



Soil cover under CA system: essential interface of a CLCA system



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LABOUR MECANIQUE



Source: INGC

RECROISEMENTS SUCCESSIFS



Source: INGC

BRULURE DES RESIDUS



Source: INGC



Source: INGC

EROSION CONTINUE



Source: INGC

GLISSEMENT DE TERRES



Source: COTUGRAIN

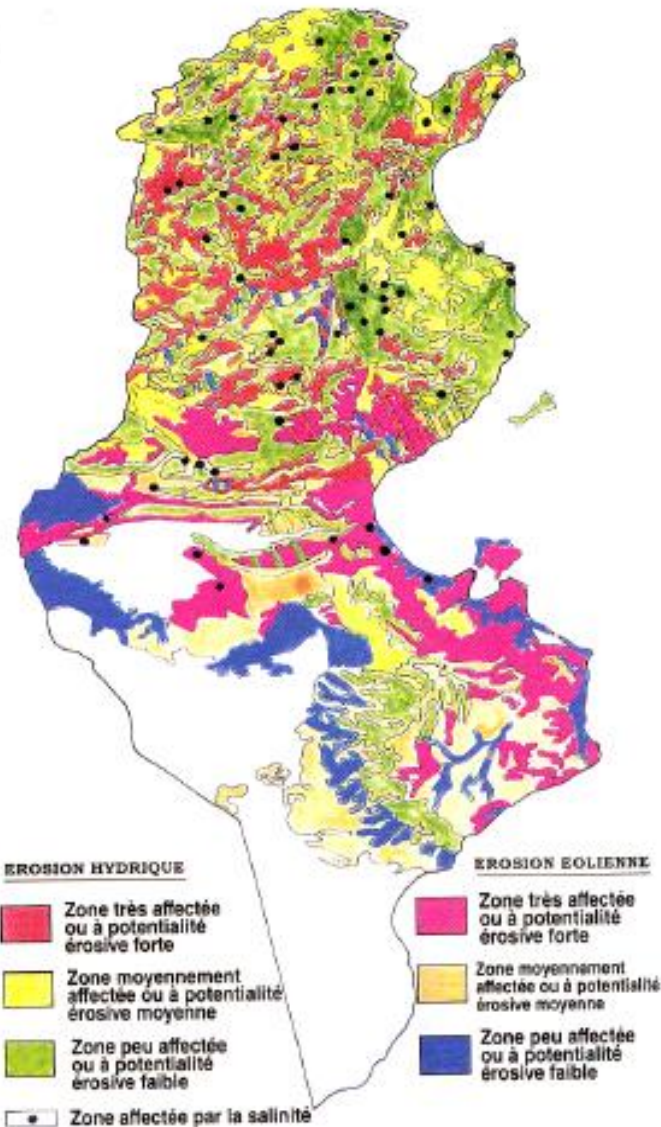


Source: INGC



ROAD DAMAGE

Dégradation des sols: érosion,....



- ✓ 3 millions ha des superficies sont exposées à l'érosion
- ✓ 25 million m³ of des sédiments (érosion sol en pente)
- ✓ 10.000 to 15.000 ha des superficies perdues par an

Début de la tragédie (USA 1900)





Terminologie???



Zéro labour

Travail minimum du sol

Semis Direct

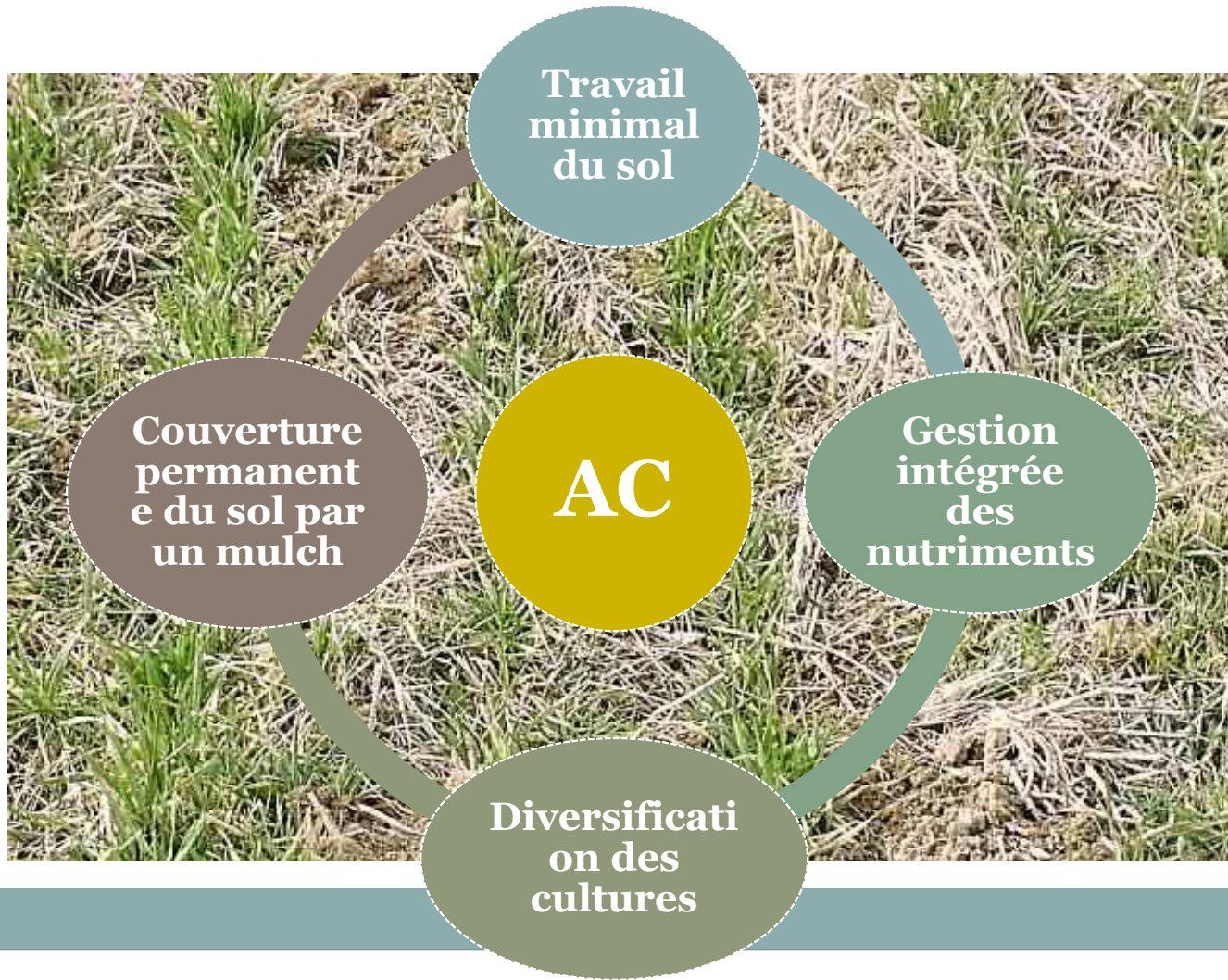
Semis sur couvert végétal

Agriculture de Conservation

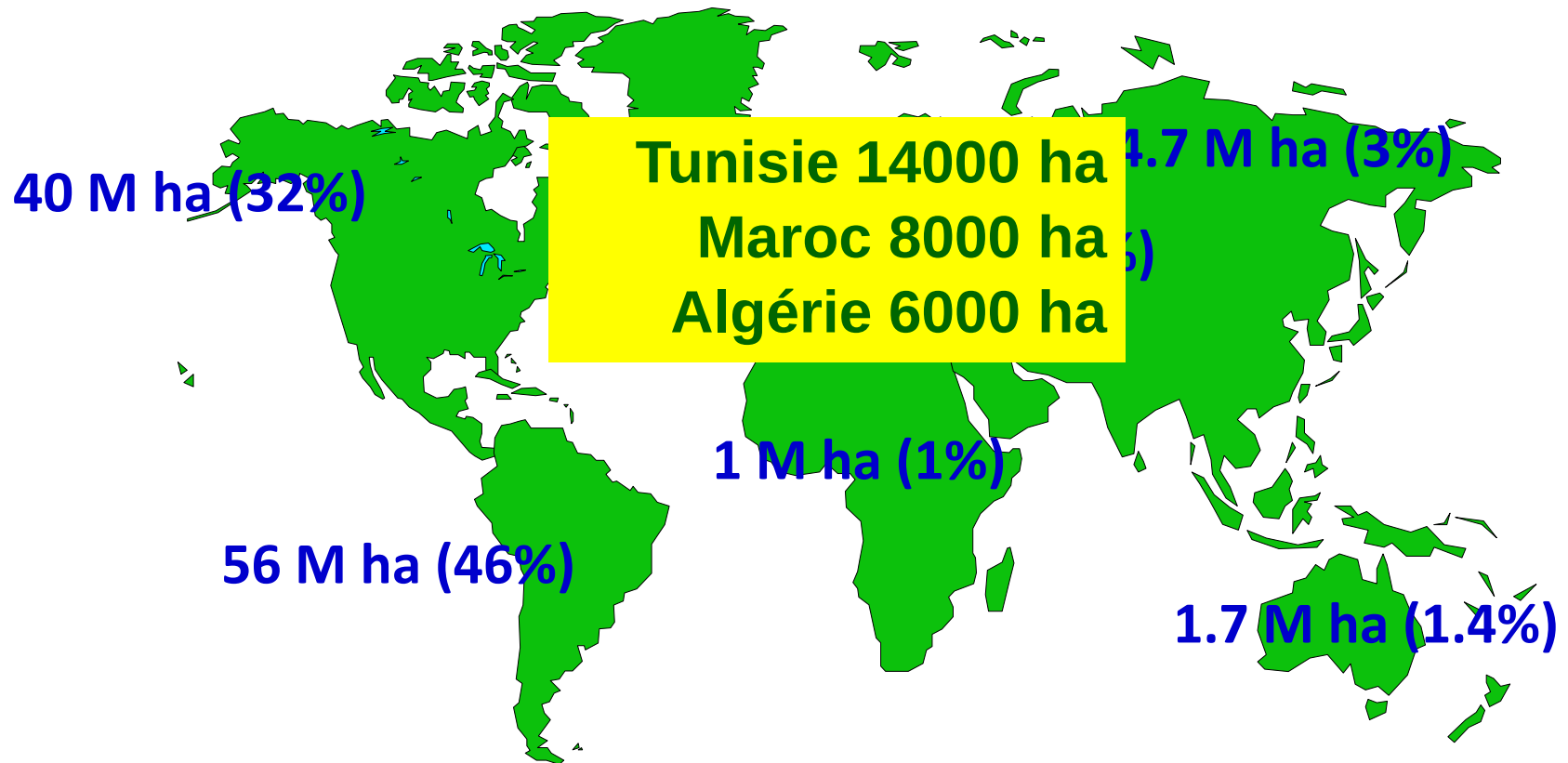
***conservation
du sol et durabilité
de la production***

