



**MOUNTAIN
HER**

Empowering women associations as drivers for
agroecological transformation to generate income
for Mountain farming communities

Task 3.4 – Training for local fertilizer enterprises



Video course

31 October 2024

Total video duration: 15 minutes

A good reason to watch this course



Agricultural and forest activities generate residues

Farmers sometimes burn or discard them ...



... but this contributes to CO₂ emissions



There are alternative options

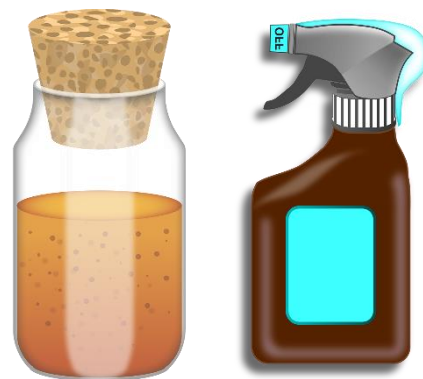
You can transform residual biomass into useful **fertilisers** and **soil improvers**.

This course offers a first training to help you start ...

Compost



Compost tea



Biochar



Different options do not have the same feasibility level,
and also the value of products can be different

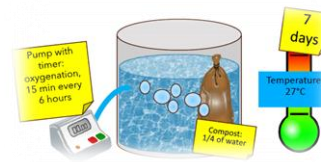
Extent of the
required
investment

higher

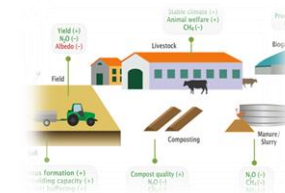


Compost

Compost tea



Biochar



lower

higher

We focus mostly on
compost, and examine also
the other two options, with
indications on how to
proceed

Complexity:

- necessary equipment
- necessary training
- ease of switching between different production volumes

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Garden Brands Best Sellers

Garden › Gardening › Soils, Mulches & Planting Media › Soils

Example of
Compost product
sold online
0,47 €/L



 **Compo - Organic Gardening Compost 40L Brown**

[Visit the Compo Store](#)
4.3 ★★★★★ 113 ratings

€18⁶⁴ (€0.47 / l)

The prices of products sold on Amazon include VAT. Depending on your delivery address, VAT may vary at the checkout. For more information, click here.

Brand Name	Compo
Item Weight	24.87 Kilograms
Item Volume	40 Litres
Global Trade Identification Number	04008398107482

About this item

- Compo High Quality Green ST
- Increased soil activity
- Fertile bottom
- Long-term organic fertiliser.

Description of the product

Product description

Compo Bio Peat-Free Garden Compost is made from high-quality, highly rotting green compost, ensuring a long-term supply of organic nutrients for plants - completely free of weed components. In addition, it has a valuable humus content and thus ensures long-term organic fertilisation. In addition, this organic peat-free product from COMPO, whether in the garden or in the bed, activates the structure of the soil and optimises its balance of air and water. This ensures good soil ventilation and the water storage capacity is improved. This ensures long-term fertility and contributes to healthy plant growth.

Floor substance made from high-quality green compost, very well rotted.

For use in raised beds and in the garden.

Rich in organic nutrients and weed free.

The valuable humus content ensures long-term organic fertilisation.

Activates soil life and improves soil structure and water storage capacity.

Optimises soil air and water tightness and ensures long-term fertility.

Contributes to healthy plant growth

Not suitable for use with greenhouse plants, not suitable for use with indoor plants, suitable for use with balcony and terrace plants.
Suitable for use with garden plants.





Garden › Gardening › Fertilisers & Plant Food › Multi-Purpose Fertilisers



Roll over image to zoom in



Biochar 15 LT Vegetable Charcoal Fertiliser for Intensive Crops, Horticulture and Houseplants

Brand: NERA BIOCHAR

5.0 ★★★★★ 8 ratings | [Search this page](#)

€36⁰⁰ (€2.40 / l)

The prices of products sold on Amazon include VAT. Depending on your delivery address, VAT may vary at the checkout. For more information, [click here](#).

- 100% Italian Charcoal Made in Piedmont.
- Fights desertification
- Subtracts carbon dioxide from the planet
- Retains water from soils and releases it slowly and increases aeration making plants stronger and healthier
- Has a long service life
- Adding biochar to soil from 10 to 20%, you double the growth of your plants
- We only use Italian woody biomass derived from controlled supply chain.
- Our material is produced in a dedicated processing plant in our own design.

