

Vongvilay Phengsouvana 2010: Lime Application in Two Acid Upland Soils for Soybean Production in Champasak Province, Lao PDR. Master of Science (Soil Science), Major Field: Soil Science, Department of Soil Science. Thesis Advisor: Professor Tasnee Attanandana, D.Agr. 77 pages.

The major challenges to soybean production in Laos are high soil acidity and low nutrient contents in soils. In addition to the soil challenges, farmers still lack sufficient knowledge of nutrient management and fertilizer application. Together these factors have resulted in low yields of major food crops and preclude use of vast regions of acid, upland soils. Field experiments assessing and illustrating the need for lime application, as well as P, and K fertilizers are needed to help farmers learn to use lime and fertilizer effectively. This study consists of three experiments: One of which was a characterization of available lime materials. Three liming materials, including $\text{Ca}(\text{OH})_2$, CaCO_3 and marl, were collected from representative suppliers and sources in Laos and Thailand. Key properties were measured including the percentage of calcium carbonate equivalent (CCE) and particle size distribution. Lime materials were sized to pass sieves of 10, 35 and 60 mesh which corresponds to particle diameters of 2.0, 0.5 and 0.25 mm, respectively. The particle size analysis of the three lime materials confirmed that calcium hydroxide ($\text{Ca}(\text{OH})_2$) had a smaller particle size than calcium carbonate CaCO_3 and marl. The percentage of the liming materials that passed through the 60 (0.25) mm sieve were 93.8 and 88.8 % for $\text{Ca}(\text{OH})_2$ and CaCO_3 , respectively, indicating these two materials would be quite reactive and would neutralize soil acidity readily if they also were characterized by high CCE. Marl, on the other hand, appears to be too coarse to be highly effective. The high percent of CCE in these three liming materials indicated that all materials have the chemical composition necessary to increase soil pH. A second study was a comparison of four methods of lime requirement determination. Eight representative soybean soils were selected from representative locations of the Lao PDR for this study. Most soils are Ultisols soil. Approximately 2 kg of each soil was collected from the depth of 0 to 20 cm. Selected physical and chemical properties of the soils were analyzed. The incubation methods of Dunn and Kissel and buffer solution methods, of Adams-Evans, were compared for eight acid soils. The results showed that lime requirement by the Dunn incubation method, which increased soil pH to 5.5 of each soil, varied greatly with soil. The lowest and highest of lime requirements were Saravanh and Xiengkouang soils, respectively. There were many soils that required less than 1000 kg $\text{CaCO}_3 \text{ ha}^{-1}$ particularly when using the Kissel and extractable aluminum methods. The Bc, Xk and Ls soils would require maximum large amounts of lime according to the Adam-Evans methods. The highest amount of LR of Bc, Xk and Ls soils was estimated at 7,600, 6,100 and 4,900kg $\text{CaCO}_3 \text{ ha}^{-1}$ which illustrates the high levels of soil acidity in the soils of Laos. The lime prediction of these three soils using the other methods was much lower. A third experiment was conducted to determine the appropriate rate of lime application for soybean on acid soil in field conditions. Two field experiments were conducted in the wet seasons 2006-2007. The grain yields were highly significantly increased with increasing liming rates (2250 and 4590 kg $\text{CaCO}_3 \text{ ha}^{-1}$) on the two contrasting soils. The amount of lime needed based on the field experiments on Bc and Hk soils was about 1125 and 1013 kg ha^{-1} in first and second year with the pH 5.2 and 5.7, respectively. The Kissel and extractable Al methods of estimating lime requirement were closely corresponded to the field lime requirement determination for the Bachieng soil. An economic dominance analysis of the soybean yields in Bachieng and Hoythakouane sites indicated very high returns to the addition of lime in both years. The net return of Bc soil was obtained extremely high in the treatment L1 (about \$ 402 ha^{-1}) in 2006, while in 2007 the net return was about \$ 519 ha^{-1} (L1). In the Hk soil, in 2006 the maximum net return was \$503 ha^{-1} (L1) the maximum net benefit of soybean of 2007 was \$ 544 ha^{-1} (L1). This illustrated that liming these soils resulted in remarkably high net benefit and would be extremely profitable.

Student's signature

Thesis Advisor's signature