Fruit and vegetable waste can be upcycled using different technologies to produce building blocks for bio-based fertiliser blends: upscaling from lab to field

2023-09-13, Ramiran Conference (Cambridge)

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RUSTICA

Demonstration of circular bio-based fertilisers and implementation of optimized fertiliser strategies and value chains in rural communities

Grant Agreement No. 101000527

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Contact:
WEBSITE: rusticaproject.eu
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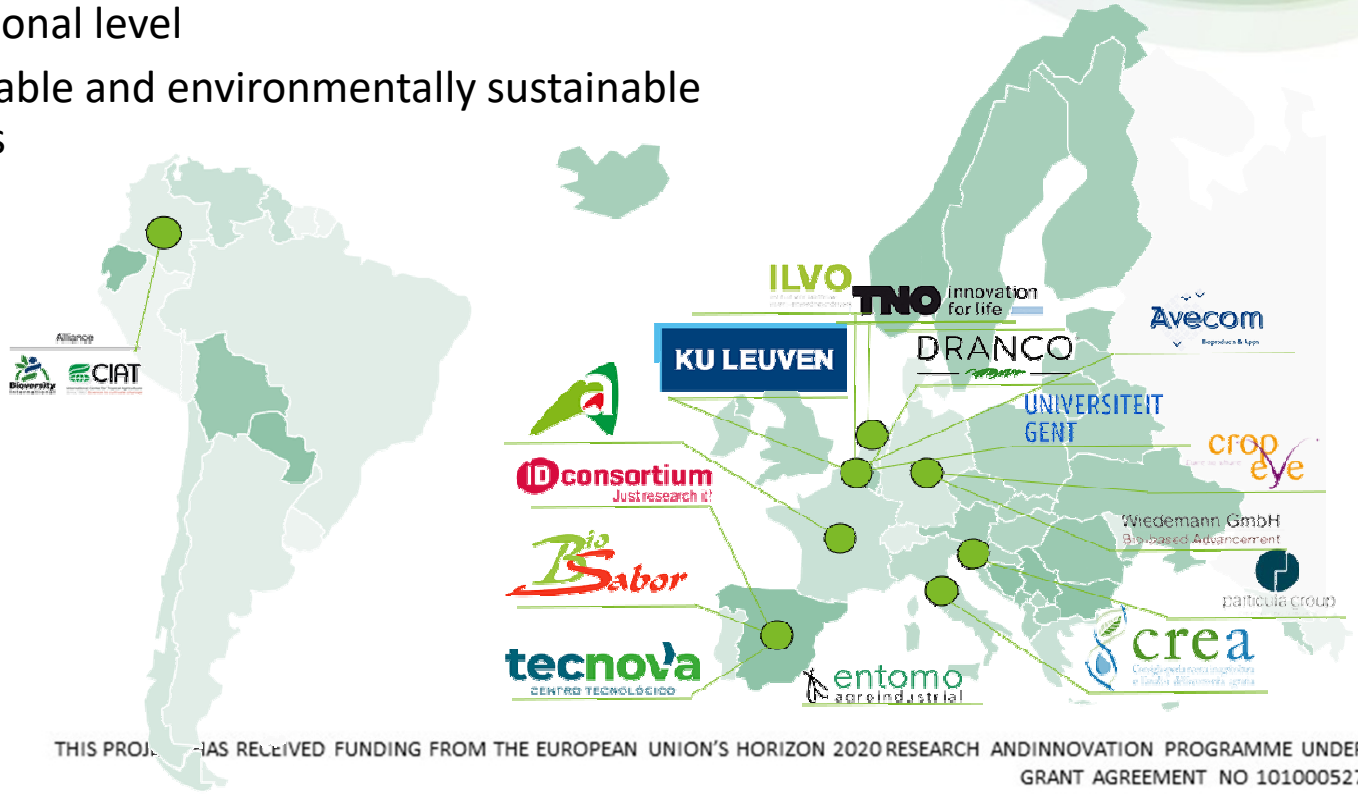
Rustica:

- foster the technical validation, demonstration and implementation of bio-based fertiliser and soil improvement production techniques
- focusing on wastes from the fruit and vegetable agro-food system
- to close nutrient cycles on a regional level
- development of economically viable and environmentally sustainable alternatives to mineral fertilisers



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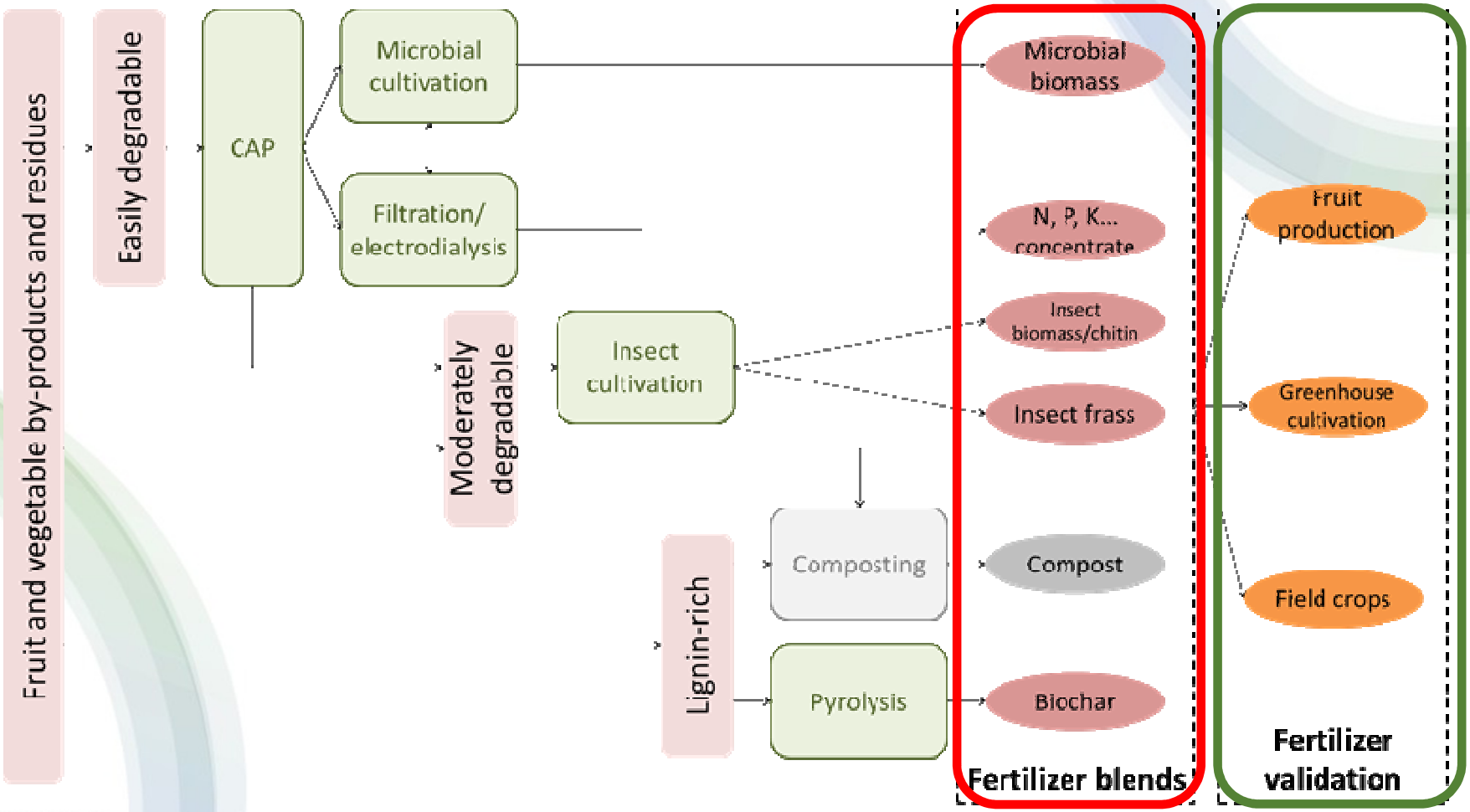
From waste to building block to fertilizer



