What new types of organic fertilisers are available for Mediterranean soils?

What are the benefits, limitations and perspectives for new developments?

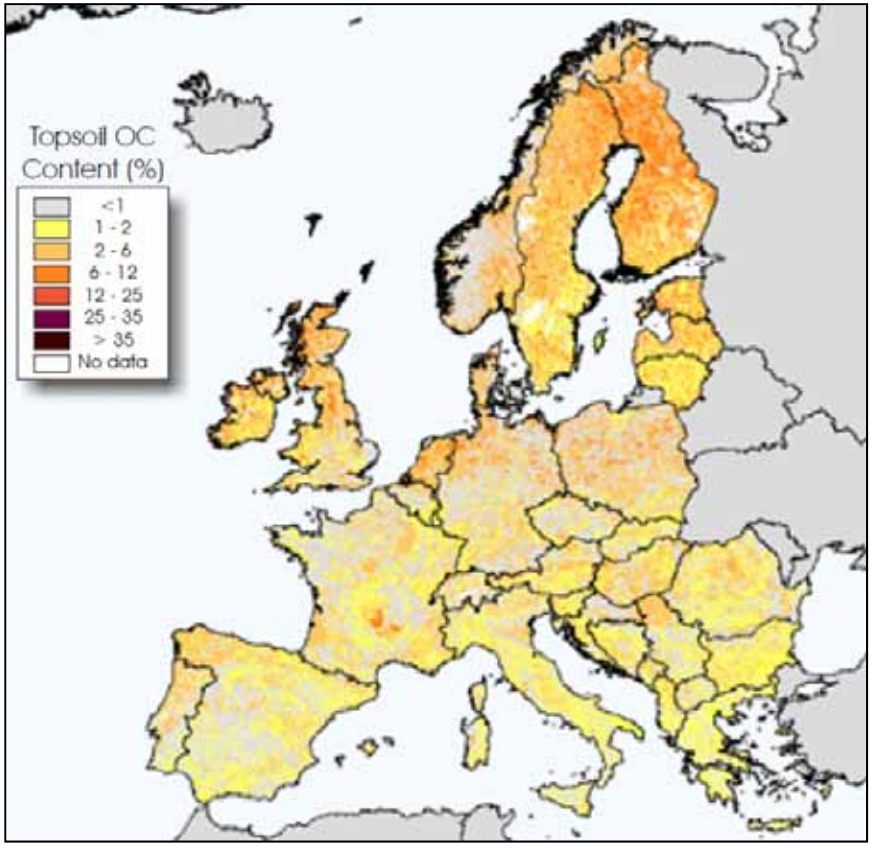
Dr. Maria Pilar BERNAL

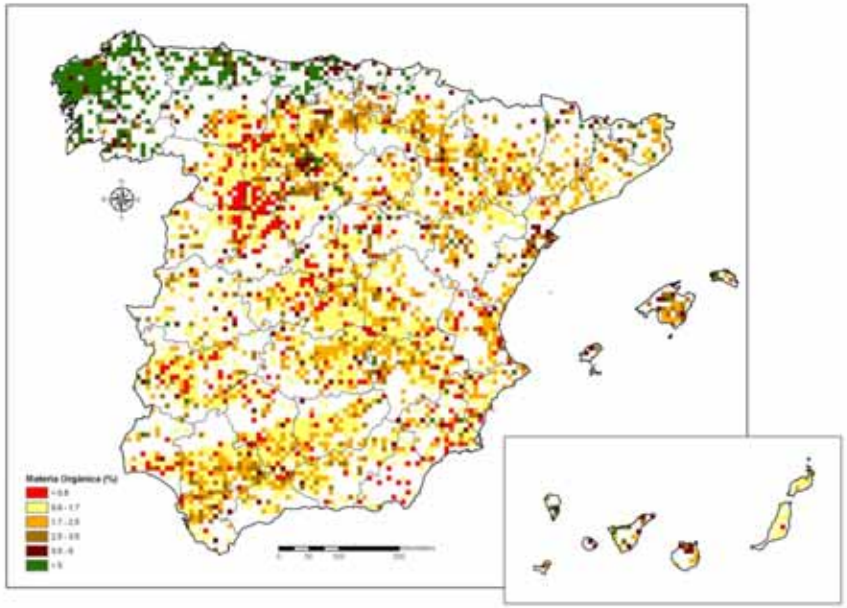
Research Professor

CEBAS-CSIC. Murcia, Spain.