Additional details

 Made in Italy
This product was wholly produced or has undergone its last substantial transformation in Italy. Discover Made in Italy. [Learn more](#)

 Small Business
This product is from a small business brand. Support small. [Learn more](#)

Example of
Biochar product
sold online
2,4 €/L

Selecting the best practice

Suggestions for the selection of the best practices that mostly suit your cooperative



What do you need to know?

To decide, you need to collect information on:

- **the available biomass, from cooperative members:** available volume per month (seasonality) and per year, characteristics (e.g. vegetable species), form in which the biomass is available, e.g. branches, round bales, wood chips, pellets; biomass humidity and potential for its possible reduction (e.g. drying tools); possibility of biomass storage and ways in which storage is possible within the cooperative;



- If necessary, the possibility of **acquiring biomass** from other nearby farms, to guarantee the necessary volumes and/or the necessary humidity, with related characteristics



- **distances** between available biomass and the place where it is processed to make fertilisers, and means of transportation.

Target volumes influence the characteristics, size and source of the necessary resources

Buildings, storage and processing areas



Equipment (more relevant for biochar)



Utilities (e.g. electricity, water ...)



Working persons (nr.)



Know-how and relative training



Solutions making sure that the activity can be managed / performed by women (e.g. need of physical strength...)



Compost and compost tea

Naturally transforming biomass into a fertiliser



What is compost?

- Compost is an organic matter that has been decomposed in a process called composting
- Compost is a rich source of **organic matter and nutrients**, which plays an important role in **improving the soil** from a physico-chemical and biological point of view.
- These advantages manifest themselves in **reduced cropping risks, higher yields** and **lower outlays on inorganic fertilizers** for farmers.



Benefits of compost



Source: SCOW, «Handbook for compost marketing», 2015



<https://www.acrplus.org/media/origin/images/project/SCOW/Handbook-for-compost-marketing.pdf>

Compost use	Soil Protection	Production/ energy savings	Sustainable use of resources	Fight against Climate change
Replacing the use of mineral fertilizers (N, P, K) and other amendments (CO2 avoided, energy-saving and GHG)	✓	✓		✓
Recovery and contribution of organic matter and nutrients contained in the amendment	✓		✓	
"Sequestration" of carbon in soils	✓		✓	✓
Increasing biodiversity	✓			
Resilience (recovery capacity) of soils	✓		✓	
Reducing erosion	✓		✓	
Supporting biological activity -> prevention of "desertification"	✓		✓	
Slow release of nitrogen sources	✓		✓	
Improved working the land	✓	✓	✓	✓
Increased soil water retention	✓	✓	✓	
Substitution of pesticides	✓	✓	✓	
Replacing peat	✓	✓	✓	✓

What can be composted?

- Crop residues
- Manure
- Straw
- Leaves and fruits
- Herbaceous stems
- Wood chips
- Small twigs
- Dried fruit shells



What cannot be composted?

- Plastic, glass, metal, non-organic materials
- Meat, dairy products, fatty products



Composition and preparation

To create a good **pile of biomass** to compost it is necessary:

- 60-70% by volume of "**nutritional**" **material** to be composted (leaves, fruits, herbaceous stems, fleshy roots, tubers, manure, etc.). This material supports microbial growth which is responsible for the degradation of plant biomass;
- 30-40% by volume of "**structuring**" **material** (wood chips, small twigs, leathery leaves, dried fruit shells, etc.) into the mass to be composted. This material gives porosity to the pile, avoiding its excessive compaction;
- **mature compost as a starter**, sprinkling it on the pile (2% by volume);

