Cover crop species, with a special focus on legumes

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Summary

This practice describes how conservation tillage, and especially zero-tillage helps reverse soil erosion caused by Soil tillage.

Description

Conservation Agriculture (CA) is an approach to managing agro-ecosystems for improved and sustained productivity, increased profits and food security while preserving and enhancing the resource base and the environment.

Keeping the soil covered is a fundamental principle of CA. Crop residues are left on the soil surface, but cover crops may be needed if the gap is too long between harvesting one crop and establishing the next. Cover crops improve the stability of the CA system, not only on the improvement of soil properties but also for their capacity to promote an increased biodiversity in the agro-ecosystem.

While commercial crops have a market value, cover crops are mainly grown for their effect on soil fertility or as livestock fodder.

In regions where smaller amounts of biomass are produced, such as semi-arid regions or areas of eroded and degraded soils, cover crops are beneficial as they:

- protect the soil during fallow periods;
- mobilize and recycle nutrients;
- improve the soil structure and break compacted layers and hard pans;
- permit a rotation in a monoculture; and
- can be used to control weeds and pests.

1. The use of cover crops

The use of cover crops as part of CA approach has a wider benefit when looking into the resilience of the agro-system and those farmers' livelihoods that adopt it. From the ecosystem perspective, the soil will be more resilient to disasters such as droughts and heavy rainfall, and at the same time, soil will improve its quality. Farmers will benefit from this improvement, because he will be able to increase the crop yield and be less vulnerable in terms of food security, and also considering new market opportunities for their increased production.

Cover crops are grown during fallow periods, between harvest and planting of commercial crops, utilizing the residual soil moisture. Their growth is interrupted either before the next crop is sown, or after sowing the next crop, but before competition between the two crops starts.

There are various crop alternatives to be used as vegetative cover, such as grains, legumes, root crops and oil crops. All of them are of great benefit to the soil; however some cover crops have certain attributes, which need to be kept in mind when planning a rotation scheme. It is important to start the first

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years of conservation agriculture with cover crops that leave a lot of residues on the soil surface, which decompose slowly (because of the high Carbon/Nitrogen ratio = an indicator for nitrogen limitation of plants and other organisms). Grasses and cereals are most appropriate for this stage, also because of their aggressive and abundant rooting system, which take less time to improve the soil.

In the following years, when the soil shows a healthier appearance, legume cover crops can be incorporated in the rotation. Later, when the system is stabilized it is possible to include cover crops with an economic function, like livestock fodder.

1.1. Factors to consider when using cover crops

When a farmer considers using cover crops, it is important to know:

- whether it needs to have more benefits (e.g. edible seeds, fodder value);
- which of the available cover crops is the most appropriate?;
- when to sow and control the cover crop;
- whether the cover crop needs a lot of water, and if this will be available;
- if it is possible to control the cover crop sufficiently, so that it doesn't turn into a weed; and
- whether the cover crop provides the same benefits as a rotation with only commercial crops (e.g. immediately following a cereal crop with a commercial legume).

In order to be able to successfully integrate cover crops in the CA production system, it is crucial to select the plants that are adapted to the different soil and climatic conditions and that have growth characteristics that allow it to fit in the rotation scheme.

For this, it is not only necessary to be conversant with the agronomic details of the species, but also all specific conditions of the site where they will be sown (soil and climate) and the anticipated objectives and socio-economic conditions of the farmers.

The species that will be used as cover crops need to be tested and validated by the farmers on their land in order for them to get acquainted with the technical details of the plant species.

1.2 Selection of cover crops

The selection of cover crops should depend on the following criteria:

- The presence of high levels of lignin and phenolic acids (a type of organic compounds, can be found in many plant species, it is high in dried fruits), which give the residues a higher resistance to decomposition and thus results in soil protection for a longer period.
- Time of sowing. Many species show dormancy (is a period in an organism's life cycle when growth and development are temporarily stopped) or photoperiodism (the developmental responses of plants to the relative lengths of the light and dark periods). This means that the production of biomass depends on the period of the year in which the plant is sown. Seeding should be done in the proper season. In order not to jeopardize the following crops, a good planning of the cover crops is necessary.
- A proper spacing / density of the cover crop is important in order to create a rapid covering of the surface to protect the soil from rain and sun and to suppress the weeds.
- Soil management: for seeding of the cover crop no land preparation is needed.
- Cover crops can be sown either using

direct seeding or broadcast over the stubble of the last crop, possibly using a tree trunk, knife-roller, disc harrow (see the explanation above) used as roller with the discs set at a disc angle close to 0 degree or chains for putting the seeds into contact with the soil. Some species, like hairy vetch, have the ability to reseed themselves.

- Seed quality: like in commercial crops, the seeds or planting material of cover crops need to be of high quality and free of pathogens to avoid failure through low quality seeds.

2. Agroecological adaptation of most commonly used cover crops:

2.1 Legumes adapted to humid lowlands

2.1.1 Scientific name

Centrosema pubescens, *Phaseolus mungo*, *Pueraria phaseoloides*.

2.1.2 English name

Centro, butterfly pea, Black gram, Tropical kudzu.

2.1.3 Spanish name

Jetirana, bejuco de chivo, Kudzú tropical.

2.2 Legumes adapted to fire

2.2.1 Scientific name

Centrosema pubescens, Desmodium adscendens , Glycine wightii, Macroptilium atropurpureum.

2.2.2 English name

Centro, butterfly pea, Glycine, Siratro.

2.2.3 Spanish name

Jetirana, bejuco de chivo, Soja perenne, Siratro.

