C.W. Brookson: New Strains of Hevea Brasiliensis in Malaya

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IMPORTATION AND DEVELOPMENT OF NEW STRAINS OF HEVEA BRASILIENSIS BY THE RUBBER RESEARCH INSTITUTE OF MALAYA

By

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The events leading up to the decision to import new strains of Hevea brasiliensis into Malaya have been reported in a previous Journal Communication.

Twentyfive selected clones from the Rubber Research Institute of Malaya and padi and oil palm material from the Department of Agriculture, Federation of Malaya were exchanged for twentyfive clones resistant to Dothidella ulei with the Instituto Agronomico do Norte, Brazil during 1953 to 1954. During 1951 and 1952 1,614 seedlings of collections from Hevea brasiliensis, guianensis, benthamiana, spruceana and pauciflora and of hybrids were also imported.

The details of importation and a plan for a future breeding programme are set out. The variety trials set up as at March 1955 are also shown. Export of the clonal material was made to colleagues in Ceylon, Indonesia and Indochina, and of the seedling material to colleagues in Ceylon during 1954 to 1955.

Tables showing the characteristics and yield of the clonal material are in the Appendix.

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I INTRODUCTION

The considerations leading up to the introduction of new strains of *Hevea brasiliensis* into Malaya have been set out at length in a paper by HILTON of the Pathological Division of the Rubber Research Institute of Malaya.[1] It has been considered necessary to document more fully the details of the exchanges noted briefly in that paper, and to set down the action taken on receipt of the imported material, up to the end of June 1955.

The account set out below is strictly factual and can serve as a reference and a starting point for all future papers on this subject. It is unfortunately impossible to give credit by name to all who assisted in the importations and exchanges, but it is hoped that no offence will be taken by those whose names are omitted, either in error or by the necessity of summarising much correspondence.

II ADMINISTRATIVE ARRANGEMENTS FOR THE EXCHANGE OF PLANTING MATERIAL

On the return of C.E.T. Mann and R.A. Altson, respectively Director and Head of the Pathological Division of the Rubber Research Institute of Malaya, from their visit to the Americas, a meeting of Research Officers from the Botanical and Pathological Divisions, who were concerned in the importation and further development of any material likely to be forthcoming, was called on 18 December 1950. A brief outline was presented of R.A. Altson's conversations with Dr Felisberto C. de Camargo of the Instituto Agronomico do Norte and also of his meeting with Dr M. Langford in Costa Rica.

It was apparent that Dr Camargo was more interested in crops suitable for smallholders in a subsistence agriculture, and wished to receive *Oryza sativa* and *Elaeis guianensis* selections, in addition to the selected *Hevea brasiliensis* clones which it had been intended to offer. An approach had previously been made to the Director of Agriculture, Federation of Malaya, Mr O.J. Voelcker, who signified his consent to such a proceeding and provided a list of oil palm and rice selections for Dr Camargo's consideration. The Board of the Rubber Research Institute was later able to reciprocate this generous gesture of the Director of Agriculture by permitting Hevea selections to be exchanged for *Theobroma cacao* selections with the West African Institute for Cacao Research, the *Hevea* selections to go to the Department of Agriculture of the Colony of the Gold Coast.

The meeting debated the following points:

DOTHIDELLA RESISTANT CLONES—The selection of clones for importation from Brazil was first considered. On notes prepared by R.A. Altson, and on opinions obtained by him from personal contacts, it was decided to ask for the twenty clones listed in TABLE I in the *Appendix*. In exchange from the Rubber Research Institute of Malaya and the Department of Agriculture, Federation of Malaya were offered the materials also shown

in the TABLE, comprising twenty *Hevea brasiliensis* selections from the RRIM '500' and '600' series clones with a supplementary list of five 'reserves', ten padi selections and a number of pedigree 'dumpy' oil palm seed of various selections. The latter material had been developed in Malaya, and is believed to be unique.

It was agreed, on the suggestion of R.A. Altson, to send both the list of material offered for exchange, and the list of *Dothidella* resistant clones required by the Institute to Dr Camargo. A similar list was also sent to Dr M. Langford of the United States Department of Agriculture Cooperative Rubber Plant Field Station at Turrialba, Costa Rica, for his examination and advice.

IMPORTED SEEDLINGS—C.E.T. Mann outlined an offer from the Colonial Office of seed of *Hevea* species (said to be other than of *Hevea brasiliensis*) from Latin America, the source of which was unknown, but some of it was believed to have originated in Peru. The general population of *Hevea brasiliensis* in that country had been favourably reported upon from the point of view of yield and resistance to disease by SIEBERT.[2]

The importation of this seed into the United Kingdom was arranged by a large commercial organisation with the eventual object after quarantine of establishing it in Nigeria for observation and yield tests, and later subjecting the vegetative progeny to a disease trial in Latin America. During the course of arranging the necessary details for importation, and the location and extent of the quarantine in the United Kingdom, half of all the expected importations were offered to H.M. Colonial Office, and this offer was passed on to the Rubber Research Institute of Malaya. It was decided to accept the offer, and to prepare to receive in Malaya about 500 seed each of an unknown number of species.

A further offer of seed was also considered, from Dr R.D. Rands, then Head of the Division of Rubber Plant Investigations of the United States Department of Agriculture. In the polyclone breeding gardens, containing *Dothidella* resistant clones and high yielding far eastern *Hevea brasiliensis* clones, maintained at that time by the United States Department of Agriculture in Latin America, only the seed showing the characters of the far eastern parent was collected and germinated. It was suggested that the Rubber Research Institute of Malaya might care to receive seed of the possible reciprocal crosses of far eastern clones with a fairly good yielding clone with high resistance, namely clone FX 25, from the isolated breeding gardens at Summit Gardens, Canal Zone.

The seed being open pollinated, the cross would not necessarily be between resistant and eastern clones, but the two types of material were represented as buddings on the same stock, and there was a fair chance that a good proportion of crosses could be expected. The male parent however could not be determined, which meant that any form of planned breeding programme could not originate directly with these seed. It was decided to accept Dr Rands offer.