Principes de l'Agriculture de conservation

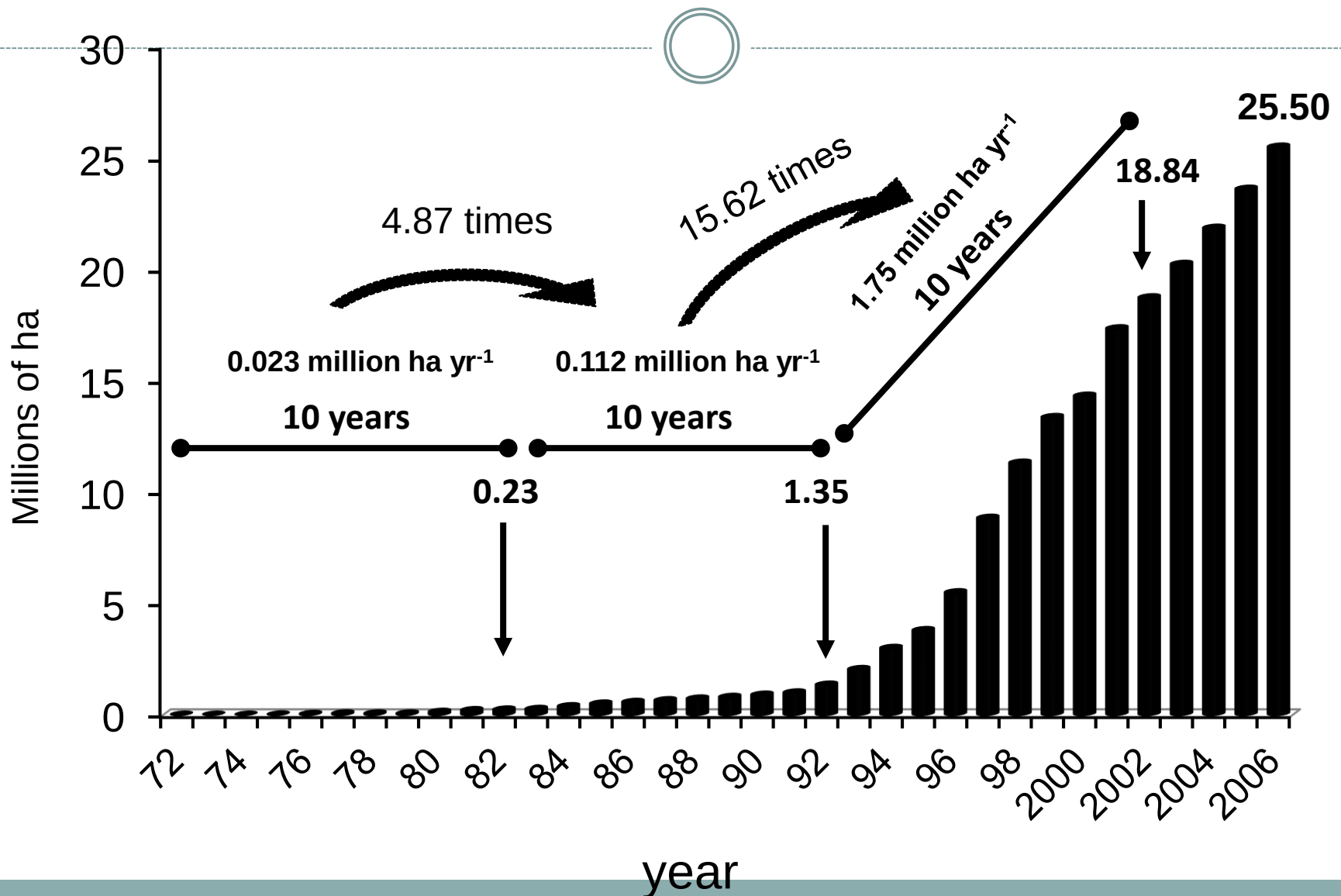
AC est une méthode de gestion des agro-écosystèmes qui a pour but une amélioration durable et rentable de la productivité, tout en préservant et en améliorant les ressources naturelles.



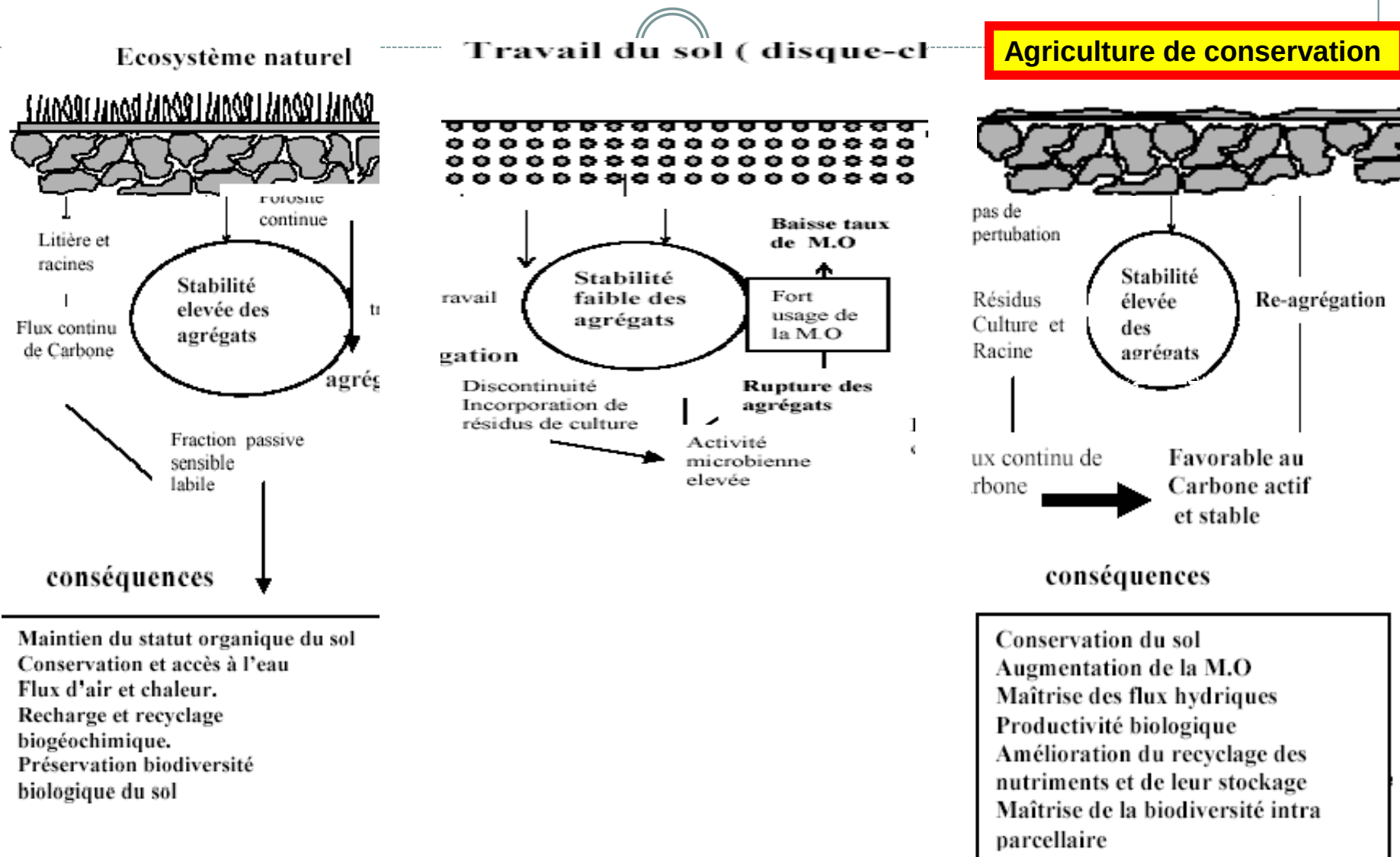
Total 195 Million ha



Développement du zero labour au Brésil (1972 – 2006)



Concept de l'agriculture de conservation



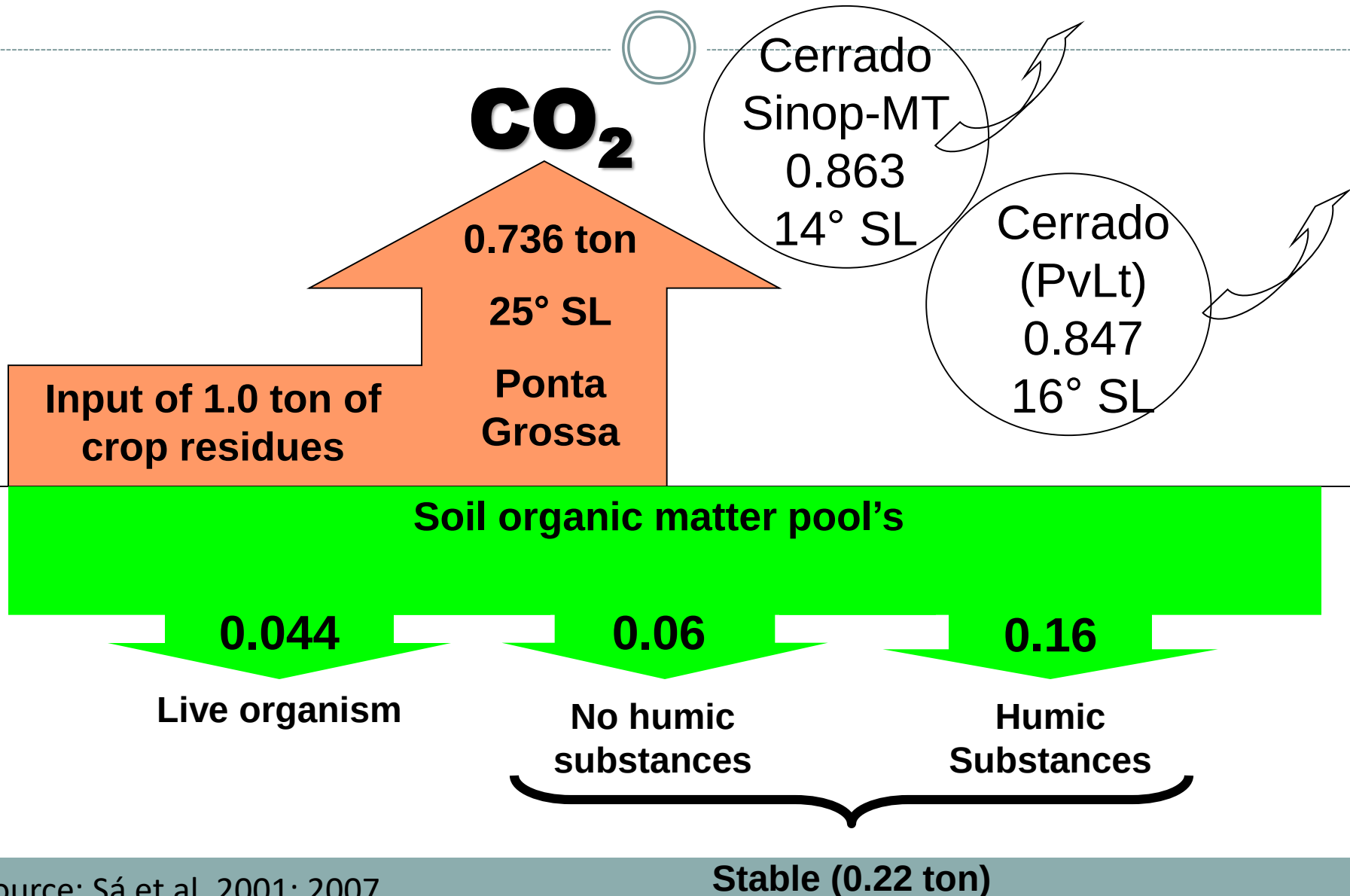
Comprendre les MOS dans le système CA



"To understand the soil organic matter in no-tillage system you have to think as a crop residue"



