THE EXPERIENCE IN EMILIA-ROMAGNA TO IMPROVE THE CARBON FOOTPRINT IN CROP PRODUCTION THROUGH OPERATIONAL GROUPS FOR INNOVATION (EIP-AGRI)

GOI (EIP-AGRI) PROJECTS:

Programma di Sviluppo Rurale dell'Emilia-Romagna 2014-2020

UNIONE EUROPEA Fondo Europeo Agricolo per lo Sviluppo Rurale — Regione Emilia-Romagna

L'Europa investe nelle zone rurali

1. **FRUTTIFI_CO:** Emilia Romagna fruit growing sequesters organic carbon in the soil
2. **RIASSORBI:** Reduction of greenhouse gases in organic farming
3. **RBR-EAS:** Reuse of residual biomass for agronomic, livestook and energy use
4. **VITICULTURE:** Assessment of the carbon footprint in relation to highly sustainable viticultural strategies

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Brussels, 31 March 2022

M.Grazia Tommasini

RI.NOVA AND ITS MEMBERS

Ri.Nova manages and implements research and technological development activities to promote the competitiveness of the agricultural and agri-food sector. RINOVA represents with its members over 60% of the Gross Salable Vegetable Production of Emilia-Romagna Region. A network of high value stakeholders that allows the development of effective responses to the innovation needs of the different production chains.

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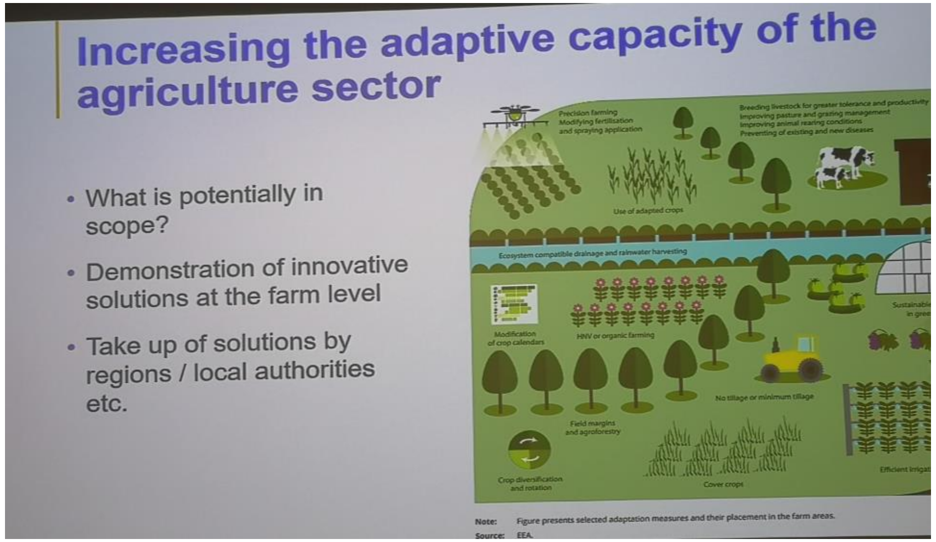
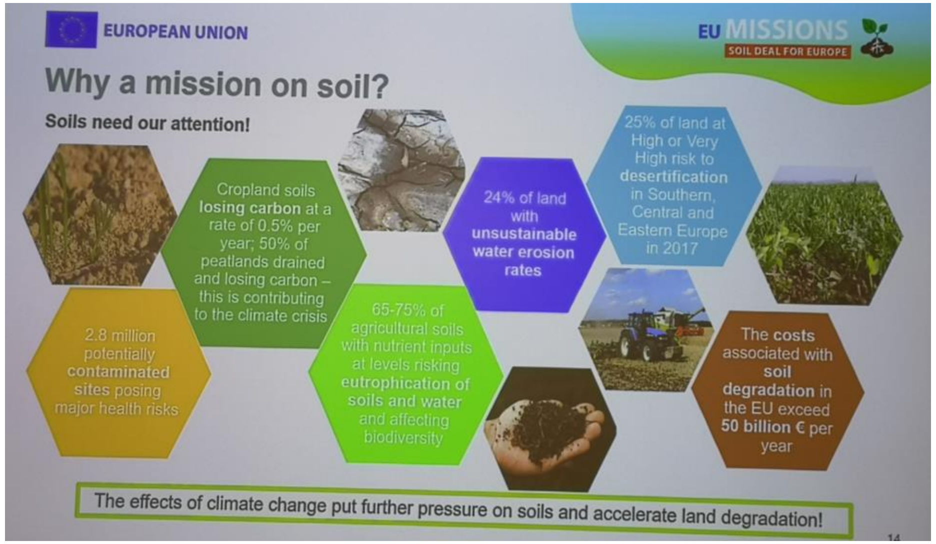
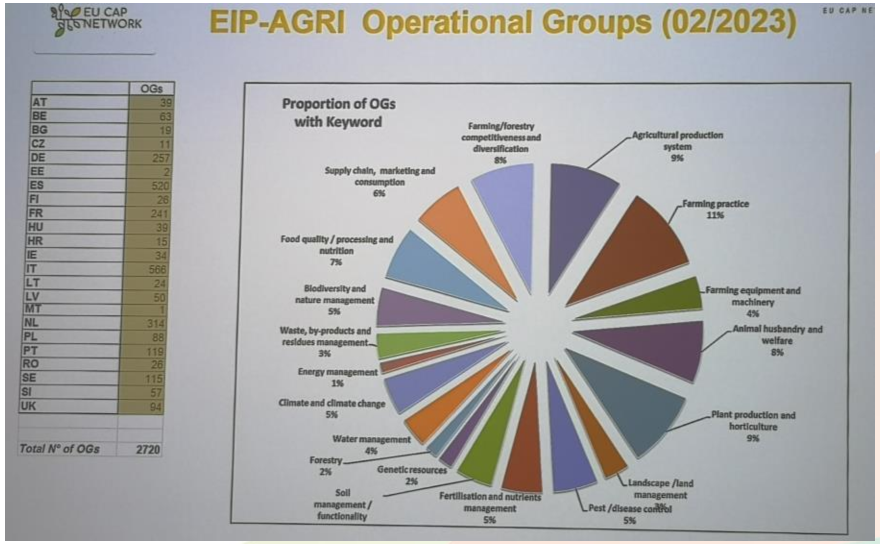




