Modifying leaf area to fruit ratio and effects on Pinot Noir phenology and composition characteristics

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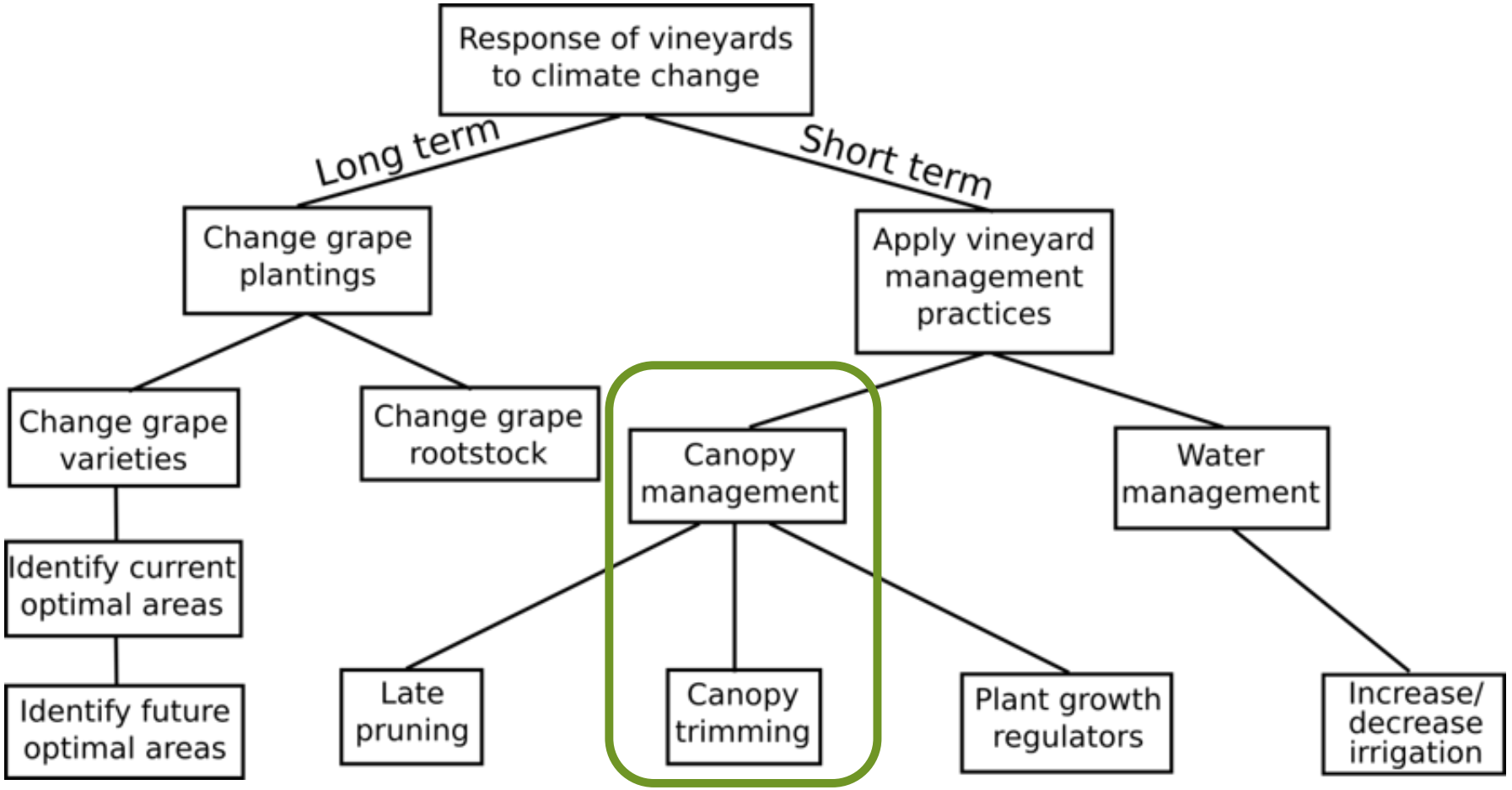
Overview

- Why alter LA:FW ratio?
- How and when?
- Yield consequences
- Journey towards a ‘target’
  - Veraison
  - Changes in berry composition
- Considerations for application of LA:FW manipulations

Introduction



STURMAN ET AL. (2015, in press and online)

Introduction

Potential increase in temperatures due to climate change

- Earlier phenology
- Earlier ripening under warmer conditions
- Compressed harvest
- Higher Brix/sugars
- Lower acidity
- Changes in flavour and aroma profiles

Introduction

- Impact of increased temperatures for Pinot Noir Burgundy

- Advance in veraison of ~ 30 days with increase of +5°C

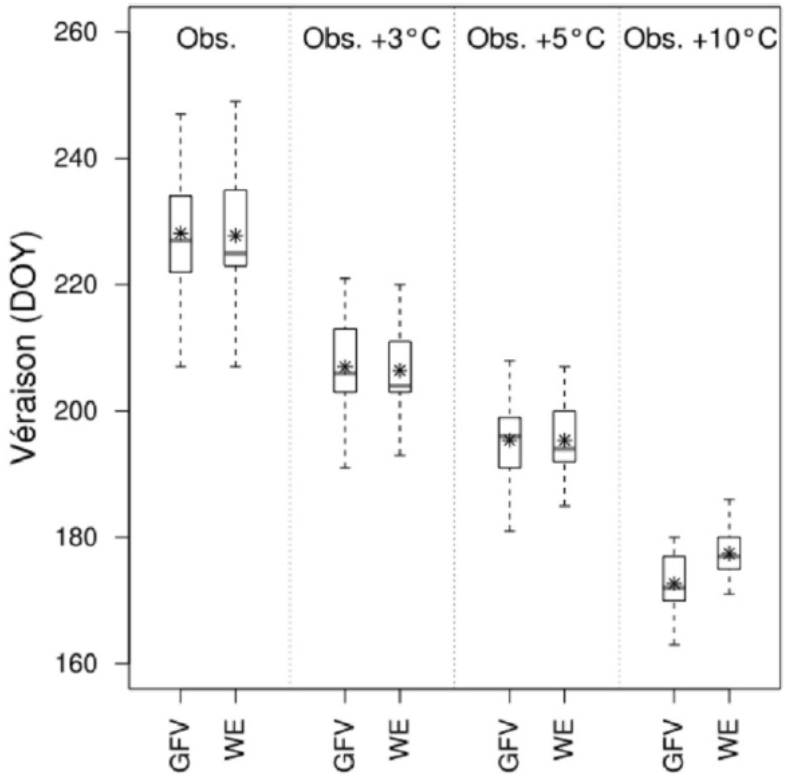


Figure 4. Boxplot (gray line : median and black asterisk : mean) of simulated véraison dates by the Grapevine Flowering Véraison (GFV) and Wang and Engel (WE) models for measured temperature data (Obs.) and +3 °C, +5 °C and +10 °C temperature scenarios. Each boxplot represents 26 values (26 years ; 1973-2005) ; véraison day corresponds to the Day of Year (DOY).

CUCCIA C., BOIS B., RICHARD Y, PARKER A., GARCIA DE CORTAZAR-ATAURI I., VAN LEEUWEN C. and CASTEL T., 2014. JISVV 48: 169-178.

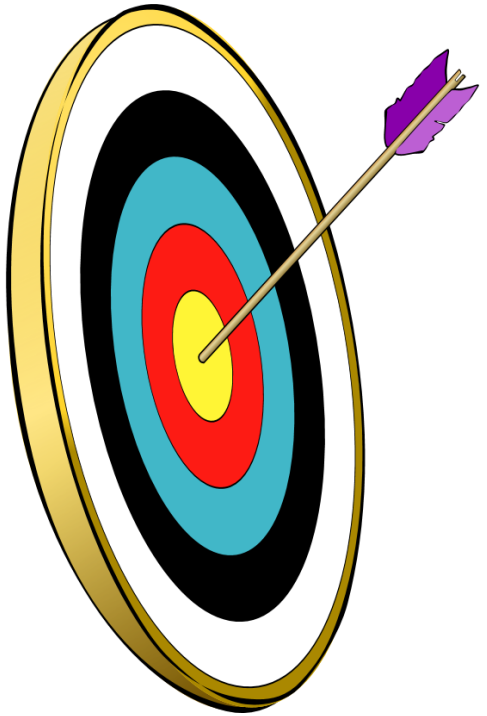
Cool climate viticulture

Cooler seasons – target harder to reach

LA:FW modifications

=

A tool to reach a target?



Leaf area to fruit weight ratio

Remove leaves

Leave crop

Leave leaves

Drop crop

Modifying the leaf area to fruit weight ratio

= Changing carbohydrate source-sink ratio of the vine

↓ Leaf area

↓ Source supply to ripen grapes

Modifying the leaf area to fruit weight ratio

= Changing carbohydrate source-sink ratio of the vine

↓ Yield

↓ Sink demand

More source for less sink

PHOTO SOURCE: M.C.T. TROUGHT

Modifying the leaf area to fruit weight ratio

- Pruning
- Shoot thinning
- Leaf removal
- Trimming (leaf removal)
- Crop removal

Modifying the leaf area to fruit weight ratio

- Pruning
- Shoot thinning
- Leaf removal
- Trimming (leaf removal)
- Crop removal

What's the consequences of modifying the LA: FW ratio?

Phenological timing

AND

Rates of change of berry components

Key composition components:

sugar, acid, pH and berry weight

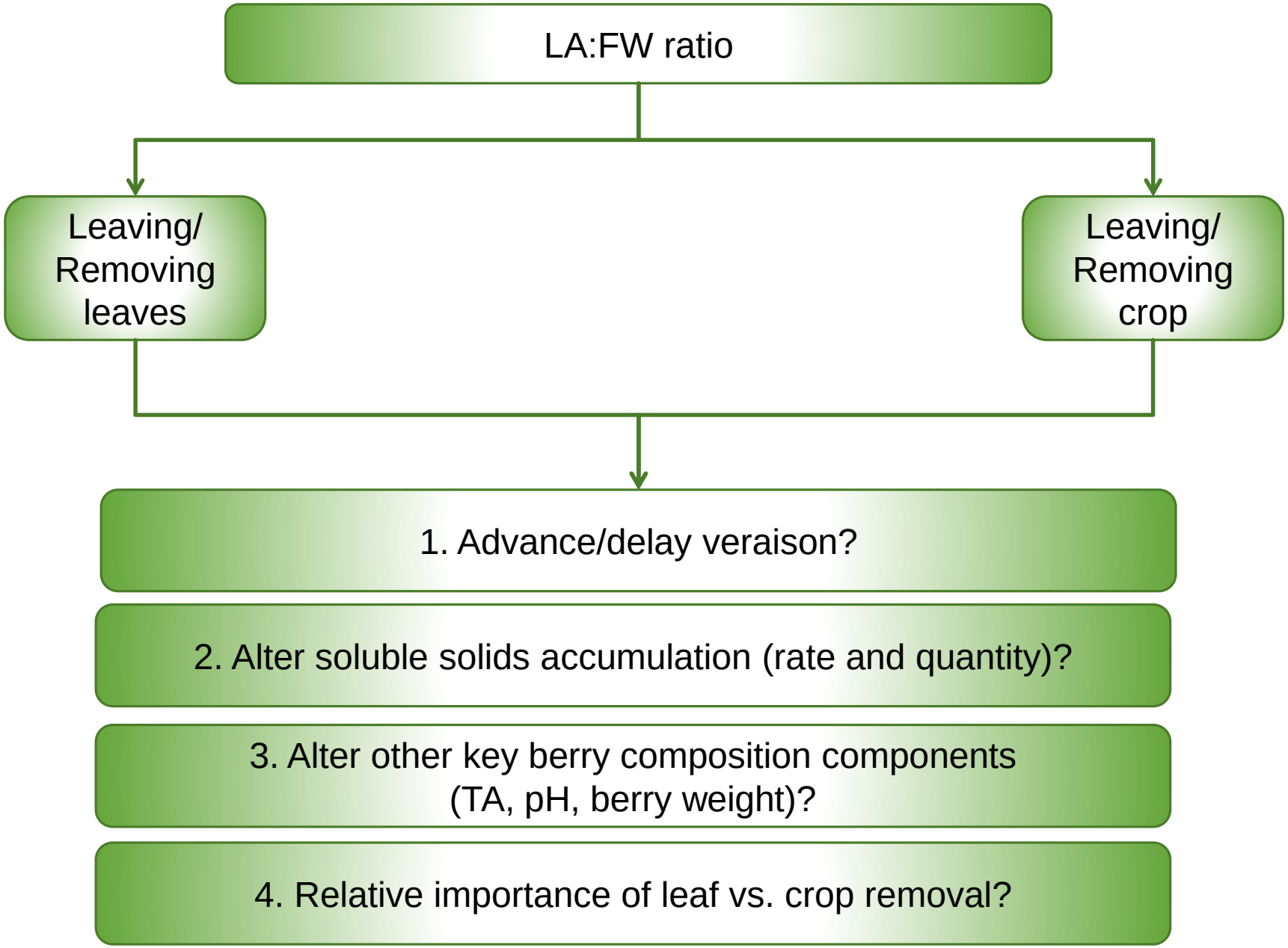
What's in it for Pinot noir?

Increasing temperatures:

- Can LA:FW ratio manipulations delay development so ripening may occur at the same time as current practices and 'quality' maintained?

In cooler climates:

- Can LA:FW ratio manipulations be used to reach targets on time in cooler seasons?


LA:FW ratio
Leaving/ Removing leaves
Leaving/ Removing crop
1. Advance/delay veraison?
2. Alter soluble solids accumulation (rate and quantity)?
3. Alter other key berry composition components (TA, pH, berry weight)?
4. Relative importance of leaf vs. crop removal?