Distribution of the decomposition products of the crop residues in the SOM pools

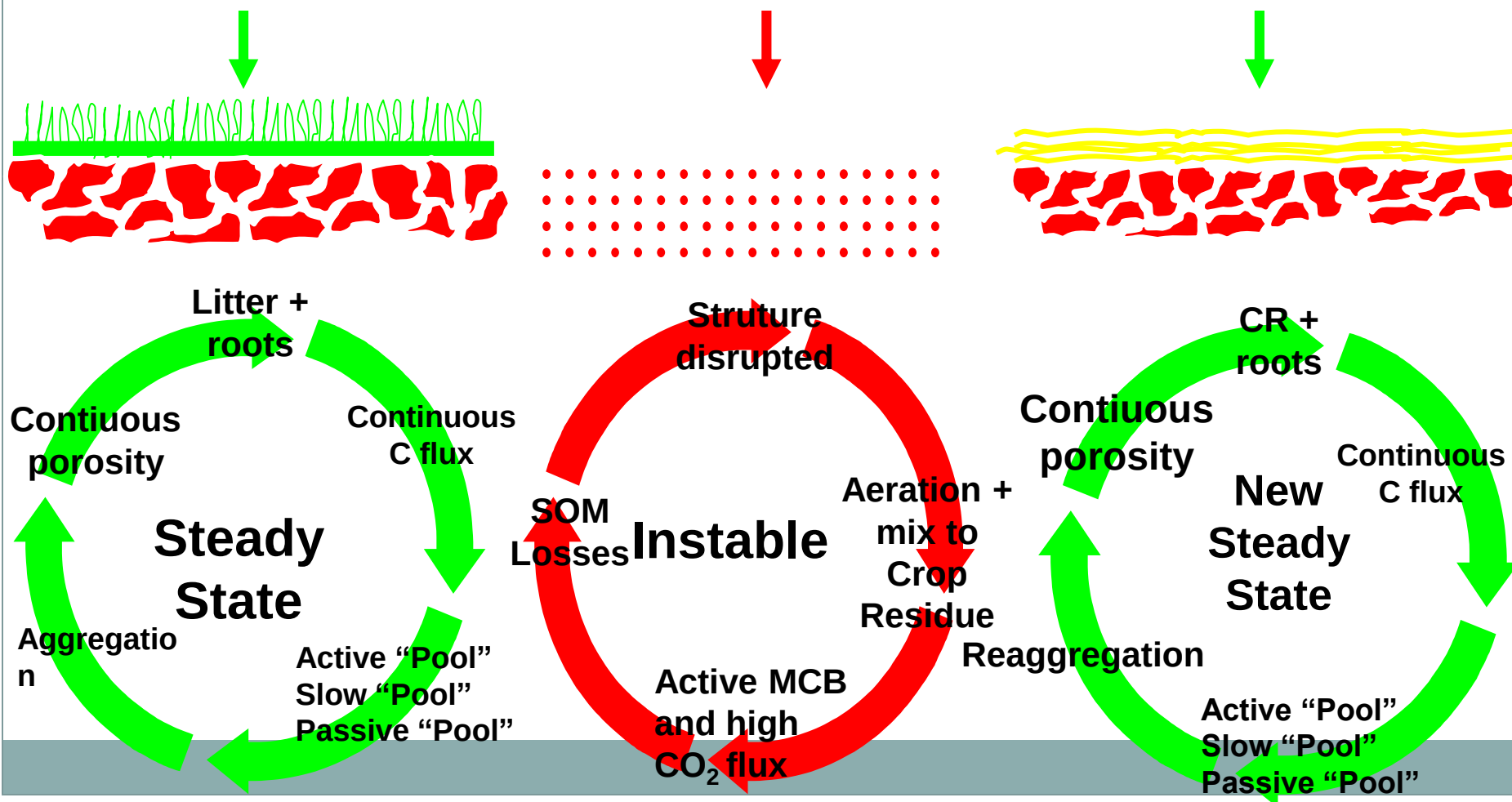


Natural
Vegetation

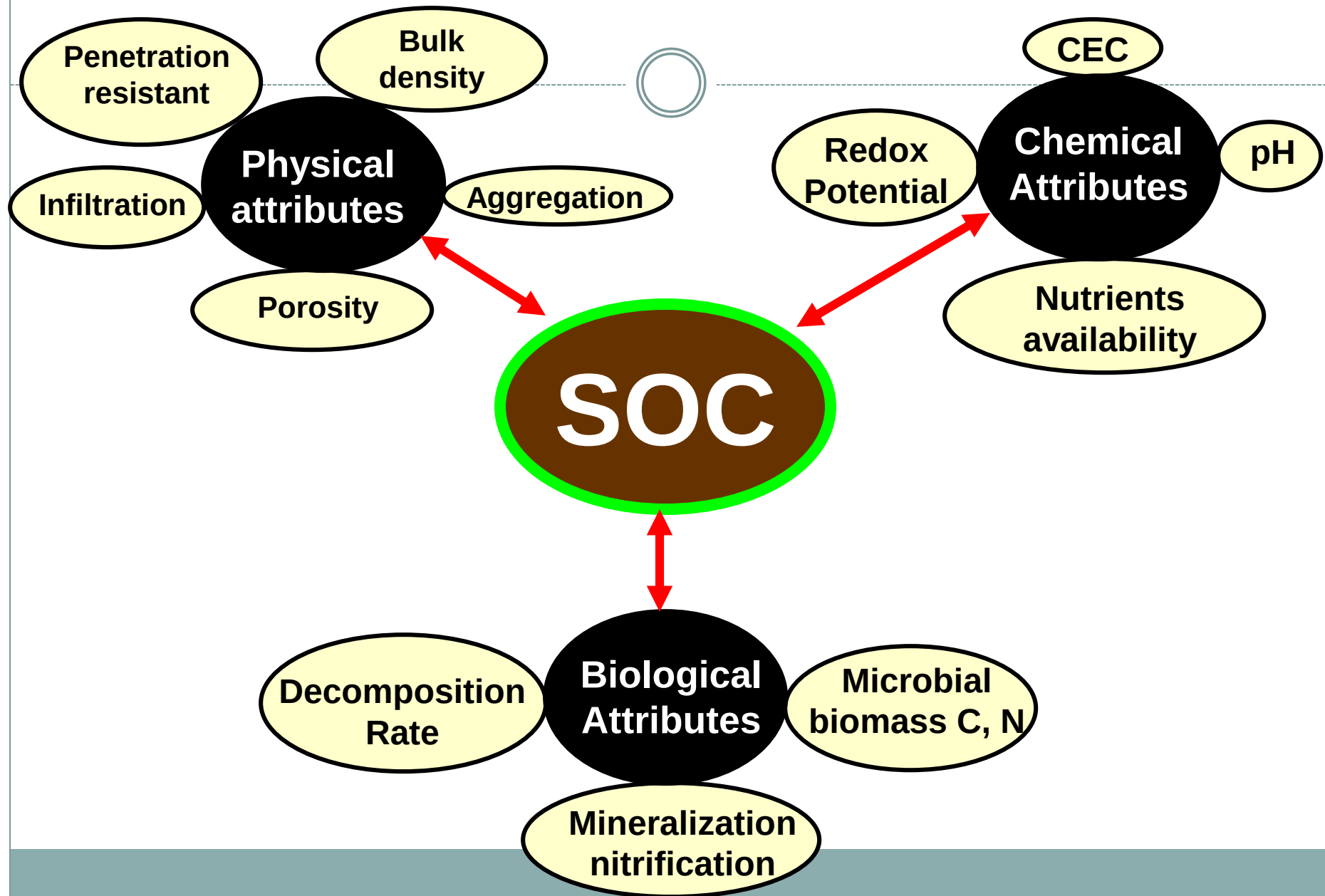
Conventional
Tillage

No-Tillage

**Basic differences among of the land
use systems**



SOC and Soil attributes interactions



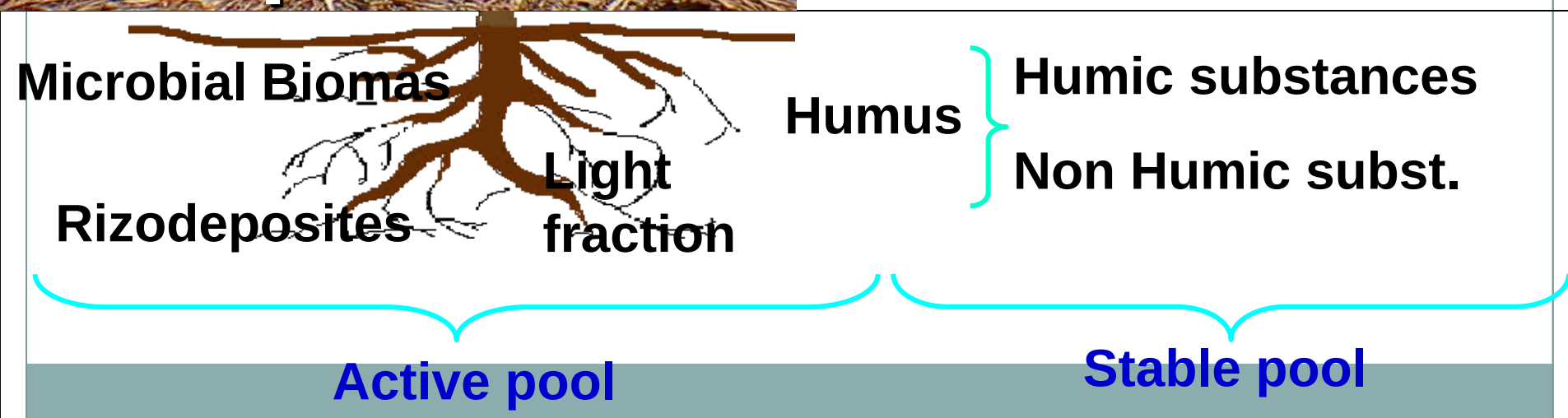
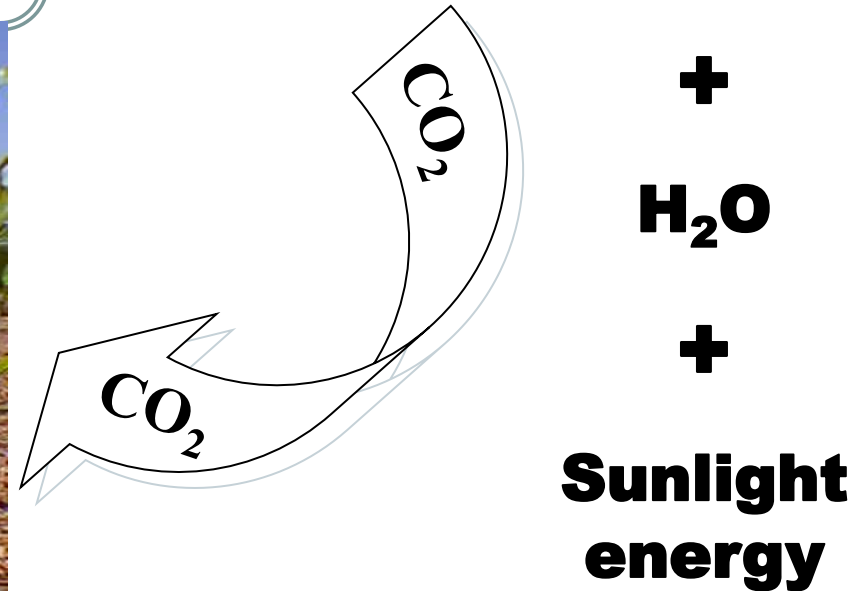


