COLLECTION OF HEVEA MATERIALS FROM RONDONIA TERRITORY IN BRAZIL

A PRELIMINARY STUDY[1]

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ABSTRACT - Seven characteristics were studied in 27 selected wild mother trees at Ouro Preto, Rondônia Territory: yield, circumference, bark thickness, total number of latex vessels, density of latex vessels per 5 mm per ring, and average distance between consecutive latex vessel rings. All the trees were also evaluated for the degree of incidence of South American Leaf Blight (SALB). Great variability was observed among the individual selected rubber trees growing under similar environmental conditions. Linear correlations among the quantitative characteristics were estimated. Positive correlations were found between yield and circumference, bark thickness, total number of latex vessel rings and density of latex vessels per 5 mm per ring. Low relationship was found between yield and diameter of the latex vessels and between yield and average distance between consecutive latex vessel rings. Regression analysis of yield and the values of the quantitative characters showed the regression coefficient to be highly significant to circumference, bark thickness, total number of latex vessel rings and density of latex vessels per 5 mm per ring.

Index terms: *Hevea* spp., rubber tree, linear correlation, regression coefficient, genetic variation, selection.

COLEÇÃO DE MATERIAL DE SERINGUEIRA SELECIONADO NO TERRITÓRIO DE RONDÔNIA. ESTUDO PRELIMINAR

RESUMO - Foram estudadas sete características de 27 matrizes selecionadas em Ouro Preto, no Território Federal de Rondônia. Nas seleções, foram determinadas a produção, a circunferência, a espessura de casca, o número total de vasos laticíferos, a densidade de vasos laticíferos em 5 mm do anel e a distância média entre os anéis consecutivos de vasos laticíferos. Todas as árvores foram avaliadas também quanto ao grau de incidência do mal sul-americano das folhas. Grande viabilidade foi observada entre os indivíduos selecionados vegetando sob as mesmas condições ambientais. Foram estimadas as correlações lineares entre as características quantitativas. Foram encontradas correlações positivas entre a produção e a circunferência do tronco, a espessura de casca, o número total de anéis de vasos laticíferos, e a densidade dos vasos laticíferos em 5 mm do anel. Foi encontrada baixa correlação da produção com o diâmetro dos vasos laticíferos e da produção com a distância média entre os anéis consecutivos de vasos laticíferos. A análise de regressão de produção e os valores dos caracteres quantitativos estudados mostraram coeficientes de regressão altamente significativos para circunferência, espessura da casca, número total de anéis de vasos laticíferos e densidade de vasos laticíferos em 5 mm do anel.

Termos para indexação: *Hevea* spp., correlação linear, coeficiente de regressão, variação genética, seleção.

INTRODUCTION

Conventional breeding takes a long time to provide a few clones with acceptable all-round characteristics for large scale commercial planting. This is because the perennial nature of the crop impose long testing cycles. In addition, multiple selection for yield and secondary characters which are often unfavourably associated with yield, reduces considerably the chances of producing good all-round clones (Ho 1972).

The first botanical expedition with the purpose of collecting botanical material of native rubber trees (*Hevea* spp.) was held in 1945 in the Rondônia Territory. The collected seeds were planted in 84 hectares but these were destroyed by fire in 1950. Later in 1962, a new expedition was designated to recollect materials from the same trees in the same area (Moraes 1963). Ten years later in 1972, a further expedition was carried out and a *Hevea* breeding programme based on the wild mother trees in jungle was initiated. From the results of previous expeditions, the Acre and Rondônia areas have shown the presence of high

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yielding vigorous germplasm (Pereira 1972, Gonçalves et al. 1973, Viegas & Gonçalves 1974, Gonçalves 1978, Gonçalves 1979).

The main objective of wild mother tree selection is to supplement the breeding programme by providing a wider range of good all-round clones in a short time. Data from the most recent collection have been subjected to analysis (mainly the various parameters connected with yield and vigor) and the preliminary findings are reported in this paper.

