

GROWTH OF NURSERY ROOTSTOCK SEEDLINGS OF *HEVEA BRASILIENSIS* MUELL. ARG. cv. TJIR 1.

PART TWO

BY

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SUMMARY

A study was initiated to examine the nature of variation in growth of an illegitimate population of nursery seedlings of rubber (*Hevea brasiliensis* Muell. Arg.) up to the time of removal from the nursery at 18 months. The stem diameter was used as the growth parameter. The seedlings which germinated early (12 to 22 days) always had a greater diameter at all stages of growth than those which germinated later (24 to 34 days). The diameter of the seedlings at the first measurement was correlated with the diameters at the later stages. The rate of growth of early germinators was higher than the late germinators. There was a high negative and significant correlation between the germination period and the rate of growth. The rates of growth during different intervals were high, low or intermediate and were associated with the rainfall pattern. The ability of the early germinators to maintain their superiority in growth could be genetical. The results show that 30 - 35% of seedlings could be culled in the germination bed itself so that only the more vigorous seedlings would be transferred to the rootstock nursery.

INTRODUCTION

Even though rubber (*Hevea brasiliensis*) is propagated vegetatively, the tree to tree intra-clonal variation of growth and yield of budlings, reduces the realization of maximum returns of a cultivar. Variation in growth delays the opening of tapping cuts in 25 - 30 per cent of the trees in a clearing and such trees take longer to give returns on the invested capital. Wide variations in yield affect the productivity of smallholdings because the lowest yielding 25 per cent of the trees have been found to give only 15 per cent of the total yield (Senanayake, unpublished results). For this same reason it also affects the profitability of estates because, the low yielders would reduce the yield intake from a tapping task and consequently increase the cost of tapping.

It has been suspected that since the rootstocks are of seedling origin and heterozygous, their variability could influence the intra-clonal variability of the vegetative propagules of rubber (McIndoe, 1958 ; Senanayake & Wijewantha, 1968). To test this view an investigation was undertaken to study the nature of variation on the growth of unselected illegitimate rootstock seedlings in a nursery, with the ultimate objective of comparing the nature of variation of such seedlings with that of the budlings grown in the field. The nature of variation of nursery seedlings during the first 6 months of growth was reported earlier by Jayasekera & Senanayake (1971). This paper examines the nature of growth of the same plants during the next 12 months of growth up to the time they were budded and removed from the nursery.

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MATERIALS AND METHODS

The description of the experimental plot, nursery management methods and the experimental methods were presented in the previous paper (Jayasekera & Senanayake, 1971). The daily rainfall records which were maintained in the Nivitigalakele Sub-Station of the Rubber Research Institute where the nursery was located were used to compute the monthly rainfall.

RESULTS

Stem Diameter

The mean stem diameter of the seedlings which germinated during different periods ranging from 12 to 34 days had a distinct unimodal growth curve at every stage of measurement (Fig. 1.) All curves were skewed to the left. Small variations in the growth curves are evident at the different stages of measurement. The stages of measurement are identified in Table 2. In general, the seedlings that germinated early always maintained a bigger stem diameter while those that germinated late had a smaller stem diameter. These differences were more pronounced as the seedlings grew older. Throughout the period of growth, two exceptions to this growth pattern were evident. Firstly, among the seedlings that germinated early between 12 to 22 days, the seedlings that germinated fastest, at 12 days, had a smaller stem diameter than those which germinated during this period from 14 to 22 days. Secondly, among the seedlings that germinated late from 24 - 34 days the batch of seedlings which germinated last at 34 days always had a bigger stem diameter than the batch which germinated before it, in 32 days.

Rate of growth of stem diameter

The rate of growth of the stem diameter during intervals 5 to 17 are presented in Figs. 2, 3 & 4. An interval is the period between two stages of measurements. Thus interval 7 in Fig. 2 represents the increment in growth between the measurement of the diameter at stage 8. (1 April, 1970) and the measurement at stage 9 (1 May, 1970). The periods which represent the different intervals are identified in Table 1.

Two features in growth are recognisable in these figures. Firstly, at different intervals of measurement the rate of growth of all the seedlings which originated from different germinating periods was not uniform. During some intervals (intervals 5 and 12) the growth rate was low while in other intervals (intervals 7, 10, 11, 13 and 14) the growth rate was high and in still others it was intermediate. Secondly during any one interval, the growth rates of the seedlings which germinated at different times were not uniform and they gave rise to fluctuating growth curves. Although the seedlings which germinated from 14—18 days had a higher rate of growth than the other seedlings, during most intervals the rate of growth curves do not compare as well with the smooth unimodal growth curve pattern of the stem diameters.

