The Response of Ipil-Ipil (Leucaena Leococephala) to Soil pH *

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Ipil-ipil (Leucaena leucocephala) is a tropical leguminous plant generally referred to as the "alfalfa" of the tropics. It is gaining popularity as animal feed ingredient. The leaves are reported to contain 25 per cent crude protein and 0.04 to 0.07 per cent carotene (3).
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Although the culture of ipil-ipil has not been given extensive attention, it is not uncommon to find them growing luxuriantly in the rolling or level areas in most places in the Philippines. They are used as shade for coffee, cacao, or ginger. The trunk and branches are excellent for making charcoal; the leaves are ground into meals for animal feeds. Attempts to grow them in acidic, reddish-brown Barotac loam soil at Camp Higher Ground, Barotac Viejo, Iloilo, resulted only in stunted seedlings compared with those growing in the slightly acidic dark soil of that municipality.

Soil reaction affects plant development largely by its influence on the availability of certain elements essential for growth (5). Provided there is adequate nutrient, plants can tolerate pH fluctuation from 4.0 to 8.0; the growth is adversely affected only at pH below 3.0 or at pH above 9.0 (2). At low pH phosphorous, calcium, and magnesium usually become limiting or deficient; at high pH most micronutrients become hardly available.

Generally, legumes need soils of pH 6.0 or above for optimum growth. The soil reaction near neutral is also optimum for effective nitrogen fixation by most bacteria which live in association with the roots of legumes (1). For example

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various strains of Rhizobia have optimum reaction for growth at pH 5.5 to 7.0 to 10 on the alkaline side (6). Nodulation in *L. leucocephala* is carried out by only a few strains of bacteria (4). This implies that the pH range for ipil-ipil may not be too wide.

The object of the study was to determine nodulation in and early growth of ipil-ipil seedlings under varying soil pH.

MATERIALS AND METHODS

Ipil-ipil seeds were sown in earthen pots filled with six kilograms of either Sta. Rita clay loam or Barotac loam soils. The chemical properties of these soil types are given in Table I. The Sta. Rita clay loam has higher CEC, available prosphorus, extractable potassium, and pH than the Barotac loam soil. The exchange complex of the Barotac loam soil is highly saturated with hydrogen ions.

There were four pH treatments consisting of adjusting the pH of the potted soil to 3.5, 4.5, 5.5, and 6.5. with HCL or $Ca(OH)_2$. Each treatment was replicated four times and arranged in split-plot in randomized complete block design with soil type as the main plot.

Table 1

Chemical Properties of Barotac Loam and Sta. Rita Clay Loam Soils.

Chemical property	Barotac loam	Sta. Rita clay loam
pH (1:1) soil-water ratio)	4.9	6.9
Organic matter (%)	1.48	2.57
Exch. potassium (m.e./100gm)	0.63	1.26
Available phosphorus (ppm)	0.43	2.19
Total nitrogen (%)	0.12	0.19
CEC (m.e./100 gm)	12.57	30.50
Hydrogen saturation (%)	62.40	23.00

The seedlings were thinned to ten per pot two weeks after germination and allowed to grow for a period of 60 days. The data obtained per pot at the end of the experiment were: (1) plant height from five tallest plants, (2) number and weight of nodules, (3) weight of shoots, and (4) soil pH and exchangeable hydrogen. All weights were made on the HS Mettler analytical balance and the pH's were measured with the Corning pH meter Model No. 7. All data were statistically analyzed using the analysis of variance and treatment means were compared using the Duncan's Multiple Range test.

RESULTS AND DISCUSSIONS

Changes in pH of the soil. The adjusted soil pH's for both soil types were not maintained throughout the duration of the experiment. The initial difference of 1.0 pH unit between two successive pH treatments decreased from 0.3 to 0.5 units in Barotac loam soil and from 0.2 to 0.7 units in Sta. Rita clay loam from 5.7 to 7.0 instead of the original pH 3.5 to 6.5. Despite the changes in pH, there was no alteration in the order of increasing acidity, i. e., the originally more acid treatments remained acid at the end

Table 2

Soil pH and Exchangeable Hydrogen at 60 Days after Adjustment of Soil pH

Initial	Barotac Loam		Sta. Rita Clay Loam	
pH	pH*	Exch. H	pH*	Exch. H
		m.e./100gm		m.e./100 gm
3.5	4.9	8.8	5.7	3.7
4.5	5.2	4.1	5.9	3.0
5.5	5.7	3.3	6.3	2.5
6.5	6.2	2.5	7.0	2.0

* pH at 60 days.

