ILLUSTRATED CONCEPTS IN TROPICAL AGRICULTURE

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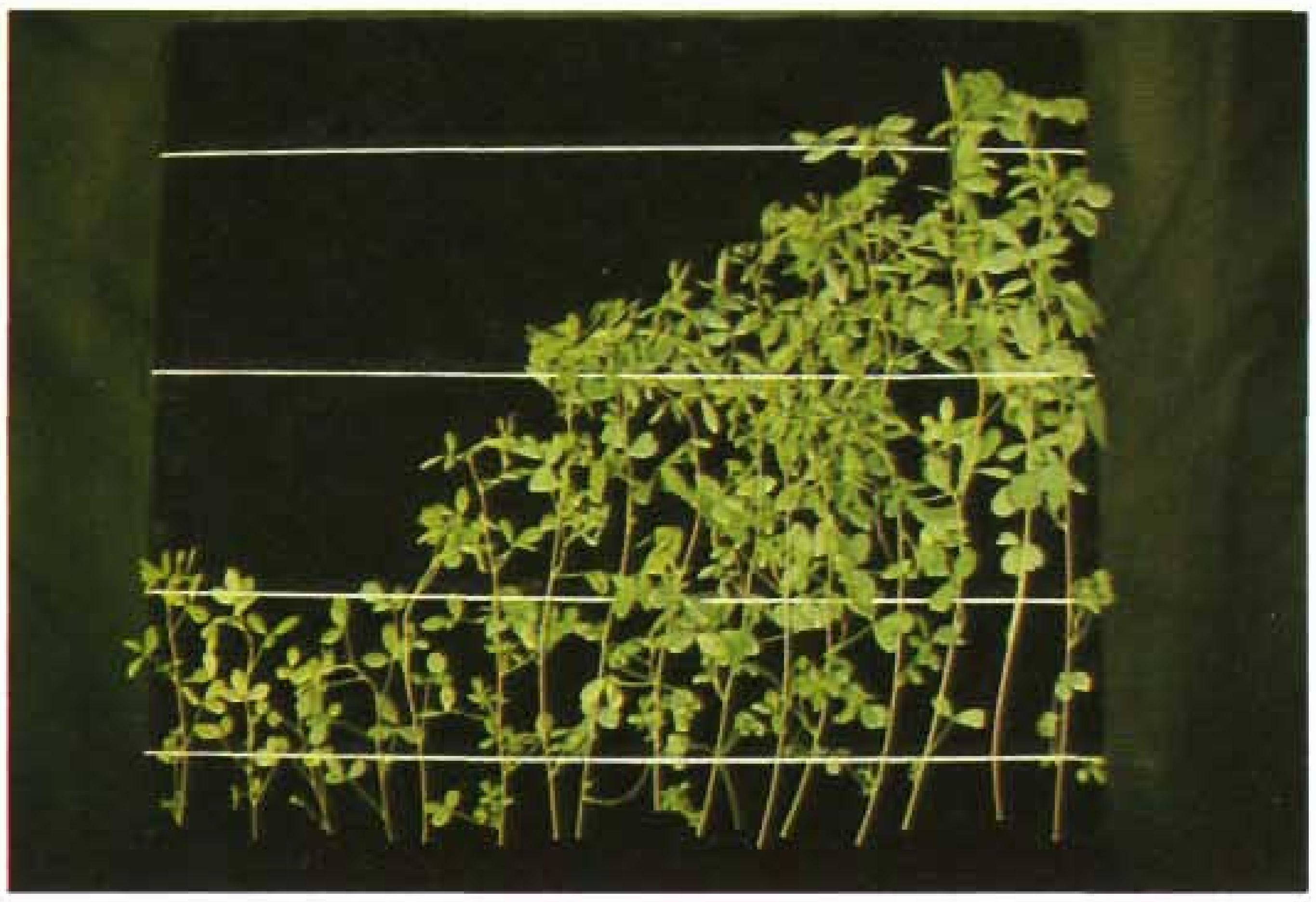
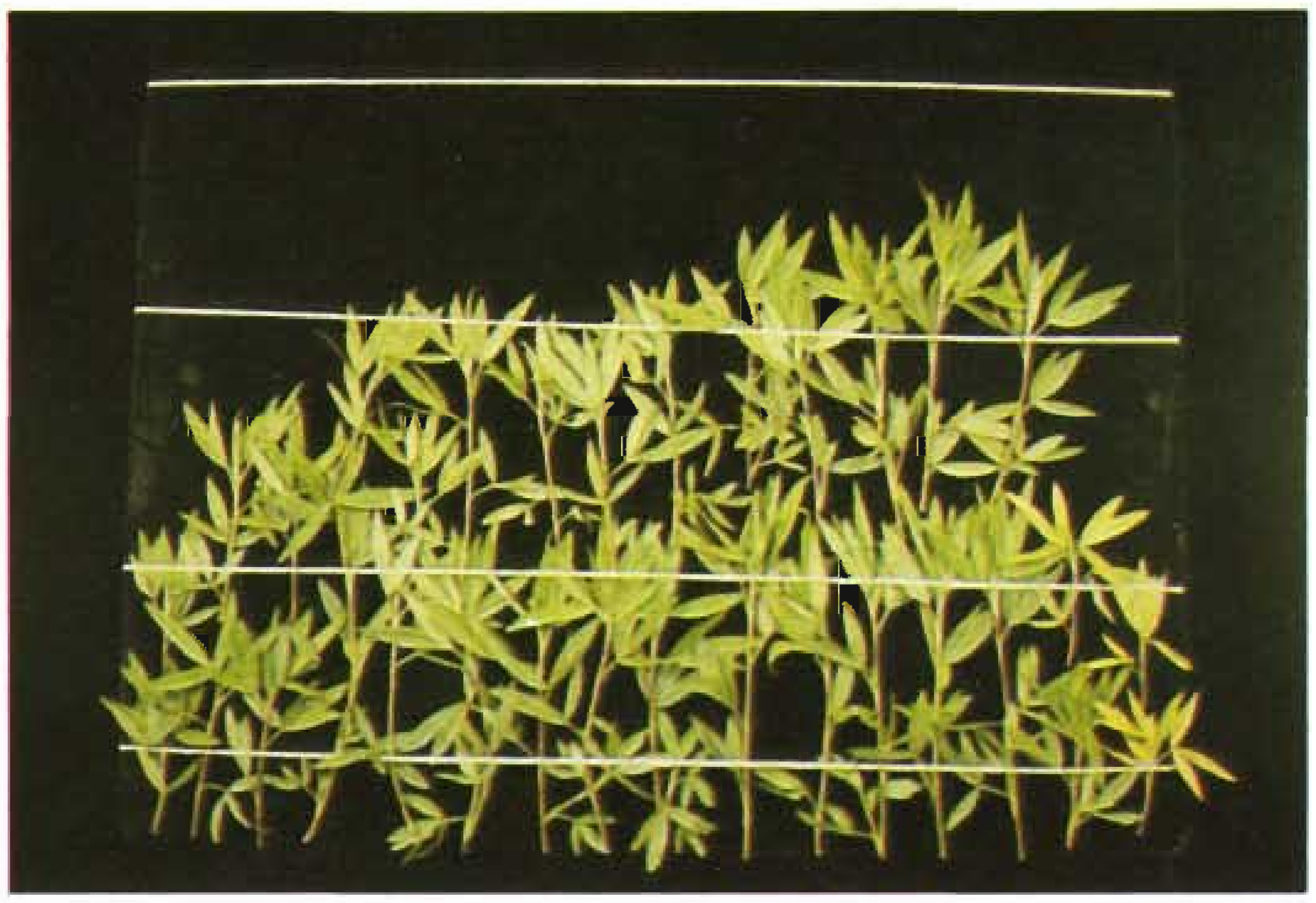
LIMING IN THE TROPICS: COMPARATIVE RESPONSE OF TROPICAL AND TEMPERATE LEGUMES





