August 1940.	1st September 1940.	15th September 1940.
	215	1940	*Chickrassia tabularis* ..	1	,,	,,	,,	,,	,,	,,	,,
	216	1940	*Bischofia javanica*	1	,,	,,	,,	,,	,,	,,	,,
	217	1940	*Mesua ferrea*	1	,,	,,	,,	,,	,,	,,	,,
Karian shola	180	1940	*Hopea parviflora*	1	,,	,,	,,	,,	,,	1st October 1940.	15th October 1940.
	181	1940	*Aglaia roxburghiana* ..	1	,,	,,	,,	,,	,,	,,	,,
	182	1940	*Calophyllum elatum* ..	1	,,	,,	,,	,,	,,	,,	,,
	183	1940	*Mesua ferrea*	1	,,	,,	,,	,,	,,	,,	,,

Locality.	Experimental Garden Experiment number.	Species.	Survival percentage in January 1941. 15th June 1940.	1st July 1940.	15th July 1940.	1st August 1940.	15th August 1940.	1st September 1940.	15th September 1940.
Chandanathode	214	*Hopea parviflora*	88	89	98	99	96	100	74
	215	*Chickrassia tabularis*	89	7	46	94	66	99	87
	216	*Bischofia javanica*	97	99	96	96	97	85	40
	217	*Mesua ferrea*	40	16	52	85	86	100	94
								1st October 1940.	15th October 1940.
Karianshola	180	*Hopea parviflora*	88	96	88	87	95	82	72
	181	*Aglaia roxburghiana*	32	78	65	70	61	58	45
	182	*Calophyllum elatum*	..	11	6	3	5	..	..
	183	*Mesua ferrea*	92	89	91	81	89	88	92

Locality.	Experimental Garden Experiment number.	Species.	Mean height growth in inches in January 1941. 15th June 1940.	1st July 1940.	15th July 1940.	1st August 1940.	15th August 1940.	1st September 1940.	15th September 1940.
Chandanathode	214	*Hopea parviflora*	12·23	9·14	8·84	7·86	7·71	7·26	6·70
	215	*Chickrassia tabularis*	11·38	13·00	12·11	14·44	15·00	17·01	15·41
	216	*Bischofia javanica*	11·13	8·85	7·52	7·96	7·24	6·61	5·55
	217	*Mesua ferrea*	5·95	7·00	6·54	7·60	6·92	7·97	7·74
								1st October 1940.	15th October 1940.
Karianshola	180	*Hopea parviflora*	10·54	8·22	10·54	7·46	7·07	9·32	8·35
	181	*Aglaia roxburghiana*	8·38	8·53	8·54	9·01	7·67	8·48	7·98
	182	*Calophyllum elatum*	..	10·27	10·00	12·66	6·60	..	..
	183	*Mesua ferrea*	8·45	7·73	7·60	7·68	6·85	7·92	8·17

491. *Stump planting—best date (under top canopy only)* (vide paragraph 381)—

Arrangement.—ABCDE EDCBA repeated 10 times in single lines of 10 plants (i.e.), 100 per treatment. *Espacement*—3′ × 1½′. *Soil preparation*—Crowbar holes. *Weeding*—Normal district practice.

Survival percentage and mean height growth in January 1941

Species.	Survival percentage of stumps planted on					Mean height growth of stumps planted on				
	15th May 1940.	1st June 1940.	15th June 1940.	1st July 1940.	15th July 1940.	15th May 1940.	1st June 1940.	15th June 1940.	1st July 1940.	15th July 1940.
	A.	B.	C.	D.	E.	A.	B.	C.	D.	E.
Karian shola Experimental Garden Experiment No. 185/40.										
Cedrela odorata	..	..	..	..	..	..	..	..	..	..
Karian shola Experimental Garden Experiment No. 184/40.										
Chickrassia tabularis ..	91	92	84	73	62	6·85	8·62	5·89	6·03	5·74
Chandanathode Experimental Garden Experiment No. 218/40.										
Chickrassia tabularis ..	90	82	67	1	38	4·34	3·77	3·43	2·00	3·24

