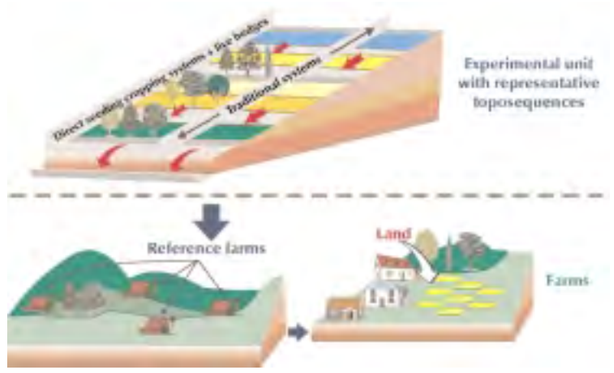
CIRAD PROGRAMME ON DIRECT SEEDING ON PLANT COVER

Working for and with farmers

Cropping systems can be regularly improved via "innovation-extension" approach, while meeting the requirements of researchers, agricultural professionals and regional institutions. This experimental approach places upstream research in an "in situ" context. The experimental units are managed by researchers and farmers. Volunteer farmers - on their so-called "reference farms" - implement several different cropping systems as-is or tailor them to meet their specific needs. The set of reference farms is representative of the diversity of the region.



Experimental unit on a toposequence, Madagascar

Cropping systems are tested in matrices (system trials in which several key factors are combined) on representative toposequences in the experimental units. New systems are developed by gradually including other production factors. Based on matrix construction rules, direct and cumulative effects of cropping system components can be interpreted over a time period. Reference farms matrices are sites of action, innovation and training. They also provide a field-monitoring laboratory for scientists and are a cropping system vivarium where tillage techniques and new direct seeding systems (simple to highly complex systems, with diversified crops, livestock production and agro-forestry) can be showcased.

Farmers in their directly seeded upland rice field, Madagascar

A world-wide network and the Agro-ecology action plan CIRAD / AFD / FFEM / MAE

Together with its various partners*, Cirad developed a research network to adapt these techniques to a wide range of bio-physical and socio-economics conditions. These situations range from very poor to rich soils, from temperate areas to tropical and equatorial conditions, from dry areas (450 mm rainfall/y in Tunisia) to very humid tropics (areas over 3000 mm rainfall/y in Amazonia), from sea level to high altitude (e.g. Madagascar highlands), and from flat land (including poorly irrigated paddy fields) to very steep slopes (e.g. northern Vietnam). They also range from highly extensive (low-cost agriculture for the poorest) to very intensive agriculture (with high capital investment and inputs), from areas integrated in the world market (Brazil) to isolated mountains (Vietnam), and from regions with very high population density to deserted areas.
French donors (AFD- Agency for Development, FFEM-Fund for World Environment and MAE-Ministry of Foreign Affairs) combined their efforts to support a world-wide Agroecology Action Plan (AAP), funding research and development programmes in five pilot countries (Laos, Cameroon, Mali, Madagascar and Tunisia).

CIRAD AND AGRO-ECOLOGY:

Cirad/ca/gec is animating an Internet forum dealing with direct seeding on plant cover: http://agroecologie.cirad.fr

It also supports and participates in the DMC initiative (Direct seeding, mulch based systems, and Conservation agriculture): http://agroecologie.cirad.fr/dmc/index.php

Furthermore, Cirad/ca/gec is focussing on a world-wide diffusion and implementation of all forms of conservation agriculture technologies through the TWCA project (Towards World-wide Comprehensive Conservation Agriculture).

** Partners : Agronorte, Embrapa & Maeda (Brazil), ANAE, FOFIFA & TAFA (Madagascar), VASI (Vietnam), NAFRI (Laos), Sodecoton (Cameroun), INRAT (Tunisia) and other partners all over the world which unfortunately can not all be cited here.*

Credits: Bouzinac, Chabanne, Chorier, Forest, Husson and Séguy: gec@cirad.fr

Towards sustainable agriculture:
Direct seeding on plant cover

Young soybean on Eleusine coracana *mulch, Brazil*

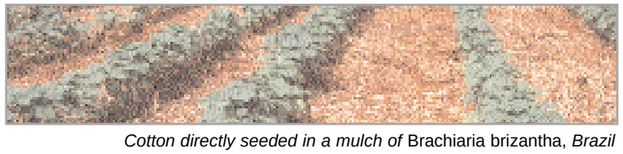
In the face of climatic, economic and social changes, agronomists are examining world-wide new ways for agriculture production. The aim is to develop, for and with farmers, specific and appropriate solutions which can be adopted rapidly, particularly by the poorest farmers.

