Resilience for Dairy (R4D) has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101000770

Agroforestry in dairy farming : how trees contribute to more resilient systems ? Results from the French R&D

Brendan Godoc (Idele – RMT AgroforesterieS)
Yasmine Kadiri (INRAE – UE FERLUS)

Webinar

06/06/2024

Agroforestry in dairy farming : how trees contribute to more resilient systems ? Results from the French R&D

1. Large overview and research results on how trees provide services in a dairy farm

   Brendan Godoc (Idele – French Livestock Institute)

2. Using trees as a source of fodder - OasYs experimental farm

   Yasmine Kadiri (INRAE)

Part of the French R&D network on agroforestry

RMT AGROFORESTERIES

applied and fundamental research institutes, chambers of agriculture, farm advisors, schools, etc..

Resilience 4 for Dairy

Agroforestry: a new word for an old practice

ALLEY CROPPING in grassland in a dairy farm © A. Deltour / CA Nord Pas-de-Calais

HEDGEROWS – "BOCAGE" France © DRAAF Bretagne

"CUT AND CARRY" FODDER TREES Brazil : dairy cattle eating *Opuntia ficus-indica* cactus © J.C.Dubeux / UFRPE

SYLVOPASTORALISM France : dairy heifers in a forest © CA Lozère

GRAZED ORCHARDS France : dairy cattle in a "pré-verger" © E. Préro

POLLARDED TREES – *France: "Ragosses" in a grassland in Bretagne* © B. Godoc / Idele

How many agroforestry dairy systems in France ?

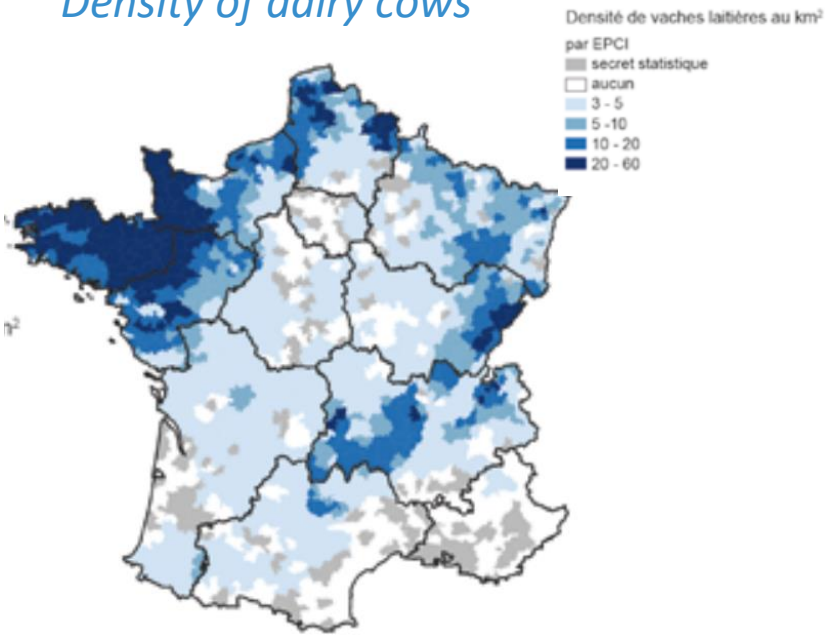
From the 2020 agricultural census, out of 50 000 dairy farms:

- 700 farms declare performing « *agroforestry* » on average on 4,7 ha (in alley cropping ?)
- 3500 farms perform *sylvopastoralism* according on the crop codes* they declare for CAP payments

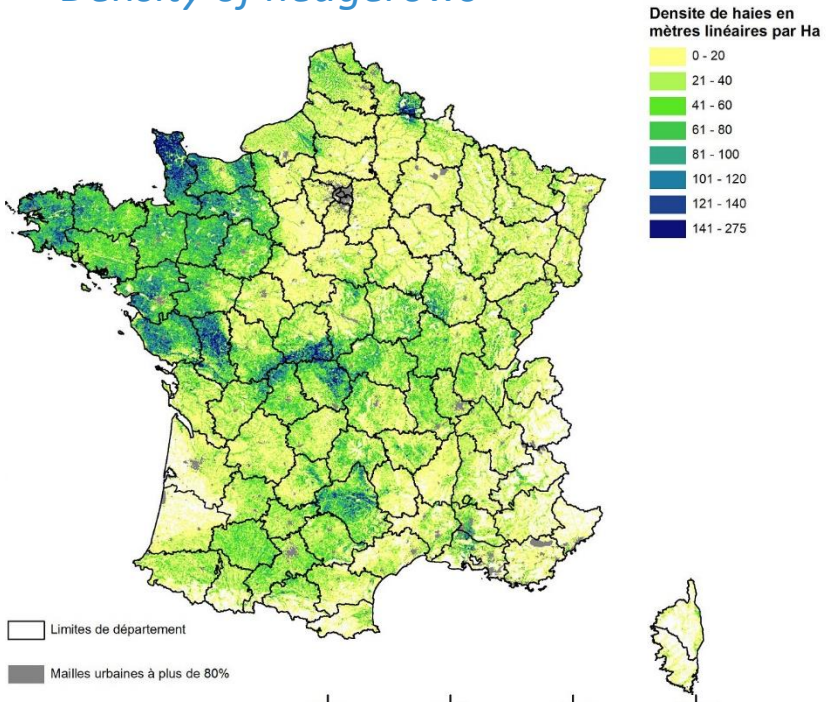
+ thousands of agroforestry dairy farms “by nature” ?

(Source: RA2020, RPG2020, treatment: Idele, (*codes: BOP, CEE, CAE and SPL))

Density of dairy cows



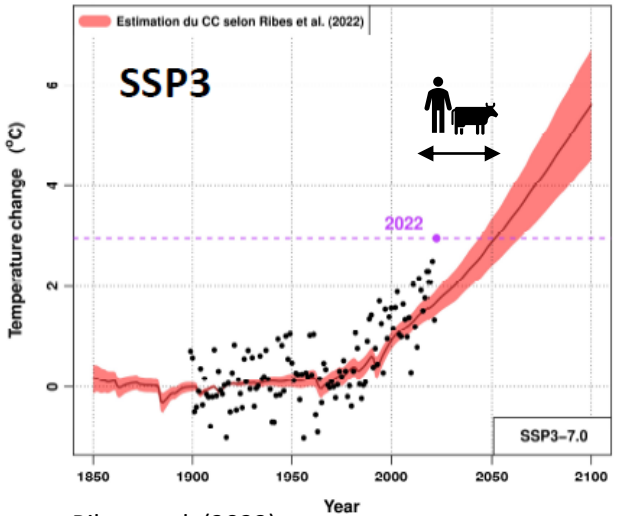
Density of hedgerows



Source: RA 2020 (left), OFB/IGN (right)