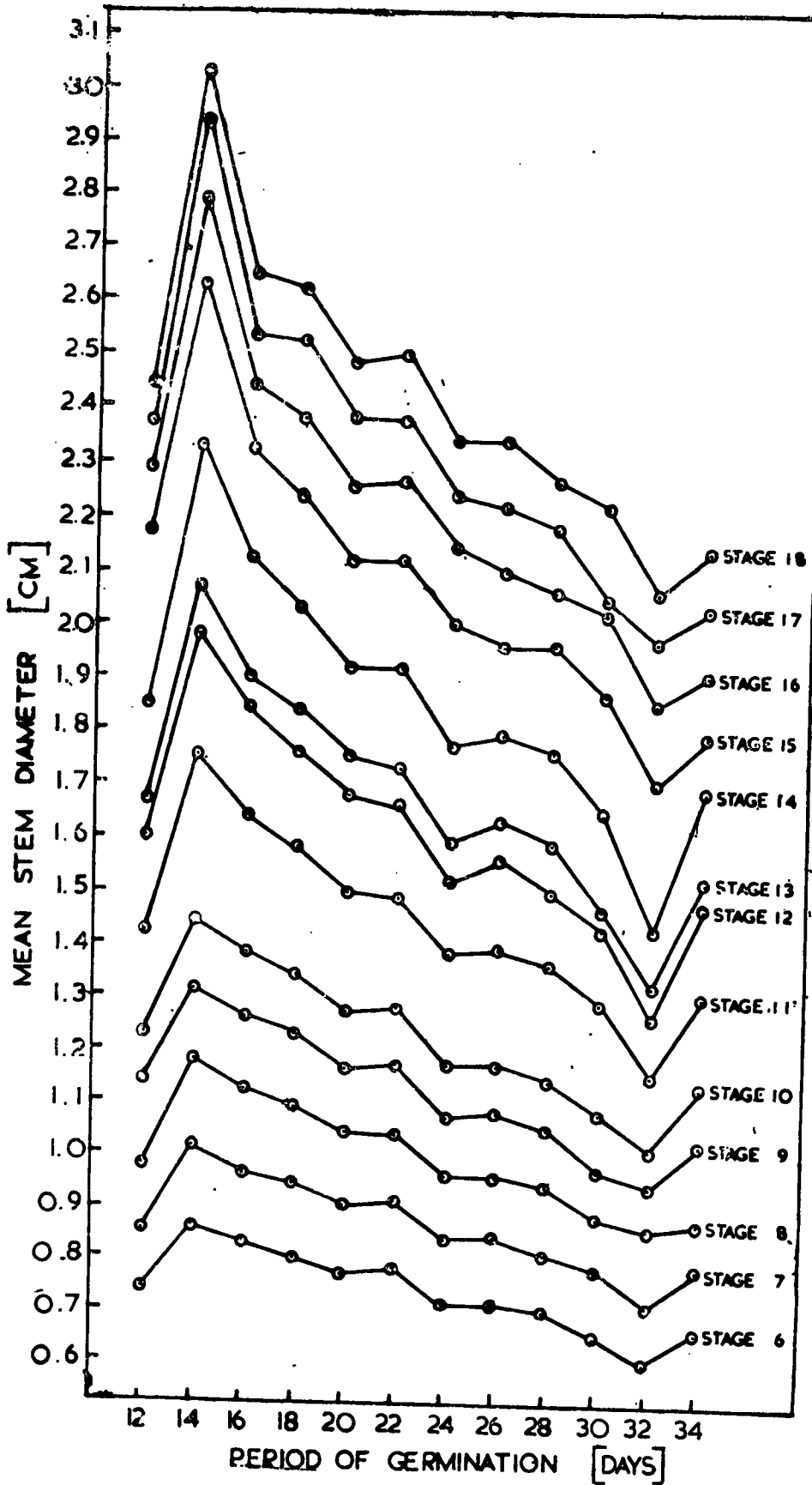


Fig. 1. Monthly mean stem diameter of seedlings which germinated on different days.