Agriculture contributes approx. 10-12% of global GHG emissions (FAO report, 2021)

The agricultural sector represents 7% of Italian GHG emissions, of which <u>78% from animal husbandry</u> (ISPRA)



Initiative of 4/1000 - COP 21 of Paris

If, globally, the organic C content of the soil is increased by 4 ‰, the increment of CO_2 in the atmosphere is canceled

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FRUTTIFI_CO: EMILIA-ROMAGNA FRUIT GROWING SEQUESTERS ORGANIC CARBON IN THE SOIL

FRUTTIFI_CO

Project objectives:

Quantifying the organic matter content and carbon sequestration in the soils of the selected plots: in the last 15-20 years, **grassing has consolidated as an inter-row management practice in Emilia-Romagna orchards.**

Verify the quality of the organic matter by applying indices that provide **indications on the soil's ability to store or dissipate the organic carbon** present.

Define and share appropriate **agronomic orchard management "guidelines"** aimed at sequestering organic carbon in the soil. Identify agricultural practices aimed at mitigating greenhouse gas emissions and promoting carbon sequestration.

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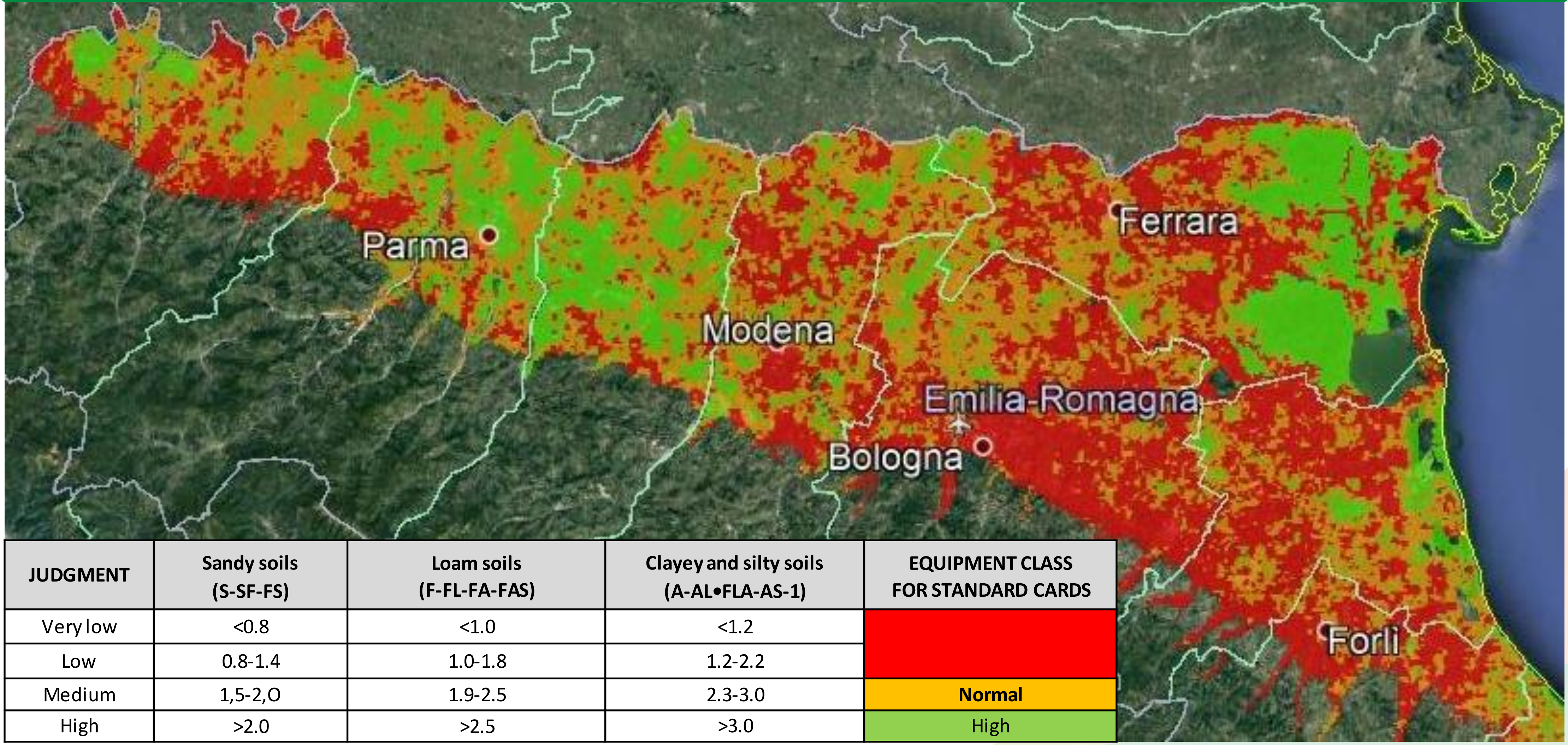
i.ter | CRPV soc. coop. CENTRO RICERCHE PRODUZIONI VEGETALI | ALMA MATER STUDIORUM A.D. 1088

BIONDI MASSIMO	SAVORANI MAURIZIO	SPADA TURILLI MARIA LUISA E FIGLI
	SOC. AGR. ZANI MONICA E ZANI MAURIZIO	MERCURIALI FLAVIO

MAP OF THE ORGANIC MATTER CONTENT OF THE LOWLAND SOILS IN EMILIA-ROMAGNA (LAYER 0-30 CM)



JUDGMENT	Sandy soils (S-SF-FS)	Loam soils (F-FL-FA-FAS)	Clayey and silty soils (A-AL•FLA-AS-1)	EQUIPMENT CLASS FOR STANDARD CARDS
Very low	<0.8	<1.0	<1.2	
Low	0.8-1.4	1.0-1.8	1.2-2.2	
Medium	1,5-2,O	1.9-2.5	2.3-3.0	**Normal**
High	>2.0	>2.5	>3.0	High

MAIN RESULTS - EMILIA-ROMAGNA FRUIT-GROWING SEQUESTERS ORGANIC CARBON IN SOILS

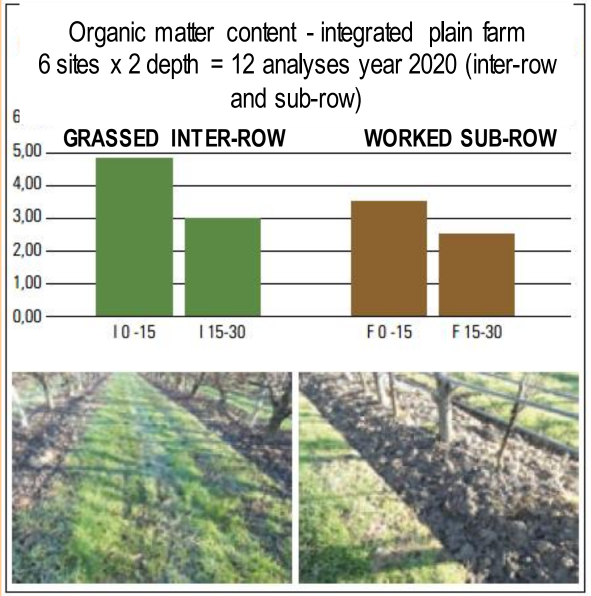


Figura 6 - Contenuto di sostanza organica monitorato nell'anno 2020 in interfila e sottofila di frutteto a produzione integrata in pianura.