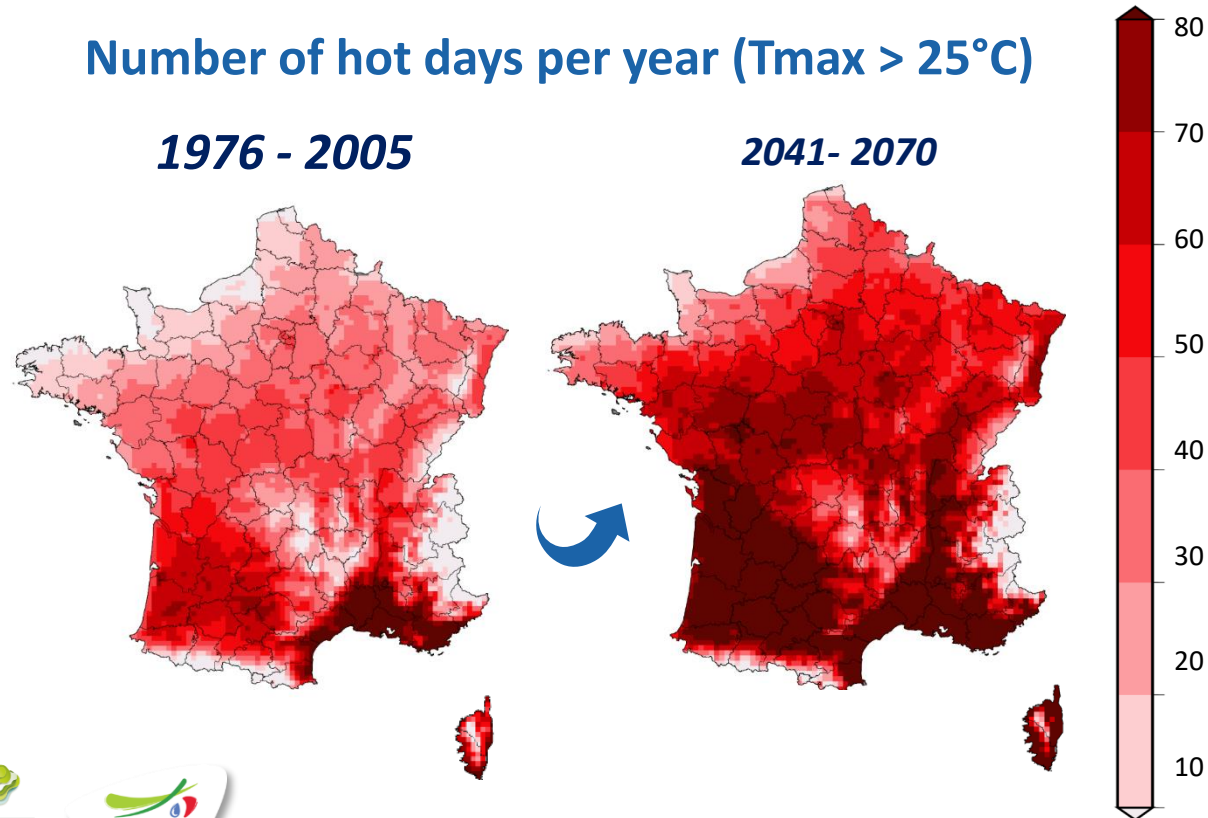
The challenge of climate change

Predicted and observed mean temperature change in France



Ribes et al. (2022)

Number of hot days per year (Tmax > 25°C)



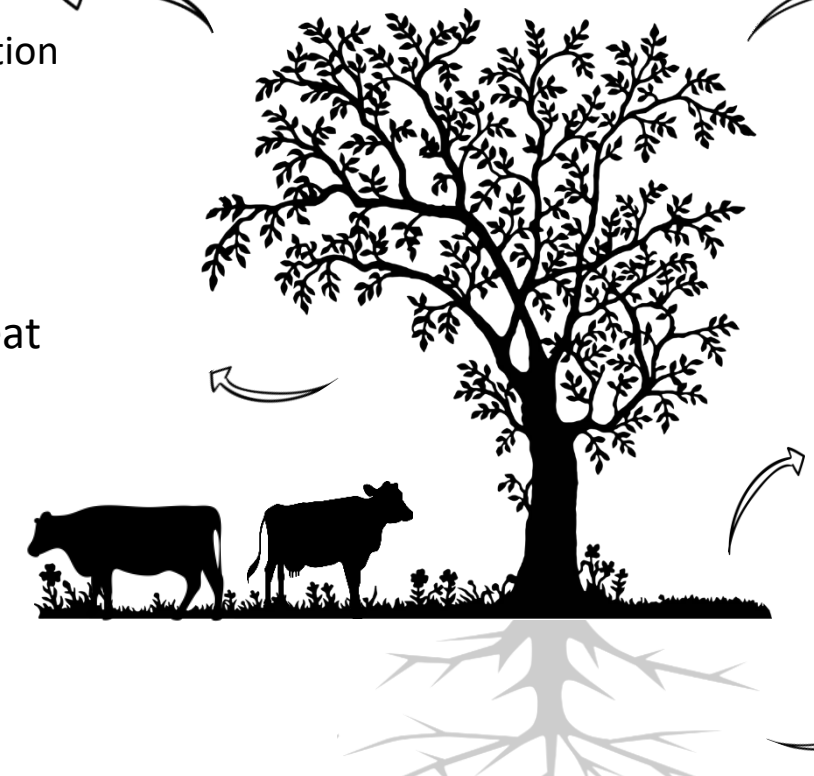
Annual mean - Référence passé et scénario RCP8.5 (Produit multi-modèles de DRIAS 2020 (médiane de l'ensemble))

Why are trees useful for dairy farmers ?

Other types of production (wood, fruits)

Source of fodder

➔ Yasmine



Animal heat comfort

Agronomic services

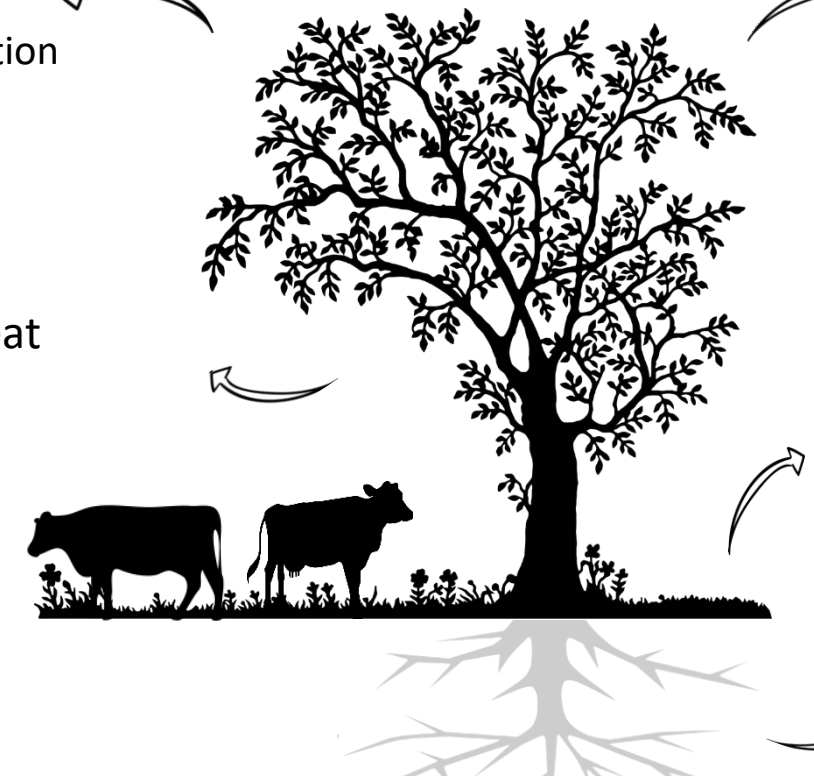
Environmental services and other externalities

Why are trees useful for dairy farmers ?

