Molecular characterisation of fertilizing materials of residual origin for a better understanding of interactions

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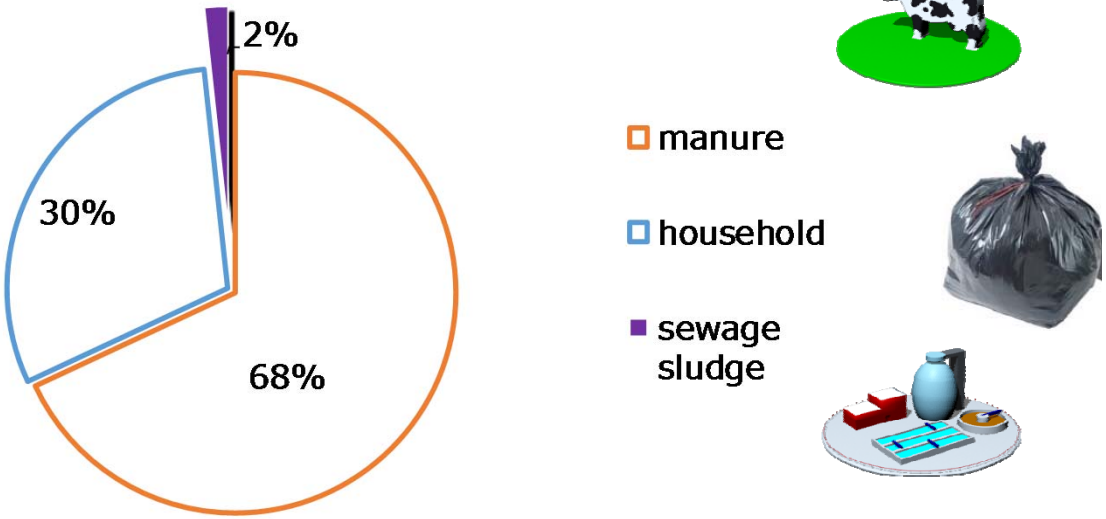
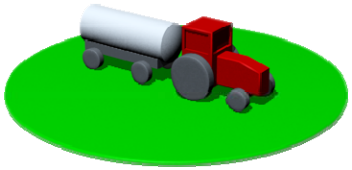
Organic waste in France



- **Households :** 354 kg/year/inhabitant
- **Sewage sludge :** 20 kg / year/inhabitant

Landfarming



Interesting solution for organic waste management

- sustainable contrarily to incineration or landfill

- accelerates the restoration of soils

- contributes to carbon immobilization (clay-humic complexes)

Hasards

Presence of

- pathogen micro organisms
- metal trace elements (MTE)
- organic micro contaminants (OMC)
- antibiotics, …

Contamination of soils, crops & finally human food chain

Handling processes

Implemented prior to land farming contribute to

- degrade contaminants
- produce energy
- reduce the volume thus transportation cost
- improve agronomic properties

Objective

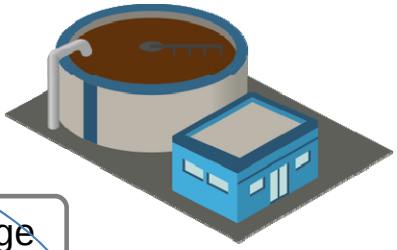
Correlate the origin and treatment of fertilizing materials

