DISCUSSIONS OF THE PAPERS PRESENTED AT THE R.R.I.M. PLANTERS' CONFERENCE, 20-22 JUNE 1963:

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DISCUSSIONS

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This supplement contains a record of the discussions which followed the papers presented at the Conference. The papers themselves were published in Planters' Bulletin 68. Papers 2 and 3 were discussed together. There were no discussions of papers 12 and 13.

CONTENTS

CONTENTS (Continued)

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DISCUSSION:

Paper No. 1. The Range of Cover Plants. By P.R. Wycherley, Rubber Research Institute of Malaya.

Mr. J. DREYER (Victoria Estate) said that Calopogonium caeruleum seemed to be very competitive with the rubber and gave details of a 4-acre experiment where 9 months after budding the girth was 0.27 in. less, and the height 1 ft 7 in. less, than under Pueraria phaseoloides cover. During the very dry weather Calopogonium caeruleum had always remained very green.

The author agreed that Calopogonium caeruleum might compete more strongly for water than Pueraria Phaseoloides; in Kedah during the recent drought the former remained green when most other covers had died back. However, such effects could only be demonstrated by trial and were likely to vary from place to place as had been the experience with Stylosanthes gracilis. Some vigorous cover plants might compete for water during the early stages, but their heavy litter production might enhance the water holding capacity of the soil later.

Dr E.A. ROSENQUIST (Chemara Research Station) stated that if one pound per acre or even less of C. caeruleum was sown in conjunction with other legumes it tended to become the dominant creeping legume when the others started to die out at about the fourth year. Thus a slight competitive effect in the early years might be compensated for by the production of long-term cover.

Mr. B.S. GRAY (Prang Besar Estate) asked DR WYCHERLEY if he thought it possible to produce a good grass cover through the use of herbicides, slashing or other cultural treatments, and if so what grasses would result. The author replied that with close mowing, the result would probably be Axonopus and Paspalum.

Mr C. CHEW (Bakri Estate) asked DR WYCHERLEY if there was not room for a legume requiring less moisture, for example Townsville lucerne (Stylosanthes humilis), a small annual. DR WYCHERLEY did not think that an annual of this sort would be of much benefit to the rubber.

Mr D.A.I. GLENNIE (Kirby Estate) asked DR WYCHERLEY if the R.R.I.M. had tried mowing the grasses and applying nitrogen to them. This was a practice in apple orchards where applying the nitrogen direct to the trees would cause an unwanted increase in branching. DR WYCHERLEY mentioned a trial comparing the grass Axonopus with legumes, cut and uncut, with and without extra nitrogen, but because there were no significant differences in the effects of the treatments on tree growth, no further comment was possible. There might be some response to mowing a strong-growing grass or to using extra fertiliser, but it would be advisable to eradicate such grasses early.

DR WYCHERLEY gave details of experiments where specific management systems were being tried out on legumes and other natural covers, through the use of herbicides and mechanical slashing or cutting, but it was too soon to assess the results. One system was designed to produce a cover of light grasses. There was a possibility that a grass cover producing a mulch of low nitrogen content could be made nutritionally equivalent to a leguminous cover by applying sulphate of ammonia or other nitrogenous fertilisers.

Mr R.A. BULL (Chemara Research Station) asked the author if he could suggest a legume which would be complementary to grass. DR WYCHERLEY replied that work was being done in the drier tropics to discover a mixture of legumes and grasses which would go together, but was directed mostly towards pastures, with cattle as controlling factors. Practically no work had been done in Malaya where there was no economic incentive, but if such a mixture could be cut as fodder then the position might be rather different. S.M. WARRIER (Chemara Research Station) asked if there were any data to show that the low carbon-

2/...

nitrogen ratio was maintained to a greater depth under a good legume cover than under grass. DR WYCHERLEY remarked that in one of his experiments the covers producing litter with the lowest carbon-nitrogen ratio were the legumes, followed by Ottochloa nodosa (Panicum nodosum) and Mikania, but he pointed out that although the carbon-nitrogen ratio was a good guide to the beneficial effects to be expected, other factors (such as the supposed toxic secretions of Mikania) had to be considered.

MR P.J. VAN DER BENT (Bristol Estate) stated that there appeared to be more competition from Stylosanthes with ring-weeding than with strip-weeding and he asked the author what method of control was used in the trials referred to. DR WYCHERLEY confirmed that strip-weeding was carried out in his experiments, but so far there was no experimental comparison of the effects of Stylosanthes when strip-or circle-weeded. S. gracilis established from cuttings had a more intensive development of the superficial lateral roots than plants raised from seed, but it was not yet known whether this had any practical significance.

DISCUSSION:

Paper No.2. Cover Plants and Tree Growth, Part I. The Effect of Leguminous and Non-Leguminous Cover Plants on the Period of Immaturity. By G.A. Watson, Rubber Research Institute of Malaya

Paper No.3. Residual Effects of Type of Ground Cover and Duration of Nitrogenous Fertiliser Treatments Applied before Tapping on the Growth and Yield of Hevea brasiliensis. By B.J. Mainstone, Dunlop Research Centre, Batang Malaka, Negri Sembilan.