Although most soils of the humid tropics are acid, not much lime is used in tropical agriculture. In fact, there is little agreement on how much, if any, lime should be used or even on what criteria are suitable for determining lime requirements of tropical soils. The reason for this uncertainty lies in the diverse effects that liming has on the fertility of soils.

The benefits of liming include: decreased H ion activity; decreased Al and Mn toxicities; increased Ca and Mg availability; increased solubilities and plant uptake of molybdate, sulfate, and phosphate; improved soil physical properties; and benefits associated with Ca as a complementary ion on the cation exchange complex. In soils that have few permanently charged sites (such soils are prevalent in the humid tropics), increasing pH increases effective cation exchange capacity, thereby retarding leaching of K^+ and NH_4^+. Also, liming may have deleterious effects on the solubility of P and metal micronutrients.

The concept that tropical legumes are more tolerant of acid soils and less responsive to lime than temperate legumes is not very useful. Within the legume family, and even within a single legume species, there is great diversity. Some of this diversity is illustrated above. Such diversity frequently makes it possible to match existing soil conditions with a suitable legume so that extensive modifications of the soil by liming are unnecessary. But such close matching can greatly reduce the number of options available to management. Few legumes grow successfully if Mn or Al dominates the suite of exchangeable cations. This is the concept illustrated here.

Upper left: Lime added to an experimental site in preparation for thorough mixing with the soil. The lime was added to contiguous strips 1 meter wide, providing a continuous range in soil pH from 4.8 to 7.1. The relative quantity of lime required can be seen by the whiteness of the surface and by the size of the bags that contained lime for a strip 16 meters long. More than 22 tons of lime per hectare was required to attain pH 7, which demonstrated that this soil (an Oxisol, Wahiawa series) is highly buffered in the pH range about neutral.

Upper right: Growth of a tropical legume, *Leucaena leucocephala,* across the lime gradient established. The unlimed soil produced small, nitrogen-deficient plants. Large plants with dark-green foliage at the far end of the row were associated with the maximum rate of lime applied, which in turn was accompanied by high concentrations of calcium in the soil solution.

Lower left: Stems of alfalfa *(Medicago sativa)* selected at 1-meter intervals across the lime gradient established in the field. Alfalfa is well adapted to high-base soils. It is intolerant of high amounts of soluble manganese.

Lower right: Stems of *Stylosanthes guianensis* selected to represent growth across the lime gradient. Stylo is a tropical legume with a reputation for tolerating low soil fertility. However, stylo did respond to the first increments of lime on this acid manganiferous soil, and, although the Wahiawa soil is 10 percent iron, iron deficiency was evident when soil pH exceeded 6.5.

Robert L. Fox and Donald N. Munns—No. 9, 1978