

THE USE OF MANURES IN THE GROWING OF *HEVEA BRASILIENSIS*.

The following is a report forwarded by Mr. H. C. Pinching, Association's Senior Scientific Officer in Malaya to Rubber Growers' Association, London:—

The value of manures in the rubber growing industry is a matter upon which there is a considerable diversity of opinion in planting circles. Even in Ceylon, where on certain rubber estates the annual application of artificial chemical manures has always been the custom, there still exist planters in that country who question whether such a procedure is advisable. Reference to the Rubber Growers' Association "Bulletin" for July, 1920, will show that as a result of my visit to that island in February and March of that year I reported as follows:—"The general concensus of opinion among the planters of Ceylon is that the satisfactory returns per acre, which many estates are now giving, are greatly due to the use of manures. A few of the people interested in rubber are somewhat sceptical of the benefits of manuring rubber, as they say that up to the present *reliable* data as to the effects of manuring are difficult to obtain and, therefore, the matter is still open to question. Of course, there is a certain amount of prejudice among planters in favour of the use of manures on account of the experience with manures in tea cultivation."

In the writer's opinion it is natural that there should exist this diversity of opinions for the following reasons:—

(1) Very few comparative experiments have been carried out whereby reliable results have been obtained showing the true results (as measured in effect upon girth of trees and yields) of the manuring. General casual observations have been made and these observations may or may not have been influenced by prejudice or by preconceived ideas of what the results should be.

(2) The differences which occur in soils, when considered from the chemical, physical and biological stand-point, have received scant, if any, attention in discussing the results of such manuring work as has been carried out. Thus Mr. X has used basic slag for manurial purposes and from general observations he is certain that marked benefits have been received from that work. On the strength of Mr. X's success, Mr. Y tries basic slag as a manure and finds it resulted in no benefits to the trees, indeed, possibly the trees look poorer for the treatment. Mr. Y therefore makes a general statement that manuring is of no use for rubber growing. Mr. Y has overlooked the fact, however, that he has been treating a different kind of soil, a different lie of land, etc., to that treated by Mr. X.

Grantham, discussing the results of the manurial work on the properties of the H. A. P. M. in Sumatra is careful to point out in his summary (*Archief Voor de Rubber Cultuur*, August, 1914) that "Attention must be directed to the fact that the results described have been obtained on the special soil types peculiar to a part of the East Coast of Sumatra, and it by no means necessarily follows that similar results will be obtained on other soil types."

With reference to Malayan soils, either taken as a whole or even in special cases, it is still unproven whether it would be a profit-bearing procedure to use chemical manures in the growing of *Hevea*. Green manures, since they serve a dual purpose, cannot be viewed quite in the same light as chemical manures. Analysis of the soil does not assist greatly in finding out what kind of chemical manure it is advisable to apply to rectify deficiencies in the soil from its rubber-growing fertility stand-point. The following statement from the Chief Secretary's Annual Report for 1920 of the F. M. S. is of considerable interest in connection with the question of the analysis of soils of Malayan rubber estates:—

"The conclusions arrived at by collating the results of soil analyses for rubber estates are recorded by the Director of Agriculture in the following terms:

"It appears from the results of chemical analyses, that much of the soil now carrying rubber is exceedingly poor, and is losing its virginal fertility with such rapidity that artificial compensating elements must shortly be resorted to on a large scale. In many cases, not only is the surface soil being denuded of its plant nutrients more quickly than weathering can replenish the supply, but the underlying subsoil is in an unhealthy condition, and likely to become more so on account of the water table and the character of the subsoil water.

"No definite data have been obtained to show the actual relationship between soil acidity and rubber yields, but the high order of acidity exhibited by the majority of estate soils shows that an unhealthy condition for root development is the rule rather than the exception.

"In connection with soil analyses for the estates, it must be recorded that there is a lamentable lack of interest displayed by the planting community in the whole subject of soil investigation, and there appears to be no desire to improve soil conditions by following up analyses with experimental work or fertilisation."