MR MAINSTONE commented that he had results available from a series of five large scale experiments planted with the usual legume creeping covers, where he had been unable to show any difference in tree growth to maturity by differential sulphate of ammonia treatments (N0, N1 and N2) commencing at 24 months after budding, that is about 36 months after planting, whereas the data presented by DR WATSON (Table 2) indicated small advantages from continuous application of fertiliser throughout immaturity under legume covers.

These findings, apparently contradictory, were probably complementary. The explanation might be related to the fact that in the comparison plots DR WATSON discontinued fertiliser application to trees at 18 months after planting, whereas he did not until 36 months after planting.

He believed that DR WATSON was going to show, in Part II of his paper, that leguminous covers were unlikely to provide appreciable nutrients to trees until 3 years after planting. Could DR WATSON therefore say, with reference to ~~Table 2~~ in his paper, when experimental measurements began to indicate that there were beneficial effects on tree growth in leguminous cover plots, resulting from the continued application of fertilisers to trees up to maturity. Did the term 'fertiliser' refer to nitrogen fertiliser only, or, if not, what were the effects of the constituents other than nitrogen being omitted when 'fertiliser application was discontinued after 18 months from planting'.

DR WATSON said that the differential fertiliser treatments were introduced at 18 months after planting. Six months later the girth recording showed an effect due to the cessation of fertiliser applications at 18 months. He noted that MR MAINSTONE had observed no effect when he stopped his fertiliser applications at 3 years and he did not think this effect was precluded by his result. One might well get a response to fertilisers between 18 and 36 months after planting but not thereafter. In areas where there were vigorous leguminous covers, it was quite possible to cease fertiliser applications from the third year, without apparent ill-effect on tree growth.

The fertiliser used in the R.R.I.M. experiments was mixture Mag. 'M' and he could not say whether the observed effect of continued fertiliser application was due to the nitrogen, phosphorus, potassium or magnesium component.

DR. WATSON asked MR MAINSTONE if he could give any idea of how much ammonium sulphate was applied in the Dunlop experiments between 18 and 36 months. MR MAINSTONE replied that approximately 1 lb per point had been applied up to 36 months and thereafter approximately 4 lb. DR WATSON expressed surprise that 1 lb would produce the growth difference referred to, especially when the extra 4 lb had produced no effect.

MR LAU THENG SIAK (Lee Plantations Ltd) asked if there was any humus left from thelegume cover after the trees had been tapped for five years, to which MR MAINSTONE replied that visually the humus content of the soil still appeared superior in the legume plots although no chemical assessment had been made. The same speaker asked whether much of the humus had been lost over these years by erosion and MR MAINSTONE replied that he considered there could be some loss once the canopy had closed and the legumes died out. Lower stands per acre and greater persistence of covers would, he considered, result in less loss of organic matter.

DR WATSON pointed out that trees grown with legumes produced about 8 lb more leaf litter per tree per annum than those grown without legumes and this amounted to about half a ton per acre per annum with a stand of 120 trees per acre. MR R.B. LULOFS (Connemara Estate) asked whether MR MAINSTONE could provide any information on the costs of establishing and maintaining legume covers and whether these costs were covered by the value of the extra crop obtained. MR MAINSTONE said he had no figures available at the moment. In the experiments however, the cost of establishing legumes would be offset by the cost of applying high nitrogen in the natural cover plots, and so the two treatments (legumes with low nitrogen and naturals with high nitrogen) were directly comparable and the value of the extra and earlier crop obtained with the former treatment could be considered as a gain.

MR HO COY CHOKE (University of Malaya) asked DR WYCHERLEY whether any work had been done on the growth and yield of rubber grown in association with catchcrops. DR WYCHERLEY pointed out that little had been done in this country; he foresaw both disadvantages and advantates in the system. Examples were quoted of successful exploitation of this kind in Indonesia and North Borneo, on the more fertile soils, and also in West Africa.

MR D.A.I. GLENNIE (Kirby Estate) asked MR MAINSTONE what were the dominant natural covers in his experiments and he replied that initially they were Panicum species but 12 months later they were Passiflora, Macaranga, Ficus, Vitis and some Mikania; within 3 months after budding Vitis trifolia was becoming very apparent; 15 months after budding Mikania was dominant in small patches and by 24 months from budding Mikania was completely dominant. He felt that Mikania invasion at this stage in a mixture would not necessarily be as depressive as a pure stand of Mikania. At 48 months the Mikania started to die out owing to shade; Vitis trifolia was still there and ferns and Ficus were coming in

MR LAU THENG SIAK (Lee Plantations Ltd) asked if any precautions were taken to guard against the difference in efficiency of tappers in his experiments and MR MAINSTONE pointed out that tappers were changed round approximately every three months.

MR MAINSTONE asked by MR BROOKSON (R.R.I.M.) about the incidence of dry trees in his plots and their relation to treatment, replied that no difference between treatments had been found although census work had not been carried out on dry panels.

MR CHEN JAN JEE (Lee Plantations Ltd) asked DR WATSON if, in his experiments, the Mikania had been controlled, as it was a normal procedure on estates to control this noxious growth. DR WATSON replied that in the experiments reported in the paper the Mikania was not actually sprayed out but the tree rows were kept free of Mikania, over a width of about 6 ft.

