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## The regional agricultural policy and the soil protection

### RDP Sicily 2007-2013

The RDP 2007-2013 identified and implemented the necessary interventions to support the development of agricultural, food and forestry areas, conservation and valorisation of environment and also the sustainable development of rural territories of the region. The regional strategy achieved a wide and articulate objective aimed to enforce the agricultural productive system and promote a competitive relaunch, integrate territorial, social, economic and environmental components, value the multifunctional role of agriculture. The Programme was articulate in four "Axes":

**First axis** - **"Improvement of competitiveness in agricultural and forestry areas"**, with the priority to improve the entrepreneurial and technical-professional capacity of workers and to rejuvenate the entrepreneurial component.

**Second axis** - **"Improvement of environment and rural space"**, with the objective to value the role that agriculture plays for environment and natural space through the following priorities:

- Conservation of biodiversity, protection and dissemination of agri-forestry systems with high naturalistic value
- Protection and sustainable management of territories
- Protection of soil and water resource
- Increase of biomass production and adoption and dissemination of practices for reduction of greenhouse gasses

**Third axis** - **"Life quality in rural zones and diversification of rural economy"**, with interventions addressed to improve the life quality in the rural zones and promote the diversification of the economic activities, to create and strengthen the employment improving the attractiveness of rural territories for enterprises and local people.

**Fourth axis** - **"Implementation of Leader Approach"**, it's a methodological axis, Regione used it to support a major integration of the initiatives, both at territorial level and supply chain. In particular, the axis aims to enforce the local planning and management capacity and value the resources inside the territories through a representative public-private partnership.



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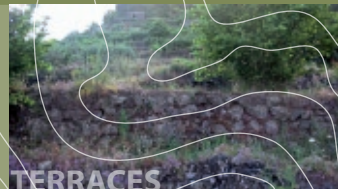
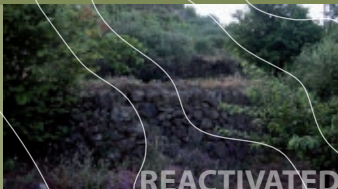
Great importance was given to the valorisation of environment and rural space (in particular in Axis 2), supporting the management of the territory through interventions aimed to promote protection and conservation of agri-forestry landscape. Territorial equilibrium, dissemination of sustainable agricultural practices, as well as environmental and economic initiatives producing benefits to rural communities, implementing specific measures. The axis measures permitted to promote a sustainable use of rural and forestry land and the conservation of the productive components in mountain and disadvantaged areas of the region.

In particular the **Measure 214 "Agri-environmental payments"**, through the submeasures **214/1A "Management of eco-sustainable farms"**, **214/1B "Agriculture and biological zootechnics"**, **214/1G "Contrasting hydrogeological instability and recovery of traditional agricultural landscape"** and the **Measure 216 action A2 "Non-productive investments in farms associated to Measure 214- Action 214/1G"**, supported decisively the agricultural and zoo technical companies that decided to implement their activities respecting environment and landscape, adopting more sustainable agricultural management models to combat water erosion of soil and preserve the increase of soil organic matter.

214  
/1A  
/1B  
/1G  
216  
/A2

AGRI  
ENVIRONMENTAL MEASURES

### ABANDONED TERRACES



### REACTIVATED TERRACES



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## RDP Sicily 2014-2020

The new RDP Sicily 2014-2020 is now being determined and it will be more directed to a sustainable development of rural zones, with a limited number of essential objectives, concerning the transfer of knowledge and innovation in agricultural and forestry areas and rural zones, the empowerment of farm profitability and the competitiveness of agriculture in all its forms, promotion of innovative technologies for farms and a sustainable management of forests, organization of agri-food supply chain, included the transformation and marketing of agricultural products, wellness of animals, management of the risks concerning agriculture, safeguard, recovering and valorisation of the ecosystems connected with agriculture and forests, promotion of an efficient use of the resources, mitigation of climate changes and adaptation to them, landscape and economy with low-carbon emission in agri-food and forestry areas, as well as social inclusion, reduction of poverty and economic development of the rural zones.

Great relevance will be given to the **soil** protection in the Measure **“Agri-environmental climate payments”**. In fact, in order that the increase of the agricultural productivity and production is sustainable, the natural resources have to be managed in a correct way, in line with the environmental needs.