1st Summit of the Organic and Organo-Mineral Fertiliser Industry in Europe

Soil Organic Matter





Hiederer R. 2013. Mapping Soil Properties for Europe. Spatial Representation of Soil Database Attributes. European Commission, Joint Research Centre.

Organic fertilisers – 1G

- Animal manures
- Slurry
- Crop residues
- Municipal solid wastes
- Biowastes
- Sewage sludge
- Biosolids
- Agro-food residues

Traditional farming

Soil application

- Nutrients and OM used for crop production.
- Soil fertility maintained.
- Minimum environmental impact.
- Nutrient balance: production/need

Livestock – arable farming split

Intensive & specialised farming systems

Nutrient input

- ✓ Economic efficiency.
- ✓ Mechanised management.
- ✓ Precision agriculture.

Nutrient input

- ❖ Change: manure to slurry.
- ❖ Manure accumulation.
- ❖ Excess of nutrients & OM.
- ❖ Environmental impact.

- ➢ Input of fertilisers & pesticides.
- ➢ Soil fertility in risk (loss of OM).
- ➢ Environmental impact.

- ▪ Scarce water sources.
- ▪ Highly valuable crops.
- ▪ Intensive production.

Organic fertilisers – 2G

- Animal manures
- Slurry
- Crop residues
- Municipal solid wastes
- Biowastes
- Sewage sludge
- Biosolids
- Agro-food residues

Wastes

- Excess: not enough agricultural land.
- Pollutants: HM, pathogens.
- Environmental impact.
- Nutrient loss.
- Food safety.

Organic fertilisers – 2G

- Animal manures
- Slurry → Separation → Solid
- Slurry → Separation → Liquid → Depuration
- Crop residues
- Municipal solid wastes
- Biowastes
- Sewage sludge
- Biosolids
- Agro-food residues

Compost
Dry solids

Organic fertilisers – 3G

- Animal manures
- Slurry
- Crop residues

- Municipal solid wastes
- Biowastes

- Sewage sludge
- Biosolids

- Agro-food residues

Resources

- Nutrient cycling.
- Energy recovery.
- C-conservation.
- Environment.

Organic fertilisers – 3G

- Animal manures
- Slurry
- Crop residues
- Municipal solid wastes
- Biowastes
- Sewage sludge
- Biosolids
- Agro-food residues

Biological

- Advanced composting.
- Anaerobic digestion.

Thermal

- Drying.
- Pyrolysis.
- Combustion.

Nutrient recovery

- Stripping.
- Precipitation.
- Filtration.