III EXCHANGE OF THE CLONES

With regard to the imported clones, the original suggestion was that the clones should be despatched from Brazil to the United States Department of Agriculture Plant Introduction Garden at Coconut Grove, Miami, Florida, where they would be budded after suitable phytosanitary treatment. They would then be kept under strict observation for leaf symptoms of the South American leaf blight.

In the event of the clones being free from disease, the sticks of budwood resulting from the grafting would be cut and despatched to the Commonwealth Mycological Institute at Kew. Here after further phytosanitary treatment, they would be budded in a special quarantine house at the Royal Botanic Gardens at Kew on stocks which were provided by the Rubber Research Institute of Malaya and which were already growing. After a further examination the budwood resulting from these latter grafts would be despatched to Malaya where they would undergo a final phytosanitary treatment, and then be budded in multiplication nurseries.

A report by H.M. Burkill of the Botanical Division of the Institute and a later report by C.G. Akhurst, then Head of the Soils Division, who were on long leave indicated that the growth of the seedlings destined as stocks for budding was extremely slow, in spite of the efforts of the staff at the Royal Botanic Gardens, and that the quarantine house was by the nature of its design, unsuitable for the growth of *Hevea brasiliensis*. Further, the quarantine house was also being used for *Theobroma cacao*, passing from Trinidad to the west coast of Africa. It will be remembered that certain strains of *Dothidella ulei* are present in Trinidad.

After consideration therefore, it was suggested by Dr R.D. Rands that the United States Department of Agriculture Plant Introduction Station at Coconut Grove, Miami, being outside the American tropics, and having been used by the United States Department of Agriculture with notable success for exports of clones of *Hevea brasiliensis* from infected to non-infected areas, might alone be suitable, and that all that would be necessary in England would be examination, treatment and repacking of the material, with destruction of the original packing material, and onward transit to Malaya.

This procedure was agreed to by the Director of the Commonwealth Mycological Institute, Dr S.P. Wiltshire, and it was then accepted that this method should be adopted. In consideration of the services of the United States Department of Agriculture it was decided to offer them budwood of the Malayan 'exchange' clones. The offer was accepted.

At this stage it was noted that although the exchange was originally planned for twenty *Hevea* clones from either side, the Instituto Agronomico do Norte was prepared to forward

twentyfive clones, as noted in the list shown in TABLE I in the *Appendix*. It was therefore decided to reciprocate with twentyfive of the RRIM clones.

The phytosanitary procedure for the budwood was before despatch from Miami, and after examination, the thorough treatment of each stick with 'Volck' insecticide and 'Fermate' fungicide, after which the ends of the sticks were sealed with paraffin wax. At the Commonwealth Mycological Institute the budwood was washed, dusted with sulphur and packed in clean packing material. On reception in Malaya, the budwood was washed in running water and then immersed in an 0.2 per cent solution of mercuric chloride in 50 per cent methyl alcohol, and the solution then washed off. All packing materials were burnt and the boxes swabbed out with the mercuric chloride solution. After budding, all spare chips of wood, and the sticks remaining were destroyed by fire. All these processes were certified by competent officers.

These final arrangements were satisfactory to all concerned, and the despatch of the budwood of the RRIM clones was made as shown in TABLE II in the *Appendix*, direct to both the Instituto Agronomico do Norte and the United States Department of Agriculture. Failure of some of the buddings made at Coconut Grove necessitated further shipments of budwood. The material despatched by the Department of Agriculture, Federation of Malaya was sent under separate arrangements made by the Director of Agriculture and arrived safely.

Import of the *Dothidella* resistant clones from the Plant Introduction Garden at Miami commenced towards the end of June 1953, and was completed by December 1954, when all clones had been established in Malaya. Dr E.D.C. Baptist, the Head of the Botanical Division of the Rubber Research Institute of Malaya was responsible for the organisation of the importation from Miami. A complete time table of these introductions is shown in TABLE III in the *Appendix*. At this juncture it is relevant to record the assistance received from Dr R.D. Rands, Dr Marion W. Parker, and Dr Loren G. Polhamus, who were successively Heads of the Division of Rubber Plant Investigations of the United States Department of Agriculture, and Mr H.F. Loomis who attended to the details of propagation, despatch and packing at Coconut Grove, Miami. Without the wholehearted cooperation of those four gentlemen the importation would have been rendered incomparably more difficult.

The treatment and packing of the budwood at the Commonwealth Mycological Institute was supervised by the Director, Dr S.P. Wiltshire, and the Deputy Director, Major H.A. Dade. Collection and despatch, and assistance from his staff was arranged by Mr J.A. Nelson, Secretary of the London Advisory Committee for Rubber Research (Ceylon and Malaya). General supervision in London was provided at various times by H.M. Burkill and C.W. Brookson of the Botanical Division and R.N. Hilton of the Pathological Division while on long leave, and

Mr M.W. Philpott of the Laboratories of the London Advisory Committee for Rubber Research at all times.

The budwood on arrival, and after inspection by the Department of Agriculture, Federation of Malaya, was given the specified treatment and was budded in an observation nursery at the Rubber Research Institute by skilled budders brought from the Rubber Research Institute Experiment Station at Sungei Buloh, under the personal supervision of Dr E.D.C. Baptist and occasionally of other officers of the Botanical Division. A detailed list of the number of buddings made, and successes obtained from them is shown in TABLE IV in the *Appendix*.

IV IMPORTATION OF THE SEEDLINGS

Before despatch from Brazil, the seeds were examined and immersed in a 1 in 200 solution of formalin for fifteen minutes. At the Commonwealth Mycological Institute they were again examined, dusted with an organo-mercurial dust, repacked in sterile material and forwarded to Malaya. They were received by the Department of Agriculture, Federation of Malaya, and released to the Rubber Research Institute of Malaya after they had germinated and had been found free from disease. All these processes were certified by competent authorities. A change in the procedure was made after the fourth consignment to Malaya.

The details of the importation of this seed are shown in TABLE V in the *Appendix*. Consignment one of *Hevea guianensis* from the Rio Tapajoz, Brazil proved to be completely non-viable on receipt, and after autoclaving the seeds were kept as type specimens for the Botanical collection. Those in consignment two of *Hevea benthamiana* from the Rio Negro, Brazil were also found to be largely dead, and were burnt.

