STUDIES ON THE GROWTH OF LEUCAENA LEUCOCEPHALA

2. EFFECT OF LIME AT SOWING ON PRODUCTION FROM A LOW CALCIUM STATUS SOIL OF THE SOGERI PLATEAU

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ABSTRACT

Leucaena is difficult to establish on low calcium status, acid soils of the Sogeri family on the Sogeri Plateau. The Peru strain of Leucaena was sown and lime applied at 1, 5 and 10 tons per acre broadcast, and at 1, 2, 4 and 8 cwt per acre drilled in the row. Significant responses were obtained to the application of 5 and 10 tons per acre ($P < 0.05$). As agricultural lime is not at this stage produced in Papua New Guinea, use of these high levels of lime cannot be considered economic.

INTRODUCTION

THE main industry of the Sogeri Subdistrict is the cultivation of rubber (*Hevea brasiliensis*). A large area of the Subdistrict is not suited to this crop. The soils of this area were described by Mabbutt *et al.* (1965) as members of the Sogeri family. They are very strongly acid, red to brown clays, with total exchangeable metal ions of approximately 5 milliequivalents per 100 g. The calcium status is low. At Ilogo Plantation exchangeable calcium was 1.6 m-equiv. per cent in the 0 to 6 in layer, and 0.8 m-equiv. per cent in the 6 to 12 in layer (Murty, personal communication).

The vegetation on this soil type is open savannah grassland in which *Ophiuros* sp. and *Themeda australis* are dominant grass species. Tree cover is provided mainly by *Eucalyptus tereticornis* and *E. papuana* (Heyligers 1965).

Because of proximity to Port Moresby a possible use for these grasslands is for the production of beef. For maximum productivity the incorporation of a legume is essential. Under suitable conditions Leucaena has the ability to produce a large quantity of highly nutritious forage (Takahashi and Ripperton 1949; Anslow 1959; Hutton and Bonner 1960). Because of its tree habit it also has greater drought resistance than shallow-rooting prostrate legumes. It was decided to investigate the establishment of this legume on a soil of the Sogeri family.

Leucaena had been reported by local planters to be difficult to establish. They considered that the altitude (about 2,000 ft) was too high for growth. This is unlikely because of the common use of Leucaena as coffee shade in Papua New Guinea up to altitudes of 5,000 ft.

Several workers have reported responses of Leucaena to applied calcium (Takahashi and Ripperton 1949; Dijkman 1950; Wu 1964; Esquivel 1965). Whether calcium is required for improved nodulation, as postulated by Norris (1967), to alter soil pH and thus improve nodulation (Esquivel 1965), or whether the plant itself has a high requirement for the element, is not clear from the available literature.

An experiment was designed to show the effect of lime on the productivity of Leucaena on the soil type in question.

MATERIALS AND METHODS

The experiment was established on a red-brown clay of the Sogeri family at Bisianumu Animal Industry Station on 23rd and 24th February, 1967. It occupied a total area of 102 x 182 ft, plots being 8 x 16 ft. A distance of 10 ft was left between plots within blocks and between blocks, with an 18 ft border at each end and a 20 ft border at each side.

The treatments were 0, 1, 5 and 10 tons of lime per acre broadcast, and 1, 2, 4 and 8 cwt

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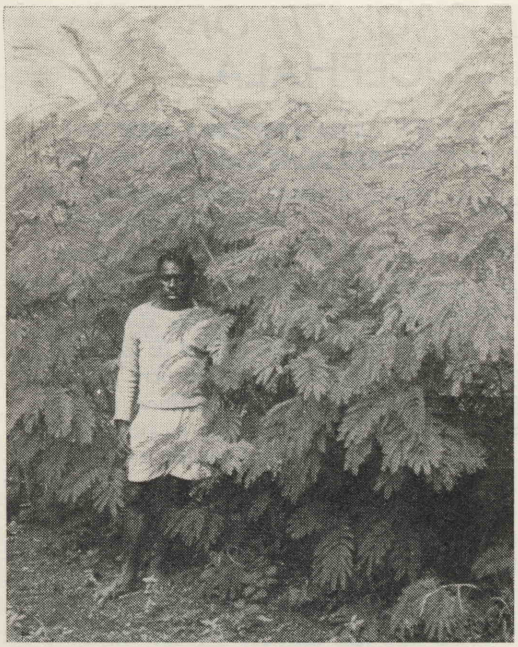