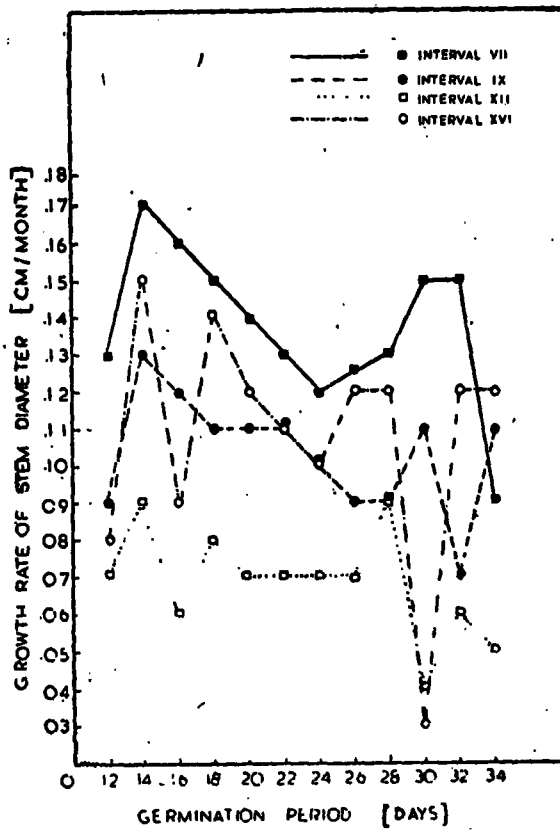


Fig. 2. Monthly growth rates of the stem during intervals 7, 9, 12 and 16.

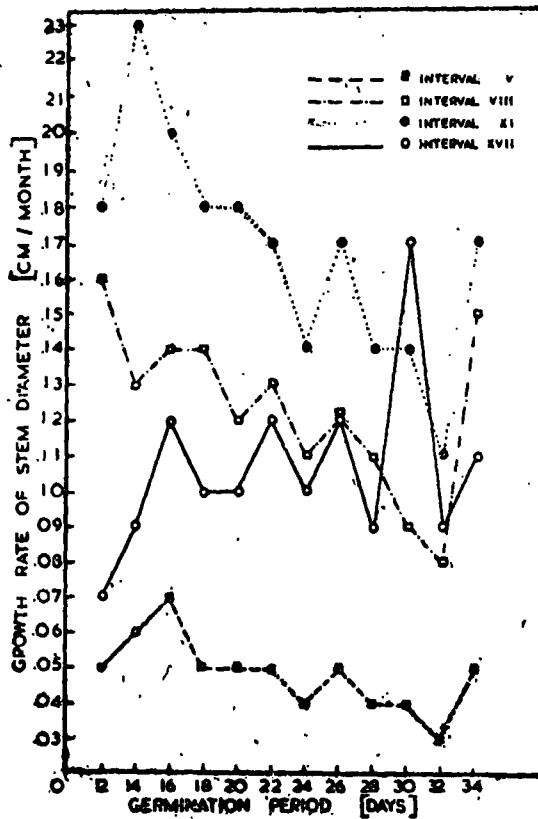


Fig. 3. Monthly growth rates of the stem during intervals 5, 8, 11 and 17.

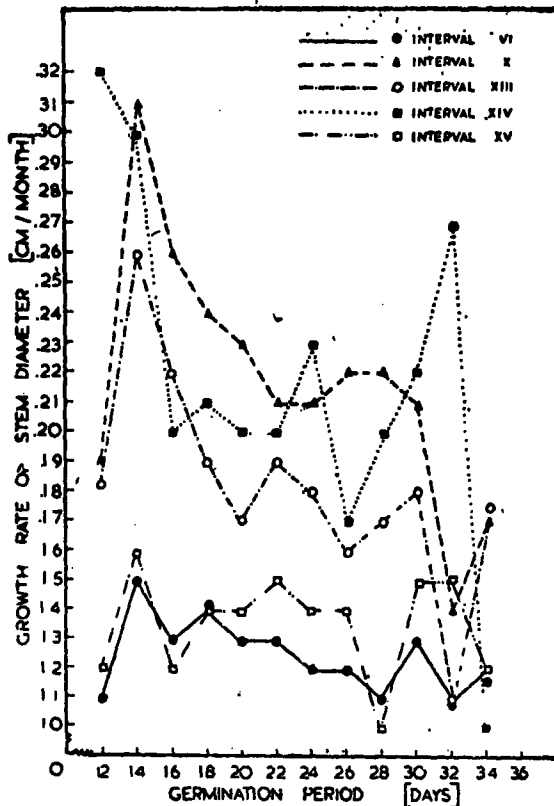


Fig. 4. Monthly growth rates of the stem during intervals 6, 10, 13, 14 and 15.