MATERIAL AND METHODS

Selection of high yielding wild mother trees

Simmonds (1969) emphasized that multiplicity of characters selected always either demanded large populations or caused a weakened selection for individual characters. The level of operation to cope with the former alternative is not practical in a conventional breeding programme. However, by resorting to commercial and other advanced generation seedlings, it is feasible to screen large populations by mass selection.

A particularly conducive situation favouring such an approach in Brazil is the ready availability of large areas of high yielding wild trees.

In the pre-selection of mother-trees in the field, the basic objective was to identify the best yielding phenotypes for further yield recording and observation. The findings from the preliminary investigations by Gonçalves (1978) have been used in the process. For the pre-selection of the wild mother-trees, the tappers (Figure 1) were contacted for location of the high yielding trees giving more than 1000 cc of latex per tapping. This information was verified and confirmed. Freedom from *Microcyclus ulei* and *Phytophthora* sp. leaf fall was cheked visually (Figure 2). Budwoods from orthotropic branches were then collected, the cut ends waxed and stored in moist saw-dust and sent to National Rubber and Oil Palm Research Centre at Manaus of grafting.

Yield, number and height of panel, circumference at 1.5 m of height and degree of disease incidence were recorded for each selected tree. Bark samples were taken for recording the thickness, total number of latex vessel rings, diameter of latex vessels, density of latex vessels per 5 mm per ring and average distance between consecutive latex vessel rings based on all rings. The sample were taken at precisely 1.5 m above the soil surface (Table 1). Budwood from 27 trees was then collected.

Bark Characteristics Measurements

The following bark characteristics were measured in the bark sample:

1. Bark thickness;
2. Total number of latex vessel rings was determined by examining the radial longitudinal sections of the bark;

FIG. 1. Native tapper carrying out tapping armed with a rifle and a zerosene head light.

3. Diameter of latex vessels was observed in the transverse section of the bark;
4. Density of latex vessels per 5 mm per ring determined by the average density based on all rings;
5. Average distance between consecutive latex vessel rings was determined based on all rings.

Estimates of correlation between the seven characters were computed from data of selected individuals.

RESULTS AND DISCUSSION

Variation of the Sampled Trees

Great variability was observed among the individual selected rubber trees of different ages growing under the same environmental conditions (Table 1).

Ule (1905) and Baldwin Junior (1974) have mentioned that very high yielding trees are found

FIG. 2. View of the tree leaves with light incidence of *M. ulei.*

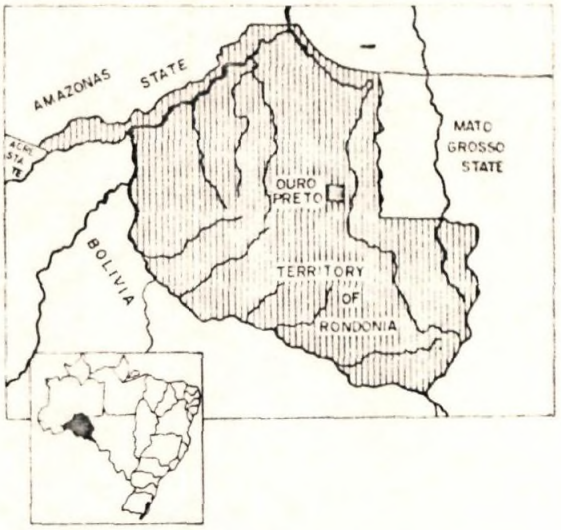

FIG. 3. Localization of Ouro Preto where the trees were collected in the Territory of Rondônia.

