AMERICAN CIDER ASSOCIATION

Beyond Variety: How Orchard Practices Shape Your Cider

PRESENTED BY:

Darlene Hayes, Rémi Bauduin, Yann Gilles

AGENDA

1. Introduction
2. Components that shape your cider
3. Fruit Load, Soil, & Fertilization
4. Climate, Irrigation
5. Fruit Maturity
6. Conclusion

1 Introduction

Further experience . . . has justified the proposition that the character of a cider is determined primarily by the quality of the juice from which it is made; and therefore, while it can be adversely affected by bad management, it cannot be improved beyond a certain point by the best possible treatment . . . Up to the time of pressing the cider-maker is concerned with the production or development of quality, whereas after that point he can only deal with that already determined, and cannot do more than make the most of it.

Report on the Work of the National Fruit and Cider Institute, 1903-10, B.T. P. Barker, Director

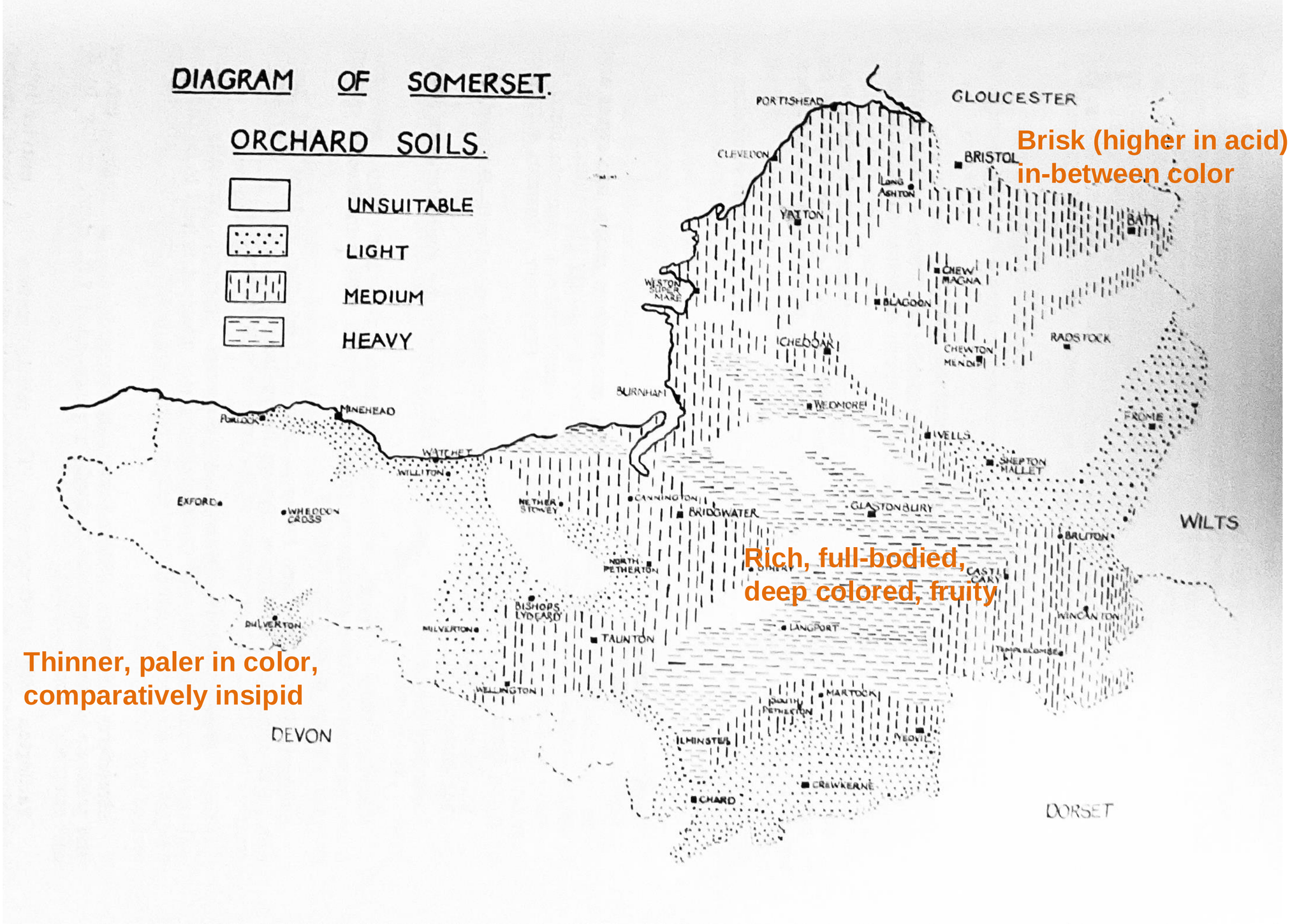


DIAGRAM OF SOMERSET.
ORCHARD SOILS.
UNSUITABLE
LIGHT
MEDIUM
HEAVY
PORTISHEAD
GLOUCESTER
CLEVEDON
BRISTOL
LONG ASHTON
YATTON
BATH
WESTON SUPER MARE
CHEW MAGNA
BLAGDON
CHEDDAR
CHEWTON MENDIP
RADSTOCK
BURNHAM
WEDMORE
MINEHEAD
PORLOCK
WATCHET
WILLITON
WELLS
FROME
SHEPTON MALLET
EXFORD
WHEDDON CROSS
NETHER STOWEY
CANNINGTON
BRIDGWATER
GLASTONBURY
WILTS
BRUTON
NORTH PETHERTON
CASTLE CARY
WINCANTON
BISHOPS LYDEARD
LANGPORT
MILVERTON
TAUNTON
WELLINGTON
MARTOCK
SOUTH PETHERTON
ILMINSTER
YEOVIL
CREWKERNE
CHARD
DEVON
DORSET
Brisk (higher in acid), in-between color
Rich, full-bodied, deep colored, fruity
Thinner, paler in color, comparatively insipid

Juice and Cider Analysis Different Orchards, Same Year (1908-1909)

AREA	SPECIFIC GRAVITY	TITRATABLE ACIDITY	TOTAL TANNIN	NOTES
Hereford	1.066	6.5 g/L	1.86 g/L	Brisk, fair body
Worcester	1.064	6.2 g/L	1.96 g/L	Rich, sweet, fruit with good briskness
Devon	1.056	4.6 g/L	**1.16 g/L**	Useful but lacks richness and pleasant briskness
Martock, Somerset	1.064	5.2 g/L	1.26 g/L	Rich, sweet, full-bodied, moderate briskness
Edgborough, Somerset	1.070	5.6 g/L	1.92 g/L	Soft, rich, medium briskness
Staplegrove, Somerset	1.058	**4.1 g/L**	1.38 g/L	Rich, soft, full-bodied, fair briskness
Easton-in-Gordano, Somerset	**1.050**	4.4 g/L	1.52 g/L	Harder than typical, lacks body
Long Ashton, Somerset	1.065	6.2 g/L	1.98 g/L	Similar to above but with more body and fuller flavor
Madresfield, Worcestershire	**1.074**	6.0 g/L	**2.64 g/L**	
Kingston, Somerset	1.060	**8.9 g/L**	1.22 g/L	
Backwell, Somerset	1.069	5.7 g/L	2.54 g/L	
Pensford, Somerset	1.065	4.5 g/L	2.58 g/L	

Juice and Cider Analysis

Same Tree, Different Years

Kingston Black

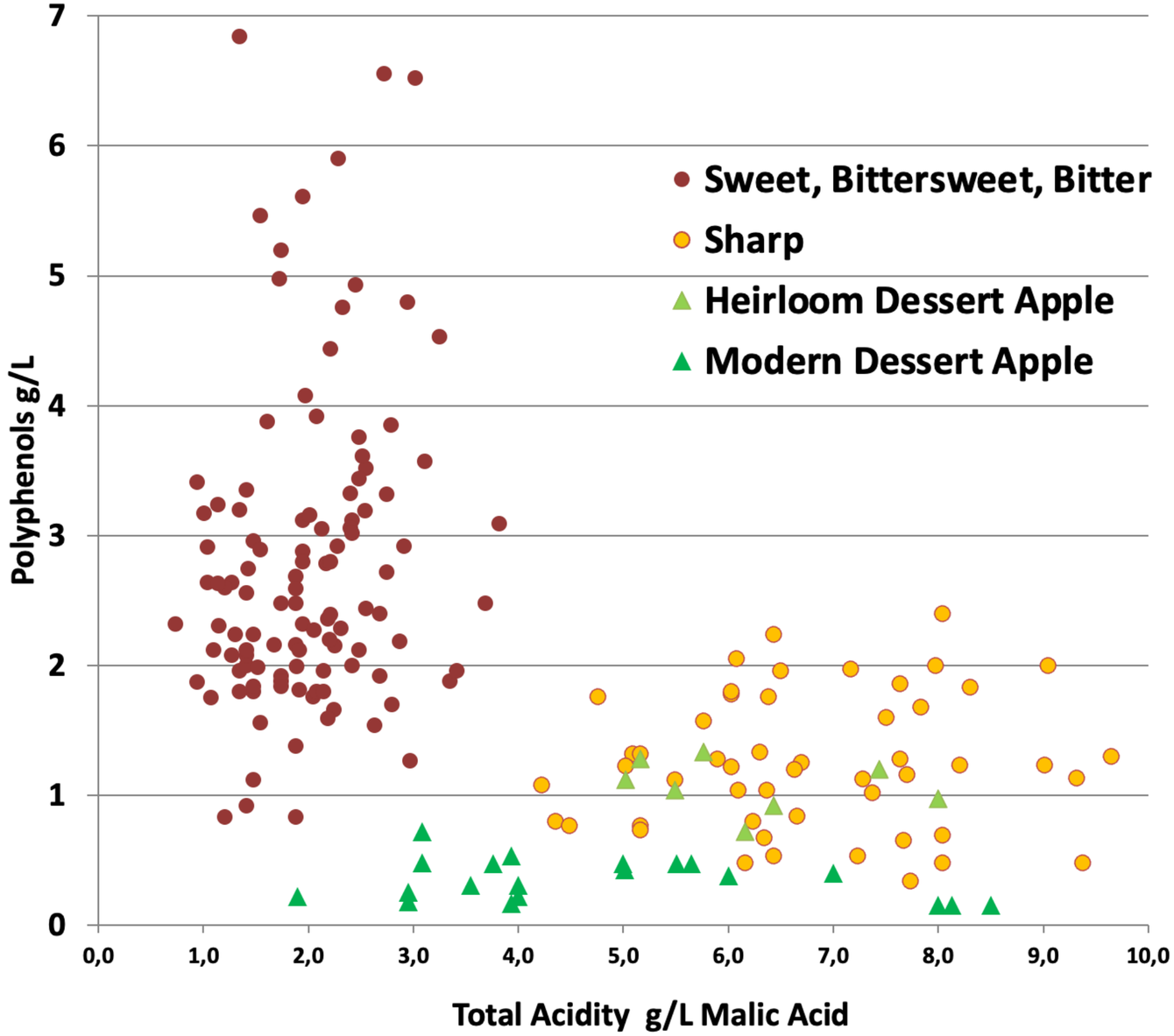
YEAR	SPECIFIC GRAVITY	TITRATABLE ACIDITY	TOTAL TANNIN
1904	1.054	**4.7 g/L**	**1.78 g/L**
1906	**1.064**	7.0 g/L	1.64 g/L
1908	1.062	**7.6 g/L**	**2.72 g/L**
1909	**1.048**	6.0 g/L	1.48 g/L

Chisel Jersey, Tree 1

YEAR	SPECIFIC GRAVITY	TITRATABLE ACIDITY	TOTAL TANNIN
1907	**1.070**	2.4 g/L	4.12 g/L
1908	1.066	**1.8 g/L**	**4.54 g/L**
1909	**1.053**	**3.7 g/L**	**1.90 g/L**

Varietal Diversity

Example : phenolic compounds and total acidity
Apples grown in France (different places and years)