2.3 Legumes adapted to cold conditions

2.3.1 Scientific name

Clitoria ternatea, Desmodium intortum, Desmodium incinatum, Glycine wightii, Lotononis bainesii, Medicago sativa, Phaseolus lathyroides, Trifolium spp.

2.3.2 English name

Butterfly pea, Greenleaf desmodium, Glycine, Lotononis, Lucerne, Phasey bean, Clover.

2.3.3 Spanish name

Campanilla, zapallito de la reina, Pega-pega, Soja perenne, Lotononis, Miles lotononis, Alfalfa, Frijol de monte, frijol de los arrozales, Trébol

2.4 Legumes adapted to frequently flooded or inundated areas

2.4.1 Scientific name

Lotononis bainesii, Phaseolus lathyroides, Pueraria phaseoloides , Vigna luteola, Vigna umbellate.

2.4.2 English name

Lotononis, Phasey bean, Tropical kudzu, Dalrymplar vigna, Rice bea.

2.4.3 Spanish name

Lotononis, Miles lotononis, Frijol de monte, frijol de los arrozales, Kudzú tropical.

2.5 Legumes that tolerate drought

2.5.1 Scientific name

Cajanus cajan, Canavalia brasiliensis, Canavalia ensiformis, Clitoria ternatea, Desmanthus virgatus, Desmodium uncinatum, Dolichos lablab, Galactia striata, Glycine wightii, Indigofera endecaphylla, Leucaena endecaphylla, Macrotyloma axillare, Stylosanthes guyanensis, Stylosanthes hamata, Stylosanthes humilis, Stylozobium spp, Vigna unguiculate.

2.5.2 English name

Pigeon pea, Jack bean - sword bean, butterfly pea, Silverleaf desmosium, Lablab bean, Glycine, Archer axillaris,

Common stylo, tropical lucerne, Caribbean stylo, pencil flower, Townsville stylo, wild lucerne, Mucuna, velvet bean, Cowpea.

2.5.3 Spanish name

Guandul, Canavalia, Campanilla, zapallito de la reina, Frijol caballo, gallinita, Frijolillo, Galactia, Soja perenne, Indigo, Alfalfa de Brasil, Tebeneque, Alfalfa salvaje, Frijol terciopelo, Caupi.

2.6 Legumes adapted to shade

2.6.1 Scientific name

Arachis pintoi , Calopogonium mucunoides, Canavalia ensiformis, Indigofera spp., Leucaena leucocephala , Pueraria phaseoloides, Trifolium repens.

2.6.2 English name

Horse groundnut, Calapo, Jack bean, sword bean, Leucaena, Tropical kudzu, White clover.

2.6.3 Spanish name

Mani forajera, Rabo de iguana, Canavalia, Indigo, Leucena, acacia bella rosa, aroma blanca, Kudzú tropical, Trébol blanco.

2.7 Legumes adapted to fertile soils

2.7.1 Scientific name

Glycine wightii, Medicago sativa, Stilozobium deeringianum (Mucuna pruriens), Trifolium spp., Vicia sativa, Vicia villosa.

2.7.2 English name

Glycine, Lucerne, Mucuna, Velvet bean Mucuna, Clover, Common vetch, Hairy vetch.

2.7.3 Spanish name

Soja perenne, Alfalfa, Frijol terciopelo, Trébol, Arveja comun, Veza peluda.

2.8 Legumes and other species tolerant to low soil fertility

2.8.1 Scientific name

Cajanus cajan, Calopogonium mucunoides, Canavalia brasiliensis, Canavalia ensiformis, Centrosema spp., Desmodium spp., Galactia striata , Indigofera spp., Leucaena leucocephala, Lotus corniculatus, Lupinus luteus, Macroptilium atropurpureum, Stylosanthes spp., Stylozobium aterrimum, Teramnus uncinatus, Vicia villosa, Vigna unguiculata, Zornia diphlla, Lolium multiflorum, Ornithopus sativus, Secale cereale, Spergula arvensis.

2.8.2 English name

Pigeon pea, Calapo, Jack bean, sword bean, Centro, butterfly pea, Desmodium, Leucaena, Birdsfoot trefoil, Yellow lupin, Siratro, Stylo, Black mucuna, Hairy vetch, Cowpea, Zornia, Italian ryegrass, Pink serradella, bird's foot, Rye, Corn spurry, spurry.

2.8.3 Spanish name

Guandul, Rabo de iguana, Canavalia, Jetirana, bejuco de chivo, Pega-pega, Frijolillo, Galactia, Indigo, Leucena, Lupino amarillo, Siratro, Frijol terciopelo negro, Mani de venado, Arveja pelluda, Caupi, Zornia, barba de burro, Centeno, Linacilla.

3. Validation of the practice

Conservation tillage, and especially zero-tillage, was successfully implemented in southern Brazil, North America, New Zealand and Australia. Over the last two decades the technologies have been improved and adapted for nearly all farm sizes; soils; crop types; and climatic zones.

Experience is still being gained with this new approach to agriculture and FAO has supported the process for many years.

4. Minimum requirements for the successful implementation of the practice

Applying CA in farms imply high initial costs of specialized planting equipment and the completely new dynamics of a conservation farming system, requiring high management skills and a learning process by the farmer.

5. Agro-ecological zones

- Tropics, warm; and
- Subtropics, warm/mod cool.

6. Related/Associated Technologies

- 7417; and
- 7415.

7. Objectives fulfilled by the project

7.1 Resource use efficiency

This practice helps maintaining soil from degradation due to conventional tilling practices.