For more than 20 years Cirad and its partners have been developing alternatives to conventional cropping systems in southern countries. Agriculture based on soil tillage is now being questioned as it seems unable to face the main challenges of soil and water conservation, environmental protection, food safety and cost reduction. Attractive, economically profitable, environmentally friendly and sustainable cropping systems have been developed and extended on a large scale, based on direct seeding on permanent plant cover without soil tillage.

PRINCIPLES OF DIRECT SEEDING ON PERMANENT PLANT COVER

Brachiaria humidicola *roots, Vietnam*

Various practices of minimum or without tillage, cover crops and direct seeding have been studied all over the world. However, Cirad and its partners, lead by L. Séguy in Brazil, have developed cropping systems based on direct seeding with permanent plant cover, mimicking a forest ecosystem while increasing crop production. In these systems, the soil is never tilled but permanently kept covered by a dead or living mulch. The mulch comes from plants that are used as “biological pumps” in intercropping or relay-cropping sustems. These plants have strong and deep root systems and can recycle nutrients from deep horizons for subsequent use by the main crops.They also have a high and fast biomass production and are able to grow in adverse conditions such as during the dry season, on compacted soil or under high weed pressure.



Cotton directly seeded in a mulch of Brachiaria brizantha, *Brazil*

Deep rooting of Arachis pintoï *on ferralitic soil, Madagascar*

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PRINCIPLES OF DIRECT SEEDING ON PERMANENT PLANT COVER (2)

Manual direct seeding, Vietnam

The plant cover can be killed (cut, applying herbicide), or kept alive but controlled by application of low doses of specific herbicides. The biomass is not turned into the soil but always kept on the soil surface, which reduces its dilution and allows the soil to act as a biological reactor.

Seeds are directly sown into the mulch, after simply opening a hole or a furrow. In Brazil, very diversified direct seeding equipment has been designed and extended such as : seed drills for large-scale farming and for small-scale motorised agriculture, seed drills for animal draft, rolling injection planters and hand-jab planters. For the poorest farmers a simple bamboo stick or a hoe can be used.

Mechanized seed drill, Brazil

Animal-drawn no-tillage planter, Madagascar

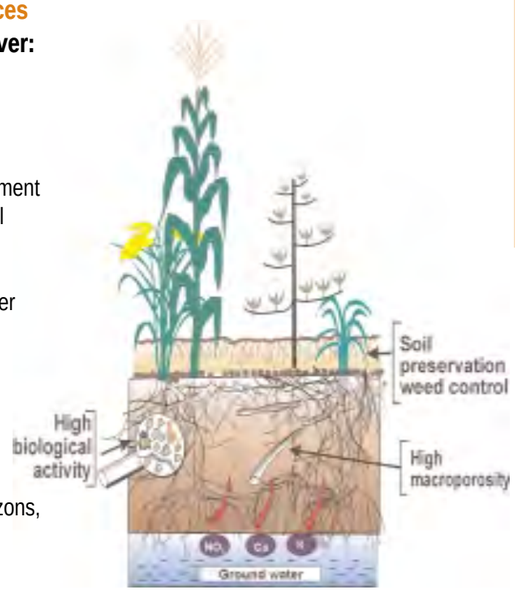
ADVANTAGES OF DIRECT SEEDING ON PERMANENT PLANT COVER

Wheat with a living cover of Lotus, Madagascar

1/ Technical performances

The permanent plant cover:

· prevents erosion
· increases infiltration
· reduces evaporation
· buffers temperature
· creates favourable environment for development of biological activity
· control weeds
· increases soil organic matter content and provides nutrients to the plants



Plants with strong root systems and intense biological activity :

· improvement of soil structure
· increase soil organic matter content
· recycle nutrients which have been leached in deeper horizons, especially nitrate
· use water stored in deeper horizons for biomass production during the dry season.