Consignment three of *Hevea spruceana* from Arredores de Manaos, Brazil, was found to be in slightly better condition, and two germinated seed were released by the Department of Agriculture, Federation of Malaya, to the Rubber Research Institute. Of these two seeds, one grew and is sole representative of this consignment. Slightly better results were obtained with consignment four of *Hevea brasiliensis* seed from Belem, Brazil. Twenty-nine seeds grew out of a total of 280 received.

After the fourth consignment it was decided that all seed should be germinated in the new quarantine house of the Royal Botanic Gardens at Kew. This procedure lessened the task of the Pathologists in Malaya, because it was obvious immediately on receiving the consignment of seed, which, if any, of them were in a diseased condition. It was not necessary to condemn any further seed after this procedure was adopted, the weeding out of the old and diseased seed being carried out by Officers of the Commonwealth Mycological Institute at the Royal Botanic Gardens, Kew. Consignments five to ten were received in good condition.

Consignments one to nine were obtained through H.M. Colonial Office. Consignment ten was obtained through the good offices of the United States Department of Agriculture from the *Hevea* breeding gardens at Summit Gardens, Canal Zone. For convenience of reference, all importations occurring in 1951 (consignments one to six) were known as the 'RRIM 1951 Collection' and all importations occurring in 1952 (consignments seven to ten) were known as the 'RRIM 1952 Collection'. After establishment in Malaya, the distinction was abolished, and they are now known as the 'RRIM Imported Seedlings Collection'.

Assistance in importing this collection was received from the Directors of the Royal Botanic Garden, Kew and of the Commonwealth Mycological Institute. Mr F.H. Rae attended to the details of transhipment in the United Kingdom, aided by H.M. Burkill of the Botanical Division when on long leave. H.M. Burkill also attended to the general administrative details. The inspection nursery at the Rubber Research Institute was supervised by Dr E.D.C. Baptist and Officers of the Botanical Division and Pathological Division. Mr K. Subramaniam attended to the routine supervision of labour, and kept the records of each plant. As a consequence of these importations 1202 seedlings were established in Malaya.

V DRAFT POLICY FOR THE FUTURE USE OF THE MATERIAL

The draft plan set out in the following paragraphs was prepared by C.W. Brookson for the disposition and use of the two collections of material, one being the seedlings forwarded to Malaya from Brazil via Kew, and obtained through H.M. Colonial Office, and the other being clones obtained from the Instituto Agronomico do Norte and forwarded to Malaya by the United States Department of Agriculture via the Commonwealth Mycological Institute.

With regard to the seedlings, it appeared desirable to make clones from them and to submit these to an early yield test, in order that both this important factor and the secondary characters and habit might be assessed as soon as possible. It was also of importance that vegetative progeny of these clones should be tested for resistance to *Dothidella ulei*, and if possible *Phytophthora palmivora*, in order to discover if the collections contain any highly resistant material. The yield tests would however take at least eleven years to complete from the time of budding, and on this basis the material could only be looked upon as a second line of defence and as a reserve of genetic material. Any highly resistant clone discovered, however, could be used for breeding purposes at once.

The clones, on the other hand, had already been tested and their ratings, on the scale devised by Dr M. Langford, known to a certain degree of accuracy. Details of this and other characters are shown in TABLE IV in the *Appendix*. Their yield

capacity was also known, and clearly fell far below the standard prevailing in clones at present existing in Malaya. These *Dothidella* resistant clones, and possibly at a later date some highly resistant clones prepared from the RRIM Imported Seedlings Collections, could be used to start immediately a breeding programme.

The programme should aim to produce high yielding clones and seedlings for immediate testing, and *Dothidella* resistant clones for top budding (five of the imported clones being already suitable for this purpose). Ultimately high yielding *Dothidella* resistant clones and seedling families for planting would result and the final objective would be the replacement of the present planting material by resistant types including the use of top budding material as an intermediate short term measure.

As stated in a paper[3] presented in 1952 to the Agricultural Section of the Conference of Far Eastern Research Institutes at Bogor, Republic of Indonesia, the preferred method is to transfer the resistance in selected *Dothidella* resistant *Hevea brasiliensis* or *Hevea benthamiana* to high yielding far eastern *Hevea brasiliensis*, by means of back crossing. The factors for resistance can be transferred even if they are recessive or linked with that for low yield by producing sufficient progeny in each generation.

Any progeny found resistant can be backcrossed immediately, the resistance test being of prime importance, even more so than that of yield. Further it is more than possible that pollination may be easier with a backcross than with a sibling cross. This method is standard for all crops in which a similar effect is desired, and the only criticism of it is that it is equivalent to a slight amount of inbreeding. Final resistant lines could however be crossed with a possible consequent manifestation of hybrid vigour.

Owing to the length of time, estimated at eighteen years, required to test one generation of *Hevea*, it was realised that the quickest method of achieving success would be to make the first cross and prepare clones from all the seedlings for yield testing. Disease resistance rating could be obtained in less than a year by sending vegetative progeny of each clone to the Americas for testing and with this information the resistant clones would be top worked for early flowering, and the second generation treated in the same manner.

Use can be made of the effect of top working juvenile flowering trees to obtain early flowering. Flowering of branch buddings has been obtained one year after the grafting operation, and grafts of *Dothidella* resistant clones have already been made at the R.R.I. Experiment Station. Although only pollen from the first year flowering of such grafts should be used, families can be produced from far eastern mother trees, and reciprocal crosses would be possible in the second year of flowering. Immediately a progeny has been tested for *Dothidella* resistance, the resistant clones can be topworked, and further back crosses made, which can again be tested.

Before any programme can be commenced, the services, operation, and location of a *Dothidella* resistance testing station must be arranged. The programme which has been outlined envisages immediate testing of material for *Dothidella* resistance in order that further back crosses can be made, while yield tests are being made at leisure on clones from all progeny, whether resistant or not.

This is the crux of the problem. The method of *Dothidella* resistance testing is quick and comparatively inexpensive, but transport of material is likely to be costly. Three alternatives are available: use could be made of the facilities of the United States Foreign Operation Administration, a joint station could be set up with other interested countries in a suitable area, or the Rubber Research Institute could set up its own testing station in a suitable area.