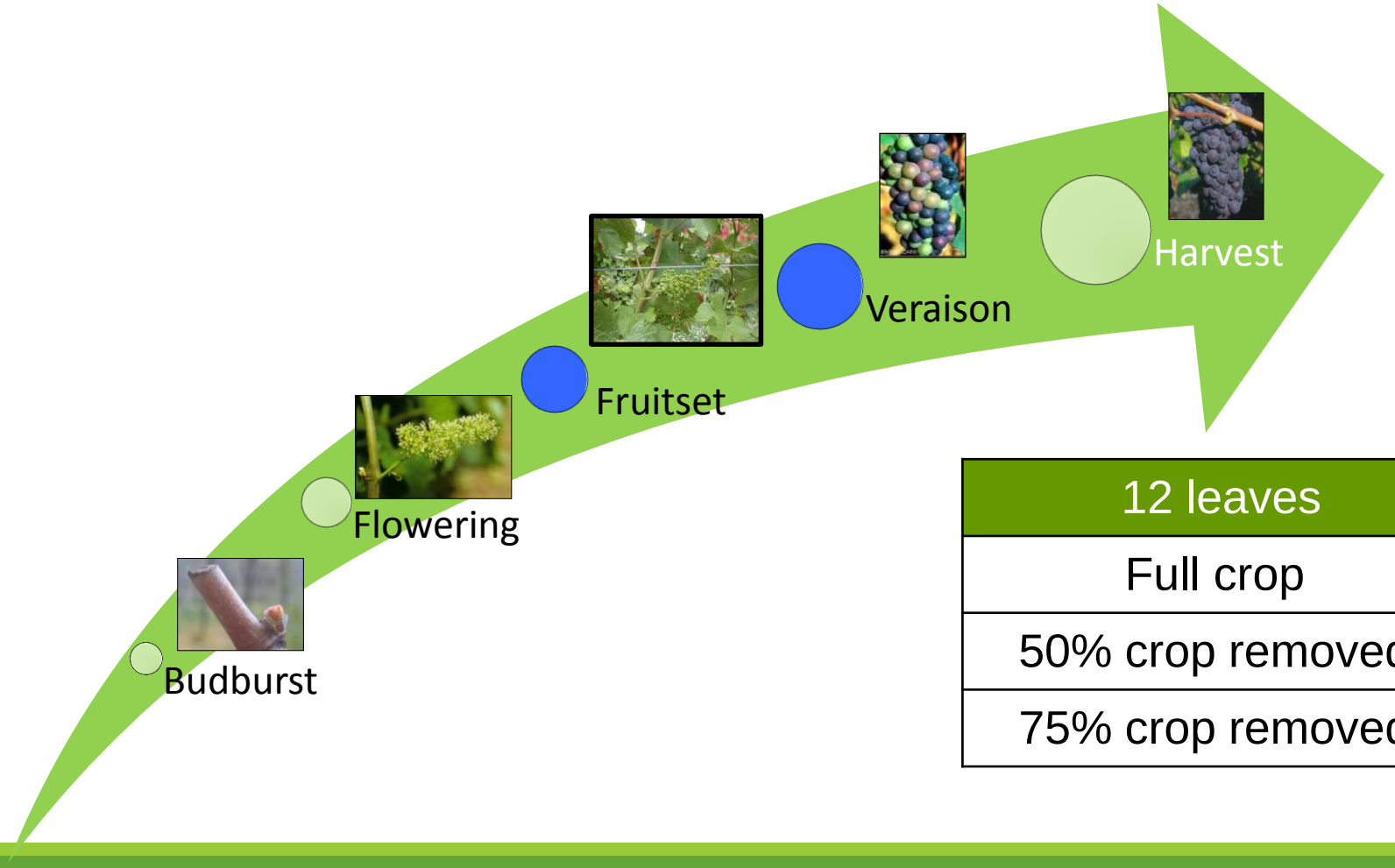
Pinot noir trial

- Wairau valley, Marlborough, New Zealand
- Planted 1998
- Clone 777, Rootstock 101-14MGt
- 4-Cane pruned VSP vines
- 1.8m within row, 3.0 m row spacing
- 2009-2011, new row each year

Results/Figures presented based on:

- Parker, A.K., Hofmann, R. W., van Leeuwen, C. , McLachlan, A.R.G and Trought, M.C.T. (2015, early view) Manipulating the leaf area to fruit weight ratio alters the synchrony of soluble solids accumulation and titratable acidity of grapevines: implications for modelling fruit development. *Australian Journal of Grape and Wine Research*.
- Parker, A.K., Hofmann, R.W., van Leeuwen, C., McLachlan, A.R.G., and Trought, M.C.T. (2014) Leaf area to fruit weight ratio determines the time of veraison in Sauvignon Blanc and Pinot Noir grapevines. *Australian Journal of Grape and Wine Research,* **20**, 422-731.

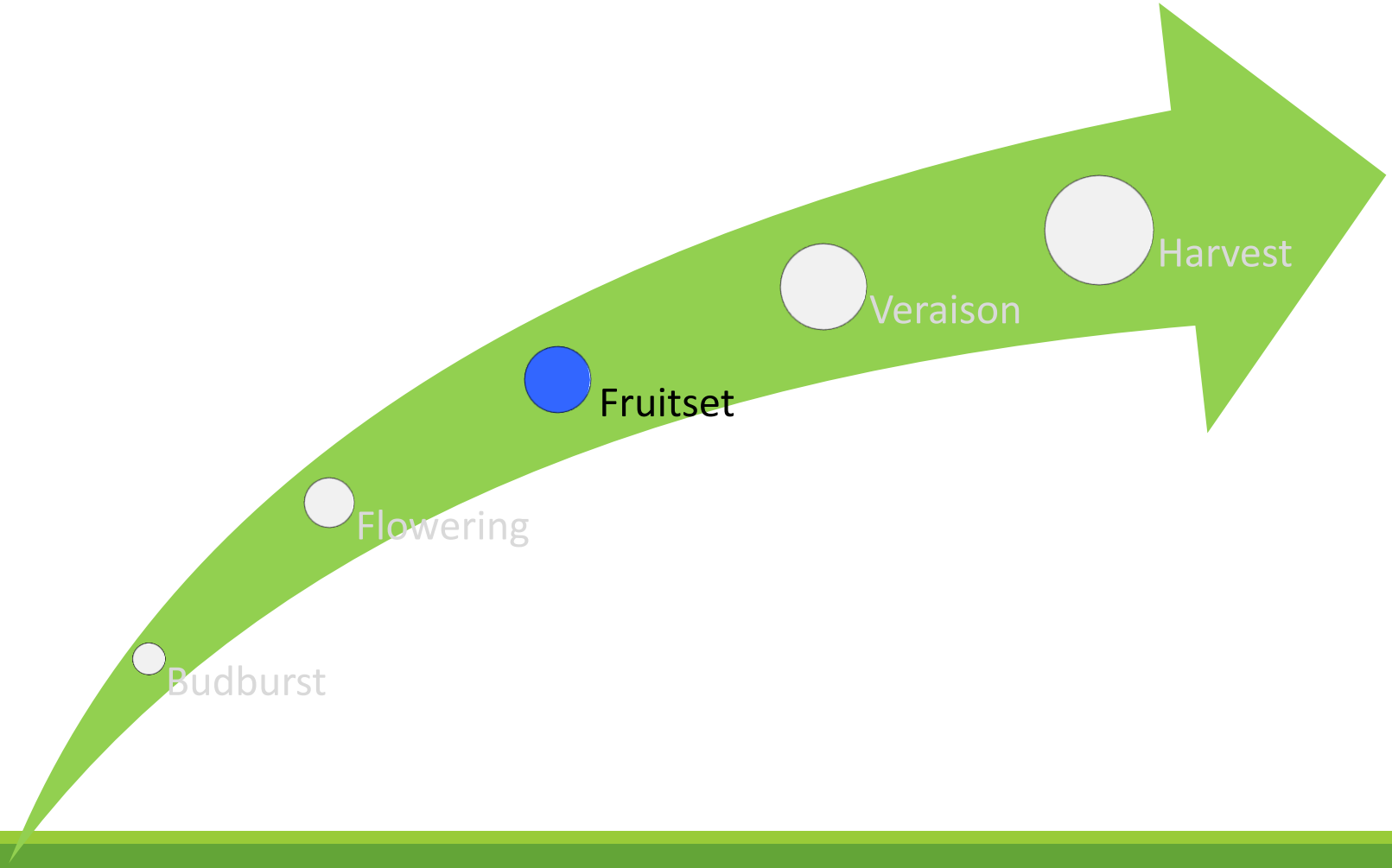
Pinot noir trial



12 leaves	6 leaves
Full crop	Full crop
50% crop removed	50% crop removed
75% crop removed	75% crop removed

PHOTO SOURCE: I.GARCIA DE CORTAZAR ATAURI, M.C.T. TROUGHT

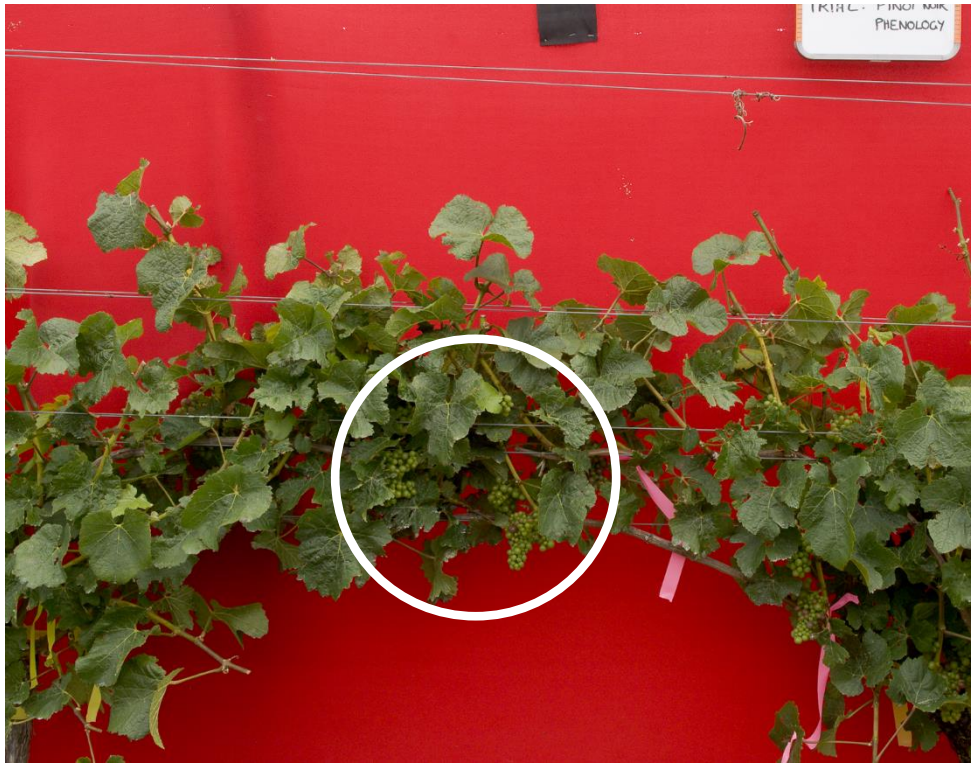
LA:FW modification at fruitset



LA:FW modifications at Fruitset: effects on yield and LA:FW

Leaves per shoot	Crop removal (% removal)	Yield (kg/m^2)	Yield (T/ha)	Leaf area (m^2/m)	LA: FW (m^2/kg)
6 leaves	0	4.10	15.2	1.18	0.29
	50	1.93	7.2	1.03	0.54
	75	1.16	4.3	1.10	0.98
12 leaves	0	3.82	14.2	1.72	0.45
	50	1.98	7.3	1.94	0.99
	75	1.34	5.0	2.33	1.8