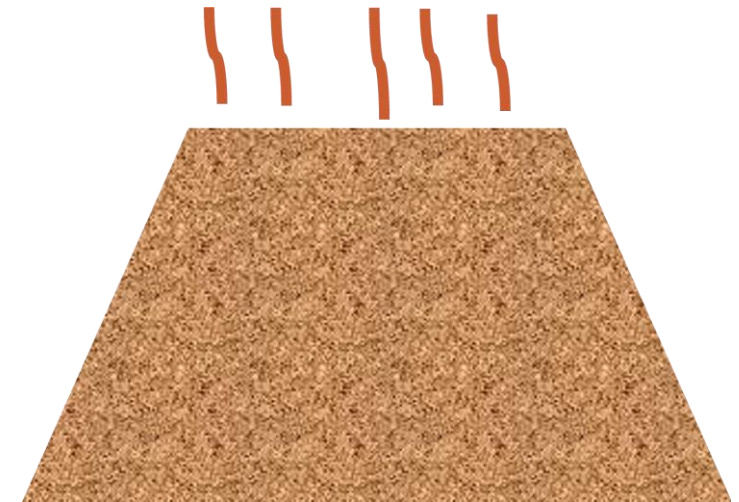
Downsizing, or **chopping up the materials**, is a sound and widely-practised technique. It increases the surface area available for microbial action and provides better aeration. This technique is particularly effective and necessary for harder materials such as wood.

Types of composting

Composting may be divided into two categories by nature of decomposition process:

- **Aerobic composting** (when composting takes place in the **ample presence of oxygen**) it is considered more efficient and useful for agricultural production. The processing time is shorter, there is a lower risk of phytotoxicity, and plant pathogens and weed seeds are destroyed by the high temperature generated by the process.
- In **anaerobic composting** (when decomposition occurs **without oxygen**) drawbacks often offset the advantages (e.i. longer process, strong odours, phytotoxicity, it leaves weed seeds and pathogens intact).

The two processes are essentially contemporary and complementary, depending on the homogeneity of the pile and the aeration methodology, one or the other is favored or not.



The aerobic composting process stages

Active composting stage – Temperature increase

Mesophilic organisms (20-45 °C) multiply rapidly on the readily available sugars and amino acids.

Thermophilic fungi and bacteria (50-70 °C) continue the process, raising the temperature of the material

Start -
Room temperature

After few days –
65 °C or higher -
Sanitation

Curing stage – temperature decrease

Another group of thermophilic fungi starts to grow, which decompose plant cell-wall materials such as cellulose and hemicellulose

The pile becomes more uniform and less active biologically; the material becomes dark brown to black in colour; the particles reduce in size and become consistent and soil-like in texture

After few weeks –
Temperature decrease

After 90 days –
Room temperature

time →

Factors affecting aerobic composting

Since aerobic composting requires large amounts of O₂ (particularly at the initial stage) good aeration may be achieved mainly by:

- ensuring adequate frequency of turning (i.e. *Turned windrows composting*)
- forced ventilation (i.e. *Aerated static pile composting*)



Windrow. Source:

<https://www.compostingcouncil.org/page/CompostManufacturing#>

Turned windrows composting

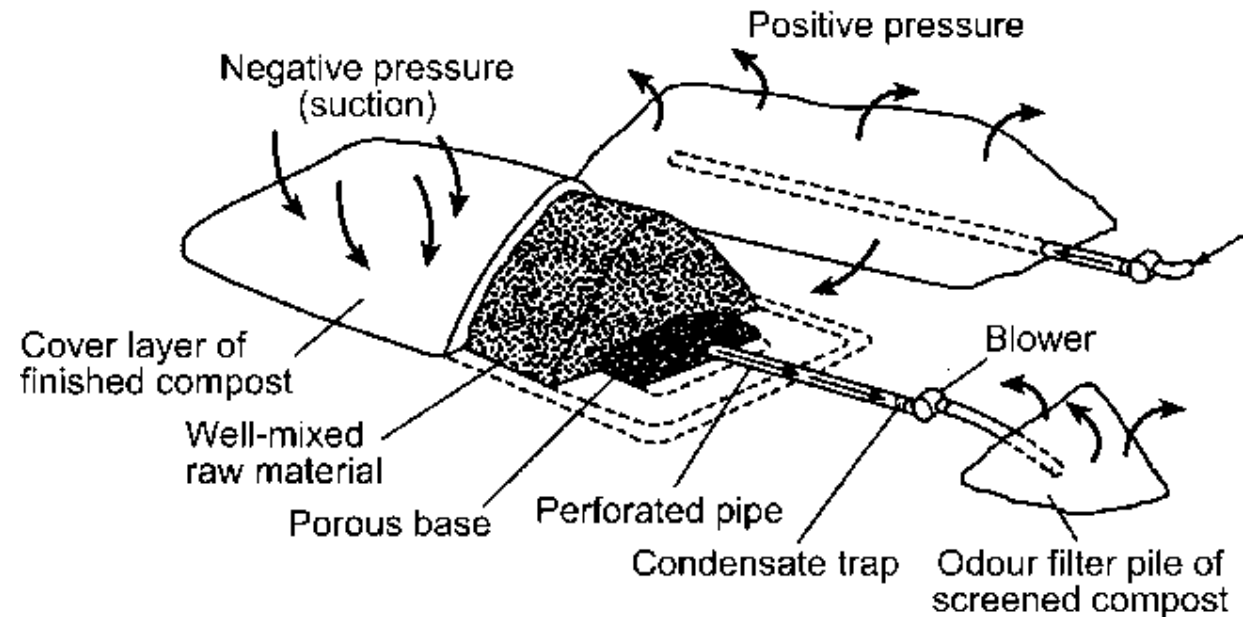
- The materials are placed in **long narrow piles/windrow** which are turned on a regular basis
- Create **mounds with a trapezoidal section**, as long as you want but 2-3 m wide and 1-1.5 m high;
- **Turning can be carried out** using manual or mechanical shovels or using special turning devices, which are commercially available and can be connected to the power take-off of tractors.
- Schedule of turning is **once or a couple of times per week**, where the frequency of turning decreases as the windrow ages.
- **In about 8-12 weeks the compost is ready to use.**