Other types of production (wood, fruits)

Source of fodder

➔ Yasmine



Animal heat comfort

Agronomic services

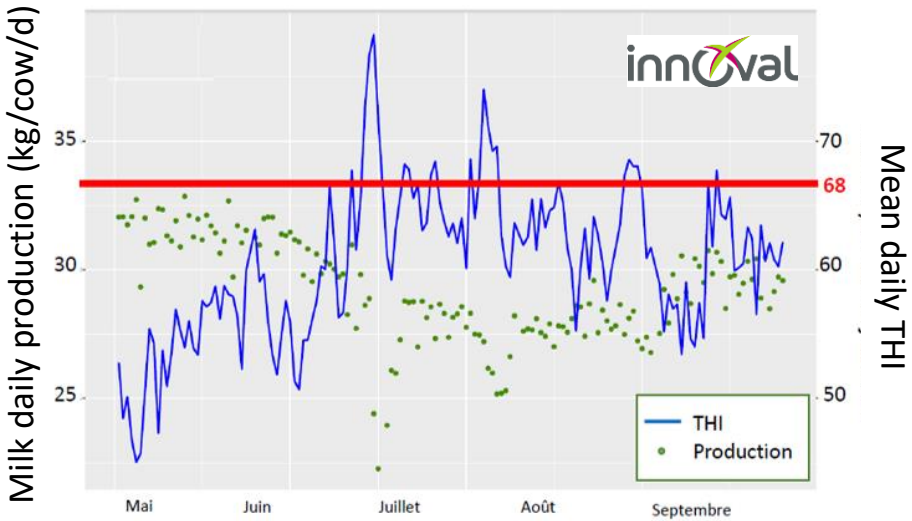
= The first and foremost interest cited by livestock farmers
(Moreau et al. 2020)

Environmental services and other externalities

Heat stress for a dairy cow

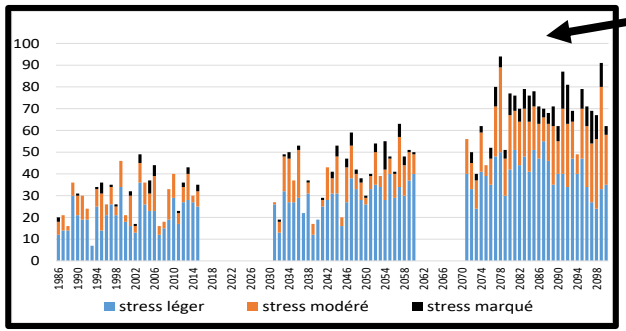
Combined to calculate the THI : « Temperature Humidity Index »

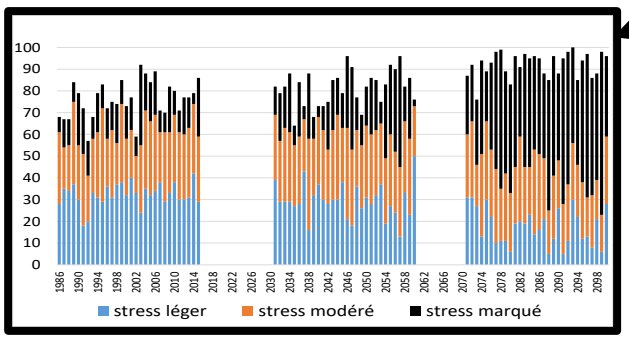
Dairy herd in Britany (west of France) in 2019

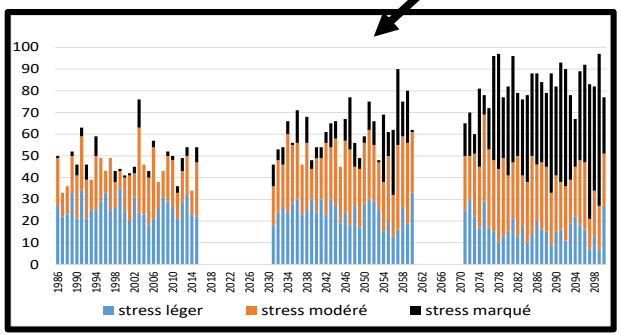


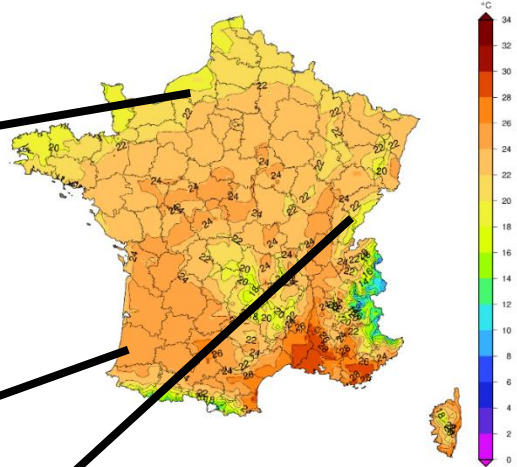
+ other consequences…

THI evolution in the future (RCP 8.5)





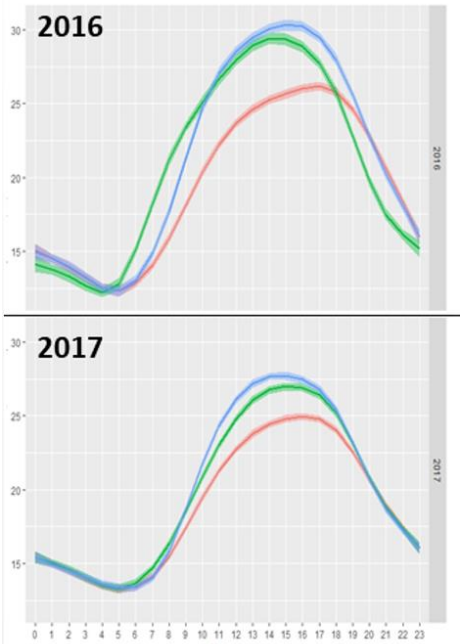




Mean of tMax over July (Drias 1976-2005)

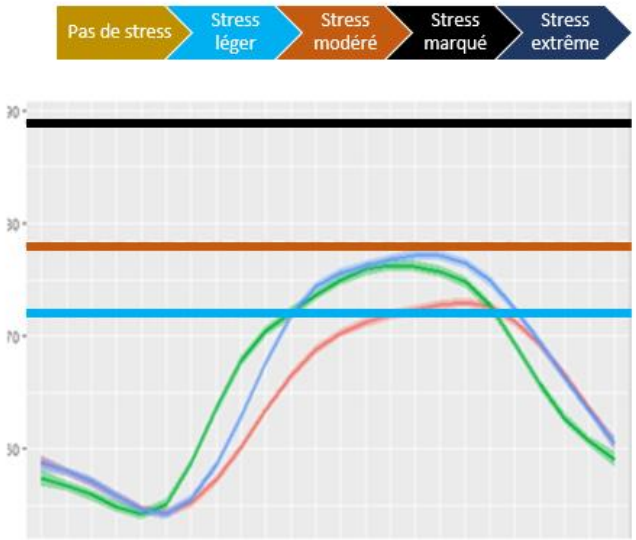
Traitements J-C Moreau (Idele)

A weather buffer



Mean temperature throughout the day

In the grazed orchard at 1 m
Between rows
On the control grassland with no trees



THI = 88
Heavy heat stress

THI = 78
Moderate heat stress

THI = 72
Light heat stress

THI evolution throughout the day

2°C on average over the month below the trees, up to - 6°C during a hot day

C Beral et J-C Moreau (2018)

The air-conditioned room ?

