REFERTIL
reduction of mineral
fertilizers by use of
biochar for
low-carbon economical
developments

European Community BioChar - EU Fertilizer Regulation
possible inclusion of a Biochar as fertilizer and/or additive into the new Regulation

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Biochar for high efficient bio-waste resource utilization
“ECBC” European Community BioChar
EU Fertilizer Regulation revision 2014

The FERTILIZER REGULATION revision is progressing towards finalization.

The REFERTIL (2011 – 2015) is biochar and compost policy support tool for FERTILIZER REGULATION revision.

The reduction of mineral fertilizers by use of biochar targeting low-carbon economical development, soil improvement, natural fertilization and drought tolerant cultivation, while offering economical and environmental benefits for SME end-user farmers.

Safe food production is based on safe soil management

Biochar for restoration of soil natural balance
• The REFERTIL (FP7 2011-2015) project is an applied science & technology programme for policy support to include the biochar and compost into the new EC Fertilizer Regulation. **Work field:** from applied agronomical science & technology - **into** - economical and ecological full industrial scale scenario.

• **EC Fertilizer concepts:** Wide range of organic waste streams (organic resources) to be recycled into safe products. N+P are critically important. SME oriented low carbon economical developments and job creations are important. Biochar safety.

• Intensive farming practice and human activities have disturbed the natural cycles of the nutrients, from which Phosphorous is the most important element. The PHOSPHOROUS supply is already an NATIONAL SECURITY issue.

• BIOCHAR is proposed to be included into the new Fertilizer Regulation:
  • **PLANT BASED BIOCHAR:** soil additive.
  • **ANIMAL BONE BASED BIOCHAR:** full value NPK-C fertilizer.

• Biochar ECONOMY: Greater the farm profitability, supports sustainable and low input/organic farming agriculture. **ROI** return on investment < 3 years. Economical industrial scale biochar productions are from 10,000 t/y and up.

**REFERTIL:** recycling treated organic waste as compost and bio-char products

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REFERTIL work elements

WP 11 PROJECT MANAGEMENT

WP 1: INPUT BIOWASTE IDENTIFICATION AND QUANTIFICATION

WP 2: BIOCHAR ASSESSMENT: available technologies and products

WP 3: COMPOST ASSESSMENT: available technologies and products

WP 4: MICROBIOLOGICAL IMPROVEMENT

WP 5: PYROLYSIS TECHNOLOGY IMPROVEMENT

WP 6: COMPOSTING TECHNOLOGY IMPROVEMENT

WP 7: “BAT” DEMONSTRATION

WP 8: FIELD TRIALS FOR VALIDATION PRODUCTS

WP 9: BEST PRACTICE AND APPLICATION RECOMMENDATION

WP 10: DISSEMINATION: SME INDUSTRY CONSUMERS AND PUBLIC SECTOR Stakeholders

ECBC European Community BioChar

ECC European Community Compost

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WHAT IS - ECBC - BIOCHAR?

BIOCHAR MATERIAL is:
- plant and/or animal bone biomass origin,
- stable carbon carboniferous material,
- Authority permitted open ecological soil enhancement use,
- eco-safe carbon negative application.

BIOCHAR PRODUCT is:
- a labeled and full value-chain safe product
- with producers product responsibly guarantees,
- meets the EU “End of Waste” criteria.

INPUT SUSTAINABILITY CRITERIA:
The feed material is:
- not from primarily and secondarily land use.
- not competing with human food, animal feed, plant nutrition.
- Equally importantly environmental, climate protection and economical sustainable.

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ABC - ANIMAL BONE BIOCHAR

ABC is:

• Food grade animal bone biomass SAFE origin.
• **Full value NPK-C natural fertilizer.**
• High concentrated Phosphate fertilizer.
• High $P_2O_5$ nutrient availability for plants.
• No heavy metals (No Cadmium, No Uranium).
• **Supporting all types of cultivations**, including GMO and/or non GMO based, organic and/or low input farming.
• **Eco-safe** carbon negative application.
• **Economical** end user application.
• Developing new industrial sector with **high job creation potential**.
• Supporting **low carbon economy**.
## Biochar and Compost Product: Organic Fertilizer or Soil Improver?

### Biochar

<table>
<thead>
<tr>
<th>BIOCHAR</th>
<th>P$_2$O$_5$</th>
<th>N</th>
<th>K$_2$O</th>
<th>CaO</th>
<th>NUTRIENT CONTENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Animal bone charcoal</td>
<td>28-30</td>
<td>&lt;0.1</td>
<td>0.4-0.8</td>
<td>30-42</td>
<td>HIGH</td>
</tr>
<tr>
<td>(recycled N +5-6%)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Plant Based Biochar</td>
<td>0.01-0.3</td>
<td>0.3-1</td>
<td>0.1-1</td>
<td>0.2-6</td>
<td>LOW</td>
</tr>
</tbody>
</table>

If the nutrient content is low, the dose/ha is high → higher load of contaminants to the land

### Compost

<table>
<thead>
<tr>
<th>COMPOST</th>
<th>P$_2$O$_5$</th>
<th>N</th>
<th>K$_2$O</th>
</tr>
</thead>
<tbody>
<tr>
<td>Animal manure / sewage sludge compost</td>
<td>3 – 4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Green waste, kitchen/ canteen waste,</td>
<td>0,5-3</td>
<td>0,5-3</td>
<td></td>
</tr>
<tr>
<td>garden / park waste compost, mixed</td>
<td>&lt; 1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>municipal compost</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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Plant based biochar:
• >90% w/w high carbon content plant origin
• micro and meso porous (1 nm – 50 nm) carboniferous product,
• high water holding and nutrient retention capacity and C sequestration,
• no soil fertilization effects. Can be recognised as soil improver? **YES**