MR CHEN JAN JEE, referring to MR MAINSTONE'S paper, asked how growth increase was distributed, since there was little difference in growth during the first and second years between trees grown with natural and legume covers, and yet the legumes plots came into bearing one year earlier.

MR MAINSTONE replied that right from the time of the first measurements, growth in the leguminous cover plots was better than that in natural cover plots. This state was maintained and improved upon (especially from 36 to 48 months after budding) right up till the time when the first plots became tappable.

MR BOON WENG SIEW (United Malacca Rubber Estates) asked MR MAINSTONE to explain why the yield under the natural cover plots was much greater in the first year of tapping than in the legume plots. The author said that measurements of leaf canopy showed that trees in the legume plots had much more leaf than those in natural cover plots and there was evidence that application of high rates of nitrogen to trees in legume plots after maturity depressed both yield and girth increment. The effect on yield was probably due to transpiration while that on girth could be related to the trees in high nitrogen, leguminous cover plots, having greater height and therefore having to put on girth over a greater length of trunk and branch tissue. With a dense canopy early morning tapping would bring up the yield due to avoiding excessive transpiration effects, but with a sparse canopy it had little effect on yield. He suggested that the higher yield in natural cover plots (100 lb per acre in the first year of tapping) was a reflection of too much canopy in the legume plots and this hypothesis might be related to the depressive influence of yield during the first three years of tapping of the high nitrogen level applications made to the legume plots during the last years of immaturity.

DR WATSON confirmed, in answer to a question by MR R.A. BULL (Chemara Research Station) that all covers (natural and legume) in his experiments, received the same amount of phosphate. He referred to Table 3, where the fertiliser effect, although less with Mikania, nevertheless alleviated the depressive effect of this cover to some extent. With a legume cover there was little difference in tree growth whether fertilisers were applied to the covers or to the trees, but where the cover was grass the fertiliser effect was best when applied to the rubber and fertiliser applied to Mikania accentuated its harmful affect on rubber. DR WATSON pointed out that although initially high nitrogen might result in an early depressive effect subsequently, with better canopy and resultant increase in growth, the initial disadvantage should become an advantage and asked MR MAINSTONE for his opinion. MR MAINSTONE referred to his girth increment rates for the third to fifth years of tapping. In the legume cover plots, the rate was 4.10 in. for low nitrogen applications, and 3.74 in. in the high nitrogen plots. This confirmed that not only the yield but also the girth increment had been badly affected. There was no indication that these early depressive effects might subsequently change to being beneficial. MR MAINSTONE doubted if such a change would occur.

MR BOON WENG SIEW asked how long the legume covers had been manured with rock phosphate, as it was possible that free calcium could have been the cause of the depressed yield. In answer to this question MR MAINSTONE confirmed that manuring of the legume covers had commenced 18 months after budding and had continued up to maturity, with 1 cwt per acre C.I.R.P. each 6 months. The same treatment had been given to natural covers. He and the R.R.I.M. were both looking into the question of calcium.

MR N. YOUNG (Rubber Fund Board, N.Borneo) stated that it was common in North Norneo to use Pueraria to control lalang and asked DR WYCHERLEY if any experiments had been carried out in Malaya with Pueraria. DR. WYCHERLEY pointed out that lalang appeared to be less vigorous in many parts of North Borneo, where in the more fertile areas of high rainfall lalang could be controlled by Pueraria, than in Malaya. He added that in Kelantan Stylosanthes could sometimes achieve the same object and thorny Mimosa could also control lalang in places.

DISCUSSION:

Paper No. 4. Advantages of a Clean Legume Cover Crop Policy in Growing Rubber. By T.A.G. Menon, Diamond Jubilee Estate, Jasin, Malacca

MR BOON WENG SIEW (United Malacca Rubber Estate), referring to Table 2 in the author's paper, asked if there was still legume cover under the shade at 5½ years, or was the figure for weeding - over $30 per acre - because of grass. The author confirmed that there was no grass; in one of the areas, planted 30 x 8 ft, there were still legumes and in the other area, planted 24 x 10 ft, the legume cover was about 40%. The cost of weeding at this stage included slashing of naturals as well as weeding out of noxious plants and cleaning round tree collars.

The same questioner said that he expected a 2800 acre replant in South Johore, planted in 1958 with only natural covers, to be opened by 1964, as the girth at present was 16 in. At this stage he was only spending an average of $24 per acre per annum on weeding and cover control. In view of the fact that it had always been claimed that weeding costs in a leguminous cover area were much cheaper than in a natural cover area, it was interesting to compare his cost with that quoted by MR MENON. The author said that the cost per round might not be cheaper, but the total cost to maturity had to be considered.

DISCUSSION:

Paper No. 5. Methods and Costs of Cultivating Sown Legumes and Comparative Cost of Natural Covers. By J.B. McIntosh, Prang Besar Estate, Kajang, Selangor

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MR C. ROBINSON (Kamuning Estate) asked the author if he had any explanation for the apparent contradiction that MR MAINSTONE said that the plots grown under legumes in his experiments wintered later and were therefore more affected by Gloeosporium, whereas MR MCINTOSH recorded that they were less affected. The author said that his young rubber did not winter until the 6th year. He believed it was general to find less Gloeosporium on trees grown with legumes. MR MAINSTONE agreed with MR MCINTOSH that trees grown under a good legume cover did appear to stand adverse weather better than those grown without legume covers, perhaps because of better rooting.