The use of cigar budwood with six to ten buds in a whorl on a short stick will give low transport charges. This pre-supposes at the *Dothidella* resistance testing station the presence of a skilled budder and spraying facilities which will allow seedlings to develop for budding and the bud shoots to produce their first leaves.

This programme, although it might be lavish in the use of land when preparing clones for yield test, would build up a large reserve of resistant clones of the various generations, all undergoing yield tests, and the estimated time of six to seven years for production of a second backcross compares favourably with the normal testing procedure.

With a new cycle commencing every year from the first crossings, it would be reasonable to cease new cycles at 1961, take stock of the position and outcross the inbred lines. The backcross method outlined is probably the surest way to produce resistant material, and the suggested scheme with certain minor modifications appears to be practicable. The main desiderata are the establishment of a *Dothidella* resistance testing station, negotiations for which are already in hand, and the production of a large number of seed.

VI ACTION TAKEN WITH THE 'RRIM IMPORTED SEEDLINGS COLLECTION'

In the previous section the desirability was mentioned of making clones from the seedling collection and testing them for yield, secondary characters and habit. Provision was made for this purpose, therefore, in the field experiment programmes on the R.R.I. Experiment Station at Sungei Buloh, Selangor for 1953, 1954 and 1956.

It appeared likely that nearly all the clones would be low yielding, and a design was therefore required which would employ the minimum of space, and yet give a reasonably accurate comparison of their worth. A design for a cubic lattice of three

replications was therefore prepared by the Statistician to the Rubber Research Institute of Malaya, D.R. Westgarth and by C.W. Brookson. Plots were of six trees in each replication, to be thinned eventually to four trees per plot. The planting distance was 30 feet x 8 feet.

The first design was budded in April 1953 as soon as budwood was available, and consisted of 343 (7^3) clones in 1028 plots. Clones RRIM 501 and RRIM 513 were employed as controls. The design was complicated to bud, and required considerable supervision to ensure that all clones were budded in the correct plots, and that a full stand was obtained. The experiment is now growing well.

In July 1953, 116 clones from the collection were budded in single plots of 12 points against clone RRIM 501 as control. This method of testing is locally known as a 'small scale clone trial'. In May 1954 a further cubic lattice design was budded of 216 clones in 648 plots with clone RRIM 501 as the control. Two hundred and fifteen clones were thus under test in this trial. In May 1954, 87 further clones were prepared in a small scale clone trial in the same field.

Seven hundred and fiftynine of the seedlings have therefore been cloned, from the total of 1084 growing in the nursery. It is not intended to test for yield clones from the seedlings of importations eight and nine, which consist of *Hevea pauciflora* and *Hevea spruceana* and which total 110 in all. Six hundred and fifteen seedlings await the propagation of clones from them, as land permits, and of these about 100 are 'runts' from importations five and six, from which clones will not be prepared. The remainder is made up largely of importations seven and ten, *Hevea brasiliensis* seedlings from Belem, Brazil, and illegitimate seedlings of clone FX 25 from the breeding gardens of the U.S. Department of Agriculture in the Canal Zone, and will be utilised when land is available in 1956-1957.

VII ACTION TAKEN WITH THE DOTHIDELLA RESISTANT CLONES

As soon as the importation of these clones appeared likely, steps were taken to include back crosses of the normal material in Malaya in the hand pollination programmes for 1951, 1952 and 1953. These back crosses showed no loss of fertility compared to the outcrosses carried on with the same clones, and it appeared possible that no difficulty would be experienced on this score when the proposed breeding programme comes into practice.

To obtain early flowering in certain of the imported clones a number of buddings have been made on two to three year old trees, using those imported clones believed to be good parents,[4] namely FX 25, F 1619 and FB 3363. A first attempt at crown budding on clone Gl 1 gave a fair success, but on ring-barking the branches to force the bud to shoot, some dieback

occurred. Further branch buddings of the same clones, and also crown buddings, have since been made on trees of the same age of clones RRIM 501, Tjir 1 and PR 107 (LCB 510). Over five hundred buddings of the two different types have been made.

Later information (obtained by personal communication) indicated that it was becoming apparent that the *Hevea benthamiana* hybrid clones, amongst which can be mentioned clones FX 360, 516, 636, 652 and 4037, are of more value for the backcrossing programme. Clones F 4542 and 4537 are also said to be of value. Steps are therefore being taken to obtain early flowering of these clones.

Before the importations, a trial of crown budding was made to accustom budders to the technique involved in crown budding, and also to pilot a more extensive experiment due to be carried out with five of the *Dothidella* resistant clones which were reported to be useful for this purpose. The imported clones said to be of use for topbudding are F 1619, F 1638, F 409, FB 3300 and FB 3363.

VIII EXPORT OF MATERIAL OF BOTH CLONES AND SEEDLINGS TO OTHER COUNTRIES

Close liaison has always been maintained between the Rubber Research Institute of Malaya and the Rubber Research Institute of Ceylon, formerly the Rubber Research Scheme, Ceylon. After some correspondence on the subject the Board of the Rubber Research Institute of Malaya agreed to the export of the clones from the RRIM Imported Seedlings Collection to Ceylon. Two consignments were sent, the first being two budded stumps each of 201 clones, and the second being one yard each of budwood of 140 clones. The details of the clones despatched is shown in TABLE VI in the *Appendix*.

At the same time the Board of the Rubber Research Institute of Malaya asked and obtained permission of the Instituto Agronomico do Norte to distribute the *Dothidella* resistant clones to the Rubber Research Institute of Ceylon.