Rainfall

The distribution of rainfall at Nivitigalakele during intervals 5 to 17 follows the typical annual rainfall pattern which is common to this location (Fig. 5). Intervals 5, 8 and 17 correspond to the dry months of February 1970, August 1970 and March 1971. Interval 15 (December 1970) and interval 16 (January 1971) were abnormally dry. Interval 8 (May 1970) and interval 14 (November 1970) were the peak monsoon months of the South-West and North-East monsoons, respectively.

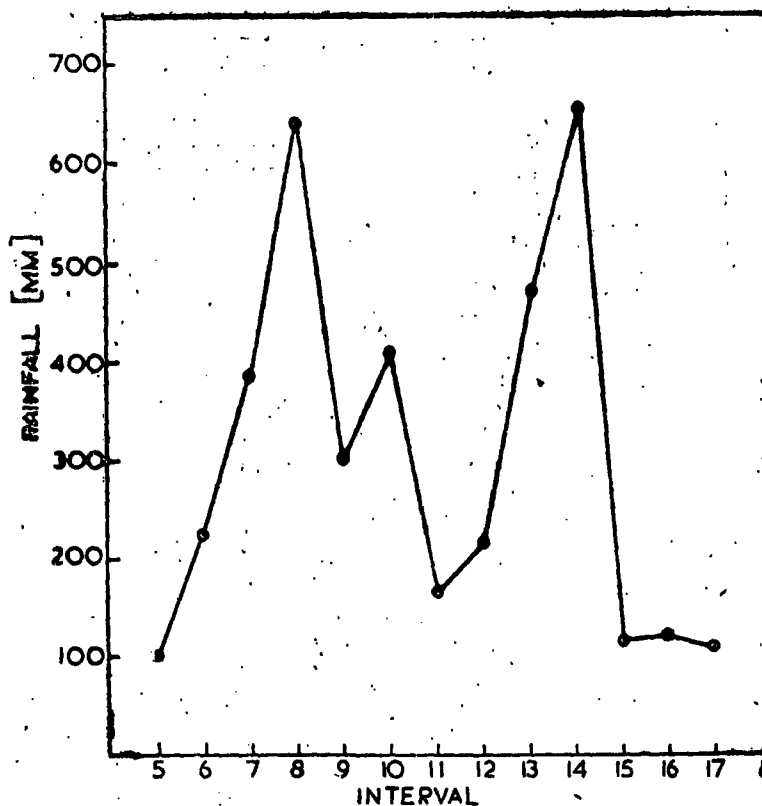


Fig. 5. The total rainfall during different intervals of growth.

Germination and rate of growth

A correlation analysis was made to compare the period of germination of the seedlings in the germination bed with the rate of growth of their diameters during their last 12 month growth period in the nursery. Correlations were determined for each interval of growth from interval 5 commencing on 15 February 1970 to interval 17 ending on 1 March 1971, (Table 1). High negative correlations were found up to interval 14 and 60 per cent of the measurements were significant. During the last three stages the correlations have weakened.

TABLE 1
 CORRELATION OF THE GERMINATION PERIOD WITH THE RATE OF GROWTH OF DIAMETER
 DURING DIFFERENT INTERVALS

Year	Interval	Period	r	
1970	5	15 Feb. — 1 Mar.	-0.6518 *	
	6	1 Mar. — 1 Apr.	-0.4665	
	7	1 Apr. — 1 May	-0.6532 *	
	8	1 May — 2 Jun.	-0.5782 *	
	9	2 Jun. — 1 Jul.	-0.4349	
	10	1 Jul. — 1 Aug.	-0.6560 *	
	11	1 Aug. — 1 Sept.	-0.7455 **	
	12	1 Sep. — 1 Oct.	-0.4950	
	13	1 Oct. — 1 Nov.	-0.6692 *	
	14	1 Nov. — 1 Dec.	-0.5736 *	
	15	1 Dec. — 1 Jan.	-0.0207	
	1971	16	1 Jan. — 1 Feb.	-0.1449
		17	1 Feb. — 1 Mar.	-0.3927

* Significant

** Highly significant

Effect of initial diameter

The first measurement of the diameter was taken on 14 November, 1969 which was the second stage of growth. A correlation study was made to compare the diameter of the seedlings at their first measurement with their diameters at subsequent stages (Stage 6 to 19) which represent a growth period of 13 months (Table 2). A significant positive correlation was found up to stage 7. The correlation remained high up to stage 10 and it weakened during the later stages. The correlation has gradually weakened as the plants grew older.

