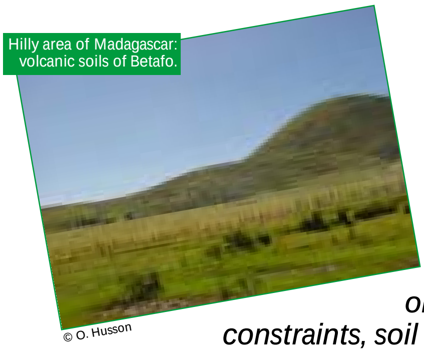
Direct seeding on plant cover with "soil smouldering" techniques

R. MICHELLON[1], L. SEGUY[2]
1. CIRAD, BP 853, Antananarivo 101, Madagascar
RAZAKAMIARAMANANA, R. RANDRIAMANANTSOA
FOFIFA, BP 1690, Antananarivo 101, Madagascar
fofifa-abe@dts.mg
2. CIRAD, CP 504 Agencia Central, 74001-970 Goiânia GO, Brazil

Hilly area of Madagascar: volcanic soils of Betafo.



© O. Husson

The soils in hilly and densely populated areas in the "Hautes-Terres" region of Madagascar are mainly ferrallitic and thus fragile, relatively infertile and prone to erosion. In addition, under low temperature conditions, organic matter breaks down very slowly and traps nutrients that are essential for crops. Direct seeding systems on plant cover offer a broad range of benefits, including erosion control and soil fertility enhancement. However, yield improvements are low because farmers —focusing chiefly on their immediate survival— apply very little fertilizer. Facing these constraints, soil smouldering, associated with direct seeding on vegetal cover, should allow a sustainable improvement of the production, with minimum inputs.

Material and methods

"Soil smouldering" involves sluggishly burning plant matter (fuel) covered with a 10 cm layer of soil in a 20 cm deep trench, with air outlets spaced every metre. Several fuels for this purpose can be obtained in fallowed fields (e.g. dried grasses, *Aristida* sp., and *Acacia mearnsii* branches), in addition to barley straw and rice husks.

Soil smouldering was carried out in fallow fields after mowing, on ferrallitic soils (Ibity), or ploughing subsequent to the harvest of food crops on volcanic soils (Betafo). Fields where soils had been smouldered were subsequently cropped using direct seeding procedures on mulch (*Aristida* sp., 7 t.ha^{-1}).

The effects of the different fuels were assessed relative to four fertilizers adjusted according to the type of soil and crop:

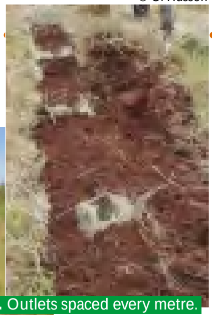
- F_0 N_0 fertilized
- F_1 Manure alone
- F_2 Manure + chemical fertilizer
- F_3 Manure + chemical fertilizer + amendment.

Soil smouldering techniques

1. Trenches manual preparation.

© O. Husson

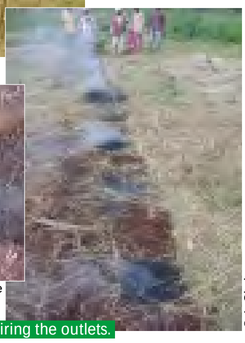
© O. Husson



2. Outlets spaced every metre.

4. Opened trenches after burning.

© A. Chabanne



© A. Chabanne

3. Firing the outlets.

The control treatment was carried out on bare soil after ploughing prior to sowing the crop. Another treatment, comparable to the ploughed control, was conducted with an initial application of ash (4 t.ha^{-1}) produced by open-air combustion of the same quantity of *Aristida* sp. as that used for the soil smouldering operation.

The experimental conditions were identical in all cases: split-plot design (with 3 replications), combining the main treatments, i.e. the fuels (and controls), with the fertilizers on 13.5 m^2 plots.