At a later date it was decided to extend this principle to cover all Research Institutes in the far east. Permission was again accorded by the Instituto Agronomico do Norte. The main reason for the extension of exports from Malaya was to reduce the chance of the introduction of *Dothidella ulei* into south east Asia by restricting importations from South America as much as possible. The point was explained by C.E.T. Mann at the Meeting of the Directors of the Rubber Research Institutes in the far east at Bogor, Republic of Indonesia, on the 17 March 1954, and arrangements were made to send material of all twentyfive clones to all Institutes interested when available. The seventeen clones forwarded up-to-date and the dates of export

are shown in TABLE VII in the *Appendix*, material having been forwarded to the Rubber Research Institute of Ceylon, the Proefstations der Centrale Proefstations Vereniging, Java; the Algemeen Proefstation der A.V.R.O.S., Sumatra; and the Institut des Recherches sur le Caoutchouc en Indochine, and the Balai Besar Penjilidikan Pertamian, (the General Agricultural Research Station in Java). This latter despatch was made at the request of the Government of the Republic of Indonesia.

Botanical Division
Rubber Research Institute of Malaya
Kuala Lumpur June 1955

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APPENDIX

TABLE I: SUGGESTIONS FOR THE EXCHANGE OF MATERIAL WITH THE INSTITUTO AGRONOMICO DO NORTE

From the RRIM First list	*From the Department of Agriculture Malaya*	*From the Instituto Agronomico do Norte*
Hevea Selections	*Padi Seed*	*Hevea Selections*
RRIM 501	*Serendah Kuning 5003*	*FX 25*
RRIM 507	*Serendah Kuning 5039*	*FX 232*
RRIM 509	*Nachin 5001*	*FX 273*
RRIM 512	*Nachin 5004*	*FX 4425**
RRIM 513	*Radin Ebos 150/50*	*FX 636*
RRIM 526	*Radin Ebos 230/50*	*FX 652*
RRIM 527	*Mayang sa batil ear-row composite sample*	*FX 664*
RRIM 600	*Mayang sa batil mass selection composite sample*	*FX 516*
RRIM 605	*Siam 50146*	*FX 2784*
RRIM 606	*Siam 50295*	*F 351*
RRIM 608	*Oil Palm Seed*	*F 4506*
RRIM 611	*Pedigree dumpy oil palm seed*	*F 4537*
RRIM 614	*High yielding F 1 progeny*	*F 4542*
RRIM 616	*selections from palm E 206*	*F 406*
RRIM 618	*Deli Type Seed*	*F 409*
RRIM 620	*Legitimate seed from good high yielding palms selected from F 1 progeny of palms E 268 and E 211. Legitimate seed from good high yielding palms selected from F1 progeny of palm E 206*	*F 1168*
RRIM 623		*F 1619*
RRIM 625		*F 1638*
RRIM 626		*F 3300*
RRIM 628		*F 3368*
Total 20		*Total 20*
Supplementary list Hevea selections	*Note*	*Additional later offer Hevea selections*
RRIM 511	*The total number of Hevea clones eventually exchanged is 25*	*FX 360*
RRIM 602		*FX 714*
RRIM 607		*FX 2831*
RRIM 613		*FX 4037*
RRIM 622		*FX 4421*
Total 5		*Total 5*

* *This clone was later reported to be non-resistant to Dothidella ulei after establishment in Malaya and clone FX 617 was substituted.*

TABLE II: EXPORT OF EXCHANGE MATERIAL FROM MALAYA TO BRAZIL AND NORTH AMERICA

Date of export from Malaya	*Material*	*Date of arrival and country*	*Success*	*Notes*
24 January 1952	*One yard each of all the twentyfive RRIM clones*	*5 February at Instituto Agronomico do Norte, Brazil*	*1899 buddings made with 862 successes. Percentage success 61.6. All clones established*	*Budwood delayed in transhipment at Dakar. Total time in transit 14 days*
14 August 1951	*Padi selections* *Oil palm selected seed*	*Said to have arrived safely*	—	—
18 January 1952	*Oil palm selected seed*	*Said to have arrived safely*	—	—

13 June 1952	*Two yards each of all the twentyfive RRIM clones*	*17 June at New York 19 June at Miami. Budded on 19 June*	*One budding each of clones RRIM 600, 602. Two buddings each of clones RRIM 507, 611, 616, 622, 625. Three buddings of clone RRIM 606.*	*At first, budding was said to be a complete failure. The final reports gave the successes shown. Only six buddings made of each clone*
13 July 1952	*Two yards each of all the twentyfive RRIM clones*	*16 July at New York 18 July at Miami Budded on 18 July*	*One budding each of clones RRIM 507, 509, 527, 600, 606, 613, 625. Two buddings each of clones RRIM 512, 608, 611,614. Three buddings each of clones RRIM 501, 602, 628.*	*Only six buddings made of each clone*
20 September 1952	*Two yards of clones RRIM 511, 512, 526, 605 606, 607, 618, 620, 623 and 626*	*23 September at New York*	—	*Only six buddings made of each clone*

TABLE III: TIMETABLE OF INTRODUCTION INTO

United States of America		United Kingdom	
Clone	*Despatch from Miami*	*Arrival Commonwealth Mycological Institute*	*Despatch Commonwealth Mycological Institute*
FX 25	*23 June 53*	*25 June*	*28 June*
FX 232	*23 June 53*	*25 June*	*28 June*
	22 Sept 53	*25 Sept*	*27 Sept*
FX 273	*21 July 54*	*22 July*	*24 July*
F 351	*22 Sept 53*	*25 Sept*	*27 Sept*
FX 360	*23 June 53*	*25 June*	*28 June*
F 406	*21 July 54*	*22 July*	*24 July*
	1 Dec	*2 Dec*	*4 Dec*
F 409	*22 Sept 53*	*25 Sept*	*27 Sept*
FX 516	*21 July 54*	*22 July*	*24 July*
FX 617	*21 July 54*	*22 July*	*24 July*
FX 636	*22 Sept 53*	*25 Sept*	*27 Sept*
FX 652	*23 June 53*	*25 June*	*28 June*
FX 664	*23 June 53*	*25 June*	*28 June*
FX 714	*22 Sept 53*	*25 Sept*	*27 Sept*
F 1168	*21 July 54*	*22 July*	*24 July*
F 1619	*23 June 53*	*25 June*	*28 June*
F 1638	*23 June 53*	*25 June*	*28 June*
FX 2784	*23 June 53*	*25 June*	*28 June*
FX 2831	*21 July 54*	*22 July*	*24 July*
FB 3300	*22 Sept 53*	*25 Sept*	*27 Sept*
FB 3363	*22 Sept 53*	*25 Sept*	*27 Sept*
FX 4037	*22 Sept 53*	*25 Sept*	*27 Sept*
FX 4421	*21 July 54*	*22 July*	*24 July*
*FX 4425**	*23 June 53*	*25 June*	*28 June*
F 4506	*23 June 53*	*25 June*	*28 June*
F 4537	*23 June 53*	*25 June*	*28 June*
F 4542	*1 Dec 54*	*2 Dec*	*4 Dec*

* *See* TABLE 1.