RDP Sicily  
2014/2020



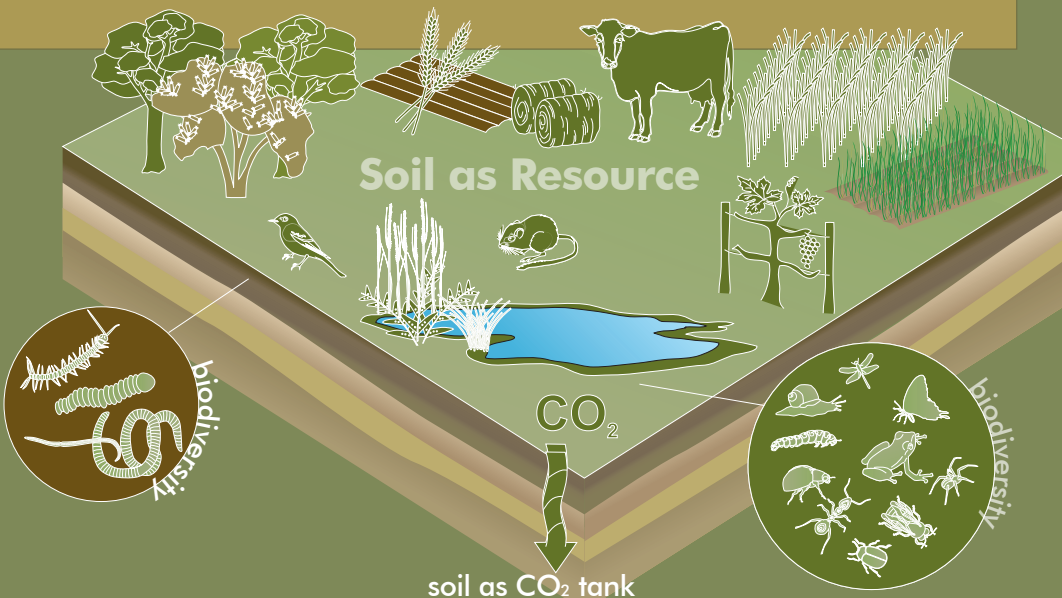
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The soil will be very important, because through it will be measured the success or failure of the more sustainable production models adopted. The soil is the essential resource for the agricultural production. The land-use interacts in different ways with the **water quality and availability, biodiversity and provision of eco-systemic services.**

The function as **carbon** tank gives the soil an essential role in the mitigation of climate changes. A correct soil management has to be able to avoid the degradation and stabilise the functions the soil carries out.

Considering the particular vulnerability of this resource and the multiple functions it has, the safeguard of the resource soil plays a really important role. With the aim to contrast in particular the water erosion and the organic matter decline, will be introduced the submeasure **"Adoption of conservative agriculture technics"** to introduce, in the areas used as alternate arable land for cereals and forage, a group of complementary agricultural practices like sod seeding or reduced land working, permanent soil cover and crop diversification and association.



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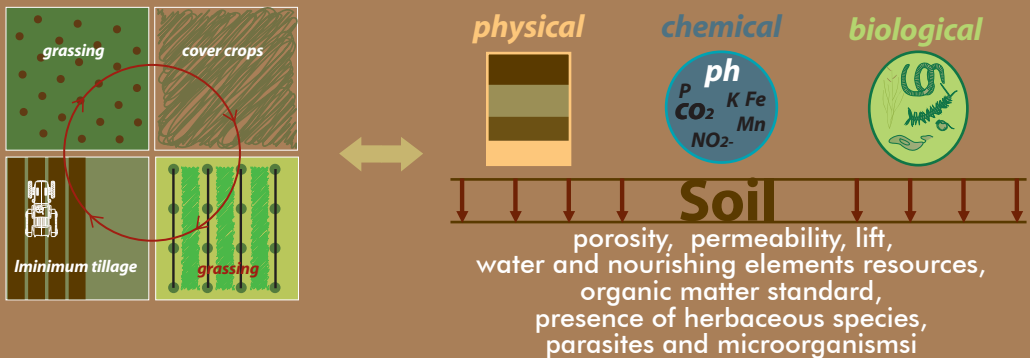
## Technical aspects of soil management

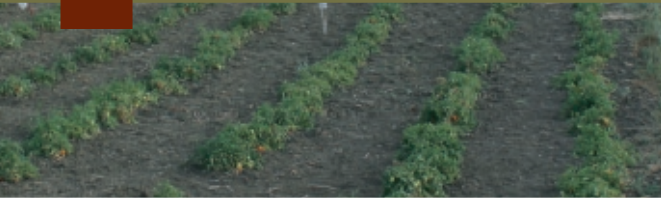
Since the past have been different the agronomical technics and the kinds of soil management used in different crop environment. The kind of management adopted can modify, also drastically, the chemical, physical and biological characteristics of the soil and, in particular, porosity, permeability, lift, availability of water and nourishing elements, organic matter content, presence of herbaceous species, parasites and microorganisms (pathogenic and symbionts).