DR BLENCOWE (R.R.I.M.) pointed out that the difference of opinion could be due to one speaker referring to a small experimental plot while the other referred to a large field planting. In the experimental areas, plots under different treatments could act as sources of infection of neighbouring plots, whereas this was unlikely to happen in field plantings.

MR R.N. HILTON (R.R.I.M.) said that it was necessary to distinguish between Gloeosporium as one of the organisms causing Secondary Leaf Fall and Gloeosporium associated with, but not necessarily the cause of poor canopies, especially in South Johore.

In reply to MR T.F. ELDER (Sabai Estate), who asked about the advisability of establishment of covers on steep land, the author suggested that if the area in question was a replanting there should be good natural covers and this should not preclude the establishment of legumes; in fact, the presence of these natural covers should be a good thing as, with absence of erosion, the legumes would spread more rapidly. In such situations everything, except perhaps the coarsest grasses and Mikania, should be left.

MR I.T. STEVENSON (Sungei Chinoh Estate) asked if the author could give some idea of the costs of eradicating heavy grasses before establishing legumes, and did the figure of $20 per acre, quoted in the paper, cover this. MR MCINTOSH felt that this $20 should be adequate (with no extra cost charged to revenue prior to replanting); it would be sufficient for one overall sodium arsenite spray and two to three follow-up rounds.

MR PERTAB SINGH (Kuala Lumpur) asked if Christmas Island rock phosphate alone was adequate for covers, or it would be better to use mixtures. The author replied that in his experience Christmas Island rock phosphate was usually sufficient, but, if there was potash deficiency sulphate of potash/magnesium mixtures would give a better response. The one to five potash/magnesium mixture was really just an insurance.

Asked by MR BOON WENG SIEW whether he would prefer C.I.R.P. or basic slag, which were equal in price, the author said he would prefer basic slag, as he had observed better growth in the early stages from basic slag.

8/...

DR WATSON (R.R.I.M.) pointed out that pre-war experiments showed that basic slag had given better growth of Centrosema and this observation had been confirmed lately. This advantage however, was only apparent during the first six month's growth. It should be appreciated, however, that using Christmas Island rock phosphate, twice as much phosphate could be applied for the same price.

MR MCINTOSH agreed with MR C.D.H. HARTLEY (Tong Hing Estate) that on the poorer soils better results were obtained from complete NPK fertilisers than from Christmas Island rock phosphate in the first year.

MR T.E. HASTIE (Malakoff Estate) asked if the $1 per acre for planting Desmodium cuttings included the nursery and harvesting costs. MR MCINTOSH felt that the figure was adequate to include harvesting and that it should be possible to get material from previously established replants.

MR V.V. CHELLAM (Rubber Estates of Malaya) stated that he had had good results from applying Sterameal two months after planting legumes. DR WATSON agreed that Christmas Island rock phosphate, or basic slag, should be all that was required under normal conditions; but on the poorest soils a starter dose of nitrogen during the first 6 months from planting might be useful. Sterameal might well overcome the danger of scorching the seedlings, although it was an expensive way of applying nitrogen.

DR WATSON, commenting on the author's costs, pointed out that recent experiments with different levels of phosphate on legumes had shown there was little benefit from phosphate applied to the legumes after the third year; if application were stopped there would be a saving of about 3 cwt per acre, reducing MR MCINTOSH's costs by $20 per acre.

DISCUSSION:

Paper No. 6. A Realistic Approach to the Use of Legumes as a Cover Plant. By Cyril Chew, Lee Plantations Ltd, China Building, Chulia Street, Singapore.

DR BAPTISTE (Vietnam) gave details of Ceylon Experiments where three rows of Guatemala grass were planted between the tree rows and cut three times each year for mulching the trees. Fertilisers were applied over the mulch after three months when it had mostly decayed and then a second layer of mulch was applied over it. Great benefit had been derived from this mulching. In view of the wide bare tree rows shown in some of the author's photographs, he asked the author if he did not believe in mulching. The author confirmed that lalang was used in the early stages for mulching, supplemented by Flemingia loppings, but it had not been established that mulching resulted in bringing the trees to maturity earlier, although there was some evidence that in the early stages the plants did benefit. The author drew attention to the cost of lopping Flemingia and applying it as a mulch. In his experience, where Flemingia was thin, it would cost between $2.50 and $3 per acre, but where the Flemingia was heavy it might cost up to $7 per acre. If this was done twice a year were the benefits worth while?

MR J.B. MCINTOSH (Prang Besar Estate) suggested that the cheapest way to achieve a mulch would be to allow the legume cover to grow over the strips and even although this might result in some undesirable competition it would perhaps be less undesirable than having the sun and rain on the clear strips. One of the advantages of legume covers was the reduced cost of strip weeding.

