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Burning of maize crop residues and weeds leads to major losses of C, N, P and K

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Abstract

Carbon and plant nutrient loss from agricultural land lead to loss of soil fertility and to greenhouse gas emissions. Such losses are known to occur during burning of crop residues, commonly practised to control weeds, pests and diseases. However, the extent of the losses are often not known, but the knowledge is needed to assess potential effects of changing management practices. This study reports two trials aiming to quantify the losses of carbon, nitrogen, phosphorus and potassium under the dominating practices of smallholder farmers in Son La province, Vietnam.

A survey showed that fields were burnt shortly before planting (37%), shortly after harvest (37%) or both (26%), and that the plant matter was either heaped before burning or burnt in its original position. We thus carried out two trials, in May and November 2020. A level field of clay soil was smoothed to provide a semi-glossy surface for the trial, with 4 replicates per treatment randomised to plots. Portions of maize residues and weeds, representing the proportions of these in the field, were arranged in heaps or scattered across the plot areas. After burning, the ashes were collected using soft brush and spade. Plant matter portions were also burnt in aluminium basins, serving as reference where no ash could be mixed with the soil. Subsamples of plant material and ash were analysed for carbon, nitrogen, phosphorus, potassium and dry matter.

Almost all carbon of the plant material was lost during burning. Most (86–96%) of the nitrogen was lost, with lowest losses from scattered material. Phosphorus losses were on average 14% in May and 27% in November, without treatment differences. More potassium was lost in May (61%) than in November (18%), and more from heaps (49%) than from scattered and reference material (35%).

The nutrients lost (approx. 30 kg nitrogen, 1 kg phosphorus and 30 kg potassium per hectare) correspond to large amounts of mineral fertiliser or manure and thus economic values, and the carbon loss accelerates loss of soil organic carbon and its benefits. This has long-term implications for the functioning of the soils and the farmers' livelihoods.

Keywords: Carbon loss, crop residue management, field burning