Malaya

Arrival and budding of budwood	*Buddings opened*	*Buddings cut back*	*Budwood available for distribution*
2 July	20 July	30 July	Jan 55
2 July			
29 Sept	19 Oct	29 Oct	Jan 55
28 July	16 Aug	27 Aug	By Jan 56
29 Sept	19 Oct	29 Oct	Jan 55
2 July	20 July	30 July	Jan 55
28 July	16 Aug	27 Aug	By Jan 56
7/9 Dec	27 Dec	6 Jan	
29 Sept	19 Oct	29 Oct	Jan 55
28 July	16 Aug	27 Aug	By Jan 56
28 July	16 Aug	27 Aug	By Jan 56
29 Sept	19 Oct	29 Oct	Jan 55
2 July	20 July	30 July	Jan 55
2 July	20 July	30 July	Jan 55
29 Sept	19 Oct	29 Oct	Jan 55
28 July	16 Aug	27 Aug	By Jan 56
2 July	20 July	30 July	Jan 55
2 July	20 July	30 July	Jan 55
2 July	20 July	30 July	Jan 55
28 July	16 Aug	27 Aug	By Jan 56
29 Sept	19 Oct	29 Oct	Jan 55
29 Sept	19 Oct	29 Oct	Jan 55
29 Sept	19 Oct	29 Oct	Jan 55
28 July	16 Aug	27 Aug	By Jan 56
2 July	20 July	30 July	Not distributed
2 July	20 July	30 July	Jan 55
2 July	20 July	30 July	Jan 55
7/9 Dec	27 Dec	6 Jan	By Jan 56

TABLE IV: INFORMATION ON DOTHIDELLA

Clones		*Parentage*	*Budwood received yards*	*Buddings made*
FX	*25*	*F 351 (Bras)* x *AVROS (49 False)*	2.7	86
FX	*232*	*F 351 (Bras)* x *PB 186*	1.3	15
FX	*273*	*F 351 (Bras)* x *PB 186*	1 1	26 42
F	*351*	*H. brasiliensis*	1	25
FX	*360*	*F 351 (Bras)* x *AVROS 49 (False)*	1.7	23
F	*406*	*H. brasiliensis*	1.9	54
F	*409*	*H. brasiliensis*	2	55
FX	*516*	*F 4542 (Benth)* x *AVROS 363*	1	23
FX	*617*	*F 4542 (Benth)* x *Tjir 1*	1	26
FX	*636*	*F 4542 (Benth)* x *Tjir 1*	1	19
FX	*652*	*F 4542 (Benth)* x *Tjir 1*	3	80
FX	*664*	*F 4542 (Benth)* x *Tjir 1*	2.3	20
FX	*714*	*F 315 (Bras)* x *AVROS 183*	1	18
F	*1168*	*H. brasiliensis*	1	11
F	*1619*	*H. brasiliensis*	1	20
F	*1638*	*H. brasiliensis*	2	51
FX	*2784*	*F 4542 (Benth)* x *AVROS 363*	2	34
FX	*2831*	*F 4542 (Benth)* x *Tjir 1*	2	35
FB	*3300*	*H. brasiliensis*	2	23
FB	*3363*	*H. brasiliensis*	2	41
FX	*4037*	*F 4542 (Benth)* x *PB 86*	1	21
FX	*4421*	*F 4537 (Benth)* x *PB 86*	3	68
FX	*4425*	*F 4537 (Benth)* x *PB 86*	2.7	51
F	*4506*	*H. benthamiana*	6	72
F	*4537*	*H. benthamiana*	1	27
F	*4542*	*H. benthamiana*	1	25

Notes: Clone FX 232 According to I.A.N. this is a cross between F 351 and PB 186
According to U.S.D.A. it is F 351 x *PB 86*

Success at opening	*Success at cutting back*	*Percentage of success at cutting back*	*S.A.L.B. resistant rating at*			
			I.A.N.	*Turriala*	*Belterra*	
					Early	*Latest*
85	84	97.7	3-++	5+	4+	3++
0	0	0	—	—	—	—
26	24	92.3	5-+++	5++	5+	5+++
41	40	95.2	8-++++	—	5+	8++++
25	25	100.0	4-+++	5-0	4-0	4+++
20	15	65.2	3-0	—	—	3-0
39	32	59.3	4-+++	—	5-0	—
53	51	92.7	4-++	5-0	5-0	4++
23	23	100.0	2-0	2-0	4-0	2-0
21	21	80.8	3-0	3-0	4-0	3-0
17	17	89.5	—	2-0	4-0	—
80	80	100.0	4-0	—	—	4-0
19	18	90.0	3-0	3-0	4-0	3-0 4-0
18	17	94.4	4-++	7++++	5+	4++
11	11	100.0	3-0	—	—	3-0
20	20	100.0	4-++	3-0	5-0	4++
44	41	80.4	4-++	—	—	4++
34	33	97.1	4-0	5+	3-0	4-0
35	33	94.3	—	2-0	3-0	3+
22	17	73.9	4-+	—	5++	4+
39	36	87.8	3-+	4+	5+	3+
21	21	100.0	3-0	4-0	3-0	3-0
64	59	86.8	—	4-0	3-0	3-0
51	47	92.2	4-+	5++++	3-0	4+
72	70	97.2	—	—	—	—
23	23	85.2	—	1-0	—	—
25	25	100.0	2-0	2-0	—	2-0