DR WATSON (R.R.I.M.) said that the author underestimated the benefits of a legume cover. In one experiment in the first year of tapping, yield increases of 150 to 200 lb per acre were obtained and a saving realised of some $60 to $70 per acre in fertiliser. In comparing MR CHEW's and MR MCINTOSH's papers, the early costs were similar, but in the first two years MR CHEW's costs were appreciably lower than MR MCINTOSH's, probably because of the differences in labour management and he suggested that this was perhaps because of the cheaper family contract weeding. DR WATSON also noted that MR CHEW's legumes were planted to prevent soil erosion, yet after two years they were sprayed out with sodium arsenite in the interests of economy. He questioned the advisability of this as it would result in poorer soil conditions than if the legumes were maintained, but perhaps this had to do with the large labour demands where large replantings had to be maintained.

The author agreed that with large replantings a lower standard might have to be accepted. The family system was just another sort of contract work and he had found it most satisfactory.

MR B.J. MAINSTONE (Dunlop Research Centre) said that they had carried out experiments with strip weeding in comparison with minimum weeding until 18 months after budding and had then switched half the treatments. Where there were legumes, minimum weeding up to 18 months after budding gave variable growth. There were higher average girths for trees in strip-weeds rows. From 18 months after budding the advantage in terms of average girth of maintaining the strip gradually disappeared and the only remaining advantage was the more regular development of the stand where strip weeding had been continuous. Once the trees were dominant there seemed to be no advantage.

10/...

The author pointed out that supervision was much more difficult if the strips were not kept clear.

MR B.J. MAINSTONE drew attention to the fact that with strip weeding approximately 1/5 of the soil was not benefiting from the legumes and in replants he considered this most important.

DR WEBSTER (R.R.I.M.) said that although it might appear illogical to spray out the legumes after two years this might not be so, because when they were sprayed out a mulch was left which persisted until there was a regrowth of grass; then from the purely protective point of view a cover was continuously maintained. The author was asked whether the mulch actually continued to give protection or whether there were signs of wash. He confirmed that except on the steeper slopes the mulch was adequate for soil protection.

MR BOON WENG SIEW (United Malacca Rubber Estates) concurred with the author's view that it did not seem reasonable always to insist on a pure legume cover to maturity and said that under certain circumstances it would seem better to encourage the better naturals which might colonise the area more quickly and prevent erosion. This of course applied more to new plantings than on replants. He quoted an example where an area which cost $600 to bring to maturity with natural covers would have cost at least another $100 per acre if legumes had had to be established.

MR J.A.S. EDINGTON (Tebrau Estate) asked the author (in view of his remarks that he reverted to spraying after the second year when grasses became a problem) whether this strong grass growth could be attributed to eradication of other plants by mechanical cultivation. The author replied that in his experience there was less grass following ploughing and the mechanical cultivation gave legumes a good start. One of the fields referred to in his paper was not mechanically cleared and grass was so heavy that they were quoted $20 per acre per month for weeding.

DR RESING (Cambodia) pointed out that very large acreages in Vietnam and Cambodia were regularly mulched with Guatemala grass or Mexican daisy (Tithonia). Unless the plants were mulched it was extremely difficult to establish rubber because of the six months' dry season. No mechanical work was carried out. Mimosa was sown after clearing. In order to obtain maximum benefit from covers under conditions in Cambodia, strip weeding was generally not carried out; noxious growth were controlled during the first three years, but later they were left.

The author confirmed, in answer to a question by MR K.M.S. STIMPSON (Sungei Samak Estate) that they reverted to strip spraying when the grasses became heavy; there was no specific time when this was started but it was usually at about 2½ years.

MR D.A.I. GLENNIE (Kirby Estate) asked the author at what standard girth he opened his trees and what number of trees per acre had to attain this standard before opening, as it was the usual procedure on most estates to wait for a girth of 20 in. Opening at a smaller girth would explain his lower costs to maturity. The author stated that they opened when 70% had reached 18 in. (there was a stand of 160 to 165 at the time of opening for tapping) but pointed out that the costs presented in his paper were not up to maturity but for the first four years.

Asked by MR C.D.H. HARTLEY (Tong Hing Estate) why it was that grasses come in after 2 years if there had been a proper weeding policy, the author suggested that it was because of loss of vigour by the legumes. MR BOON WENG SIEW considered that the covers were set back by unfavourable weather conditions at wintering time.

MR F.A. HUGHES (United Patani) stated that it was the purpose of a cover crop, whether legume or grass, to leave as little soil exposed as possible, and that he had adopted the policy of allowing the planting strip to be completely covered, spraying back 3 to 4 times a year before manuring.

DISCUSSION:

Paper No. 7. Seed Treatment and Early Growth of Legume Covers.
By M.M. Chandapilla, Rubber Research Institute of Malaya

MR V.V. CHELLAM (R.E.M.) asked about the need for Rhizobium culture if scarified seed was used. The author pointed out that the purpose of the culture was not to improve germination, but to ensure the presence of bacteria in the seed's environment and as such was to be recommended.

In answer to a question by MR TEH WAN BOON (Talisman Estate) the author said that in view of the hazards of using acid for seed treatment and the drought susceptibility of acid-treated seed if not thoroughly dried, there would seem to be much in favour of using scarified seeds. There was practically no difference in germination between the two types.