Plate I.—Plot of Leucaena which had received equivalent of 10 tons of broadcast lime per acre, 23rd January, 1968

drilled in the row. A randomized block design with three replicates was used. No other fertilizer was applied.

The trial was sown to the Peru strain of *Leucaena leucocephala* at the rate of 10 lb per acre, each plot comprising four rows 2 ft apart. Prior to sowing, seed was scarified using the method of Gray (1962) and was inoculated with Rhizobium strain NGR 8.

Broadcast lime was worked into the soil with spades. Drilled lime was placed in a shallow furrow directly under the seed.

The experiment was inspected twice prior to harvest. Observations were made on height, colour, establishment and nodulation. At harvest the central 14 ft of the two inside rows of each plot were cut to 3 inches from ground level and the green weight recorded.

RESULTS AND DISCUSSION

Progress of Trial

When inspected on 14th April, 1967, there were no obvious differences among treatments. Average height of plants was 4 in. In a few plots, some plants were yellow. This was not related to treatment and all plots were effectively nodulated. On inspection, roots of yellow plants were found to have been damaged by an insect.

A second inspection was made on 22nd September of the same year. By this time responses to treatment could be seen. Mean height of plants in control plots was 15 in, while mean height of plants which had received 10 tons of broadcast lime was 36 in. In all cases, plots which had received broadcast lime were greener and more even in growth than controls. Plots which had received drilled lime did not respond as well, but no valid comparison can be made as rates were not comparable.

The experiment was harvested on 23rd January, 1968. At harvest it was observed that a fertility gradient ran across the site from block 1 to block 3. The effect was partially taken into account by the randomized blocks design.

Effect of Lime on Forage Production

Plots which had received high rates of lime were taller than controls and darker green (see *Plates* I and II). The effect of treatments on green matter yield was very highly significant ($P < 0.001$).

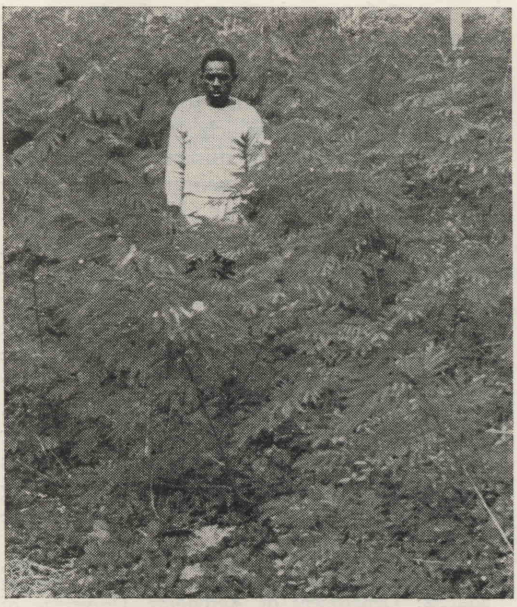

Plate II.—Control plot 23rd January, 1968

The values for the various treatments are shown in the *Table*. A Duncan multiple range test was performed on the results. The responses to 5 and 10 tons were significantly different from each other and all other treatments at the 0.05 level of probability.

Figures 1 and 2 show the regressions of the two methods of lime application. For broadcast lime

$$Y = 8{,}552.69 + 1{,}327.89X \quad (t = 9.05^{***}) \quad (1)$$

(very highly significant response), while for drilled lime the equation is

$$Y = 8{,}248.42 + 215.86X \quad (t = 0.913 \text{N.S.}) \quad (2)$$

(no significant response), where in each case Y = yield of green forage in lb per acre, and X = lime in tons per acre (1) and cwt per acre (2).