ABC: animal bone biochar:
• The input animal bone meal is food grade category 3 rendering by-product with economical importance, produced in large industrial scale (2-3 million t/y) which **concentrated high P content apatite** is an critically and strategically important inside EU natural and **RENEWABLE RESOURCE**.
• <20% w/w low carbon and high calcium phosphate/ apatite mineral content
• macro porous (50 nm – 63k nm)
• **Containing significant amount of nutrients.**
• Can be recognised as organic fertiliser? **YES**
APPLICATION RATES FOR BIOCHAR PRODUCTS

- **Plant based biochar:** not fertilizer, ~90\%C, micro & mesoporous structured. Effects: water retention, carbon sequestration. **2,500 - 5,000 kg/ha** – 20,000 kg/ha (economy ?)

- **Bone based biochar:** full value natural NPK-C biochar mineral fertilizer, ~30\% P\textsubscript{2}O\textsubscript{5}, fully macroporous, macromolecular organic adsorber, soil optimized biochar, high CEC. Effects: PGP, water retention, carbon sequestration, biocontrol by-effect. **200 kg/ha** – **1,000 kg/ha**

**HIGHER DOSES = HIGHER TOTAL VOLUME OF CONTAMINANTS** applied to 1 unit of soil

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The ECBC applications are successfully field test demonstrated 2005 – 2013 under different climatic and soil conditions in Germany, Italy, Spain, UK, Ireland, France, The Netherlands, Hungary, Denmark, Israel.

Commercial production tests

The advanced 3R results are achievements of the integrated European Union top science and technology cooperation.

Drought tolerance tests

The final product SAFE FOOD for affordable cost

ABC
Animal Bone bioChar

Efficiency tests

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Biochar – heavy metals

**BIOCHAR: complex solution to meet complex challenge**

If the land needs 61.5 kg $\text{P}_2\text{O}_5$/ha we also add with **Plant type biochar:**
- 304 g/ha Pb
- 493 g/ha Ni
- 783 g/ha Cr
- 230 g/ha Zn

If the land needs 61.5 kg $\text{P}_2\text{O}_5$/ha we also add with **ABC Animal Bone BioChar:**
- <0.1 g/ha Pb
- 2.1 g/ha Ni
- 0.9 g/ha Cr
- 29.8 g/ha Zn

Biochar soil application is irrevocable.

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If the land needs 61.5 kg P₂O₅/ha

PAHs are TARGET CONTAMINATION

If the land needs 61.5 kg P₂O₅/ha we also add with **Plant type BC**:  
+ 435 g/ha PAH

If the land needs 61.5 kg P₂O₅/ha we also add with **Bone Biochar (ABC)**:  
+ 0.1 g/ha PAH

**Recommendation**: Setting up a safe application rate (t/ha dosage) for plant base biochar for minimizing the risk from heavy metal loads.

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The occurrence of PAHs in biochar primarily derive from low grade and inefficient pyrolysis condition.

In industrial scale the pyrolysis technology performance is the prime definition factor for the biochar quality.

The sub-optimal pyrolysis operating industrial conditions may not only reduce the benefits associated to biochar application, but also enhance the risk of land and water contamination.

If the nutrient content is low (plant biochar), there is a risk that large amounts of respective product could be used for a certain area to supply the plants with sufficient nutrient. The higher application dosage results in higher PAH loads of the agricultural land.
1. **PERMIT AVAILABILITY**: the biochar product is Government Authority permitted for open ecological soil applications. Biochar production is under REACH above 1 t/y production from 2018.

2. **Meets all the WfD “end of waste criteria”**, where the biochar product is fully eco safe, economical market demanded and soil use optimized carbon – mineral product.

3. **Low VOC/PAH and other potentially toxic residuals**. PAH 6 mg/kg. Meet POP protocol.

4. **Stable carbon**, mainly **macro porous** structured. Low temperature biochar = improved agronomic benefits. High temperature biochar = recalcitrant and better for carbon sequestration.

5. **BIOCHAR ECONOMY**: benefits VS costs are positive, incl. market based economical and environmental positive balance. Uses:
   
   a) **Low dose**: NPK-C natural fertilizer bone char 200 – 1000 kg/ha.
   b) **Medium dose**: plant based biochar 2,500 – 10,000 kg/ha.
   c) **High dose**: plant based biochar 10,000 – 20,000 kg/ha.

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REFERTIL CONCLUSIONS

1. **There is no one fit for all solution**, the climate, soil and local diversity must be considered.

2. The **recycling and reuse** of the Billion tons/year US/EU agri and food industrial waste streams is the critical element of the future sustainable food production supply.

3. The recycling and reuse processing is **supporting all types of agri cultivations**, incl. low input, organic and GMO as well.

4. The plant available and low/no heavy metal content **PHOPSHOROUS** is the biggest challenge for the **SAFE FOOD** production beyond 2015.

5. The recycling and reuse processing is creating strong and for long term sustainable **low carbon economy** and **stabile agri industrial jobs**.

6. The biochar production pyrolysis performance is the most important definition factor for the biochar quality in industrial scale. Advanced BC production processing is towards zero emission performance.

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The REFERTIL (289785) Collaborative project is co-funded by the European Commission, Directorate General for Research, within the 7th Framework Programme of RTD, Theme 2 - Food, Agriculture and Fisheries, and Biotechnology.
THANK YOU!

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