OBSERVATIONS ON THE PROGRESS OF CERTAIN MANURIAL TRIALS ON ST COOMBS

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I intend to open the afternoon session, which is devoted to the question of manuring, by abstracting some of the salient points from our programme of field trials on St Coombs. I shall restrict myself to a discussion of trials which are in existence on mature seedling tea, and I shall concentrate on bush development on the one hand and nitrogen levels on the other. This is not to be taken as representing any such restriction in the Institute's general approach to the broad subject of manuring.

NPK Trials No. 3 Field

The first of these trials was started by Dr Eden in 1931 and acquired a world wide reputation, because it was a pioneering effort in applying statistical methods of investigating manurial response in a tropical crop. The main treatments comprised three levels of each of the three major nutrients N, P and K. For many cycles some of the plots—referred to as "deficiency plots"—have had no P or no K, but I shall here concentrate on the behaviour of the 24 plots which have had all three nutrients at various levels, and which I shall call "the better-manured plots".

The trial came under my control in 1958 and we were faced with a major problem. Manurial levels, the nitrogen component of which, since 1937, had been unchanged at 40, 60 and 80 lb N per acre per annum, quite obviously called for review, especially as it was apparent that this tea was capable of giving a yield response to nitrogen in excess of 80 lb N. Bush vigour also demanded attention. Yields from the better-manured plots had for five cycles averaged close to 900 lb dry weight per acre per annum where 80 lb N had been the annual dose, but by 1958 frames were poor. The upper wood was thin while the main limbs and trunks were severely rotted. The damage almost certainly arose after the pruning at the end of 1949. Early 1950 was exceptionally dry for St Coombs and the 4½ acres of this trial mostly cover exposed slopes and hill tops, and have had no shade trees which might have prevented or lessened sun-scorch of the exposed wood. We had to decide how to bring the trial up to date in more than one respect, therefore, and there was little doubt about the first step. The Institute has preached the doctrine of "the well-being of the bush", consistently enough over the years, and we considered that it was justifiable in this NPK Trial to put this idea into practice by planning a rejuvenation pruning. This was to be done in two stages at each of which half of the old degenerate branches were to be sawn off at the trunk or close to ground level.

It was not possible to combine this treatment, scientifically, with a change in manurial levels which were therefore continued as before. The first hard prune was done in 1959 after resting for a few months, and recovery was better than expected especially so on the poorly manured plots, *e.g.* 40 lb N. It was soon clear that we had encouraged shoot formation from the base of the original trunk, usually in positions which would allow development unhampered by the intervention of rotting wood between the shoot and its root system. Casualties were no more than had resulted from previous prunes, which had been of the high cut-across type with minimal cleaning-out, and which had resulted in very little growth of healthy, well placed shoots from the trunk. Some bushes were in such a condition that they were collar-pruned, and even here the casualty rate was much lower than had been anticipated. Even in those plots where many bushes had suffered repeated defoliation as a result of 28 years' absence of potash manure, the recovery from this hard prune was quite good.

After 2½ years, when this trial had been in plucking for 18 months, we were able to see that the bushes had a potential vigour which was greater than we had expected. In the last 12 months of plucking we took yields of 640,790 and 1,010 lb per acre from plots receiving 40, 60 and 80 lb N respectively; omitting the "deficiency plots". Still more important is the fact that these yields were obtained in conjunction with a good growth of new wood. This in turn prompted us to bring the second stage of the rejuvenation prune forward to 2½ years. We also decided to treat the bushes harder after pruning and to increase manurial levels. Nitrogen, for example, was raised to 120, 150 and 180 lb N per acre per annum. Figures 1—4 illustrate the type of frame left after the 1962 prune.

Tipping in 1962 was earlier and lower than in 1959 and plucking was harder from the start. This treatment, although at first we doubted its wisdom, in fact had the desired effect. Although crops were low in the first year, nowhere more than 400 lb per acre, side branches and additional new shoots developed plentifully and at such a level that they could already be considered as part of the future frame. This corrected an error we had made in 1959, by being too gentle at the tipping stage, thereby fostering branching at too high a level. The second year of this cycle, from March 1963, has so far coincided with favourable weather and the rate of growth has increased encouragingly. At 21 months there was a good cover of side branches, see Figure 5, except in the deficiency plots but the plucking table still has room to expand. In 10 months, the second-year yields of the better-manured plots were already 825, 950 and 1,080 lb per acre for 120, 150 and 180 lb N. Monthly yields increased steadily over that period and for the last five months have averaged 95, 110 and 130 lb per acre, for N levels of 120, 150 and 180 lb, again in the better-manured plots.