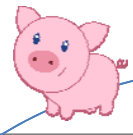
with its fate in soils

Characterise residual organic materials

at the global and molecular level

Samples





Pig manure

Cattle manure

Horse manure

Digested cattle manure

Thickened sludge

Reed bed sludge

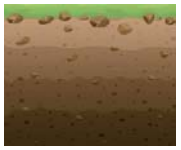
Digested sludge

Limed sludge

Filtrated

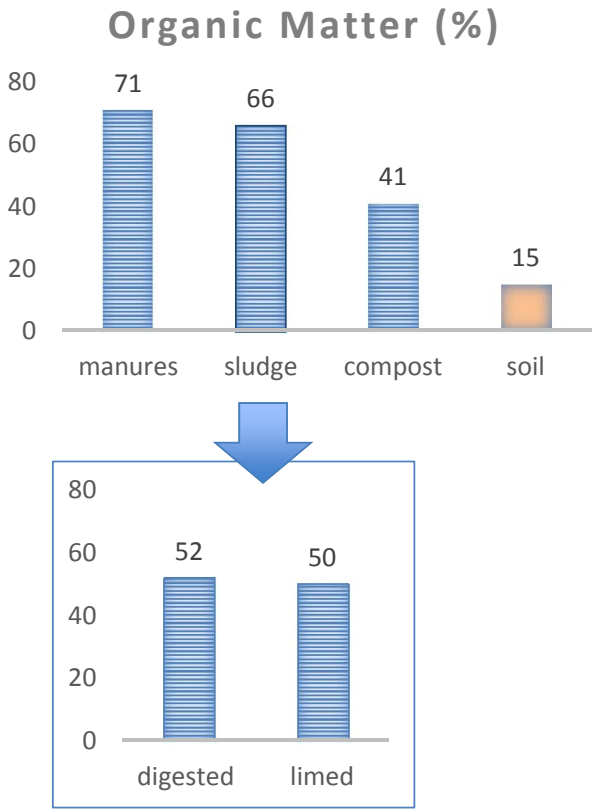
Centri dried

3 Soils
Andosol, Brunisol, Calcosol

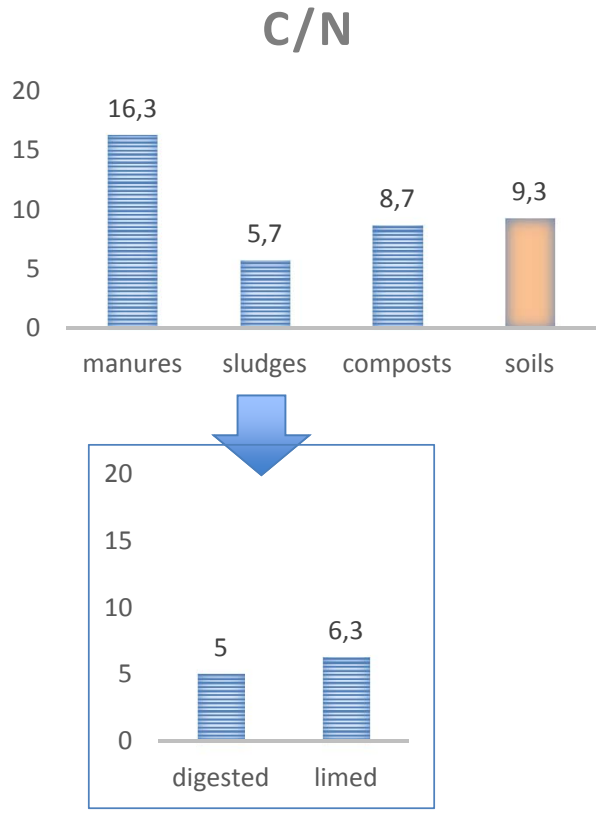


