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Performance of Recent Introductions of Hevea in Malaya

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A number of Hevea *collections was introduced into Malaya from Brazil. A cubic lattice design did not show any advantage over a randomised block design with this low-yielding material.*

Illegitimate progeny of FX 25 proved to be the best population for yield and vigour. Hevea benthamiana *from Rio Negro and* H. brasiliensis *from Madre de Dios gave low yields compared with modern oriental selections; these were however fair, relative to the original Wickham collection material. There are indications from current work in Trinidad and earlier work elsewhere that these are good sources of genes for resistance to* Dothidella ulei. *International co-operation is necessary to breed material resistant to* Dothidella ulei, *because tests against the disease must be carried out in the neo-tropics.*

South American leaf blight, caused by the fungus *Dothidella ulei* P. Henn., was first reported in the Amazon valley in 1904 and is still confined to the neo-tropics. Among the provenances tested for resistance to this disease at the Ford Belterra Plantation, the material collected from the lower Tapajos river was found to be most susceptible. Because trees in that area gave the best rubber production then known in quantity and quality, Wickham collected the material which was subsequently introduced into the East in 1876. Furthermore, the clones bred and selected for high yield in the East also showed susceptibility to the disease when tested in South America. As an insurance against the advent of the disease in Southeast Asia, Malaya negotiated an exchange of *Hevea* planting material with Brazil (HILTON, 1955). The details of the exchange and the action taken on receipt of the material in Malaya have already been reported (BROOKSON, 1956). The performance of the clones from the imported seedlings in the various trials at the Experiment Station of the Rubber Research Institute of Malaya at Sungei Buloh is reported here.

MATERIAL AND DESIGN OF TRIALS

The material was grouped according to species and provenance. A formal cubic lattice design was used for clones from more vigorous seedlings of the 1951 and 1952 collections budded during 1953 and 1954 in Fields 55A and 56B respectively. The balance of the material each year was budded in Fields 55B and 56C respectively in unreplicated observation plots with RRIM 501 as control. The distribution of the material of different origins in the various trials is given in *Table 1*. The material is referred to here by a 'collection number'.

RESULTS

The results of the trials of cubic lattice design were analysed statistically. The effective error variances obtained by analysis as cubic lattices were not appreciably smaller than those obtained by analysis of the same results as three complete randomised blocks. Thus, the use of the cubic lattice design for these trials has not shown any marked improvement in accuracy compared with the simpler design. Therefore the treatment means given in the *Tables* have not been adjusted for block effects. Since formal statistical analysis is not possible for the unreplicated observation plots, the means for each collection are given with the means and standard errors for the plots of the control clone RRIM 501, the latter to show the variability in each field.

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TABLE 1. DISTRIBUTION OF THE INTRODUCTIONS IN THE VARIOUS FIELD TRIALS

Collection	Species	Provenance	Field in which it is planted, with the number of clones of each			
			55A	55B	56B	56C
3	*Hevea spruceana*	Arredores de Manaos, Brazil	1†			
4	*Hevea brasiliensis*	Belem, Brazil	17	5		
5	*Hevea benthamiana*	Rio Negro, Brazil	165	30	1†	
6	*Hevea brasiliensis*	Madre de Dios, Peru	158	79	41†	
7	*Hevea brasiliensis*	Belem, Brazil			96	25
8	*Hevea pauciflora*	Serra de Santana, Rio Negro				3†
9	*Hevea spruceana*	Illha Matapari, Brazil			47	26
10	FX 25 illegitimate	(Summit Seed Garden) Panama			29	31
Control clone RRIM 501			1††	29	2††	15
RRIM 513			1††			

† One or more clones omitted from the analysis owing to very poor growth.
†† Omitted from the analysis because of low number of clones.