A more detailed look at a typical bush, Figure 6, will emphasise that the bushes have produced plenty of new wood and maintenance foliage over this period.

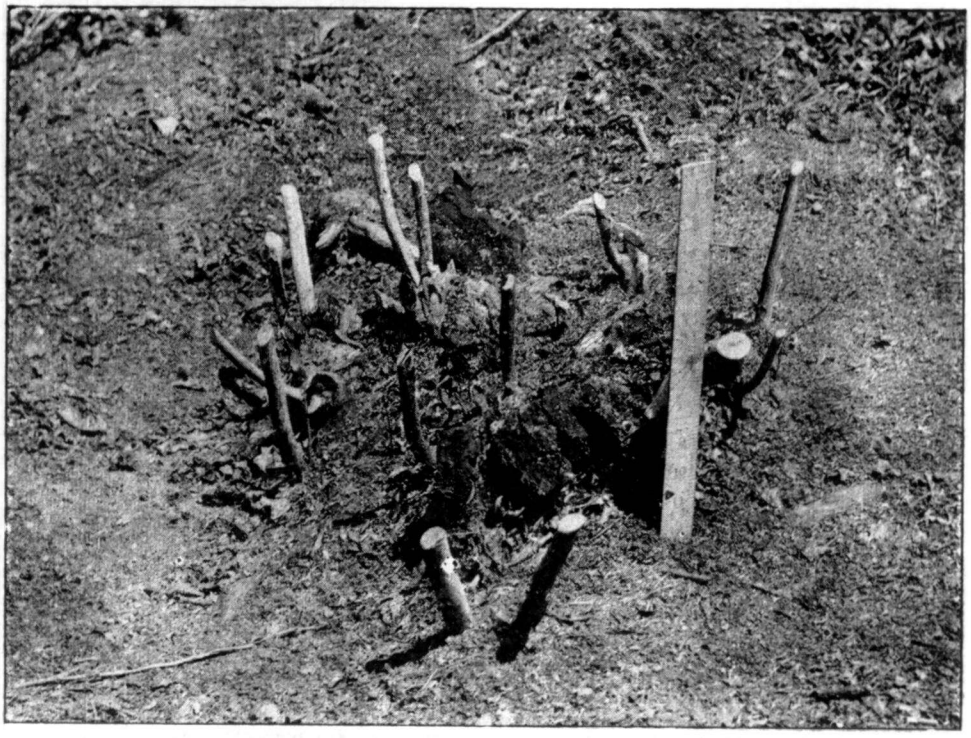
Before we leave this trial you might be interested to see one of the more severely potash deficient bushes, 21 months after the second saw-prune. It is surprising that it is still alive. (Not illustrated).