The equilibriums instituted, in the course of time, between the different herbaeous species and between these ones and the telluric microflora, are the first to be subjected, for long time, to the effects of soil management practices. The strategies of soil management, and in particular vines, are connected mainly to the pedological and climatic characteristics of the zones and this explain, with the arrival of a modern agriculture, the considerable quantity of technics implemented to face the needs of crops and farmers.

Until now, in our environments characterized by a Mediterranean climate with summer drought, the traditional technic recommended the complete removal of spontaneous and ruderal flora, potential element of competition with agrarian crops, through repeated mechanized workings or chemical weeding. Now this management model was called into question by many experimental works and, in particular, in those environments where the working is difficult because of inadequate conditions of soil practicability, especially in autumn for rain or in lands subject to erosion due to high slopes and intense rain.

### Agronomic technics and soil management can modify the characteristics



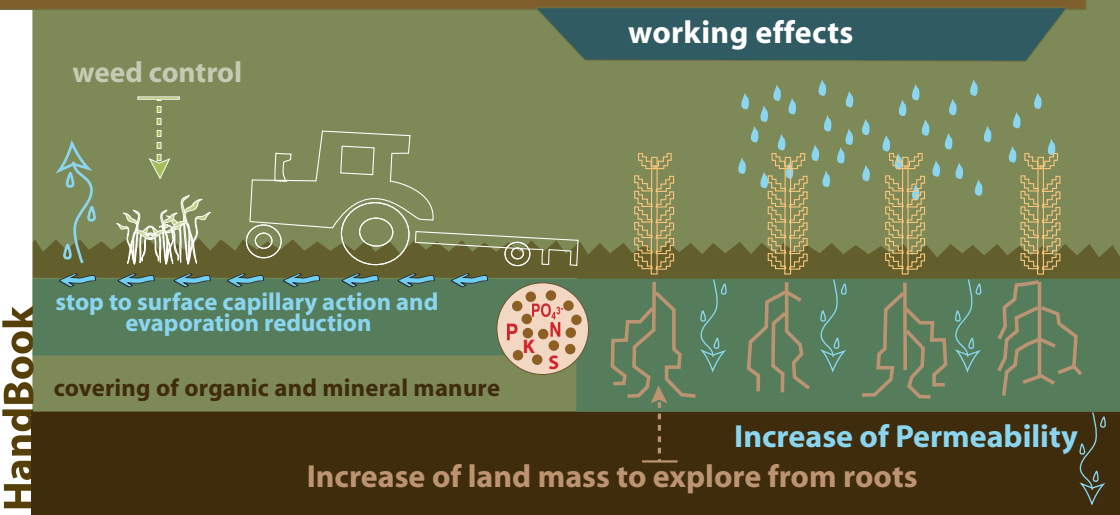


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## Workings

The soil working has been for long time the most popular practice in agriculture to contain the presence of spontaneous weed. The annulment of the hydro-nutritional competition of the spontaneous flora towards the crops is for sure the key to success of this technic. Among the vantages explaining the popularity of this strategy, nowadays the most popular at regional level, we can mention:

- Increase of permeability of the soil layer subject to workings and then control of water circulation with reduction of stagnation phenomena
- Destruction or containing of weed and some plant and animal parasites
- Interruption of the surface capillary action and reduction of evaporation losses
- Covering of organic and mineral fertilizer, correctives, amendments and crop remains.



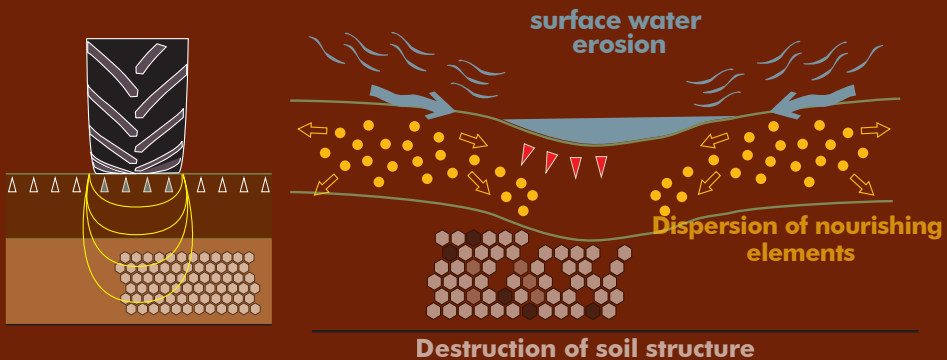
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Where precipitations are lower than 400/500 mm/year and there's no possibility for crop supporting irrigation, the total working is one of the usable technics; it permits to store water and eliminate the weed competition. The absence of competition is fundamental in these constraining environments because it permits to address the poor water resources to a main crop.