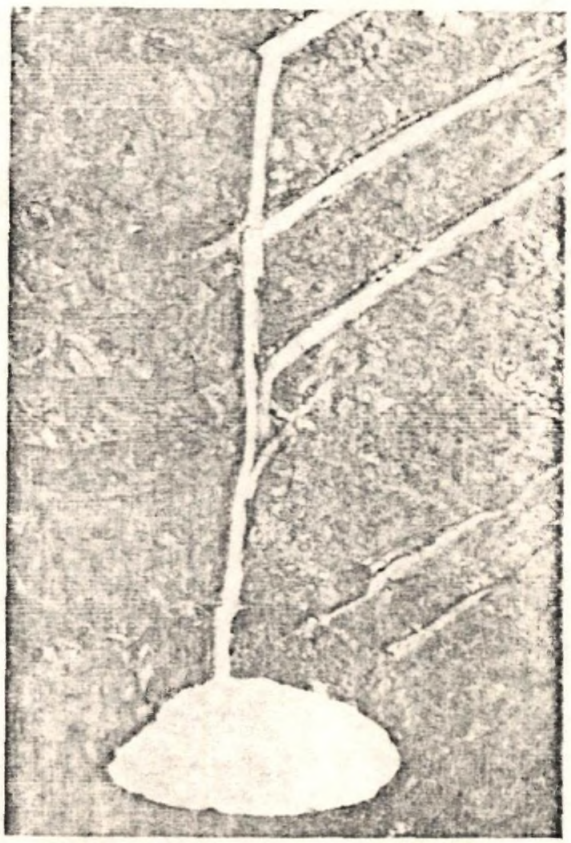

FIG. 4. *Hevea brasiliensis* with purple bark from Ouro Preto, estimated to be 60 years old.

in the Ouro Preto area of Rondônia Territory of Brazil (Figure 3).

The morphological characters of the trees studied followed the description of *Hevea brasiliensis* as given by Seibert (1974). It was noted that the majority of trees in this area, including those collected, had purple cortical tissue (Figure 4), but the latex of all trees was white. A rough estimate of the age of the trees based on the girth showed a variation from 20 to 300 years. Total number of latex vessel rings per tree ranged from 19 to 71. Bark thickness ranged from 0.61 to 2.42 cm in the trees (Table 2). Part of the observed differences in the latter characteristics was associated with the difference in tree circumference. Number of panels was also associated with the magnitude of circumference (Table 3).

Disease Incidence

The *Hevea* tree defoliates and renews its foliage

TABLE 1. Details on estimated age, yield, circumference and bark characters of the 27 mother trees collected from Ouro Preto. Federal Territory of Rondônia, Manaus, AM. 1980.

Number[1] of the tree	Estimated age (years)	Yield tapping tree (litre)	Circumference (metre)	Thickness (cm)	Total number of latex vessel rings	Diameter of latex vessels (mm)	Density of latex vessels per 5 mm per ring	Average distance between consecutive latex vessel ring (mm)
01	50	3.0	1.78	1.63	48	24.4	472.13	282.13
02	50	1.0	1.71	1.71	27	23.4	208.84	298.67
03	20	0.5	0.61	0.61	21	18.3	240.98	206.10
04	150	3.0	3.00	1.55	37	22.1	263.93	268.40
05	60	2.0	1.88	1.05	40	23.4	459.02	228.14
06	100	5.0	2.65	1.47	38	24.4	436.07	275.72
07	90	3.0	2.30	1.32	42	22.1	293.44	236.06
08	30	1.0	0.85	0.93	29	18.3	285.25	295.20
09	150	5.0	3.00	2.42	71	22.1	698.36	362.48
10	100	4.0	2.60	1.46	34	23.4	390.16	318.28
11	300	5.0	4.13	2.17	53	21.3	521.32	366.59
12	140	3.0	2.51	1.92	42	23.4	413.11	306.90
13	250	3.0	3.27	1.54	33	21.3	326.59	482.08
14	90	2.0	2.18	1.40	29	23.4	332.79	416.48
15	140	2.5	2.85	1.43	37	22.1	363.93	379.19
16	100	4.0	2.29	1.68	29	21.3	285.25	397.13
17	280	3.0	3.70	1.77	35	22.1	401.64	332.89
18	100	3.0	2.38	1.65	34	22.1	390.16	274.50
19	80	1.5	1.96	1.28	47	21.3	462.30	231.80
20	50	1.5	1.50	1.47	30	22.1	344.26	226.92
21	80	2.0	1.95	1.34	41	21.3	403.28	271.45
22	90	2.5	2.32	1.30	32	23.4	340.97	262.30
23	100	1.5	2.16	1.67	31	22.1	355.74	345.67
24	300	3.5	3.80	1.86	32	24.1	367.21	320.25
25	250	6.0	3.47	1.94	39	22.1	414.75	325.33
26	80	3.0	1.80	1.26	32	21.3	314.75	206.37
27	70	2.5	1.46	0.95	19	19.9	349.18	271.45