492. *Comparison of sowing, transplanting different sizes and stump planting different sizes under top canopy cover* (vide paragraphs 383 to 388)—

Experimental Garden Experiment No. 166 *of* 1939—*Chandanathode.—Species—Artocarpus integrifolia. Arrangement*—ABCDEF FEDCBA repeated 5 times in lines of 10 plants (i.e.), 50 plants per treatment. *Espacement*—3′ × 1½′. *Soil preparation*—A worked patches, B to D standard pits, E and F crowbar holes. *Stock used and planting done*—(A) sowing, (B) transplanting small on 23rd June 1939, (height 6″ to 10″ on 16th August 1939), (C) transplanting medium 12″ to 22″ (height) on 16th August 1939, (D) transplanting large 2′ to 3′ on 16th August 1939, (E) stump planting small 0·3″ to 0·4″ and (F) stump planting large 0·6″ to 0·8″ in diameter, 9″ root and 1″ shoot on 16th August 1939. *Tending*—Normal district weeding.

Experimental Garden Experiment No. 171 *of* 1939, *Chandanathode.—Species—Chickrassia tabularis. Arrangement*—ABCDE EDCBA repeated 10 times in lines of 10 plants (i.e.), 100 plants per treatment. *Espacement*—As above. *Soil preparation*—A worked patches, B and C in standard pits, D and E crowbar holes. (A) sowing on 28th May 1939, (B) transplanting small 7″ to 14″ on 17th August 1939, (C) transplanting large 30″ to 48″ on 17th August 1939, (D) stump planting small 0·2″ to 0·3″ on 17th August 1939, (E) stump planting large 0·4″ to 0·7″ in diameter on 17th August 1939, 9″ root and 1″ shoot.

Experimental Garden Experiment No. 172 *of* 1939, *Chandanathode.—Species—Cedrela odorata. Arrangement*—As Experimental Garden Experiment No. 166 of 1939. *Espacement*—Lines 3′ apart and stakes 2½′ apart in the lines. *Soil preparation.*—A worked patches, B C and F standard pits, D and E crowbar holes. *Stock used and planting done*—(A) sowing on 26th May 1939, (B) transplanting small 15″ to 28″, (C) transplanting large 30″ to 54″, (D) stump planting small 0·3″ to 0·6″ diameter, (E) stump planting large 8″ to 1·0″, (F) cutting planting 0·8″ to 0·9″ diameter and 9″ long—all planted on 19th August 1939.

Experimental Garden Experiment No. 138 *of* 1939, *Karianshola.—Species—Artocarpus hirsuta. Arrangement.*—As above. *Espacement*—3′ × 1½′. *Soil preparation*—As Experimental Garden Experiment No. 166 of 1939, Chandanathode. *Stock used and planting done*—(A) sowing 30th May 1939, (B) 2″ to 3″, (C) 9″ to 15″, (D) 24″ to 40″ in height, (E) ·2″ to ·3″ and (F) ;4″ to ;5″ diameter—all on 17th June 1939.

Karianshola Experimental Garden Experiment No. 145 *of* 1939.—*Species—Artocarpus integrifolia. Arrangement*—As above. *Stock used and planting*—(A) sowing on 12th June 1939, (B) 6″ to 15″, (C) 18″ to 36″, (D) 35″ to 54″ in height, (E) 0·2″ to 0·4″ and (F) 0·5″ to 0·8″ in diameter—all planted on 16th June 1939.

Karianshola Experimental Garden Experiment No. 146 *of* 1939.—*Species—Acrocarpus fraxinifolius. Arrangement, etc.*, as Experimental Garden Experiment No. 171 of 1939, Chandanathode. *Stock used and planting*—(A) sown on 31st May 1939, (B) 2″ to 2½″, (C) 24″ to 45″ in height planted on 9th June 1939, (D) 0·3″ to 0·4″, (E) 0·8″ to 1·0″ in diameter planted on 8th June 1939.