But the working may cause also negative effects as:

- Reduction of soil lift and consequent limited practicability
- Damage of soil structure
- Increase of surface and subsurface erosion risk because of the working sole formation
- Loss of nutritional elements for surface water erosion and percolation.



It was observed that the practice of mechanized workings, used for decades in an irrational way, caused in many kinds of soil phenomena of degradation of soil structure and fertility, with effects like compaction, erosion, nitrates degradation and, above all, organic matter decline.



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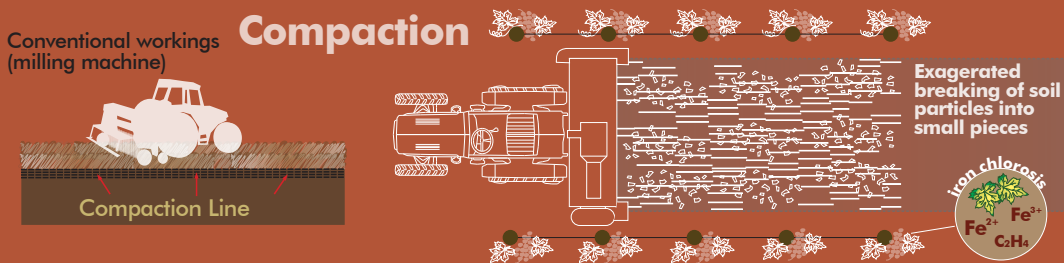
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## Compaction

The continuous passage of the machines may cause phenomena like compaction, more or less serious, in relation to the kind and stability of the soil structure, above all where a carriageway exists, with negative effects on the root apparatus activity. This phenomenon, studied mainly on vines and particularly evident in clay lands, reduces gradually the soil porosity and influences negatively on the root development: in effect the compaction has low values in the row area, it's more evident in the inter-row area and reaches the highest values in the area directly involved in the machine passage.

Another kind of compaction is that one caused by workings implemented with machines that break the soil particles into very small pieces, machines like the milling cutter. In different regional environments, in particular in red Mediterranean lands, these working organs, even if they permit the formation of a soft surface soil layer reducing substantially the water loss for evaporation, they cause "compaction stress", characterized by reduction of vigour and productivity, abnormal yellowing and reddening associated to leaf deformation and, especially in vines, also plant apoplexy.

The soil compaction can cause the appearance of more or less serious iron chlorosis, as consequence of the accumulation of ethylene in the soil, inhibiting the formation of new roots, the only structures able to absorb iron ion.



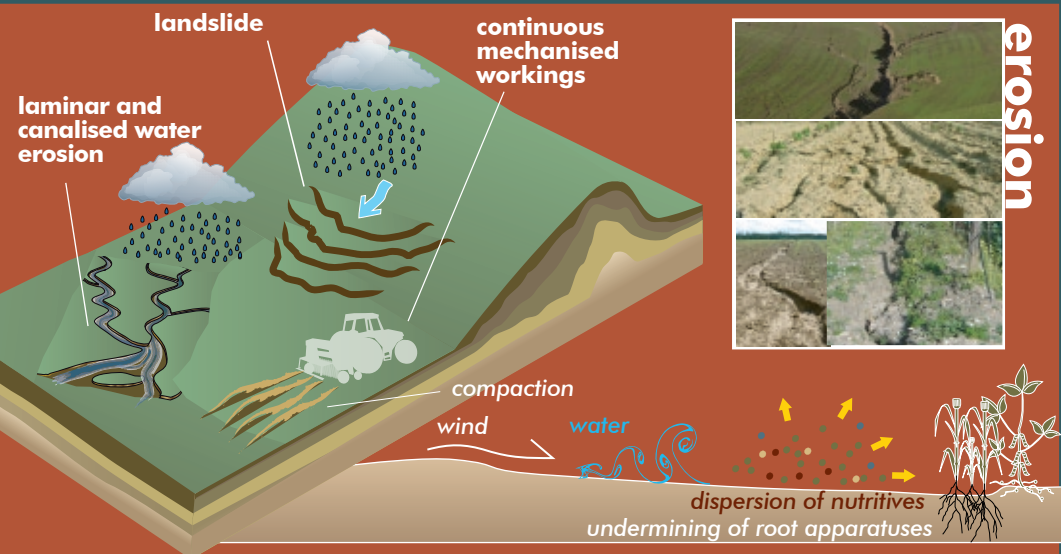
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## Erosion