**How is the organic matter formed
under no-tillage soils?**

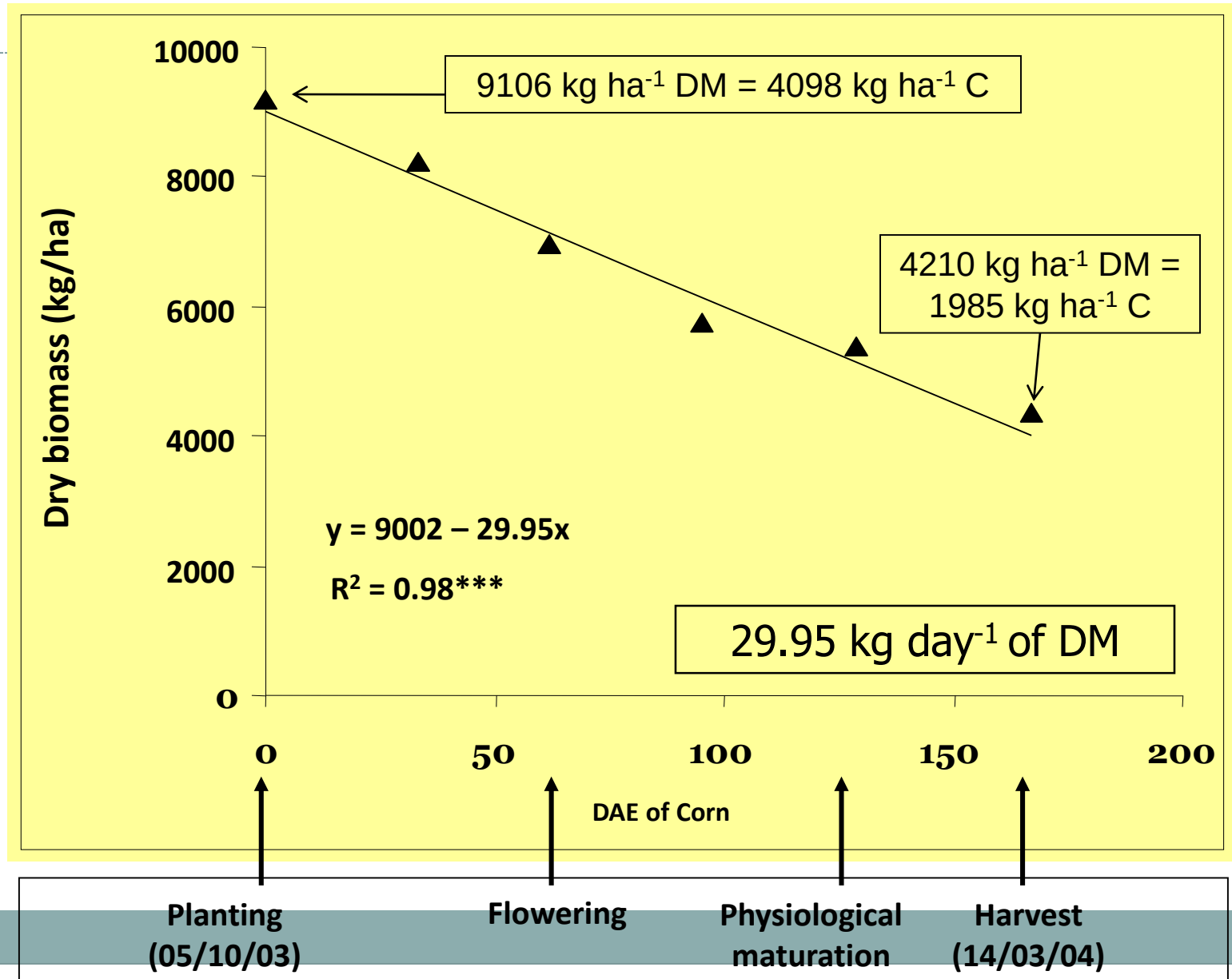
Pools of the soil organic matter



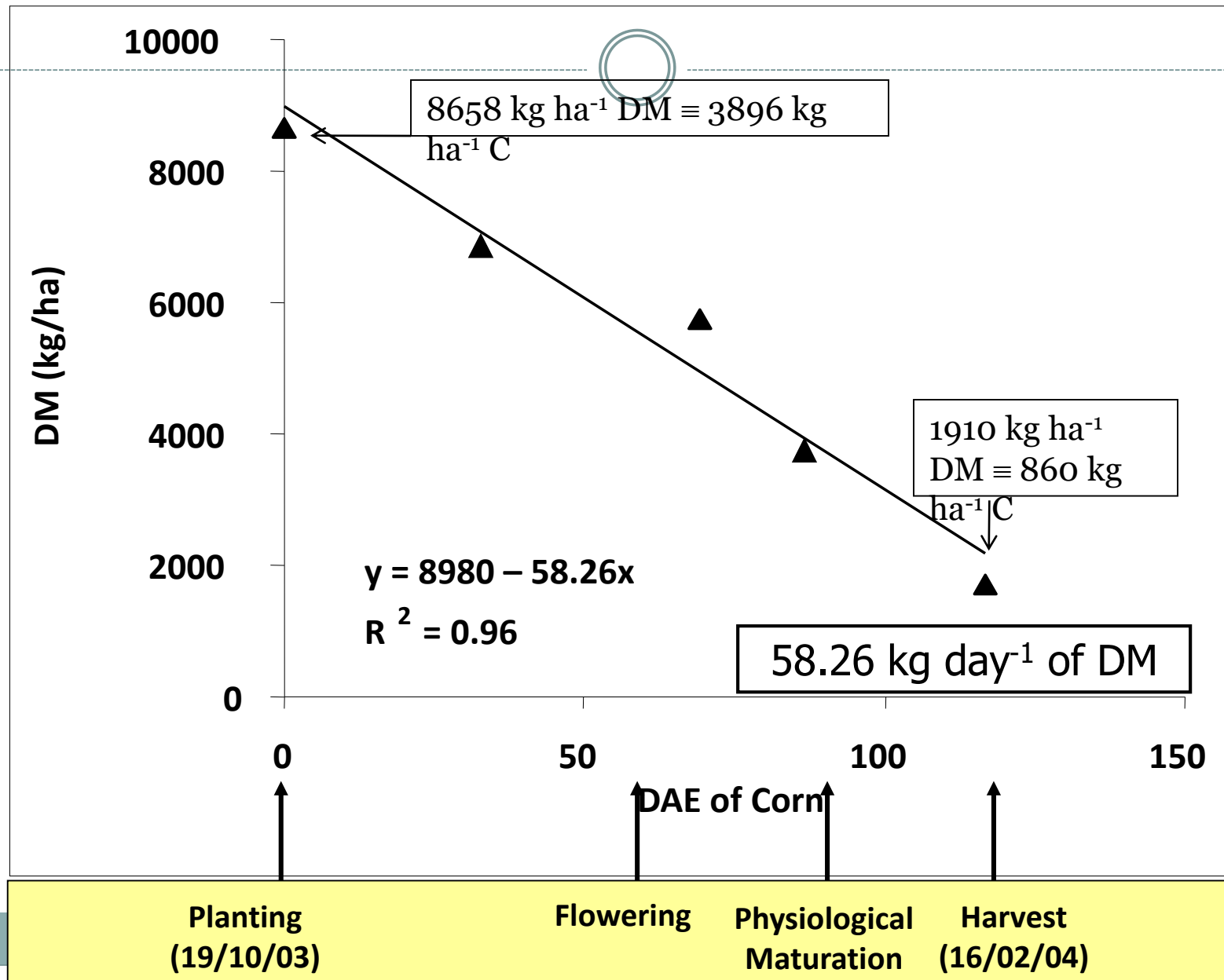
Crop Residues



Crop residues decomposition (oats + remaining residues) during the corn development (Piraí do Sul, 910 m ASL, 25 °SL, 2003-04, Oxisol (62% of clay))



Crop residues (*Brachiaria decumbens*) decomposition during the **corn** development
Rio Verde, 880 m ASL, Latitude $\cong 16^\circ$ S, 2003-04, Oxisol 65% of clay)

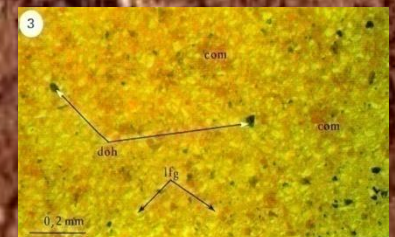
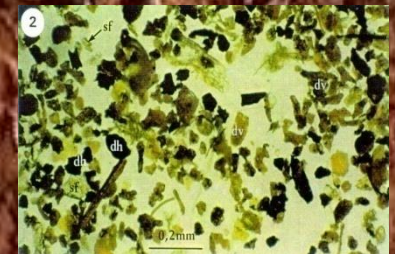


Impact of crop residues on Soil Organic Matter



C and N Stock

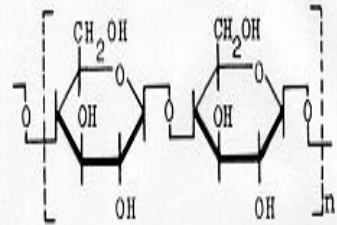
Particle size



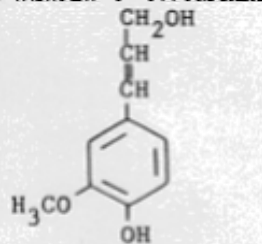
> 212 μm
53 to 212 μm
< 53 μm

4 mm

Continuous C flux

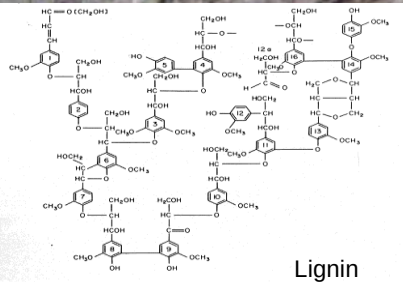


Cellulose



Coniferyl alcohol

(Polifenols)