Chandanathode Experimental Garden Experiment No. 196 *of* 1940.—*Species—Artocarpus integrifolia. Arrangement, etc.*, as Experimental Garden Experiment No. 166 of 1939, Chandanathode. *Stock used and planting*—(A) sowing 14th June 1940, (B) 9″ to 18″, (C) 20″ to 30″, (D) 35″ to 60″ in height planted on 17th August 1940, (E) 0·3″ to 0·4″ and (F) 0·6″ to 0·9″ in diameter planted on 8th August 1940.

Chandanathode Experimental Garden Experiment No. 202 *of* 1940.—*Species—Chickrassia tabularis. Arrangement. etc.*, as above. *Stock used and planting*—(A) sowing 2nd June 1940, (B) 9″ to 14″, (C) 18″ to 26″, (D) 28″ to 38″ in height planted on 18th August 1940, (E) 0·2″ to 0·3″, (F) 0·5″ to 0·9″ diameter planted on 8th August 1940.

Karianshola Experimental Garden Experiment No. 164 *of* 1940.—*Species—Artocarpus integrifolia. Arrangement*—ABCDE EDCBA repeated 10 times in lines of 10 plants (i.e.), 100 plants per treatment. *Stock used and planting done*—(A) sown on 31st May 1940, (B) transplants small 6″ to 9″, (C) transplants large 15″ to 20″ planted on 14th June 1940, (D) stumps small 0·3″ to 0·4″ and (E) stumps large 0·5″ to 0·6″ in diameter planted on 12th June 1940.

Karianshola Experimental Garden Experiment No. 165 *of* 1940.—*Species—Acrocarpus fraxinifolius. Arrangement, etc.*, as above. *Stock used and planting done*—(A) sown on 28th May 1940, (B) 15″ to 20″, (C) 30″ to 48″ in height planted on 14th June 1940, (D) 0·3″ to 0·5″ and (E) 0·6″ to 1·0″ in diameter planted on 29th May 1940.

Karianshola Experimental Garden Experiment No. 166 *of* 1940.—*Species—Bischofia javanica. Arrangement, etc.*, as above. *Stock used and planting done*—(A) sown on 29th May 1940, (B) 5″ to 6″, (C) 12″ to 72″ in height, (D) 0·3″ to 0·5″ and (E) 0·6″ to 1·0″ in diameter.

Chandanathode Experimental Garden Experiment No. 140 *of* 1938.—*Species—Swietenia macrophylla. Arrangement, etc.*, ABCD DCBA. *Stock used and planting*—(A) sown on 4th June 1938, (B to D) transplanted on 1st August 1938, (B) 6″, (C) 18″, (D) 30″ to 40″ in height.

Karianshola Experimental Garden Experiment No. 106 *of* 1938.—*Species—Swietenia macrophylla. Arrangement, etc.*, DBMS SMBD. *Stock used and plantings done*—(D) sown on 3rd June 1938, (BM and S) transplanted 3rd June 1938, (B) big 30″ to 40″, (M) medium 18″ to 24″, (S) small 6″ to 8″ in height.

Karianshola Experimental Garden Experiment No. 150 *of* 1939.—*Species—Swietenia macrophylla. Arrangement, etc.*, as Experimental Garden Experiment No. 140 of 1938, Chandanathode. *Stock used and planting done*—(A) sowing 31st May 1939, (BC and D) transplanted 7th June 1939), (B) 9″ to 12″, (C) 24″ to 30″, (D) 36″ to 48″ in height.

Karianshola Experimental Garden Experiment No. 151 *of* 1939.—*Species—Hopea parviflora. Arrangement, etc.*, as above. *Stock used and plantings done*—(A) sowing 9th June, (B to D) transplanted 3rd July 1939, (B) 1″ to 2″, (C) 6″ to 9″, (D) 15″ to 24″ in height.