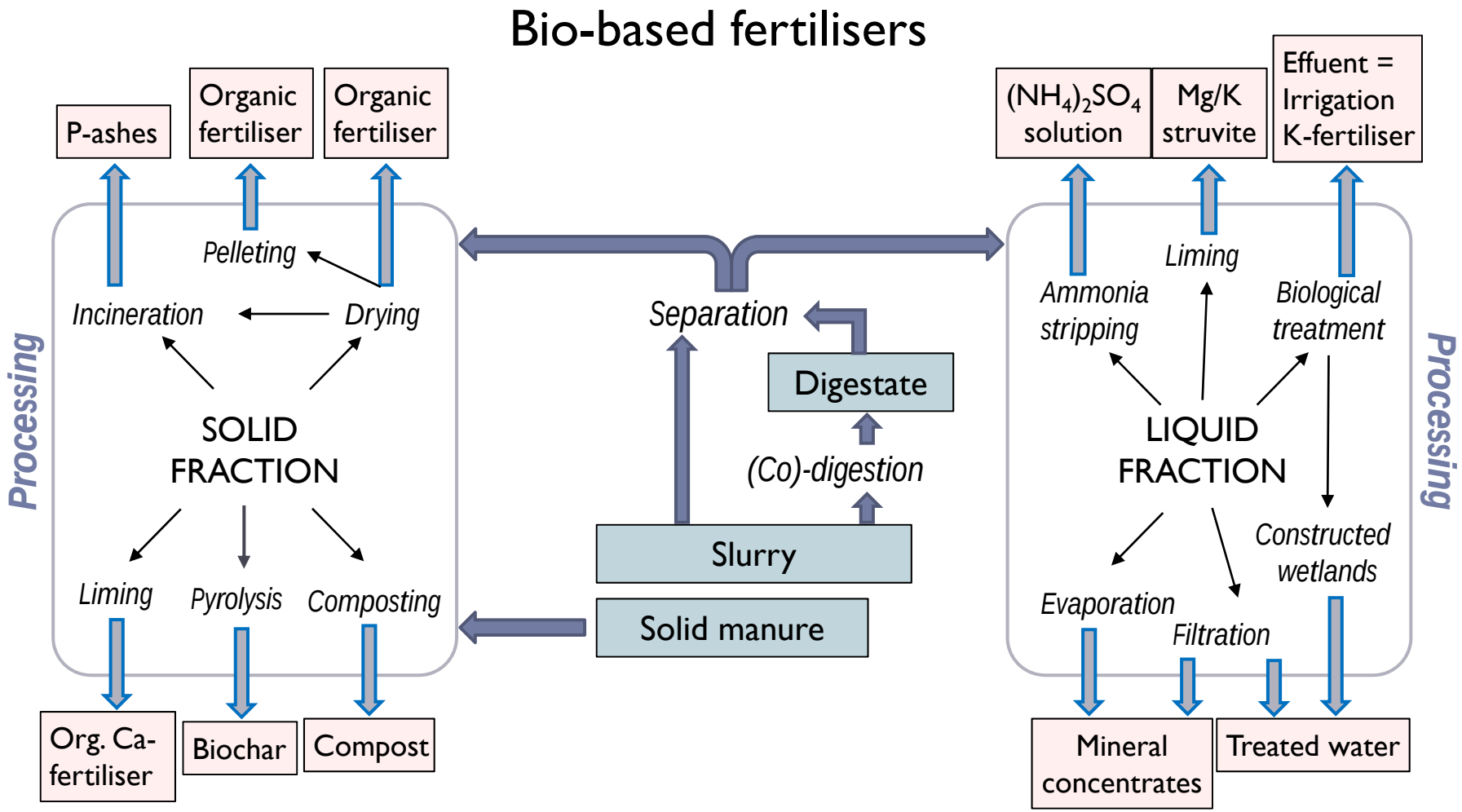
Products

Compost
Digestate

Pellets
Biochar
Ash (P / K)

NH_4-sol.
Struvite
Phosphates
Concentrates

Organic fertilisers in a Circular Economy



Adapted from: *EIP-AGRI Focus Group. How to improve the agronomic use of recycled nutrients (N and P) from livestock manure and other organic sources?*

Organic fertilisers

Compost

- ✓ Microbial stability
- ✓ Reduced moisture
- ✓ Pathogen and weed destruction
- ✓ Nutrient concentration
- ✓ Stable OM
- ✓ Easy to transport/use
- ✓ Quality standards
- ✓ Recognised fertiliser/amendment

- × Gaseous emissions
- × Investment and running costs
- × OM mineralisation & N-loss
- × Organic / HM contaminants

Dry solids

- ✓ Physical stability
- ✓ Very low moisture
- ✓ Pathogen and weed destruction
- ✓ Nutrient concentration
- ✓ Easy to transport/use
- ✓ High OM

- × Microbial instability
- × Gaseous emissions
- × Investment and running costs
- × High energy requirement
- × N-loss
- × HM contaminants

Nutrient availability?

Organic fertilisers

Biochar

- ✓ Microbial stability
- ✓ Very low moisture
- ✓ Pathogen and weed destruction
- ✓ High-C conservation
- ✓ Recognised amendment
- ✓ Production of energy
- ✓ Reduction of GHG from soil

- × High investment and running costs
- × High N-loss
- × Organic contaminants (PAHs)
- × Quality criteria not established