* *Tapping S/2.d/2 (year July—June)*

Applicable to I.A.N. only

Age	*No. of trees in tapping*	*Average girth 7/53 in cms*	*Mean yield per tree per tapping*				
			47/48	48/49	49/50	50/51	51/52
12	3	64.6	5.0	12.0	18.7	27.2	35.7
—	—	—	—	—	—	—	—
12	6	71.3	0.9	3.5	9.6	13.7	22.2
—	—	—	—	—	—	—	—
		Generally low yielding. No recent records					
11	4	69.7	—	3.5	5.1	7.7	9.2
		Generally low yielding. No recent records					
		Generally low yielding. No recent records					
11	3	69.6	—	2.5	6.6	10.2	14.6
11	2	52.2	—	—	—	6.7	8.3
11	1	70.0	—	—	5.1	6.3	9.1
11	4	75.0	—	4.0	8.7	8.8	15.3
11	4	78.7	—	3.1	5.9	6.0	9.5
11	3	57.1	—	5.4	10.1	8.0	12.0
		Generally low yielding. No recent records					
		Generally low yielding. No recent records					
		Generally low yielding. No recent records					
10	3	62.0	—	3.2	8.0	9.1	7.2
—	—	—	—	—	—	—	—
—	—	*Generally low yielding. No recent records*					
—	—	*Generally low yielding. No recent records*					
10	5	60.0	—	4.1	8.9	9.6	12.6
—	—	—	—	—	—	—	—
10	5	55.9	—	5.7	10.6	13.5	13.2
		Generally low yielding. No recent records					
		Generally low yielding. No recent records					
		Generally low yielding. No recent records					

*in grams dry**		*Notes*	*Remarks by U.S.D.A.*
52/53	*53/54*		
36.5	28.5	1	*Vigorous, good yield, susceptible to Phytopthora*
—	—	—	*Vigorous*
22.8	11.3	1	
—	—	—	*Not vigorous at Belterra, liable to leaf spot*
—	—	—	*Resistant to Catacauma, good breeding clone*
8.8	8.4	1, 3	*Vigorous*
—	—	—	—
—	—	—	*Very susceptible Phytophthora, leaf fall and dieback. Good breeding clone in Brazil. Good top clone for growth of panel*
13.8	12.5	1, 3	*Vigorous in Brazil. Average in Costa Rica. Susceptible to Phytophthora; good breeding clone. High percentage of fruit set*
7.5	3.5	3	*Less than average vigour*
10.0	4.5	—	*Vigorous at Belterra; susceptible to Phytophthora. Good breeding clone with high percentage fruit set.*
13.9	9.1	1	*Vigorous. Liable to Catacauma in Brazil. Heavy seeder in early years*
9.8	6.1	1	*Very vigorous. Highly susceptible to Phytophthora.*
6.9	4.9	1	*Average to vigorous*
—	—	—	—
—	—	—	*Very susceptible to Phytophthora*
—	—	—	—
7.9	7.4	1	*Vigorous*
—	—	—	*Vigorous*
—	—	—	—
—	—	—	*Susceptible to Phytophthora in Costa Rica. Tolerant to Pellicularia in Peru*
11.4	4.6	2	*Vigorous*
—	—	—	*Vigorous*
15.8	12.5	1, 2	*Average to vigorous. Very suceptible Phytophthora*
—	—	—	—
—	—	—	*Very susceptible to Phytophthora, both Brazil and Costa Rica*
—	—	—	*Resistant to Phytophthora in Brazil and Costa Rica. Tolerant to Pellicularia in Peru*

1 Tapping on renewed bark
2 Includes yield of 'B' Trees
3 Tapping panels changed to other side of tree during the year

TABLE V: SHOWING THE POST-WAR INTRODUCTIONS OF SEEDLINGS INTO MALAYA, 'RRIM SEEDLINGS COLLECTION'

	Family	Species	Alleged origin	Despatched from South America		Royal Botanical Gardens Kew		MALAYA			
				Number	Date	Arrival	Despatched	No. planted in germination cage	Date	No. planted in nursery	Date
1951 Collection	1	*H. guianensis*	*Rio Tapajoz*	315	*21 Mar*	*27 Mar*	*29 Mar*	*No germination*	—	—	—
	2	*H. benthamiana*	*Rio Negro*	320	*27 Mar*	*7 Apr*	*8 Apr*	*Destroyed on arrival*	—	—	—
	3	*H. spruceana*	*Arredores de Manaos*	320	*27 Mar*	*6 Mar*	*8 Apr*	1	*12 Apr*	1	*12 May*
	4	*H. brasiliensis*	*Belem*	280	*3 Apr*	*9 Apr*	*9 Apr*	29	*16 Apr*	27	*24 May onwards*
	5	*H. benthamiana*	*Belem*	241	*11 Apr*	*18 Apr*	*1-17 May*	241	*6-21 May*	214	*12-24 May*
	6	*H. brasiliensis*	*Madre de Dios*	493	*10 May*	*14 May*	*24-28 May*	486	*28 May - 4 June*	423	*5 June onwards*
1952 Collection	7	*H. brasiliensis*	*Belem*	306	*5 Feb*	*9 Feb*	*25 Feb onwards*	306	*1 Mar onwards*	303	*10-11 Apr*
	8	*H. pauciflora*	*Serra de Santana Rio Negro*	22	*14 Apr*	*18 Apr*	*1 May*	22	*5 May*	15	*31 May - 19 June*
	9	*H. spruceana*	*Ilha Matapuri*	196	*30 Apr*	*4 May*	*27 May 10 June*	196	*2-15 June*	196	*24 June - 16 July*
	10	*H. brasiliensis FX 25 Illegitimate*	*Summit Canal Zone*	333	*8 Sept*	*12 Sept*	*19 Sep onwards*	333	*14 Sept 9 Oct.*	305	*10 Nov*
		Total	—	2826				1614		1484	

Percentage of seedlings despatched from South America reaching Malaya — *51.1 per cent*
Percentage of seedlings despatched from South America growing in Malaya — *52.5 per cent*
Percentage of seedlings reaching Malaya now growing — *91.9 per cent*