TABLE 2. GROWTH CHARACTERISTICS AND YIELD DURING 1960/62 (FIELD 55A)

Collection		Girth (in.) at commencement of tapping at 60″ above the union		Mean yield in g/tree/tapping over the first two years		Girth increment (in.) during period of tapping	
No.	n	Mean	S.E.	Mean	S.E.	Mean	S.E.
4	17	20.52	±0.50	2.34	±0.42	4.96	±0.25
5	165	20.10	±0.20	6.15	±0.21	3.54	±0.07
6	158	20.60	±0.18	2.60	±0.12	5.49	±0.07
Comparison		Difference	S.E.	Difference	S.E.	Difference	S.E.
4 vs. 5		0.42 NS	±0.54	3.80***	±0.47	1.42***	±0.26
4 vs. 6		0.08 NS	±0.54	0.25 NS	±0.44	0.53*	±0.26
5 vs. 6		0.50 **	±0.27	3.55***	±0.25	1.96***	±0.10

*** $P<0.001$ ** $P<0.01$ * $P<0.05$ NS: Not significant

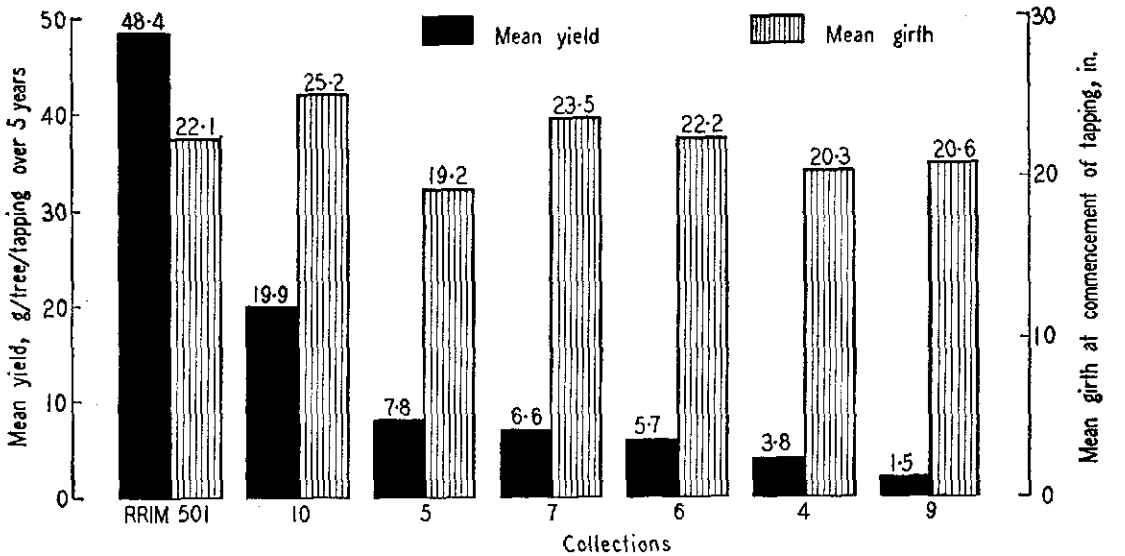

Figure 1. Mean yields and girths at commencement of tapping of the imported material and the control clone.

The following observations were made: girth at commencement of tapping and girth increment during tapping; virgin bark thickness at commencement of tapping and renewed bark increment at the end of the period of study. The mean yield over the first five years of tapping has been analysed for Fields 55B, 56B and 56C. But, only the mean yields over the first two years were recorded in Field 55A, because the trial was discontinued owing to the large proportion of low-yielding material being uneconomical to tap.

The yields were recorded by cup coagulation twice a month and calculated according to Method I of ROSS AND BROOKSON (1966), in which the mean yield per tree per tapping is not reduced to allow for the number of dry trees.

Table 2 gives the collection means and compares the various observations in Field 55A. Collection 5 is superior to the rest in yield but is inferior in girth increment during tapping. The collections did not differ markedly in girth at commencement of tapping.

Table 3 presents the observations made in Field 56B. The most outstanding collection is No. 10, which leads the rest in yield, vigour during immaturity and virgin bark thickness, whereas Collection 9 is the poorest for these characters, Collections 6 and 7 being intermediate. There is not much difference between the collections in girth increment during tapping and renewed bark increment, except that Collection 9 is the poorest.

The observations for Field 55B are summarised in *Table 4*. The control clone RRIM 501 yields nearly seven times more than Collection 5, which is the highest yielder but has the poorest girth at commencement of tapping. Collection 6 leads in girth at commencement of tapping and girth increment during tapping. Collection 4 is the lowest yielder.