3 Composts
Cahors, Ticol, Berneuil

Elemental analysis

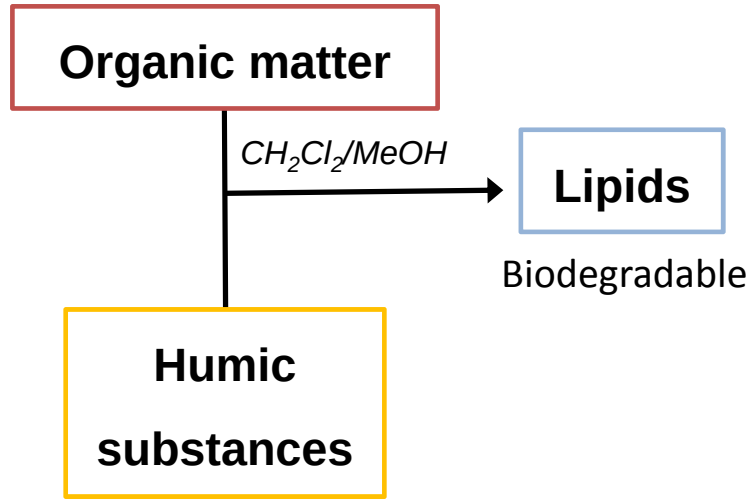


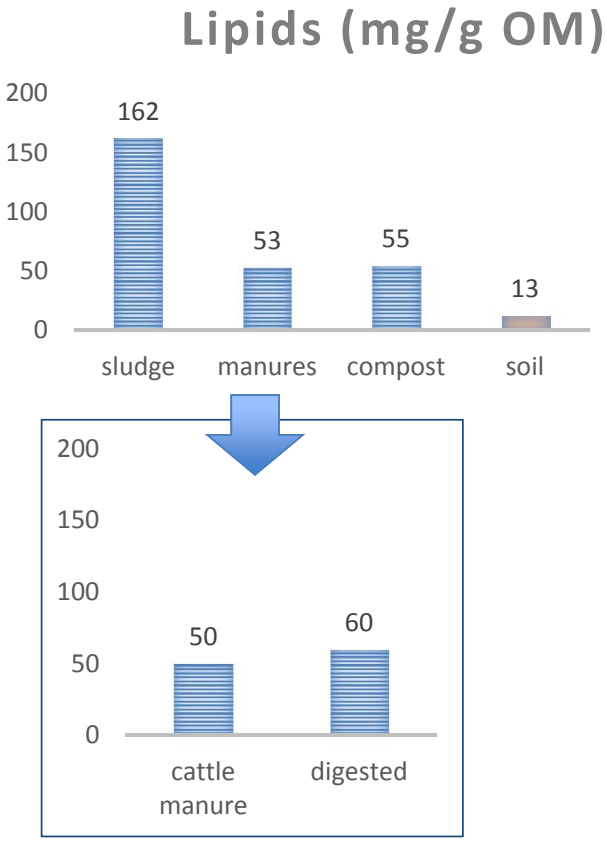
decrease in OM content



no improvement of C/N

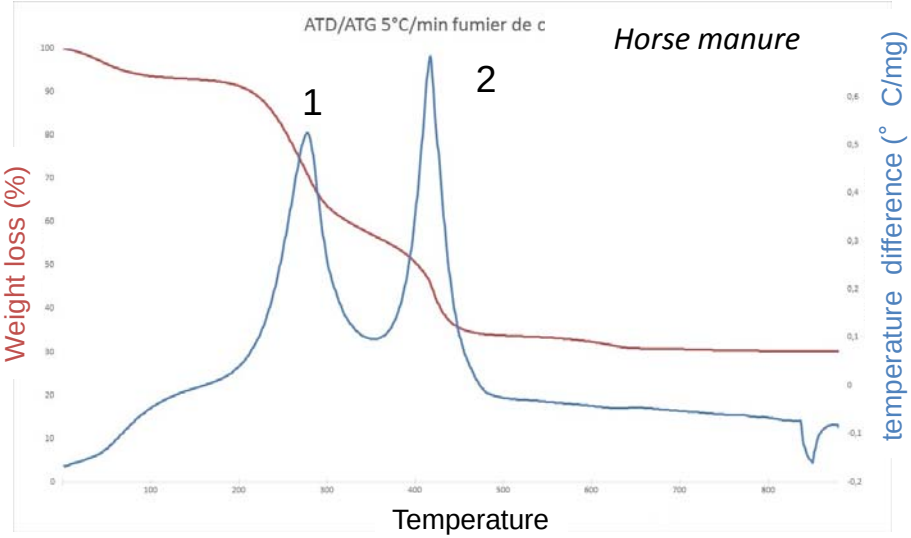
Chemical fractionation

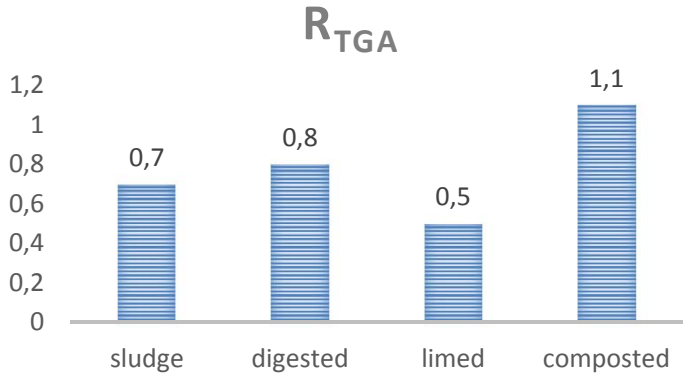




Weakening of OM

Thermal analysis





DSC: 2 exotherms

- 1 : desorption of volatiles (350° C)
- 2 : oxidation of heavy weight compounds (500° C)

