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Soil Temperatures During Burning of Large Amounts of Wood in a Humid Forest Agro-eco System: Effects on Soil pH and Subsequent Maize Yields

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Abstract

Slash and burn agriculture is still the dominant form of food production in the humid and sub-humid tropics of Africa, Asia and South America. In large parts of the Congo basin secondary and primary forest is cleared for particular crops. Little information is available on the temperatures attained during burning and the immediate changes of soil chemical properties. Soil temperature was measured during, and soil pH changes after burning 1000, 3000 and 5000 Mg ha⁻¹ of wood, representing fuel loads of a range of tree boles commonly felled and burned for land preparation on southern Cameroonian Ultisols and Oxisols. During the burning of 1000, 3000 and 5000 Mg ha⁻¹ of wood, the mean temperature at the soil surface reached 770°C and 214°C at 5 cm depth, without differences between fuel loads. At 10 cm depth the soil temperature was higher under 3000 (173°C) and 5000 (208°C) Mg ha⁻¹ fuel loads than under 1000 Mg ha⁻¹ (133°C). At 20 cm depth the temperature was higher under 5000 Mg ha⁻¹ fuel load (163°C) than under 1000 (52°C) and 3000 Mg ha⁻¹ (105°C). At 30 cm depth no differences were found (32 to 68°C). Burning of 10 Mg ha⁻¹, representing the natural regrowth of two years fallow on deforested land, caused no discernable temperature increases at any depth. At 24 hours after ignition, soil under 10 Mg ha⁻¹ fuel load was at ambient temperature. At 3, 5, 10, and 12 cm depth temperatures were different between all fuel loads. At the surface the difference between 10 and 1000 Mg ha⁻¹ fuel load was not significant, all others were.

Soil pH in 0–5 cm depth, increased within 9 days after burning (DAB) from 6.5 to 8.0 under 1000, 3000, and 5000 Mg ha⁻¹ fuel load. Under 3000, and 5000 Mg ha⁻¹ fuel load the pH continued to increase until 37 DAB, reaching 9.25. The pattern of pH with soil depth did not change between 37 and 79 days after burning.

Maize yields were significantly reduced when planted immediately after burning of 3000 and 5000 Mg ha⁻¹ of wood, mainly due to low crop establishment.

Keywords: Cameroon, maize, slash and burn, soil pH, soil temperature, Ultisol