NITROGEN SUPPLY TO TEA*

(REVIEW)

The Indian Tea Association's Experimental Station at Tocklai, Assam, was started at the turn of the century and during its forty odd years of existence has accumulated a considerable quantity of data on the manuring of tea. Mr. H. R. Cooper, the Senior Chemist who for more than half this time has been associated with Tocklai's work on this aspect of tea culture has recently surveyed the manurial and cultivation experiments, more particularly those relating to the use of nitrogen, and, under the title "Nitrogen Supply to Tea" has published the most informative account of manuring that the tea industry has yet had. The memorandum gives a reasoned exposition of the whole science of manuring amply illustrated by examples from the various experiments carried out over a long period of years.

Mr. Cooper brings to his task not only enthusiasm but deep and wide knowledge of tea culture. His method of presentation is a model for all who have the task of giving current advice on matters about which a good deal, but not everything, is known. He distinguishes most carefully between what is fact and what is theory. Where a fact is established he says the results "indicate clearly." Where the evidence is showing a definite trend but is not complete he is content to say "we think then," etc., and where he steps outside definite experimental evidence, he carefully considers what related experimental data are available as a guide and straightforwardly says "the best guess we can make at the moment is. . . ." A good deal of confusion in current ideas and practice would be avoided if, when debating the scientific aspects of tea culture, speakers would indicate and hearers could realise where definitely ascertained fact ends and where attractive speculation begins.

The scope of Mr. Cooper's memorandum is seen from a brief survey of its chapter headings: Nitrogen compounds naturally present in the soil; The use of Manures; Trials of different forms of Nitrogen on Tea; Cattle and Line Manure; Humus Composts and the use of

* "Nitrogen Supply to Tea." H. R. Cooper. Memorandum No. 6. pp. 185.—Indian Tea Association, Tocklai Experimental Station.

Waste Materials; The use of Leguminous Plants; Results to be expected from Manuring; Relation of Manuring to other Field Operations; Application of Manure; Soil Erosion. Besides various tables in the text there is a 32-page appendix giving results of experiments and explanatory matter.

For Ceylon readers, the most that can be done in a short article is to draw attention to various aspects of the Tocklai work that correspond with or are complementary to work done at the Tea Research Institute. There are matters in which local circumstances and practices have a preponderating effect in deciding the result. When, as in so many experiments independently planned and carried out by the stations, the same conclusions are reached, the agreement has a very high evidential value. Readers should refer to the original for details, but the following comparisons are of interest:—

Efficiency of Manures.—At Tocklai the experiments show "with any type of manure, the increase in crop is proportional to the quantity of manure up to fairly high limits." (Page 73). This is in accord with our findings which Mr. Cooper quotes. The upper limit of the generalisation appears to be 80 lb. of nitrogen per acre at Tocklai, and less at the Dooars Sub-Station (Page 103). The response given by a pound of nitrogen is higher in Assam than at St. Coombs. The highest figure we have so far obtained is 4.8 lb. of tea for every pound of nitrogen and the average over the whole experiment is about 4. At Tocklai the highest figure is double this. Here then is an example where the general principle is the same and the detailed operation of the principle different in the two regions.

In regard also to the perennial question of the use of inorganic nitrogen, particularly sulphate of ammonia, Mr. Cooper demonstrates that in the early years of the experiment sulphate of ammonia equalled any other source of nitrogen in crop response, but that from 1924 it has produced significantly greater crops. (Page 24). He ascribes this to the slow but progressive increase in soil acidity that sulphate of ammonia causes. (The general run of pH values in Assam is higher, *i.e.* more towards the alkaline side of the scale, than those in Ceylon). Whether on soils usually more acid from the start we shall find our yields follow the same course remains to be seen. Mr. Cooper's findings on rate of availability of organic manures correspond with ours. "It will be observed also that the animal meal (or concentrated organic manure commonly presumed to be slow acting) is fully as rapid in action as sulphate of ammonia, just as blood meal and horn meal are at Borbhetta." (Page 125).

Quality.—After considering various kinds of nitrogenous manures including inorganic and organic artificials and cattle manure, the

memorandum sums up the findings in these words: "Although differences in quality due to manuring are so small that it is difficult to prove them significantly great, the results obtained always indicate drops in quality with increased crop, but quality shows no relationship with the form of nitrogen used." The quantity of nitrogen required to show up a quality effect is 80 lb. (in comparison with 40 lb. or nil). Our results have not yet given a consistent difference even with 80 lb. though they may well do so when the successive doses of 80 lb. have brought the bush yield to a ceiling. Then, as Sir John Russell indicated at the last Conference, is the time to expect quality effects of recognisable dimensions.