Phosphate Manurial Trial No. 13 Field

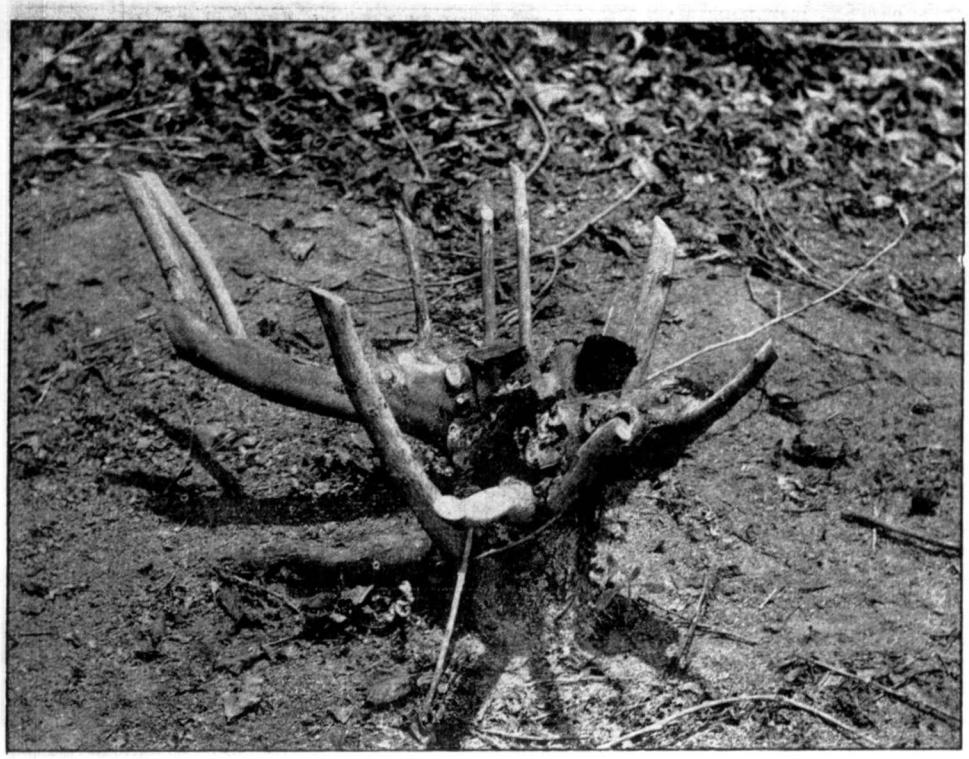
While we were involved in rejuvenation of the NPK Trial we also had another old trial which did not seem to be in a condition according with our ideas of bush vigour. This trial, until recent months, was designed to compare the effects of two types of phosphatic manure each at three levels of P_2O_5. Nitrogen and potash have been uniform for all plots and therefore I can merely quote certain observations to supplement what I have just said about the NPK Trial.

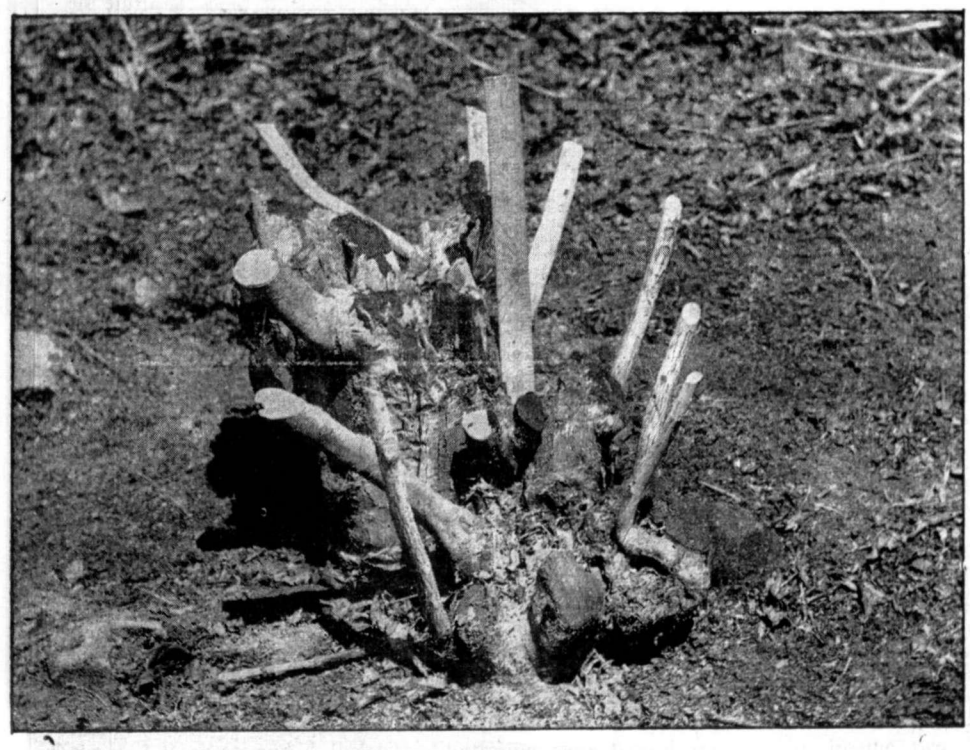
The bushes for the Phosphate Trial were planted in 1937, and the generally poor upper frames which were present in 1958 might have owed their condition to potash deficiency in the early years. Portsmouth (1950) had diagnosed this trouble and had increased the potash from 20 to 40 lb K_2O per acre per annum in 1950. Even this increase may not have been sufficient to have allowed an appreciable improvement in frames over the intervening cycles.