R_{TGA} : Weight loss associated with exo2/exo1
higher for a humified OM

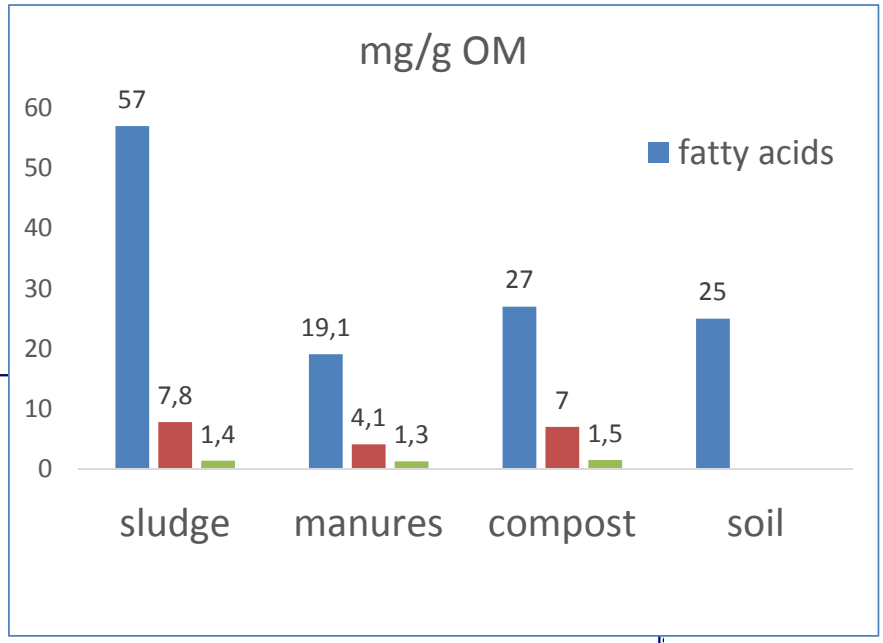
Liming induces a weakening of OM

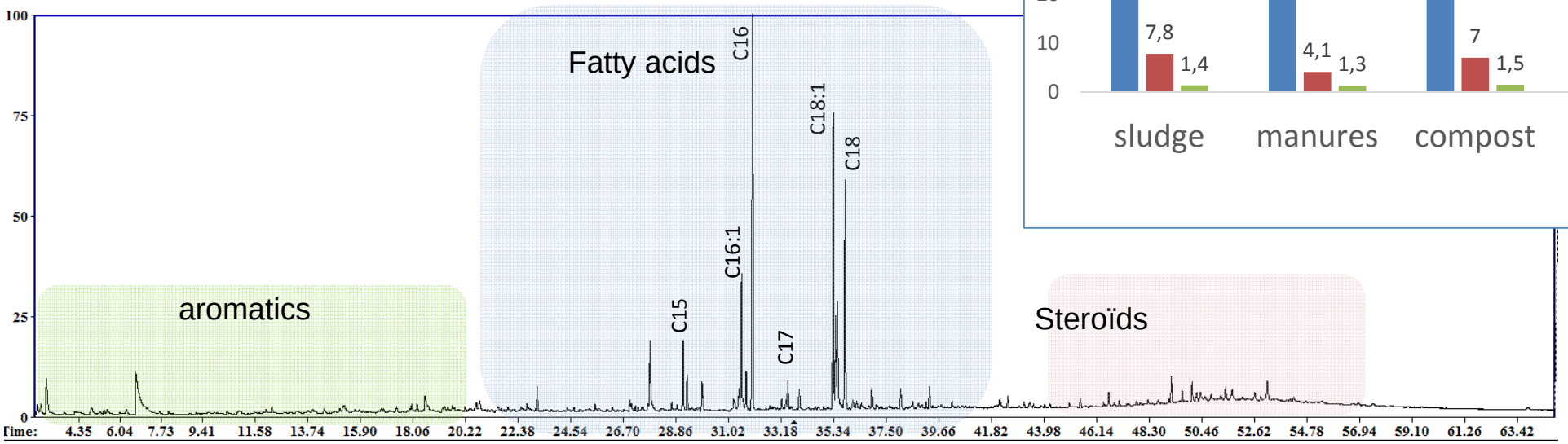
Composting favors humification

Thermochemolysis – GC/MS

Pyrolysis at **350°C** with in situ methylation (TMAH)