Karianshola Experimental Garden Experiment No. 152 *of* 1939.—*Species—Bischofia javanica. Arrangement, etc.*, as above. *Stock used and planting done*—(A) not sown for want of seed, (B to D) transplanted on 28th June 1939, (B) 6″ to 12″, (C) 18″ to 30″, (D) 40″ to 60″ in height.

Karianshola Experimental Garden Experiment No. 153 *of* 1939.—*Species—Mesua ferrea. Arrangement, etc.*, ABC CBA repeated 10 times in lines of 10 plants (i.e.), 100 plants per treatment. *Soil preparation*—(A) sowing prepared patches, (B and C) transplants in standard pits. *Stock used and plantings done*—(A) 15th July 1939, (B) 2″ to 4″ and (C) 6″ to 9″ in height planted on 25th July 1939.

Karianshola Experimental Garden Experiment No. 161 *of* 1939.—*Species—Chickrassia tabularis. Arrangement, etc.*, as Experimental Garden Experiment No. 152 of 1939, Karianshola. *Stock used and planting done*—(A) sown on 31st May 1939, (B) 4″ to 7″, (C) 15″ to 24″ and (D) 36″ to 54″ in height planted on 18th June 1939.

Chandanathode Experimental Garden Experiment No. 170 *of* 1939.—*Species—Mesua ferrea. Arrangement, etc.*, as Experimental Garden Experiment No. 153 of 1939, Karianshola. *Stock used and planting done*—(A) sowing 28th May 1939, (B) 5″ to 9″ and (C) 10″ to 18″ in height planted on 18th August 1939.

Karianshola Experimental Garden Experiment No. 171 *of* 1940.—*Species—Chickrassia tabularis. Arrangement, etc.*, as Experimental Garden Experiment No. 161/39, Karianshola. *Stock used and planting done.*—(A) sowing 30th May 1940, (B) 16″ to 20″, (C) 24″ to 30″ and (D) 36″ to 54″ in height planted on 14th June 1940.

Karianshola Experimental Garden Experiment No. 172 *of* 1940.—*Vateria indica.—Arrangement, etc.*, as above. *Stock used and plantings done*—(A) sowing on 18th July 1940, (B and D) not done for want of stock. (C) 6″ to 36″ planted on 18th July 1940.

Karianshola Experimental Garden Experiment No. 173 *of* 1940.—*Species Hopea parviflora. Arrangement, etc.*, as above. *Stock used and plantings done*—(A) sowing 20th June 1940, (B) 6″ to 9″, (C) 12″ to 15″ and (D) 24″ to 36″ in height planted on 22nd June 1940.

Chandanathode Experimental Garden Experiment No. 202 of 1940.—*Species—Dipterocarpus indicus. Arrangement, etc.*, ABC CBA repeated 5 times in lines of 10 plants (i.e.), 50 plants per treatment. *Stock used and plantings done*—(A) sown on 17th July 1940, (B and C) transplanted on 19th August 1940. (B) 3″ to 6″ and (C) 8″ to 12″ in height.

Chandanathode Experimental Garden Experiment No. 201 *of* 1940.—*Species—Mesua ferrea. Arrangement, etc.*, as above. *Stock used and plantings done*—(A) sown on 14th June 1940, (B) 3″ to 7″ and (C) 9″ to 14″ in height planted on 16th August 1940.

Comparison of sowing, transplanting different sizes and stump planting different sizes under Top canopy cover (vide paragraphs 383 to 388). Results of measurement in January 1941.