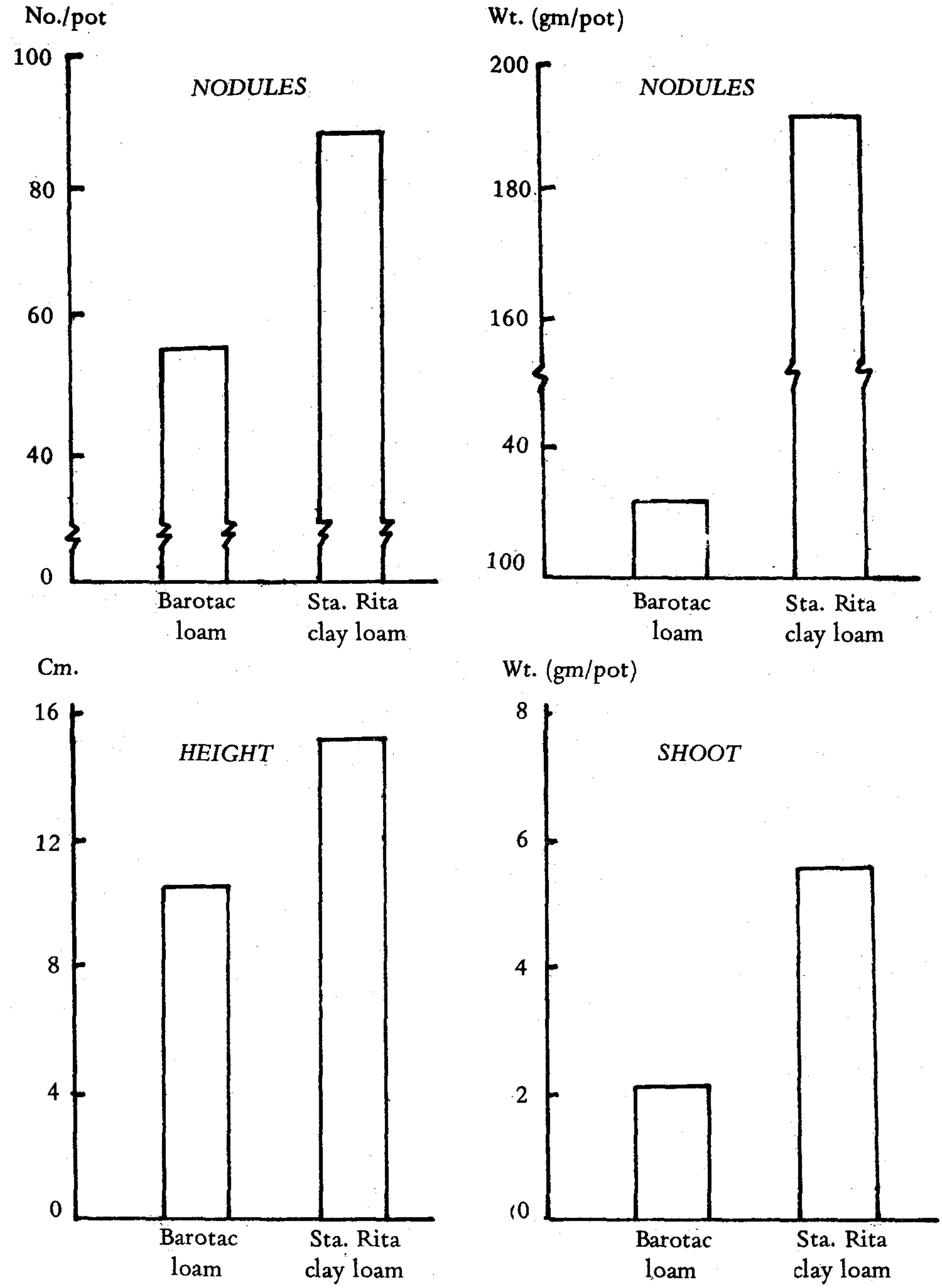

Fig. 1. The Agronomic Characteristics of Ipil-ipil *(Leucaena leucocephala)* Seedlings Grown in Barotac Loam and Sta. Rita Clay Loam Soils at Sixty Days of Growth.

of the experiment. This fact is supported by the amount of exchangeable hydrogen which decreased at increasing pH in both soil types. These data are shown in Table 2. It was further observed that for a given pH, the amount of exchangeable hydrogen was higher in Barotac loam than Sta. Rita clay loam soil.

Unless specified, the succeeding discussions will make reference to the original values of the pH treatments instead of the final pH for convenience in the presentation of the results.