In July 2022 – North of France

43,1°C -9,8°C 33,3°C

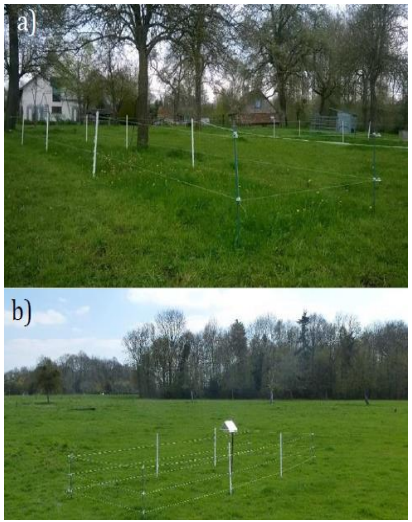
Source: A. Deltour (CA N-PdC)

Trees by a cowshed ?

Positive influence

D'après J Capdeville et Morgane Lambert

Agronomic services



yields	By the tree – competition for light and water At the plot scale : no impact – wind belt effect ?	density ➔ Stay below 50 trees/ha
phenology	Production curve that is lagged → Function of species and density of shade	
Feed value	Better feed value	
botany	Less legumes Other species	

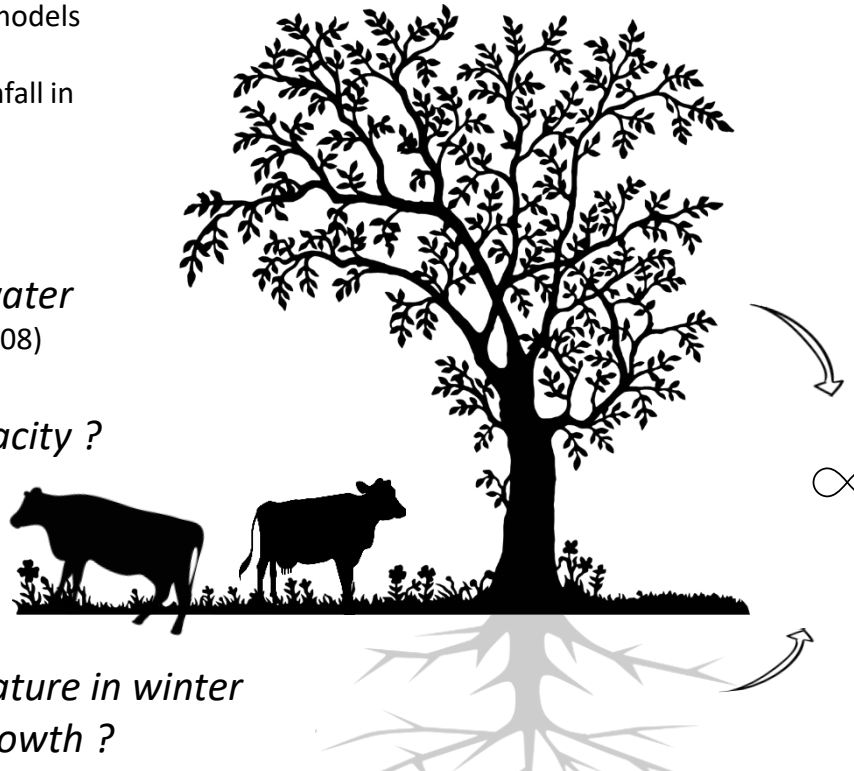
Architecture and management

Agronomic services

Over the 21st century climate models indicate for France :
↗ rainfall in winter and ↘ rainfall in summer
↗ heavy rainfalls

A buffer for excess of water
See: Carnet (1978) Ghazavi (2008)

Better soil bearing capacity ?



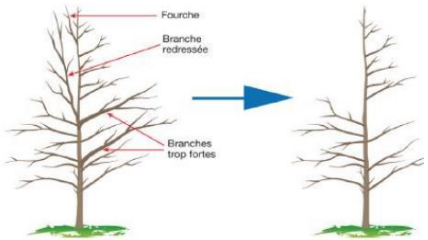
Nutrient circle

+ 1-2°C in temperature in winter
➔ *better grass growth ?*

➔ *To be further developed in research*
Careful : water competition in summer !

Other valorisation

Timber



Energy

For heating, transformation of milk or a drying barn ?

Fruits

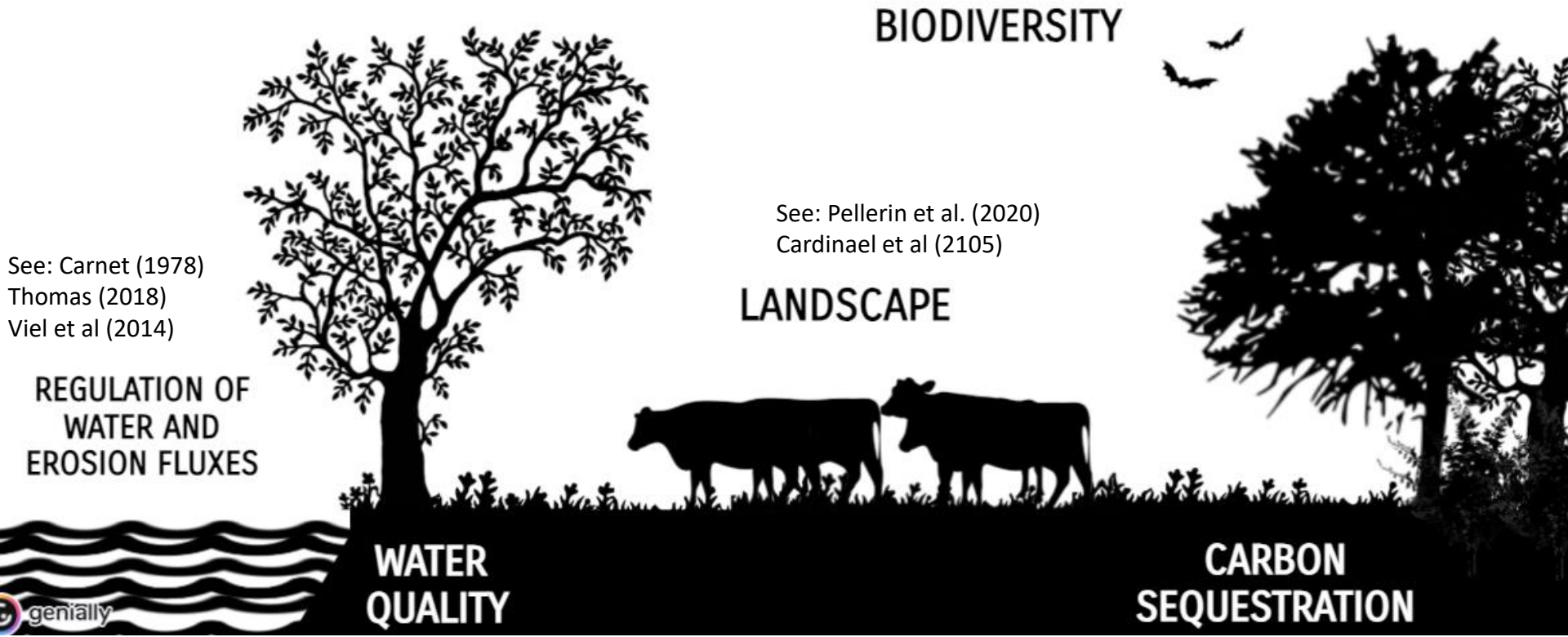
Wood chips for energy or litter

42,5 €/ton in autoproduction

Source: ferme expérimentale Blanche Maison

Other services :

See: Boinot (2019)
Leroux et al. (2008) PIRAT Project, INRA (2012)
Manneville et al. (2014)



See: Pellerin et al. (2020)
Cardinael et al (2105)