Locality.	Experimental Garden experiment number.	Year.	Species.	Sowing. Survival per cent.	Sowing. Mean height growth in inches.	Transplanting. Small. Survival per cent.	Transplanting. Small. Mean height growth in inches.	Transplanting. Medium. Survival per cent.	Transplanting. Medium. Mean height growth in inches.	Transplanting. Large. Survival per cent.	Transplanting. Large. Mean height growth in inches.	Stump planting. Small. Survival per cent.	Stump planting. Small. Mean height growth in inches.	Stump planting. Large. Survival per cent.	Stump planting. Large. Mean height growth in inches.	Cuttings. Survival per cent.	Cuttings. Mean height growth in inches.
Results after two growing seasons.																	
Chandanathode ..	166	1939	*Artocarpus integrifolia* ..	78	26·1	22	12·2	10	11·2	10	25·4	48	9·7	64	13·0	..	..
	171	1939	*Chickrassia tubularis* ..	..	..	81	22·3	..	..	69	42·1	5	11·0	7	13·0	..	..
	172	1939	*Cedrela odorata* ..	..	..	30	20·8	..	..	18	45·3	10	19·8	2	[illegible]	2	15·0
Karianshola ..	138	1939	*Artocarpus hirsuta* ..	77	14·2	31	10·4	44	10·9	92	25·7	44	8·2	77	12·2	..	..
	145	1939	*Artocarpus integrifolia* ..	92	3·6	63	2·8	30	3.0	23	3·6	62	2·0	70	2·4	..	..
	146	1939	*Acrocarpus fraxinifolius* ..	34	3·8	55	4·1	..	..	39	5·1	5	2·7	25	3·4	..	..
Results after one growing season.																	
Chandanathode ..	196	1940	*Artocarpus integrifolia* ..	62	7·4	68	11·3	80	18·8	70	29·1	50	4·6	66	3·2	..	..
	202	1940	*Chickrassia tabularis* ..	..	..	95	11·9	62	21·1	92	27·3	68	3·6	..	..	..	..
Karianshola ..	164	1940	*Artocarpus integrifolia* ..	99	23·9	94	23·8	..	..	0	..	53	7·4	48	7·5	..	..
	165	1940	*Acrocarpus fraxinifolius* ..	16	13·3	51	18·1	..	..	64	37·8	2	5·0	8	10·0	..	..
	166	1940	*Bischofia javanica* ..	0	0	74	15·0	..	..	85	37·4	46	7·1	88	10·2	..	..
Results after three growing seasons.																	
Chandanathode ..	140	1938	*Swietenia macrophylla* ..	..	..	9	17·6	39	26·2	35	37·4	..	..	..	..	..	..
Karianshola ..	106	1938	Do. ..	8	30·5	83	40·3	85	49·4	86	64·0	..	..	..	..	..	..
Result after two growing seasons.																	
Karianshola ..	150	1939	*Swietenia macrophylla* ..	80	36·6	92	41·5	97	49·7	94	65·0	..	..	..	..	..	..
	151	1939	*Hopea parviflora* ..	62	9·2	5	7·8	56	12·6	21	22·7	..	..	..	..	..	..
	152	1939	*Bischofia javanica* ..	0	0	89	5·5	89	6·3	89	7·1	..	..	..	..	..	..
	153	1939	*Mesua ferrea* ..	1	9·0	64	8·6	..	..	8	7·5	..	..	..	..	..	..
	161	1939	*Chickrassia tabularis* ..	39	28·0	89	36.1	92	38·8	82	58·9	..	..	..	..	..	..
Chandanathode ..	170	1939	*Mesua ferrea* ..	17	7·1	10	5·3	..	..	30	7·5	..	..	..	..	..	..
Results after one growing season.																	
Karianshola ..	171	1940	*Chickrassia tabularis* ..	35	8·6	99	31·7	99	30·1	95	38·4	..	..	..	..	..	..
	172	1940	*Vateria indica* ..	99	13·5	..	..	..	..	73	8·0	..	..	..	..	..	..
	178	1940	*Hopeal parviflora* ..	90	4·9	91	9.1	99	14·6	100	28·3	..	..	..	..	..	..
Chandanathode ..	200	1940	*Dipterocarpus indicus* ..	90	3·1	60	3·8	..	..	66	6·6	..	..	..	..	..	..
	201	1940	*Mesua ferrea* ..	20	5·2	78	5·6	..	..	84	7·9	..	..	..	..	..	..