[1] The collected mother trees were cloned at National Rubber Research Centre as CNS-RO 7901 to CNS-RO 7927.

TABLE 2. Overall means, standard deviation and coefficients of variation of 27 mother trees collected from Ouro Preto, Federal Territory of Rondônia, Manaus, AM, 1980.

Characteristic	Mean	Range	Units	Standard deviation	Coefficient of variation (%)
Yield/tapping/tree	2.85	0.50- 6.00	litre	1.33	46.7
Circumference	4.74	0.61- 4.13	m	2.55	53.8
Bark thickness	1.49	0.61- 2.42	mm	0.38	25.5
Total number of latex vessel rings	36.40	19.00- 71.00	-	10.34	28.4
Diameter of latex vessel	44.18	18.30- 24.40	mm	23.40	52.9
Density of latex vessels per 5 mm per ring	375.38	208.84-521.32	-	98.20	26.2
Average distance between consecutive latex vessel rings	289.38	206.10-482.80	mm	68.71	23.7

TABLE 3. Number of trees and their yield, circumference range and number of panels in the mother trees collected in Ouro Preto, Federal Territory of Rondônia, Manaus, AM, 1980.

Nº of trees	Yield (litre)	Circumference range (metres)	Nº of panels in exploration
1	0.5	0,61	1
2	1.0	0.85-1.71	1, 3
3	1.5	1.50-2.16	1, 4 e 6
3	2.0	1.88-2.18	3, 3 e 3
3	2.5	1.46-2.85	2, 3 e 5
8	3.0	1.78-3.70	3, 3, 3, 4, 4, 5, 5 e 6
1	3.5	3.80	7
2	4.0	2.29-2.60	5 e 5
3	5.0	2.65-4.13	4, 6 e 7
1	6.0	3.47	8

annually and this phenomenon is commonly known as wintering. Unlike the trees in temperate countries where defoliation occurs during the winter period of the year, in *Hevea brasiliensis* which grows in the tropics this takes place during the drier months of the year.

In addition, the incidence and severity of infection of the disease is strongly influenced by the prevailing climatic conditions during the wintering time. Regions having a high and well distributed rainfall with no pronounced dry season are observed to have severe disease incidence while areas receiving moderate rainfall but without a long dry season may have disease incidence intermediate in severity. Therefore, the prospected area which showed an extended drought for about months, receiving ponderate intensities of rainfall, experienced only low incidence of *Microcyclus ulei* and *Phytophthora* sp. in the foliage.

Yield-Bark Characteristics Relationship

Correlation studies for circumference, bark thickness, total number of latex vessel rings and diameter of the latex vessels in the collected material were in good agreement with the findings of various workers (Wycherley 1969, Narayanan et al. 1973, Ashplant 1928) with clonal rubber tree selections. Linear correlations between yield and bark characteristics such as thickness ($r = 0.7290^{**}$), total number of latex vessel rings ($r = 0.5139^{**}$) and density of latex vessels per 5

mm (r = 0.5397**), were significant at the 0.01 level (Table 4). Thus, 53 percent of the total variation was associated with bark thickness. The magnitude of the correlation (r = 0.7290) for bark thickness is in close agreement with the r = 0.8089 reported by Gonçalves et al. (1980), who used one-year old clones. Although Brookson (1959) showed that there was positive correlation between the yields of individual mature seedlings and clones derived from them, Wycherley (1969) pointed out that this evidence was inadequate. A similar situation may also exist for the collected material in this study. In view of the above, it is still necessary to repeat the test of the budgrafts made from these collections for further selection. It would be interesting to see whether collections from different geographic areas of Brazil show different behaviour.