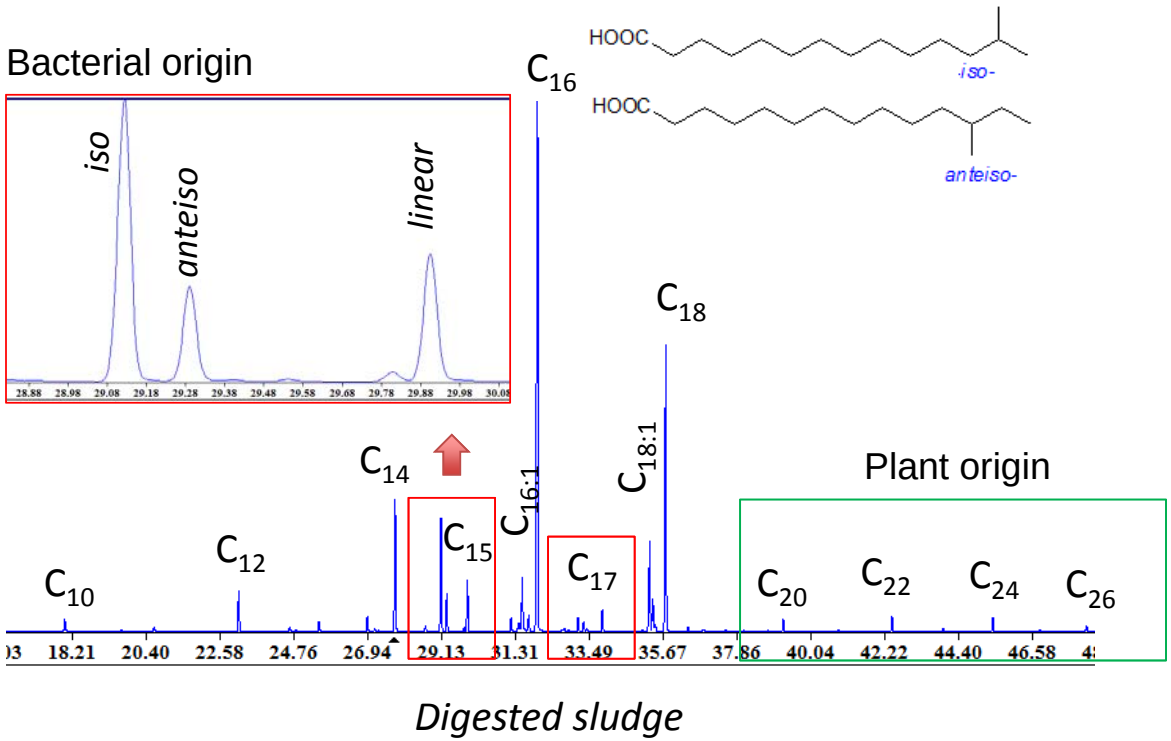
➡ molecular information on the lipidic fraction