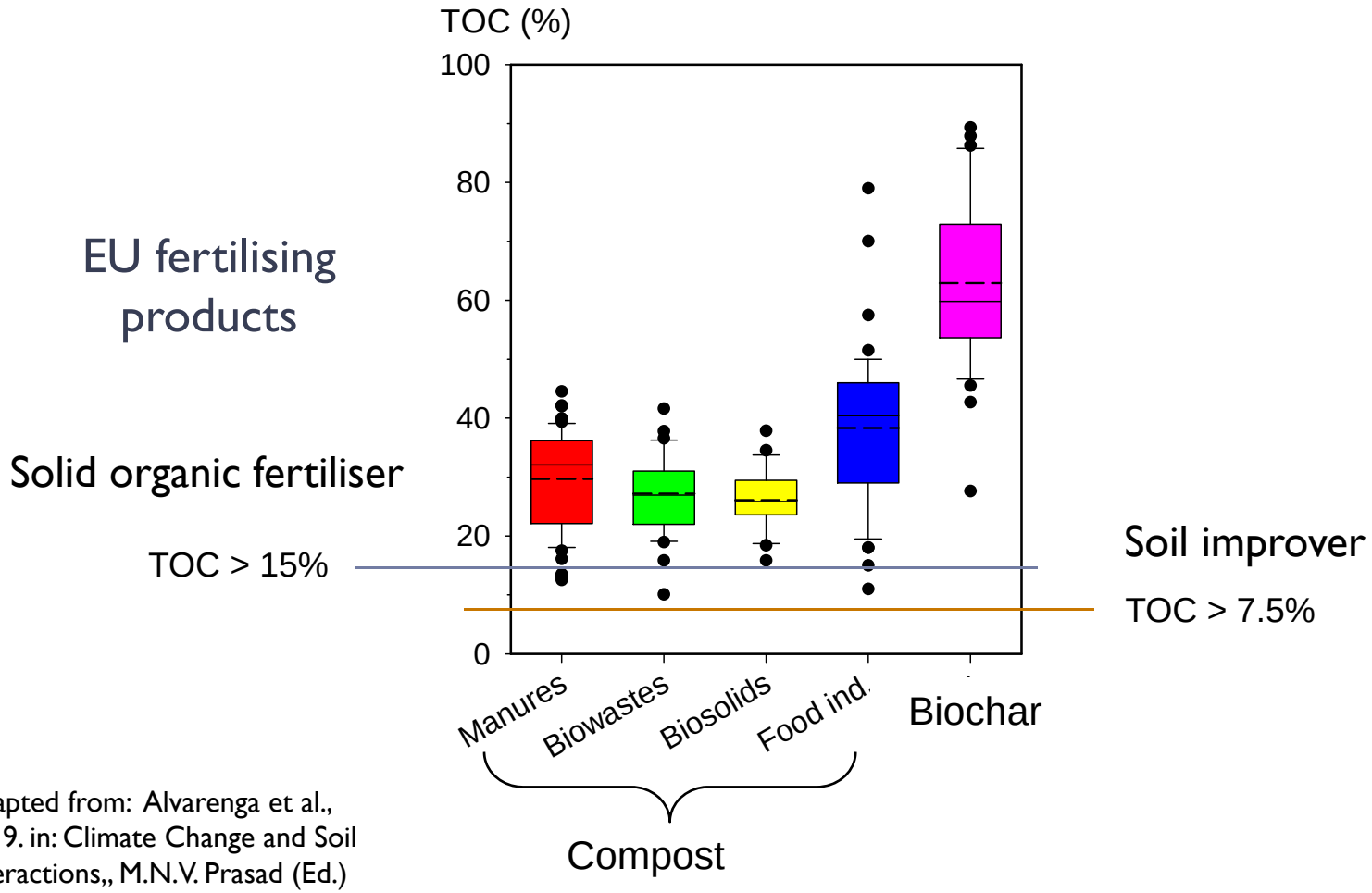
Ash

- ✓ Physical stability
- ✓ Very low moisture
- ✓ Pathogen and weed destruction
- ✓ Nutrient concentration
- ✓ Easy to transport/use
- ✓ Rich in P and K

- × Gaseous emissions
- × High energy requirement
- × Low in N and C
- × HM contaminants

Nutrient availability?