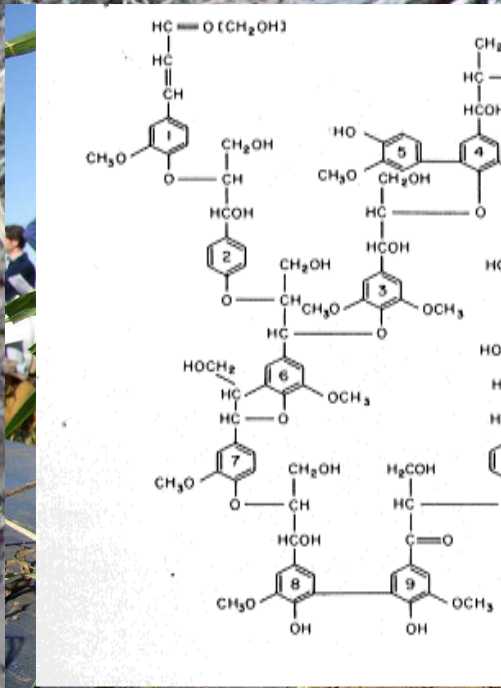


Lignin



Buffer Front and aggregation

Continuous C flux



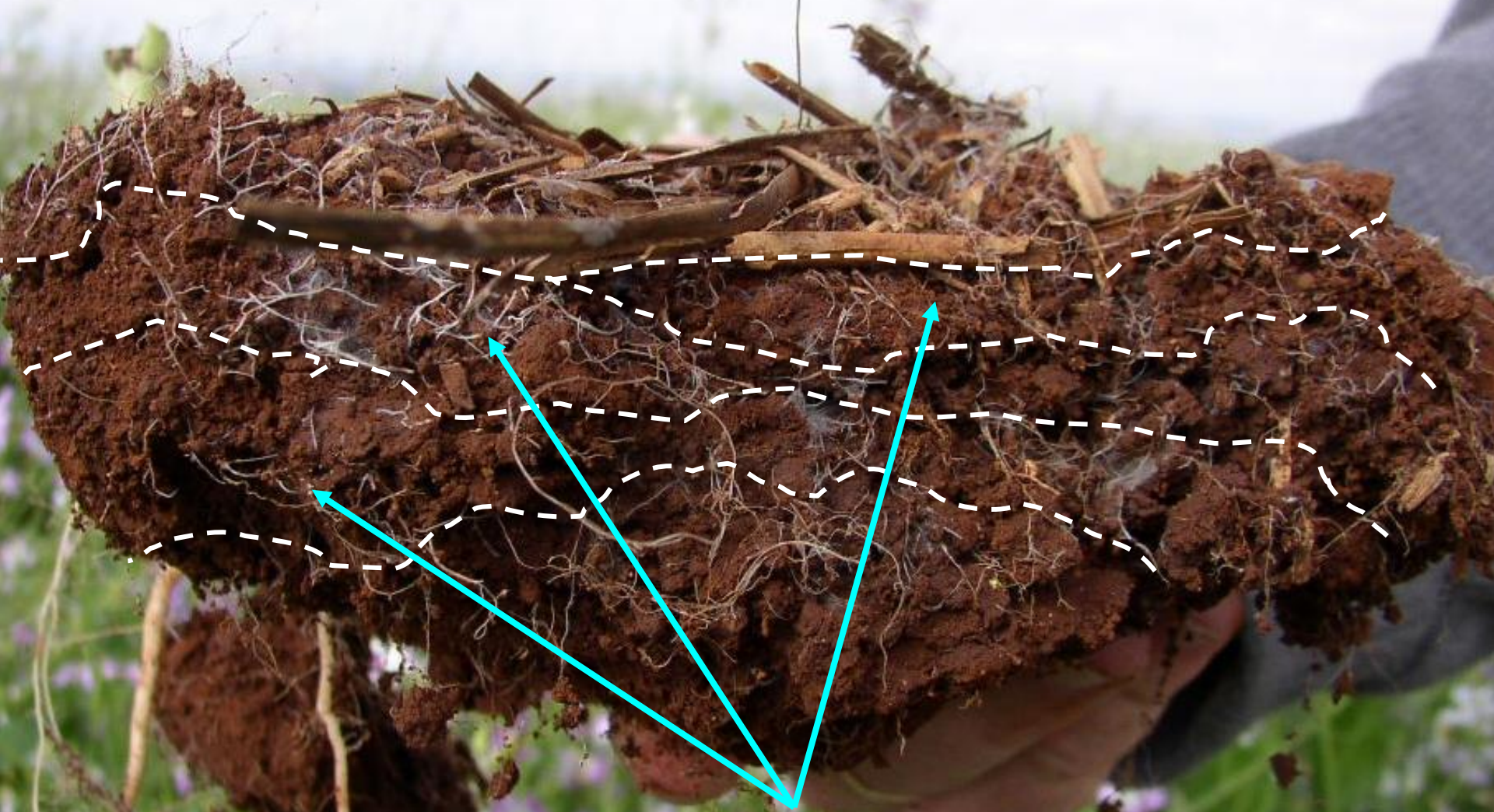
Macroaggregation (Physical protection)



Decomposition active zone

Aggregation active zone

Zone of aggregation in layers



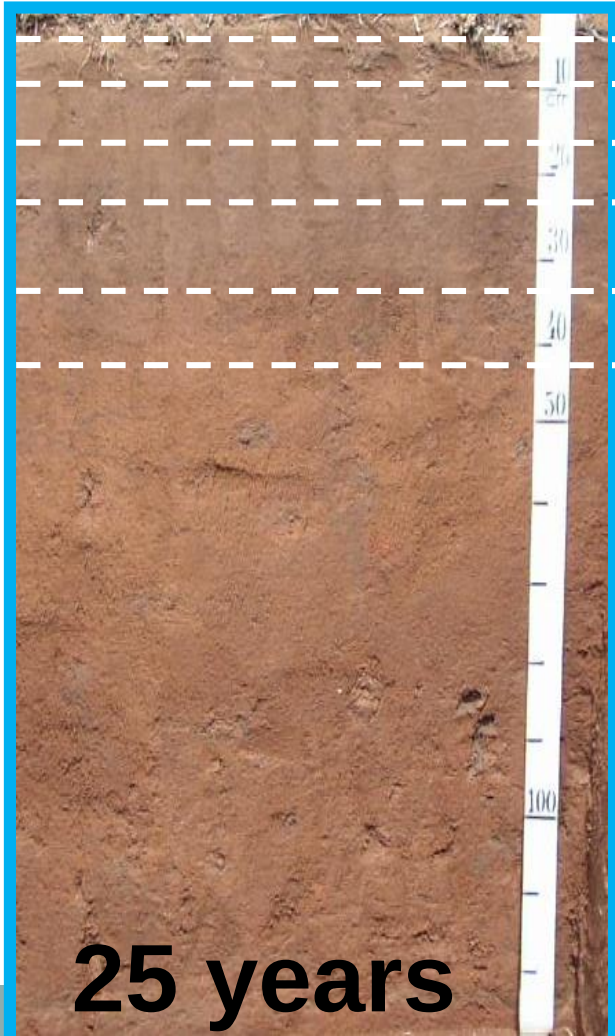
The aggregates are formed in layers accordingly
with the crop residues replacement