Variety = Main factor of diversity

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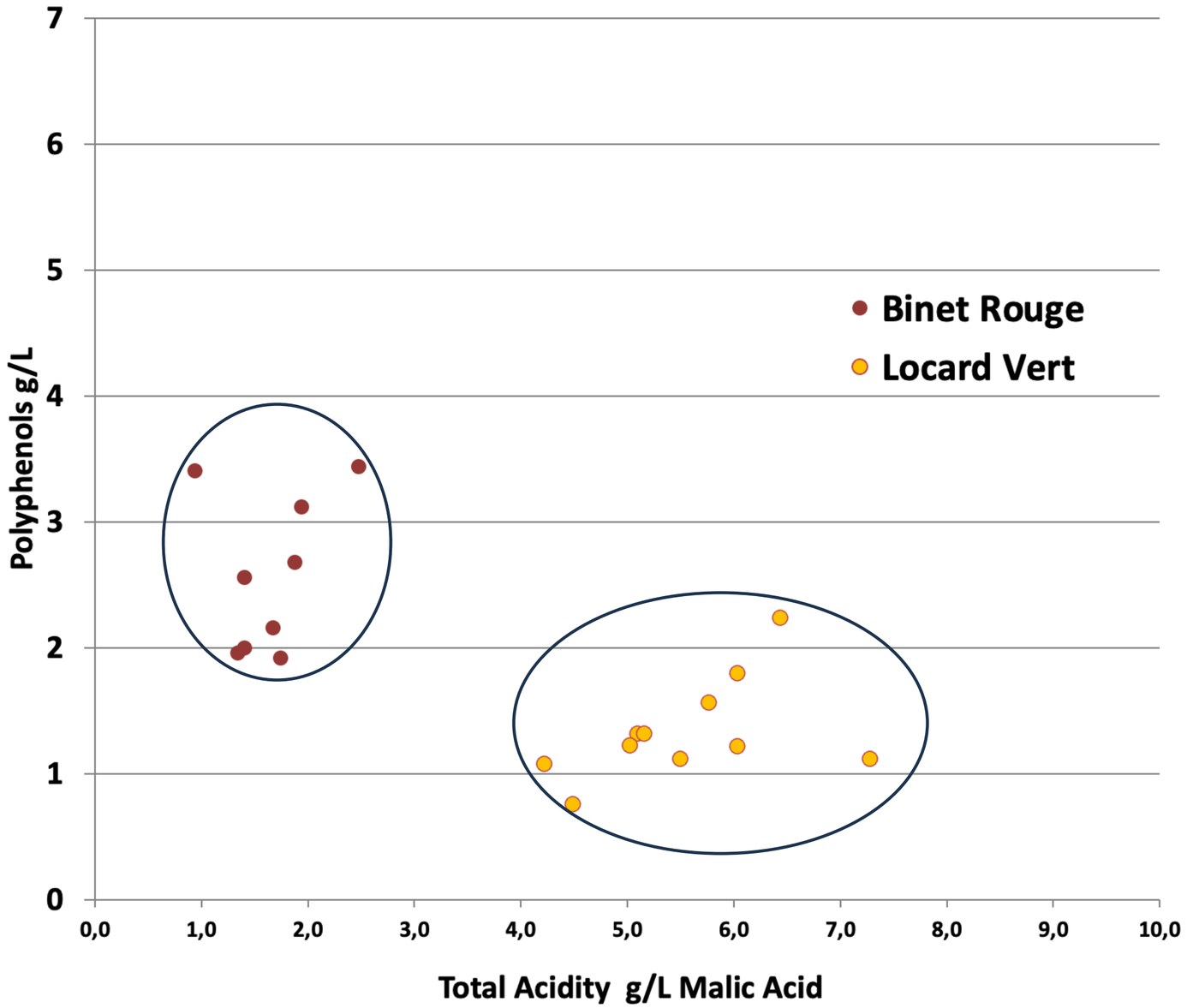
Varietal Variability

Exemple : phenolic compounds and total acidity



But….
Large variability within one variety

2 Components that shape your cider

What shapes your cider ?

Taste

Sugar-Alcohol

Specific gravity, ˚Brix

Sweetness

Malic acid

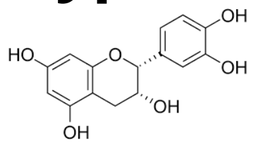
Total acidity

Acidity

Bitterness

Astringency

Polyphenols



Folin, HPLC

What shapes your cider ?

Pre-fermentation and fermentation behaviour :

Soluble pectin

- Essential ingredient for « *chapeau brun* » (keeving process)
- Quantitative needed (alcohol test)

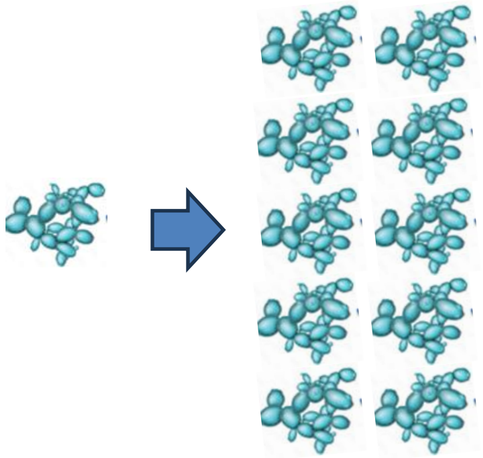
- But … for depectinisation there is no need for pectin !

What shapes your cider ?

Pre-fermentation stage and fermentation behaviour :

<u>Yeast Assimilable Nitrogen (YAN)</u>

- Needed for Yeast multiplication ⇨ Direct effect on Yeast cell number



- French traditionnal cider process (slow fermentation + residual sugar + no pasteurisation)
  - Low YAN amount is prefered 40 to 70 mg/L
- For complete & non-sluggish fermentation (distillation) + cider production
  - A sufficient YAN amount is needed > 90 mg/L

What shapes your cider ?

Aromas

Yeast Assimilable Nitrogen (YAN)

Quantitative effect

Generated during fermentation

From fruit

Terpenes
Acetate Esters

Released

Varietal aromas
(Thiols)

Higher alcohols
Acetate Esters

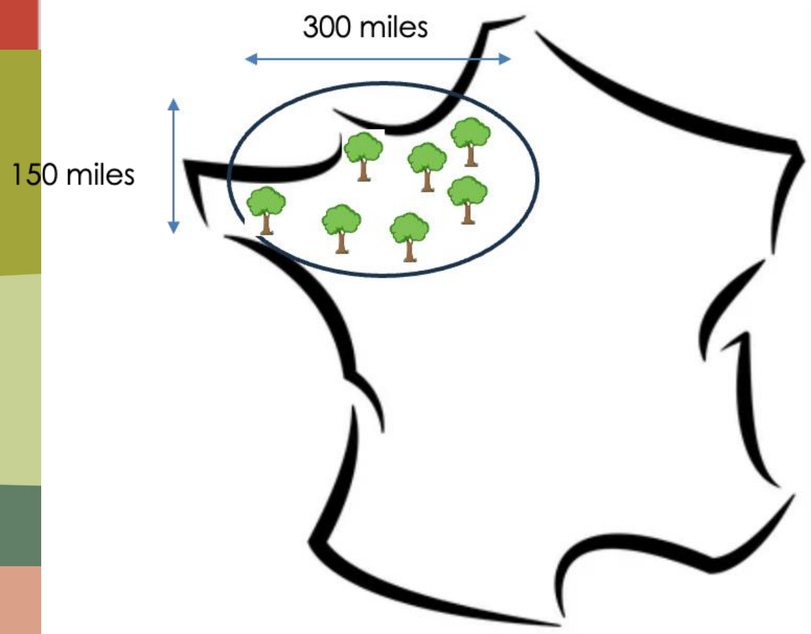
Volatile sulfur compounds (reduction)

Phenylethanol & phenylethyl acetate (*Sacch.Uvarum*)

3

Fruit Load
Soil & Fertilization

Orchard network – 12 year old study



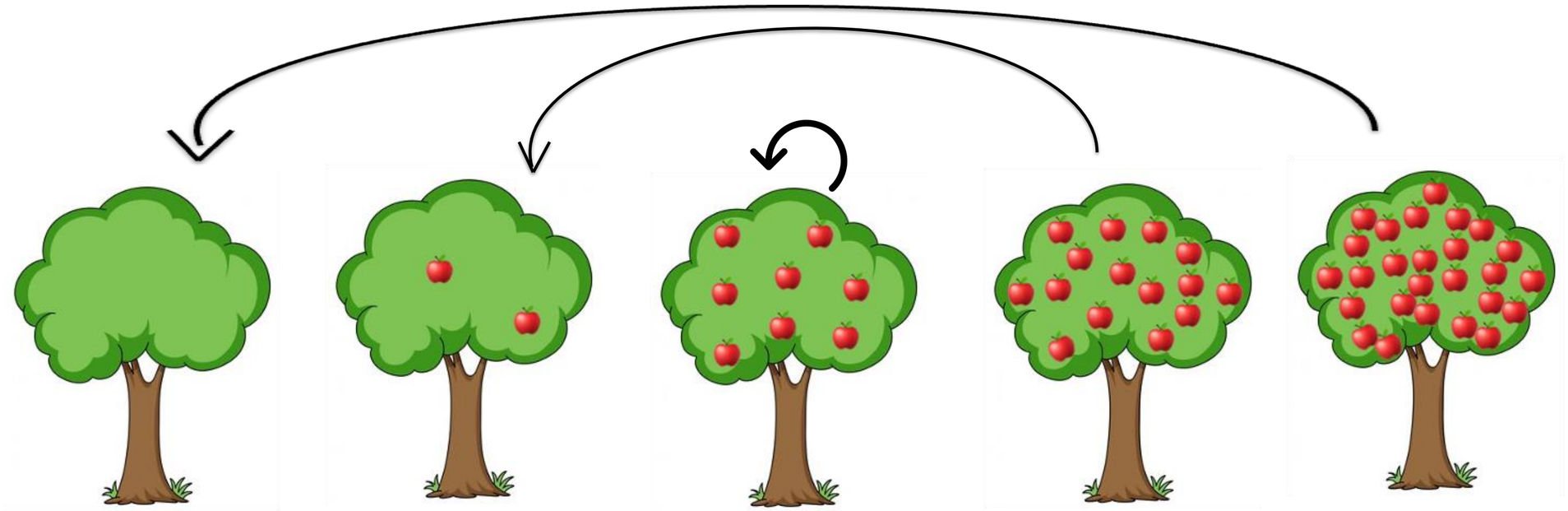
*Closest climate to Normandy and Britany in USA : **West Washington State***

Experimental Design
- 40 Growers orchards
- 4 main varieties
- 12 years (1999 – 2011)

Orchard characteristics
- Type of soil
- Climate (yearly)
- Variety

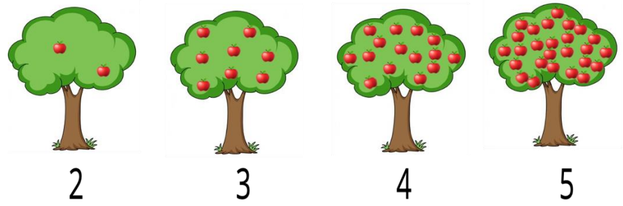
Apple & Juice Analysis
Fruit load
Juice composition (sugar, acidity, nitrogen, phénolic compounds….)