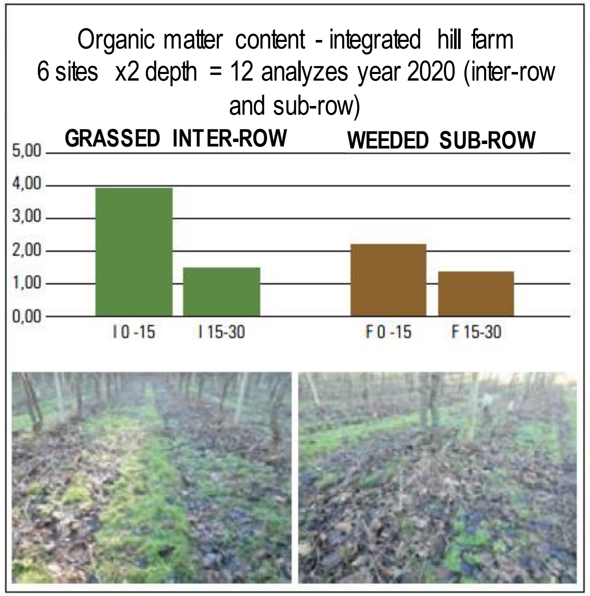


Figura 7 - Contenuto di sostanza organica monitorato nell'anno 2020 in interfila e sottofila di frutteto a produzione integrata in collina

The figures above show in both cases that **the grassed inter-row has a higher content of organic matter than the under-row** and the greatest accumulation is expressed in the first 15 cm as a result of grassing

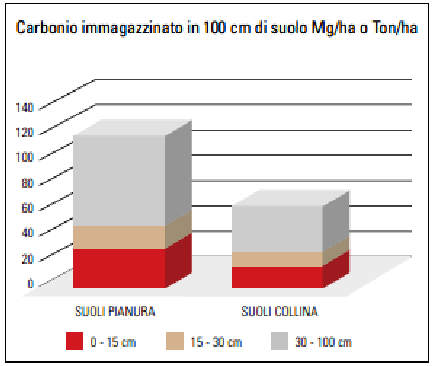


Figura 8 - Stima della capacità media di immagazzinare carbonio nei primi 100 cm di suolo nei frutteti in pianura e in collina.

La stima della capacità dei suoli dedicati alla frutticoltura di immagazzinare Carbonio organico nei primi 100 cm ha fatto riferimento alla seguente equazione di valenza mondiale (Batjes, 1996):

$$stockCO = \frac{CO * Da * s * (1 - rm) * 1}{10}$$

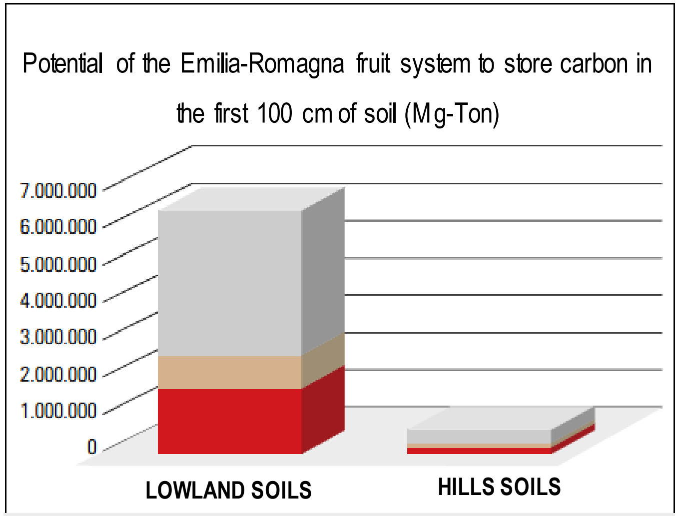
"stockCO": espresso in t/ha (equivalenti a Mg/ha);