The main point of interest that arises from these results is the continued linear response to broadcast lime up to 10 tons per acre. This appears to indicate that it is the plant itself which requires the lime. If lime were required for production some visible response to lower treatment levels would have been expected even if only in the initial stages of the experiment. On the other hand, if the lime were required to change pH and thus improve nodulation, responses to the higher levels could be expected as Leucaena is very tolerant of highly calcareous soils (Mullenax 1963).

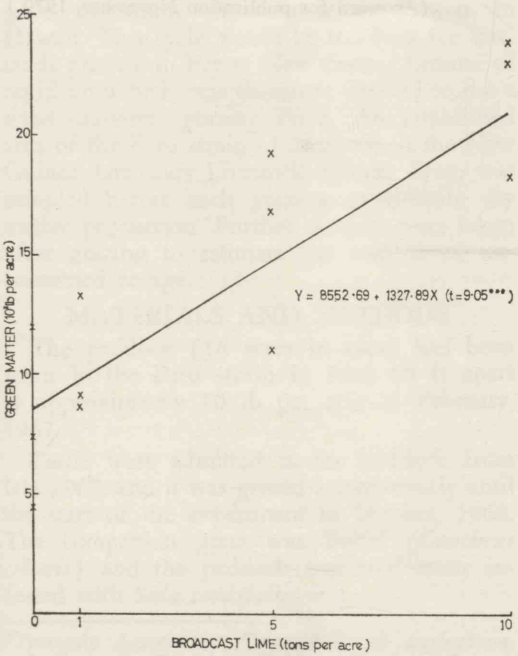

Figure 1.—Response of Leucaena to broadcast lime at 1, 5 and 10 tons per acre

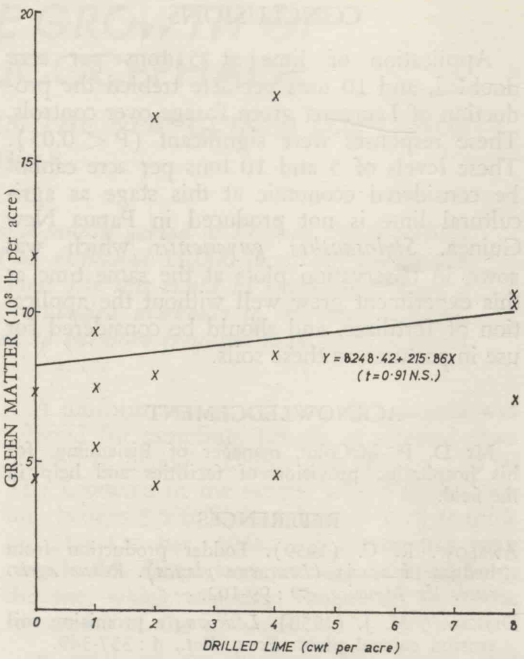

Figure 2.—Response of Leucaena to drilled lime at 1, 2, 4 and 8 cwt per acre (there was no significant increase in production)

Table.—Effect of lime on production of Leucaena at Sogeri

Treatment	Mean Yield Green Mattter (lb per acre)
10 tons broadcast lime per acre	21,560
5 tons broadcast lime per acre	15,660
1 ton broadcast lime per acre	10,291
4 cwt drilled lime per acre	10,120
2 cwt drilled lime per acre	9,536
8 cwt drilled lime per acre	9,365
Control	7,941
1 cwt drilled lime per acre	7,478

Any two means not enclosed by the same brace are significantly different at the 5 per cent level.

CONCLUSIONS

Application of lime at 5 tons per acre doubled, and 10 tons per acre trebled the production of Leucaena green forage over controls. These responses were significant ($P < 0.05$). These levels of 5 and 10 tons per acre cannot be considered economic at this stage as agricultural lime is not produced in Papua New Guinea. *Stylosanthes guyanensis* which was sown in observation plots at the same time as this experiment grew well without the application of fertilizer, and should be considered for use in pastures on these soils.

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