498. *Transplanting (under top canopy cover)—Comparison of Natural forest seedlings and nursery transplants.* (Vide paragraphs 389 to 393)—

1939 *Experiments.*

Karianshola Experimental Garden Experiment No. 158.—Species—Calophyllum elatum. Arrangement, etc. AB BA repeated ten times in lines of ten plants, i.e., 100 plants per treatment. *Espacement*—3′ × 1½′. *Soil preparation*—1′ cube pits. *Stock used.* Nursery plants 4″ to 12″ high, one year old; (B) forest transplants 4″ to 12″ high. *Date of planting*—24th June 1939.

Karianshola Experimental Garden Experiment No. 159.—Species—Aglaia roxburghiana. Arrangement, etc., as above. *Stock used*—(A) nursery transplants 4″ to 9″ high, one year old; (B) forect transplants 4″ to 9″ high. *Date of planting*—24th June 1939.

Karianshola Experimental Garden Experiment No. 160/1939.—Species—Palaquium ellipticum. Arrangement, etc., as above. *Stock used*—(A) nursery transplants 9″ to 15″ high, one year old; (B) forest transplants 9″ to 15″ high. *Date of planting*—25th June 1939.

Chandanathode Experimental Garden Experiment No. 189/1939.—Species—Palaquium ellipticum. Arrangement, etc., as above. *Stock used*—(A) nursery transplants 7″ to 12″ high, one year old; (B) forest transplants 7″ to 12″ high. *Date of planting.*—23rd June 1939.

Measurements in January 1941 (after two growing seasons).

Locality.	Experiment number.	Species.	Percentage survivals. A. Nursery trans-plants.	Percentage survivals. B. Forest trans-plants.	Mean height in inches: A. Nursery trans-plants.	Mean height in inches: B. Forest trans-plants.
Karianshola ..	158	*Calophyllum elatum* ..	2	9	8·5	12·6
	159	*Aglaia roxburghiana* ..	57	21	15·4	10·4
	160	*Palaquium ellipticum* ..	13	7	15·7	12·3
Chandanathode ..	189	*Palaquium ellypticum* ..	86	17	9·3	7·5

1940 *Experiments.*

Karianshola Experimental Garden Experiment No. 168 of 1940.—Species—Mesua ferrea. Arrangement ABBA repeated ten times in lines of 10 plants, i.e., 100 plants per treatment. *Espacement*—3′ × 1½′. *Soil preparation.*—Standard 1′ cube pits. *Date of planting*—1st July 1940. *Size of transplants*—(A) nursery 6″ to 9″, one year old; (B) forest, 6″ to 9″.

Karianshola Experimental Garden Experiment No. 186 of 1940.—Species—Calophyllum elatum. Date of planting—29th June 1940. *Arrangement, etc.,* as above.

Karianshola Experimental Garden Experiment No. 187 *of* 1940.—*Species—Palaquium ellipticum. Date of planting*—29th June 1940. *Size of transplants*—6″ to 12″. *Arrangements, etc.*, as above.

Karianshola Experimental Garden Experiment No. 188 *of* 1940.—*Species—Hopea parviflora. Date of planting*—29th June 1940. *Size of transplants*—6″ to 9″. *Arrangement, etc.*, as above.

Chandanathode Experimental Garden Experiment No. 219 *of* 1940.—*Species—Palaquium ellipticum. Date of planting*—16th August 1940. *Size of transplants*—Both nursery and forest, 6″ to 12″. Nursery stock one year old. *Arrangement, etc.*, as above.