Source: <https://www.fao.org/4/y5104e/y5104e07.htm>

Aerated static pile (ASP) composting

- Here, a **pipe aeration system** underneath the static pile connected to a blower is used to supply the air
- It eliminates the needs of turning
- The initial height of the pile is about 150-200 cm
- The raw material mixture is piled over a base of woodchip, chopped straw or other very porous material
- The **forced insufflation of air** can be achieved by means of a fan or a compressor which periodically injects air (which supplies oxygen) into rubber pipes suitably perforated every 15-20 cm, placed underneath the piles. **Typically, 5-10 minutes of insufflation every 3-4 hours are sufficient.**



Source: <https://www.fao.org/4/y5104e/y5104e07.htm>

On-farm composting

In detail, the devices necessary to create an "on farm" aerated static pile composting are:

1. Composting and storage platform;
2. Air blowing system, consisting of fan, timer and perforated pipes;
3. Irrigation system for wetting the pile;
4. Probes for measuring the temperature in the pile.



Source: <https://www.fao.org/land-water/overview/onehealth/composting/en/>

Practical advice

- **Keep the mounds covered** to protect them from the weather. To repair the piles, canopies or greenhouse-tunnels can be built; alternatively, the piles can be covered using waterproof sheets or non-woven fabric. If covered, remember to water the mounds occasionally to maintain moisture.
- To ensure that composting occurs without problems, you need to **check** whether
 - there is a **rise in temperature** up to 60-65 °C within 24-48 hours from the creation of the pile;
 - **the heap does not emit bad odors and does not produce smelly dark leachate**, due to a lack of oxygen, which can occur as a result of reduced aeration or an excess of water in the pile.



Main factors affecting aerobic composting

Aeration: Aerobic composting requires large amounts of oxygen, particularly at the initial stage. Aeration is the source of O_2 , and, besides, removes excessive heat, water vapour and other gases trapped in the pile. Good aeration may be achieved by controlling the physical quality of the materials (particle size and moisture content), pile size and ventilation and by ensuring adequate frequency of turning.

Moisture: Moisture is necessary to support the metabolic activity of the micro-organisms. Composting materials should maintain a moisture content of 40-65%.

Nutrients: Micro-organisms require C, N, phosphorus (P) and potassium (K) as the primary nutrients. Optimal C:N ratio of raw materials is between 20:1 and 40:1.

Temperature: temperature is a major factor and it can be regulated by turnings and aeration of compost.

pH value: optimum pH for proper microbial growth in composting pile is between 6.0 and 7.5 for most microbes.

An example

This Italian farm makes compost also with residues from other farms and plant management activities.