"CO": contenuto in carbonio organico (g di carbonio/kg) derivante dalle analisi con analizzatore elementare eseguite su specifici campioni prelevati per ciascun orizzonte pedologico riconosciuto nei profili di suolo studiati;

"Da": densità apparente (g/cm^3) selezionata dalle pedofunzioni elaborate dal Servizio Geologico Sismico e dei suoli (Guermandi et al., 2013) in riferimento alle misure effettuate nei profili di suolo;

"s": spessore dell'orizzonte genetico riconosciuto (cm); in questo caso si è valutato lo spessore dei vari orizzonti riconosciuti entro 100 cm escludendo il substrato geologico nei suoli di collina quando presente entro questa profondità;

"rm": volume occupato dallo scheletro (es ghiaia, ciottoli di diametro > 2 mm) contenuta nell' orizzonte genetico.



ZONA ALTIMETRICA	ETTARI FRUTTETI
Montagna	777
Collina	8.743
Pianura	47.827
Totale	**57.347**

The figure on the right shows the interesting **potential carbon storage capacity of the Emilia-Romagna fruit growing system** by comparing the average soil storage capacity with the hectares of lowland and hillside dedicated to fruit growing.

Linee Guida

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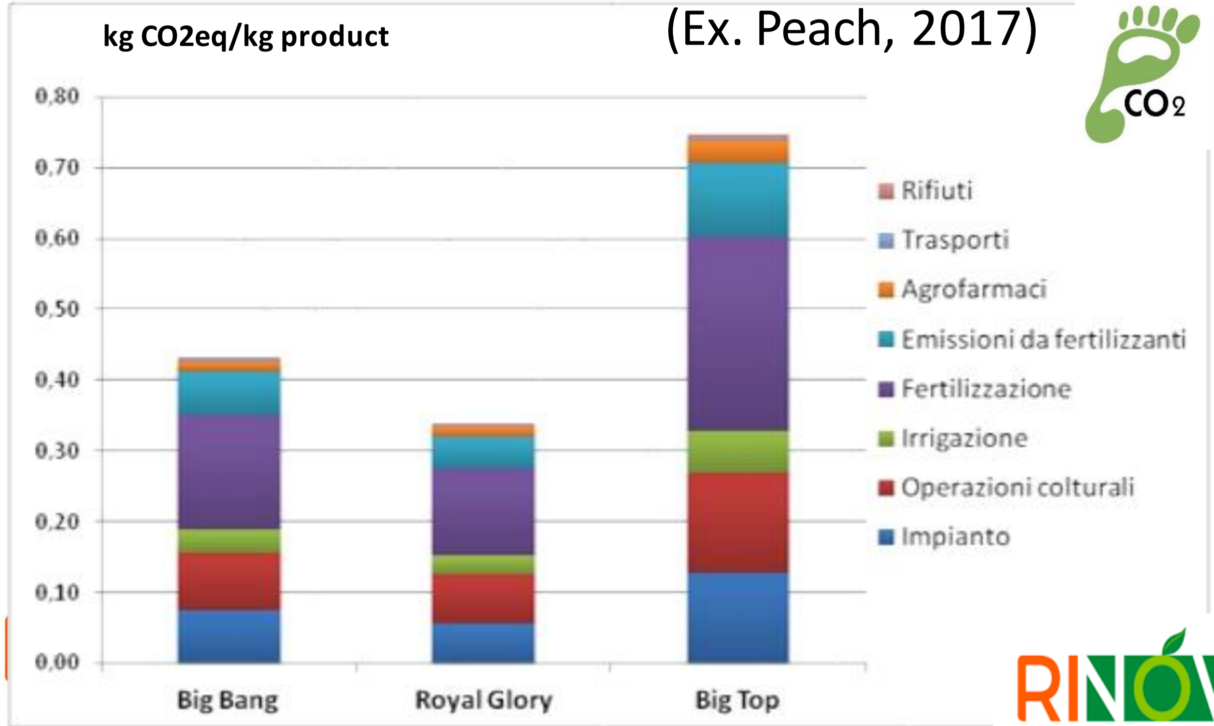
RIASSORBI
REDUCTION OF GREENHOUSE GASES IN ORGANIC FARMING

Project objectives

Identify the **environmental impacts related to the cultivation of some organic fruit species (peach, apple and pear)**, in terms of greenhouse gas emissions, through the application of the LCA (Life Cycle Assessment) analysis

Identify and quantify **practices to mitigate GHG emissions from agriculture** (from cradle to farm gate).