The observations made in Field 56C are presented in *Table 5*. Collection 10 is the most outstanding and Collection 9 is again the poorest, as in Field 56B. None of the collections has yielded more than the control RRIM 501,

TABLE 3. GROWTH CHARACTERISTICS AND YIELD DURING 1960/65 (FIELD 56B)

Collection		Renewed bark increment (mm) between 1st and 5th year of tapping		Girth (in.) at commencement of tapping at 60″ from the union		Virgin bark (mm) at commencement of tapping		Mean yield g/tree/tapping over 5 years		Girth increment (in.) during period of tapping	
No.	n	Mean	S.E.	Mean	S.E.	Mean	S.E.	Mean	S.E.	Mean	S.E.
6	40	1.13	±0.06	21.14	±0.36	5.98	±0.10	5.60	±0.34	8.26	±0.33
7	96	1.13	±0.04	23.48	±0.24	5.21	±0.05	6.93	±0.40	8.74	±0.16
9	48	0.85	±0.07	20.61	±0.48	4.75	±0.08	2.10	±0.29	5.56	±0.35
10	29	1.08	±0.07	25.16	±0.47	6.18	±0.10	20.45	±2.17	7.97	±0.31
Comparison		Difference	S.E.	Difference	S.E.	Difference	S.E.	Difference	S.E.	Difference	S.E.
6 vs. 7		0.002 NS	±0.07	2.34***	±0.44	0.77***	±0.11	1.33 NS	±0.64	0.48 NS	±0.32
6 vs. 9		0.28*	±0.09	0.54 NS	±0.62	1.24***	±0.10	3.50***	±0.44	2.70***	±0.49
6 vs. 10		0.05 NS	±0.09	4.02***	±0.58	0.20 NS	±0.13	14.85***	±1.89	0.29 NS	±0.47
7 vs. 9		0.28 **	±0.07	2.88***	±0.48	0.46**	±0.12	4.83***	±0.60	3.18***	±0.33
7 vs. 10		0.05 NS	±0.08	1.68*	±0.51	0.97***	±0.13	13.52***	±1.39	0.77 NS	±0.35
9 vs. 10		0.23 NS	±0.10	4.56***	±0.72	1.43***	±0.13	18.35***	±1.72	2.41***	±0.51

*** $P<0.001$ ** $P<0.01$ * $P<0.05$ NS: Not significant

TABLE 4. GROWTH CHARACTERISTICS AND YIELD DURING 1960/65 (FIELD 55B)

Collection	Girth (in.) at commencement of tapping at 60″ from union	Virgin bark (mm) at commencement of tapping	Mean yield g/tree/tapping over 5 years	Girth increment (in.) during period of tapping
5	19.22	4.49	7.75	4.39
6	23.25	6.27	5.84	8.09
4	20.26	5.22	3.76	5.82
Control (RRIM 501)	23.53	7.34	50.56	4.34
S.E. of control	±0.49	±0.12	±1.89	±1.82

TABLE 5. GROWTH CHARACTERISTICS AND YIELD DURING 1960/65 (FIELD 56C)

Collection	Girth (in.) at commencement of tapping at 60″ from the union	Virgin bark (mm) at commencement of tapping	Mean yield g/tree/tapping over 5 years	Girth increment (in.) during period of tapping
7	21.22	5.68	6.34	8.78
9	19.10	4.60	0.86	7.23
10	22.30	6.08	19.33	8.26
Control (RRIM 501)	20.74	6.95	46.17	4.15
S.E. of control	±0.67	±0.17	±2.13	±2.14

which has the poorest girth increment during tapping.

Yields and girths at commencement of tapping are presented in *Figure 1*.

DISCUSSION AND CONCLUSIONS

The superiority of the illegitimate progeny of FX 25 (Collection 10) in both yield and vigour is evident. One of the clones from this population has been designated RRIM 725 and is now being tested on a large scale. The female parent of Collection 10, FX 25, is one of the better yielding of *Dothidella*-resistant clones imported from Brazil (RUBBER RESEARCH INSTITUTE OF MALAYA, 1968); it has been used in the breeding work of the R.R.I.M. and deserves further employment. Collections 5 and 7 share the next ranking in yield. No. 5 is *H. benthamiana* of Rio Negro origin. According to TOWNSEND (1960), Ford 4542 selected from a similar Rio Negro population, *H. benthamiana*, has been found to be immune to all variants of *Dothidella ulei* tested; it also transmits resistance to a large proportion of its progeny of crosses with Eastern clones. Further selection within this population may discover other parents able to transmit resistance to *Dothidella*. Although this *H. benthamiana*, Collection 5, is of rather poor vigour and Ford 4542 itself has very poor vigour, TOWNSEND (1960) found that many of the first hybrid with Eastern clones demonstrated exceptional vigour.