TABLE VI: LIST OF CLONES FROM THE RRIM SEEDLINGS COLLECTION DESPATCHED TO CEYLON

Budwood despatched on 18.6.1954 (140 clones)					*Budded stumps despatched on 11.6.1953 (201 clones)*				
Seedling No.	*Seedling No.*	*Seedling No.*	*Seedling No.*	*Seedling No.*	*Seedling No.*	*Seedling No.*	*Seedling No.*	*Seedling No.*	*Seedling No.*
3/1	5/140	5/22	6/19	4/8	5/166	6/201	5/53	6/87	6/86
4/2	5/143	5/30	6/21	4/9	5/173	6/211	5/60	6/89	6/289
4/3	5/145	5/43	6/23	4/10	5/178	6/219	5/68	6/129	6/82
5/2	5/146	5/46	6/40	4/11	5/193	6/227	5/69	6/102	6/303
5/15	5/147	5/50	6/52	4/20	5/197	6/241	5/77	6/107	6/304
5/16	5/150	5/52	6/63	5/4	5/198	6/259	5/78	6/108	6/310
5/17	5/152	5/73	6/64	5/6	5/200	6/270	5/79	6/118	6/315
5/23	5/156	5/80	5/125	5/7	6/1	6/283	5/82	6/130	5/81
5/26	5/157	5/84	6/114	4/13	6/6	6/293	5/86	6/131	6/320
5/27	5/158	5/89	6/122	5/9	6/7	6/307	5/88	6/133	6/321
5/33	5/163	5/90	6/123	5/18	6/11	6/308	5/114	6/144	6/334
5/38	5/169	5/91	6/140	5/32	6/17	6/314	5/127	6/146	6/341
5/45	5/170	5/95	6/157	5/35	6/35	6/329	5/130	6/147	6/342
5/54	5/177	5/97	6/188	5/37	6/46	6/332	5/155	6/151	6/344
5/55	5/179	5/98	6/213	5/41	6/47	6/387	5/160	6/158	6/360
5/56	5/187	5/107	6/98	5/47	6/49	6/394	5/161	6/97	6/106
5/58	5/188	5/118	6/232	5/49	6/59	6/411	5/180	6/160	6/378
5/59	5/192	5/120	6/239	5/62	6/77	6/417	5/184	6/166	6/380
5/67	5/194	5/133	6/312	5/65	6/92	6/420	5/185	6/169	6/390
5/74	5/195	5/136	6/279	5/70	6/93	6/421	5/206	6/172	6/397
5/75	5/196	5/148	6/278	5/71	6/95	6/423	6/3	6/176	6/398
5/85	5/207	5/151	5/111	5/76	6/103	4/1	6/8	5/102	6/401
5/93	5/212	5/154	6/299	5/83	6/104	4/4	6/9	6/178	4/27
5/99	5/214	5/162	6/305	5/92	6/109	4/15	6/13	6/193	6/404
5/100	6/60	5/165	6/382	5/110	6/112	4/19	6/14	6/196	6/416
5/105	6/79	5/171	6/383	5/117	6/116	4/22	6/16	6/212	6/298
5/106	6/85	5/182	5/31	5/119	6/127	4/24	6/18	6/218	
5/108	6/113	5/186	6/126	5/123	6/134	4/25	6/20	6/179	
5/112	6/167	5/190	6/316	5/134	6/138	5/3	6/24	6/234	
5/116	6/168	5/199	6/184	5/135	6/148	5/11	6/33	6/235	
5/122	6/340	5/203	6/68	5/138	6/154	5/21	6/45	6/249	
5/124	4/14	5/204	6/136	5/139	6/161	5/29	6/48	6/262	
5/128	6/410	5/211	6/284	5/141	6/181	5/34	6/51	6/265	
5/129	5/19	5/213	6/194	5/149	6/189	5/48	6/57	6/269	
5/131	5/20	6/10	6/191	5/164	6/190	5/51	6/66	6/273	

Family 3 is H. spruceana (Arredores de Manaos), 4 H. brasiliensis (Belem, Brazil), 5 H. benthamiana (Rio Negro, Brazil) and 6 H. brasiliensis (Madre de Dios).

Total amount of budwood sent was 140 yards (one yard of each clone). Total number of stumps sent was 402 (2 stumps of each clone).

TABLE VII: LIST OF THE CLONES RE-EXPORTED FROM MALAYA UP TO JUNE 1955

F 1619	*F 1638*	*F 4506*	*F 4537*	*FX 25*	*FX 360*
FX 652	*FX 664*	*FX 2784*	*F 351*	*F 409*	*FB 3300*
FB 3363	*FX 232*	*FX 636*	*FX 714*	*FX 4037*	

Table with dates of despatch of the 17 Dothidella resistant clones noted above and clones from the RRIM Imported Seedlings Collection, showing recipients

Date	*Material despatched*	*Recipient*	*Remarks*
16 June 1953	*402 budded stumps of 201 clones from the RRIM 'Imported Seedlings Collection'*	*Rubber Research Institute of Ceylon*	*At least one stump of each clone established. Despatched by sea*
21 June 1954	*140 yards of budwood, 1 yard each of 140 clones from the RRIM Imported Seedlings Collection*	*Rubber Research Institute of Ceylon*	*6 clones not established. Despatched by sea*
21 Jan 1955	*Two yards of budwood of each of the 17 DR clones tabled above*	*Rubber Research Institute of Ceylon*	*Despatched by air*

3 Feb 1955	*Five yards each of budwood of the 17 DR clones noted above*	*Proefstations der Centrale Proefstations Vereniging (2 yards)* *Proefstations der Algemene Vereniging van Rubberplanters ter Oostkust van Sumatra (2 yards)* *Balai Besar Penjelidekan Pertanian (1 yard) (General Agriculture Research Station, Bogor)*	*All material for the Republic of Indonesia was collected by Dr. W. C. van Heusden Director of the Proefstations der C.P.V. and Mr. Sukotjo Pringgoputro, Acting Director of B.B.P.P.* *Despatched by air*
8 Feb 1955	*Two budded stumps of each of the 17 DR clones noted above*	*Institut des Recherches sur le Caoutchouc en Indochine*	*Drought conditions in Indochina rendered the receipt of budwood undesirable* *Despatched by air*
13 May 1955	*Two yards each of budwood of each of the 17 DR clones noted above*	*Institut des Recherches sur le Caoutchouc en Indochine*	*Despatched by air*