Fruit Load / Yield

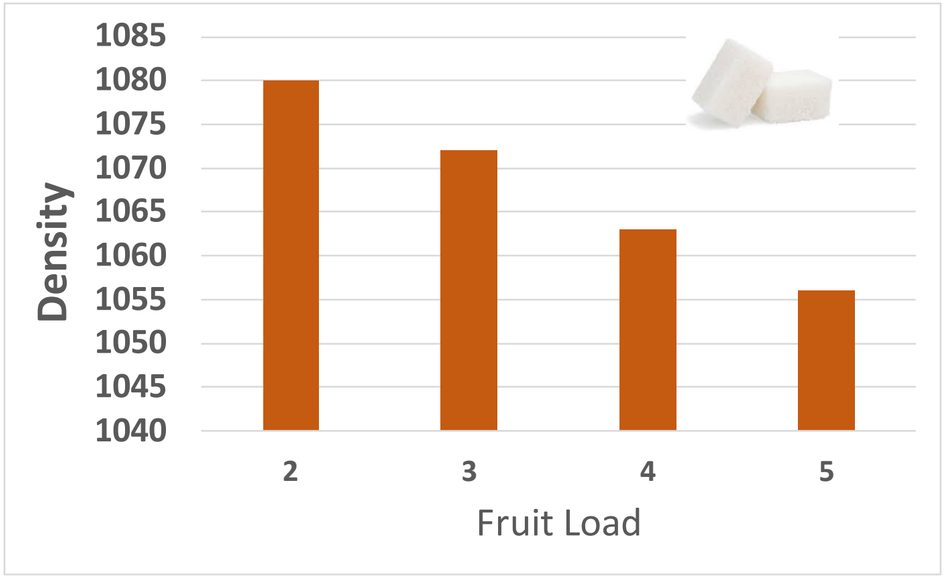


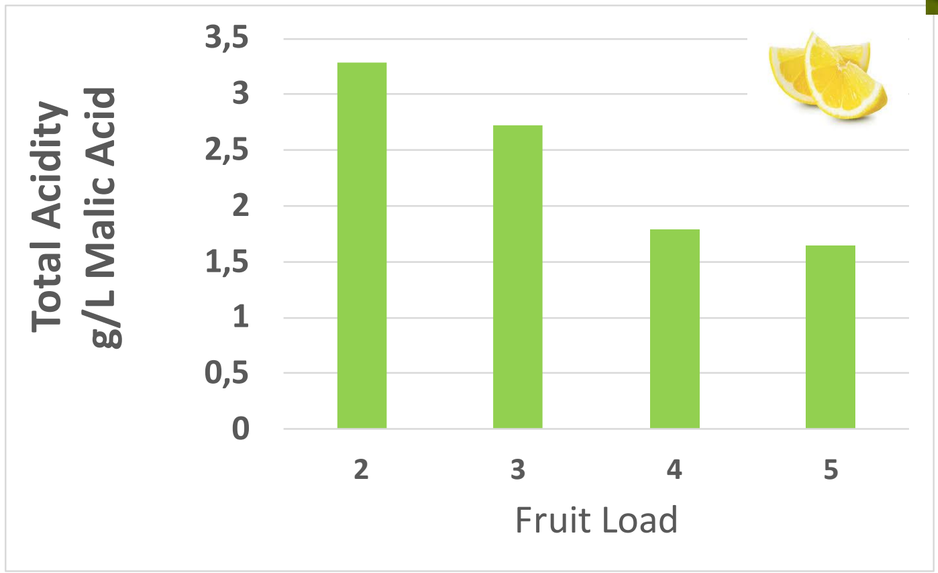
1	2	3	4	5
Totally Alternate	Somewhat Alternate	Balanced crop load Will not alternate the year after	Reduced crop the year after	No crop the year after

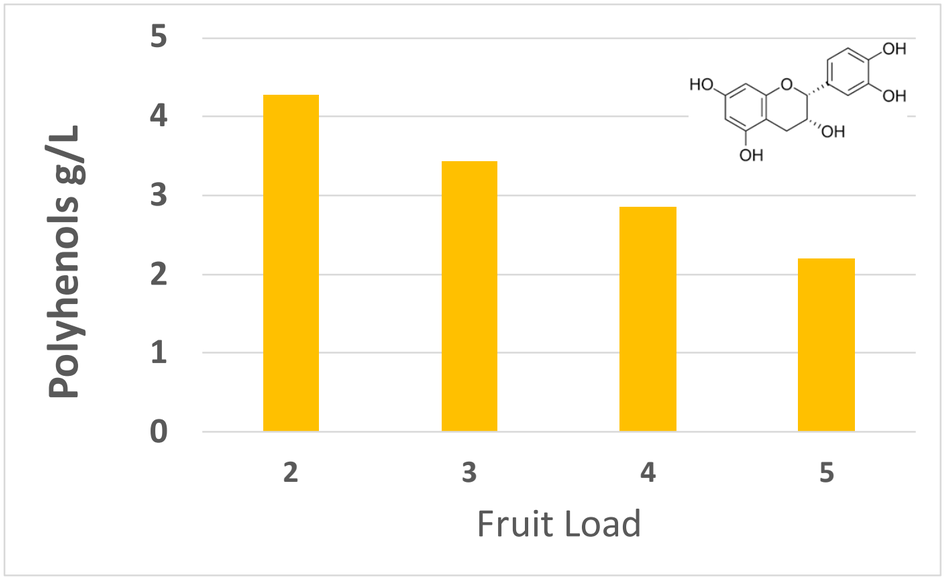
Fruit Load / Yield

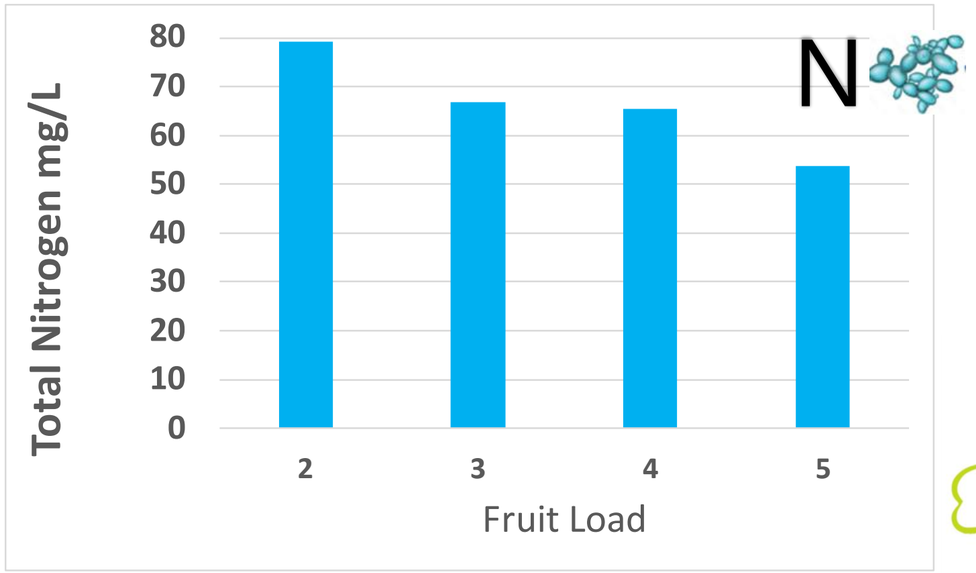


Douce Moen









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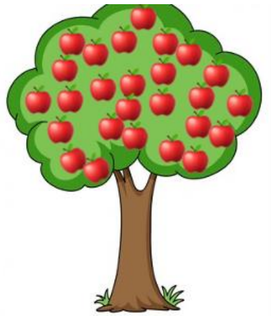
Fruit Load / Yield



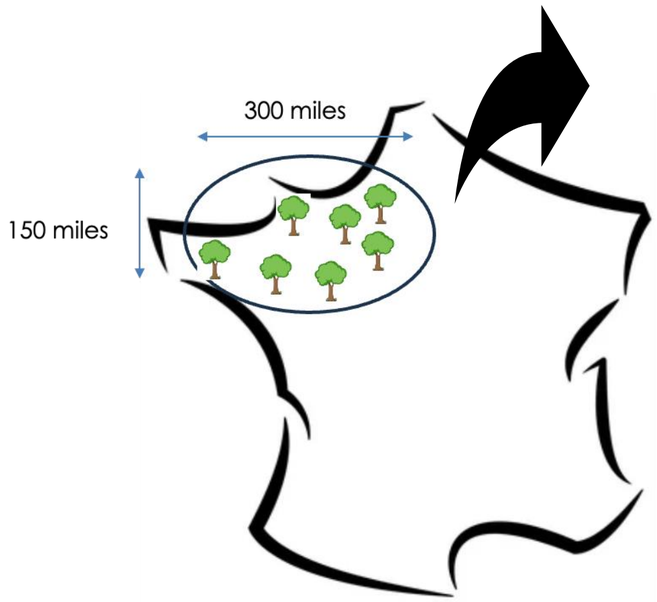
High Fruit Load -> poor juices = **dilution** effect on Sugar, Acidity, Polyphenols and Nitrogen.

Apple and Cider Richness can be enhanced by **Fruitlet Thinning**

« Crop load management can result in more consistent yields and more consistent juice quality, and greater production of tannins when measured over successive years »

In David L, et al 2023. Fruitlet Thining Improves Juice Quality in seven High-Tannin Cider Cultivars in HortScience 58(10) :1119-1128)

Soil

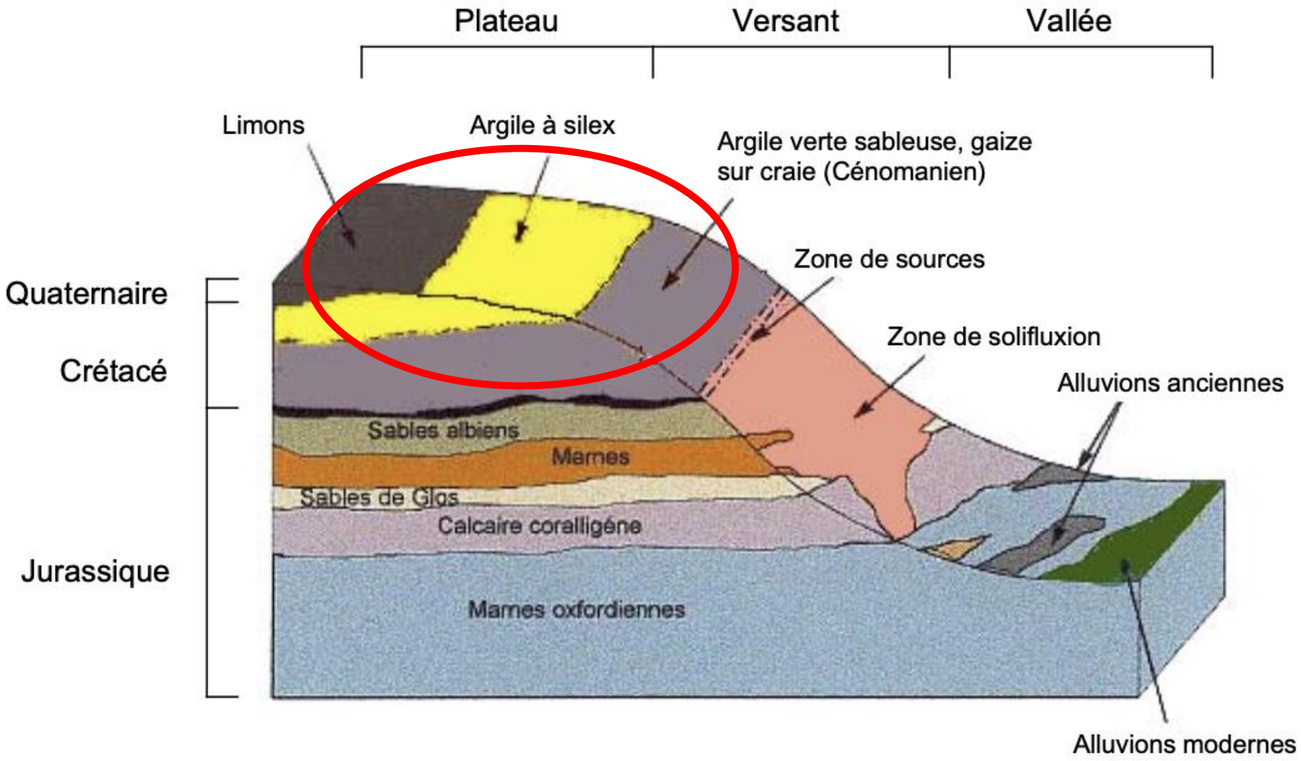


More tannins and sugar with shallow soil rather than deep and rich soil

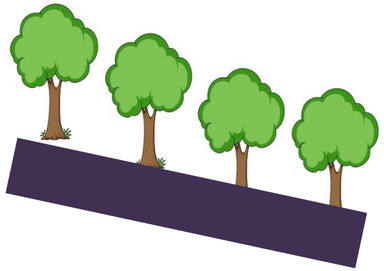
Soil

Thesis from Isabelle Travers (2004)

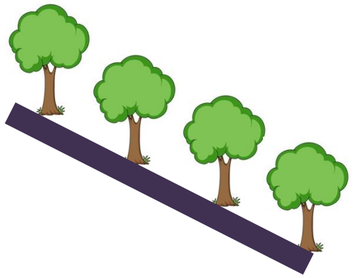
Influence of the soil and climatic conditions of the terroir on apple tree behavior and the composition of cider apples in the Pays d'Auge