The pruning which we did in 1960 was hard and clean, using a knife only, and many bushes were reduced to multiple stumps rather than true branches. For reasons due to a shortage of staff at the time, the intended resting period after pruning had to be extended longer than was warranted by observation of the new growth. During the first year, nitrogen-deficiency symptoms showed when the shoots began to develop more rapidly after an initial lag, and the nitrogen dose for that year was then raised from the previous annual level of 80 lb N per acre to 120 lb N. At the



Figures 1.—(above) and 2 (below) — Frames in the No. 3 Field NPK Trial, 1962 prune. Showing new growth, two and a half years old, resulting from the 1960 prune on bushes which had lost most of the original trunk. Figure 1 illustrates one of the more severely damaged bushes.





Figures 3.—(above and 4 (below).—Illustrating more typical frames than in the two preceding Figures. The bush in Figure 3 is one of the few which had formed, prior to 1960, a new limb (on left) which was worth retaining.

Figure 5.—Showing the cover at 21 months from the second "rejuvenation prune" in two of the better-manured plots of the NPK Trial. Deficiency plots constitute the poor tea in the foreground.

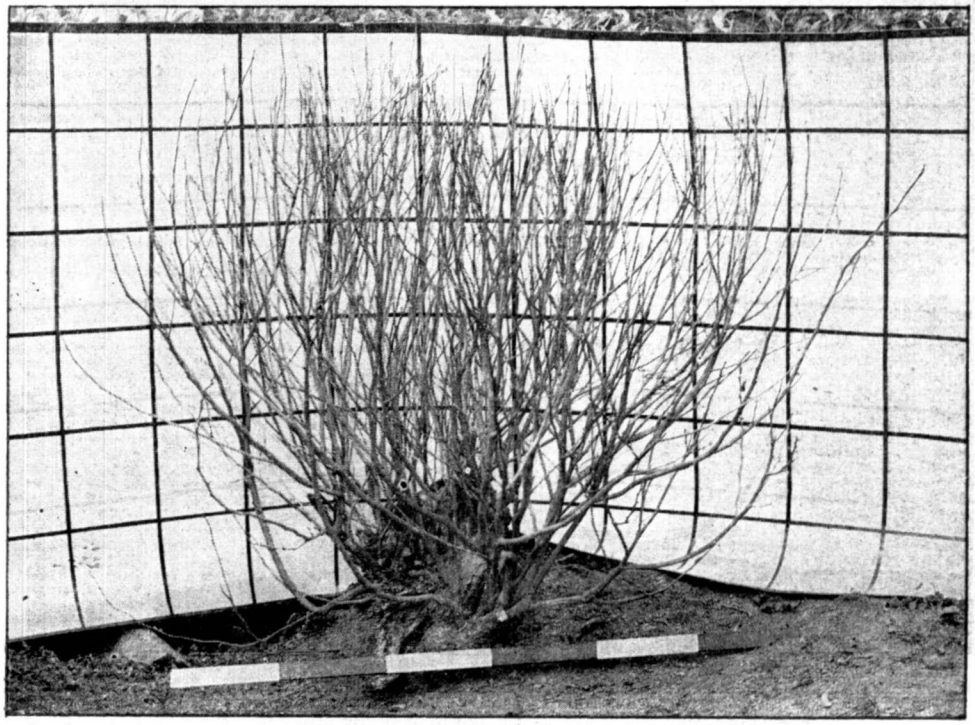


Figure 6.—A bush defoliated by hand to show the development of a new frame ,21 months after the 1962 prune. Scales marked in 6-inch divisions.

Figure 7.—The Phosphate Manurial Trial in No. 13 Field, showing an average group of frames after the 1963 prune.