Results in GHG emissions - Carbon Footprint (CF) (with LCA calculation)

CF considers all climate-altering gases: carbon dioxide (**CO_2**), methane (**CH_4**), nitrogen oxide (**N_2O**) as well as other minor ones (Kyoto Protocol)

The IPCC conversion factors are used for the CO_2eq calculation (Intergovernmental Panel on Climate Change 2007 - UN): 1 Kg N_2O = 298 Kg CO_2e and 1 Kg CH_4 = 25 Kg CO_2 (in 100 yr).

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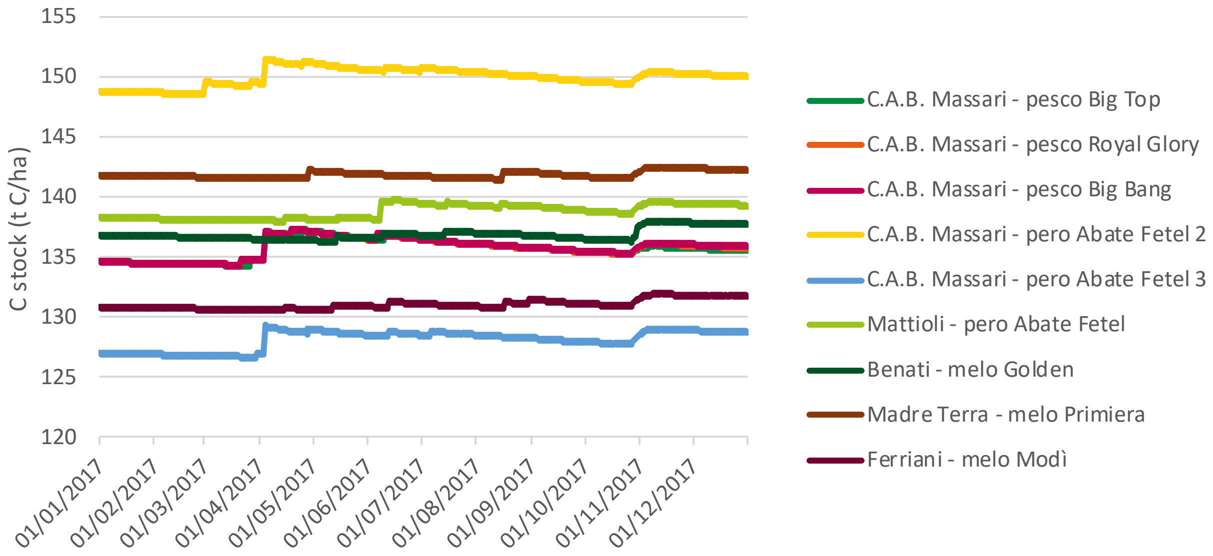
Azienda Agricola Mattioli Stefano (Modena)

RESULTS: SOIL CARBON DYNAMICS AND BEST PRACTICES



A progressive increase in soil carbon accumulation is observed, with different degrees depending mainly on the contribution of organic matrices in fertilization.

Interestingly, **even where there were no organic fertilizer imputs**, such as on the Primiera apple tree, the model still estimates a slight increase in the carbon stock, resulting from soil management (completely covered with grass) and pruning (chopped in the field).

REDUCTION OF CARBON EMISSIONS

- **Optimization techniques in the use of fertilizers** (especially synthetic nitrogen) and **good management of organic amendments** in the field (to reduce N_2O emissions):
- **Adoption of nutritional balances** (use of DSS and fertility analysis) to contain nitrogen dose and product choice;
- More efficient techniques such as **fertigation;**
- **To reduce N_2O losses in the atmosphere**: contain soil compaction, ensure surface drainage and more generally, respect good agronomic practices in soil management that enhance soil microbial functionality
- **Use of renewable energy sources**;
- **Optimize irrigation**: use of DSS and local sensoristics;
- **More efficient use of pesticides** and replacement with less impactful protection techniques

CARBON SEQUESTRATION

Carbon sequestration in the soil can assume, especially in organic farming, very important values and is favored by**:**

- **Application of organic and green manure amendments;**
- **Soil management with grassing;**
- If there are no particular phytosanitary problems, **leave the pruning residues in the field and chop** them.

RBR-EAS
REUSE OF RESIDUAL BIOMASS FOR AGRONOMIC, LIVESTOOK AND ENERGY USE

Project objectives:

Use of **Biochar**, obtained from farm biomass waste, as a **stable soil amendment**, biofuel and supplement for animal husbandry use,

as an **additive on manure and other livestock matrices to reduce CH4 & CO2 emissions**.