LA:FW modifications at fruitset: effects on veraison



LA:FW modifications at fruitset: effects on veraison

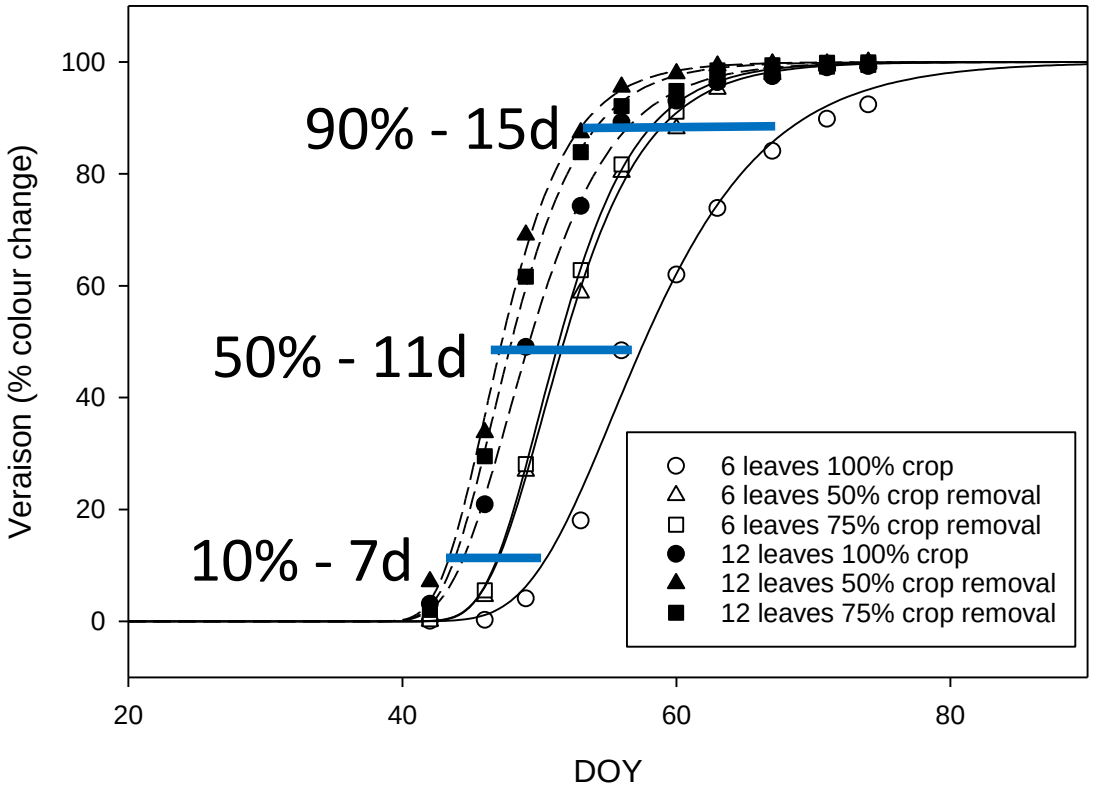
12 main leaves per shoot

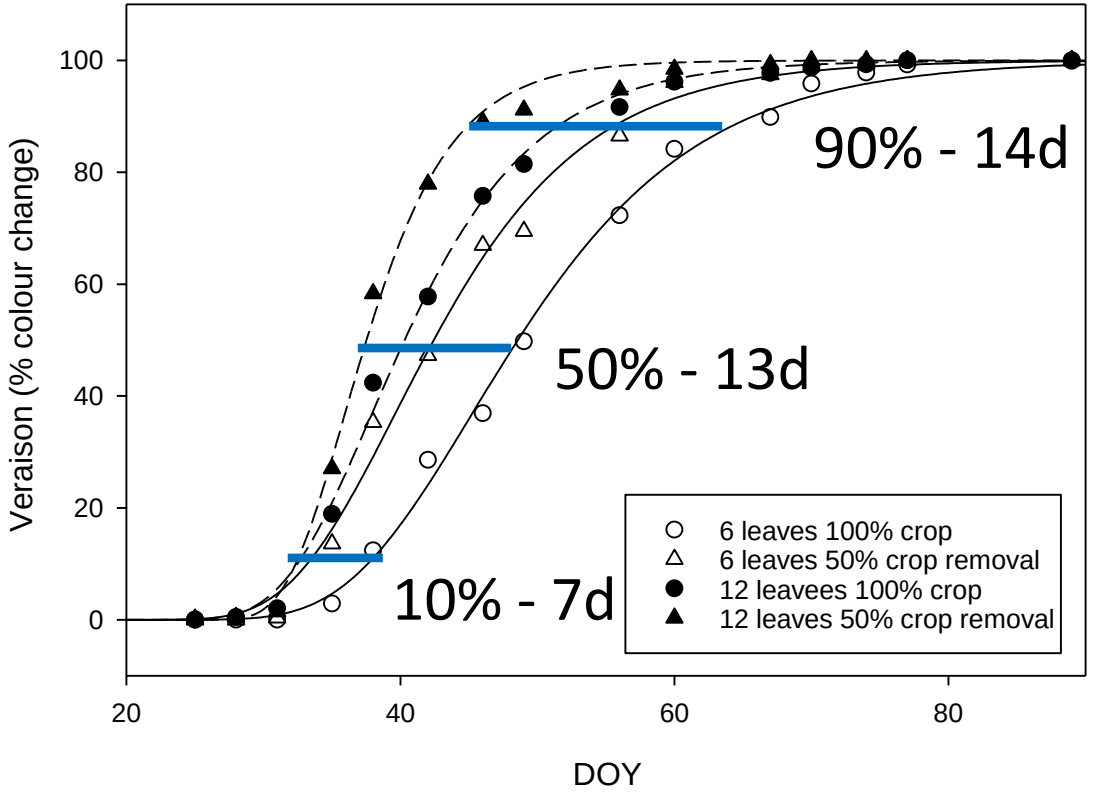
50% crop removed

6 main leaves per shoot

75% crop removed

LA:FW modifications at fruitset: effects on veraison

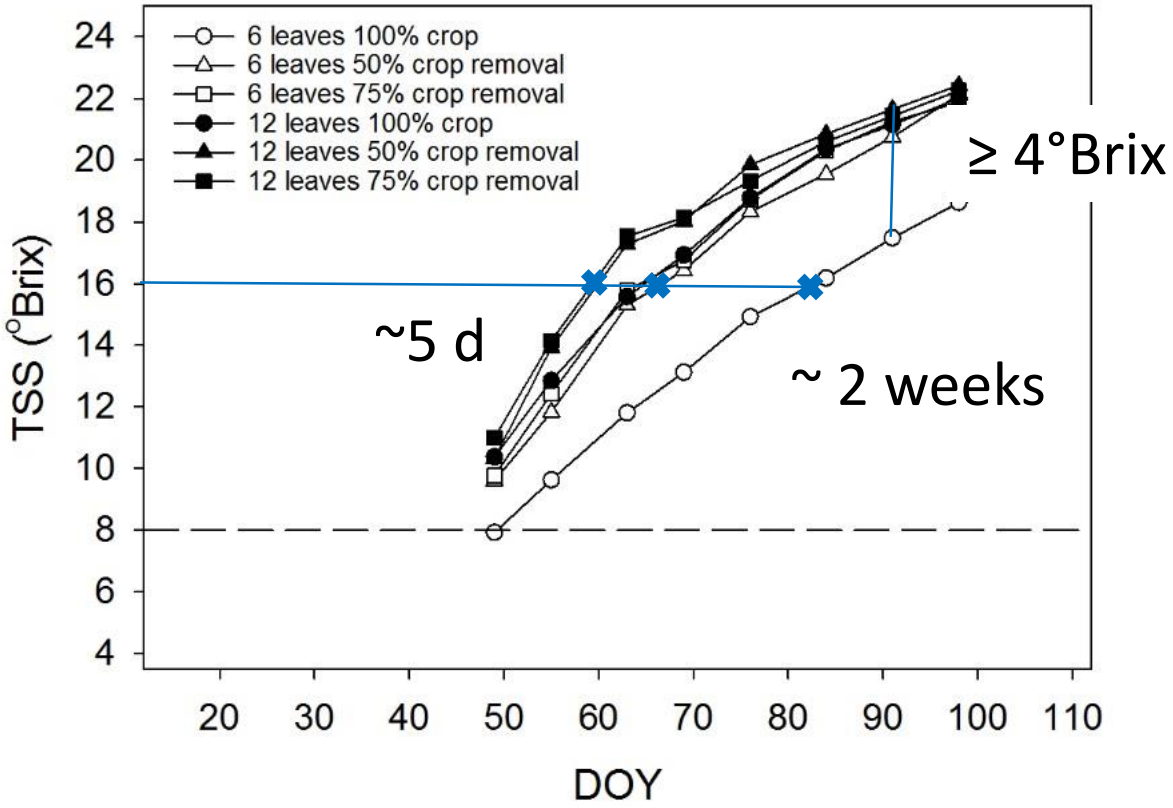




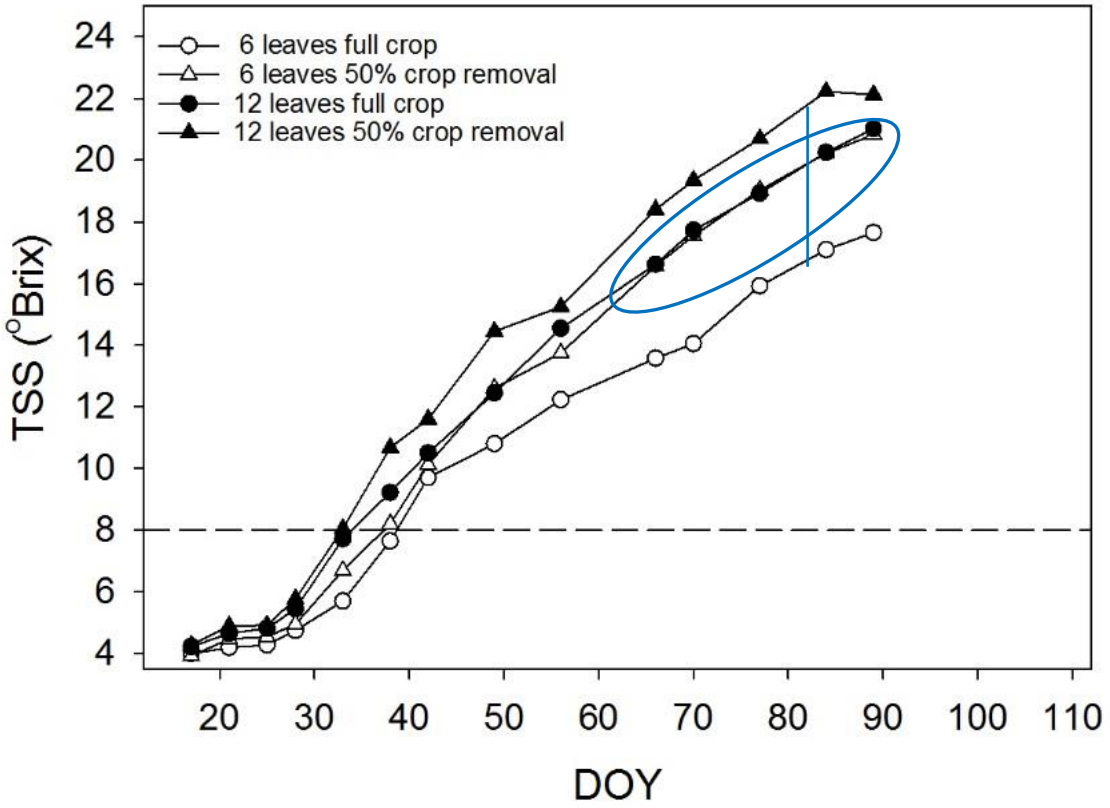
2009-2010

2010-2011

LA:FW modifications at fruitset: effects on total soluble solids concentration