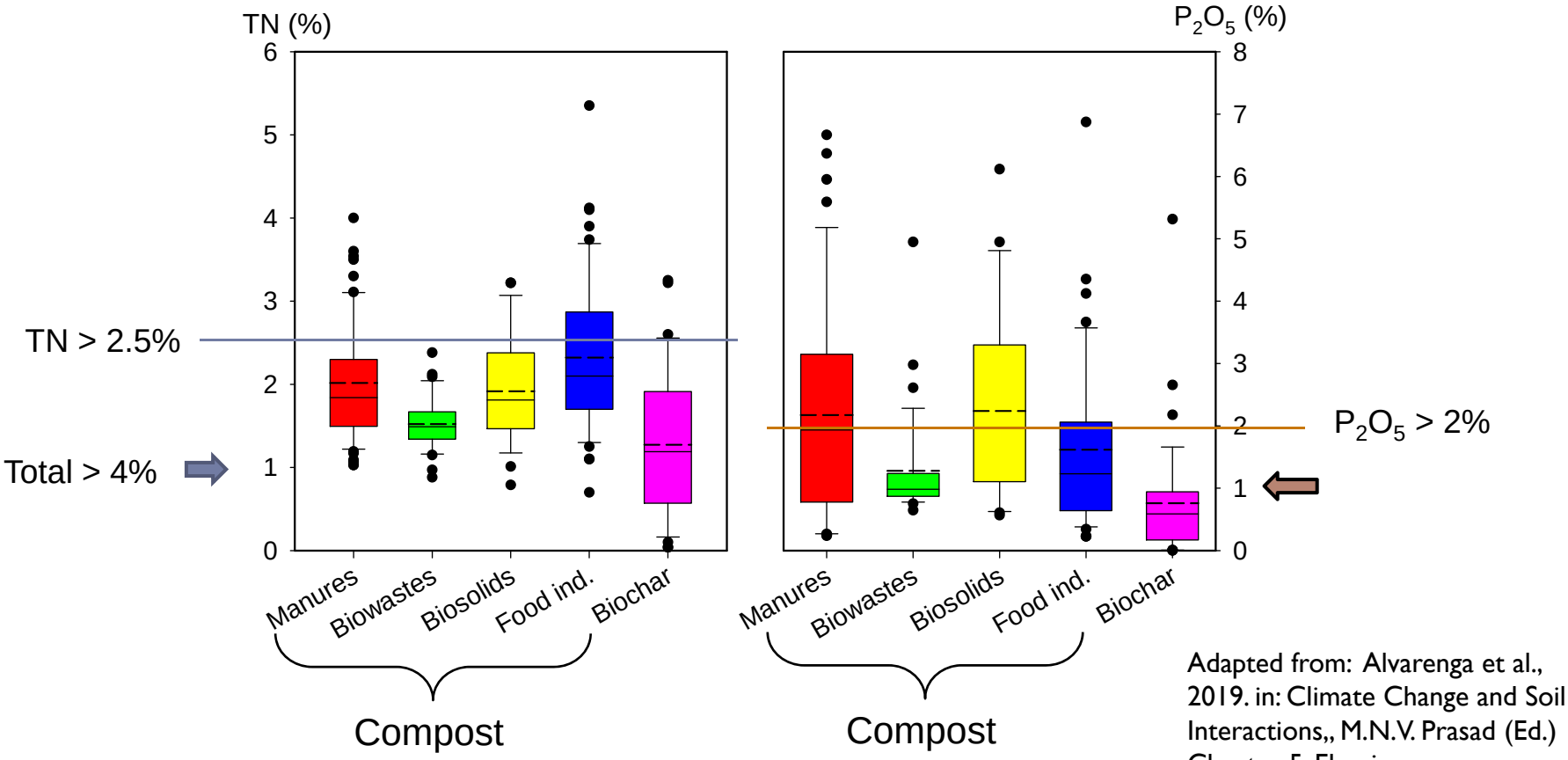
Organic-C in compost *vs.* biochar



Adapted from: Alvarenga et al., 2019. in: Climate Change and Soil Interactions,, M.N.V. Prasad (Ed.) Chapter 5. Elsevier.