<http://www.smaltimentoverde.it/index.html>



Source: image from Google Earth

Useful links

- [FAO, «On farm composting methods», 2003: https://www.fao.org/4/y5104e/y5104e00.htm#Contents](https://www.fao.org/4/y5104e/y5104e00.htm#Contents)
- <https://www.compost.it/en/>
- <https://rodaleinstitute.org/why-organic/organic-farming-practices/composting/>

National law

Italy:

Decreto Legislativo n. 75 del 29 aprile 2010

Dm Politiche agricole 10 ottobre 2022

Compost tea

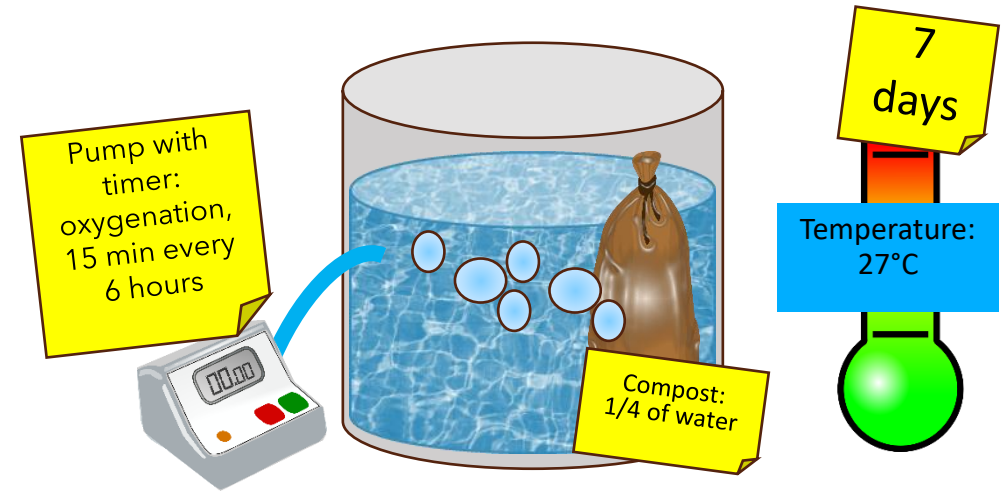
If you **infuse and oxygenate your compost in water**, you can obtain «Compost tea».

The **necessary equipment** involves: compost, a filter bag to contain it, water, access to electricity, a pump (like those used for aquariums) for oxygen, the possibility to keep a stable temperature (27°C) during processing.

The compost tea is obtained by **fermentating compost**, and can be used as **biostimulant and fertiliser**.

It must be **stored** at max 7°C, and used (nebulisation or fertigation) within 3 months.

Dilution: 1:20. Use a **sieve** (nozzles >0,4mm) to avoid clogging of the sprayer.



Useful links

- <https://rodaleinstitute.org/blog/compost-tea-a-how-to-guide/>
- [Horizon Program Best4soil.eu; https://www.best4soil.eu/assets/actsheets/22.pdf](https://www.best4soil.eu/assets/actsheets/22.pdf)

Biochar

Transforming biomass into a soil improver
and carbon sink, by means of a rather simple
technique



What is biochar?

Biochar is a material **rich in carbon** (even 60%) that results from the **pyrolysis** of any biosolid material such as wood, fruit shells, residues of plants, manure, industrial and municipal waste, sewage sludge, farming, and fermentation residuals.

Biochar remains in the soils for thousands of years and it is therefore considered more resistant to decomposition than organic matter, acting as an important **long-term carbon sink**

See also: [https://esajournals.onlinelibrary.wiley.com/doi/epdf/10.1890/1540-](https://esajournals.onlinelibrary.wiley.com/doi/epdf/10.1890/1540-9295%282007%295%5B381%3ABITB%5D2.0.CO%3B2)

[9295%282007%295%5B381%3ABITB%5D2.0.CO%3B2](https://esajournals.onlinelibrary.wiley.com/doi/epdf/10.1890/1540-9295%282007%295%5B381%3ABITB%5D2.0.CO%3B2)