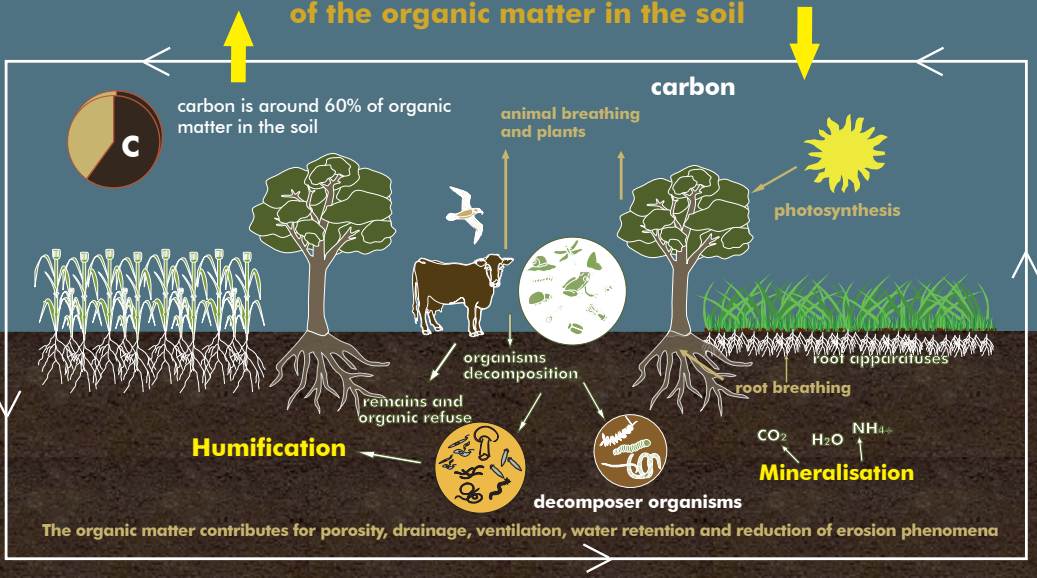
The continuous mechanized workings also expose the soil to the serious phenomenon of water erosion, laminar and canalised, that is a real calamity. In effect the climatic characteristics and the morphology of the Sicilian territory make the soil easily subject to water erosion. In these cases, the macroscopic event (landslide), with any problem concerning reactivation and reinforcement of the damaged area, is not the main problem: the most serious damage for the agri-ecosystem is the gradual and constant removal of the surface layer that causes a reduction of the fertility and also a progressive undermining of the root apparatuses. We have to specify that the kind of working and machines can affect considerably the importance of the erosion phenomena that are as accentuated as major is the breaking of the surface soil layer into small pieces. For example, what we observed with the milling doesn't happen with other workings and machines, like grubbers or disc harrows, that break the soil in a rough way causing lower erosion and compaction.



## The soil organic matter

The organic matter is considered one of the most important indicators of soil quality and the organic carbon, that is around 60% of the organic matter in the soil, plays a fundamental positive function on many soil characteristics. It represents a nutritional and energetic sublayer for soil organisms and a source of nourishment for plants, it gives a good structure to the soil thanks to the porosity increase and the stability of the aggregates, this reflects a good drainage and ventilation, increase of water retention and reduction of erosion phenomena. The soil organic matter includes remains of plants, animals, microorganisms at different decomposition levels and also substances synthesized again by the soil living population. The quantity of organic matter in the soil depends on quantity and quality of organic remains reaching the soil but also the balance of the natural processes of humification (increase) and mineralisation (decrease) whom such remains are exposed to, in relation to climate and some physical and chemical characteristics in soils because they control the activity of microorganisms and land fauna.

### The conventional agricultural practices change the fragile equilibrium of the organic matter in the soil



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The reduction of organic matter happens diffusely in the agri-ecosystems of the semi-arid environments in different areas of Sicilian territory where, because of pedological and climate conditions, low contents of organic matter cause agricultural soil degradation phenomena. "The maintenance of the fertility of the soil is the first condition of any permanent system of agriculture"; with these words in 1940 the famous English agronomist Albert Howard prepared the ground for the organic farming method. Fertility is the capacity of the soil to maintain its productivity in a long-term period; it must be preserved and, if possible, increased. Also the organic matter in the soil is affected by the soil workings because these ones interfere with the humification and mineralisation processes.