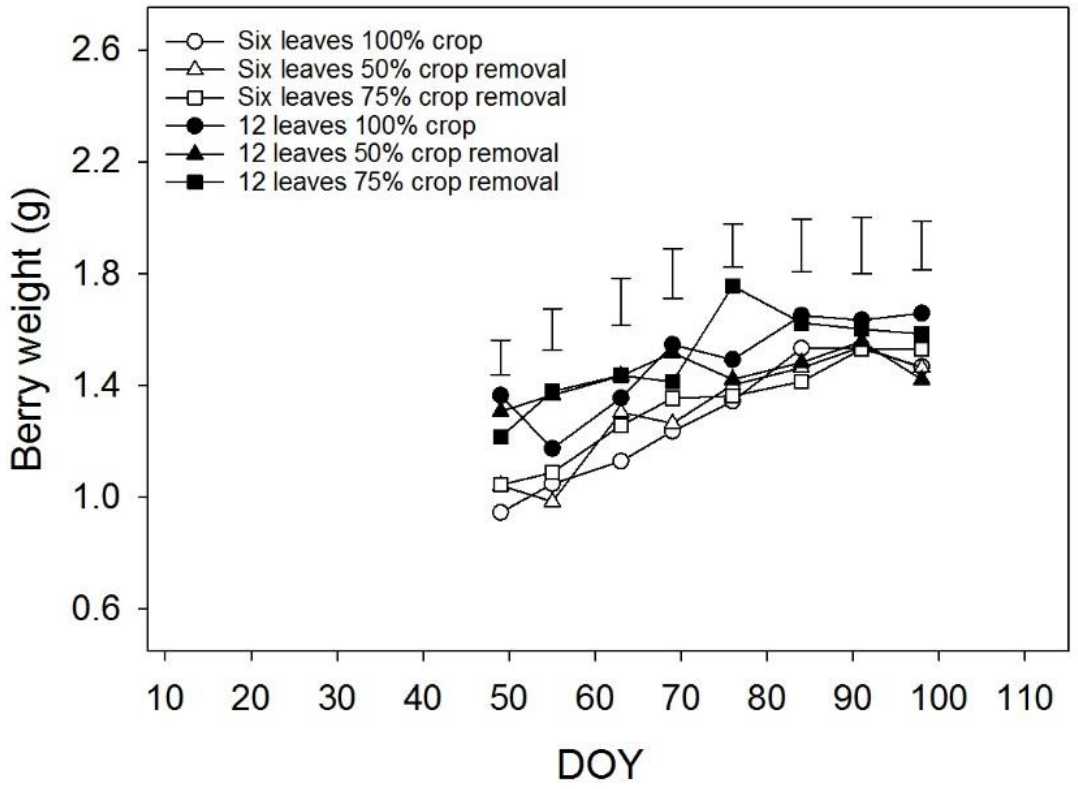


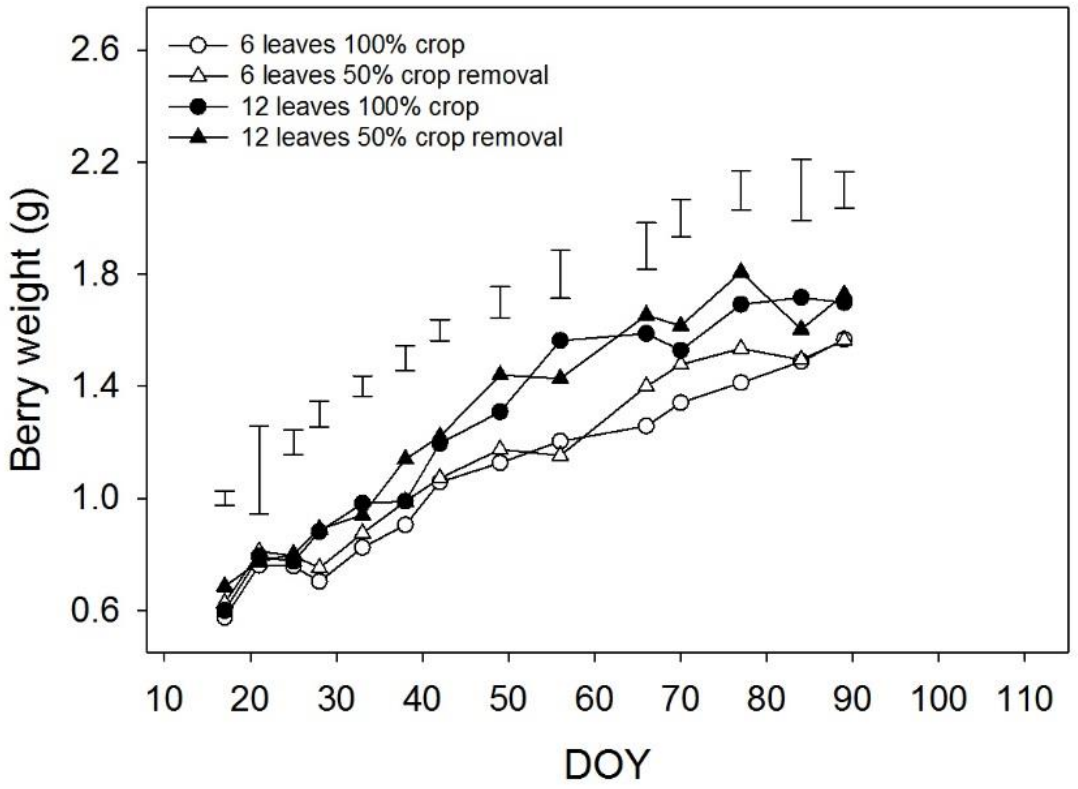
2009-2010



2010-2011

LA:FW modifications at fruitset: effects on berry weight

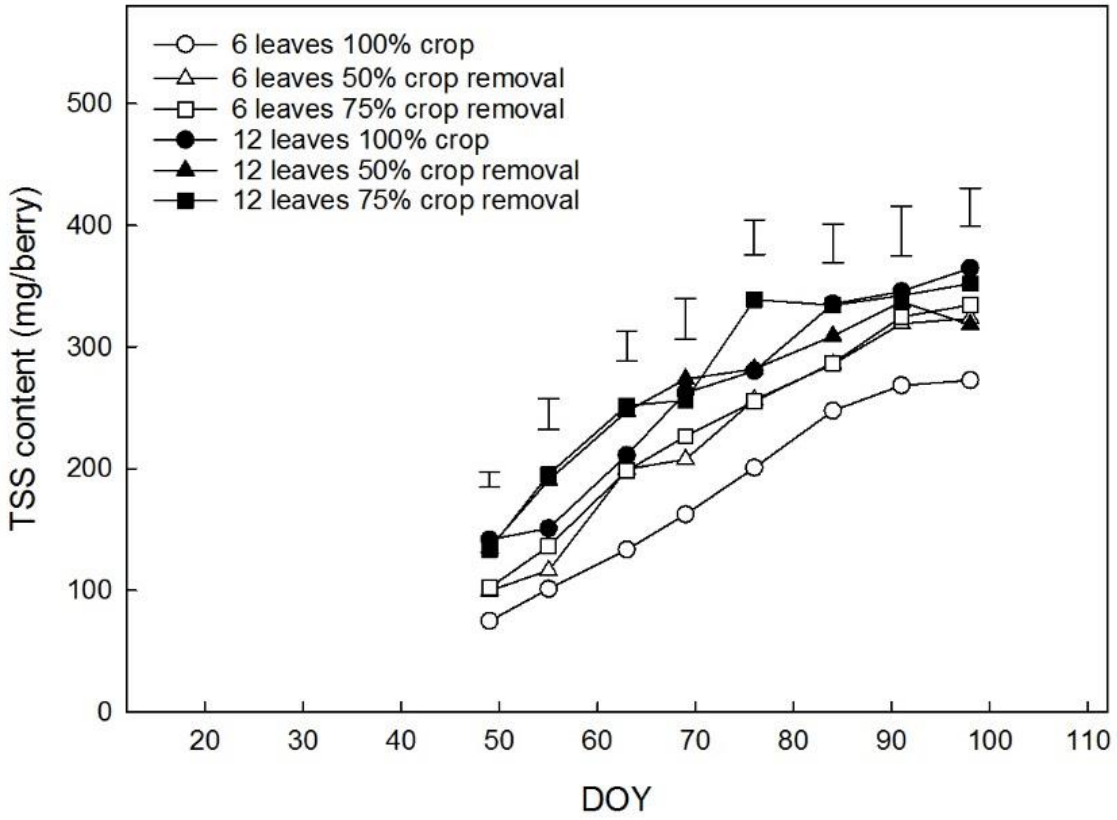




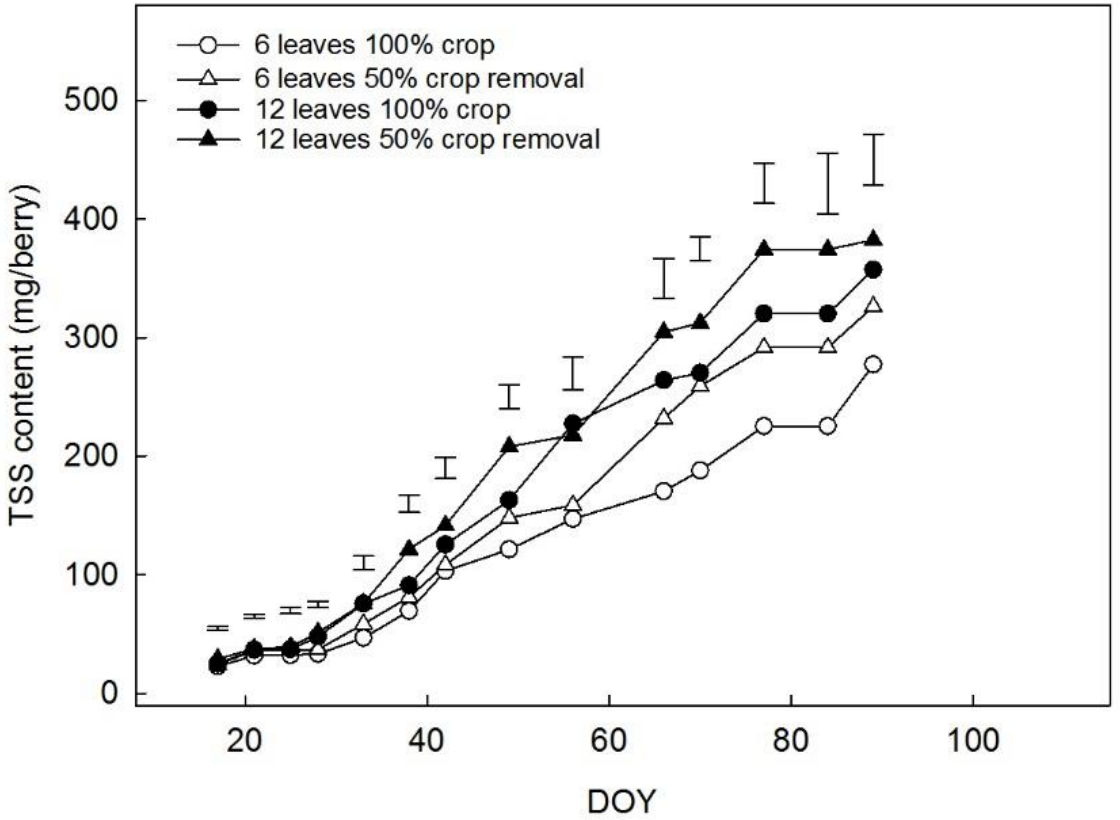
2009-2010

2010-2011

LA:FW modifications at fruitset: effects on total soluble solids content



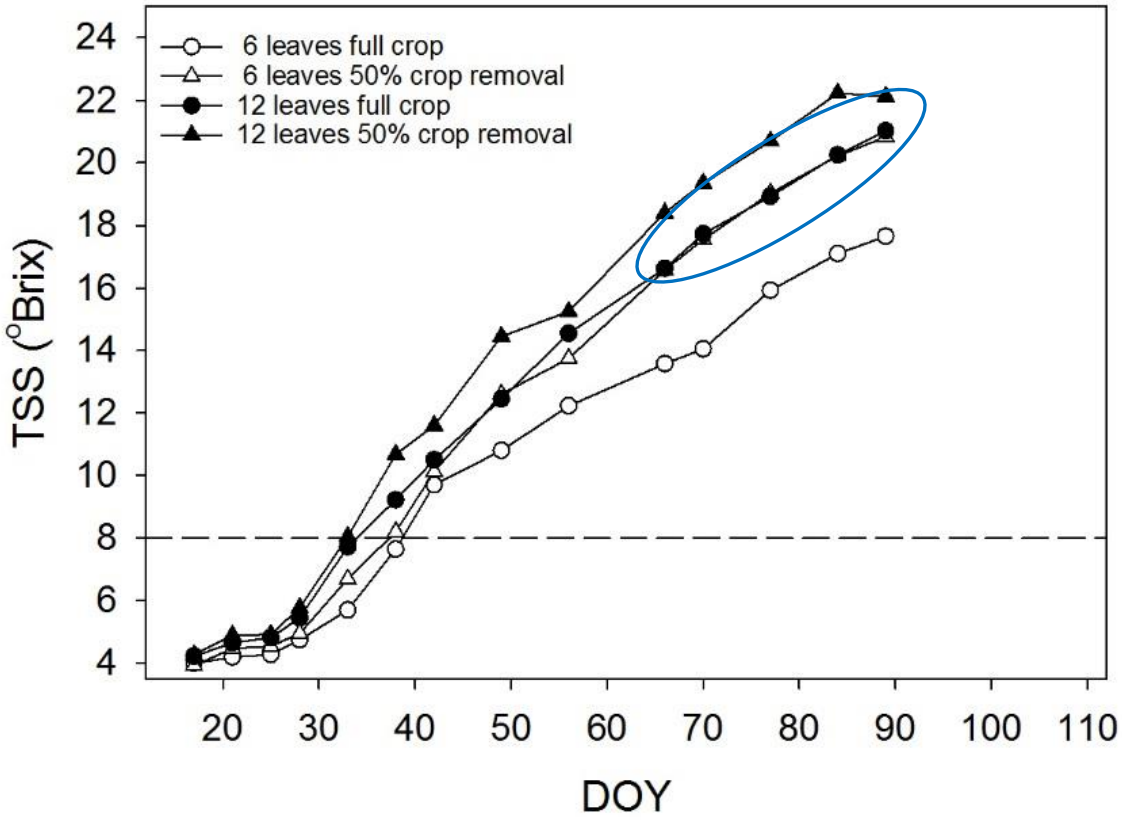
2009-2010

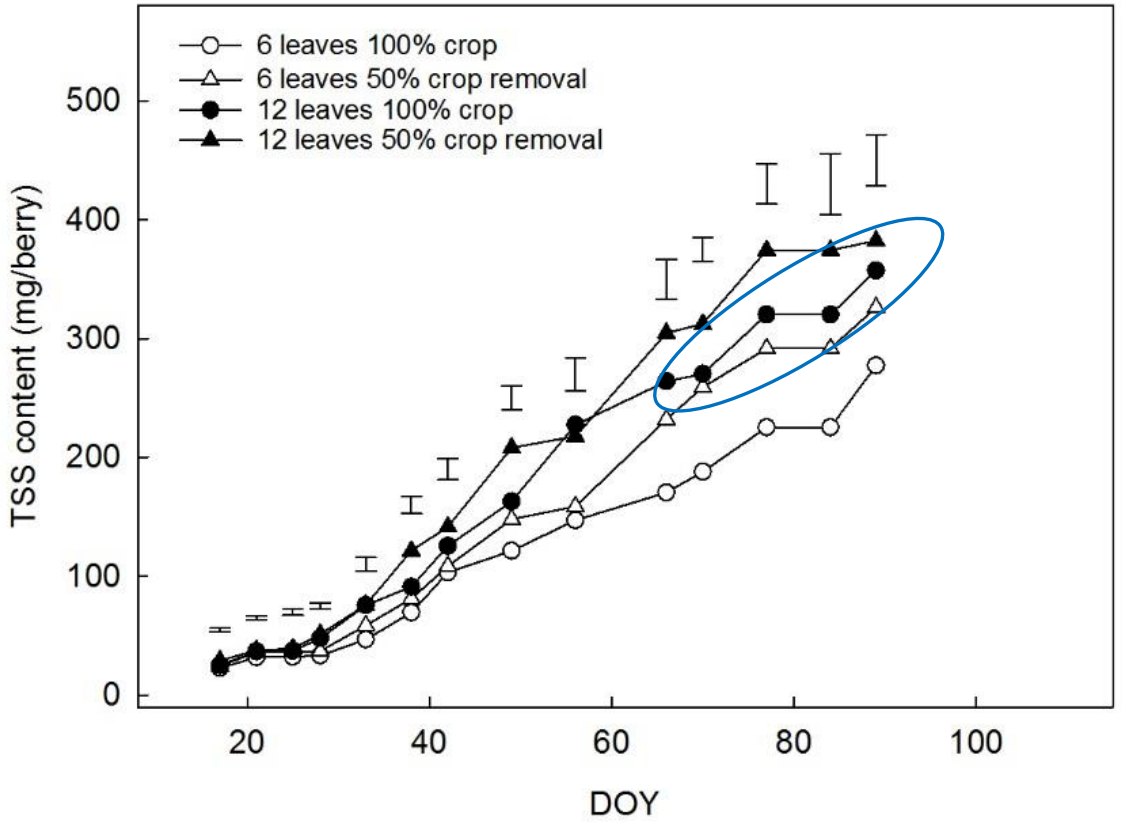


2010-2011