The only remark which one can make in comment of the above statement is that generally speaking the growth of the rubber trees in Malaya, their yields and general development have been of such a nature to satisfy up to the present, those who have invested their money in the rubber growing industry. At the same time, however, several hundreds of acres of land unsuitable for the growing of rubber (to judge from the results obtained) have been planted up and, further, no one will deny that the rigid clean weeding method of dealing with areas under *Hevea* which was carried out for many years on the older estates has resulted in a great loss of fertility to the soil. In many cases the gradual retardation of the rate of growth of the trees planted on such areas has been very noticeable. To what extent this retardation is due to the gradual decrease in fertility or diminution of plant food in the soil is difficult to say, as in most cases of old areas two other factors, viz: Overtapping and overcrowding of the trees have also played a part. In the more recent years efforts have been made on estates to reduce the effects of these last two factors by tapping more lightly, by resting the trees from tapping for periods to allow a better bark renewal, by thinning out so that the improved spacing might cause an improvement in the branching of the trees which would stimulate growth and

improve the rate and nature of the renewal of the bark. Efforts have also been made to improve the soil conditions on many of these old areas by attempting to grow green manures and cover crops. Experience has shown that in many cases the establishment of cover crops or green manures on these old areas under rubber is very difficult, both the poverty of the soil and also the shade of the trees preventing satisfactory growth.

This naturally brings one to the question of the advisability of using chemical manures in the growing of rubber and this question seems to divide itself into the following sections:—

(1) The use of chemical manures to improve the fertility of impoverished soils which originally were fertile. The impoverishment can be produced either by "wash" and loss of plant nutrients by leaching or by the land having been planted with some other crop prior to the planting of rubber.

(2) The use of chemical manures on naturally unsuitable soils to render them suitable for rubber growing.

(3) The use of chemical manures on ordinary fertile soils to give an increased return.

(4) In all the above instances what manures should be applied? In connection with the first section I would suggest, that in view of our ignorance upon the matter, it would be highly advisable for estates possessing such areas under *Hevea* to carry out properly conducted manurial experiments with different chemical manures. Different soils may respond to different manures and until experiments have been carried out no practical manuring scheme should be entertained. That improvement in growth, in appearance and, what is most important, in yield, can be obtained by the use of chemical manures with rubber trees growing on impoverished soils has been clearly demonstrated by the careful experimental work, and the consequent field work carried out on the properties of the H. A. P. M. in Sumatra. A full account of this manurial work is given by Grantham in the *Archief Voor de Rubber Cultuur* for August, 1924. Accepting the possibility of producing an improvement in growth, vitality and yield of rubber trees by using chemical manures, the great question, with which one is confronted is whether this improvement, when measured in terms of increased latex yields or increased longevity (that is in terms of revenue bearing potentiality) is commensurable with the expenditure necessitated by the work. The late Mr. Kelway Bamber, in discussing the statements made in the Chief Secretary's Annual Report for 1920 with reference to Malayan soils (c. f. *The Planter*, Vol. II, No. 2, p. 50) stated:—

... he was aware that very little manuring was done in the F.M.S. His experience was that the planting community there was rather averse to it, as manuring did not increase the yield of latex to any appreciable extent, and, therefore it was considered that it did not pay.

"Manuring was practised much more generally in Ceylon than in Malaya because it had been found that though it did not necessarily increase the yield, it kept the trees in a healthy condition. One of the chief results was the ensurance of healthy bark renewal. In a poor soil, where cultivation and fertilisation were neglected, the bark recovery was liable to be

poor. The effect of manuring was mainly on the tree itself. It was an excellent preventative of disease, as it kept trees strong and healthy.

"But," added Mr. Bamber, "manuring in the Malay States is absolutely out of the question from a financial point of view. There would be plenty of indications if this inability to manure was affecting the trees to any great extent. As I have said, the bark renewal would be poor, the leaves would be smaller and lose colour, and the whole appearance of the trees would show that they were not receiving sufficient nourishment. These possible ill-effects of non-manuring could, however, be prevented to a very great extent by proper cultivation, thinning out, and the prevention of wash."