See: Carnet (1978)
Thomas (2018)
Viel et al (2014)

See: Carluer et al (2017) Thomas (2018)

See: Pellerin et al. (2020)
Cardinael (2015)
CARBOCAGE project (2018)

Thank you for your attention

Please visit : https://rmt-agroforesteries.fr/groupes-de-travail/elevage/

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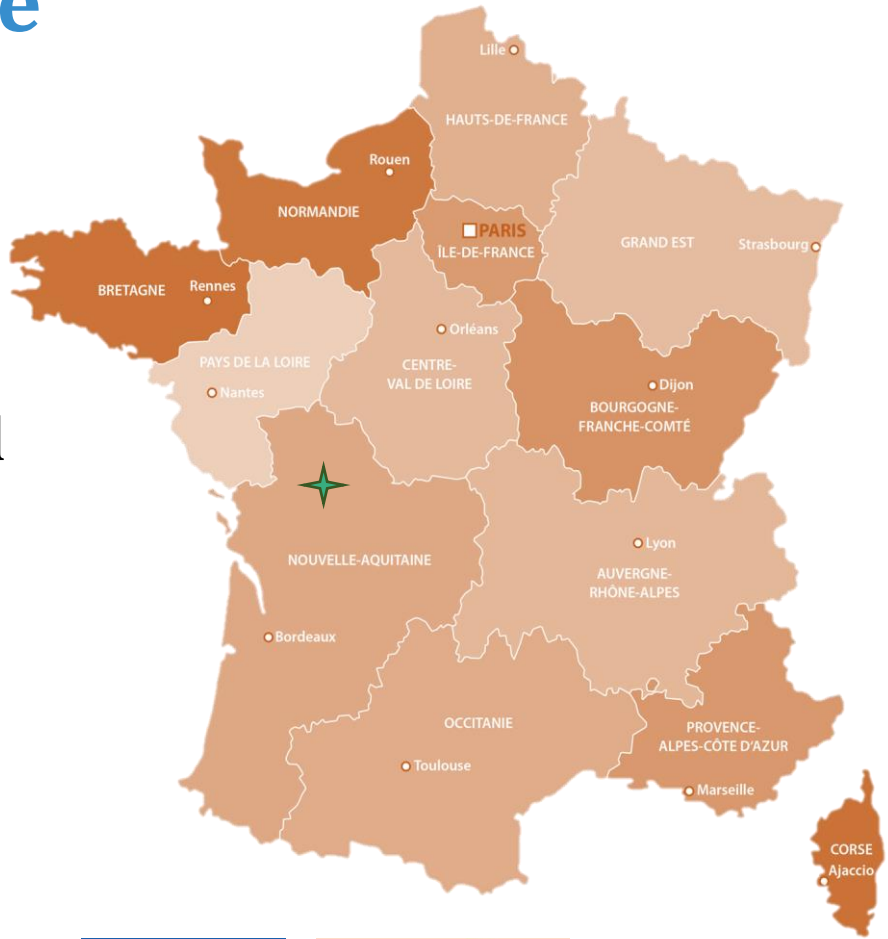
Yasmine Kadiri
INRAE UE Forage Environment Ruminant

Lusignan - France 06/06/2024

OasYs: an agroecological dairy system adapted to climate change

- To permit farmers to live from their dairy system
- In a context of climate change
- While saving water and fossil fuel resources
- And contributing to a sustainable agriculture



OasYs: the farm

- Experimental Unit FERLUS
- Project start : 2013
- Project manager : Sandra Novak
- 72 3-breed crossbred dairy cows:
  - Holstein
  - Jersey
  - Viking red

Resilience 4 for Dairy

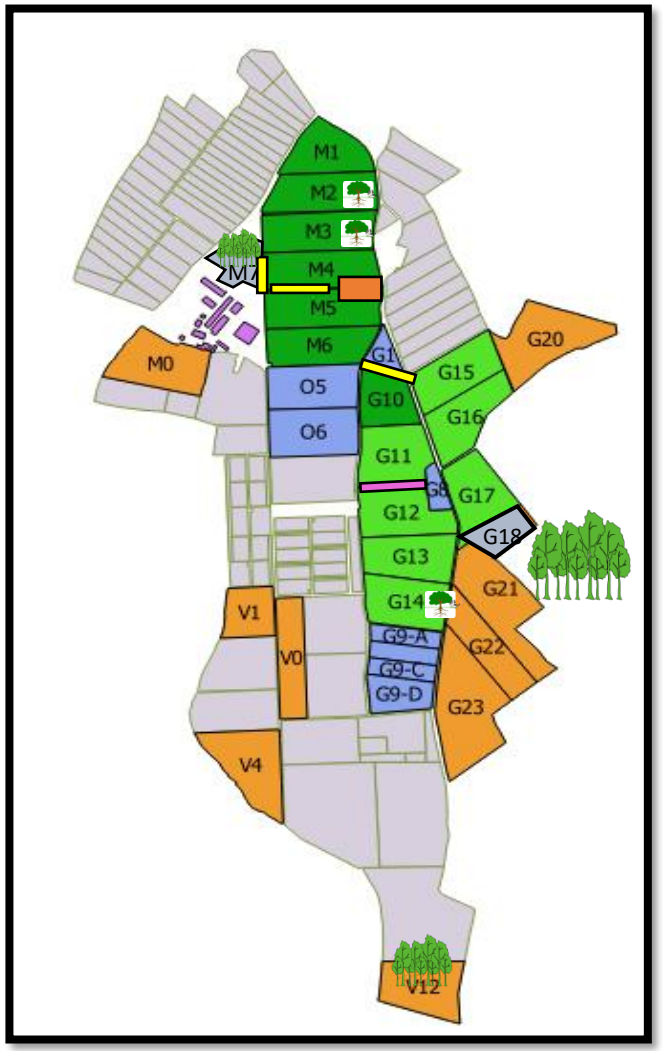
INRAE

FONDATION DE FRANCE

OasYs

OasYs: the farm

- 91 hectares of rotational meadows and crops
- 4 agroforestry plantations
- 3 arboretum
- 1 grove
- 1 wood

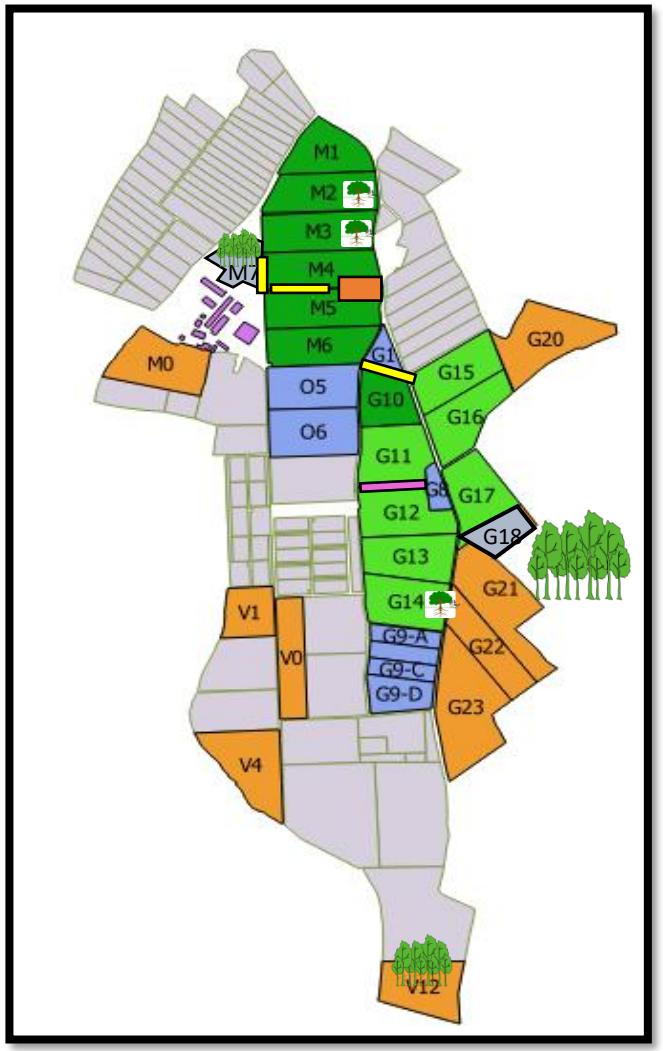


OasYs: the farm

- 91 hectares of rotational meadows and crops
- 4 agroforestry plantations
- 3 arboretum
- 1 grove
- 1 wood

