Effects of direct seeding techniques on soil fertility indicators under equatorial climatic conditions

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Maize in *Mucuna* mulch.

In the Boumango agroindustrial area (2°S, 13°E) of Gabon, 2000 ha has been intensively cropped since 1980 under mechanized conditions, with an annual sequence of maize and soybean. New alternative cropping systems are now required to solve the cultivation problems that have arisen. Experiments were carried out to test systems involving direct seeding on plant cover that were initially developed in central-western Brazil. Several soil fertility indicators were monitored over a 3-year period, their evolution under three different crop management sequences and two fertilizer levels are reported.

Material and methods

Test site

The experiment has been carried out for 4 years in a large crop plot (24 ha) on ferrallitic soil. Cropping systems were compared in 0.3-1 ha subplots.

Treatments

Three crop management sequences:

- Two crops per year and one mouldboard ploughing (maize/soybean-ploughing sequence)
- Maize with direct seeding into *Calopogonium mucunoides* mulch (DS-*Calopogonium* sequence)
- Soybean with direct seeding into mulch of millet or guinea sorghum (DS-cereal sequence)

… overlaid with two fertilization levels:

- High corrective fertilization (HC)
- Progressive corrective fertilization (PC).

Measurement

Chemical parameters: soils were sampled and analyzed twice: before setting up the treatments and at the end of the 3-year test period.

Soil bulk density: it was measured at the end of each first cropping cycle in the PC subplots at 10-cm intervals in the [5-45 cm] horizon and under the initial natural cover (a wooded savanna).


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Maize in mulch.

Results and discussions

Chemical parameters

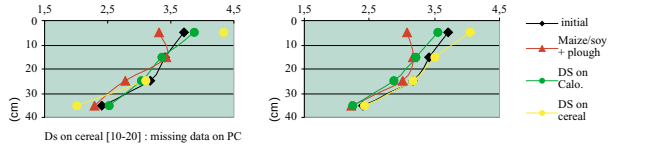
Plough tillage induced a slight drop of organic matter by 0,2-0,3 %/year at the soil surface (Fig 1). This drop was more pronounced under HC fertilization. Mechanical redistribution in the first 30 cm by ploughing and deep lixiviation reduced the efficiency of mineral inputs on acidity and nutrient availability (Figs 2, 3, 4 and 5).

Direct seeding induced pronounced improvements of chemical parameters on top soil horizon [0-10 cm] compared with ploughing and initial status:

- the organic matter level and the cationic exchange capacity stabilized and even increased (greater extent under cereal straw mulch, Figs 1 and 3);
- sharp drop in soil acidity (Fig 2);
- higher exchangeable base saturation rate (Fig 4);
- higher exchangeable phosphorus level (Fig 5).

Soil bulk density

The initial soil bulk density was around 1.3. The density fluctuated around this value with ploughing. However, sequences with plant cover induced a decrease, which was greater under cereal cover: the mean soil bulk density in the [0-30 cm] horizon reached 1.09, close to levels noted under natural cover (range 0.9-1).



Ds on cereal [10-20] : missing data on PC

Fig. 1. Soil organic matter level (%) according to depth - PC (left), HC (right) corrective fertilization.

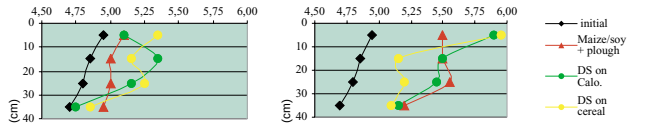


Fig. 2. pH_{water} according to depth - PC (left), HC (right) corrective fertilization.

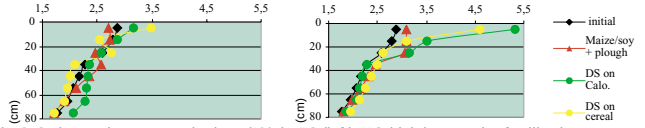


Fig .3. Cation exchange capacity (meq/100g) - PC (left), HC (right) corrective fertilization.

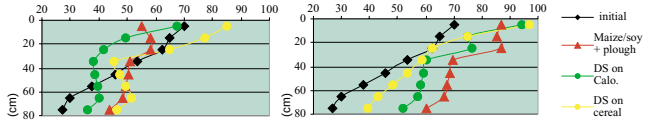


Fig. 4. Exchangeable base saturation (%) according to depth - PC (left), HC (right) corrective fertilization.

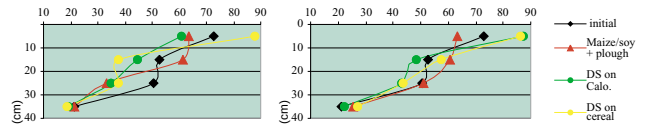


Fig. 5. Exchangeable phosphorus (ppm) according to depth - PC (left), HC (right) corrective fertilization.

Conclusion

The differentiation of soil profile under ploughing and direct seeding in plant cover are quite different:

- ploughing induced a drop of organic matter, a slight decrease in nutrient availability, which could be temporarily offset by more important inputs application; despite soil tillage physical conditions remained a constrain;
- direct seeding in plant cover had beneficial improvements for chemical indicators in top soil horizon which became more favorable for plant mineral nutrition; progressive improvements of physical conditions allowed deep root system development.

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