

THE LACK OF PHOSPHATE IN CEYLON S.W.
ZONE SOILS. A CHATTY EXPERIMENT
WITH MAIZE.

H. W. R. BERTRAND

THE following experiment was carried out in April, 1939, with a view to finding out if there was a phosphate deficiency in the soil of a field which was to be replanted with budded Rubber. It was not intended to publish the results at so late a date because the subsequent work of the Rubber Research Scheme (Ceylon) has already shewn that in most of such soils phosphoric is the first limiting factor in the growth of young Rubber. Some recent and unreplicated observations on the effect of phosphoric on the growth of manioc have prompted the writer to publish a brief account of the maize chatty experiments as it would seem that these might have a useful bearing on the production of food-stuffs, particularly in young replanted Rubber clearings. They seem, also, to offer a technique which is within the reach of anyone and which may be of practical help in solving a number of soil problems, such, for example, as the rate of "reversion" of the various vehicles of phosphorous in our top-and subsoils.

The two following experiments with manioc are not capable of statistical analysis. They would not be mentioned except that, following the highly significant statistical results of the chatty experiments, they are some small further proof of the general need for phosphoric of most economic plants in our soils.

1. In a Rubber nursery on upland laterite soil, which had been replanted 5 or 6 times in different parts during the last few years, a portion 40 ft. by 80 ft. approximately, was planted in manioc. When the plants were about 9" high both halves, 40' x 40', were fully manured with Ground Nut Cake and ashes. One half was given Safaga phosphate at a rate of 250 lb. per acre (73.7 lb. P 205). After nearly 3 months there has been no appreciable difference. Investigation of the past history of the nursery shewed that it had been very fully manured with complete N. P. K.

2. In the bungalow garden there was a fairly large area which had been levelled off down to the subsoil some 22 years ago and allowed to grow grass. In this area a uniform plot

SUB-SOIL SERIES.



Left to right—

1. Complete N. K. plus Superphosphate.
2. " " " Safaga phosphate.
3. " " " Basic slag.
4. " " No phosphate.

approximately 20×38 ft. was divided into three beds of 20×12 . All three beds were uniformly manured with Gr. Cake and ashes. The middle bed was given Rock phosphate at approximately 250 lb. per acre. Almost from the start this bed ran away from the other two. At one time the plants were about twice as high, but, having reached nearly the normal maximum, the others are now slowly catching them up.

It is, of course, established that heavy starch producers, such as potatoes, require much potash, but it is obvious that no amount of potash can effectively function if phosphoric is so lacking as to limit growth. On the other hand, if addition of phosphoric enables the plant to put up its "factory" in appreciably shorter time, relatively cheap applications may materially expedite the food drive.

THE MAIZE CHATTY EXPERIMENT.

The Chatties.—40 of these were bought. They were approximately 5" deep with mouths closely averaging 10" diameter, which was very nearly the maximum diameter. Holes were knocked in the bottom for drainage. The experiment was started on April 30, 1939.

Twenty chatties were marked 1 to 20 and the others marked 1x to 20x. The first series were filled with equal amounts of well mixed and sieved samples of soil taken from the filled holes in the field. These were called the "Top-Soil" series.

The X series were filled with well mixed samples of the subsoil taken from various parts of the clearing. These were called the "Red Soil" series.

All 40 chatties were manured with 2 gm. each, separately weighed, of Sulphate of Ammonia, and .7 gm. of Muriate of Potash. This was equivalent to 70 lb. per acre of Nitrogen and Potash.

No. 1-5 were given 2.3 gm. Superphosphate. (about 60.5 lb. P. per acre.)

No. 6-10 were given 2.3 gm. Safaga phos. (about 99 lb. P. per acre).

No. 11-15 were given 2.3 gm. Basic Slag. (about 64 lb. P. per acre).

No. 16-20 (including, of course, 16x to 20x) had no phosphoric.

These applications of phosphate were based on current and more or less normal prices. The method is open to scientific criticism, such experiments usually being laid down with equal amounts of P205, but the writer wanted to know, as soon as possible, which vehicle of phosphate would give the best return for equal amounts spent.

The pots were sown with 10 maize seeds each, later thinned to 5 seedlings. Tested with a B. D. H. Soil Indicator all shewed an equal and slight acid reaction. They were changed round daily to ensure their receiving equal amounts of water and light.

