WAR-TIME MANURING

SHORTAGE OF SULPHATE OF AMMONIA

THE war in Europe is making it difficult to get certain manures. Sulphate of ammonia is the most important manure which is affected. Ammonia is produced in Great Britain both synthetically (from the air) and as a by-product from gas works and coke ovens. In peace time there is a large exportable surplus, mostly in the form of sulphate of ammonia. But ammonia can also be oxidized to nitric acid, which is essential for the manufacture of high-explosives and propellants. Sulphate of ammonia is also needed now in greater amounts in Great Britain for manuring of food crops. It is thus obvious why the export of this fertilizer from Great Britain is restricted.

Large amounts of ammonia and nitrates were manufactured for export, in Germany, Norway, Holland and Belgium. These sources of supply are of course no longer available to us.

Sulphate of ammonia, nitrate of soda and cyanamide, all good nitrogenous fertilizers, are exported also from some neutral countries, notably the U.S.A. and Chile, as well as from Canada. But owing to the need to conserve Sterling for direct war purposes, exchange control operates to hinder the purchase of these fertilizers from non-Sterling countries.

ALTERNATIVE NITROGEN MANURES

Supplies of sulphate of ammonia are therefore almost certain to be short, for manuring Malaya's rubber areas in 1941. Cyanamide is not likely to be obtainable in its place, but it is now hoped that sufficient amounts of Chilean nitrate of soda will be imported. This depends upon special arrangements not involving sacrifice of Sterling exchange.

Even if sufficient inorganic nitrogenous fertilizers are not available in these forms (sulphate of ammonia and nitrate of soda), organic manures such as oil cakes—notably ground nut cake from India—will always be obtainable. The relative merits—technical and economic—of these manures, for Hevea, are discussed later in this article.

PHOSPHATES AND POTASH

Phosphate manures are likely always to be available in abundant amounts. Before the war superphosphate was exported in large amounts by Holland and Belgium. Supplies from America are hampered by exchange control. But for practical purposes mineral phosphate is as good as superphosphate for rubber-manuring in Malaya. Sufficient supplies from Christmas Island—which is part of Malaya—are likely to continue to be imported.

---

* Copied from the *R. R. I. Planters' Bulletin* issued by the Rubber Research Institute of Malaya No. 13 of September 1940.

The chief sources of supply of potash fertilizers used to be the mines in Germany and Alsace. Potash is still available from Palestine, but shipping difficulties may hinder its import to Malaya. However, potash fertilizers are of relatively minor importance for Hevea manuring. The intelligent conservation of smoke-house ash (which if protected from the rain is quite rich in potash) should suffice to ensure adequate supplies for all areas really needing potash. There is also a grade of Chilean nitrate which contains potash as well.

PROBLEMS RAISED BY SHORTAGE

Shortage of nitrogen fertilizers raises several important practical problems, notably :

(*a*) the relative importance of manuring rubber areas of different ages and history ;

(*b*) the wisdom of manuring mature areas with phosphate only if no nitrogen manures are available ;

(*c*) the relative merits of different nitrogen manures, especially sulphate of ammonia, nitrate of soda and organic nitrogen manures. These problems are discussed below in that order.

MANURING YOUNG RUBBER

The early years of life of the young rubber plant are of the greatest importance so that manuring of young rubber areas must have priority over that of mature areas. Moreover, the soil of most replanted areas is more or less impoverished, whilst in new clearings there are usually adequate supplies of plant food, or at any rate of nitrogen, unless the soil has been exhausted by previous growth of some other crop. Young rubber on new clearings is showing a response to phosphate manuring in some cases, but not to nitrogen. Even in replanted areas the chief need is for phosphate, but here nitrogen is also of importance. After its fourth year of life the young rubber plant, should be well-grown enough and have a sufficiently wide root system, to enable it to do without manuring for a time without a serious set-back. But during the first four years, the check resulting from lack of manuring might permanently harm the trees.

REPLANTED AREAS

Hence, *areas replanted* (or planted after having been previously exhausted by another crop) *since January 1, 1937, should have priority over all other rubber areas*, for manuring with nitrogen (as well as with phosphate). Only for replantings on coastal clays and peats is this not true. It is understood that, if enough nitrogenous fertilizers are not available for all needs in 1941, official steps will be taken to reserve a sufficient amount for such areas, leaving for other purposes only such surplus as may remain.

Immature areas over four years from planting will suffer less from a break in their nitrogen manuring programme. This applies more particularly to trees planted originally on newly-cleared reserve land than to trees of equal age which are in replanted areas or on land which has previously carried other crops.