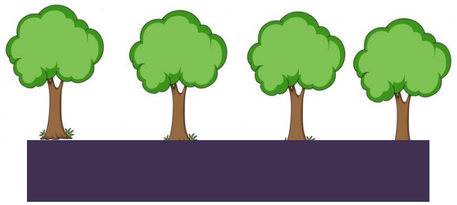
Soil



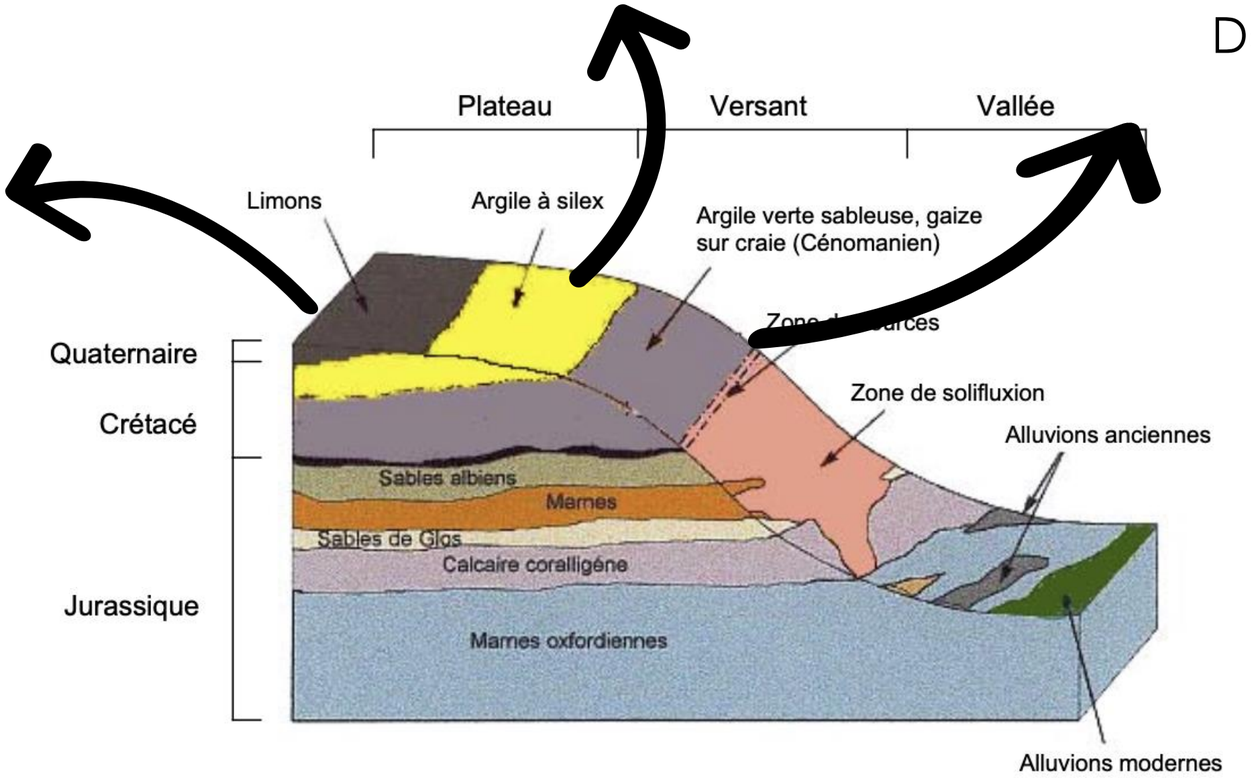
Flint Clay. Gentle slope
Depth 70 cm (27 in)



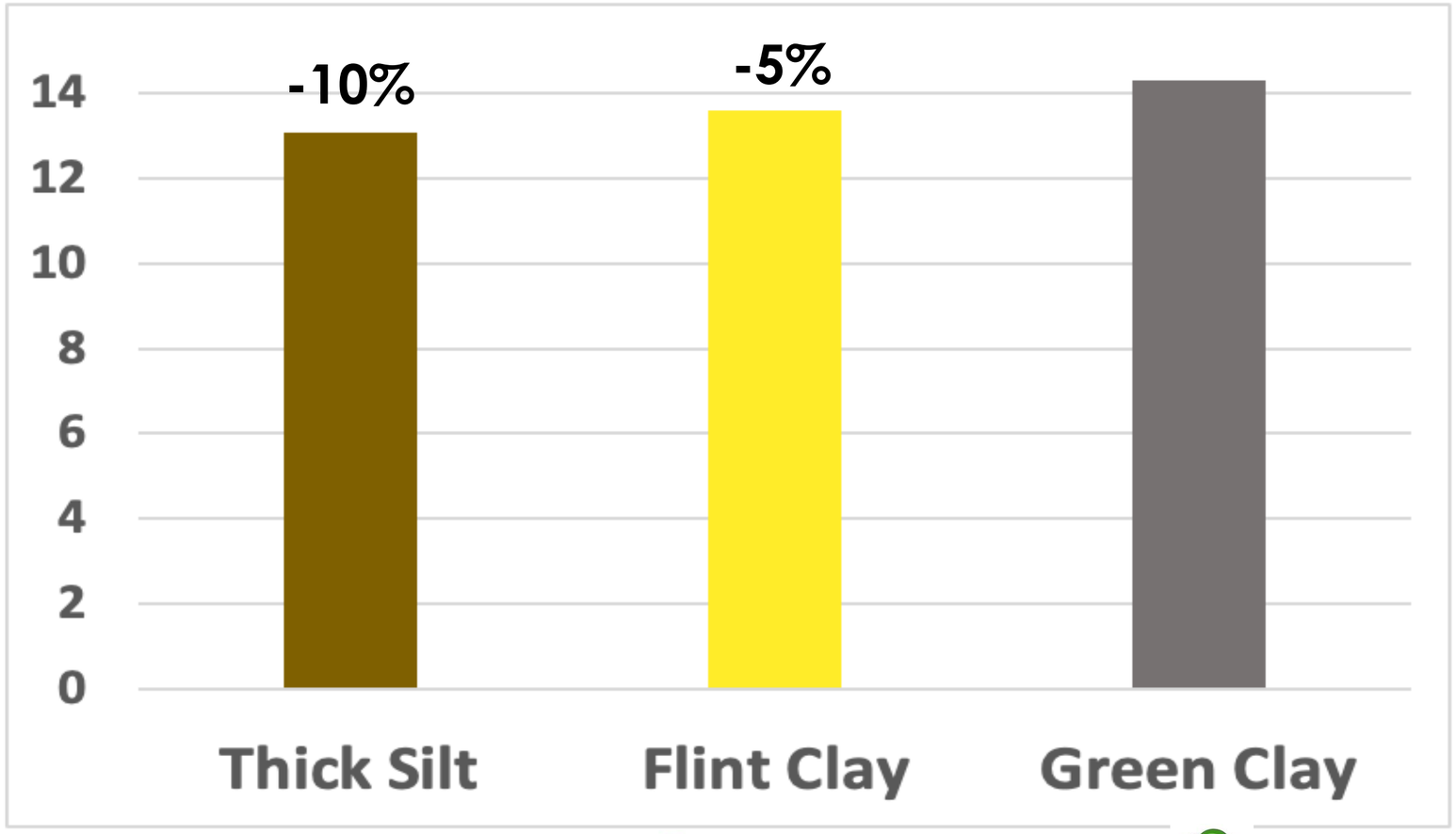
Sandy **Green Clay**
on Chalk
Steep slope
Depth 30cm (12 in)

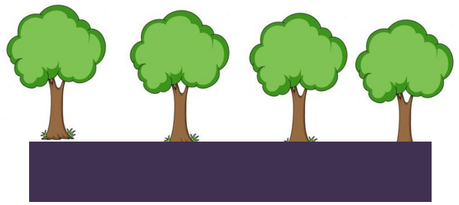


Thick Silt.
Depth 90 cm (35 in)

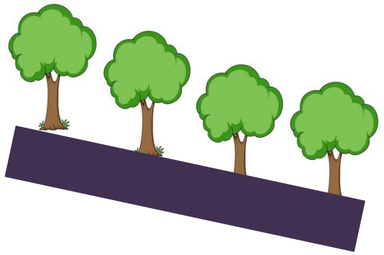


Soil

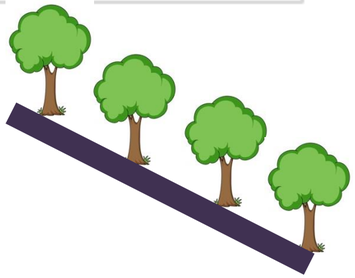




Thick Silt. Slope. Depth 90 cm (35 in)



Flint Clay. Gentle slope Depth 70 cm (27 in)



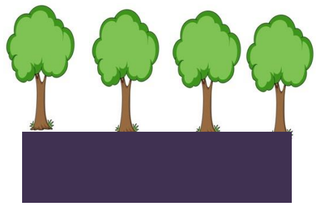
Sandy **Green Clay** on Chalk Steep slope Depth 30cm (12 in)

Soil

2 Orchards (distance 100 miles). Normandy
Var Douce Moen. Rootstock MM106. 20 years old.

200 In

80 in



Deep silty-clay
Limestone subsoil
Depth 15 m (16,50 yd)

Shallow clay-silty
Limestone subsoil
Depth 20 to 40 cm
(8 to 16 in)

Soil

Yann Gilles
Cidrologue & Œnologue

2 Orchards, Var. Douce Moen, Rootstock MM106, 20 years old.

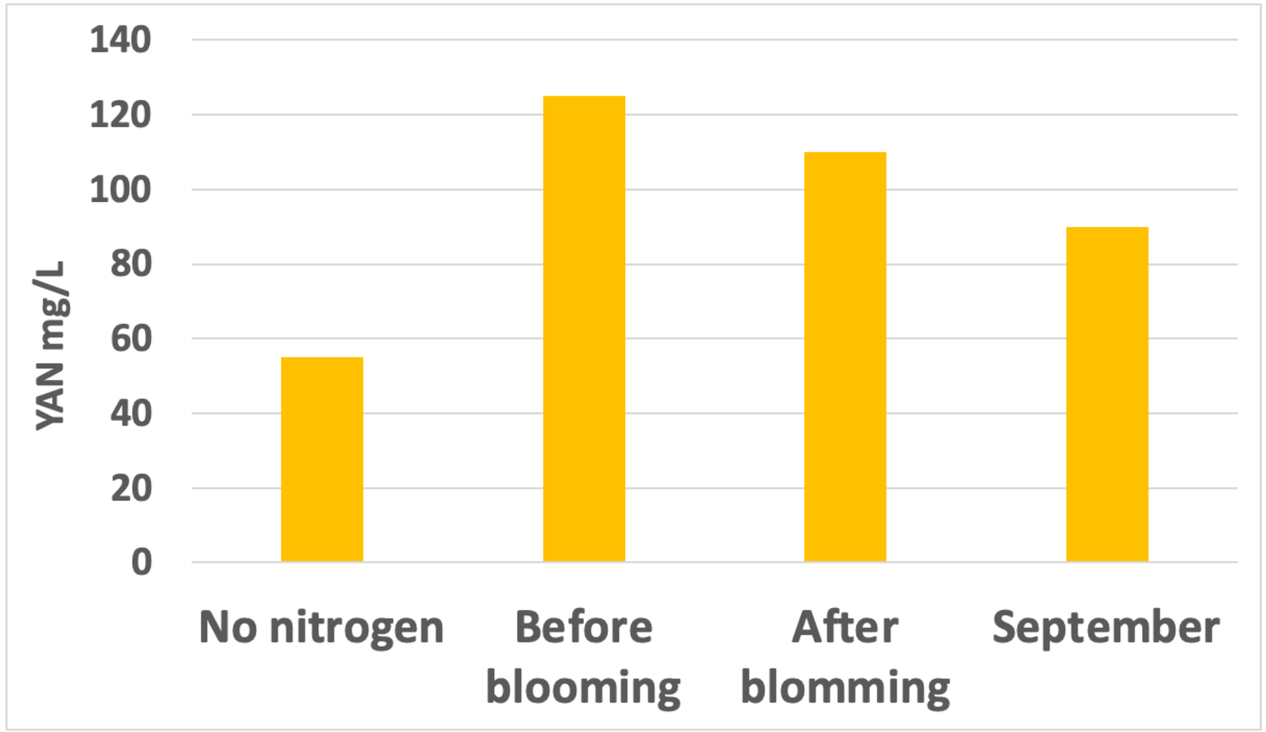
80g (2.8 oz)/fruit
Yield 40T/ha (16T/acre)
SG 1.050
TA 2.5 g malic acid/L