LA:FW modifications at fruitset: TSS concentration versus content

12 leaves treatments TSS content
> 6 leaves treatments

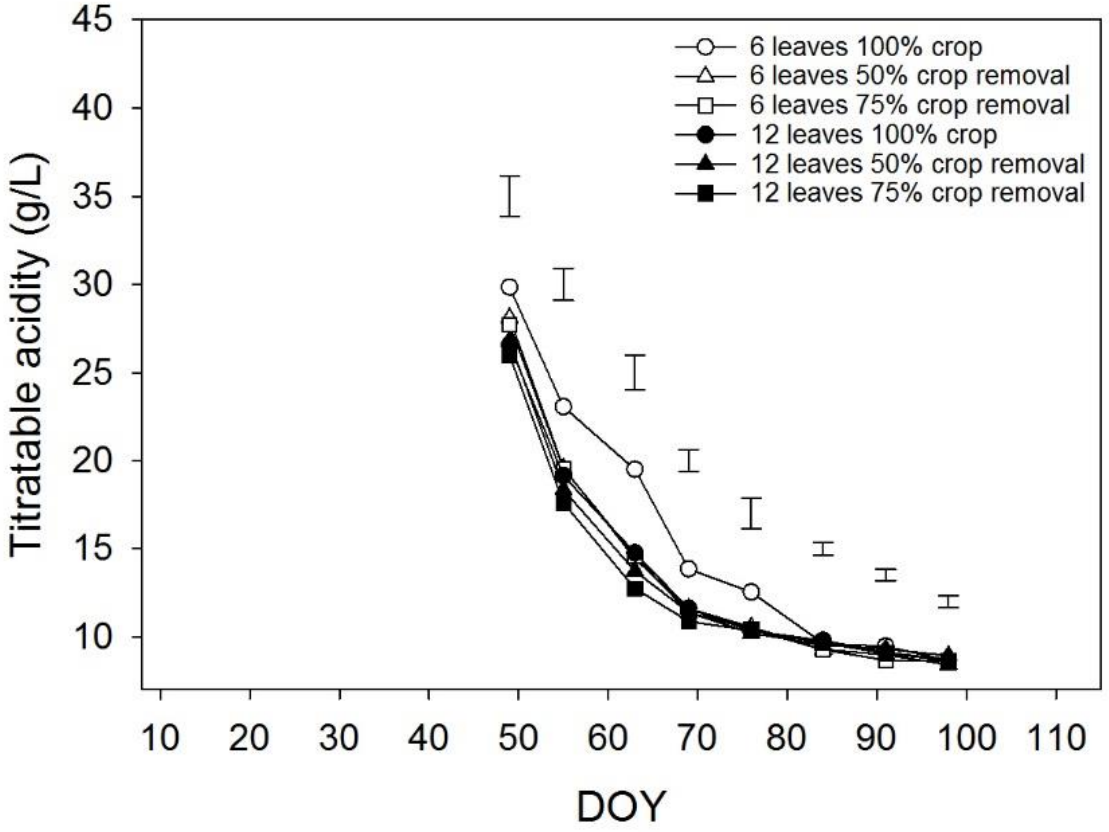




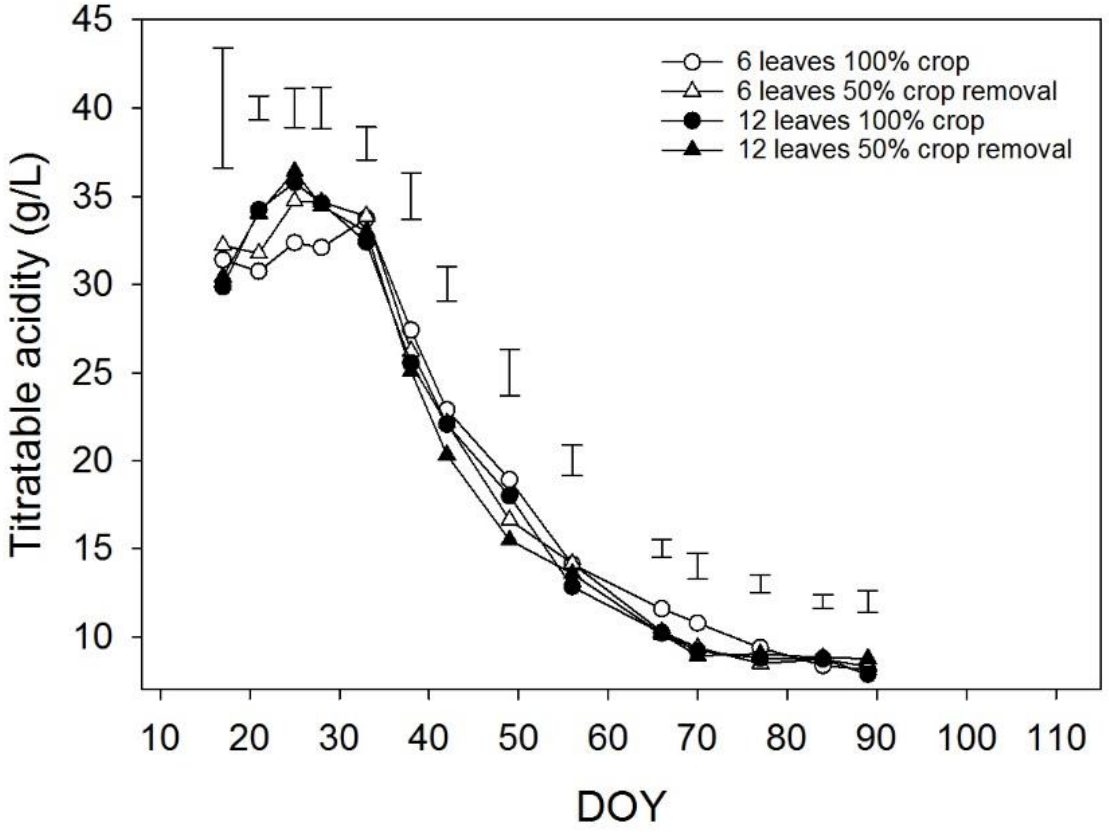
TSS concentration

TSS content

LA:FW modifications at fruitset: effect on titratable acidity

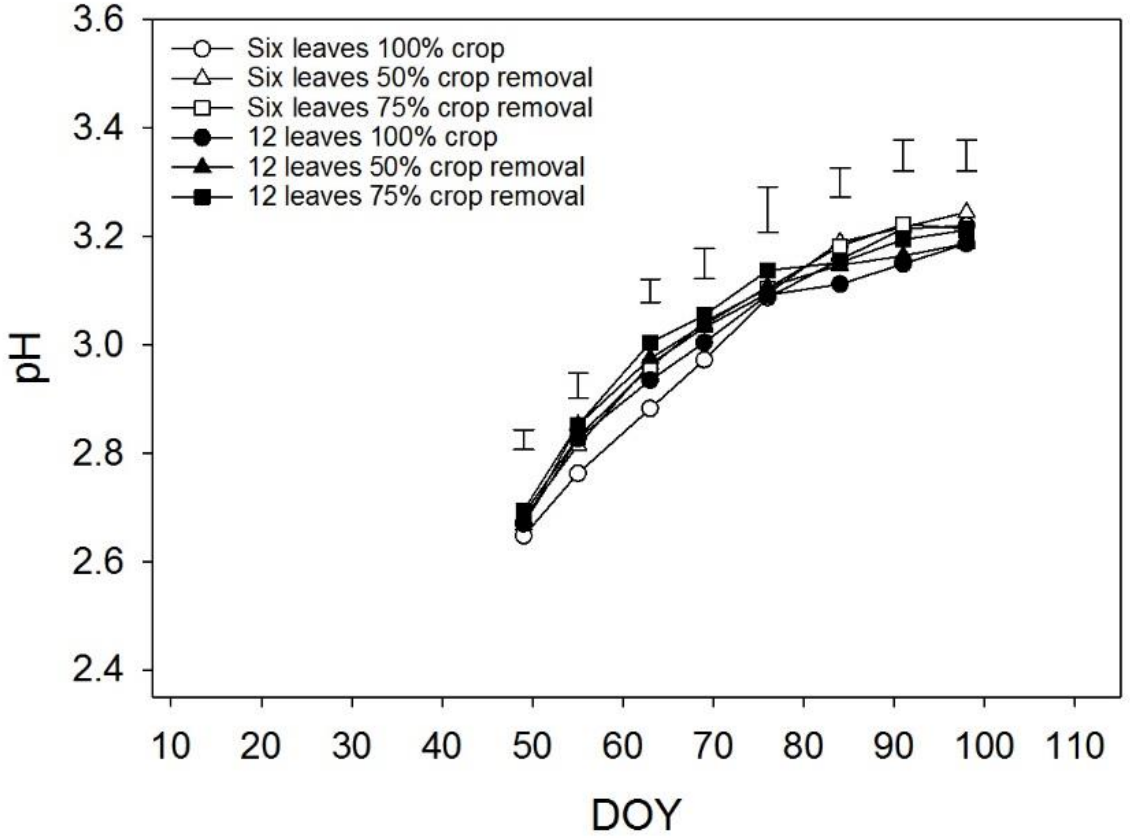


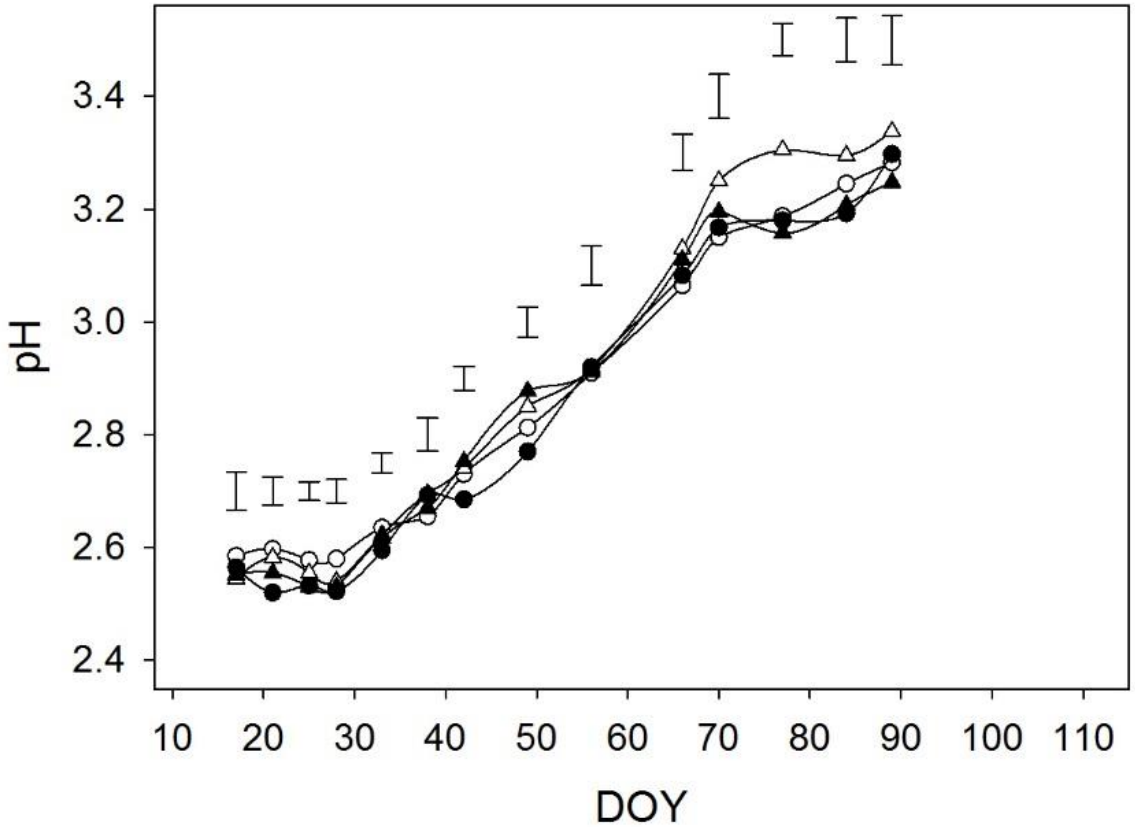
2009-2010



2010-2011

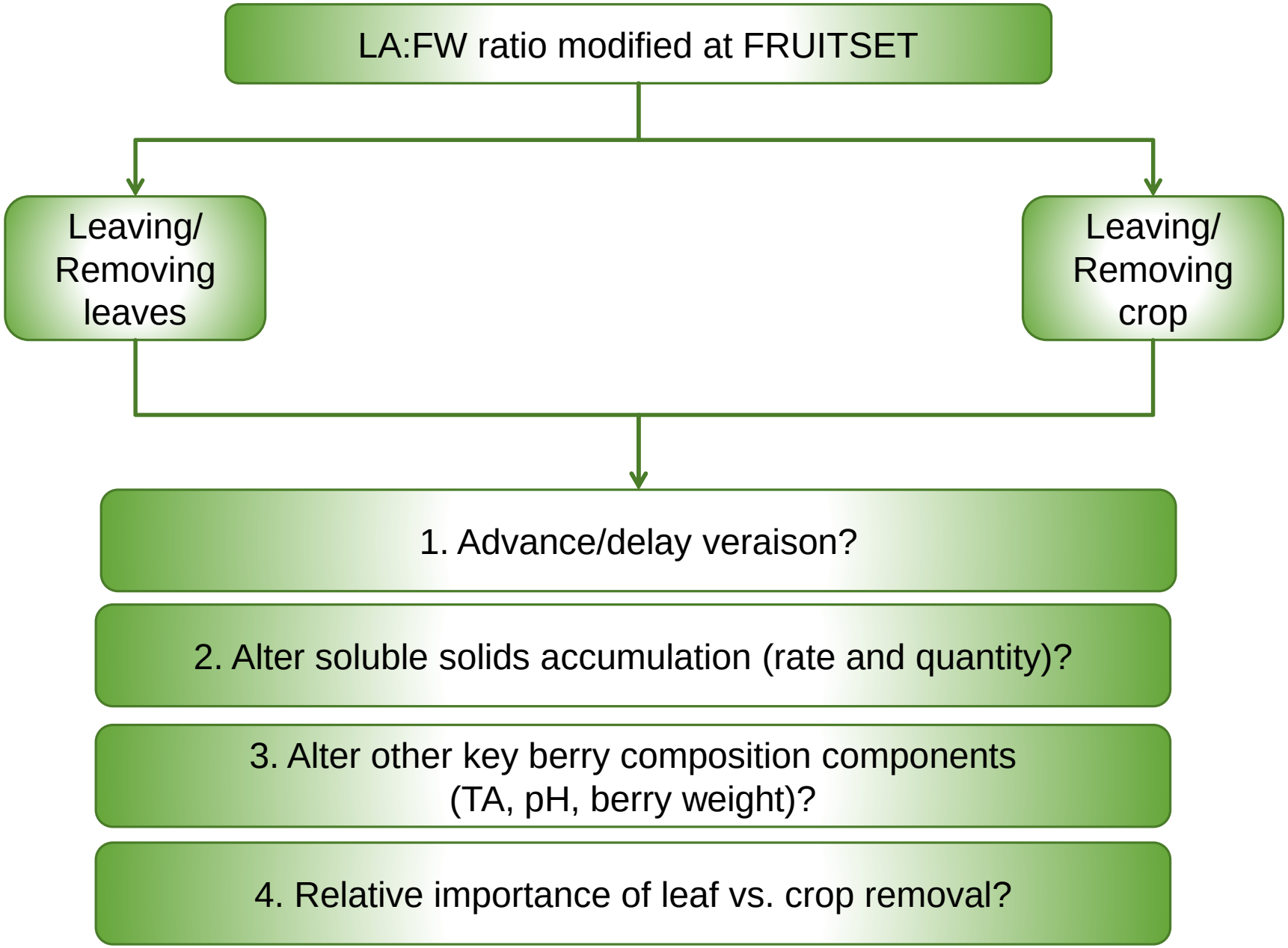
LA:FW modifications at fruitset: effects on pH