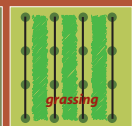
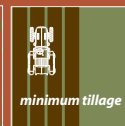
### Conventional Agricultural Practices



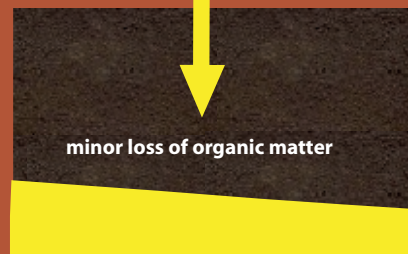
disturbance effect  
(major)



### Conservative Agricultural Practices



disturbance effect  
(minor)





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## The soil organic matter conservation

A good soil structure permits the roots to develop in a wider and deeper space, with more water resources, nourishing elements and oxygen needed for their metabolic processes. Generally a good soil structure permits the increase of number and diversity of land organisms, reduces the number of the harmful ones and fosters the release of nourishing elements from the organic matter. The organic matter improves the water resources in the soil for plants and micro fauna. The constant organic matter includes source of energy and nourishing elements for the soil microorganisms that, through their normal metabolism divide and transform the organic matter. Diversity and abundance of soil microorganisms depend on the kind and quality of the organic remains in the soil. If adequately nourished, these useful microorganisms can compete successfully with the pathogenic ones through their antagonistic activity, preventing or reducing the "soil diseases". Of great importance are kind and quantity of organic matter in the soil because the availability of organic matter, together with water and oxygen (at root level), causes the availability of nourishing elements for plants

In a sustainable agricultural activity, soil fertility and biological activity must be preserved and increased through different virtuous practices like:

- a) Leguminous plants cultivation, green manure plants and plants with deep root apparatus, included in an appropriate long-time crop diversification;
- b) Integration of manure from organic livestock;
- c) Integration of other organic material from organic farms, in accordance with the communitarian and national rules.



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## The green manure practice

It consists of planting a single species or herbaceous mixed species with the objectives to not obtain a production but integrate the green biomass in the soil, to increase or maintain the organic matter and fertility and introduce the nourishing elements for the next crops. We think that 50% of nitrogen taken by a leguminous plant from the green manure is available for the immediate next crop. It's a good rule to maintain the soil without cover for the shortest time possible. In this way we can implement crops not aimed to the harvest like the cover crops. The cover crops protect the soil from the erosion phenomena and loss of soil fertility, reduce the organic matter oxidation, suppress weeds, enrich the soil with their own crop remains, are destined to the green manure.

The trap plant or catch crops are aimed to immobilise in the green biomass the nitric nitrogen in the soil, taking it away from the degradation, especially in winter, to give it back later as green manure.

*In brief, the main functions of the cover crops are the following:*

1. Improvement of the chemical-physical characteristics of the soil
2. Soil protection from degradation
3. Protection of surface water and groundwater
4. Increase of the availability of nourishing elements
5. Stimulation of the microbiological activity
6. Weed control
7. Biocide action
8. Contribution to humic equilibrium
9. Improvement of business practicability



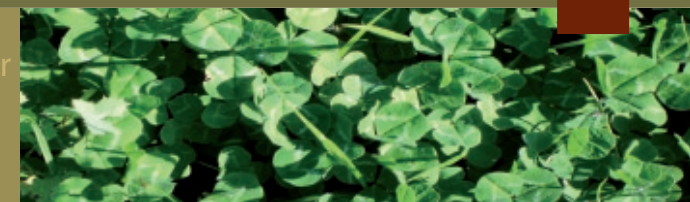
# green manure





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## OBJECTIVES

### OBJECTIVES

Species or type	Erosion control	Weed Competitivity	Organic matter contribution	Nitrogen contribution	Nitrates control	Business practicability	Management costs €/ha (for: seeds, sowing and green manure)	
							With workers	On the cheap
Oat	++	+++	++	+	+++	+	256 – 261 €/ha	160 – 165 €/ha
Tall fescue	+++	++	+	+	+++	+++	381 – 491 €/ha	285 – 395 €/ha
Lolium perenne	+++	++	+	+	+++	+++	456 – 552 €/ha	360 – 456 €/ha
Barley	++	+++	++	+	+++	+	233 – 261 €/ha	147 – 165 €/ha
Corn	+++	++	++	+	+++	+	288 – 297 €/ha	180 – 200 €/ha
Poa pratensis	+++	++	+	+	++	+++	576 – 720 €/ha	480 – 624 €/ha
Red fescue	+++	+++	+	+	+++	+	336 – 396 €/ha	240 – 300 €/ha
Sheep fescue	+++	++	+	+	++	+++	366 – 441 €/ha	270 - 345 €/ha
Medicago polymorpha L.	++	++	+++	+++	+	+	421 – 456 €/ha	325 – 360 €/ha
Trifolium sub-terraneum	+++	+	++	+++	+	+++	266 – 286 €/ha	170 – 190 €/ha
Trifolium repens	+++	+++	++	+++	+	+++	616 – 776 €/ha	520 – 680 €/ha
Minor beck	+	++	+++	+++	++	+	294 – 320 €/ha	198 – 224 €/ha
Vetch	++	++	+++	+++	++	+	260 – 282 €/ha	164 – 186 €/ha
Frencj honeysuckle	++	+	+++	+++	++	+	276 – 306 €/ha	180 – 210 €/ha