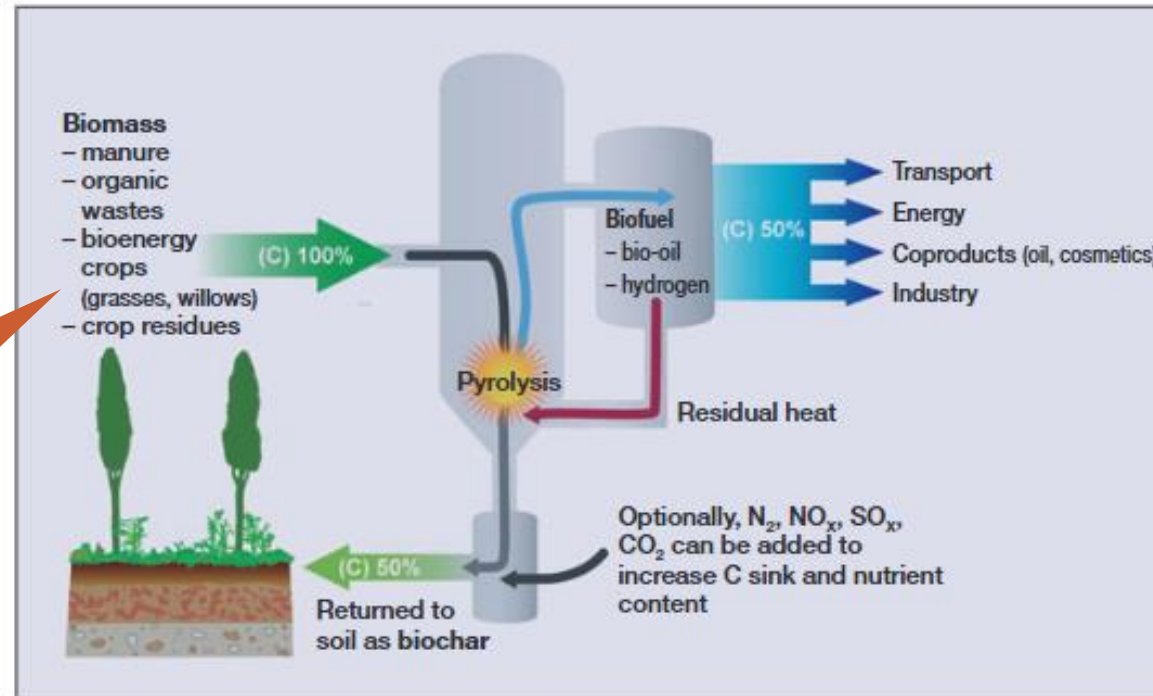
Slow pyrolysis heats and decomposes biomass in the **absence of oxygen**. The liquids and gases that are produced can be used for energy.

The **biochar** solids are a byproduct that can be used to improve soil fertility. This process results in approximately 50 percent bioenergy and 50 percent biochar. **Fast pyrolysis** can also be used, but less biochar is produced while the amount of liquid biofuel production increases. **Pyrolysis gases** and liquids can be captured to create electricity, bio-oils, hydrogen gas, ethanol, methane, and other coproducts that can be used by different industries.