With reference to manuring in Ceylon and maintaining the trees strong and healthy, Reeve, then Physiological Botanist to the Association in Ceylon, informed me when I paid the visit to the island, referred to above, that he considered that manuring had a marked beneficial effect in combating "secondary leaf fall" and "pod" diseases. It cannot be denied that repeated attacks by "secondary leaf fall" on the trees, have a marked detrimental effect upon the vitality of the trees, their yields and the rate of bark renewal. Hence if the application of manure to the soil can only cause the trees to withstand these attacks so that the trees can continue their normal rate of growth and yield, then the value of the manuring is a measurable quantity.

As has been already stated above, very little data is available expressing in a measurable quantity the value of using chemical manures for *Hevea* growing soils. Reference to my Report on my visit to Sumatra East Coast made in October and November, 1923, will show that I was informed by Mr. Grantham, that in some cases over 100 per cent. increase of yield was obtained as a result of the application of certain manures. Yields at the rate of between 500-600 lb. per acre were being harvested from the plots manured with sodium nitrate as against a yield of 280 lb. per acre from the unmanured plots. Further, no guide was necessary to inform a stranger which plots had received the sodium nitrate manures, for the effects of this manure upon the growth of the trees, their leaves and latex yield were remarkable. The growth of the trees on the unmanured control areas was poor, their branching scanty, and the comparatively few leaves they bore were of a sickly yellowish colour. On the other hand the trees on the manured plots had a much more vigorous growth, their leaves were plentiful and of a dark olive-green colour. According to Yates (*Archief Voor de Rubber Cultuur*, September, 1923), the rate of formation of latex vessel rings was accelerated by the application of various manures (sodium nitrate, calcium nitrate and ammonium sulphate) to the soils with which he was experimenting. It is essential to emphasize here that, according to Grantham, the use of basic slag, potassium chloride and lime was without effect on the two classes of soils experimented with, while superphosphate was actually harmful.

It was found on the H.A.P.M. that manuring with the sodium nitrate or ammonium sulphate every other year had nearly the same beneficial effect as a yearly application. About 5 lb. of manure was applied per tree around which it was merely broadcast. Mr. Grantham informed me that the manurial work cost about Gls. 40 per acre, i.e. Gls. 20 per acre

per annum. Thus, assuming that the average increase of crop per acre when the work is carried out on a large scale is 200 lb., then the extra crop costs ten cents (guilder) per pound for manure or if the cost is taken over the total crop per acre it works out at about 4 guilder cents per lb. of rubber harvested. Where an estate output is unhampered by respective legislation then the work of manuring giving such beneficial results as obtained on the properties of the H.A.P.M. is certainly justifiable from the increased revenue stand-point. Where "restriction of output" legislation operates and where the ordinary cost of tapping per pound from unmanured fields is under four cents per pound, then viewed purely from a yield return stand-point, the manuring work would be hardly justifiable.

To Malayan estates the cost of manurial work with chemicals would exceed, in all probability, that stated above. The H.A.P.M. operates very large areas and purchases the manures in very large quantities. As far as I can gather the present prices of chemical nitrogenous manures are as follows :—

A local Kuala Lumpur firm quotes \$ 210 per ton for sodium nitrate (16% nitrogen) and \$ 240 per ton for ammonium sulphate (20—21% nitrogen). I have received another quotation of about \$ 133 per ton c.i.f. Penang or Singapore for ammonium sulphate. The Singapore Gas Co.'s price for ammonium sulphate is, I understand \$ 250 per ton f.o.r. The Chilean Nitrate Producers' Association quote the following selling prices for nitrate of soda for the year 1924-25. In July, 1924, the price will be £9 15s. 10d. per ton, delivered free at Chilean ports. The price will rise by small half monthly increments until January, 1925, when it will be £10 10s. 10d. per ton, at which figure it will remain until May 31st, 1925.

