

"New concepts for sustainable management of cultivated soils through direct seeding mulch based cropping systems: the CIRAD experience, partnership and networks"

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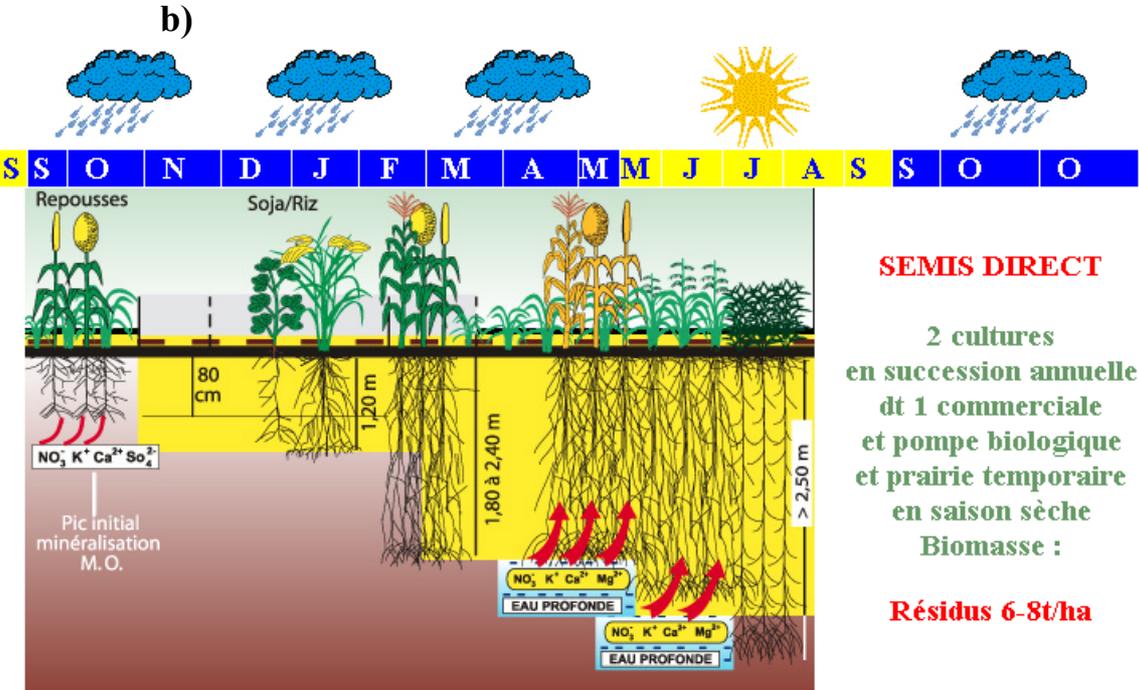
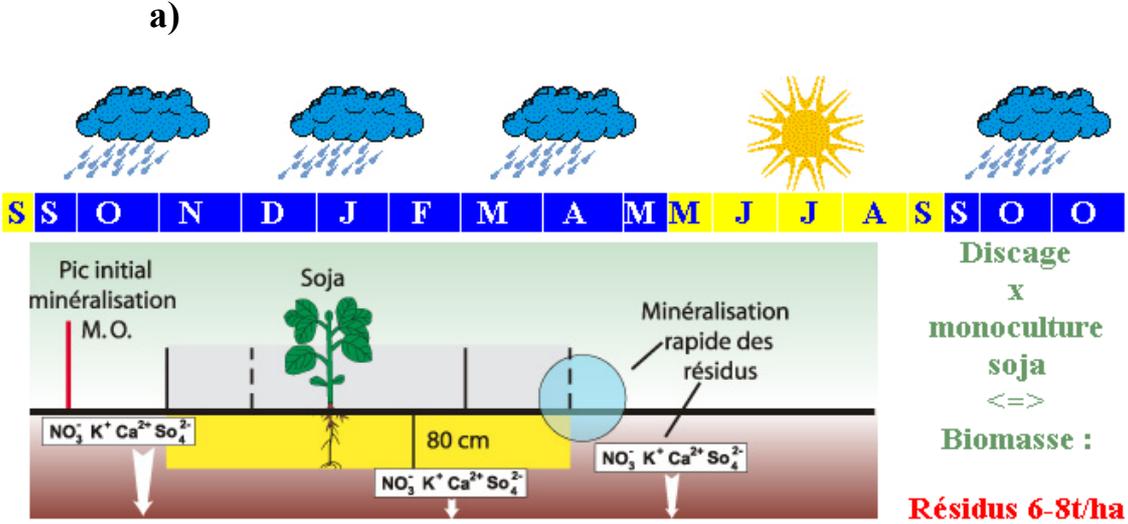
Summary:

Direct seeding mulch based cropping systems (DMC) form an attractive alternative to combat soil degradation and to sustain agricultural activities in many countries of the world. Since 20 years CIRAD in partnership with several national and international research organisations, contributes to enhance this type of cropping systems through developing new concepts and adapting them to different environmental and socio-economical conditions.

Organic matter management is the key factor for the efficient functioning of these systems and aims at maintaining the soil permanently covered and protected by a vegetal mulch. In the humid zones of the tropics where mineralisation of crop residues is rapid due to favourable environmental conditions, it has been necessary to introduce additional cover crops before and/or after the main commercial crops (figure 1). These cover crops have been selected in order to mimic the functioning of the natural forest ecosystem of these regions. Thus, an efficient cover crop is able to rapidly produce biomass even in marginal growing conditions and it has a strong and well developed root system for an optimal use of soil resources. These characteristics permit to produce biomass when climatic conditions are risky (at the beginning or at the end of the rainy season and even during the dry season), maintaining the soil covered through all year. Besides, the cover crop is a means to recycle soil water and nutrients that have not been taken up by the commercial crop, avoiding irreversible nutrient losses by leaching. The concept of "nutrient pumps" applied to cover crops has been fundamental to improve the sustainable production of annual crops with DMC in the humid tropics.

In this context, the cover crops must play several functions to improve the efficiency of the DMC systems. Aboveground, it must produce biomass to protect the soil, it returns nutrient to the system through mineralisation, it may produce grain and/or fodder and it contributes to control weeds through its shadowing or allelopathic effects. Belowground, its well developed root system congregates the soil and avoids compaction, enhances soil porosity and aggregation, recycles water and nutrients from deeper soil layers, is able to extract nutrients even in poor and acid soils. In addition, through large organic matter returns to the soil, cover crops enhance biological activity. Finally, some plants are even able to reduce toxicity problems related to pesticides, aluminium and salinity for successive commercial crops. The most efficient cover crops are those which are able to fulfil the maximum of these functions and more particularly to alleviate the most limiting factors for a specific situation. This concept of multi-functionality has been fundamental to select new species to be used as cover crop for the DMC systems. Besides, cover-crops have also been selected to answer technical and economical criteria, for example the easiness of their management and their economical benefit.

Figure 1: Cropping systems in the humid tropics, a) before with conventional tillage and b) after with DMC concepts (multi-functional cover crops at the beginning and/or end of the rainy season, real “nutrients pumps” for the system)



Using the above concepts, many new DMC systems have been developed for different climatic conditions:

- Humid tropical zones such as the Cerrados region in Brazil, Laos, Vietnam and east cost of Malagasy
- Semi-arid zones such as South-west of Malagasy and in Tunisia
- Temperate zones such as different regions in France (Berry, Loire valley, Cher...)

The CIRAD research has been developed with different types of partners in several countries as for example:

- National and international research organisations (EMBRAPA, USP/CENA in Brazil, FOFIFA in Malagasy, INRAT in Tunisia, VASI in Vietnam, NAFRI in Laos, CIMMYT and INIFAP in Mexico...)
- Development organisations (ANAE in Malagasy, SODECOTON in Cameroon)
- Private companies (MAEDA, AGRONORTE in Brazil)
- Producers and cooperatives (COODETEC in Brazil)
- Foundations (Fundação Rio Verde in Brazil) and NGOs (TAFA in Malagasy)

With the funding of some French donors (AFD, FFEM, MAE) the APA (Action Plan for Agroecology) network has been created between CIRAD and local partners to innovate DMC systems and to enhance their adoption by the farmers in Tunisia, Cameroon, Mali, Malagasy and Laos.

More recently, CIRAD, CIMMYT and some other partners, with approval of the GEFAR, have created the DMC network to enhance the exchange of information between several partners working on DMC all around the world.