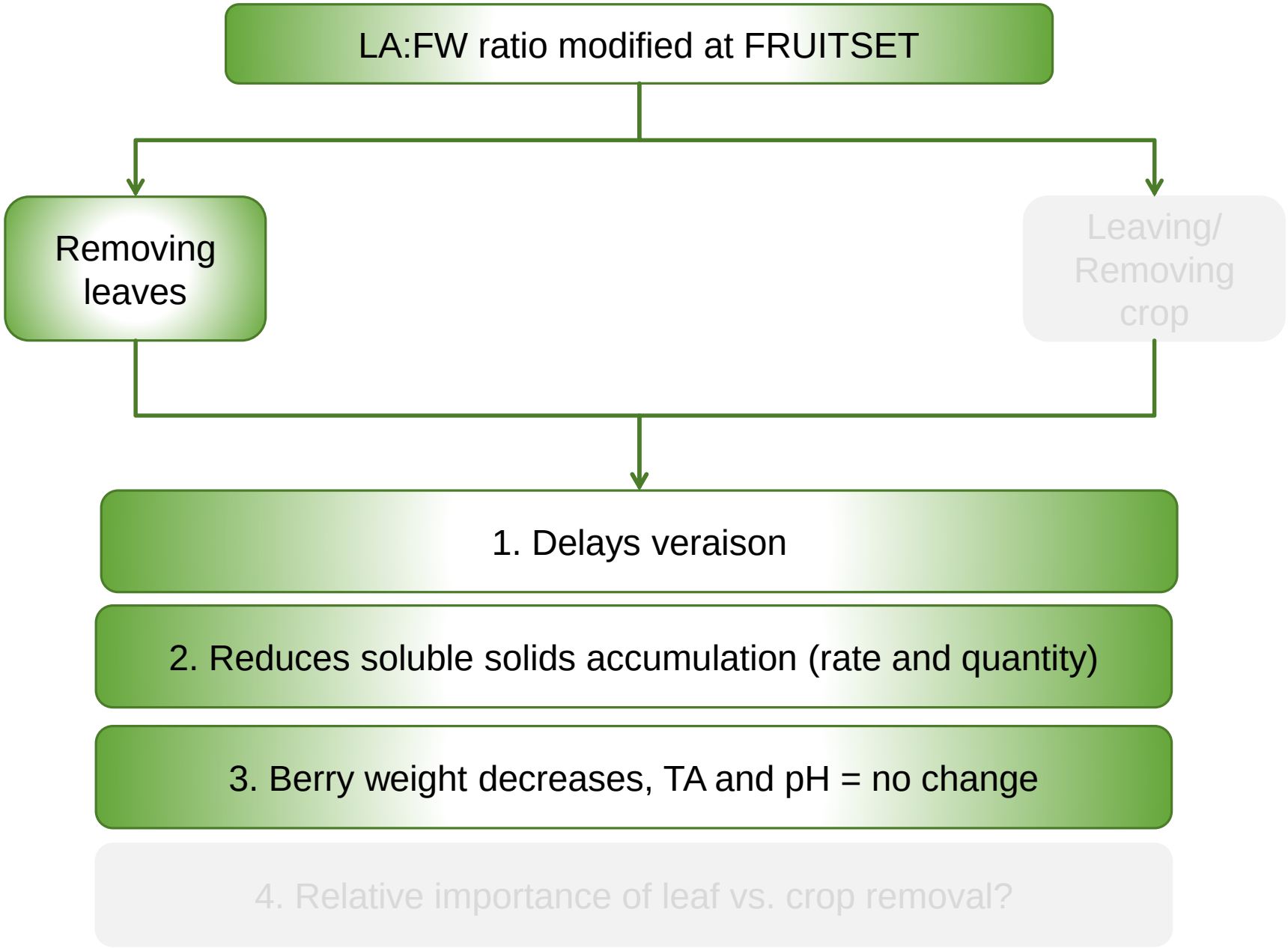


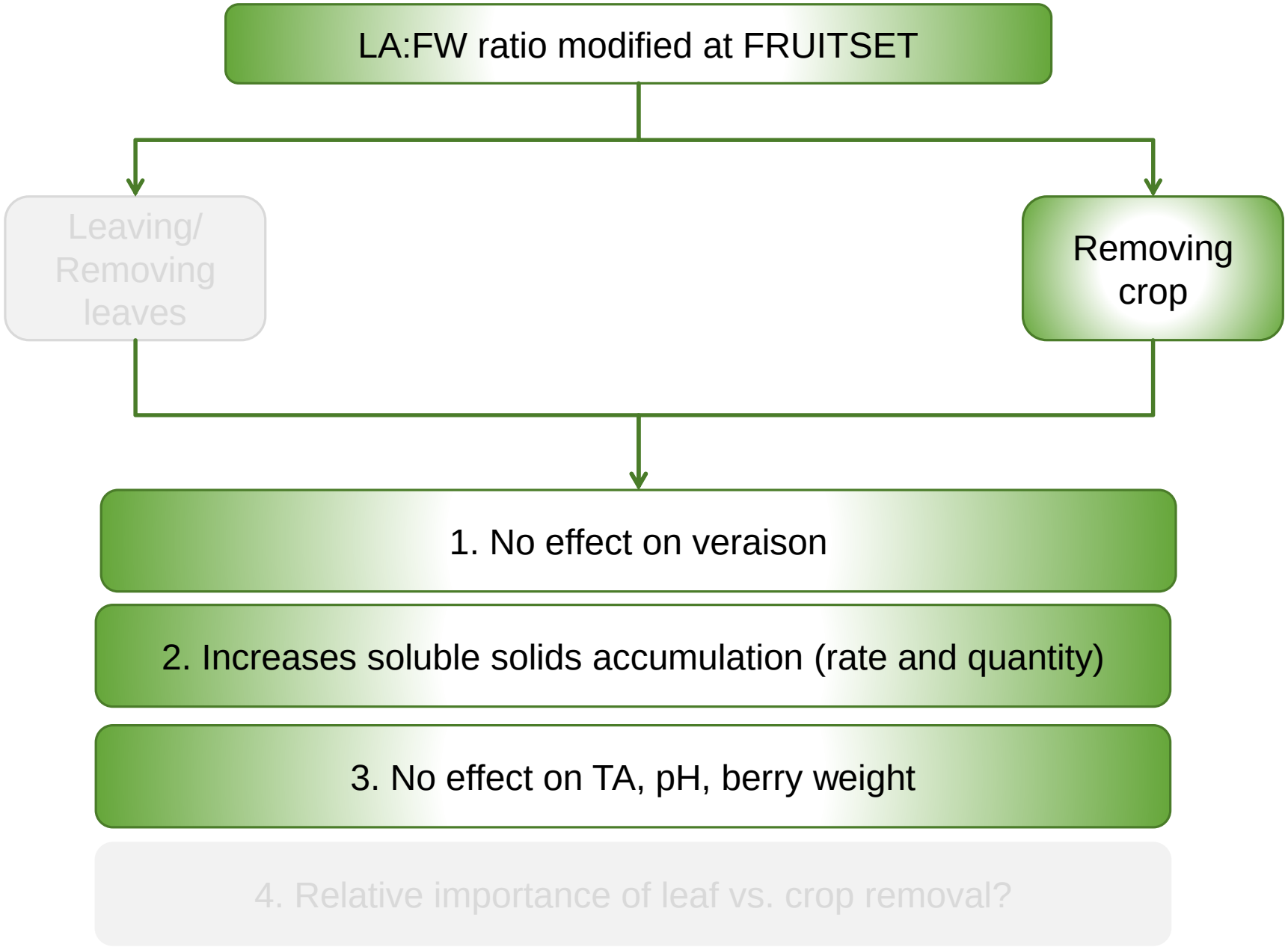


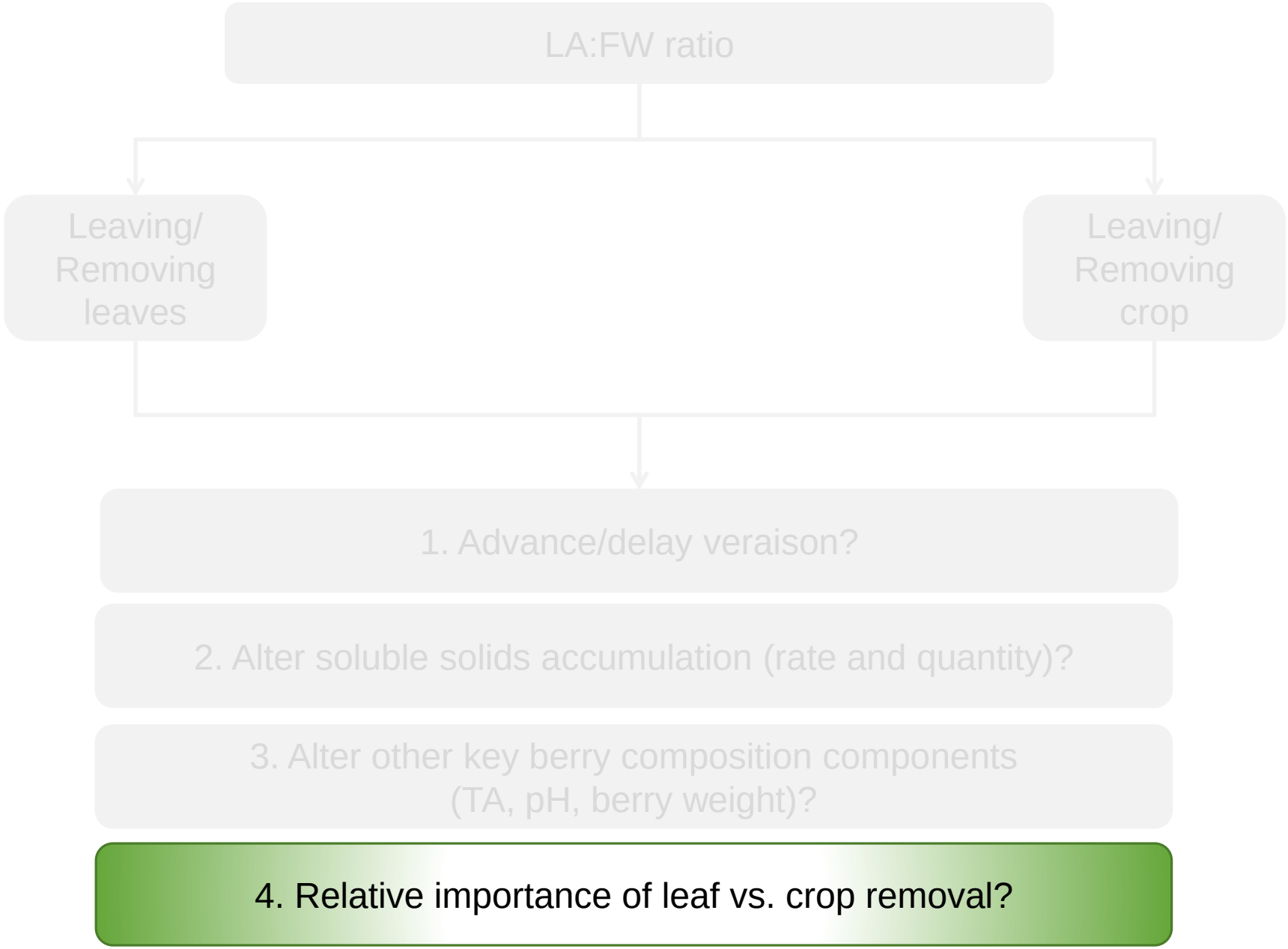
2009-2010

2010-2011


LA:FW ratio modified at FRUITSET
Leaving/ Removing leaves
Leaving/ Removing crop
1. Advance/delay veraison?
2. Alter soluble solids accumulation (rate and quantity)?
3. Alter other key berry composition components (TA, pH, berry weight)?
4. Relative importance of leaf vs. crop removal?


LA:FW ratio modified at FRUITSET
Removing leaves
Leaving/ Removing crop
1. Delays veraison
2. Reduces soluble solids accumulation (rate and quantity)
3. Berry weight decreases, TA and pH = no change
4. Relative importance of leaf vs. crop removal?