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Building block lab analysis

- Microbial biomass:
  - Very nutrient rich, high content of available N

  - High organic matter content, very easily biodegradable: boost for microbial life
- Insect biomass:

  - Nutrient rich
  - High organic matter content, easily biodegradable: boost for microbial life
- Insect frass:

  - Variable composition, depending on feedstock
  - Low to high biodegradable organic matter
  - Nutrient rich, less total N but more available NO_3^- and NH_4^+

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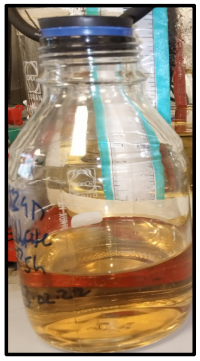
Building block lab analysis

- Biochar:
  - High organic matter content (if not 'contaminated' with soil), not degradable
  - High pH
  - Rather low nutrient content (depending on feedstock), no available N

- NPK concentrate:
  - ! Liquid !
  - Rather high salt content
  - High K content
  - rather low N (but available) and P content

    -> Searching for more suitable nutrient contents for fertigation

    -> To include in solid fertilizers by 'loading' concentrate on biochar: especially interesting for increasing available K content



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Defining blends for regions

- 5 test regions:
  - Flanders (Belgium)
  - Pays de la Loire (France)
  - Alméria (Spain)
  - Friuli Venezia Giulia (Italy)
  - Valle del Cauca (Colombia)
- Defining local demand: organic matter increase in soil? Stimulating soil microbiome? Fast or slow N release to crops? Recovering degraded soils?
- Formulating different blends of building blocks to match local demands
  - E.g. 20% biochar, 50% insect frass, 10% microbial biomass, 20% compost
  - 15 blend proposals were made

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Validation of the blends

Lab validation (2022):

- mixing with soil, 30 days of incubation
- Follow-up breakdown, greenhouse gas emissions
- Follow-up microbial biomass
- Follow-up enzymatic activity
- Follow-up nutrient availability

Adaptations of blends (beginning 2023)

Greenhouse and field validation in different regions (2023-2024)

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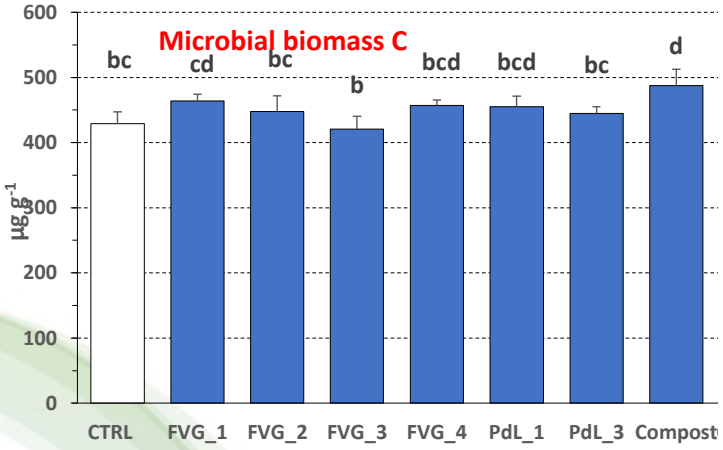
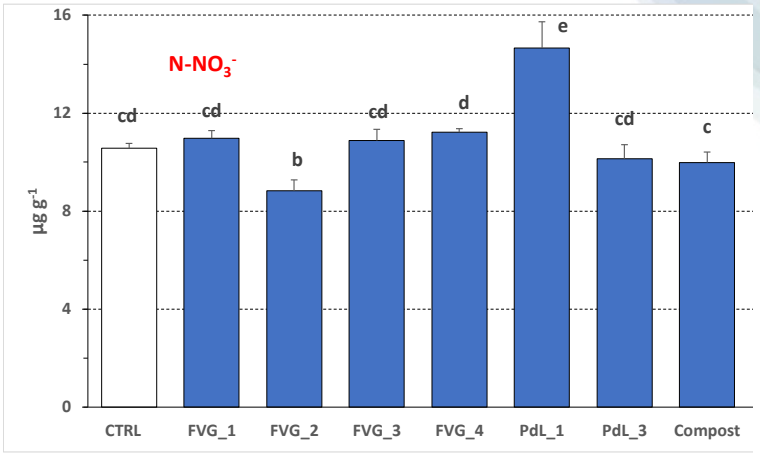
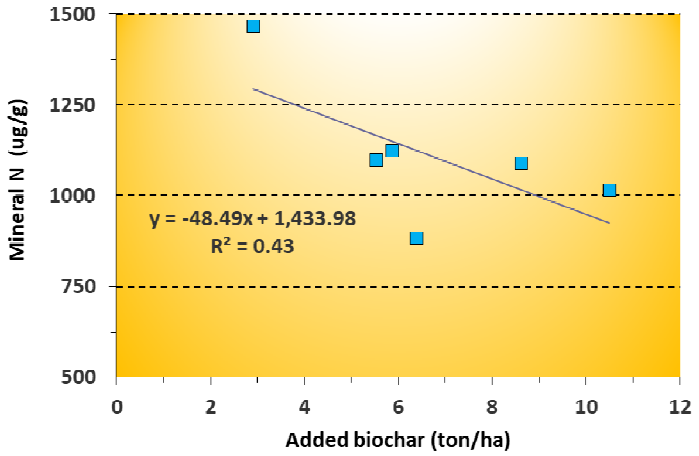
Lab validation