Hevea brasiliensis of Madre de Dios origin, has been studied elsewhere and is worth exploiting further in breeding. SEIBERT (1947) first reported this population as being highly resistant to *Dothidella*. This has been confirmed by BOS AND MCINDOE (1965), at Firestone Plantations' testing stations in Guatemala and Brazil; thus, this population provides an alternative source of genes for resistance to *Dothidella*. The other two populations of *H. brasiliensis* reviewed here, Collections 4 and 7, came from Belem, which is further east of the Wickham collection area in the Amazon. They probably lack a high degree of resistance to South American leaf blight, because this has not been reported in any selections, such as the FB (Ford Belem) series, from this area. The yields of Collections 4 and 5 were variable. The *H. spruceana* population, Collection 9, has been the worst of these recent imports.

Although none of the clones made from these imported seedlings has yielded as much as the control clone RRIM 501 and the means of the populations are considerably lower, selections from the natural populations (except Collection 10, which is from Summit Seed Garden) can be classified as being similar in yield to the early primary clones in Malaya. In *Figure 2*, the mean

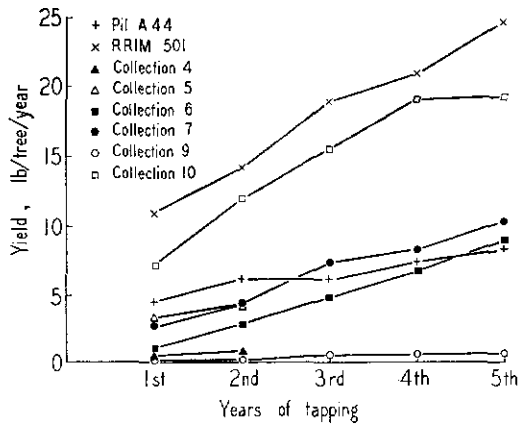

Figure 2. Yield trends of the imported clones, compared with those of Malayan primary and secondary clones.

yields of the collections are compared with RRIM 501 in the same trials and with Pil A 44 elsewhere at the R.R.I.M. Experiment Station, clone Pil A 44 being an example of the early Malayan primary clone.

Facilities for screening the material against *Dothidella* are not available in Malaya, because the efforts to contain the disease within the Americas have so far been successful. However, a few vigorous selections were sent to Trinidad for test against the disease and the results are given in the *Appendix* (HOLLIDAY, *1967*). Plans are in hand to send more material including RRIM 725 and 600 for screening against *Dothidella ulei* in the American tropics, and to test this material more widely against *Oidium* and *Gloeosporium* in Malaya. Satisfactory resistance is found in plants of Collection 5 (*H. benthamiana*, Rio Negro and *H. brasiliensis*, Madre de Dios) as reported by others.

If material resistant to South American leaf blight is to be bred by the research institutes in the East, this can be facilitated with the co-operation of the plantations and institutes in the 'new world' tropics where the material can be tested against the various races of the fungus hitherto recognised (LANGFORD, 1960 and 1961; LANGDON, 1965; MILLER, 1966).

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REFERENCES

BOS, H. AND MCINDOE, K.G. (1965) Breeding of *Hevea* for resistance against *Dothidella ulei* P. Henn. *J. Rubb. Res. Inst. Malaya*, **19(2)**, 98.

BROOKSON, C.W. (1956) Importation and development of new strains of *Hevea brasiliensis* by the Rubber Research Institute of Malaya. *J. Rubb. Res. Inst. Malaya*, **14**, 423.

HILTON, R.N. (1955) South American leaf blight. A review of the literature relating to its depredations in South America, its threat to the Far East and the methods available for its control. *J. Rubb. Res. Inst. Malaya*, **14**, 287.

HOLLIDAY, P. (1967) Private communication. Rubber Research Institute of Malaya.

LANGDON, K.R. (1965) Relative resistance or susceptibility of several clones of *Hevea brasiliensis* and *H. brasiliensis* × *H. benthamiana* to two races of *Dothidella ulei*. *Pl. Dis. Reptr*, **49(1)**, 12.