Relation of Manuring to Pruning.—Mr. Cooper fully upholds our experimental conclusions regarding the relationship between the pruning operation and manuring. It must be remembered that annual pruning in Assam is very light, similar to our cut-across. A reference to Plate 5A in Tea Research Institute Bulletin No. 14 will give a reasonable idea of typical Assam pruning. Recovery from this is rapid. But every 10 or 15 years it becomes necessary to prune back bushes severely in order to prevent them from becoming too high. This "medium pruning" (to distinguish it from the normal operation on the one hand and collar pruning on the other) is similar to our clean pruning. Speaking of such pruning the memorandum says, "In 1933 the tea, which had become very high, was cut back to 18 inches from the ground. In that year no manure was applied, it having been shown on other plots that cut back tea carried too little leaf to make use of manures." (Page 26). Later, on a similar theme we have, "It is useless to manure a collar pruned bush. Even a medium pruned bush benefits little . . . . . It is quite safe to save money by omitting manuring in the year in which a section is cut back." (Page 72).

Green Manuring and Composting.—There are a number of references to the alternative use of green manure loppings and compost. As in our own case, Tocklai has established by parallel investigation the wasteful folly of composting green manures, including prunings. "For example, the leaves of *Boga medeloa* (*Tephrosia candida*) and indeed of most leguminous plants, contain so much nitrogen that they are readily available nitrogenous manures if hoed into the soil in a fresh, green state. If composted they lose nitrogen and become of less value" (Page 39). In one experiment at Tocklai *T. candida* cuttings were used as a manure. Observation and yield records of these plots showed that "the cuttings prove very rapid in action. There was never any trace of any 'poisoning' effect on the tea." Tocklai carried out the interesting experiment of using the raw materials of compost manufacture (including rice straw which

alone will not rot down) hoed into the soil direct in one case, and normally composted in the other. The results were equivalent (pages 50, 123).

The Effect of Weeds, Subsidiary Crops and Cultivation.—Mr. Cooper deals with this subject incidentally as interconnected with manuring and so does not display the relevant data which are, however, available in other publications. His summary reads: "All our trials at Borbhetta or Tulsipara indicate clearly that increase in cultivation, either in frequency or in depth, produces little or no effect beyond the point at which weeds are suppressed, but that any increase in the cover of weeds reduces tea crop. (Page 80). As in our case he is particularly insistent on the harmful effect of grass. (Page 84).

Time of Application.—The correspondence between the findings of the Tocklai Station and the Tea Research Institute is impressive and there is little divergence of opinion. One such apparent divergence needs detailed consideration. Discussing time of application of manure Mr. Cooper says: "Application later than June fails to give full effect in the season of application, but what is not then used increases crop in the next season" (Page 81). Later, the memorandum repeats this statement with the added suggestion that what is not used remains in the soil. (Page 91). This is contrary to our experience, but though we cannot speak with certainty on this matter we can, as Mr. Cooper occasionally does, make an intelligent guess as to the reason. In the first place if the manure lies dormant in the ground, in Assam it is doing so in a dry season with a minimum of loss due to seepage. But there is another possibility that cannot be rejected. The bush may *absorb* the bulk of the manurial dressing quite soon after its application and after elaboration store the nitrogen not used immediately for growth. Nitrogen unlike carbohydrate appears to be stored throughout the tissues of the bush. Under Assam conditions of light pruning little of this is sacrificed; under Ceylon conditions of clean pruning a large proportion goes into the fire as prunings. We should have to know much more about the physiological use of nitrogen in the bush before we could state with assurance anything more definite than this. This point is closely connected with another which Mr. Cooper words as follows: "We may say then that about three quarters of the effect of steady manuring at the same annual level, is due to dressings of the previous years, and only one quarter to the dressings of the current year." (Page 91). This may be interpreted in two ways: (1) that there is a residual portion of previous dressings in the soil having a belated effect, (ii) that the increase in size and vigour of a bush by reason of previous manuring makes

it a better forager for soil nitrogen, and that in this sense the effect of manuring is cumulative. This second interpretation is the correct one, and is borne out by Mr. Cooper's figures in the appendix. The return in immediate crop from manuring is approximately steady (what I have called the "*nitrogen* equivalent"); the subsidiary effect of continuous manuring is to raise the "residual equivalent."

Mr. Cooper's association with Tocklai is unfortunately drawing to a close. This memorandum is a distinguished contribution whereby his labours should be remembered with gratitude by all concerned with the culture of tea.

T. EDEN.