Goal

Maximizing forage diversity to offset the effects of climate change



OasYs: agroforestry plots

Intra-parcel fodder pollards =forage

Intra-parcel fodder liana = forage

Intra-parcel multipurpose trees
= shade / forage

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OasYs

OasYs: agroforestry plots

Intra-parcel high stem trees
= wood

Arboretum
= species and pruning collection

Little wood
= shadow / wood

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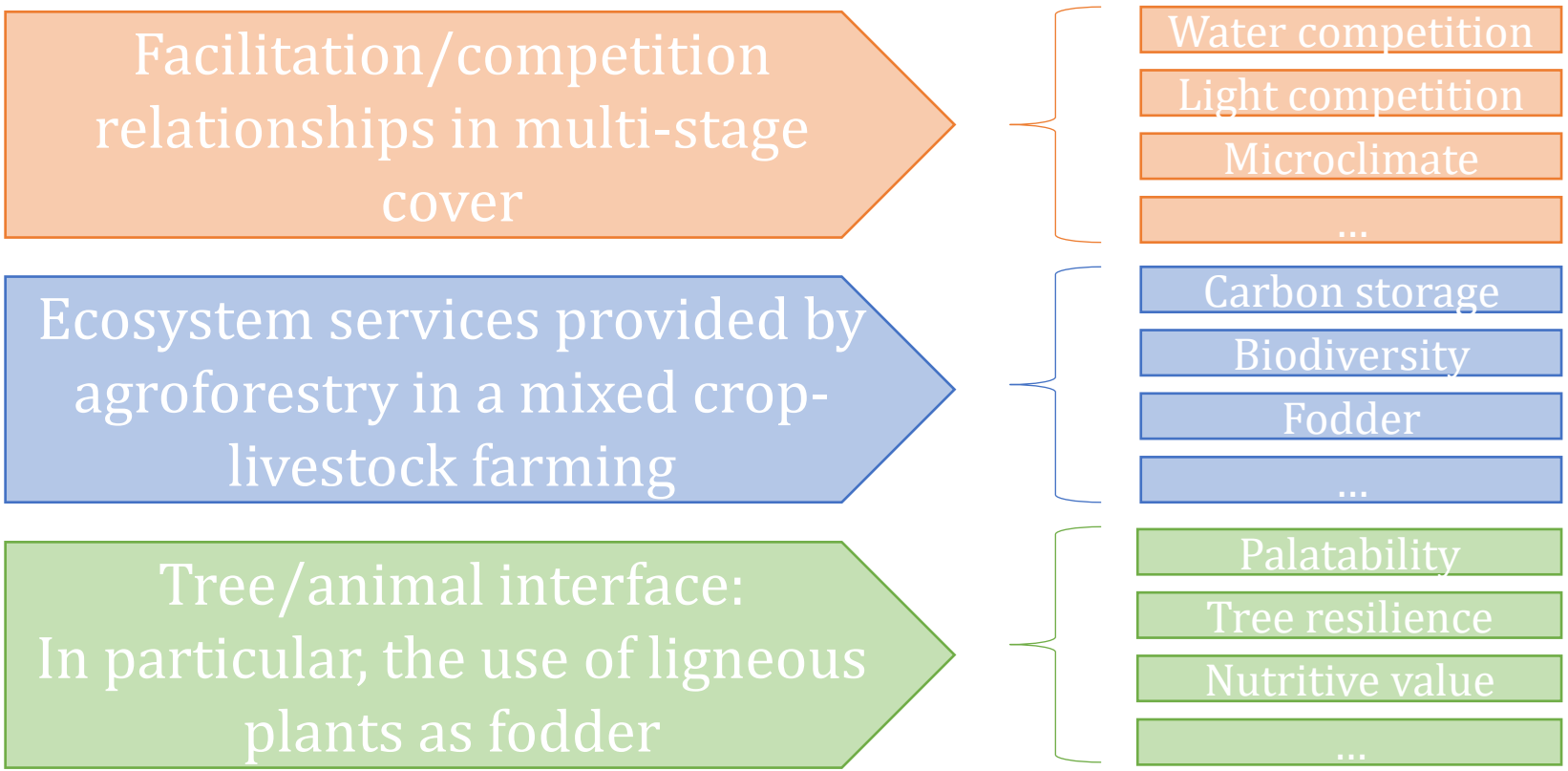
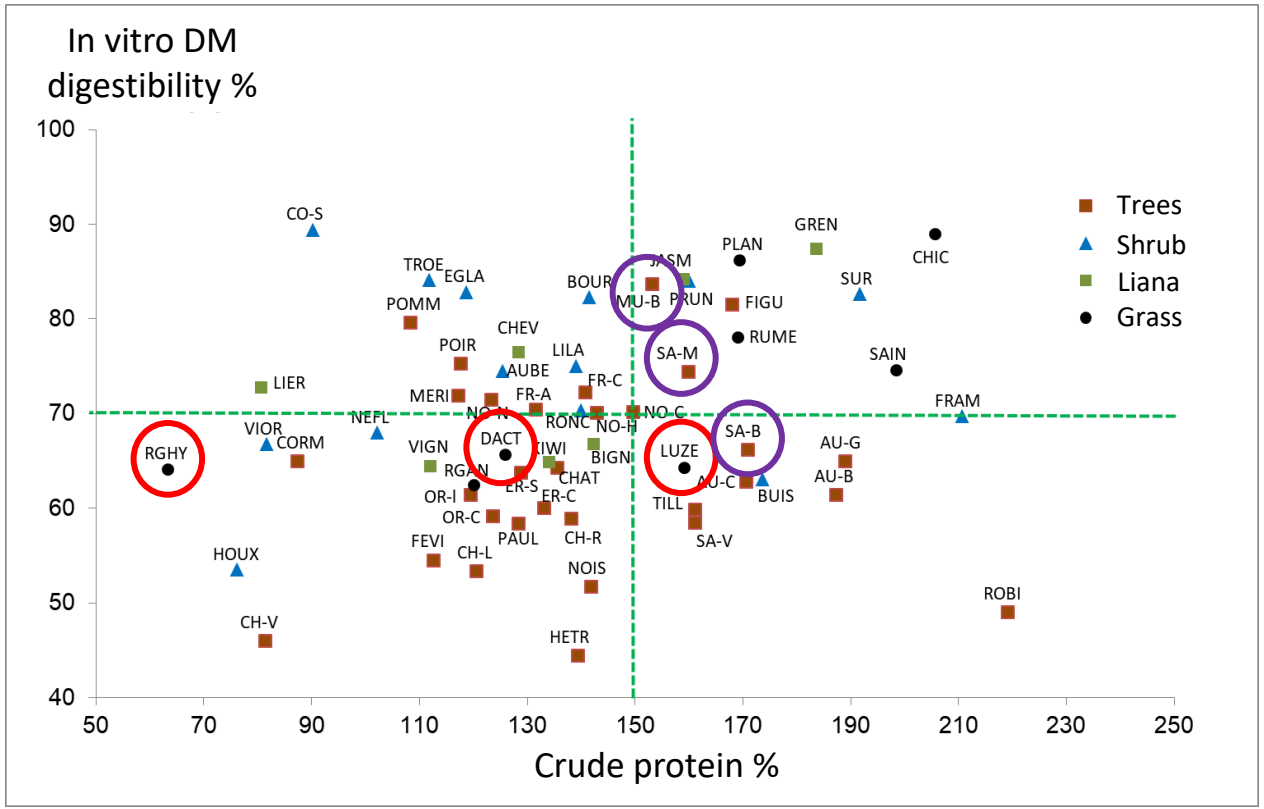
OasYs