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# Grass and leguminous plants



Oat



Tall fescue



Lolium perenne



Barley



Corn



Poa pratensis



Red fescue



Sheep fescue



Medicago polymorpha



Trifolium sub-terraneum



Trifolium repens



Minor beck

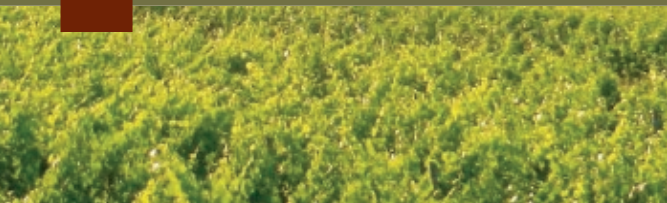


vetch



Frencj honeysuckle





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## Cautious choice between grass and leguminous plants

The types used are mainly **grass and leguminous plants**, the adoption of one or other species, because of the different kinds of root apparatuses, needs a different use and distribution of mineral elements and consequently a different effect on the main crop and soil. The leguminous plants are more exigent regarding temperature and less resistant to cold, they well resist drought thanks to a deep and tap-root apparatus. They can make very thick covers but, generally, for a short time and all of them can improve the chemical fertility because they generate nitrogen in the soil. They are more exigent also about cutting and kind of soil and are sensitive to stagnation.



Vetch



Lolium



Minor beak



Festuca



Trifolium



Corn

**Grass plants** are better than leguminous ones for permanent monofito lawn. The fasciculate roots are like a wide felt with a great anti-erosion power and can improve the physical fertility of the soil, maintaining a good structure and renewing annually the root apparatus that contributes to maintain a good standard of organic matter in the soil. They are more resistant than leguminous plants to stagnation but more sensitive to drought, as they are generally microtherm species are less exigent regarding temperatures.



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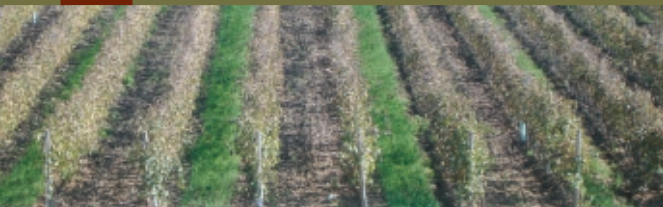


## Grassing

### Grassing in alternate rows

This specific technic adopted in vines consists of maintaining a row free of weeds, through a mechanised working, and the other one with grass; it's used in environments with sufficient rainfall but badly distributed, with summer long-time drought or over well drained soil, to contain the competition between lawn and vines and permit the entrance to the vine after a rainy time. The types used are the same considered before and the management system is the same.





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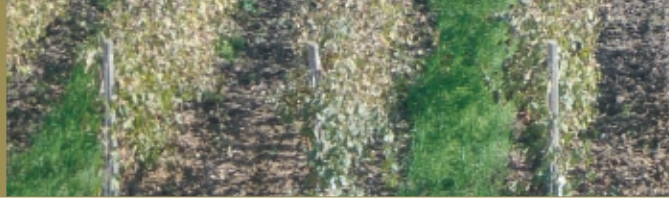
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## Year-long grassing

It can be implemented both with a classic green manure, with shredding and annual covering of selected types, and creating a natural mulching layer. The green manure, being a practice introduced time ago as system of integration working-grassing, can be implemented in an innovative way, for example combining vigorous grass plants and deep root development with leguminous plants that permit to increase nitrogen in the soil. The use of mix permits also to balance the contributions, combining biomasses with different contribution between carbon and nitrogen, taking advantage from the different levels of stability in the organic matter given to the soil. In relation to an annual management of grass, there is the possibility to avoid annual shredding, using instead the crushing of the herbaceous biomass to obtain a natural mulching effect. In this way we permit the gradual deterioration of the herbaceous crop that needs a long-time activity of the grass in respect to a direct shredding, a long activity of accumulation and increase of the C/N ratio of the biomass.