Nutrients in Compost *vs.* Biochar

EU fertilising products: Solid organic fertiliser

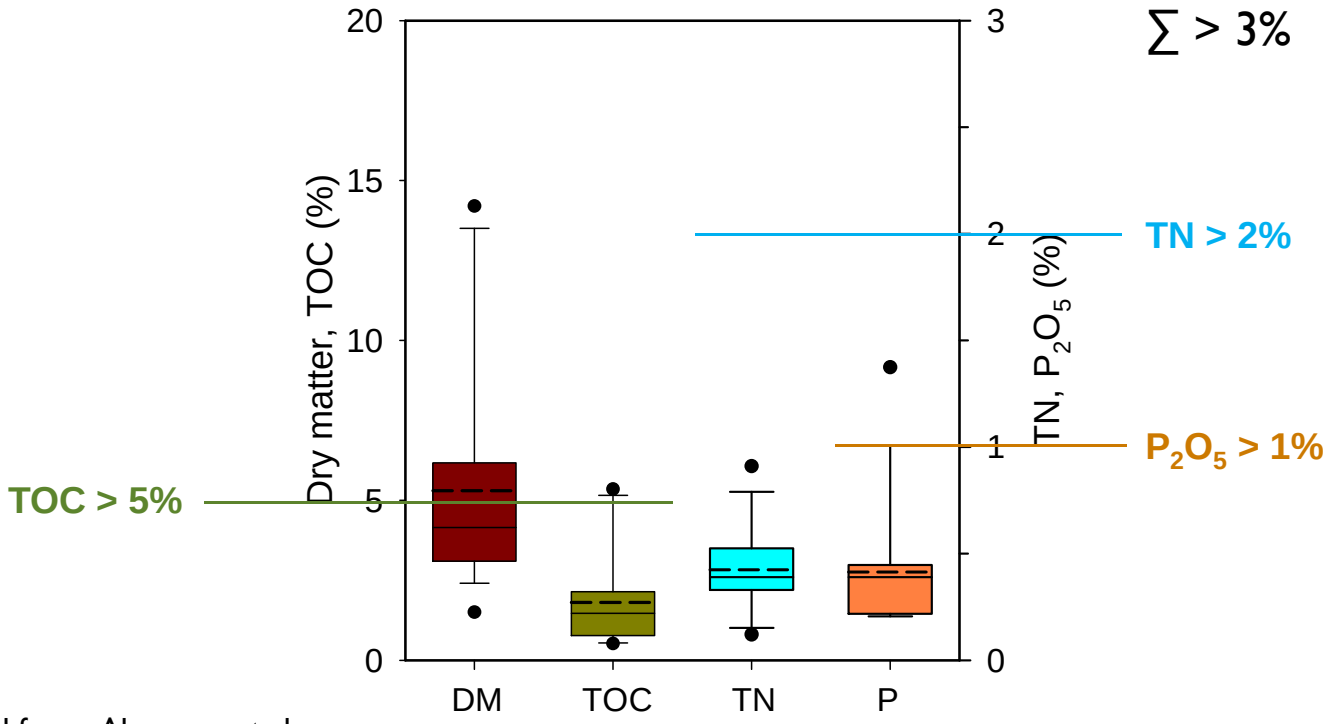


Adapted from: Alvarenga et al., 2019. in: Climate Change and Soil Interactions,, M.N.V. Prasad (Ed.) Chapter 5. Elsevier.

Struvite, biochar and ash-based products are not included in categories of component materials, but will be further considered.

Digestate

EU fertilising products: Liquid organic fertiliser



Adapted from: Alvarenga et al., 2019. in: Climate Change and Soil Interactions,, M.N.V. Prasad (Ed.) Chapter 5. Elsevier.

Organic fertilisers – 4G

Why?:

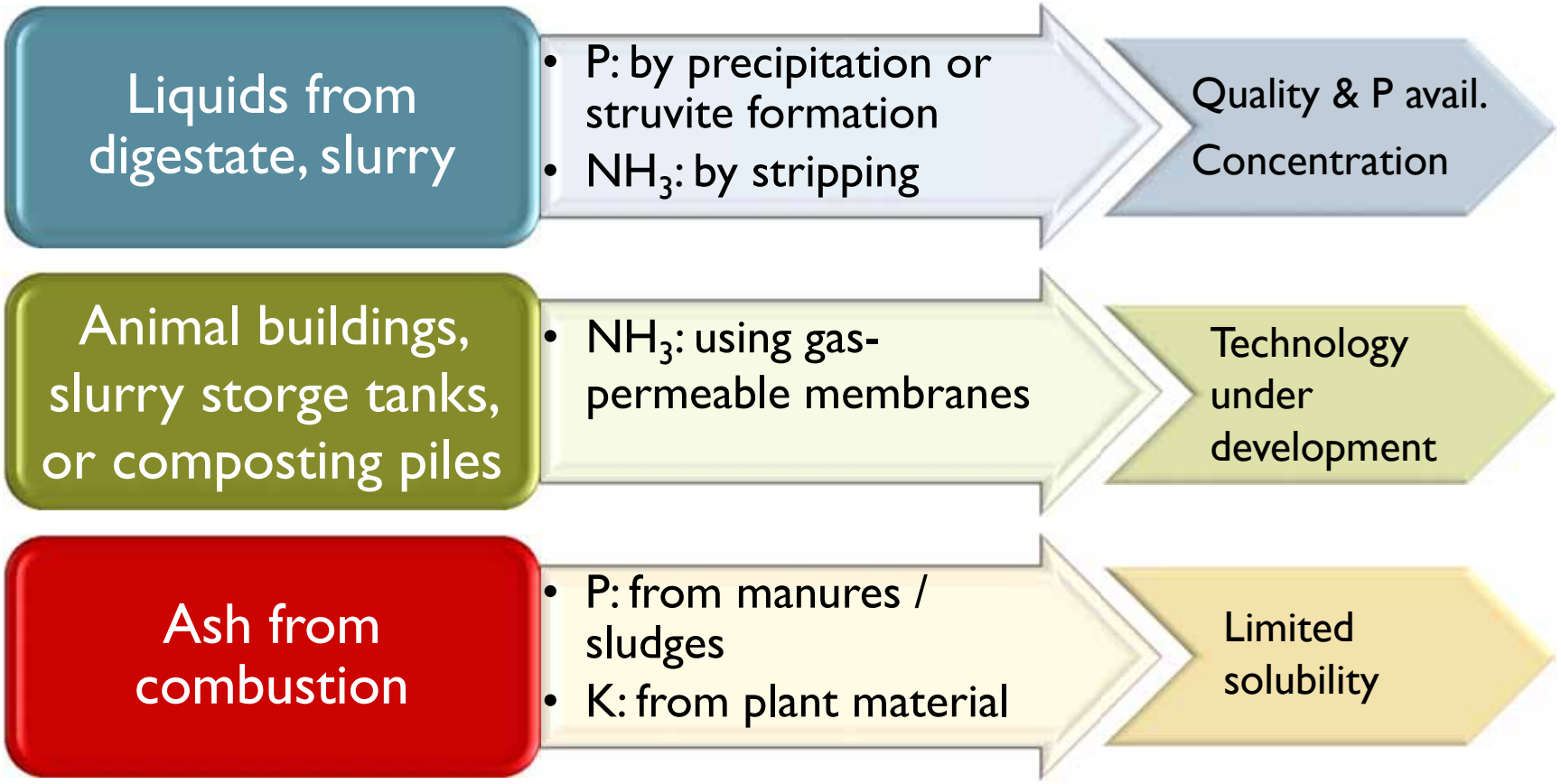
- Improve nutrient availability;
- Reduce GHGs;
- Water use efficiency;
- Prevent soil degradation.