MR I.T. STEVENSON (Sungei Chinoh Estate) asked for advice on the best method of applying Rhizobium to scarified seed. MR R.N. HILTON (R.R.I.M.) said that application to scarified seed was being looked into but it appeared that the only change necessary was to use less water.

In reply to a question by MR LAU THENG SIAK (Lee Plantation Ltd) on the storage of scarified seed, the author said it could be kept under dry conditions for about six months, without deterioration in germination.

DISCUSSION:

Paper No. 8. Establishment of a Mixed Cover of Creeping and Shrubby Legumes Using a Soil Block Method. By D.A.I. Glennie, Kirby Estate, Labu, Negri Sembilan.

DR WATSON (R.R.I.M.) referred to the idea of obtaining a single optimum cover and pointed out that the R.R.I.M. did not think this possible. A mixed cover, as suggested by the author, was more in line with his views.

On the question of soil pretreatment before planting the covers, the author stated that timber was sold off the estate and where the covers were to be planted, the strips were harrowed where possible once or twice to provide a seed bed and Rhizobium was applied to the seed. Further fertiliser applications followed the usual R.R.I.M. recommendations for legumes, that is, Christmas Island rock phosphate at the rate of ½ cwt per acre increasing to 1 cwt per acre twice a year.

MR R.A. BULL (Chemara Research Station) pointed out that Flemingia was a deep rooted plant and presumably transpired water from some depth and asked if it would be desirable to slash Flemingia during dry weather. The author confirmed that it was their practice to slash back the Flemingia but because of the fire hazard during dry weather, slashing was usually left until the rains came.

DR BAPTISTE (Vietnam) pointed out that this competition for moisture could equally apply to Stylosanthes. In Ceylon it had definitely been established that Stylosanthes was most competitive for moisture and it was most unfavoured. There was some evidence that if Stylosanthes was established from cuttings it was not so deep-rooted and the same competition might not arise. The author drew attention to the fact that he only planted about 80 Stylosanthes plants per acre and these were planted as cuttings in soil blocks. Derris had also been successfully established in soil blocks.

MR M.M. CHANDAPILLA (R.R.I.M.) made reference to root studies on Stylosanthes, Flemingia, Centrosema, Pueraria and Mikania. The Flemingia root system extended to a depth of 7 ft and covered a radius of 8 ft. Stylosanthes showed a vertical and horizontal penetration of 4 ft after one year's growth.

The author considered Pueraria the best cover and said his aim was to have this in the first two to three years; bushes were added, at a very low density, so as not to compete with Pueraria but to take over when the Pueraria thinned, instead of grass.

MR A.H. WOOD (Serapoh Estate) asked the author if he had tried planting the Flemingia in small polythene bags as this would probably be cheaper. The author thought it would probably be more expensive, although he had not tried it. He actually established his nurseries throughout the area for replanting and there were therefore practically no costs. If bags were used they would have to be carefully watered.

DR WYCHERLEY (R.R.I.M.) referred again to the moisture competition of cover plants and pointed out that there was practically no information on this point. A deep-rooted bush such as Flemingia might draw water from a depth not usually reached by the rubber roots, and therefore there might be less water competition than with a surface rooting plant such as Pueraria, which draws from the same

14/...

horizon as the feeding roots of Hevea. He gave example of cover experiments: on a course free-draining sand, tree growth was better with Stylosanthes than under Pueraria; on a wet coastal soil, the opposite effect was noted. He asked DR BAPTISTE if there was any experimental evidence to support the views in Ceylon on the water competition attributed to Stylosanthes. DR BAPTISTE confirmed that there was no experimental evidence, but girth measurement in field observations showed that growth was better under Pueraria than under Stylosanthes.

MR Y.S. MENON (St Andrew Estate) noted that in the costs quoted by the author there was no item to cover the cost of transporting the soil blocks to the field. The author replied that this was negligible as nurseries were sited in the field and the women planting collected their own material and carried it to where they were planting. This cost was included in the planting figure.

DISCUSSION:

Paper No. 9. Selection, Establishment and Maintenance of Covers in Relation to Replanting. By A.J. Abbott, Baling Estate, Kuala Ketil, Kedah.

DR BAPTISTE (Vietnam) asked the author if his method of stacking timber in the inter-rows did not result in trouble with root disease. The author replied that if the trees were stacked well in the centre of the inter-rows there was little trouble, provided three-monthly rounds of inspection and treatment were carried out. Most of the disease was encountered about the third year and he had little trouble after that.

MR BOON WENG SIEW (United Malacca Rubber Estates) asked about the tapping system used in the area of Tjir 1 which during the sixth year of tapping had given about 2100 lb per acre per annum; also, was it grown with a leguminous or natural cover? The author stated that the area was tapped S/2.d/2.100% and at one stage there was a solid Siam weed cover, although originally legume covers had been planted. He disputed the suggestion that natural covers were as good as legumes and quoted a case where RRIM 501 with legumes gave a better yield than another area of the same clone under a natural cover.