Growth characteristics under two soil types. The differences in various growth characteristics of ipil-ipil seedlings planted in Barotac loam and Sta. Rita clay loam soils are graphed in Figure 1. The average height of plants at 45 days after sowing was 10.4 cm. in Sta. Rita clay loam and 7.6 cm. in Barotac loam soils. This increased to 13.9 and 10.8 cm. respectively, at 60 days of growth.

Ipil-ipil grown in Sta. Rita clay loam soil produced more dry matter than those planted in Barotac loam soil. The total shoot weight in the former was 5.5 gm. while the latter had 2.1 gm. per pot. The weight and number of nodules per pot in Sta. Rita clay loam was 192.8 and 90.0 mgm, respectively. On the other hand, there were 57.3 nodules found in Barotac loam soil, all weighing 111.9 mgm. The above observed characteristics were all significantly lower in Barotac loam than Sta. Rita clay loam soils.

The results show that the more fertile and less acidic Sta. Rita clay loam soil provided better growing medium for ipil-ipil than the more acidic Barotac loam soil. Better growth of ipil-ipil in Barotac loam may be obtained by liming the soil.

Influence of soil pH on agronomic characteristics. The data are presented in Table. 3. The results show that plants grown under high pH were taller than those planted in more acidic conditions. The corresponding heights at decreasing pH treatments from 6.5 to 3.5 were 14.3, 12.7, 11.7, and 10.2 centimeters.

The total dry matter weight was heaviest at treatment pH 6.5. This decreased at increasing acidity and was lowest at treatment pH 3.5. Increasing the pH increased the number and weight of nodules in the roots of ipil-ipil seedlings. At treatment pH 6.5, there were 97.4 nodules; at pH 5.5; 71.0; at pH 4.5, 63.9; and at pH 3.5, 56.2 nodules. In the same order of pH treatments, the corresponding weight of the nodules were 206.2, 151.2, 133.4, and 118.8 milligrams. The nodules were not examined whether they were effective or non-effective, but the data implied that nodulation in ipil-ipil could be adversely affected by low soil pH.

The relationship between nodulation and soil pH is illustrated in Figures 2 and 3. The abscissa values represent the final pH of the two soil types. For Barotac soil, the relationship is curvilinear; for Sta. Rita clay *loam, it is linear. It is* noted from the figure that the number and weight of nodules decreased even at pH as high as pH 5.0. Generally at pH higher than 5.5, nodulation appears to be a linear function of soil pH.

Table 3

Agronomic Characteristics of Ipil-ipil (Leucaena leucocephala) as Influenced by Soil pH

Initial pH	Height 60 days	Number of nodules	Weight of nodules	Weight of shoot
	cm	no./pot	mgm/pot	gm/pot
3.5	10.2 c	56.2. b	118.8 b	2.8 c
4.5	11.7 b	63.9 b	133.4 b	3.7 b
5.5	12.5 b	71.0 b	151.2 b	3.9 b
6.5	14.3 a	97.4 a	206.2 a	4.8 a

Treatment means followed by the same letter are not significantly different from each other at the 5 per cent level of probability.