24g (0.85oz) /fruit
Yield 8T/ha (3,3T/acre)
SG 1.070
TA 3.6 g malic acid/L

Fertilization

Variety Bedan, Rootstock MM106
N application (urea) : 40kg N /ha from 1st to 9th Leaf and 100kg N/ha from 10th to 17th Leaf

YAN in Apple Juice (average) from 10th to 17th leaf

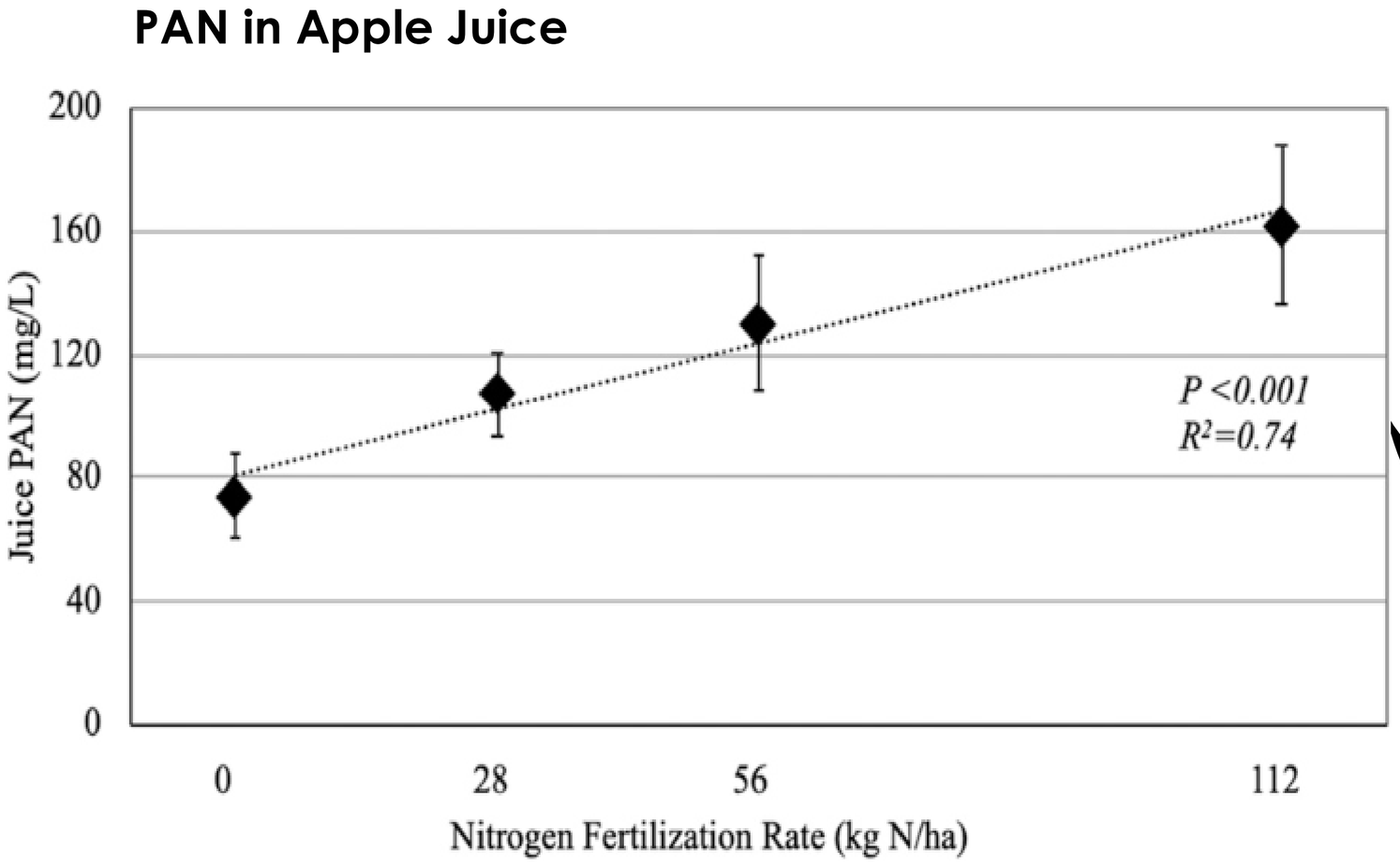


Nitrogen application around blooming has more impact on YAN content in the must

Primault, et al. 2005. Fertilisation azotée raisonnée et composition du jus. Revue Pomme à cidre, n°12.

Fertilization

Variety Medaille d'Or
Calcium Nitrate, 2 Applications around blossom

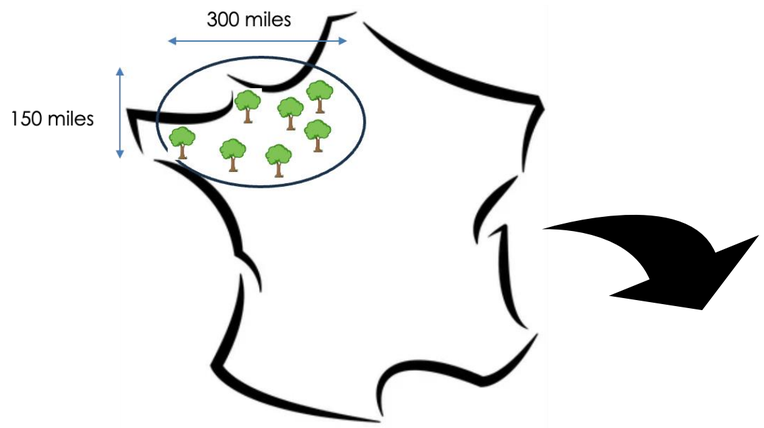


Nitrogen fertilization rate has a direct influence on Nitrogen content in the must

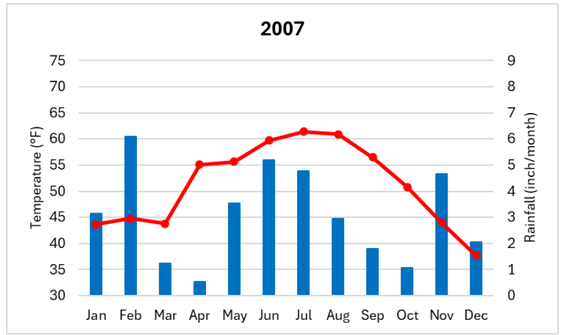
Karl et al, 2020. Soil nitrogen fertilization increases yeast assimilable nitrogen. Concentrations in golden russet and medailled 'or apples used for cider production. Hortscience 55(8):1345-1355

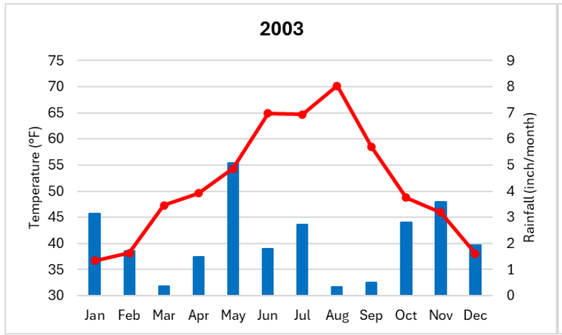
4 Climate & Irrigation

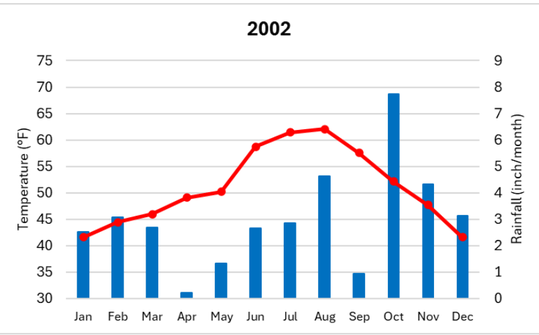
Climate



	Type 1 : Average temp, regular rain	Type 2 : Hot and dry summer	Type 3 : Average temp & rainy automn
Total Rainfall sept - nov	**7,5 inches**	**7 inches**	**13 inches**
Avg. temp June - August	**61 °F**	**67 °F**	**61°F**