Horizontal and vertical funky action

Soil organic carbon on the soil profile

CT

27 g kg⁻¹
25 g kg⁻¹
23 g kg⁻¹
19 g kg⁻¹
12 g kg⁻¹
8 g kg⁻¹



NT

55 g kg⁻¹
43 g kg⁻¹
32 g kg⁻¹
19 g kg⁻¹
11 g kg⁻¹
8 g kg⁻¹

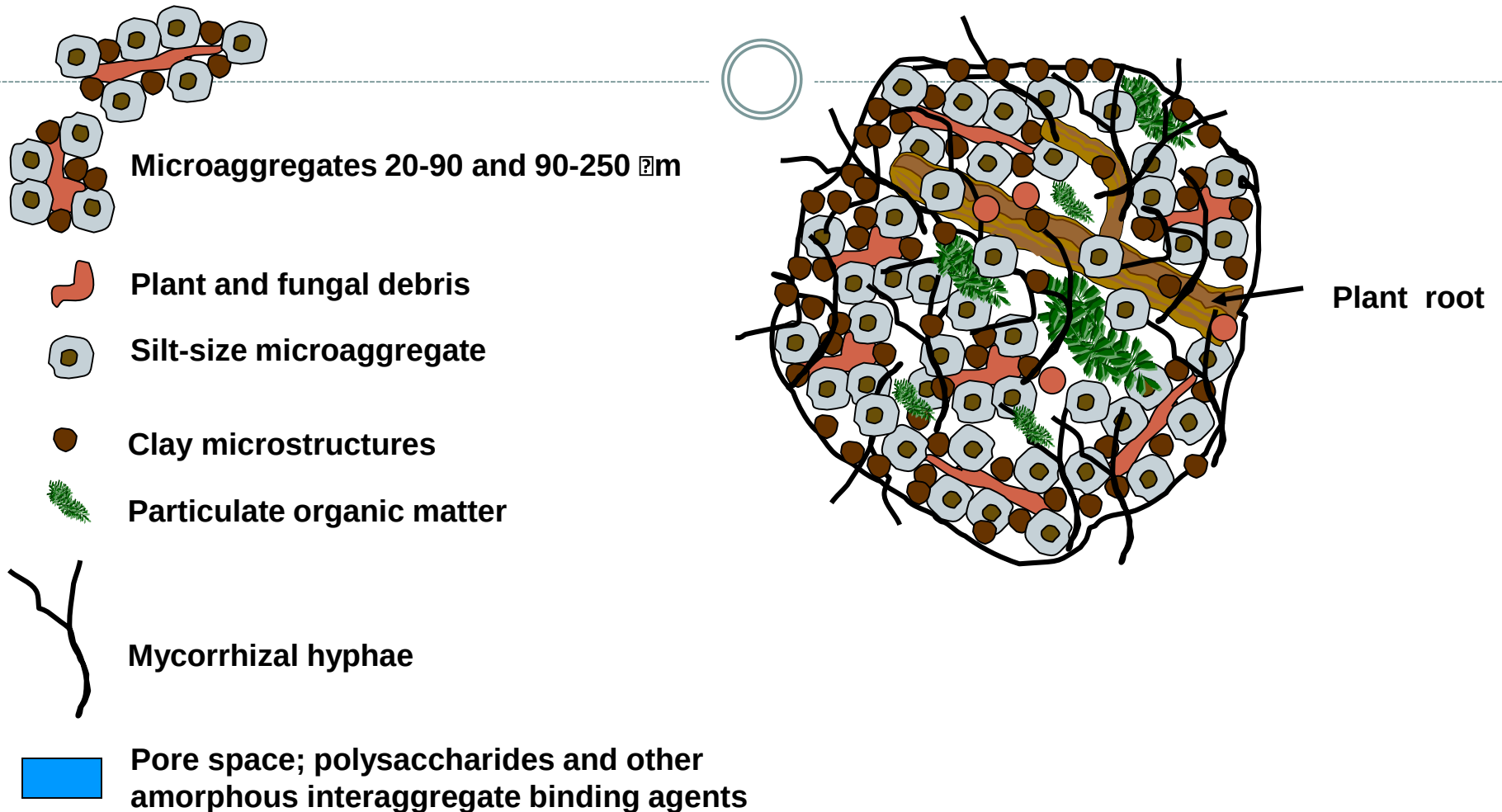


Understanding the aggregation in Conservation Systems with permanent cover crops





Microaggregates-macroaggregates model

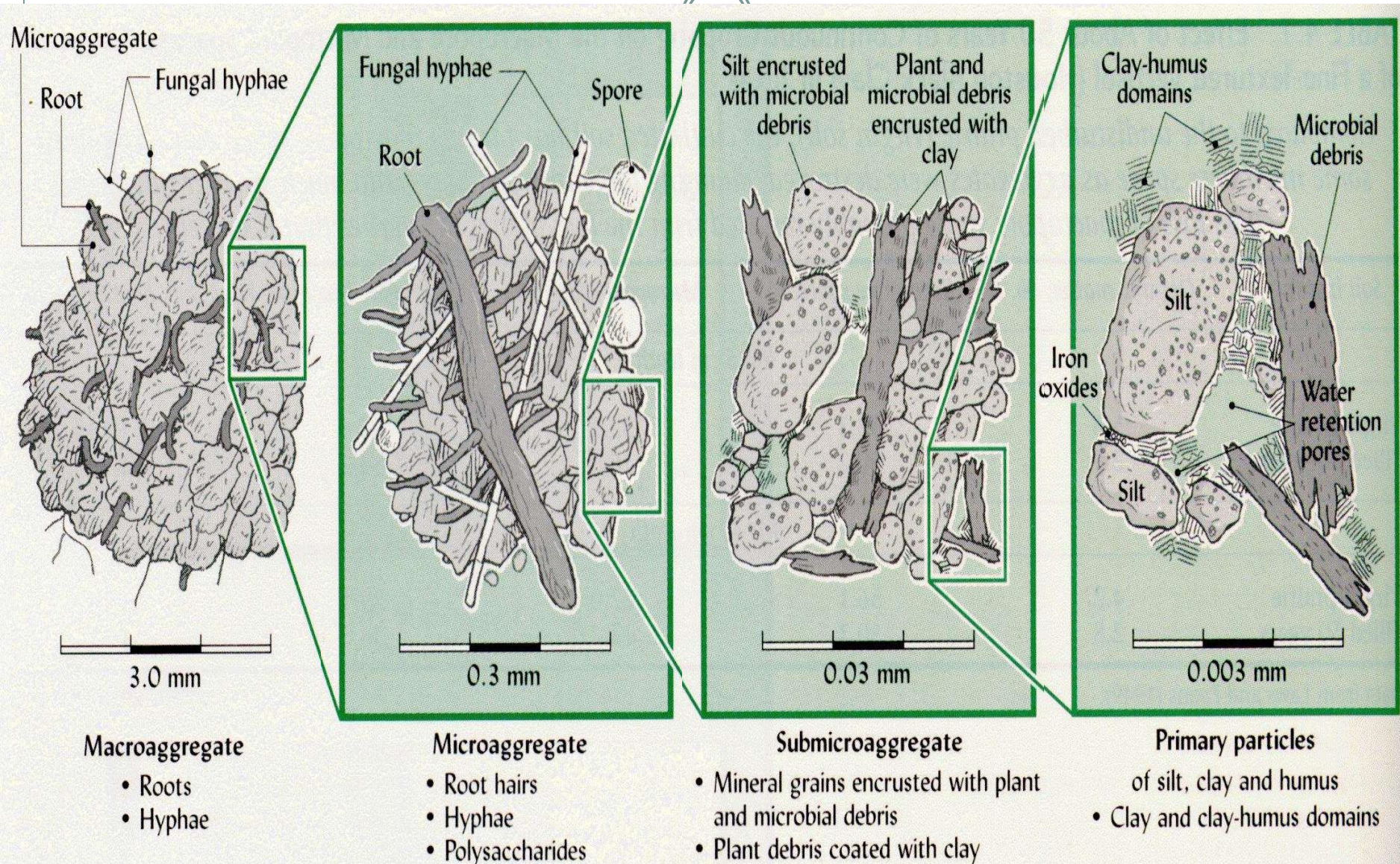


Adapted from Jastrow and Miller, 1997

Slide from Dr. Charles Rice Presentation - Argentina

Macroaggregate model and hierarchy

(Tisdall & Oades, 1982)

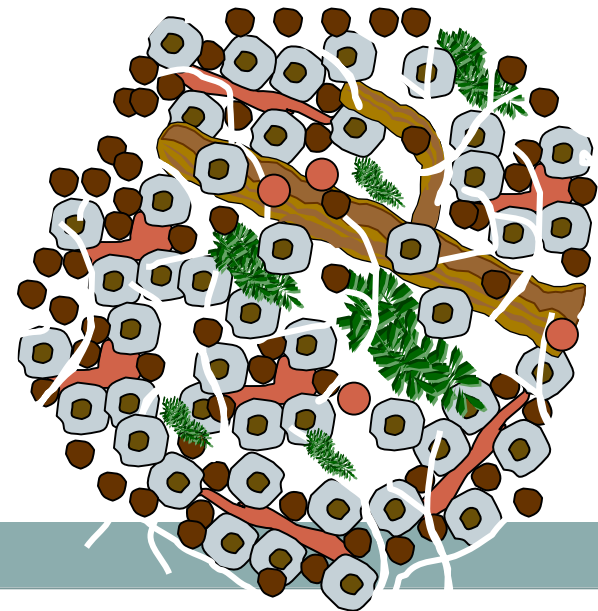
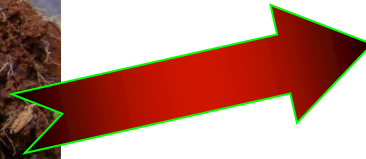


Aggregates

- Macroaggregates

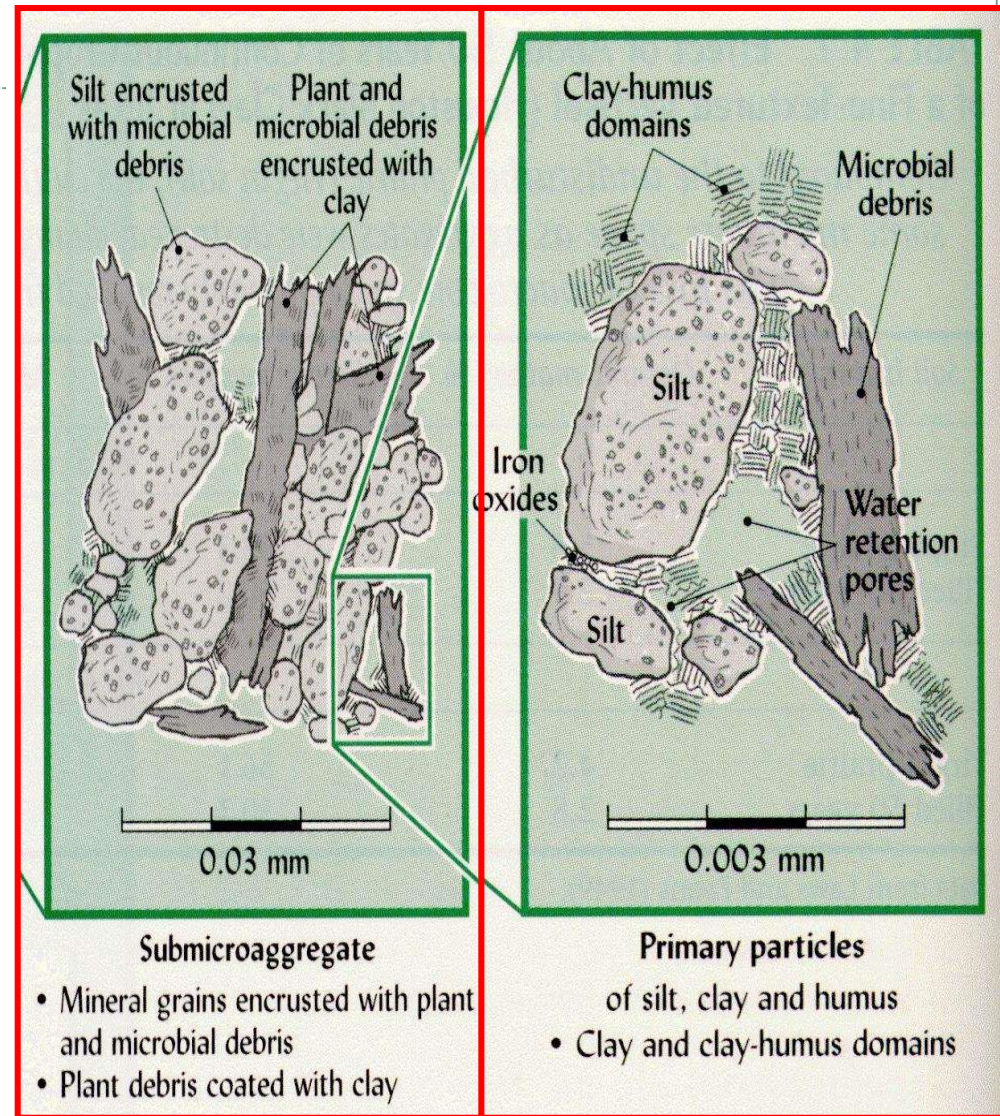


- Binding between microaggregates
- Weak binding than microaggregates
- Easily disrupted
- On the field are affected by soil management system

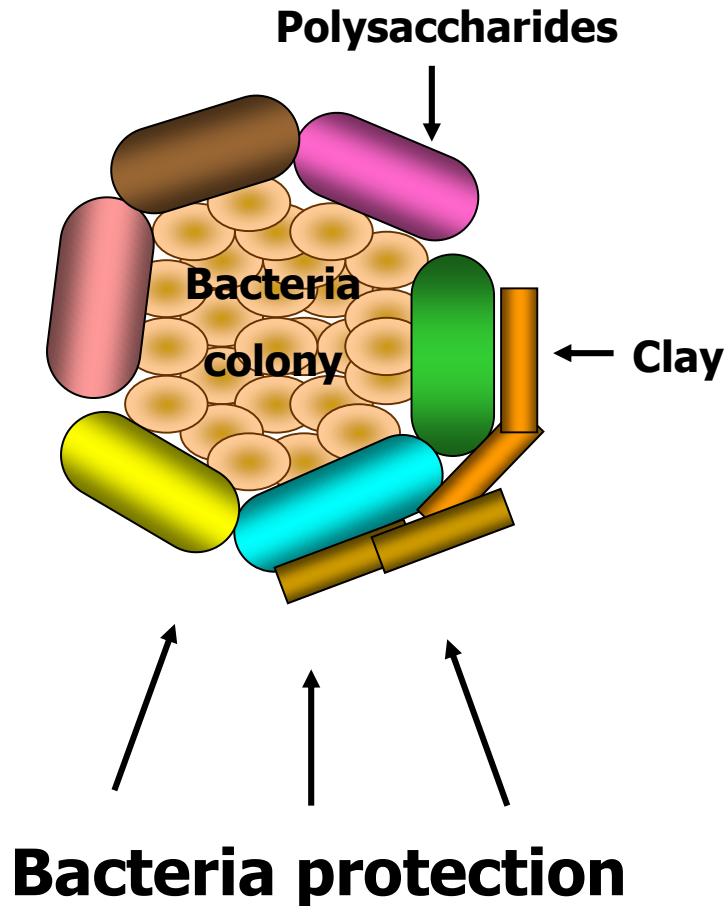


Microaggregates (Diameter < 250 μm)