Source: USDA, Climate hubs

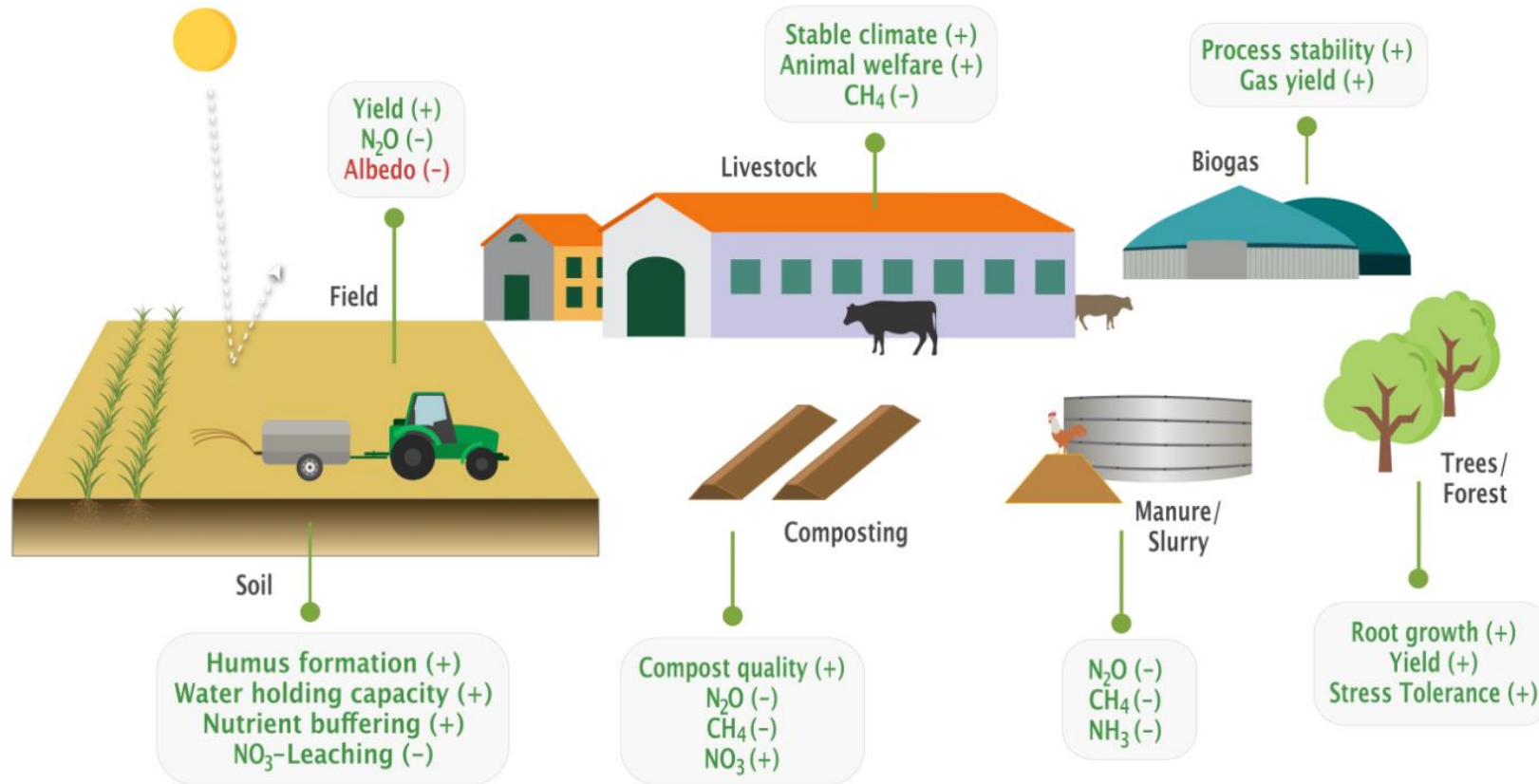
The biochar production process

The plant often needs biomass to be prepared (chipped, pelletised ...)



Source: Johannes Lehmann, «Bio energy in the black», 2007, [https://doi.org/10.1890/1540-9295\(2007\)5\[381:BITB\]2.0.CO;2](https://doi.org/10.1890/1540-9295(2007)5[381:BITB]2.0.CO;2)

Benefits of biochar



Source: <https://www.biochar-industry.com/biochar/>

How biochar can be made by farmers

A biochar plant can require a relevant investment.

Before reaching a sufficient dimension to justify the investment in a pyrolysis equipment, farmers can start making biochar (small batches) by themselves.

They need:

- ✓ Their **vegetal biomass**
- ✓ A **container for fire**, in a safe place, where the presence of oxygen can be managed (reduced). The best equipment might be an **on-purpose designed cookstove or klin**. There are several equipments that can be bought. It is better to buy one than to build one, and to closely **follow the builder's instructions**.
- ✓ **Training to avoid any risk** linked with the fire, the heat and combustion gases.

The biomass should be selected, dried (also sundried is ok), and shed or chipped.

The production process consists in heating the biomass at a target temperature, and managing outputs (energy, biochar).

The obtained biochar should be let cool down for 24 hours.

Biochar should be mixed with manure and/or with microbial consortial, to enhance its effect.