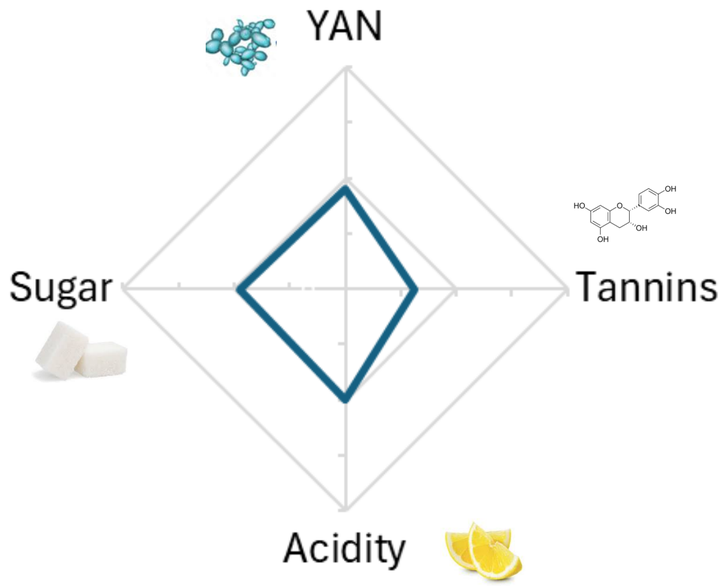






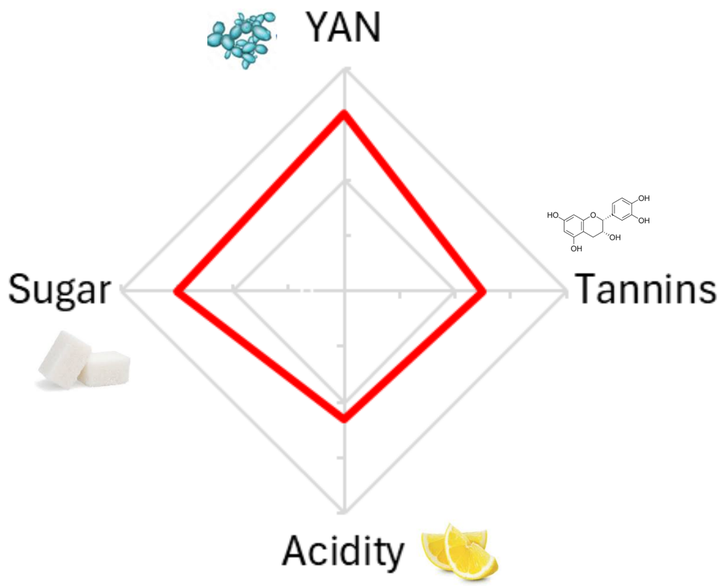
Climate

average climate



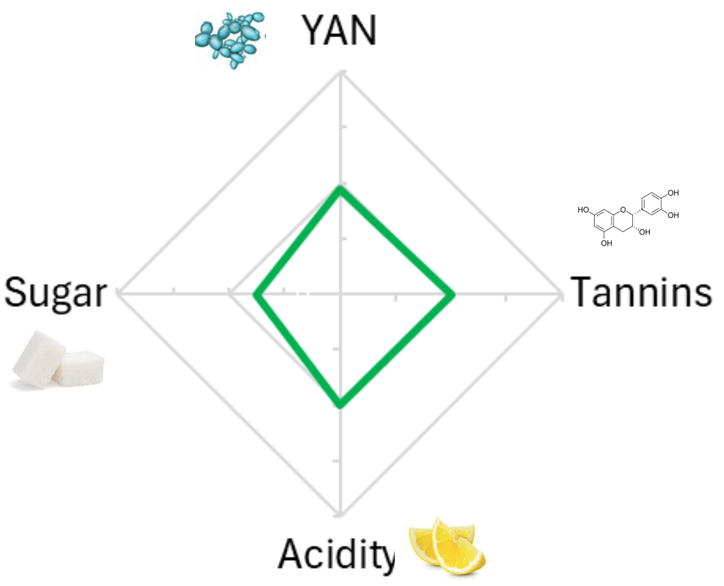
⇨ **Less tannin**

hot & dry summer



⇨ **More Sugar, tanins & YAN**

humid autumn



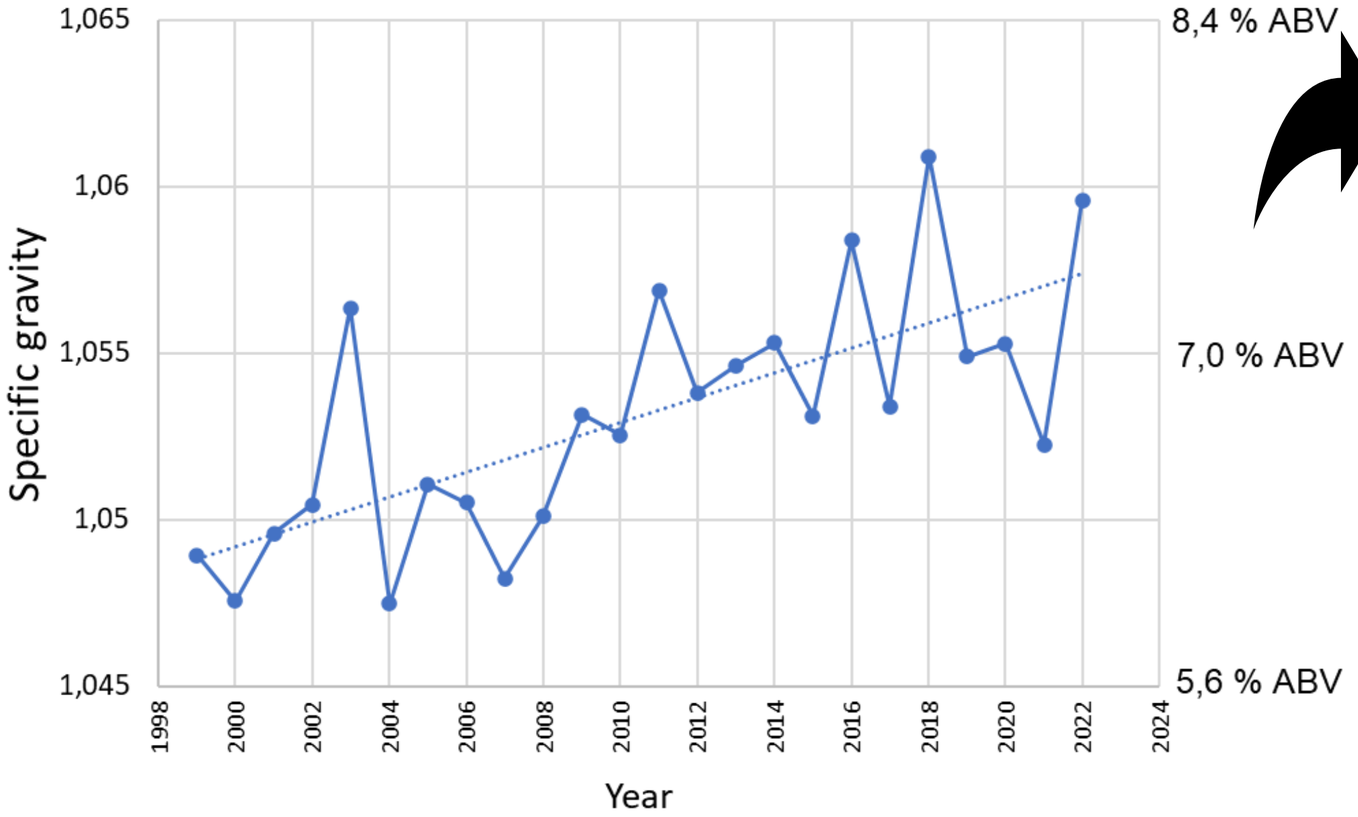
⇨ **Less sugar**

More frequent with climate change !

Guillermin, P., Piffard, B., Primault, J., Dupont, N., & Gilles, Y. (2015). Fruit quality prediction on cider apple: Effect of annual fruit load, soil and climate. Acta Horticulturae, 1099, 803-810.

Climate change !

Survey of cider apple juice North-West France from 1998 to 2022

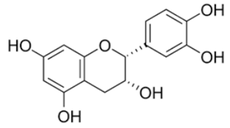


Inter-annual variability …
… but a strong trend

Over the last 10 years

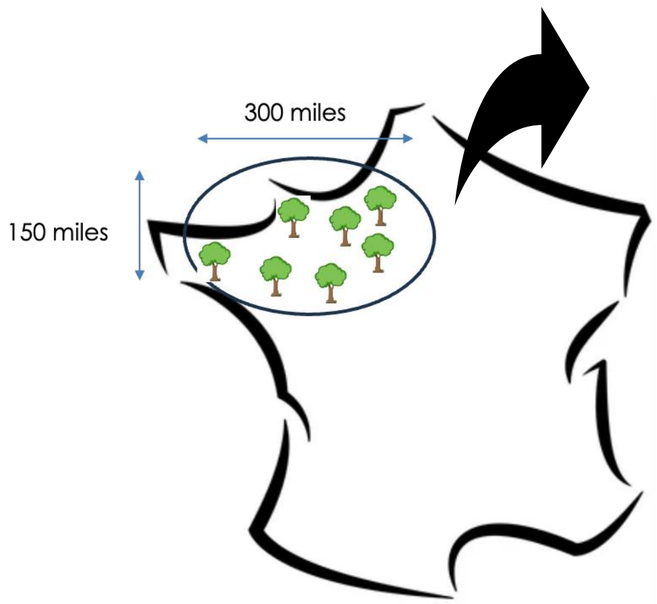
+ 0,35
% ABV

- 0,45 g/L
Total acidity



No data for polyphenols

Climate



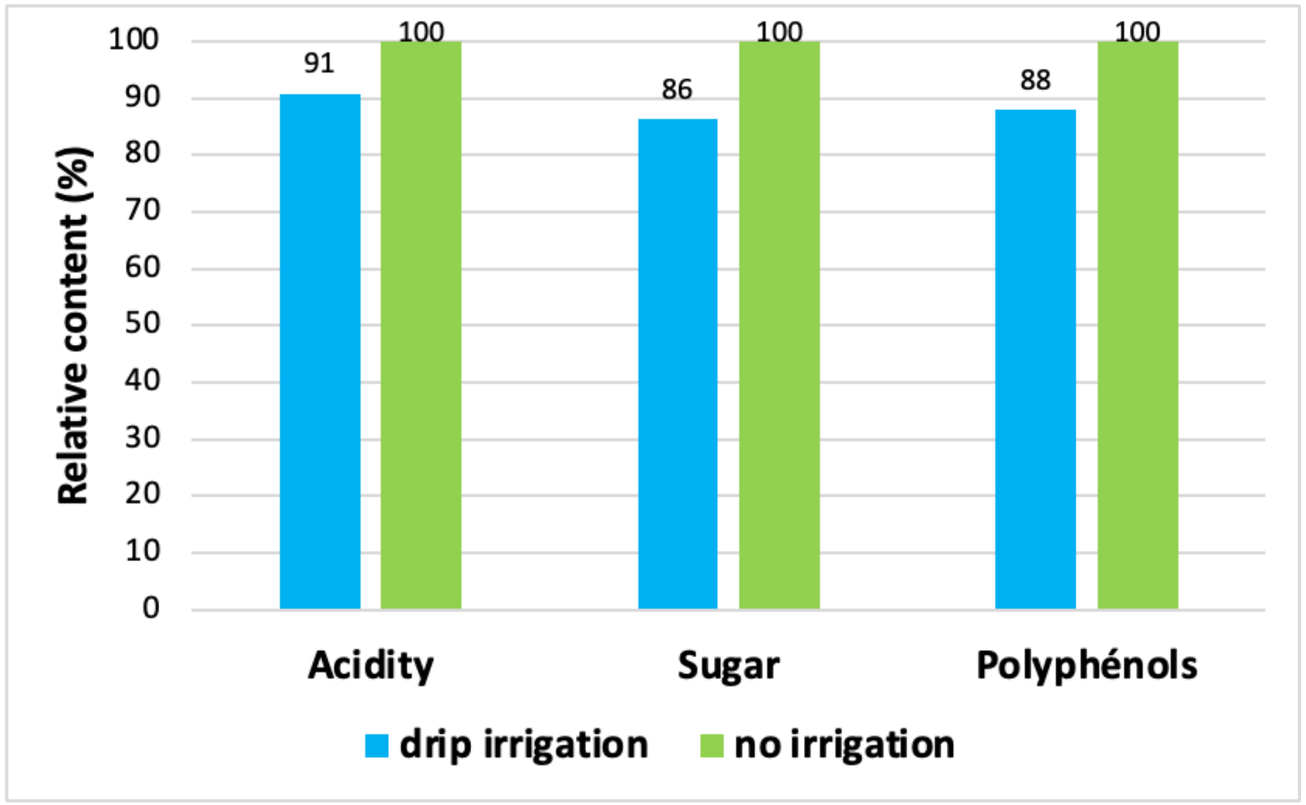
Strong impact of climate on must composition