- First lab incubation:







- Some blends increased microbial biomass and activity
- Mineral N was decreased or increased
  → Influence of biochar!

→ Adaptations of the blends

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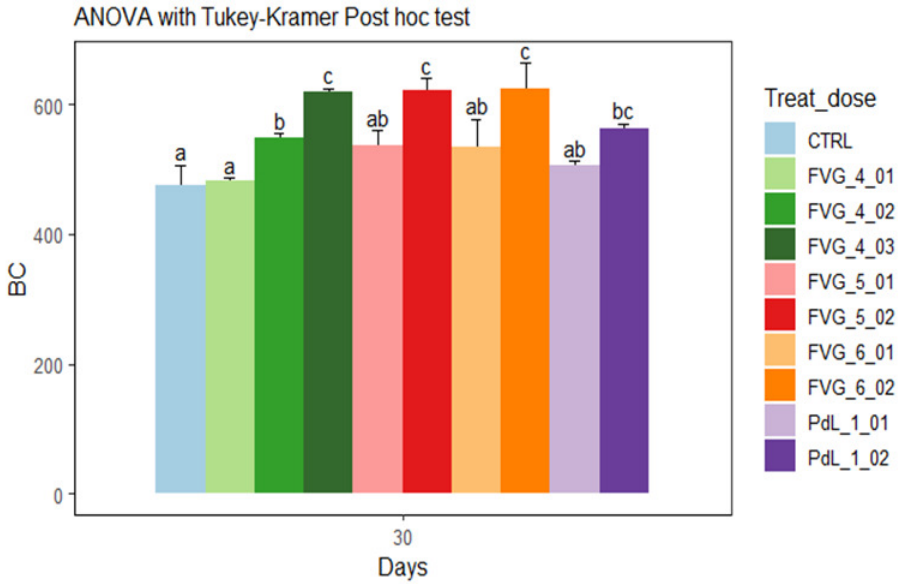
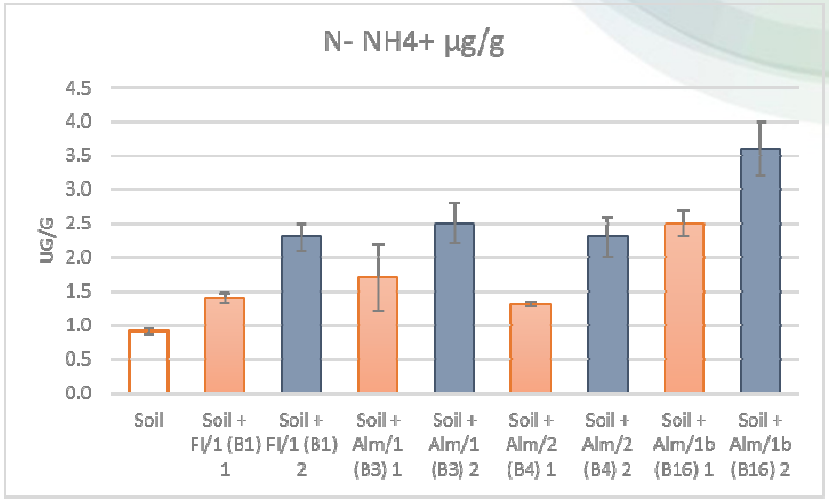
Lab validation