TABLE 2
CORRELATION OF THE DIAMETER OF SEEDLINGS AT FIRST STAGE OF MEASUREMENT (STAGE 2) WITH THE
DIAMETER AT SUBSEQUENT STAGES

Year	Stage	Date	r	
1970	6	15 Feb.	+ 0.6232*	
	7	1 Mar.	+ 0.5983*	
	8	1 Apr.	+ 0.5439	
	9	1 May	+ 0.5195	
	10	1 Jun.	+ 0.5074	
	11	1 Jul.	+ 0.4873	
	12	1 Aug.	+ 0.4622	
	13	1 Sep.	+ 0.4475	
	14	1 Oct.	+ 0.4392	
	15	1 Nov.	+ 0.4115	
	16	1 Dec.	+ 0.3797	
	1971	17	1 Jan.	+ 0.3687
		18	1 Feb.	+ 0.3718
		19	1 Mar.	+ 0.3697

* Significant

DISCUSSION

It has been established that the height and diameter of nursery seedlings of *H. brasiliensis* have a high positive correlation and therefore it was suggested that one of these growth attributes could be used to study growth relationships (Jayasekera & Senanayake, 1971). In view of this, only the growth of the stem diameter is discussed here. Unpublished results of the authors on the growth in height show a close relationship to girth.

The size of seedlings at any stage of measurement (Fig. 1) shows that the early germinators were always the larger plants, even after 18 months, whereas the late germinators were smaller plants. This result confirms a similar observation which was reported in the previous paper on the growth of the seedlings during the first 6 months. This difference could be genetical. Being an illegitimate population of seedlings, the heterozygous nature of the seed and the polyploid nature of inheritance could cause the positively skewed growth curves of the seedling population. Additional evidence of an inherent relationship is present when the germination period is compared with the rate of growth (Table 2). The negative correlation between the two parameters indicate that when the germination period is low (short) the rate of growth is high and when the germination period is high (long) the rate of growth is low. The correlation was high up to interval 14 when the plants were 15 months old and it was significant during most intervals particularly during the intervals when the growth rates were high.

The positive correlation of the diameter at first measurement with the diameter at subsequent measurements indicates that the seedlings which had a bigger initial girth continued to have this characteristics even at later stages. The correlation was high up to stage 10 when the plants were 10 months old and it was significant

up to stage 7 when the plants were 7 months old. The correlation decreased as the plants grew older. Changes in the plant such as variable leaf senescence during periods of soil moisture stress and the associated changes in dry matter production as a result of it and the differential shading of leaves could weaken the correlation as the plants grew taller.

The small differences in the growth curves at different stages (Fig. 1) were due to the differences in the rates of growth of the seedlings of the population during the intervals (Figs. 2, 3 & 4). Even though the rate of growth curve during an interval was less uniform than the seedling diameter curve at a given stage, yet during most intervals the rate of growth of the early germinators was more than the late germinators. It is possible to recognise a relationship between the differences in the rate of growth and the rainfall pattern. Intervals of low growth rates such as intervals 5 and 12 were preceded by periods of low rainfall. Intervals showing high growth rates such as intervals 7, 10, 11, 13 and 14, always followed a period of increased rainfall. When the growth rate was intermediate as during intervals 6 and 9, the rainfall was also intermediate. The differences in growth could therefore be due to a soil moisture-plant growth relationship. An intermediate rate of growth was also observed when the rainfall was low as during intervals 15, 16 and 17. Perhaps in these instances the soil moisture stress would not have affected the growth rate to the same extent as in intervals 5 and 12, because the plants being older would have had deeper roots that would have been able to use the soil moisture of the lower layers.

The range of the germination period of the seeds in this study was 22 days. The seedlings which germinated after the 10th day could be considered as the inherently weaker seedlings. They represented 33 per cent of the germinated seedlings (Jayasekera & Senanayake, 1971). The results suggest that the seedlings which are being grown for rootstocks could be culled in the germination bed itself by grouping all seedlings as early germinators and late germinators.

The late germinators would constitute about 30 - 35 per cent of the plants. Their removal at this stage would eliminate the costs of establishing, maintaining and later culling them in the nursery. It will also reduce the amount of culling that would be necessary if any, from among the remaining plants in the nursery when the rootstocks are maturing.

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