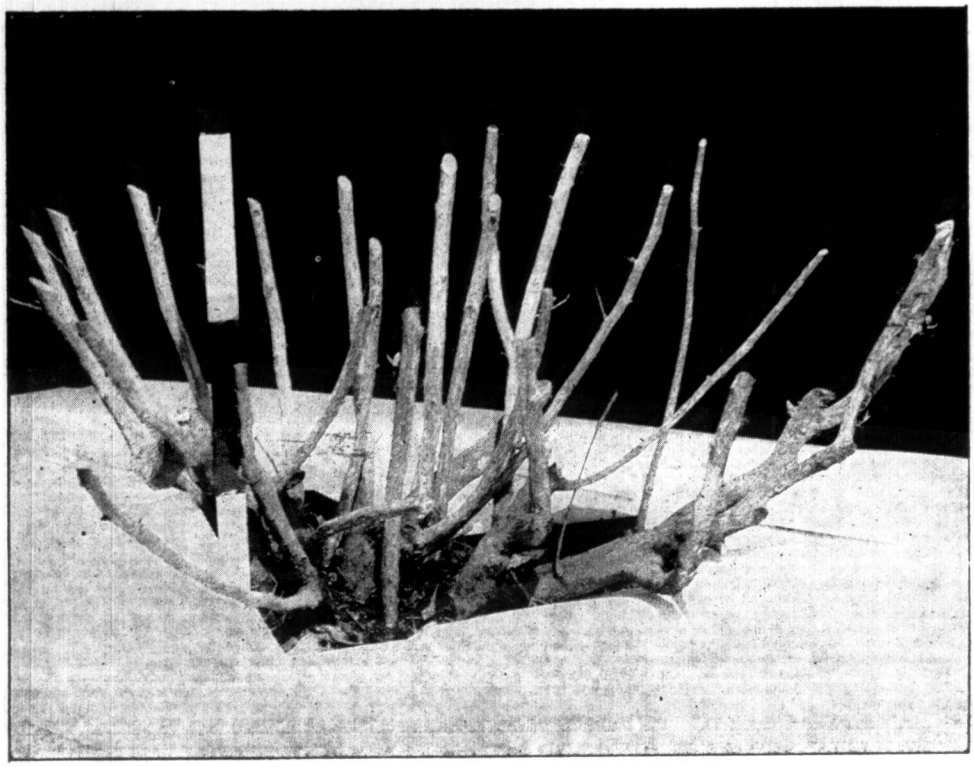


Figure 8.—Illustrating the development of new wood, three years old, from a small bush, prior to thinning out. Scale in both Figures marked in 6-inch divisions.

same time we decided to make a further increase, to 180 lb N, for each subsequent year and to increase the potash in proportion to nitrogen. Potash is now at 90 lb K_2O per acre per annum.

The cycle after the 1960 clean prune ran for only three years, as we decided to change the objective of the trial, but in that period we had made some interesting observations. In the second year, which covered only 10 months of plucking, the overall yield was 1,460 lb per acre. In the third year it was 2,100 lb, each year receiving 180 lb N. The illustrations of the development of new wood over the three-year cycle speak for themselves; see Figures 7 and 8.

Our experience with these two trials leads me to suggest that in the older, NPK Trials, the better-manured plots with 180 lb N ought to be capable of reaching the 2,000 lb mark in their third year, even though the wood development is not so advanced as it was at a comparable stage in the Phosphatic Tral. In contrast, bush spread seems to be superior in the NPK Trial.

Foliar - Spraying Trial No. 9 Field

Among the newer manurial trials is one that should soon provide valuable comparison with the two older trials, because it is on a very different agronomic basis. Known as the Foliar—Spraying Trial, it aims to study the relation between three levels of N as a soil application, and three levels of Zinc sulphate, applied as a foliar spray at three frequencies of application each year.

Here the tea was in a much better condition than in the two earlier trials. Better jat and frames, a more sheltered location and more generous manuring in recent years. Approximately 150 lb N (in a balanced mixture) had been applied in the year before I took over and pruned these plots. From a slightly older and simpler trial in the same field (to compare three different forms of nitrogenous manure) we already had information to suggest that this type of tea, under our methods of management, could respond to more than 150 lb N per acre per annum. The three levels of N for the Foliar-Spraying Trial were therefore fixed at 75, 150 and 225 lb per acre per annum. Pruning, in November 1962, was a cut-across with minimal cleaning - out, and plucking was hard from the start, perhaps a little more vigorous than our recent plucking in the NPK Trial.