IN THE FIELD: distribution of biochar *vs* manure *vs* biochar+manure on a field following sowed for the cultivation of soft wheat for feed use. To evaluate the agronomic use of the biochar the production data were collected at the end of field trial.

IN THE STABLE: the effect of biochar to reduce greenhouse gas emissions was evaluated. It was distributed on manure and other matrices deriving from livestock farms (slurry and digestate).

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FondAgri

Consiglio Nazionale delle Ricerche
Istituto per la BioEconomia
Dipartimento di Scienze Bio Agroalimentari

Azienda Agricola Martini Cesare
(Galeata – FC)

arable farm with an organic beef cattle stable

RESULTS IN THE STABLE AND IN THE FIELD

IN THE FIELD: Wheat production for animal feed using biochar as a soil improver increased by 15% with a direct and indirect productive and economic advantage

Direct benefit

Increased production

Indirect benefit

Environmental sustainability
(no fertilizers or other production factors)

The biochar amendment (25t/ha) resulted in a net sequestration of atmospheric carbon dioxide equal to 60 t/ha.

on the emissions market they are worth about 3000 €/ha.

Quotation of 30/07/2021 equal to about 50€ /t (source: https :// ember-climate.org /data/carbon-price - viewer /)

(1 t biochar contains about 700 kg of carbon; conversion factor C/CO2 = 3,6)

Biochar represents an extremely stable form of C sequestration in the soil as it is not mineralized like other organic matrices

IN THE STABLE: Biochar mixed with manure reduces CO2 emissions by 20% and methane emissions by 40%

RI

ASSESSMENT OF THE CARBON FOOTPRINT IN RELATION TO HIGHLY SUSTAINABLE VITICULTURAL STRATEGIES

Project objectives:

- **Creation of an INTEGRATED SYSTEM** in which the **HIGHLY SUSTAINABLE MANAGEMENT of the soil and canopy (HSVS)** of vineyard is focused on the efficient use of NATURAL RESOURCES.

Monitoring the **EFFICIENCY of the system in reducing the emission of GREENHOUSE GASES.**

IN **THREE DIFFERENT WINE-GROWING AREAS** representative of the Emilia-Romagna Region comparison between:

GA Business management	HSV extension Highly Sustainable Viticultural System

SOIL MANAGEMENT	• **Cultivation**, along the row, of **self-reseeding legumes** with low water requirements and of a mixture of herbaceous species in the inter-row
CANOPY MANAGEMENT	• **Maintenance** of a **high leaf area** by delaying, in a targeted manner, the topping and defoliation interventions in the spring and in the first part of the summer, when water availability is not limiting
USE OF KAOLIN	• **Reduction** of the negative effects due to **water, heat and light stresses** that occur quite frequently in the vineyards of the E.R. Region

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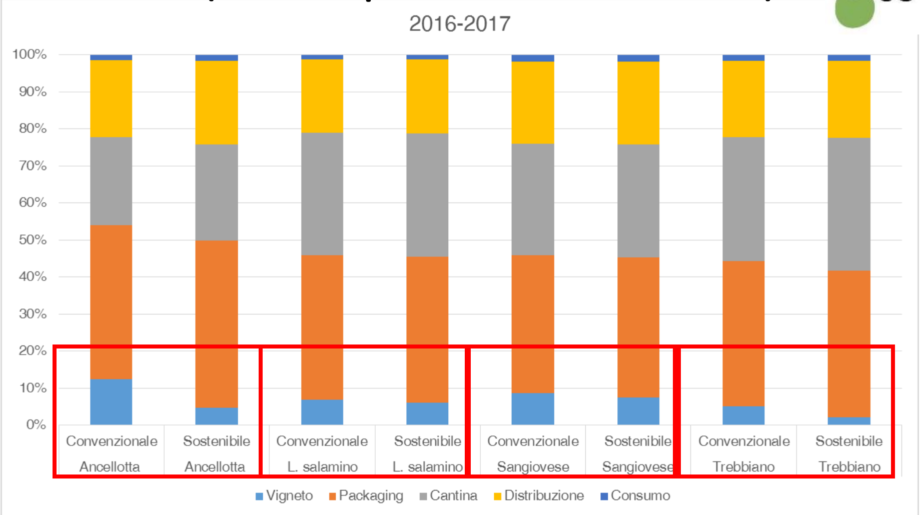
ASTRA — TERRE CEVICO — CANTINE RIUNITE & CIV — Cantina Sociale di San Martino in Rio — CAVIRO