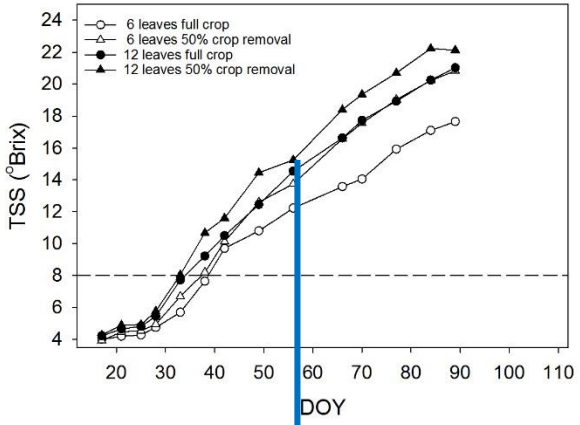

LA:FW ratio modified at FRUITSET
Leaving/ Removing leaves
Removing crop
1. No effect on veraison
2. Increases soluble solids accumulation (rate and quantity)
3. No effect on TA, pH, berry weight
4. Relative importance of leaf vs. crop removal?

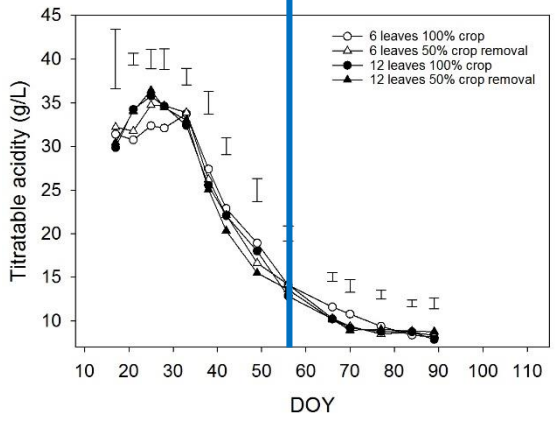

LA:FW ratio
Leaving/ Removing leaves
Leaving/ Removing crop
1. Advance/delay veraison?
2. Alter soluble solids accumulation (rate and quantity)?
3. Alter other key berry composition components (TA, pH, berry weight)?
4. Relative importance of leaf vs. crop removal?

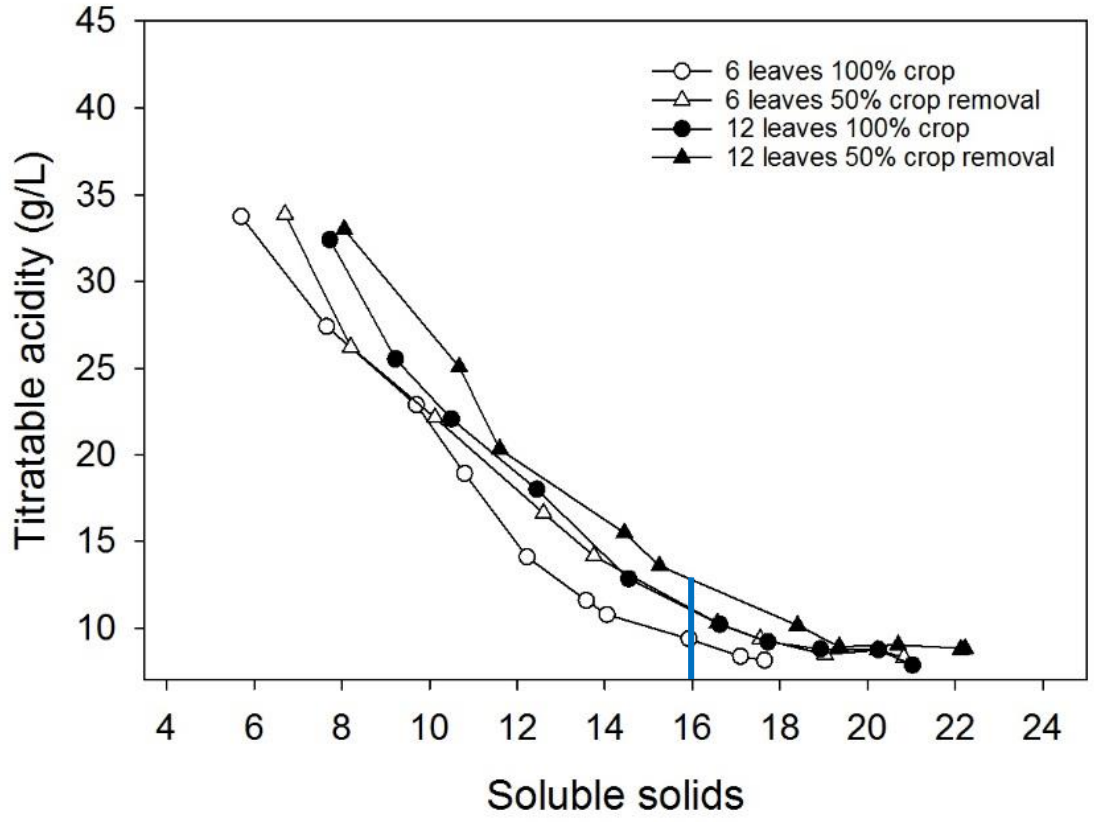
Leaf versus crop removal

- Same ratio by different means = same rate of TSS accumulation
- Reduced yield can compensate for source limitation (reduced LA)
- Combination of reduced LA and no crop removal = slowest rates