MANURING MATURE RUBBER AREAS

For the manuring of mature rubber areas, regard must be had to the condition of the trees and to the past manuring history. If the area is yielding well, and shows no serious signs of deterioration of foliage or fall in yield, it will suffer no serious harm if it has to do without manuring for one year. This is true not only for areas in good heart which have not been manured previously, but also for areas which have been maintained in or brought back to good condition by manuring in the past. In other words, *manuring for maintenance* can safely be omitted on 1941. *Manuring for recovery*, however, is in a different category. Where obvious deterioration, such as poor foliage and bark, " stag-heads ", and falling yield, is being treated by manuring, it is more desirable that such manuring should not be interrupted. For example, areas of deteriorated rubber trees which are being brought back to good condition by manuring, and which have had only one or two dressings, may lose much of the benefit from those previous dressings if they cannot continue to be manured according to plan.

RELATIVE PRIORITY OF MANURING FOR RUBBER AREAS

The relative order of importance for the continuation of nitrogen manuring according to programme may therefore be summarized thus :—

1. Areas replanted (for planted after exhaustion by another crop), later than 1936.
2. (*a*) Immature areas replanted (or planted on previously cropped land) before 1937.
   (*b*) Mature areas which are being manured for recovery from deterioration and have received only one or two dressings already.
3. (*a*) Immature areas originally planted on newly-cleared jungle.
   (*b*) Mature areas not showing any signs of deterioration, which are being manured for maintenance, not for recovery.

The relative priority of (*a*) and (*b*) under 2, and similarly under 3, cannot be stated with certainty, and will depend on a detailed consideration of the circumstances in each individual case. On coastal clays and peat areas manuring is usually unnecessary for rubber of any age.

PHOSPHATE MANURING WITHOUT NITROGEN

Another problem concerns the manuring of mature rubber areas with rock phosphate if nitrogen manures are not available. It has been suggested that manuring with rock phosphate alone would be better than no manuring at all. This is a more difficult question.

Not all Malayan soils are deficient in phosphate. Although manuring experiments are in progress on mature rubber trees on most kinds of Malayan soils used for rubber-growing, many of them have not been in progress long enough to show conclusively whether phosphate manuring is required. Under these circumstances, even in normal times, advice as to whether or not phosphate manuring should be used, for mature rubber trees on any given estate, cannot usually be given with anything approaching certainty.

Our standard policy is to advice the use of a " complete " mixture containing some phosphate (and also a little potash) as well as nitrogen. (See this Bulletin, Nos. 9, February, and 10, April, 1940). Phosphate is cheap and its inclusion is a cheap insurance against possible phosphate starvation, on soils of which the phosphate requirement is not yet definitely known.

Used in conjunction with nitrogen, it is probable that phosphate, even if it does no good, will do no harm. In all the mature-rubber-tree-manuring experiments which are being carried out by or in conjunction with the R. R. I., no instance of a depression of yield as a result of adding phosphate to nitrogen manuring has yet been recorded. From some experiments conducted independently of the R. R. I. it is understood that there are indications, not conclusive, that in some circumstances a slight depression may occur.

Now, however, in view of possible shortage of nitrogen fertilizers advice is sought as to whether phosphate alone should be used on areas which have received straight nitrogen manuring hitherto. Because phosphate may do good, and in any case probably does little or no harm, when used along with nitrogen, it by no means follows that this must be true of phosphate used alone.

BALANCED AND UNBALANCED MANURING

Manuring with any single manure, by itself, may be " unbalanced " manuring. This is particularly so with mineral manures such as phosphate, and less so with nitrogen manures ; for excess nitrogen tends to be lost quickly from the soil, whilst excess phosphate remains.

If the soil is deficient in P_2O_5, phosphate manuring, especially after straight nitrogen manuring, tends to rectify the balance rather than to disturb it. But if the soil is already well-supplied with P_2O_5, then phosphate manuring creates unbalanced nutritional conditions : these are the circumstances under which, if phosphate manuring can ever be harmful, it is most likely to be so.

It is fortunate, therefore, from this standpoint, that the R. R. I. experiments in which " straight " phosphate manuring of mature rubber trees is included, are on soils which now appear to be already amply supplied with phosphate. These are experiments on coastal soils. In none of these experiments has any harmful effect of phosphate, on yield or growth, been recorded. It is possible that on other types of soil inland, with less favourable water supply, different results would be obtained. So far as the available evidence goes, however, it is believed that straight phosphate manuring of mature rubber trees which have previously received only nitrogen manuring is not likely to do any harm, and may do good. Moreover, phosphate is more likely to be of value to areas which have previously had two or more straight nitrogen dressings, than to areas which have had only one.