On June 14th, 45 days after planting, all chatties in the top-soil series (except the first one of each, Nos. 1, 6, 11, 16) were dug up, roots carefully washed, and put into the hot loft to dry in separate numbered pans. When very thoroughly dried each lot was weighed.

| DRY WEIGHTS IN GRAMMES OF WHOLE PLANTS IN TOP-SOIL | | | | | | |
|--|---------------------|-----------------|----------------|-----------|--------|--------|
| Replica- tions | Super- phosphate | Safaga Phos. | Basic Slag. | Controls. | Totals | |
| 1 | .. 41.0 | .. 50.5 | .. 52.5 | .. 33.5 | .. | 177.5 |
| 2 | .. 48.5 | .. 59.5 | .. 56.5 | .. 34.0 | .. | 198.5 |
| 3 | .. 51.5 | .. 52.5 | .. 41.0 | .. 29.0 | .. | 174.0 |
| 4 | .. 49.5 | .. 40.0 | .. 51.5 | .. 24.5 | .. | 165.5 |
| Totals | .. 190.5 | 202.5 | 201.5 | 121.0 | | 715.5 |
| Means of 4 | .. 47.6 | 50.6 | 50.4 | 30.2 | | (44.7) |

The Standard Error of a mean of 4 = 2.9

| | | | |
|---------------------------------------|--------|----------------------|-------|
| Significant difference (1 in 20 odds) | = 9.3 | Per cent of Controls | 30.8% |
| „ (1 in 100 odds) | = 13.3 | „ | 44.3% |
| „ Super minus Control | = 17.4 | (58%) | |
| „ Saf. Phos.— | = 20.4 | (67%) | |
| „ Basic Slag.— | = 20.2 | (67%) | |

The effect of phosphate in all three forms is highly significant.

The Sub-Soil Series.—On the 27th June, *i.e.*, 57 days after planting, the “red-earth” pots were dug up, washed and dried in the hot loft.

| DRY WEIGHTS IN GRAMMES OF WHOLE PLANTS IN SUB-SOIL SERIES | | | | |
|---|---------------------|-----------------|-------------|----------|
| Replica- tions | Super- phosphate | Safaga Phos. | Basic Slag. | Controls |
| 1 | .. 30.5 | .. 30.5 | .. 14.5 | .. 0.5 |
| 2 | .. 12.0 | .. 45.5 | .. 21.5 | .. 1.5 |
| 3 | .. 26.0 | .. 25.5 | .. 27.0 | .. 1.0 |
| 4 | .. 29.5 | .. 65.5 | .. 22.5 | .. 1.0 |
| Totals | .. 98.0 | 167.0 | 85.5 | 4.0 |
| Means of 4 | .. 24.5 | 41.8 | 21.4 | 1.0 |

In this series the differences in favour of phosphoric are so marked that statistical analysis would only unnecessarily prolong the account of a small experiment. The Controls grew barely an inch high and, as plants, were a complete failure in every case, whereas the Safaga phos. pots grew to a weight no less than 41.8 times their weight. In this series the differences between

the three vehicles of phosphoric are of interest. They are probably significant and certainly merit further inquiry in view of the deficiency of humus in replanted soils.

In both the Top-Soil and Sub-Soil series one chatty of each treatment and one of each of the controls was kept back and weighed up, after drying, on the 26th July. They were dug up 72 days after planting and appeared to be beginning to stale on account of lack of root room. Although this reduced the statistical value of the two series previously detailed it was considered advisable, in order to determine how long a similar experiment might be run in future. The dry weights in grammes were as follows :—

| | | Top-Soil | | Sub-Soil |
|--------------|----|----------|----|----------|
| Superphos | .. | 114 | .. | 39 |
| Safaga Phos. | .. | 124 | .. | 34 |
| Basic Slag. | .. | 111 | .. | 32 |
| Controls .. | .. | 86 | .. | 4 |

As these two series have only one Control in each they are not capable of statistical analysis, but, combined with the previous figures, they clearly indicate, in the case of the Sub-Soil series, the deficiency of phosphoric.

Summary.—The results of the experiment show that, in the soils examined, particularly the Sub-Soil, the lack of phosphoric is a serious limiting factor in growth. They seem also to indicate that Ground Rock phosphate is the best money value in these conditions.

In conclusion, my thanks are due to Mr. T. E. H. O'Brien, Director of the Rubber Research Scheme (Ceylon), and to his officers, Dr. Whelan for his encouraging comments, and to Mr. Clement de Silva for the trouble he has taken to examine and improve on my statistical figures.