- ✓ The SOM is linked and is protected by long time (> 1000 years)



Microaggregates formed by bacteria



Foster, 1983 - cells and bacteria colonies are enclosed for polysaccharides capsules, being parallel the enclosed capsule and aligned by clay particles in the wall cells, forming an aggregate

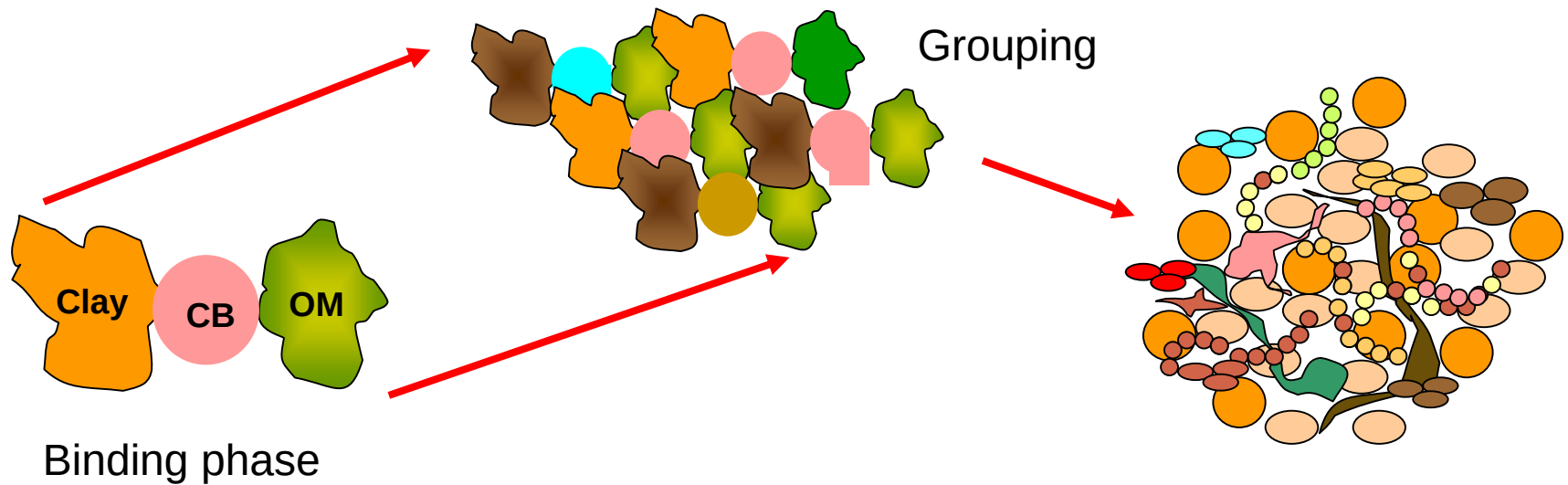
40 to 60% of the soil microbial biomass can be associated with the microaggregates from 2 to 20 μm , depending on the amount and clay type

Robert e Chenu, 1992 - 90% of the bacteria content is linked to clay mineral

The biomass apparently died due to the dry soil can retake growth with the wetting.

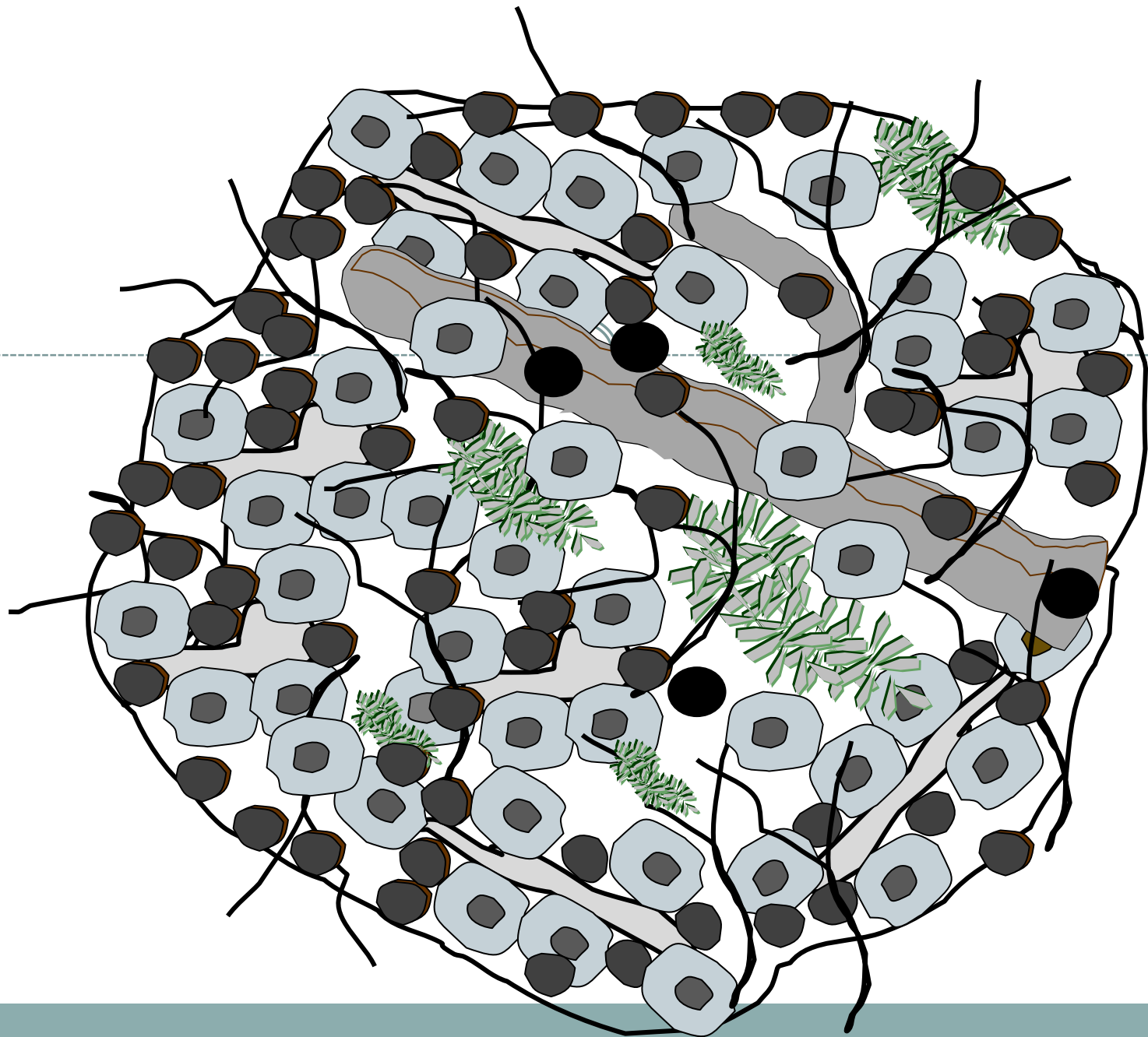
Microaggregates (20 to 250 μm)

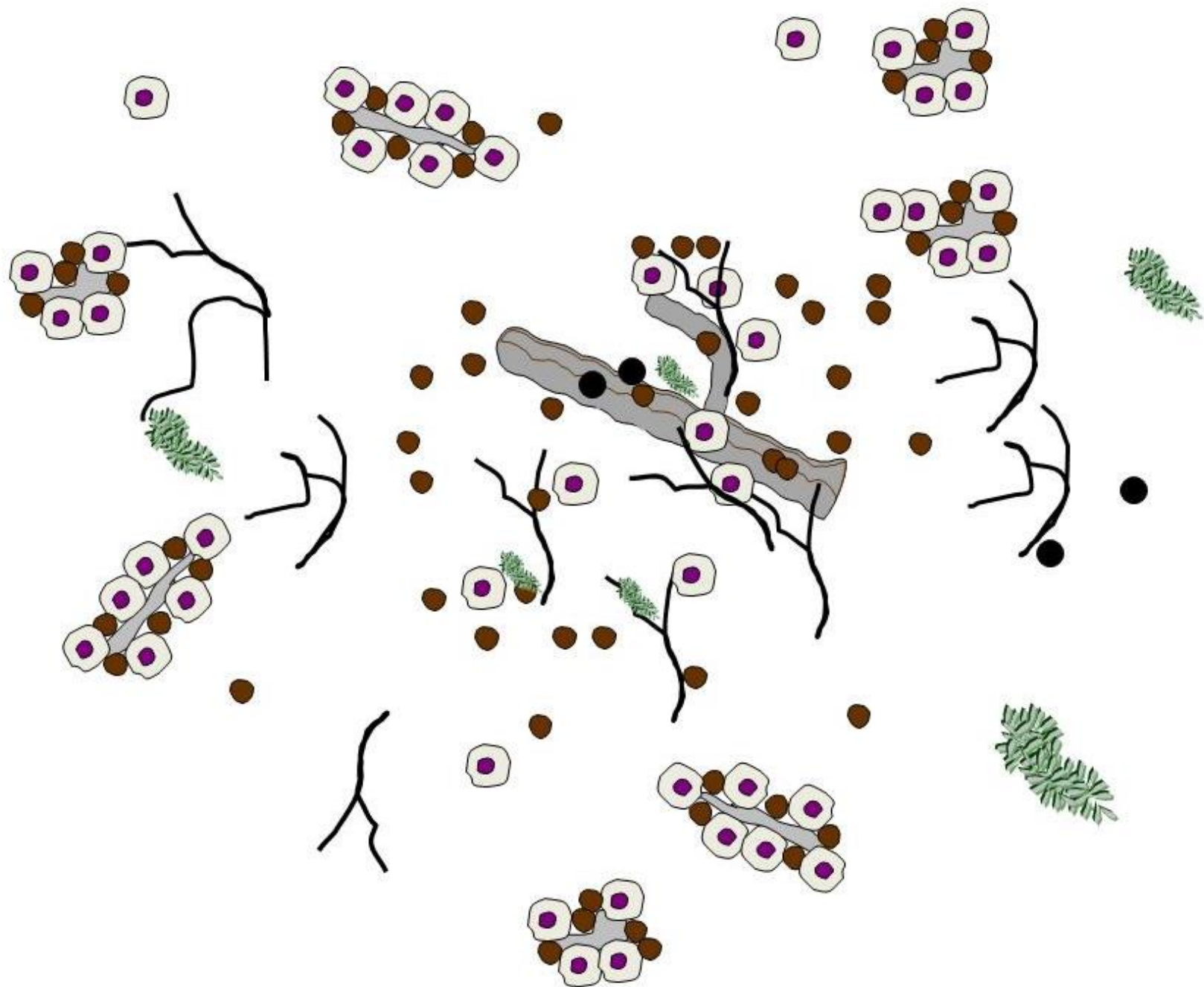
Formed through the union of particles or microstructures
smaller than 20 μm