Strong root system of Eleusine Coracana, Brazil

As a consequence, water and nutrients use and efficiency and yields of the main crops are increased and stabilised. For example, on acid ferralitic soils in the Cerrados of Brazil (without irrigation) yields up to 7 tonnes/ha of upland rice, 5 tonnes/ha of cotton and 4.5 tonnes/ha of soybean, with a 30-50% reduction of mineral fertilisation as compared to conventional practices.

Upland rice, Brazil

Cotton field and harvest, Brazil

Plant breeding programmes (with classical breeding techniques) conducted with direct seeding techniques allow us to create and identify varieties adapted to, and increasing the performance of, the various mulch-based systems. This approach allows a permanent optimisation of genotype x soil management x crop rotation combinations.

Sorghum breeding, Laos

Breeding of rice varieties, adapted to both irrigated and rainfed conditions, with direct seeding techniques. Partnership with Agronorte, Brazil.

" We may doubt the long-term efficiency of programmes aiming at improving living conditions in rural areas if at the same time, a significant effort is not made to guaranty long-term preservation of environmental capital. Preservation of the production potential on a concerted and perennial basis is therefore a key element to improvement of long term safety of the less-favoured population and in this respect, is part of the fight against poverty". D. Loyer, French Agency for Development, 2000.

2/ Environmental considerations

This agro-ecological agriculture proposes solutions for the following major challenges the world will have to face in the near future :

· soil preservation and recovering of soil fertility
· carbon sequestration and reduction of the greenhouse effect
· reduction of water consumption by agricultural production and production of rainfed crops in marginal dry areas
· reduction of fertiliser and pesticide use, and thus reduction of pollution and improvement of food quality and safety
· buffering of water flows and reduction of risks on flooding
· stabilisation of agriculture and reduction of deforestation

3/ Economic and social aspects

A major advantage of these cropping systems is that, apart from technical and environmental benefits, they are particularly attractive from an economic point of view. as they allow reduction of labor and drdgery. Optimisation of work organisation is easier thanks to access to fields, there is reduced fuel consumption in the case of large scale farming, less inputs (fertilisers and pesticides), and smaller investments (tractor, plough, etc.)are needed. As a consequence, these systems provide higher land, capital and labour profitability than conventional systems while they respect the environment.

From a social perspective, preservation of soil is fundamental : when loosing his soil the farmer is doomed. The adaptability of these systems to various agro-ecological conditions, production means and input levels, also makes them accessible to a broad range of farmers, including the poorest. Furthermore, direct seeding on plant cover is the first credible and practical way towards the development of biological agriculture for the less advantaged farmers who can then add value to their products on the world market, in accordance with consumers' requirements.

All the experts agree that, in 10 years, Brazil with more than 13 million ha of land cultivated with direct seeding, has preserved over a billion tonnes of arable land, spared eleven billion US$ and 1.3 billion litres of fuel, and has sequestrated more than 500 million tonnes of CO2 (Borges et al., Editorial, Especial 10 anos retrospectiva dos principais fatos que foram noticia-Revisão plantio direto, edição n°59, 09 10 2000).
J. Landers and the "Associação de Plantio Direto no Cerrado" (2002) indicated that thanks to direct seeding, 18 tonnes per ha and per year of soil are preserved (reduction of 76 % in erosion losses as compared to conventional systems in Brazil), and rainfall run-off is reduced by 69 %.

Healthy soybean on oats mulch, Madagascar

TOWARDS SUSTAINABLE AGRICULTURE, IF...

Adoption of direct seeding systems by farmers relies on highly participatory and adaptive approaches. Accompanied by agronomists, farmers gradually realise that the new systems they develop can combine improvement of soils, increased production, economic benefit and respect for the environment. The first steps are difficult and should be actively facilitated by outsiders as direct seeding on plant cover requires dramatic changes, not only in the mind but also in the cropping practices. Direct seeding on plant cover is not only a sound combination of resource-conservation techniques, it is first of all a different philosophy for production, in harmony with nature.

Diversified production systems

Sustainable cultivation based on direct seeding with vegetal cover is not possible without crop rotations and diversified productions, which contribute to biodiversity (especially the fauna, from micro-organisms to macro-fauna).
These types of cropping systems allows an Integration with livestock systems as most plants used for soil structure improvement and mulch production also are excellent forages.
Finally, association between crops or forages and trees is possible.

Cattle grazzing Brachiaria brizantha, Brazil

Arachis pintoï in a citrus orchard, Ile de la Réunion