Climate change is deeply modifying the must composition

Irrigation

Douce Coet, Rootstock MM106, Loire Valley, 2022

Relative Amount Acidity/Sugar/Polyphenols of Apple Juice



Irrigation induces a must dilution

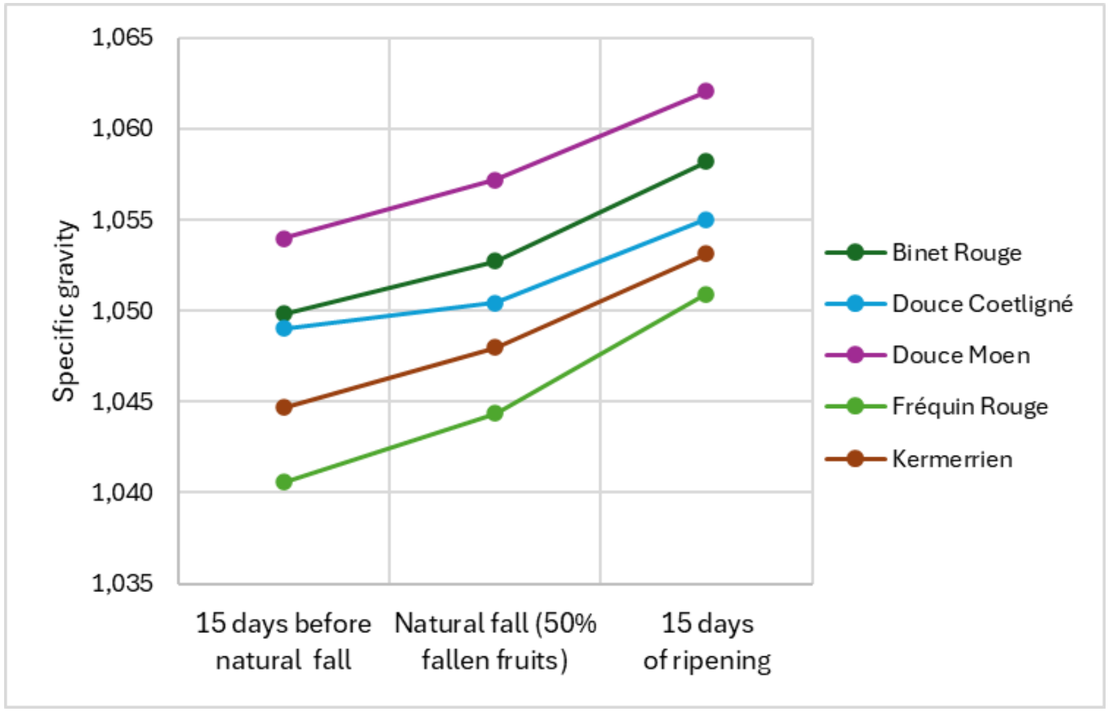
5

Fruit Maturity

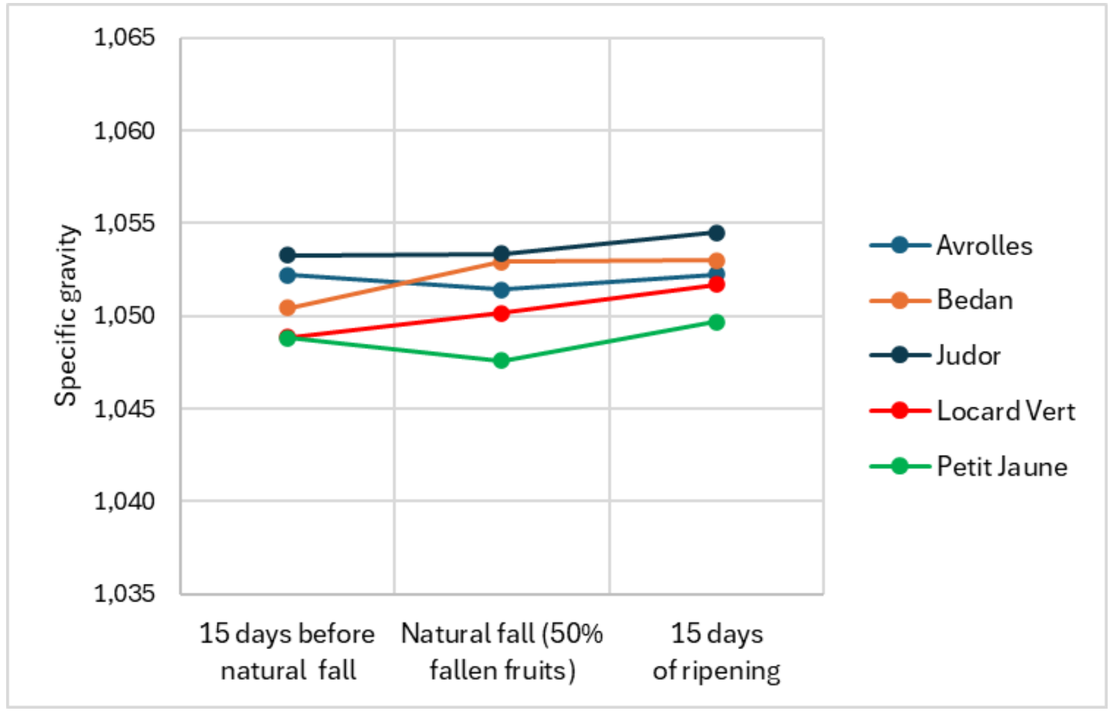
Apple maturity

- **Must Sugar content**

Strong **varietal effect** … and **two** kinds of evolution



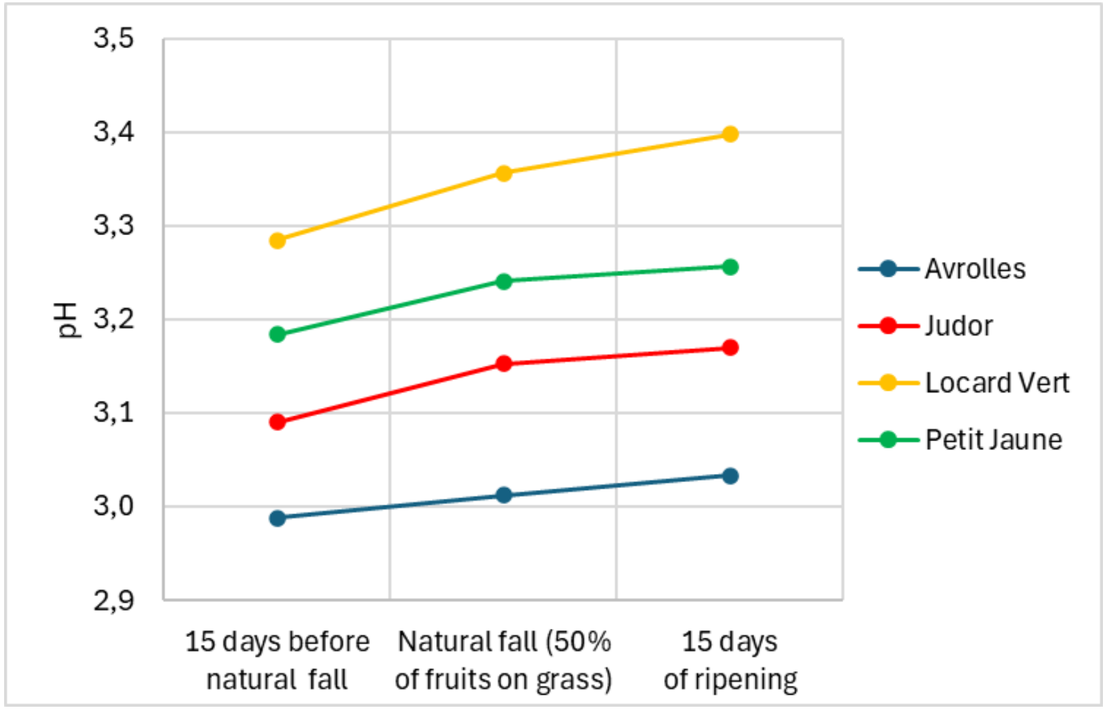
Starch regression + dehydration



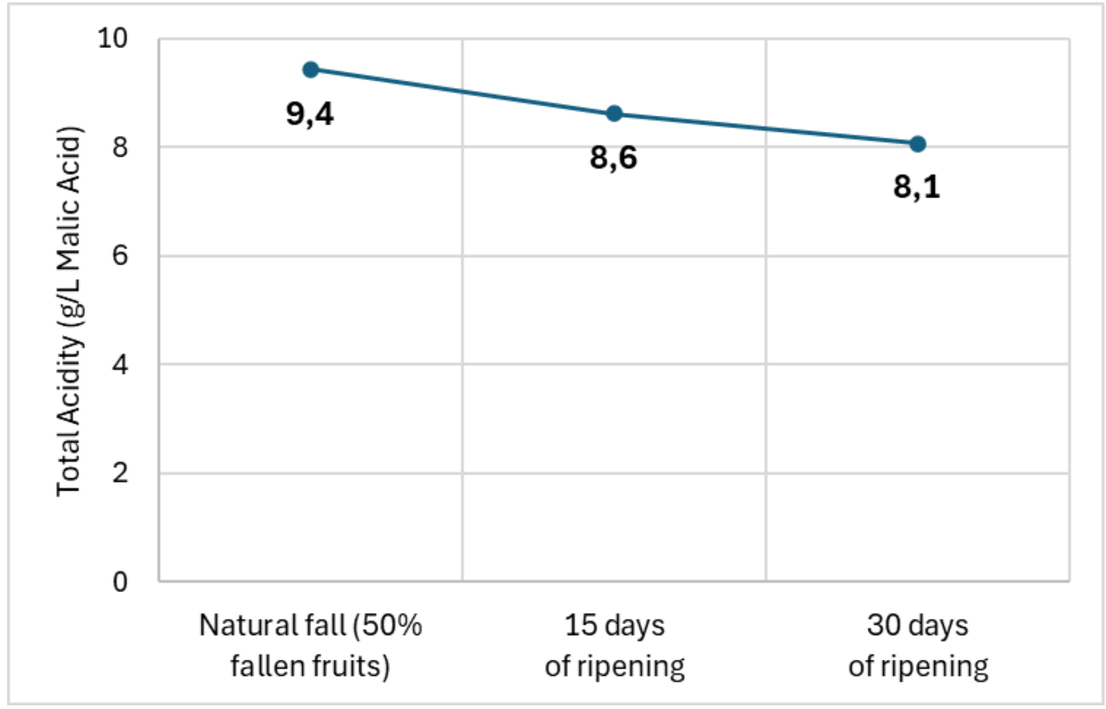
Less starch regression + waxy skin

Apple maturity

- **pH & Acidity**



Guillevic (sharp variety)

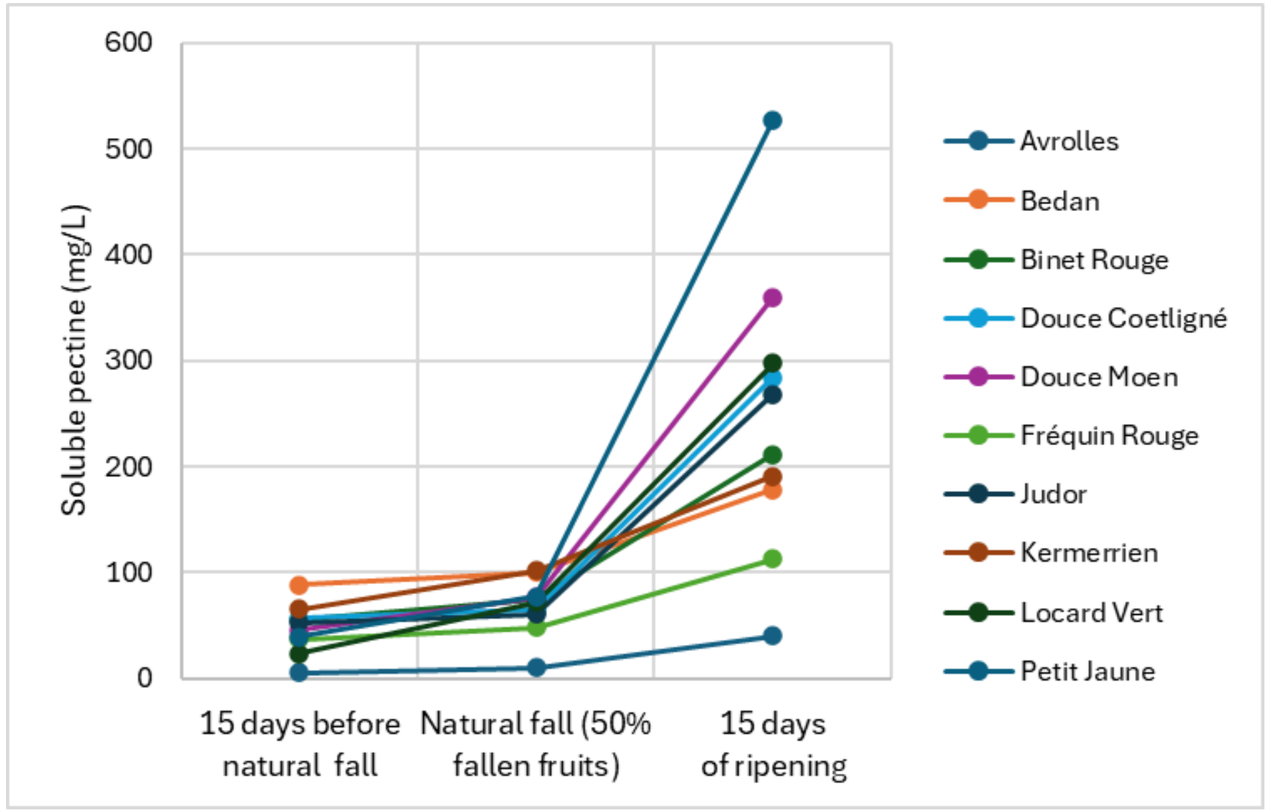


Increase of pH (less bacterial stability)
Decrease of acidity (less sharp)