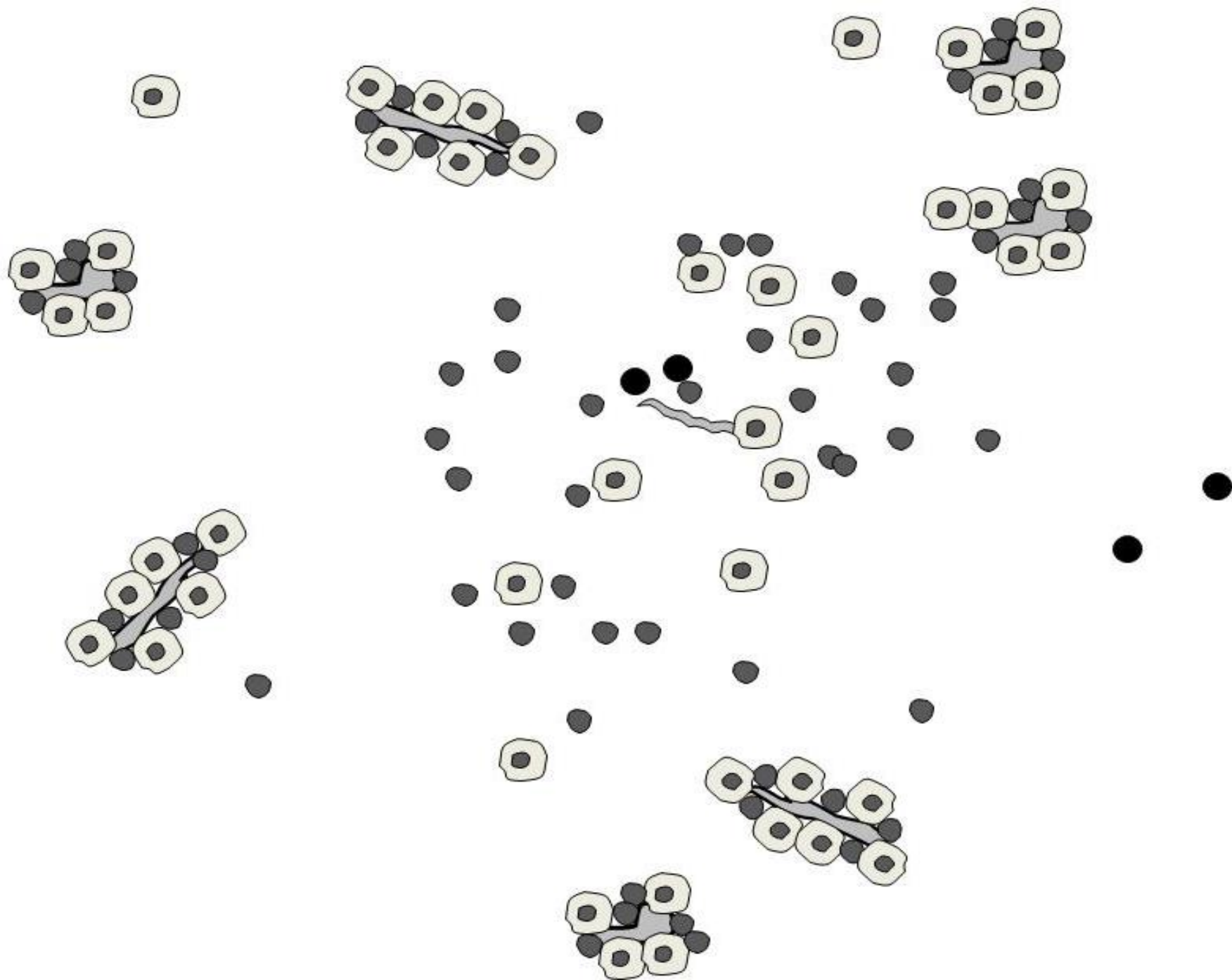


**Linked for fungus debris, crystalline oxides and aluminosilicates
highly disordered**

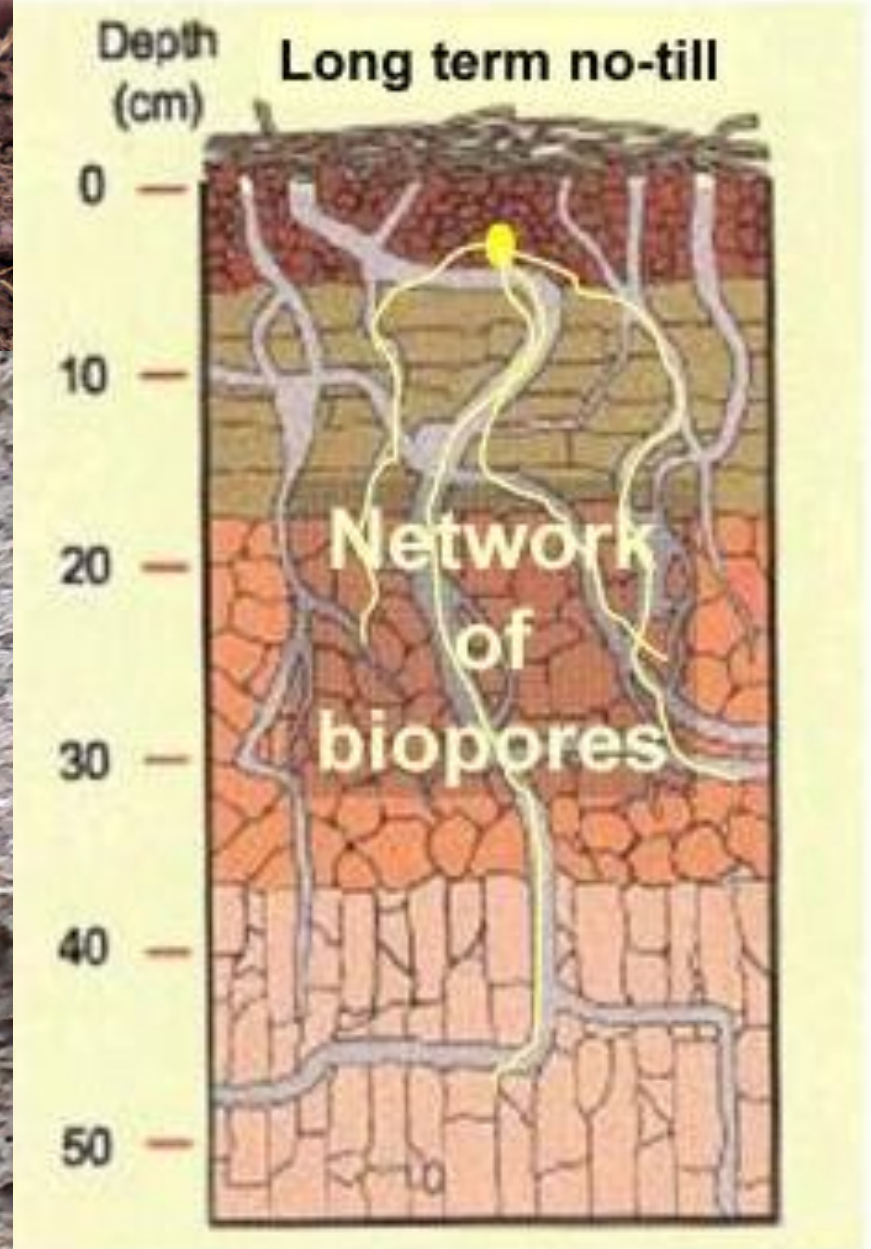
Organic matter little decomposed (high C/N ratio and high concentration of the O-Alkyl-C). In some soils, particles of that size can be easily eroded, when great amount of organic matter is removed.







Effet de l'AC sur la vie dans le sol

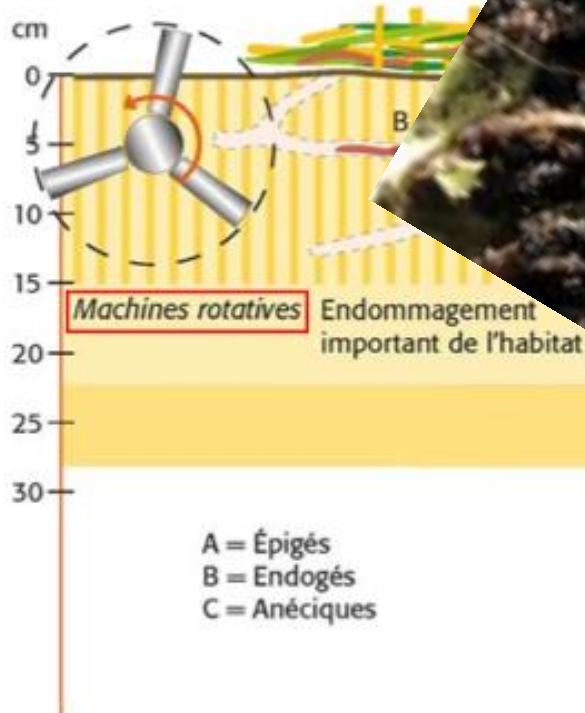


Effet du travail du sol sur la biomasse des lombrics



Travail du sol intensif

Mortalité des vers de terre jusqu'à env. 70 %



Travail du sol moyennement intensif

Mortalité des vers de terre jusqu'à env. 25 %



Graphique: Lukas Pfiffner, Claudia Kirchgraber

Results and Discussion

Results of this study were given in the table below (table 1).

Cropping season	Treatment	Grain yield (kg/ha)		TDM (kg/ha)		WUE-g (kg/ha/mm)		WUE-b (kg/ha/mm)	
		W/W	W/F	W/W	W/F	W/W	W/F	W/W	W/F
2007-2008	CA	2800 ^a	3100 ^a	6900 ^a	7500 ^a	7.36 ^a	8.15 ^a	18.15 ^a	19.73 ^a
	CoA	2600 ^b	3300 ^b	6300 ^b	7950 ^b	6.19 ^b	7.85 ^b	15.00 ^b	8.92 ^b
	LSD _(0.05)	175	193	266	320	0.15	0.28	1.13	1.41
2008-2009	CA	3200 ^a	3420 ^a	7600 ^a	8050 ^a	8.08 ^a	8.50 ^a	19.00 ^a	20.12 ^a
	CoA	3000 ^b	3460 ^a	7250 ^b	8100 ^b	6.66 ^b	7.55 ^b	16.15 ^b	18.00 ^b
	LSD _(0.05)	192	210	320	460	0.36	0.42	1.32	1.18
2009-2010	CA	3050 ^a	3430 ^a	7300 ^a	8080 ^a	7.14 ^a	8.09 ^a	17.38 ^a	19.23 ^a
	CoA	2980 ^a	3640 ^a	7280 ^a	8250 ^a	6.52 ^b	7.82 ^a	15.82 ^b	7.93 ^b
	LSD _(0.05)	160	202	380	500	0.41	0.38	0.95	1.22

CA: Conservation agriculture; CoA: Conservation Agriculture; W: Durum wheat; F: Faba bean; TDM: Total Dry Matter; LSD: Least Significant Difference

Cheikh M'hamed et al., 2014

Crop rotation	EUE-MST (kg m-3)			
	2013-2014		2014-2015	
	CA	CovA	CA	CovA
wheat/vetch	1,52	1,40	2,40	2,08
wheat/Faba bean	1,41	1,46	2,27	1,98
Wheat:wheat	1,29	1,27	2,10	1,90

Cheikh M'hamed et al., 2017



Merci de votre attention