Rice (cvs FOFIFA 133 or 152) and soybean (cv FT10) were sown in seed holes with 10 cm spacing on pairs of rows (30 cm between paired rows), with 50 cm spacing between pairs of rows.

Crops are conducted with plowing or with direct seeding and mulch.

Results

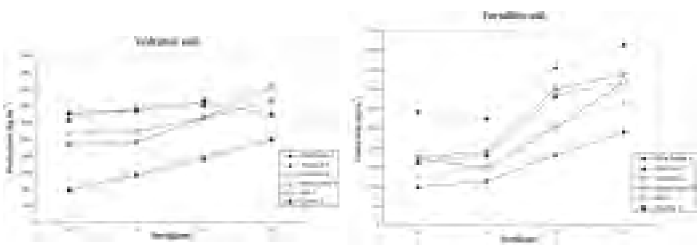
In the first year, the soil smouldering technique had spectacular effects, i.e. boosting rainfed rice yields to levels that could be achieved with high chemical fertilizer inputs—to which farmers have no access for financial reasons (Fig. 1). On the two types of soil, mean yield gains of 1-2 t.ha^{-1} were obtained, depending on the fuel, as compared to the ploughed control treatment, without any effect of the fertilization level.

The type of material used for fuel affected crop yields, with rice husk fuel giving the best results on ferrallitic soils.

Lower yield gains were achieved when applying ash produced by open-air combustion of the same quantity of *Aristida* sp. as that used for the soil smouldering operation, i.e. 0.5 t.ha^{-1} of rice on ferrallitic soils, but this input had no effect on volcanic soils.

A residual effect was observed on soybean yields in the year following the soil smouldering operation—this effect was more substantial on volcanic soils (Fig. 2).

Fig. 1. Effects of the type of fuel used for soil smouldering on rainfed rice yield.

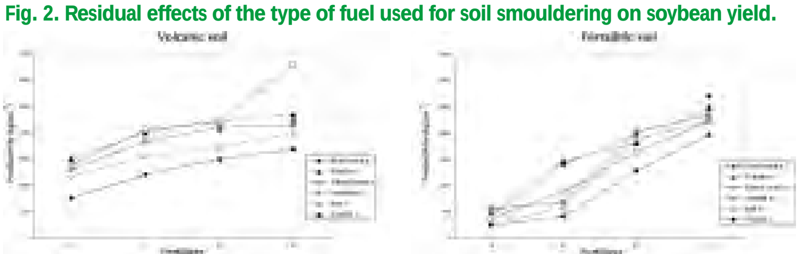


Treatments ranked by the Newman and keuls test (5% threshold)
CV fuels= 21%; CV Fertilizers= 15%, respective SDs= 580 and 428 kg.ha^{-1}

Fuel dose in t.ha^{-1} d.m.: acacia 39, aristida 54, rice husks 50, barley straw 19

Treatments ranked by the Newman and keuls test (5% threshold)
CV fuels= 18%; CV Fertilizers= 11%, respective SDs= 469 and 283 kg.ha^{-1}

Fig. 2. Residual effects of the type of fuel used for soil smouldering on soybean yield.



Treatments ranked by the Newman and keuls test (5% threshold)
CV fuels= 20%; CV Fertilizers= 19%, respective SDs= 372 and 342 kg.ha^{-1}

Treatments ranked by the Newman and keuls test (5% threshold)
CV fuels= 23%; CV Fertilizers= 34%, respective SDs= 319 and 468 kg.ha^{-1}

Acknowledgements
We thank N. Moussa and F. Rakotoniaina from the NGO Terre et Développement (TAFA) for technical assistance.

FOFIFA
Centre national de la recherche appliquée au développement rural Madagascar

CIRAD
Centre de coopération internationale en recherche agronomique pour le développement

Cirad-Editions - maquette@cirad.fr - September 2001

Document obtenu sur le site Cirad du réseau http://agroecologie.cirad.fr