Apple maturity

- **Soluble pectin**

No soluble pectin when apples are on the trees

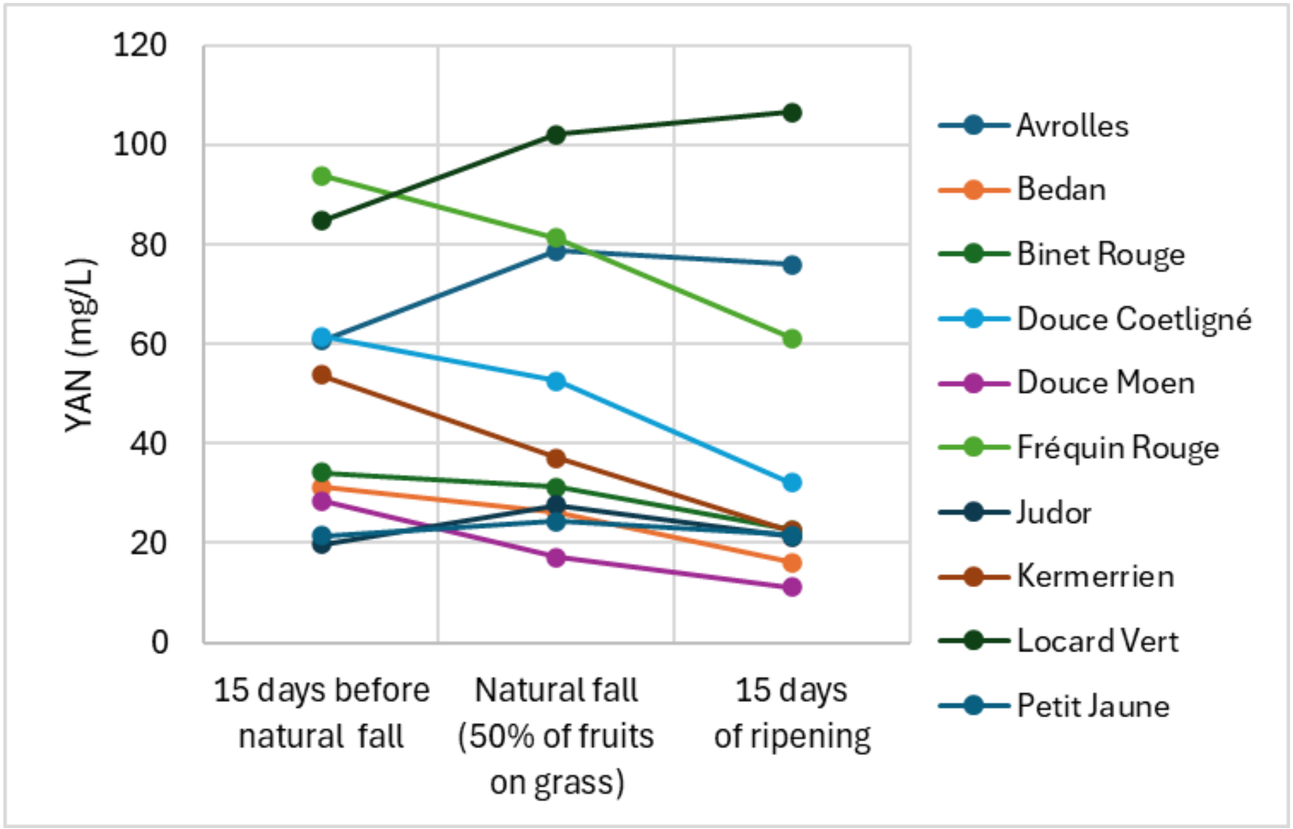


5-7 days of ripening is a minimum for “chapeau brun” in the keeving proces !

Apple maturity

- **YAN**

  As a general rule, **YAN decreases during ripening** (some exceptions)

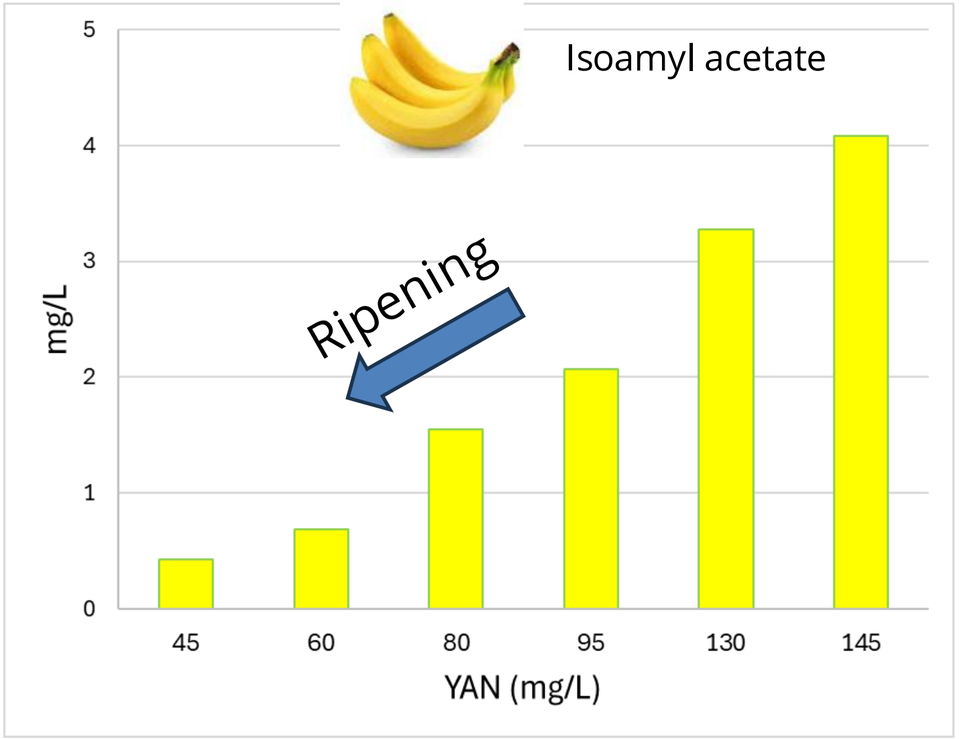


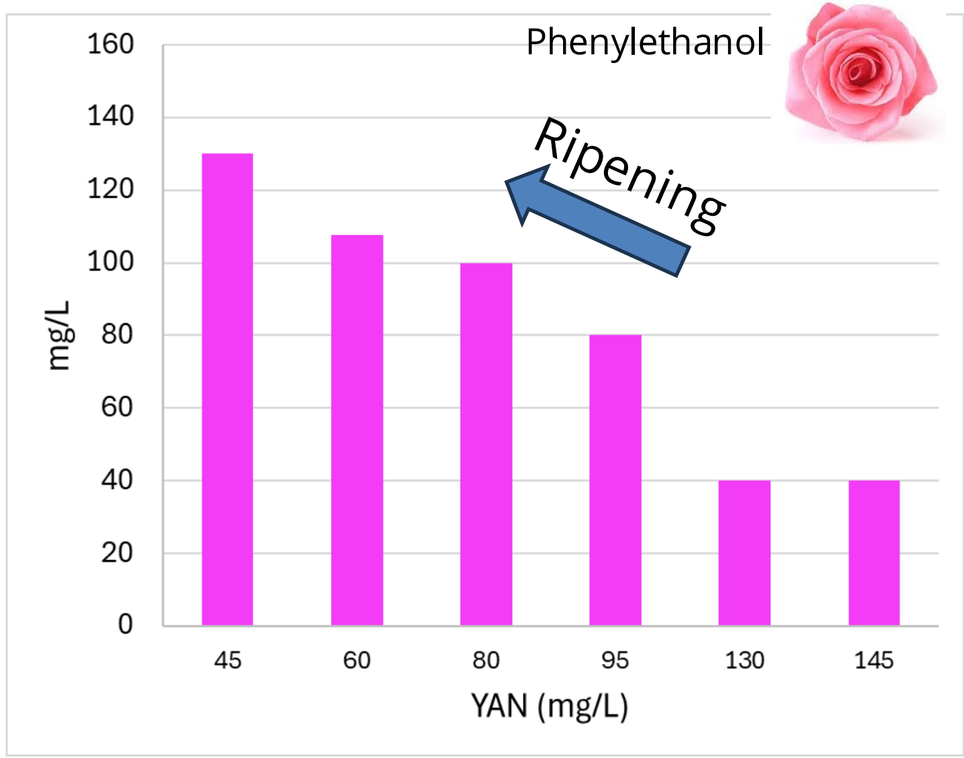
Ripening could be a tool to modulate YAN

Apple maturity

- **YAN decreases during ripening**
  As a consequence :
  Lower production of fruity esters
  Enhanced floral notes (for *Sacch uvarum*)

Ripening could be a tool to modulate aroma

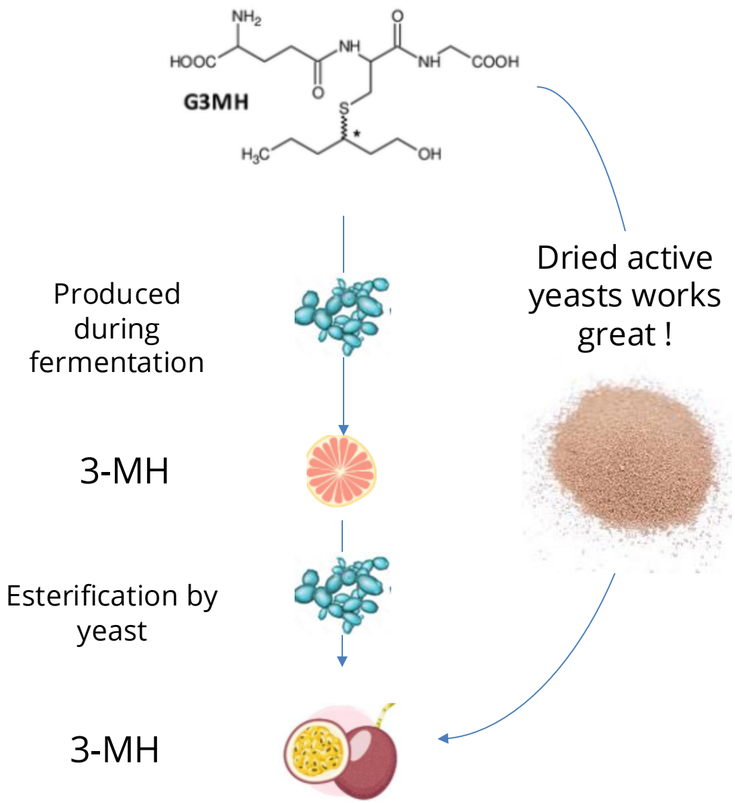


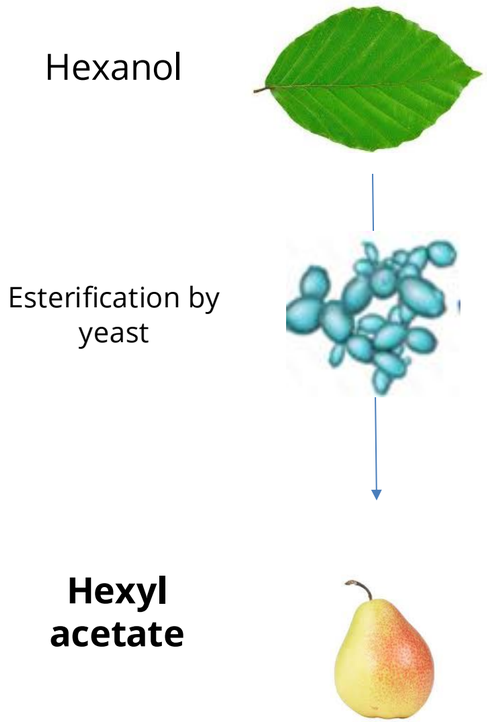


Apple maturity

- **Aromatic precursors : Varietal thiols & Hexanol**

Ripening fruits 15 days increases concentration by a factor of 2.5

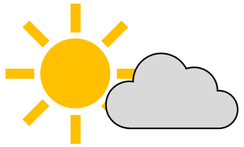


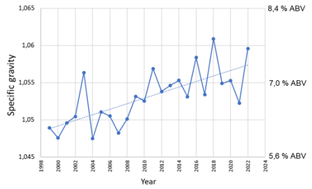


Ripening increases the potential of fruity aromas

6 Conclusion

Conclusion

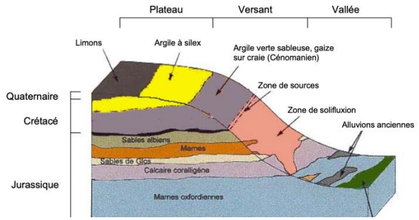




Irrigation

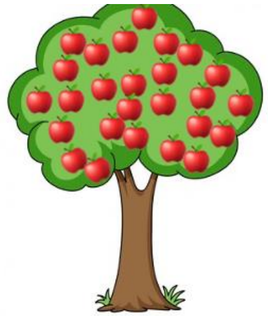
Variety

Cider processing



Fertilization

Fruit Maturity



Alternate management

Other growing practices

Thanks for your Attention !

Any Questions ?

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