Examples of biochar professional equipment

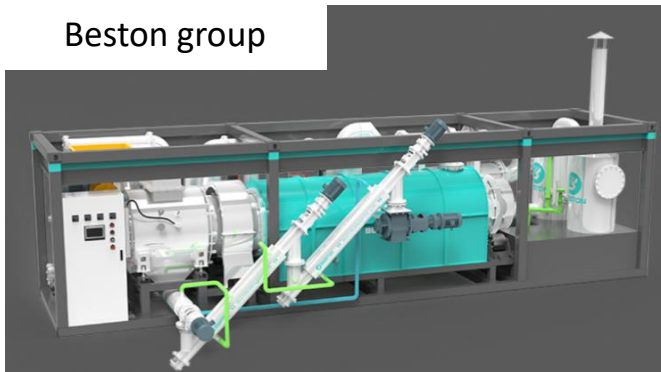
Whatever plant is chosen, **the composition of biomass influences results and yields a lot.** *Equipment producers often offer a pre-evaluation service of each client's main biomass, in order to assess the performance potential of the plant in each specific case.*

Wastex



BioGS-1.0

Beston group



Iridenergy

Reset - Energy

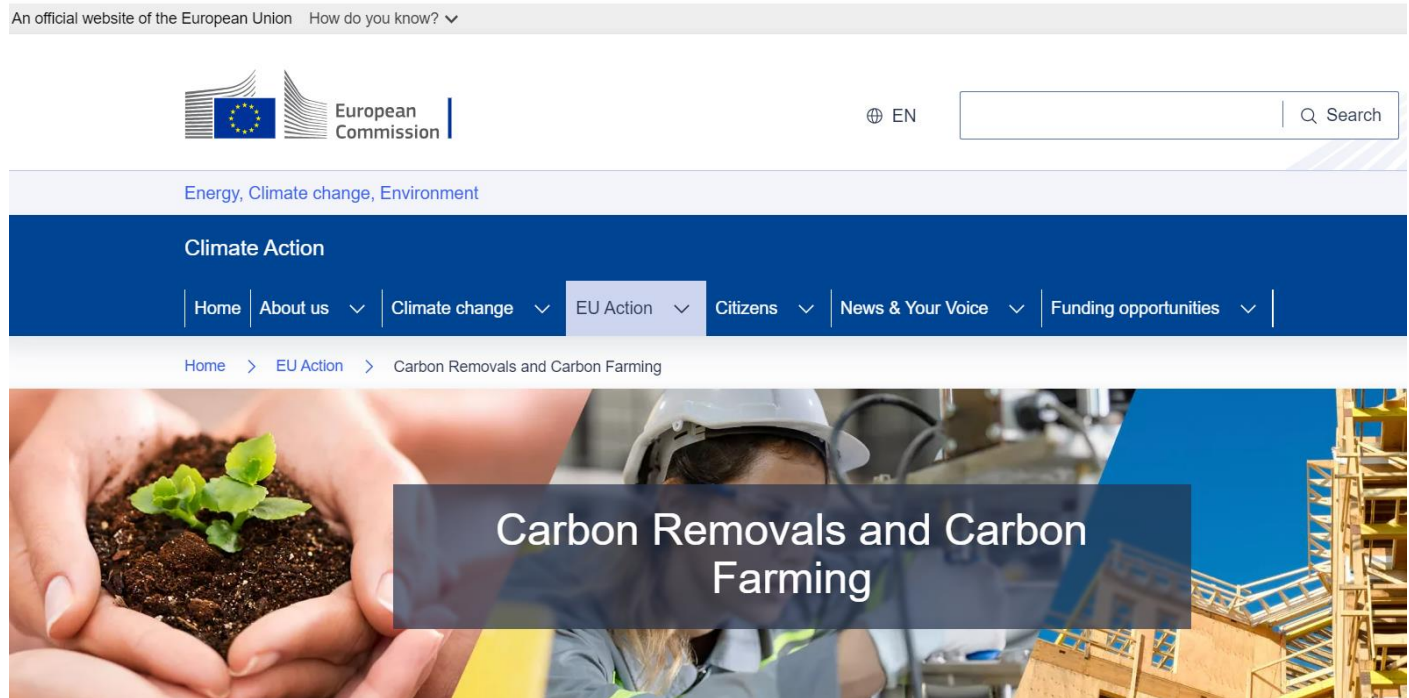


EU regulation on biochar products

https://ec.europa.eu/info/law/better-regulation/have-your-say/initiatives/12136-Fertilising-products-pyrolysis-and-gasification-materials_en

<https://www.european-biochar.org/en/ct/2-EBC-and-WBC-guidelines-documents>

https://climate.ec.europa.eu/eu-action/carbon-removals-and-carbon-farming_en



Thank you!