Yields of all selected rubber trees were regressed on their bark characteristics. Table 5 shows the simple linear regression equations of yield (y) on the six variables. The analysis indicated that the slope of the regression line was significant at the 0.01 level (F = 28.36**) for bark thickness, indicating that bark thickness is closely related to yield, independent of the age of the tree. A similar situation possibly existed for total number of latex vessel rings and density of latex vessels per 5 mm per ring. For both characteristics the slope of regression lines (F = 8.97**) and (F = 10.27**) respectively (Figure 5) indicated that were closely related to yield of the trees.

TABLE 4. Linear correlation coefficients between yield and the various structural parameters of the 27 mother trees collected in Ouro Preto, Territory of Rondônia, Brazil. Manaus, AM, 1980.

Parameters	Symbol	Y	C	B	T.V.R.	D.L.V.	D.V.R.	A.D.C.V.
Yield/t/t	Y	1	0.7304**	0.7290**	0.5139**	0.3464 n.s.	0.5397**	0.3355 n.s.
Circumference	C		1	0.7894**	0.4380*	0.4274**	0.4536**	0.4508**
Bark thickness	B			1	0.6765**	0.4302**	0.6585**	0.5002**
Total number of latex vessel rings	T.V.R.				1	0.2721 n.s.	0.9623**	0.1155 n.s.
Diameter of latex vessels	D.L.V.					1	0.3691 n.s.	0.1155 n.s.
Density of latex vessels per 5 mm per ring	D.V.R.						1	0.0534 n.s.
Average distance between consecutive latex vessels per ring	A.D.C.V.							1

*Difference significant at 5% level of probability

**Difference significant at 1% level of probability.

TABLE 5. Linear regression equations between yield and various structural characters of the 27 mother trees collected from Ouro Preto, Federal Territory of Rondônia. Brazil. Manaus, AM, 1980.

Regression of yield (y) on	$\hat{Y}$	Regression coefficient
(C)	1.059 + 0.461 (C)	0.461**
(B)	-0.940 + 2.540 (B)	2.540**
(T.V.R.)	0.576 + 0.063 (T.V.R.)	0.063**
(D.L.V.)	3.724 + 0.297 (D.L.V.)	0.297 n.s.
(D.V.R.)	-0.040 + 0.007 (D.V.R.)	0.007**
(A.D.C.V.)	0.081 + 0.006 (A.D.C.V.)	0.006 n.s.