Measurements in January 1941 *after one growing season.*

Locality.	Experiment number.	Species.	Percentage survivals.		Mean height in inches.	
			Nursery transplants.	Forest transplants.	Nursery transplants.	Forest transplants.
Karianshola ..	168	*Mesua ferrea*	88	62	7·3	6·7 S
	186	*Calophyllum elatum* ..	31	32	7·4	8·0 N
	187	*Palaquium ellipticum* ..	46	62	9·1	10·8 S
Chandanathode ..	188	*Hopea parviflora*	84	86	8·7	10·4 S
	219	*Palaquium ellipticum* ..	43	73	7·0	10·0 S

494. *Comparison of direct sowing, naked root transplanting and basket planting.* (Vide paragraphs 391 to 397)—

Karianshola Experimental Garden Experiment No. 154 *of* 1939.—*Species—Vateria indica. Arrangement* ABC CBA repeated 10 times in single lines of 10 plants, i.e., 100 plants per treatment. *Espacement*—3′ × 1½′. *Soil preparation*—Sowing in prepared patches 1′ square, 6″ deep. Transplanting, naked and basketed in standard pits 1′ cube. *Stock used*—Sowing three seeds per stake, naked root transplants, 9″ to 24″ high, one year old. Basketed transplants, 4″ to 15″ high, one year old. *Treatment*—Kept clean weeded.

Karianshola Experimental Garden Experiment No. 157 *of* 1939.—*Species—Gluta travancorica. Arrangement*—ABCDE EDCBA repeated 10 times in single lines of 10 plants, i.e., 100 plants per treatment. *Espacement, soil preparation* and *weeding* as above. *Stock used*—Sowing one seed per patch. *Transplants*—Small one year old, 3″ to 6″. Medium one year old, 9″ to 12″. Large one year old 15″ to 24″. *Basketed plants*—One year old; 3″ to 12″.

Chandanathode Experimental Garden Experiment No. 167 *of* 1939.—*Species—Dysoxylum malabaricum. Arrangement*—ABC CBA repeated 10 times in single lines of 10 plants, i.e., 100 plants per treatment. *Espacement, soil preparation and weeding*—As above. *Stock used*—Sowing, 3 seeds per patch. *Transplants*—One year old, 6″ to 12″ high. *Basket plants*—One year old, 3″ to 12″.

Chandanathode Experimental Garden Experiment No. 169 *of* 1939.—*Species—Gluta travancorica. Arrangement*—ABCDEF FEDCBA repeated 10 times in single lines of 10 plants, i.e., 100 plants per treatment. *Soil preparation*—Seed not sown due to lack of seed. Transplanting in prepared 1′ cube pits. Stump planting in crowbar holes. *Stock used*—Size of transplants. Small, one year old, 4″ to 9″ in height. Medium, one year old, 12″ to 15″ in height. Large, one year old, 16″ to 22″ in height. Size of basketed plants, 4″ to 9″ in height. Size of stumps, 0·4″ to 0·6″ in diameter. *Espacement and weeding*—As above.

Growth data after two growing seasons.

Locality.	Experimental garden experiment number.	Year.	Species.	Treatment.	Survival per cent.	Mean height in inches.
Karianshola ..	154	1939	*Vateria indica.*	Direct sowing ..	60	12·0
				Transplanting ..	93	18·0
				Basketed transplants.	98	19·4
Do. ..	157	1939	*Gluta travancorica.*	Direct sowing ..	..	..
				Small transplants.	5	12·8
				Medium transplants.	12	17·3
				Large transplants.	..	..
				Basketed transplants.	60	18·4
Chandanathode.	167	1939	*Dysoxylum malabaricum.*	Direct sowing	1	6·0
				Transplanting ..	20	10·5
				Basket transplants.	59	8·5
Do.	169	1939	*Gluta travancorica.*	Small transplants.	66	11·0
				Medium transplants.	63	14·7
				Large transplants.	49	20·2
				Basket plants ..	78	11·7
				Sowing ..	..	..
				Stump plants ..	..	..

Karianshola Experimental Garden Experiment No. 169 *of* 1940.—*Species—Dipterocarpus indicus. Arrangement*—ABCDDCBA repeated 10 times in single lines of 10 plants,

i.e., 100 plants per treatment. *Espacement*—3′ × 1½′. *Soil preparation*—Sowing in prepared patches 1′ square and 6″ deep. Transplanting and basket planting in standard 1′ cube pits. *Stock used*—Sowing, three seeds per stake. Small transplants, 2″ to 3″ high about one month old. Large transplants, 4″ to 12″ high, and one year old. Basketed plants, 4″ to 12″ high, one year old. *Tending*—Normal district practice.