In the first 12 months from pruning yields were 1,050, 1,125 and 1,200 lb per acre, on 75, 150 and 225 lb N respectively. Monthly yields seemed to have reached their peak early in this period, which covered an unusually favourable South-West monsoon. These plots have averaged, for the three N levels and over the last five months, 135, 155 and 170 lb per acre per month. This compares with 95, 110 and 130 lb of made tea per month over the same five months from some of the NPK Trial plots, on 120, 150 and 180 lb N.

The Foliar-Spraying Trial plots, in addition to the advantages quoted show fewer virus-like distortions than either of the two older trials and are less interrupted by drains and vacancies than the NPK Trial plots. By comparison therefore I would have expected their yields to have been better than they actually are. One observation is of the generally poor development of side-branches which is bound to slow down the spread of the plucking table, whereas in the NPK Trial the rapid growth of side-branches is one of the most encouraging features.

It is always difficult to compare one trial with another, especially when they are in their early stages—and I consider that the two older trials must now be treated as relatively new, in view of the drastic renewal of frames. In a few year's time we shall be in a better position to judge how the bush response to manure in these three

trials has been affected by variations in jat and in environment, both above and below ground level, and by methods of management. The figures of yield levels and manure levels which I have quoted must be read in context and must not be taken to support this or that "theory of manuring". Proper evaluation of the relation between yield and nitrogen, or any other nutrient, must wait until more data are available.

Having said that, I now want to digress a little to develop a theme which has run through this paper: pruning in relation to bush development. I hope I shall not be mis-quoted as favouring saw-pruning "for the fun of it". My contention is that if a bush, in our manurial trials or elsewhere, is to respond properly to manure the frame should be in a condition which permits the most efficient transport of nutrients and foodstuffs. If it is necessary and possible to take positive action and remove large but unhealthy parts of a bush, in order to promote the build-up of a well-developed new frame, then take positive action. This, of course, is a point of view which has gained favour with a number of planters in recent years, and their accumulated experience warrants consideration. You will appreciate that I do not include the Low Country in these remarks. It is possible that our oldest manurial trial, the NPK plots, may already have something useful to offer in developing these ideas. You will remember that the increased manurial levels, between 120 and 180lb N, already seem to have promoted a worthwhile yield response, 1,080 to 1,300 lb per acre over 22 months while new frames are developing rapidly. And this is after extremely hard treatment between 1959 and 1962. You will also recall that the second trial, the Phosphate Manurial, after a shorter time lag and less rigorous treatment, reached a yield of 2,100 lb in its third year—by present-day standards a respectable yield level. Also on 180 lb N.

From experience I feel that there is still much tea, in various Districts, which is capable of a performance well above its present level. More and more estates are, of course, showing what can be done to increase yields and bush vigour at one and the same time, but perhaps the rate of increase itself might be capable of improvement still within the limits of economics. It must be obvious by now that I consider the relation between general bush development and response to manure to be of paramount importance. So much so that two of my newest trials concentrate on this aspect. One will study the relation between manurial levels and two extreme types of pruning, together with a study of distribution of a given cycle dose of manure between the individual years of the cycle. The other will study the effect of size of dose of manure, at the applications just before and just after pruning.

I have simplified the accounts of these trials, but even so you may feel that matters are becoming rather involved. If so, then I have at least achieved one object. Manuring *is* a complex subject, within itself, and in its relation with other agronomic factors. We must not forget that. Our research programme tries to remove these complications, but first our trials must be planned to take them into account as far as practicable for each series of trials. No quick answer can be expected, and tea itself is a crop which would make attempted short cuts dangerous. Its cropping capacity depends on a balance between check and growth, with particular reference to plucking. If it were possible for example, that level of manuring could affect the position of the point of balance, then our ideas on the relation between cropping and manuring would have to change. With this state of affairs we could not expect a simple answer to questions relating to the best way of using manure in estate practice. In the course of the afternoon's discussions we shall no doubt have to emphasise this again and again, and I hope that we shall thereby be able to explain why there is so much need for a greatly increased programme of experiments, yours as well as ours.