** Difference significant at 1% level of probability.

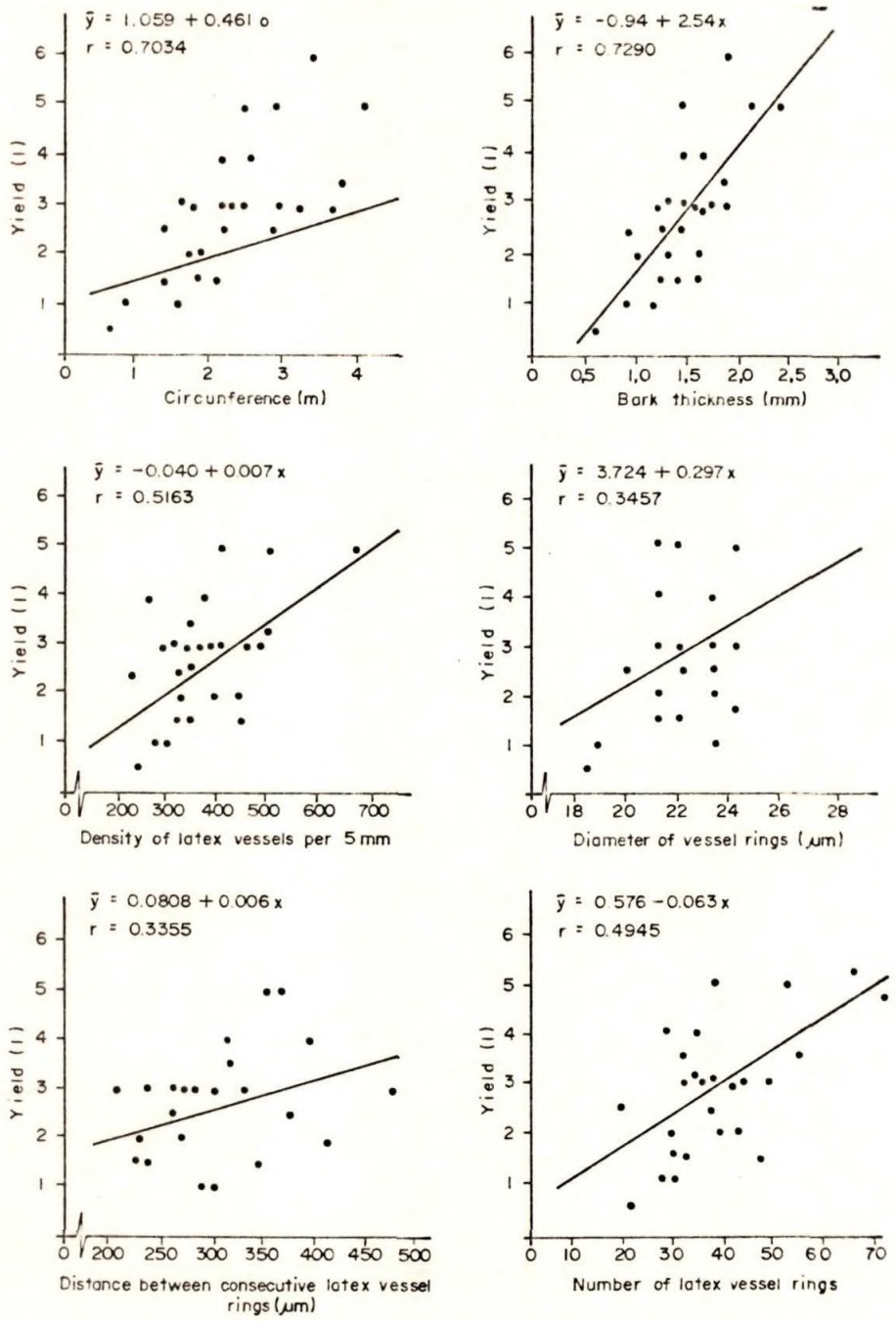

FIG. 5. Relationship of yield with circumference, bark thickness density of latex vessels per 5 mm, diameter of vessel rings, distance between consecutive latex vessel rings, and number of vessel rings of the trees collected in Ouro Preto. Territory of Rondônia.

CONCLUSIONS

Hevea breeders recognise the difficulty of producing good all-round clones quickly. Fresh approaches have therefore been sought. One of these is by mother-tree selection from populations of wild rubber trees. The main advantages of such an approach are the following:

1. No controlled crossing is necessary;

2. No capital outlay for land is required as these populations are in the native environment.

The early results from the wild mother-tree selection are promising.

1. Positive and significative correlations were found between yield and circumference, yield and bark thickness, yield and total number of latex vessel rings, and yield and density of latex vessels per 5 mm per ring.

2. No relationship was found between yield and diameter of the latex vessels and between yield and average distance between consecutive latex vessel rings.

3. Regression analysis of yield on other characters showed the regression coefficient to be highly significant for circumference, bark thickness, total number of latex vessel rings and the density of latex vessel per 5 mm per ring. The regression coefficient of diameter of the latex vessels and average distance between consecutive latex vessels rings not significant.

There is need to repeat the tests of budgrafts made from this collection and it would be of interest to see whether latex collections in different geographic areas of Brazil differ in behavior.

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