Thus applying about 5 lb. of manure per tree, *i.e.* approx. 4 cwt. per acre, the cost of the work, using locally procured chemicals, will be about \$ 50 per acre per application.

According to the late Mr. Bamber the rubber tree does not demand a rich soil and the physical character of the soil is more important than its chemical character. In spite of this, however, I do not think it would be a commercial proposition to try to grow *Hevea* on naturally unsuitable soils (say, tin mine tailings) with the hope that the application of chemical manures will assist the growth. Neither do I consider it advisable where companies possess areas in which, by the failure of the present planting of *Hevea* to grow satisfactorily, the unsuitability and poverty of the soil has been clearly demonstrated, to uproot the present poorly grown trees, apply chemical manures to the soil and then replant the area.

Sufficient evidence is to hand to demonstrate the possibility of improving the growth and yields of trees growing on impoverished soil by the use of chemical manures and one is naturally led to enquire whether an advantage commensurable with the outlay would be obtained by using such manures in good soils, where the growth of the tree is satisfactory and the yields per acre over, say, 500 lb. per acre. Unfortunately no information is to hand as to the possibilities on this score. It is probable that the improvement might not be so great and further, by stimulating the growth of the tree to too great a degree, the possibility of rendering it more liable to attack by disease naturally arises. Still without a carefully planned experimental

enquiry nothing definite can be stated on this question. The possibility of rendering the soil toxic to the rubber tree by over manuring must not be lost sight of.

The question of what manures to use must necessarily depend upon the results of experimental work. Neither chemical nor mechanical analysis would render much assistance in settling this question. Chemical analysis indicates that many Malayan soils exhibit a high order of acidity and that they are poor in nitrogen. Most old estates have carried out a certain amount of liming of the soil in view of this natural acidity of the soil, but, writing generally, I have never seen any marked benefits resulting from such work. It might be added that usually the amount of lime applied per acre in these cases was not sufficient to neutralise the natural acidity of the soil. According to Barrowcliff (*Agricultural Bulletin*, F.M.S., November, 1914) the inland undulating land of the Peninsula has an acidity corresponding to 2-3 tons of lime per acre whilst the clays and peaty clays found near the West Coast would require 5-6½ tons to produce neutrality. Still it would appear that as some of the best rubber is to be found growing on distinctly acid soils, the question of acidity is not so important.

Having once found by experiment a chemical manure which is capable of stimulating the growth and yield of the rubber trees, either in the case of trees growing on impoverished or on good fertile soils, it is necessary, in my opinion to continue such manuring in these areas. Otherwise when the stock of extra supplied plant food is exhausted the trees will have to go back to their premanurial days supply of food. Hence they will not be able to maintain the same extent of leaf and branch as they required with the increased food supply. The trees will then show signs of dieback and be very susceptible to attacks by different fungi which may do considerable harm. Thus any company in deciding to carry out any manurial work must be prepared to continue such work. Without such a provision I would suggest that it is better to leave the trees to make the best of the natural supply of plant food existing in the soil, or to try some green manure, the effects of which will be more lasting.—The Malayan Tin and Rubber Journal, Vol. XIV, No. 7.

"BUBBLES" IN SHEET RUBBER.

In a paper published in a recent issue of the *Rubber Growers' Association Bulletin*. (Vol. 6, 10, p.625) Mr. H. C. Pinching, A. R. C., Sc., Senior Scientific Officer in Malaya, ascribes the formation of "bubbles" in sheet mainly to fermentation of the latex caused by micro-organisms prior to coagulation. If, for various reasons, bubble formation is to be feared, sodium sulphite as an antiseptic should be employed, but otherwise there is no reason for the use of this anticoagulant. Is it quite certain that premature coagulation may not take place irrespective of "bubble" formation, and if so, is it generally accepted that the use of "field-sulphite" is limited to the prevention of the particular "fermentation" which causes bubbles.—Dr. Philip Schidrowitz, In the *India-Rubber Journal*, Vol. LXIX, No. 17.