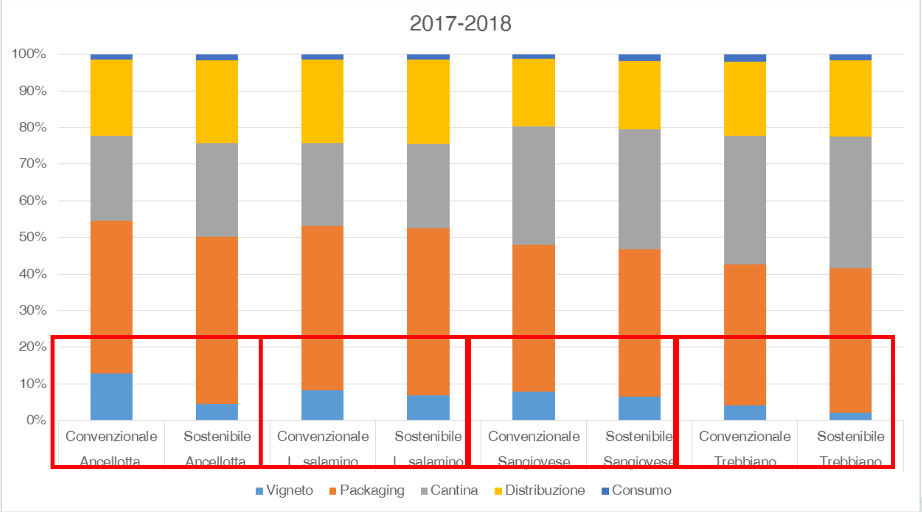
Az. Agricola Silvia Manzoni (BO)
Az. Agricola Podere della Rosa (FC)
Az. Agricola Ovi Dina (RE)

RESULTS: COMPARISON BETWEEN FARM MANAGEMENT AND SUSTAINABLE VITICULTURAL SYSTEM-HSVS

Results on GHG emissions – Carbon Footprint (LCA for ARIA indicator calculation *VIVA program*)

(CO2 equivalent emissions)





The **carbon footprint relating to the "Vineyard" phase** alone (**≤ 10% of total CF along supply chain**) **is lower in HSVS** (the agro-ecological cultivation system) than in standard farm management (GA).

Analysis show (average among years):

- **GA emission ca. 1,450 kg CO_2 eq/ bottle 0,75 litres**
- **HSVS emission ca. 1,300 kg CO_2 eq/bottle 0,75 litres**

Carbon Footprint (CF): the highest impact for GHG emissions against which mitigation practices can be identified:

- **packaging**: ca. 37% of total CF
- **wine production:** ca. 28% of total CF
- **distribution** of final product: ca. 23% of total CF

Vegetative-productive aspects of the HSV system compared to GA

Analysis of leaves, phenological phases, diseases and ripening curves show that:

- Major fungal diseases are less prevalent in HSVS vs GA;
- The vegetative-productive balance (Ravaz index) is better in the HSVS vs GA system.
- On the fruit, the HSVS system leads to a reduction in the content of soluble solids, an increase in acidity and a lower pH. These characteristics are positive for the production of wines with a good balance between structure and acidity and a good aromatic component, qualities in hight demand by the final consumer.

WHAT GOOD PRACTICES HAVE BEEN IDENTIFIED TO MITIGATE GHG EMISSIONS DURING CULTIVATION IN AGRICULTURE:

- **Increase production efficiency:** sustainable intensification that improves production through a more efficient use of inputs.
- **Reducing emissions:** mainly optimizing nitrogen fertilization (doses, periods, types of fertilizers, precision technologies, distribution methods especially for livestock manure) and the use of other technical means (water, Plant Protection Product) → **other OGs, e.g., Input.ARB, Orto.Bio.Weed, Si.ORTO, SPOTS, DUNE**
- **Producing and saving energy trough:**
  1) energy saving measures
  2) increases of energy efficiency of the machines
  3) installation of energy production plants from renewable sources (e.g. photovoltaics).
- **Sequestration of carbon from the atmosphere in the soil:** carbon sequestration techniques are all the agricultural practices aimed to preserve soil fertility, by increasing its organic matter content → **other OGs, e.g., Si.ORTO, SPOTS, DUNE**

Thanks you for attention

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