In answer to a question by DR WATSON (R.R.I.M.), the author confirmed that the manuring programme followed the R.R.I.M. recommendations exactly, although he had found it necessary, with a good legume cover, to cut down on fertilisers during the later years.

Detailed costs of establishment were not given said the author, in reply to a question by MR PERTAB SINGH (Kuala Lumpur), as these were always controversial. Over 2000 acres which had come into bearing over the past 10 years the average cost had been $725 per acre, but costs were coming down each year through the use of weedicides and the subsequent reduction in hand labour. Although his previous replants came into bearing in 5½ years, he considered it possible, with newer clones, to reduce this period, and therefore, the costs to maturity.

MR W.C. TAPPAN (Sumatra) pointed out that the method used by the author was very similar to those used in Liberia by Firestone and as a matter of interest quoted a root disease incidence of 8% - 10%, in such clearings.

DR BAPTISTE (Vietnam) noted that in countries with a high rainfall the incidence of root disease under such clearing methods was very much higher; in Ceylon, with a 170 to 180 inches of rainfall, the incidence of Fomes lignosus was very high indeed, if the trees were left on the ground.

MR R.N. HILTON (R.R.I.M.) said that although the incidence might be higher, tree poisoning was a recommended method under Malayan conditions. Root disease treatment was not complicated by the author's proposals as it was no longer recommended to trace disease sources beyond the edge of the planting strip; and, under the conditions described by the author, sources of infection quickly rotted away.

MR C.C.P. WILKINS (Kinta Kellas Estate) asked about the nutrient value of the stacked debris and its beneficial effect on tree growth. DR WATSON said that the value was considerable but convenience of replanting was the main consideration.

DISCUSSION:

Paper No. 10. Cover Plants and Tree Growth, Part II. Leguminous Creeping Covers and Manuring. By G.A. Watson, Rubber Research Institute of Malaya

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MR LAU THENG SIAK (Lee Plantations Ltd) suggested that the maximum benefit was not being obtained from the legumes and he said that it would perhaps be better to plough them in after the second year, allowing regeneration from seed already set and then perhaps to plough in the second population about 18 months later. He based these views on the following facts;

(1) for the first two years, rubber grown under legumes was not much better than rubber grown under grass or natural covers, owing to competition from the cover plants themselves;

(2) the capacity of the legumes to build up humus reached its maximum by 2 years and then diminished rather rapidly;

(3) the beneficial effects of legumes were only observed for about two years, that is between the third and fifth year. The legumes could be ploughed in at about 18 months (when the legume cover had produced its maximum amount of humus) and competition would thus be stopped. After regeneration, the covers could be ploughed again at 36 months. If this system was followed the build-up in humus in the soil by the fifth year would be more than the humus build-up by one crop standing during its declining years. The humus would also be incorporated with the soil.

DR WATSON (R.R.I.M.) confirmed that some estates had ploughed in legume covers and had good regeneration, but the degeneration of covers was generally due to the increase in density of tree canopy and therefore if the cover was ploughed in, the second and subsequent generations of cover would be similarly limited by the developing tree canopy. The ploughing of the cover would undoubtedly result in tree flushing and heavier canopy and this in effect would make further cover regeneration more difficult and the regenerated cover would be most unlikely to fix nitrogen at any appreciable rate.

On the other points raised by the questioner the author said that it should be appreciated that he had given a simplified annual picture of what was going on and although the questioner had quoted the figures for 18 months as the time when the maximum benefit had accured, there was a continual uptake by the covers and return of dead leaf litter with a high nitrogen content which was available for the developing rubber and cover roots. The paper showed that the dry weight had considerably increased between the end of the first and the end of the second year and on some sites even until the end of the third year and thereafter; the legumes had not in fact produced the maximum benefit by 18 months.

There was no evidence that ploughing in the humus prevented it being washed away. There might however be circumstances in stagnating rubber, and where the legumes were invaded by grasses, where ploughing in with an application of ammonium sulphate would stimulate growth.

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DR WYCHERLEY (R.R.I.M.) said in reply to MR LAU's second point on the shading-out of creeping legumes, that use could be made of Flemingia, which produced three times as much dry matter and three times as much nitrogen per acre as a creeping legume and after four years from budding still provided a good cover. Concerning MR LAU's third point, he noted that that regeneration from self-sown seed was variable, because most of the leguminous seed falling to the ground under a standing cover would become hard, that is it would germinate only if the top soil was exposed and dried and heated by the sun to 50°C, a condition unusual and undesirable in older plantings. It was this effect which was responsible for the strong regeneration of legumes often observed in mechanically cleared or burnt replantings.

MR BOON WENG SIEW (United Malacca Rubber Estates) asked whether growing legume covers was the cheapest way of supplying rubber with nitrogenous nutrients when chemical fertilisers were so cheap. From the figures and results quoted it would be possible to purchase 14 cwt of ammonium sulphate. Also, natural covers had been shown to provide a greater weight of humus than legumes. Therefore, would the natural covers and the extra ammonium sulphate not give the same result as legumes and could the R.R.I.M. give manuring advice for various cover policies or managements that would ensure growth equivalent to that obtained under a legume policy.