ECONOMICS OF PHOSPHATE MANURING

It remains to consider whether although unlikely to be harmful to the trees, it is likely to be a good business proposition to apply phosphate to mature areas which have had one or two straight dressings of nitrogen (and no phosphate) previously. It has already been stated that the experimental data do not

yet allow advice in this regard to be very sure. The odds in favour of getting an economic benefit from the application of phosphate under these conditions may be assessed at not better than evens, and probably more like 2 to 1 against.

Thus, being fairly sure of not doing harm, it becomes a matter of commercial policy to decide whether the relatively small expenditure involved in manuring mature areas with rock phosphate is worth while, with one chance in two or three that the trees will benefit appreciably thereby.

For areas which have received phosphate along with nitrogen in recent dressings, no further phosphate manuring is recommended unless nitrogen can be given at the same time.

RELATIVE MERITS OF DIFFERENT NITROGEN MANURES

The relative merits of *sulphate of ammonia*, *nitrate of soda*, and *organic fertilizers such as groundnut cake* must be considered on the basis of cost and manurial effectiveness.

Nitrate of soda contains 15 to 16 per cent. of nitrogen, and groundnut cake about 7 per cent. against about 21 per cent. in sulphate of ammonia. Normally nitrate of soda and sulphate of ammonia are about the same price per ton, so that the unit of nitrogen in nitrate of soda costs about 30 per cent. more than in sulphate of ammonia. Groundnut cake is a valuable feeding stuff for cattle, and so it has usually cost two or three times as much as sulphate of ammonia, per unit of nitrogen.

Hitherto nitrate of soda has not been much used for manuring Hevea in Malaya, largely because sulphate of ammonia has been a cheaper source of nitrogen. Both are soluable fertilizers which may be applied in the same way, on the surface of the soil, no digging-in being needed. Groundnut cake, however, contains its nitrogen in an insoluble form, which must be converted into a form available to the plant by means of microbiological action in the soil. If it is applied on the surface, much of its nitrogen is liable to be lost, so that to ensure its effective use it must be buried in the surface soil by digging in, envelope forking or similar means. This adds appreciably to the costs of using it, particularly in areas carrying a heavy growth of covers.

For practical purposes, *per unit of nitrogen, all three manures may be taken to be of about equal effectiveness.* Special experiments to compare them for manuring Hevea have not been carried out by the R. R. I., but their relative merits as sources of plant food for a very wide range of other crops, on many different kinds of soil, have been so fully studied that there is no doubt of their similarity in value—per unit of nitrogen.

Nitrate of soda is an alkaline fertilizer, whilst sulphate of ammonia is acid, (in their effects on the soil), whereas the effect of groundnut cake is more or less neutral. Nitrate of soda, if used repeatedly on clay soils, tends to render them sticky and impervious to water; the other two do not have this effect Nitrates are easily washed out of the soil, ammonia not so easily. Nitrates are commonly somewhat quicker-acting than ammonium salts, and organic fertilizers such as groundnut cake are rather slower. Nitrate of soda and ground nut cake may contain traces of other elements beneficial to plants, which are

usually absent from sulphate of ammonia. Groundnut cake, besides containing a little phosphate and potash, is also a source of humus, but at the rates used for supplying nitrogen to the crop, the effect on the humus content of the soil is negligible. Nitrate of soda is liable to absorb moisture and become damp and sticky in humid climates, causing difficulties in mixing and in application. However, none of these differences is of much practical importance for rubber-manuring in Malaya, so that, per unit of nitrogen, it is unlikely that there would be more than say, a 10 per cent. difference either way, at the most, between their effects.

The choice may therefore safely be allowed to depend on cost per unit of nitrogen. On this basis, if sulphate of ammonia cannot be obtained, the use of nitrate of soda is more economic than groundnut cake, particularly in view of the extra cost of applying the latter.

Another way of providing nitrogen for the nutrition of rubber trees is by the use of composts. An article on this subject was published in an earlier issue of this Bulletin (No. 5, July 1939). A further article on the subject will appear in the next issue.

In conclusion, one other aspect merits consideration. Although the omission of manuring for a year or two may do no permanent harm to trees in good heart in a mature area in bearing, the yield of rubber obtained may possibly suffer a temporary decrease for lack of the manure. At times of high release such as the present, this may make it difficult to produce the full exportable allowance. Besides being unfortunate for the estate, this might react unfavourably on Malaya's contribution to the British War effort, by lessening the amounts of Dollar credits obtainable in U. S. A. from sales of rubber. It is therefore most desirable that adequate supplies of nitrogenous fertilizers should be available.