LANGFORD, M.H. (1960) A new strain of leaf blight in rubber trees in Costa Rica. *Report to Agency for International Development (AID), Washington D.C.*

LANGFORD, M.H. (1961) A new strain of leaf blight in rubber trees in Costa Rica (Second Report). *Report to AID, Washington D.C.*

MILLER, J.W. (1966) Differential clones of *Hevea* for identifying races of *Dothidella ulei*. *Pl. Dis. Reptr*, **50(3)**, 187.

ROSS, J.M. AND BROOKSON, C.W. (1966) Progress of breeding investigations with *Hevea brasiliensis* III. Further data on the crosses made in the years 1937 – 1941. *J. Rubb. Res. Inst. Malaya*, **19(3)**, 158.

RUBBER RESEARCH INSTITUTE OF MALAYA (1968) *Rep. Rubb. Res. Inst. Malaya 1967*, 19.

SEIBERT, R.J. (1947) A study of *Hevea* (with its economic aspects) in the Republic of Peru. *Ann. Mo. bot. Gdn*, **34(3)**, 261.

TOWNSEND, C.H.T. JR. (1960) Progress in developing superior *Hevea* clones in Brazil. *Econ. Bot.*, **4(1)**, 189.

APPENDIX

DEGREE OF INFECTION ON *HEVEA* CLONES IN 1964–1967 AT EL REPOSO (TRINIDAD)

Material	Clone	Conidial count†	Scores*			
			1964	1965	1966	1967
Hevea brasiliensis, Belem, Brazil	4/ 20	—	3.60	3.02	3.20	—
	4/ 27	—	—	1.97	2.40	—
Hevea benthamiana, Rio Negro, Brazil	5/ 16	120	0.38	0.10	0.12	0.20
	5/ 18	2 410	—	0.00	0.40	0.20
	5/ 26	29 700	—	0.37	0.80	0.59
	5/ 34	770	—	0.00	0.05	0.03
	5/ 45	880	0.50	0.52	0.49	0.50
	5/ 69	240	—	0.07	0.08	0.08
	5/119	880	—	0.04	0.00	0.02
	5/139	14 900	—	1.00	1.07	1.04
	5/151	1 770	—	0.27	1.00	0.64
	5/154	5 240	0.80	0.42	0.53	0.58
	5/187	5 890	0.86	0.87	0.92	0.88
	5/188	6 650	—	0.35	0.73	0.54
	5/203	22 600	—	—	0.93	0.93
	5/206	5 420	—	0.45	0.93	0.69
Hevea brasiliensis, Madre de Dios, Peru	6/ 57	60	—	0.00	0.00	0.00
	6/169	180	—	0.00	0.00	0.00
	6/183	120	—	0.42	0.42	0.42
	6/212	1 120	—	0.00	0.00	0.00
	6/353	—	—	0.00	0.00	0.00
	6/388	—	—	0.70	0.62	—
Dothidella-resistant Ford clone	Ford 4542	—	—	0.00	0.00	0.00
	FX 25	590	—	0.21	0.53	0.37
Oriental material	RRIM 605	92 000	3.08	3.42	3.77	3.42
	RRIM 501	99 000	—	—	3.80	3.80
	Tjir 1	—	3.20	2.65	3.65	—

† Conidial count per cm^2 of leaf during 1967

* Score: 0 (most resistant during four years) to 4 (least resistant)

DISCUSSION

Chairman: Dr. Mohd. Rashdan bin Baba

Mr. S. Subramaniam agreed with Mr. C.W. Brookson that the pollen parents of the FX 25 illegitimate progeny from Summit Garden may have been AVROS 49, PB 86 and Tjir 1.

Dr. P. de T. Alvim reported that FX 25 had been severely attacked by *Dothidella* in Bahia (Brazil), during the last three or four years. Moreover, FX 25 was susceptible to *Phytophthora* leaf fall, which had first appeared in Bahia in 1964 and was very severe in 1965. However, Dr. Alvim considered *Dothidella* to be a greater problem than *Phytophthora*, because the latter was more dependent on wet, cool weather which occurred often, but not always during June and July, in Bahia. The disease testing reported in the paper was carried out in Trinidad and the races of *Dothidella* may be different from those in Bahia.

Mr. E. Bellis remarked that the mean girth of 25 inches at opening of the FX 25 illegitimate clones in Field 56B was much in excess of commercial practice. Mr. Subramaniam agreed but this did not invalidate comparisons within the trial.