Chandanathode Experimental Garden Experiment No. 197 *of* 1940.—*Species—Dysoxylum malabaricum. Arrangement*—ABCCBA repeated 10 times in single lines of 10 plants, i.e., 100 plants per treatment. *Tending, espacement and soil preparation*—As above. *Stock used*—Sowing 5 seeds per patch. Naked root transplants, two years old, 12″ to 20″ high. Basketed transplants, two years old, 9″ to 16″ high.

Chandanathode Experimental Garden Experiment No. 199 *of* 1940.—*Species Gluta travancorica. Arrangement*—ABCDEF FEDCBA repeated 10 times in single lines of 10 plants, i.e., 100 plants per treatment. *Espacement and tending*—As above. Soil preparation, sowing. Not sown for want of seed. Transplanting, naked root and basketed transplants. In prepared 1′ cube pits. Stump plants in crowbar holes. *Stock used*—For transplants and stumps, two-year old nursery stock. *Size of transplants*—Small and basketed, 8″ to 16″ high. Medium, 18″ to 24″ high. Large, 28″ to 34″ high. *Size of stumps*—0·5″ to 0·8″ diameter, with 9″ root and 1″ shoot.

Growth data after one growing season.

Locality.	Experimental garden experiment number.	Year.	Species.	Treatment.	Survival per cent.	Mean height in inches.
Karianshola ..	169	1940	*Dipterocarpus indicus.*	Sowing ..	27	6·3
				Small transplants.	74	5·7
				Large transplants.	92	9·1
				Basketed transplants	93	8·2
Chandanathode.	197	1940	*Dysoxylum malabaricum.*	Sowing ..	..	..
				Transplanting ..	83	21·7
				Basket planting.	79	7·0
Chandanathode.	199	1940	*Gluta travancorica.*	Sowing ..	..	..
				Small transplants.	92	11·3
				Medium transplants.	92	17·8
				Large transplants.	90	23·1
				Stump plants ..	20	3·0
				Basketed plants.	86	7·7

495. Comparison of stump planting and planting cuttings from nursery transplants and natural forest trees (vide paragraphs 398 and 899)—

1939 *Experiments.*

Karianshola Experimental Garden Experiment No. 155.—*Species—Chickrassia tabularis—Arrangement*—ABCCBA repeated ten times in single lines of ten plants, i.e., 100 plants per treatment. *Espacement*—3′ × 1½′. *Soil preparation*—Planting in crowbar holes. *Stock used*—Stumps 0·3″ to 0·4″ diameter. *Nursery cuttings*—0·4″ to 0·5″ diameter with a length of 9″ to 10″. Forest cuttings 0·4″ to 0·5″, with a length of 9″ to 10″. *Date of planting*—27th June 1939.

Karianshola Experimental Garden Experiment No. 156 *of* 1939.—*Species—Cedrela odorata—Arrangement, etc.*, as above. *Stock used*—(A) Sowing ten seeds per patch, (B) Stumps from nursery seedlings one year old, 0·5″ to 0·8″ diameter and (C) Cuttings from nursery seedling, one year old, 10″ long and 0·4″ to 0·6″ diameter. *Date of planting*—12th June 1939. *Date of sowing*—31st May 1939.

Measurements in January 1941 *after two growing seasons.*

Locality.	Experimental Garden Experiment number.	Species.	Treatment.	Survival per-cent.	Mean height in inches.
Karianshola ..	155/1939.	*Chickrassia tabularis.*	(A) Stumps	80	21·1
			(B) Nursery cuttings.	39	24·6
			(C) Forest cuttings ..	38	25·0
Do. ..	156/1939.	*Cedrela odorata* ..	(A) Sowing	1	5·0
			(B) Stump planting ..	3	4·9
			(C) Nursery cuttings.	19	6·0

INDEX TO SPECIES.