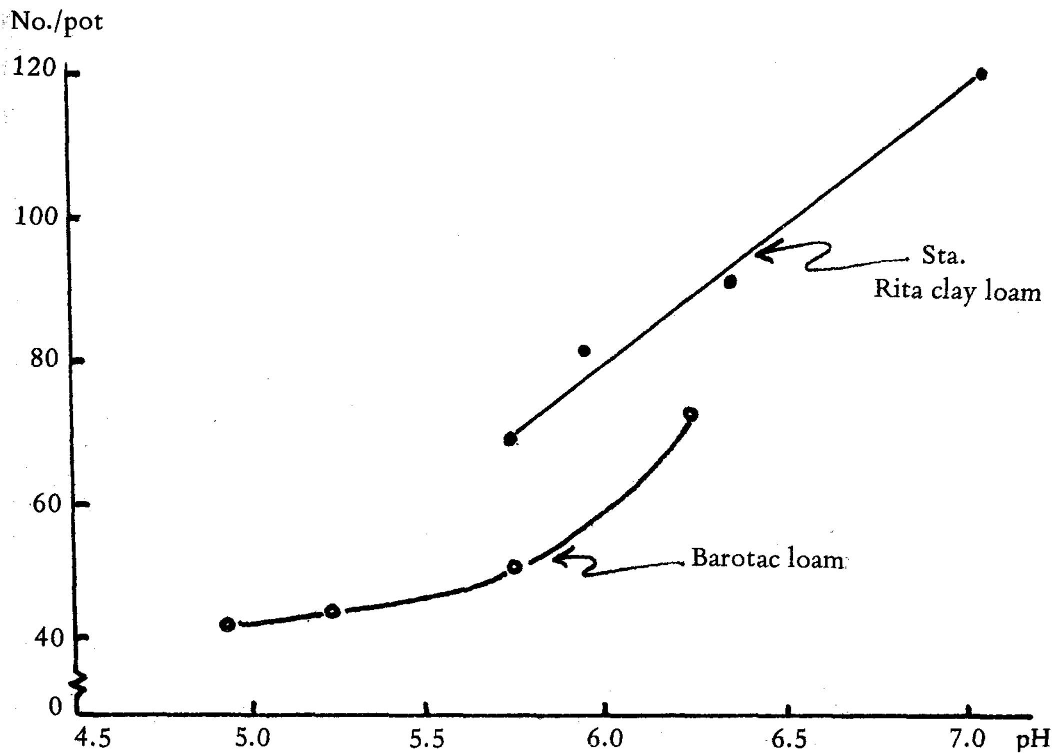

Fig. 2. The Relationship between Soil pH and the Number of Nodules of Ipil-ipil Seedlings Grown in Two Soil Types.

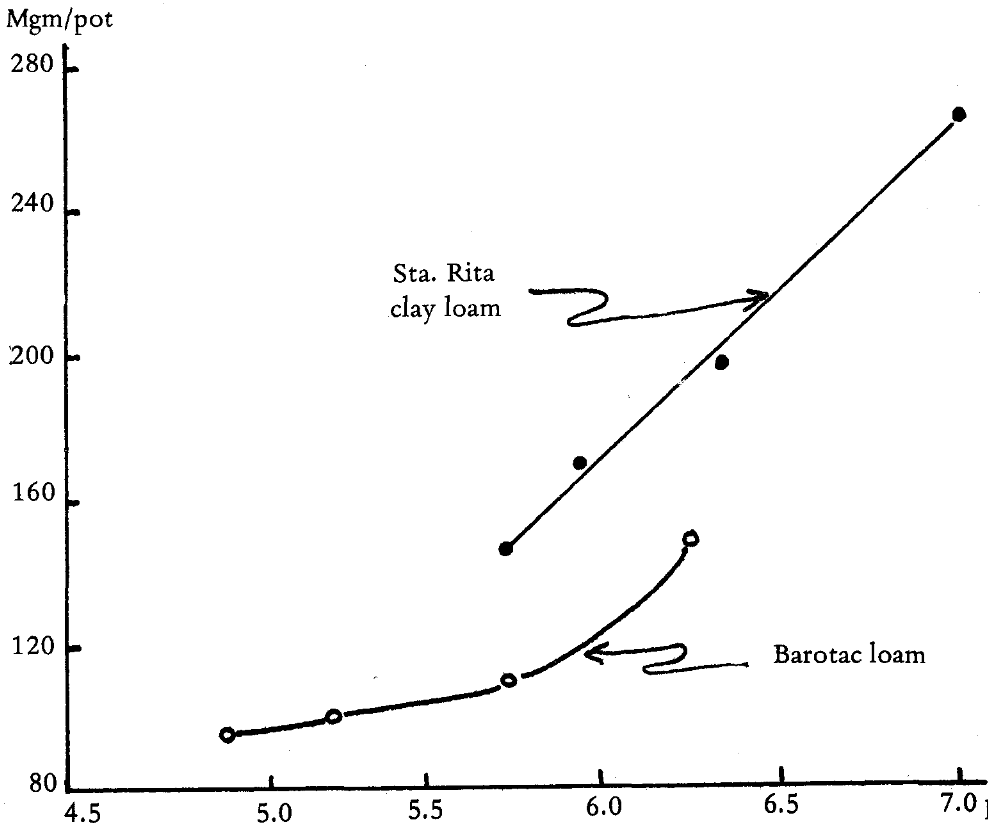

Fig. 3. The Relationship between Soil pH and the Weight of Nodules Ipil-ipil Seedlings Grown in Two Soil Types.

Statistical analyses of height, number and weight of nodules, and weight of shoot showed that treatment of pH 6.5 was significantly higher than all the other pH treatments. Except for the number and weight of nodules where there were no significant differences among pH treatments lower than pH 6.5, the treatment pH 3.5 was significantly lower than pH 4.5 and 5.5 for plant height and weight of dry matter of ipil-ipil seedlings.

SUMMARY

The height, dry matter, and weight and number of nodules of ipil-ipil seedlings were significantly higher at the highest soil pH than the lower pH treatments studied. These agronomic characteristics were also significantly higher in Sta. .Rita clay loam (pH 6.9) than in Barotac loam (pH 4.9) soils.

Nodulation was adversely affected at pH below 5.5. At pH higher than 5.5, it appeared to be a linear function of pH.

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