OasYs: three research topics



OasYs: chemical compounds



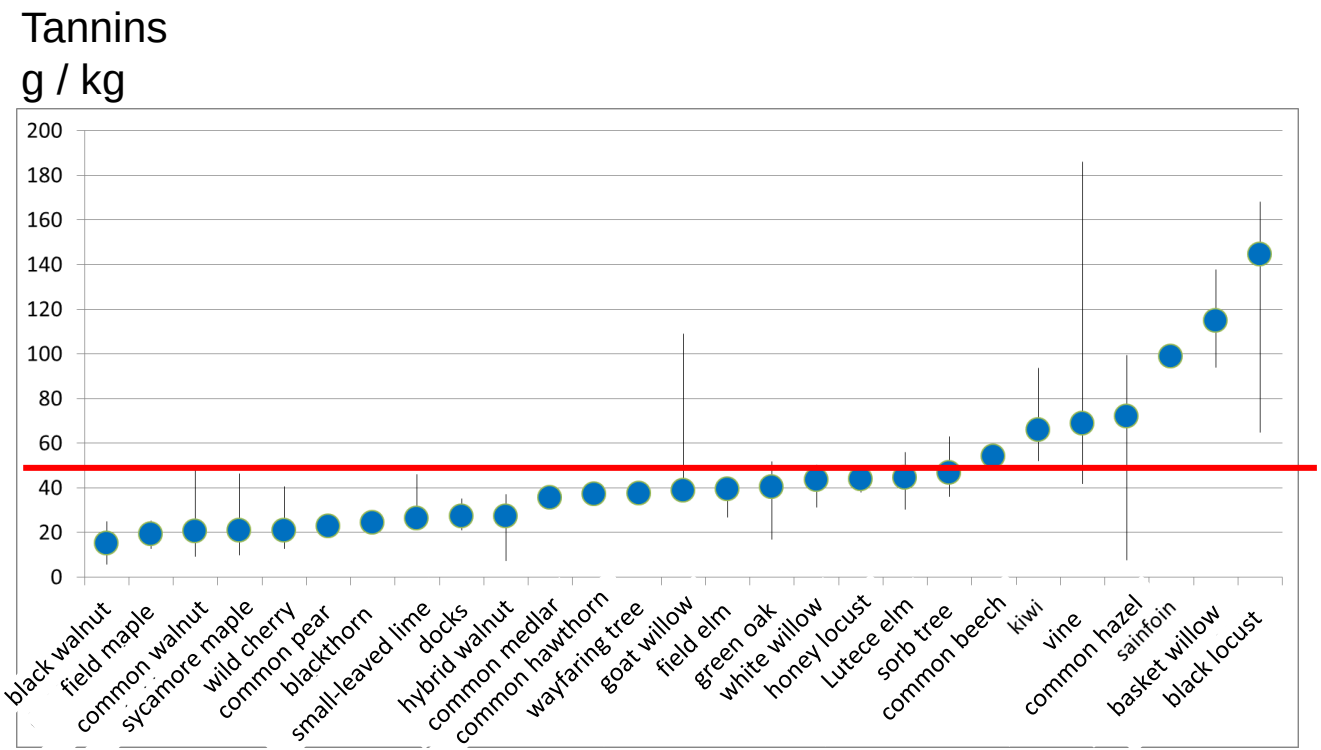
MU-B= White mulberry
SA-M= Goat Willow
SA-B= White Willow

LUZE= Lucerne
DACT= Dactyl
RGHY= Hybrid ryegrass

Crude protein:
MU-B and SA-M = LUZE

IVDMD:
MU-B and SA-M > LUZE

OasYs: chemical compounds



Anti-nutritional threshold

But tannins can be anti-metanogenic and anti-parasitic
→ Proportion in the ration

OasYs: chemical compounds

Phosphorus

corn (1,8 g/kg MS) et natural meadows (3 g/kg MS)

> 4 g/kg MS : black walnut, common medlar, wayfaring tree

Calcium

corn (2 g/kg MS) et leguminous fodder crops (14 g/kg MS)

> 30 g/kg MS : fig tree, white mulberry, small-leaved lime

Magnesium

corn (1,2 g/kg MS) et leguminous fodder crops (2,6 g/kg MS)

> 6 g/kg MS : fig tree, elder tree

Manganese

corn (24 mg/kg MS) et natural meadows (113 mg/kg MS)

> 350 mg/kg MS : fig tree, elder tree

Zinc

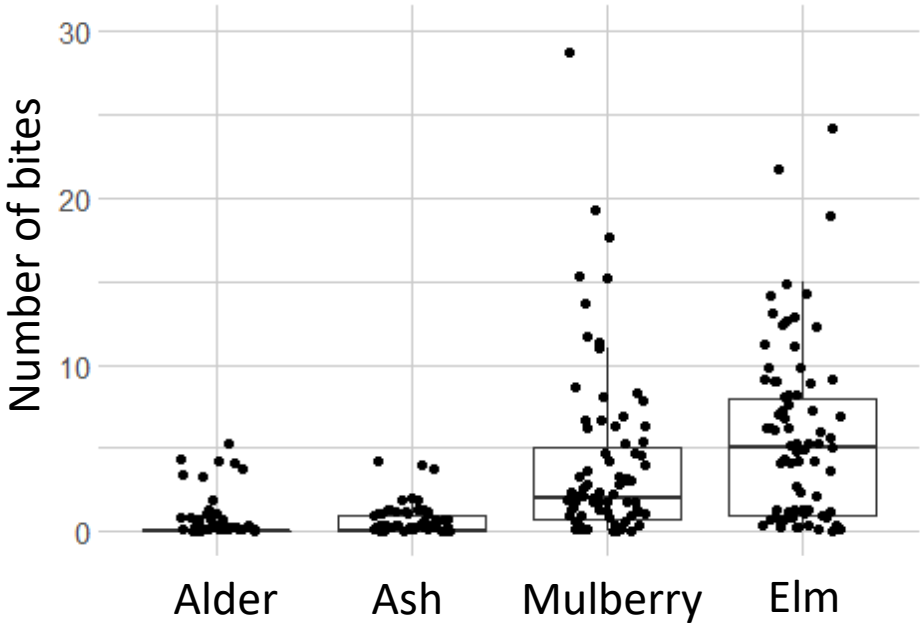
corn (20 mg/kg MS) et natural meadows (40 mg/kg MS)

> 50 mg/kg MS : white alder, field maple, basket willow, white willow

OasYs: feeding behavior

4 tree species tested:

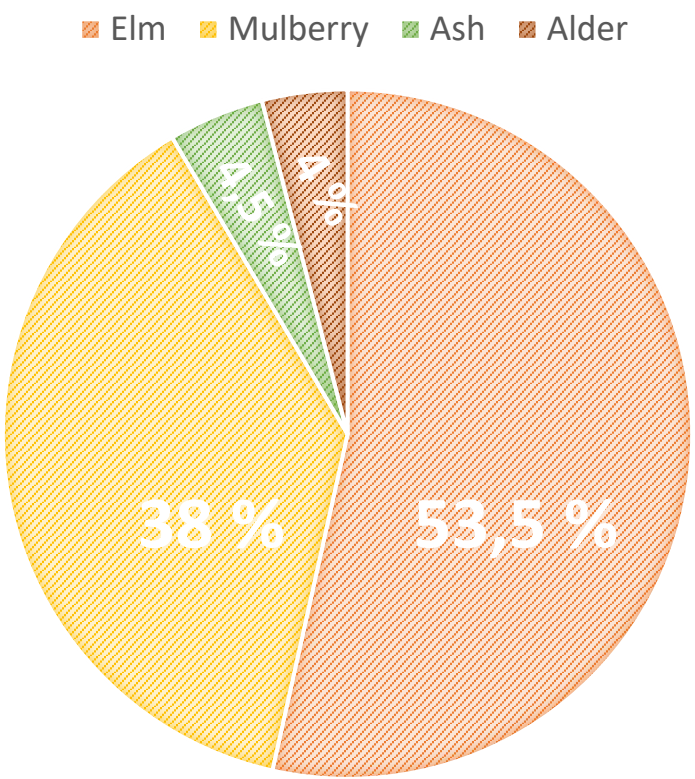
- Corsican alder
- Common ash
- White mulberry
- Lutece elm

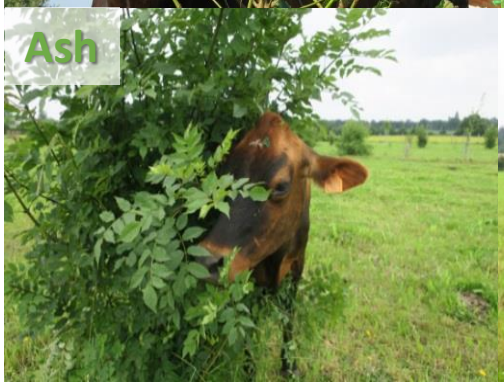


Elm > Mulberry > Ash > Alder

OasYs: feeding behavior

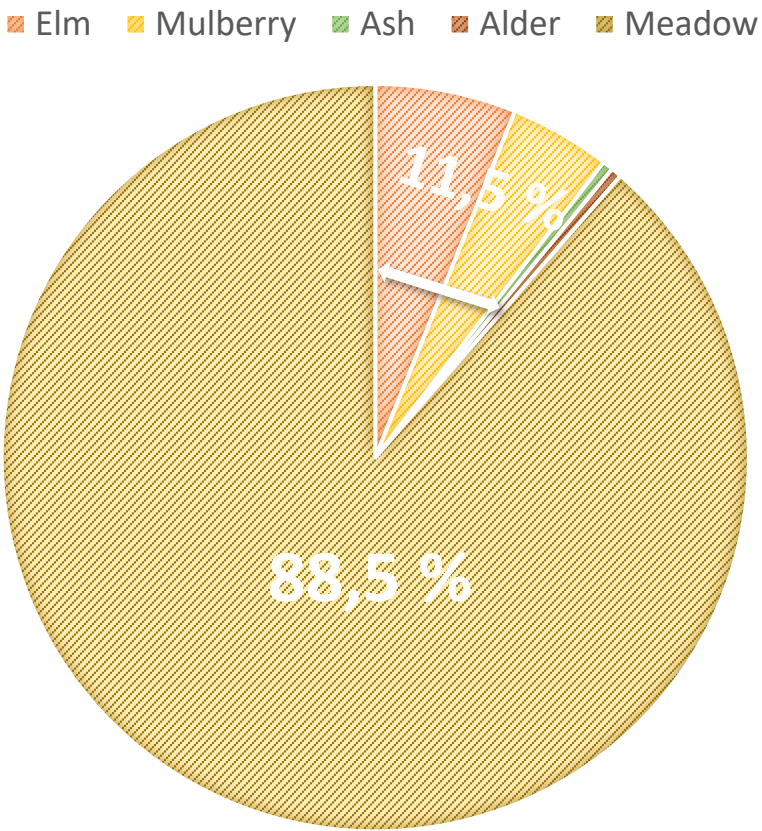
Trees
839 bites:
2021 : 467
2022 : 372

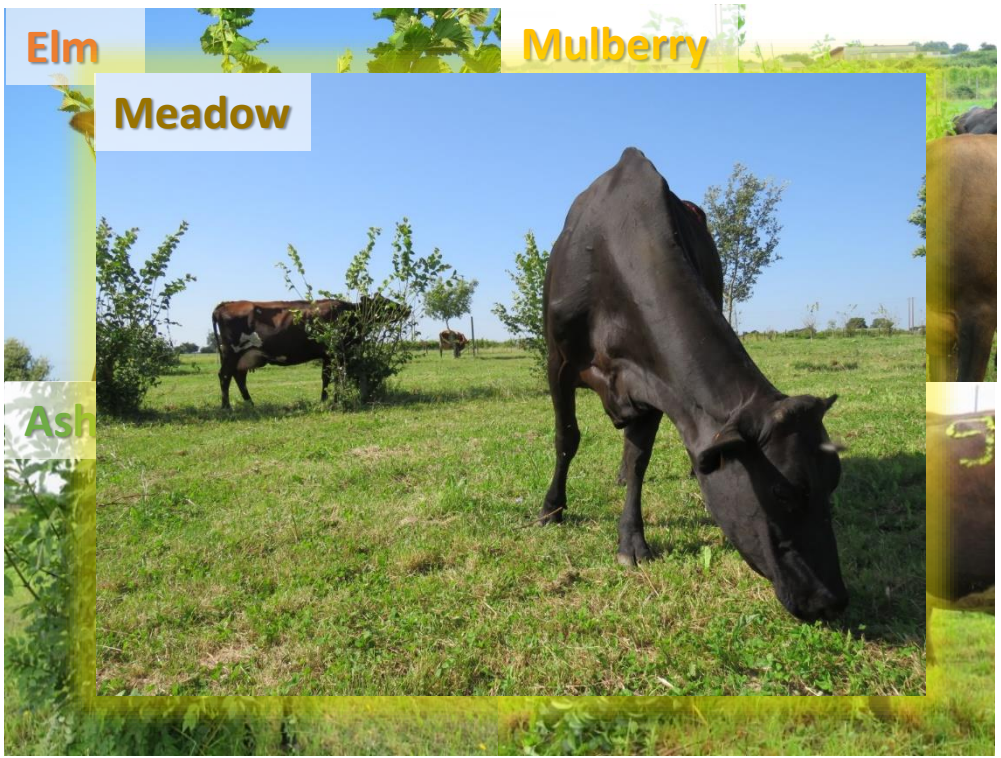




OasYs: feeding behavior

Trees
839 bites
Meadow
6500 bites





OasYs: conclusion

- Interesting values in chemical compounds
- Certain species seem to be more appreciated
- It was the beginning of the experiment. We need :

- To replicate the feeding experiment
- To test the resilience of the trees
- To know the proportion in the ration
- To find the quantity of other chemical compounds and their health value

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