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## Multi-year grassing

This kind of management is aimed to guarantee a good herbaceous soil cover for many years, to permit a good practicability for the machines through the vines, a context more and more tied to mechanisation. This aspect is well inserted in the organic management of the vines that, because of the absence of weed killer products, could benefit by a semi-permanent no competitive cover, going from an annual working to a multi-year one (around every three years). The mulching effect of herbaceous crop remains in summer acts as contrast to weed. The species that better adapt to the grassing come from the grazing species showing a major rusticity and resistance to the trampling. In vines located in environments characterised by long summer drought is favourable if the competition between vines and lawn ends before the florescence. Different workings show how water stress in this period can cause a reduction of the quantity of grape produced as consequence of the lower fruit set and berry weight, moreover they negatively affect the wine quality that are more aggressive because of the gross tannins content.





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## Crop remains shredding

It's a practice that consists of shredding (breaking into 5 cm long fragments with special machines) the pruning remains and covering them a bit so to start the humification process. The remains are generally collected and accumulated out of the rows to be burnt, an old practice used until now in spite of prohibitions and irrationality, because it takes organic matter away from the soil. The data collected from the latest experimentations show that the covering of pruning remains has maintained, and sometime increased, the content of organic matter in the soil.



## Biomass compost and reuse

In the organic farms the contribution of nourishing elements to the crops comes from the biomass reuse (compost). On the contrary the intensive chemical farms have left since long time the traditional and natural biomass reuse methods, with consequences like soil degradation, desertification and increase of plant susceptibility to diseases and insect attack. The compost gives the opportunity to transform the production waste into farm resources and great benefits like increase of soil fertility and productivity, increase of biodiversity, reduction of ecological risks and environment safeguard.

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## Nitrogen manure

The mineralisation process of the organic matter given to the soil is effected by many factors, like temperature, oxygen contribution, humidity, ph, inorganic nourishing elements and C/N ratio of plant remains that are the main factors that control the degradation velocity (Stevenson, 1982). Nitrogen is a key nourishing element for the microbial growing and consequently for the organic matter decline. It's always inside the plant, animal and microbial tissues but availability and quantity are different. If the nitrogen content of the sublayer is high the microflora satisfies its needs only from this source. If the sublayer lacks nitrogen the decomposition is slow and the carbon mineralisation will be stimulated by additional nitrogen (inorganic form). In this last case the nitrogen manures cause increase of greenhouse effect gasses as consequence of the increase of the cellulose degradation. In semiarid environments the organic matter is affected by sudden mineralisation, above all in agri-ecosystems where the exaggerated use of inorganic fertilisers and workings facilitate the destruction of the aggregates, exposing the protected organic matter to oxidised processes created by the microbial community in the soil. The sustainability of the land ecosystems is based on the nourishing elements reuse but also on the aggregates stability; for this reason it's necessary an equilibrium between organic matter mineralisation efficiency in the soil and reactivation of its reserves.





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## Conclusion

Thanks to the studies implemented over the last 10 years, the crop management in a semiarid environment, based essentially on mechanised and chemical treatments to remove crop remains and eliminate weed, is gradually giving place to new management models based on the use of cover crops (leguminous or grass plants in inter-rows space) with the aim to protect the soil from the water erosion risk and covering of crop remains as carbon source to incorporate in the surface layers of the soil. The soil fertility is strictly depending from the organic matter content. In semiarid environment like in Sicily increasing or maintaining a good level of organic matter in the soil is very hard because of the climate conditions that accelerate the mineralisation processes. Moreover also the agronomical technics implemented in a not correct way can worsen the problem. The frequent soil workings and the exaggerate contribution of inorganic manures are an example.



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For a more and more sustainable and eco-compatible agriculture it's necessary to adopt agronomical technics safeguarding the organic matter content in the soil and its fertility. The soil grassing and the following covering is now a well-known technic to give organic matter and other nourishing elements, in particular nitrogen. The vine grassing limits the surface erosion, reduces the element loss for percolation, maintains the availability of iron and phosphorus contrasting their retrogradation, reduces the influence of the *Botrytis cinerea* attacks, makes easier the crop operations and permit a reduction of the management costs. The only environmental limit to the grassing is the water availability, insufficient nourishing elements or the necessity to sow only in spring or autumn have effects only on the species choice, reducing the variety of usable species and the plasticity of this technic in controlling the vegetative vigour. To induce a specific competitive level we can act modifying the grassing duration, the width of the weeded belt, the kind of used species for the grassing; to help this technic we can modify the nutritional strategy, in accordance to the needs.





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