→ ***Climate Smart Agriculture***

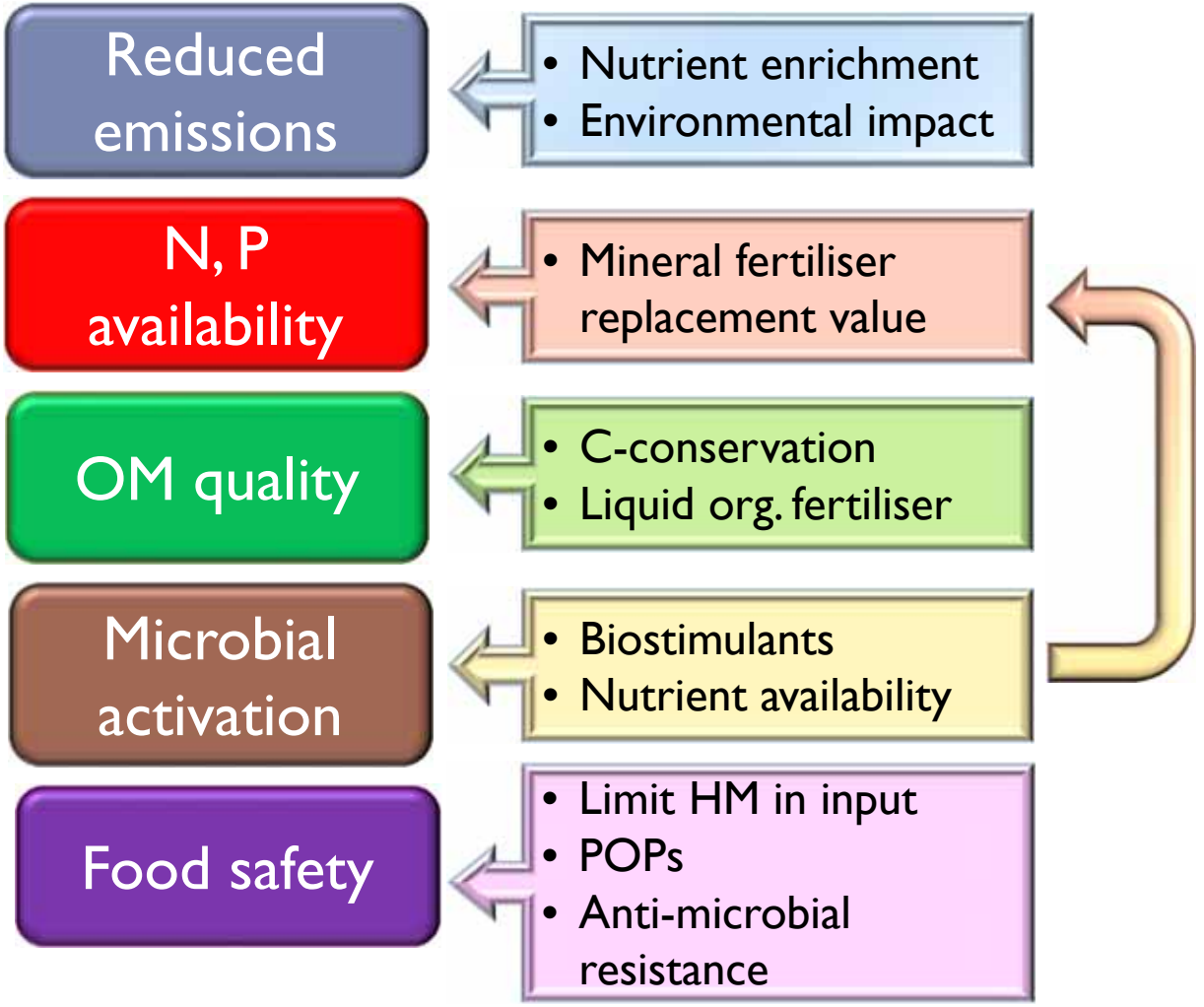
Source materials:

- ✓ Organic wastes
- ✓ Products from waste treatment;
- ✓ Plant / seaweed extracts.

Recovery of nutrients



Organic fertilisers – 4G



Plant Biostimulants

- Improve plant characteristics
- Improve soil rhizosphere

→

- Nutrient use eficiency
- Tolerance to abiotic stress
- Quality traits
- Availability of confined nutrients in the soil or rhizosphere

Microbial Plant Biostimulants

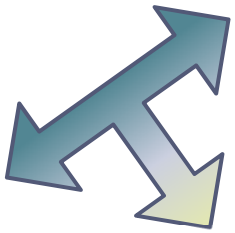
Azobacter spp.

Mycorrizal fungi

Rhizobium spp.

Azospirillum spp.

Non-Microbial Plant Biostimulants



New fertilisers

Achievements

- Source materials
- Process developed
- Characteristics evaluated
- Quality parameters
- Pollutants: HM, organics
- Soil: OM, microbial activity, etc.
- Environmental implication
- Regulation by legislation

Challenges

- Nutrient efficiency
- Biorefinery: Recovery of nutrients and compounds.
- Food safety
- Prevention of pollution: Emerging contaminants
- Enhance soil health and functions
- Mitigation of GHGs: test, evaluation and implementation.
- Cost-benefit
- User acceptance
- Market development

Future?

pbernal@cebas.csic.es