The author confirmed that the R.R.I.M. was now in a very good position to make these recommendations on manuring policies. Also he confirmed that studies were being made on heavy nitrogenous applications to grasses to see if they could be made to match legume cover results.

The author also agreed that natural covers had a high dry matter weight but said that Flemingia was a more useful alternative cover which held promise of better effects in the long run than those of creeping leguminous covers. The establishment of a good natural cover is not always easy in replantings, especially when situated away from jungle. Grass covers appeared to be more promising but they took time to establish. The alternative would be to carry them through into the replanting if they were already established in the old rubber, but they would be more competitive in effect than in the experiments reported, where they were sown at a planting and took 1½ years to give a complete sward.

Heavy rates of application of ammonium sulphate would of course have an effect on tree growth but would also result in leaching from the soil of large amounts of calcium, magnesium, potash and manganese. This could be alleviated by using a less acidifying source of nitrogen. It should also be appreciated that legumes contributed high levels of potash, magnesium and calcium, which helped to balance the nitrogen return.

DISCUSSION:

Paper No. 11. Covers and Root Disease. By A. Newsam, Rubber Research Institute of Malaya

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MR C.D.H. HARTLEY (Tong Hing Estate) asked the author if there was any evidence that cattle grazing aggragavated root disease incidence, as in Scandinavia, where cattle grazing in coniferous forests was discouraged because it was believed to increase the incidence of Fomes annosus. DR NEWSAM confirmed that no cattle were grazed in the grass plots of the experiments quoted.

In response to a suggestion by MR S.M. WARRIER (Chemara Research Station) that the figures in Table 5 indicated a superiority of natural covers over legumes, in that there was a lower root disease incidence, DR NEWSAM pointed out that the results were obtained from experiments not primarily designed to indicate root disease effects, and hence firm conclusions could not be drawn. Only the grass treatments showed constant effects.

MR D. LAM (Sementan Estate) asked whether the collar fungicides could be used on rubber of greater age than the one-year-old plants seen at the Experiment Station the previous afternoon. DR NEWSAM replied that they should be effective on trees of all ages but would of course cost more to apply to older trees.

MR J.F. CROOKE (Sungei Toh Pawang Estate) asked about treating stumps before planting. Dr NEWSAM thought it would be pointless to apply the dressing at so early a stage, unless it were to be found to persist for several years, as its effect might have worn off by the time protection was most needed, usually about three years after replanting.

DR NEWSAM went on to explain that the collar protectant had been developed to be applied after treatment for root disease or to trees adjacent to diseased trees, to protect them and prevent the spread of infection along the planting row.

MR LIM POH LOH (R.R.I.M.) noted that root disease incidence was low where the cover was Mikania, and asked if there might be some antagonistic effect associated with this cover. DR NEWSAM replied that the apparent effect on root disease did not seem consistent; however, Mikania extracts being studied by the Soils Division had been found to inhibit growth of F.lignosus in culture.

MR W. BINNENDIJK (Triang Estate) asked if bananas had any effect on Fomes as it has been noted that smallholdings where bananas were interplanted with rubber seemed to have little root disease. MR K.P. JOHN (R.R.I.M.) stated that F.lignosus had been isolated from banana rhizomes. MR R.N. HILTON (R.R.I.M.) suggested that bananas might hasten the rooting of sources of infection through the very wet mulch produced by cut banana plants. Further, it was pointed out that reports of beneficial effects of bananas might have related to areas where, under this crop, sources of root disease had rotted away.

DR GRIFFITHS (University of Malaya) understood DR NEWSAM to say that the nature of the cover did not really influence the incidence of root disease but his Table 5 showed quite a variation, according to cover type. DR NEWSAM said that what was implied was that if there was not much root disease in the area then it did not matter too much what the cover was. He did not mean to imply that

these differences were any less significant.

MR PERTAB SINGH (Kuala Lumpur) asked the author for details of the collar fungicide used; its cost of application and whether Tillex was still recommended. DR NEWSAM stated that the active ingredient was quintozene and the formulations now being used contained 20%. Various carriers had been tried but these did not seem to be critical. He suggested that the cost would be approximately 5 cents per tree for each year of age. Tillex had never been recommended.

DISCUSSION:

Paper No. 14. Cover Plants, Weeds and Weed-Killers. By. G.A. Watson, Rubber Research Institute of Malaya

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MR A.J. ABBOTT (Baling Estate) asked if the author's reference to spraying out grasses after the rubber had come to maturity was because he thought the effect was on yield. DR WATSON (R.R.I.M.) replied that he thought it was a matter of degree only and that a thin scattering of grasses, in the absence of other covers, could only be beneficial. If, however, there was a strong stand of grasses it would effectively exclude the feeding roots of rubber from the more fertile surface soil.

MR T.A.G. MENON (Diamond Jubilee Estate) was interested in the use of pre-emergence weed-killers in establishing legume covers, but in his experience the effect was only temporary and after about three months weeding had to be undertaken if for any reason the covers did not grow vigorously. He asked if the application of pre-emergent derbicides was really economic. Dr WATSON said that the answer to this question seemed to lie in whether it was cheaper to eradicate grasses one or two years before replanting or to use a pre-emergence herbicide at planting.