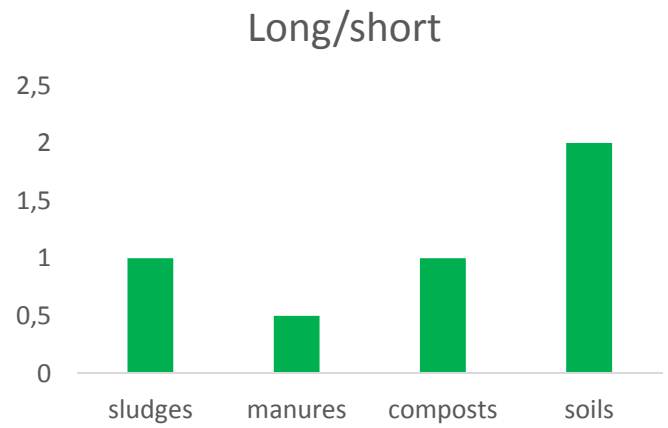


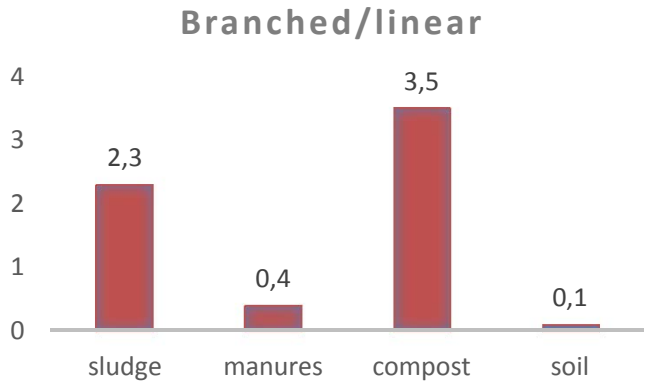
Raw thickened sludge

Fatty acids



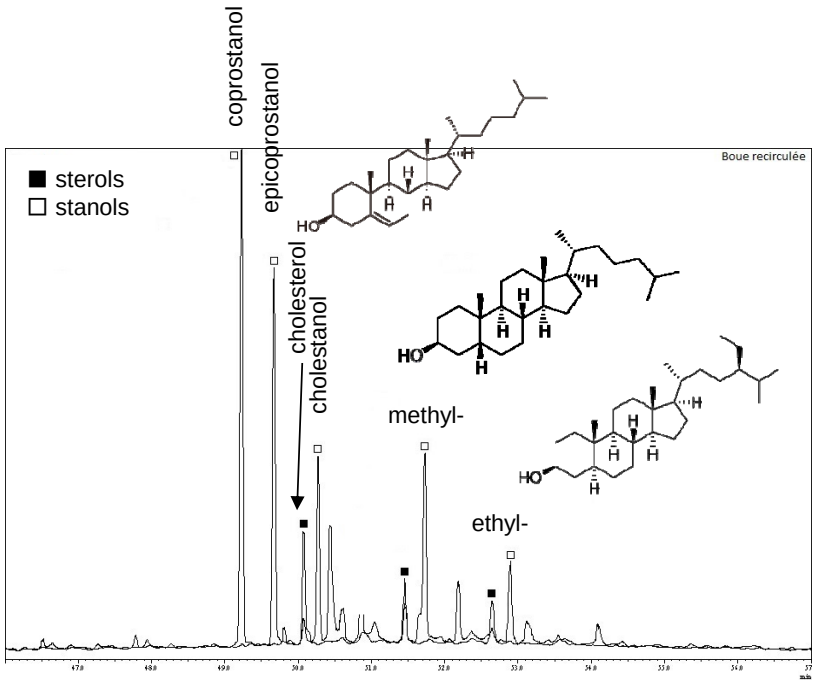
Digested sludge



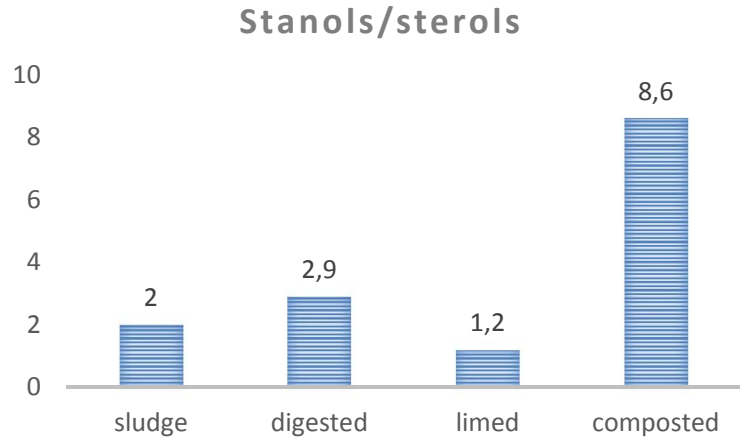


Monitor biological activity during treatment & after amendment

Steroids



Raw thickened sludge



Hydrogenation of sterols during digestion

Dehydration of sterols during composting

Specific biomarkers :

- Coprostanol : faecal origin
- Ergosterol : fungal origin
- Sitosterol : plant origin

Conclusion

- Residual OM constitutes an interesting source of Carbon and N for soils
- All the treatments induce a loss of OM
- Digestion and liming weaken the OM
- Composting leads to a stable and humified OM with a good C/N balance

- Py-GC/MS provides molecular information

useful to envisage the fate of residual carbon in soils

Thanks for your attention