- Second lab incubation (adapted blends + several doses):

Microbial biomass C





- Reducing the share of biochar in the blend resulted in increased N availability and microbial content
- Linear relationship between dose and response of soil properties

→ Final adaptations of the blends

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Greenhouse and field trials

In 2023 and 2024, greenhouse and field trials will be performed in 5 regions

- Flanders (BE): leek and cauliflower (field)
- Alméria (ES): tomato and cucumber (greenhouse)
- Pays de la Loire (FR): lettuce (field and greenhouse) and grapes
- Friuli Venezia Giulia (IT): grapes
- Valle del Cauca (CO): beans, corn and tomato

Blends will be tested and compared with reference (standard) treatments

Not only focus on crop, also on soil quality

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Field trial in Flanders (Belgium)

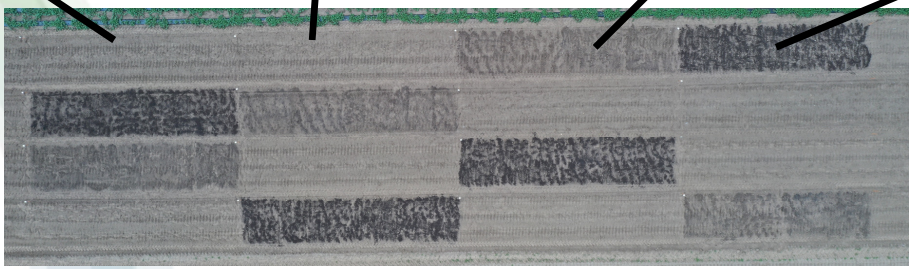
Focus:

- ! N-delivery !
- Soil carbon and health

Crops:

- 2023: leek
- 2024: cauliflower (same field, cumulative effect)

Blank (no N fertilizer) Reference (mineral fertilizer) Rustica blend Fl/2 Rustica blend Fl/1



Ton/ha	Fl/1	Fl/2
Compost	10	2
Biochar	1	2
Microbial biomass	1	1
Insect frass	1	1.5

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Additional test in Flanders (Belgium)

N mineralisation test in the lab during three months

- How much N can be released to soil by the blends?
- How does the N delivery of the blends vary over time?
- Does biochar decrease N delivery?
  - In total?
  - Only in the beginning?
  - Slow release?

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Conclusions

- Feasible to make bio-based fertilisers from fruit and vegetable wastes
- Optimisation of fertilisers by:
  - Combining building blocks in different ratios
  - Adapting blends based on trial results
- Greenhouse and field trials necessary

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Rustica Project Consortium

(KU LEUVEN) University of Leuven
(DRA) Dranco
(CRAPDL) Chambre Régionale d'Agricultures des Pays de la Loire
(BIO) BioSabor, S.A.T.
(CREA) Consiglio per la Ricerca in Agricoltura e l'Analisi dell'Economia Agraria
(TEC) Fundacion para las Tecnologias Auxiliares de la Agricultura
(AVE) Avecom NV
(ENT) Entomo Consulting S.L.
(PAR) Particula Group d.o.o.
(WIED) Wiedemann GmbH
(IDC) IDConsortium SL
(CROP) Stichting CropEye
(EVILVO) Eigen Vermogen van het Instituut voor Landbouw, Visserij en Voedingsonderzoek
(TNO) The Netherland's Organisation of Applied Scientific Research
(UGENT) Universiteit Gent
(CIAT) Centro Internacional de Agricultura Tropical

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