LA:FW modifications at fruitset: decouples SS:TA

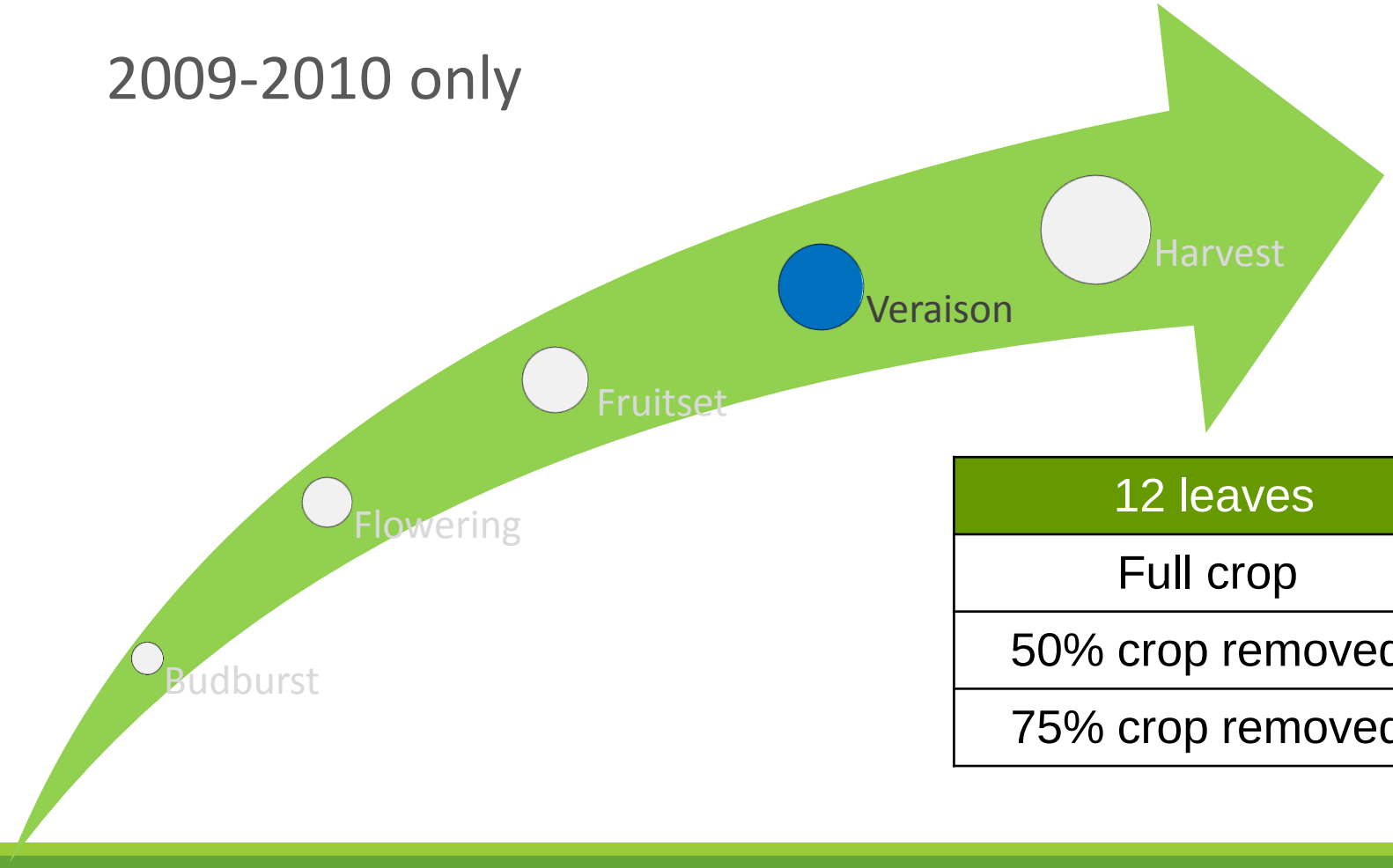






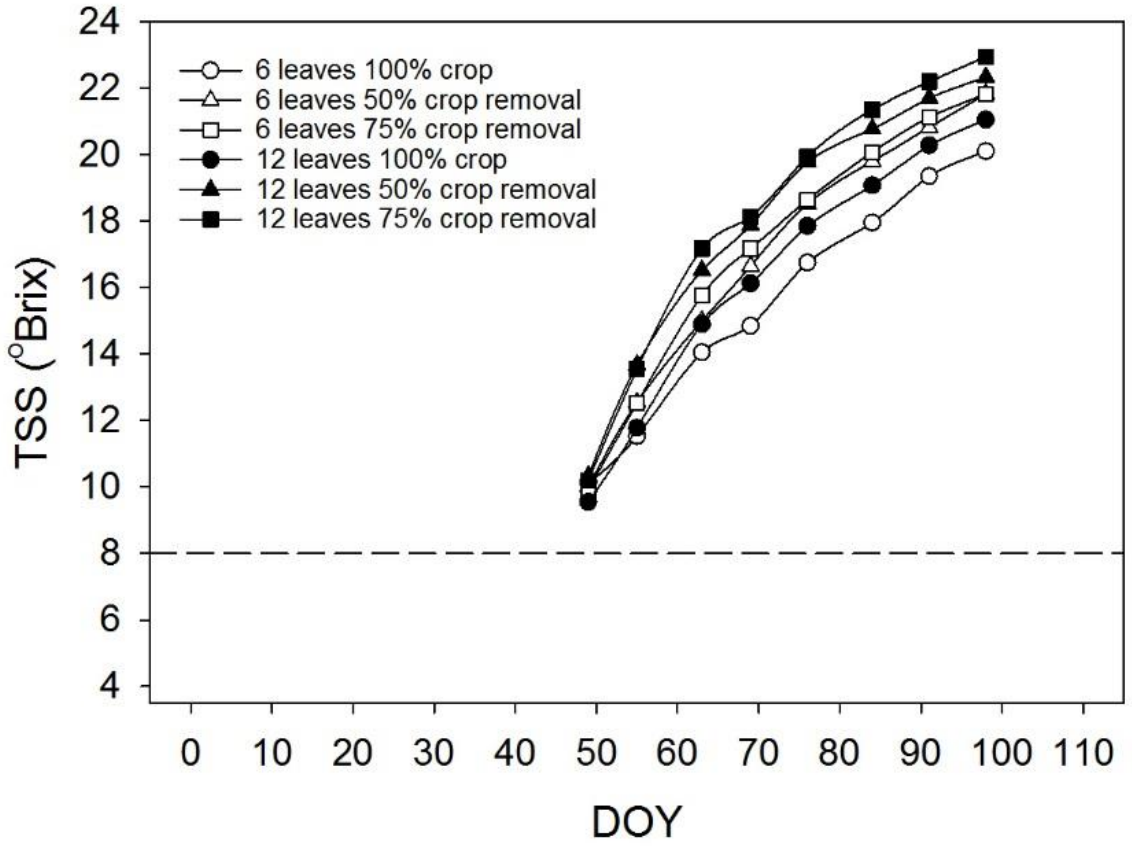
LA:FW modifications at veraison

2009-2010 only

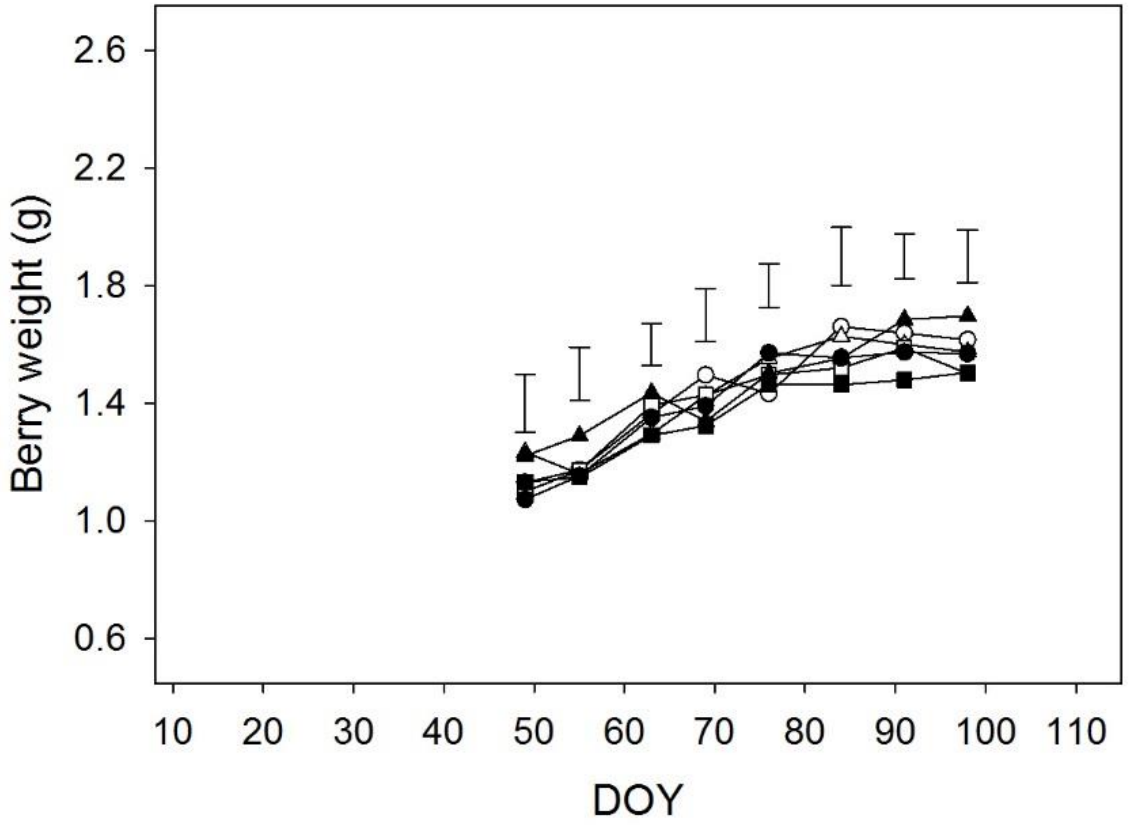


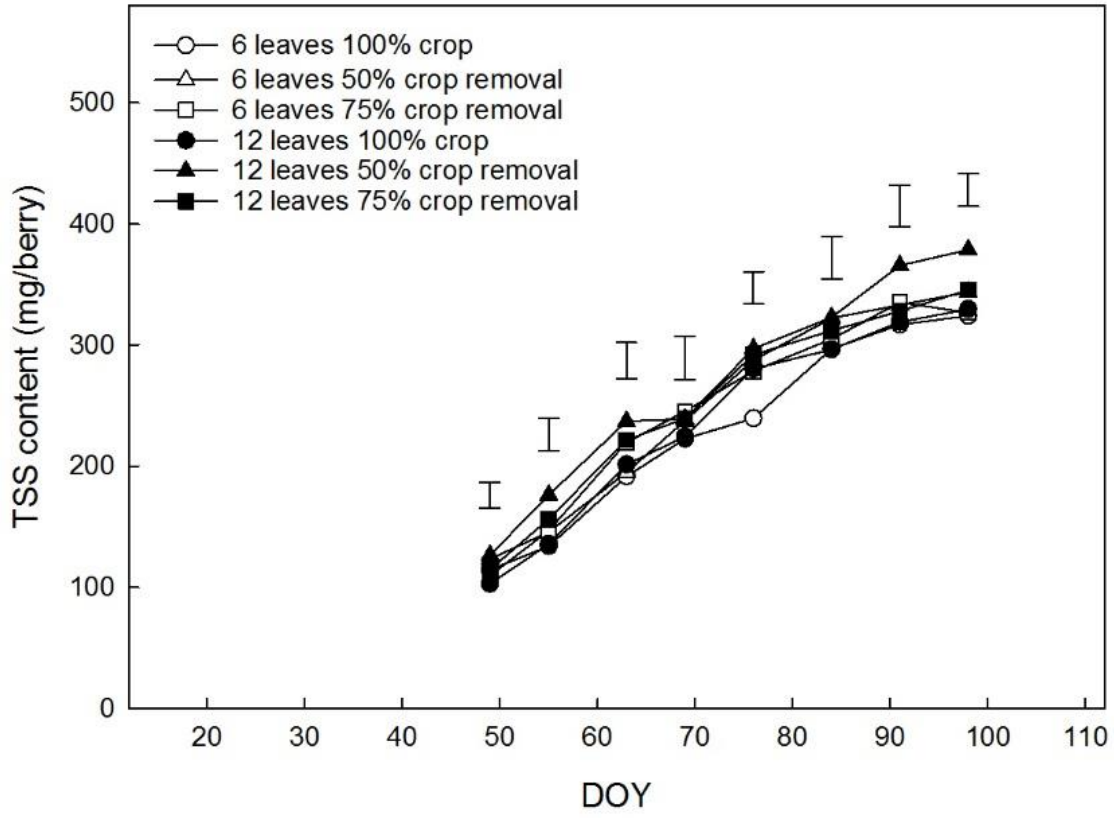
12 leaves	6 leaves
Full crop	Full crop
50% crop removed	50% crop removed
75% crop removed	75% crop removed

LA:FW modifications at veraison: effects on total soluble solids concentration

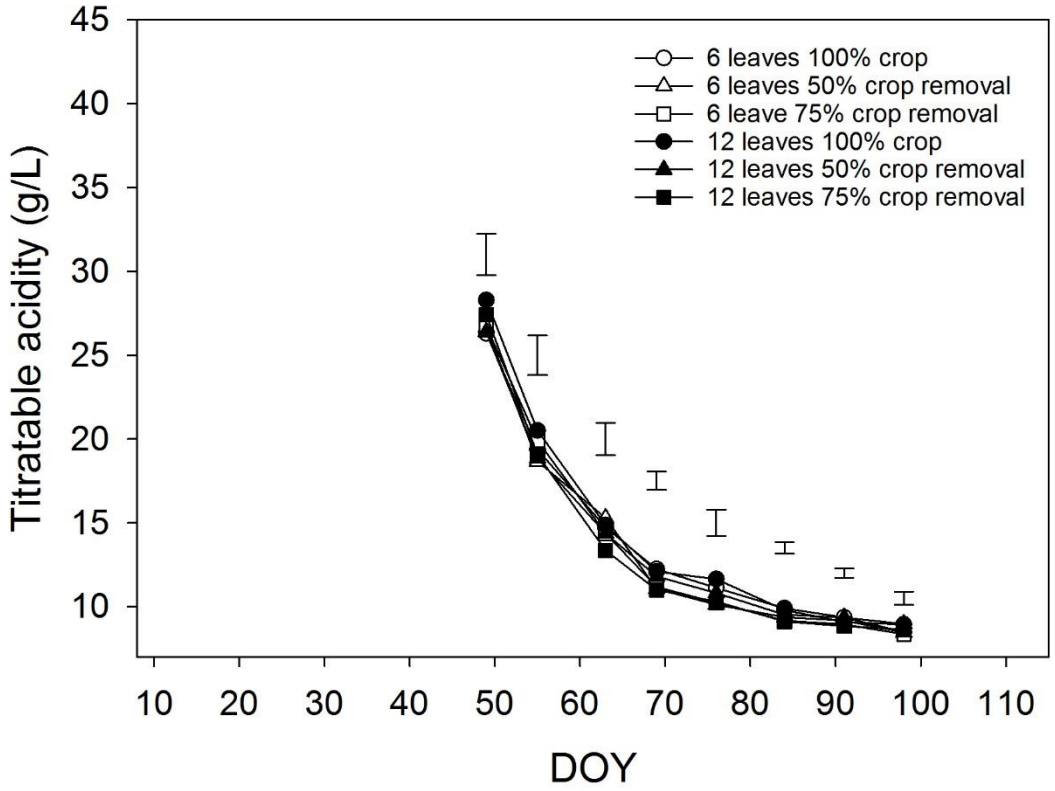


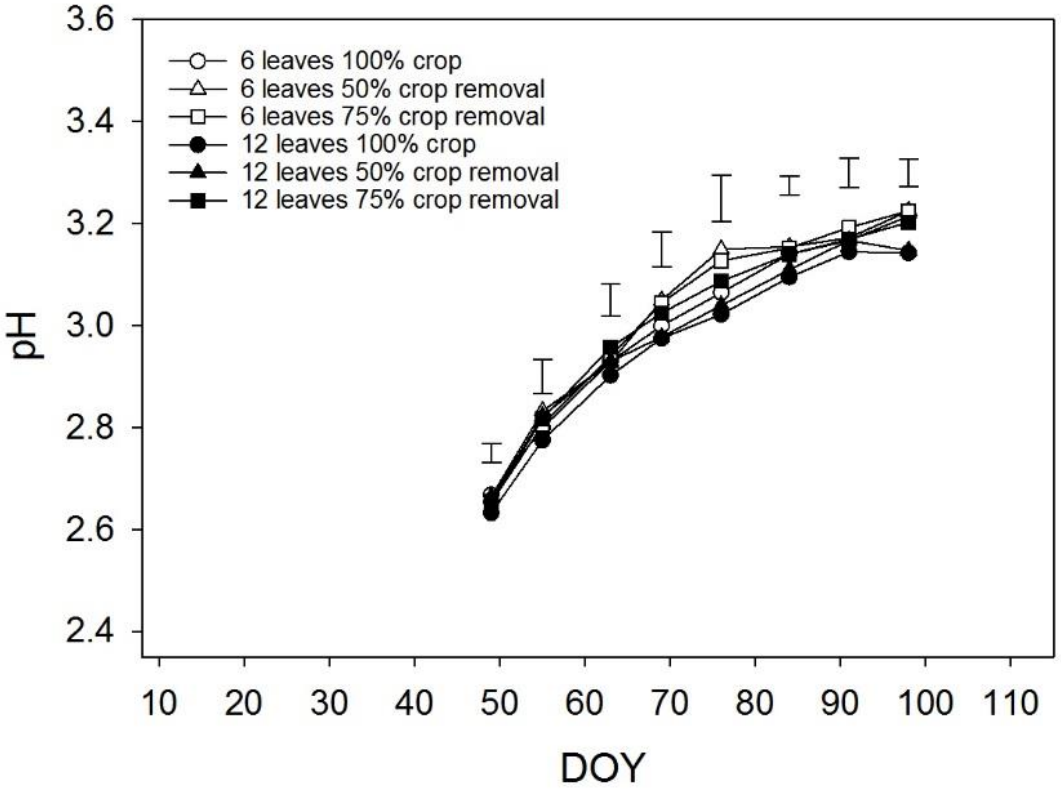
LA:FW modifications at veraison: effects on berry weight and TSS content

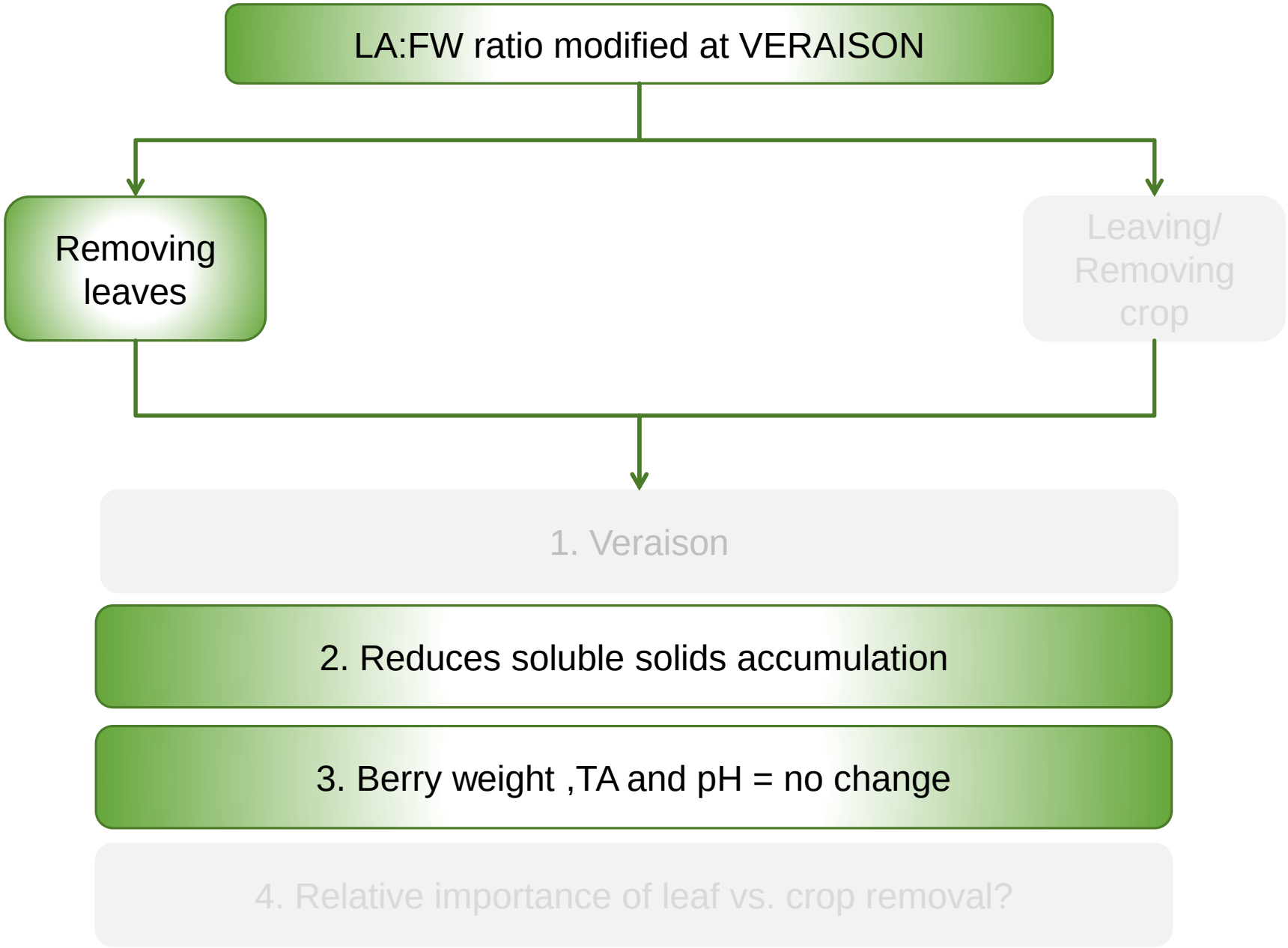


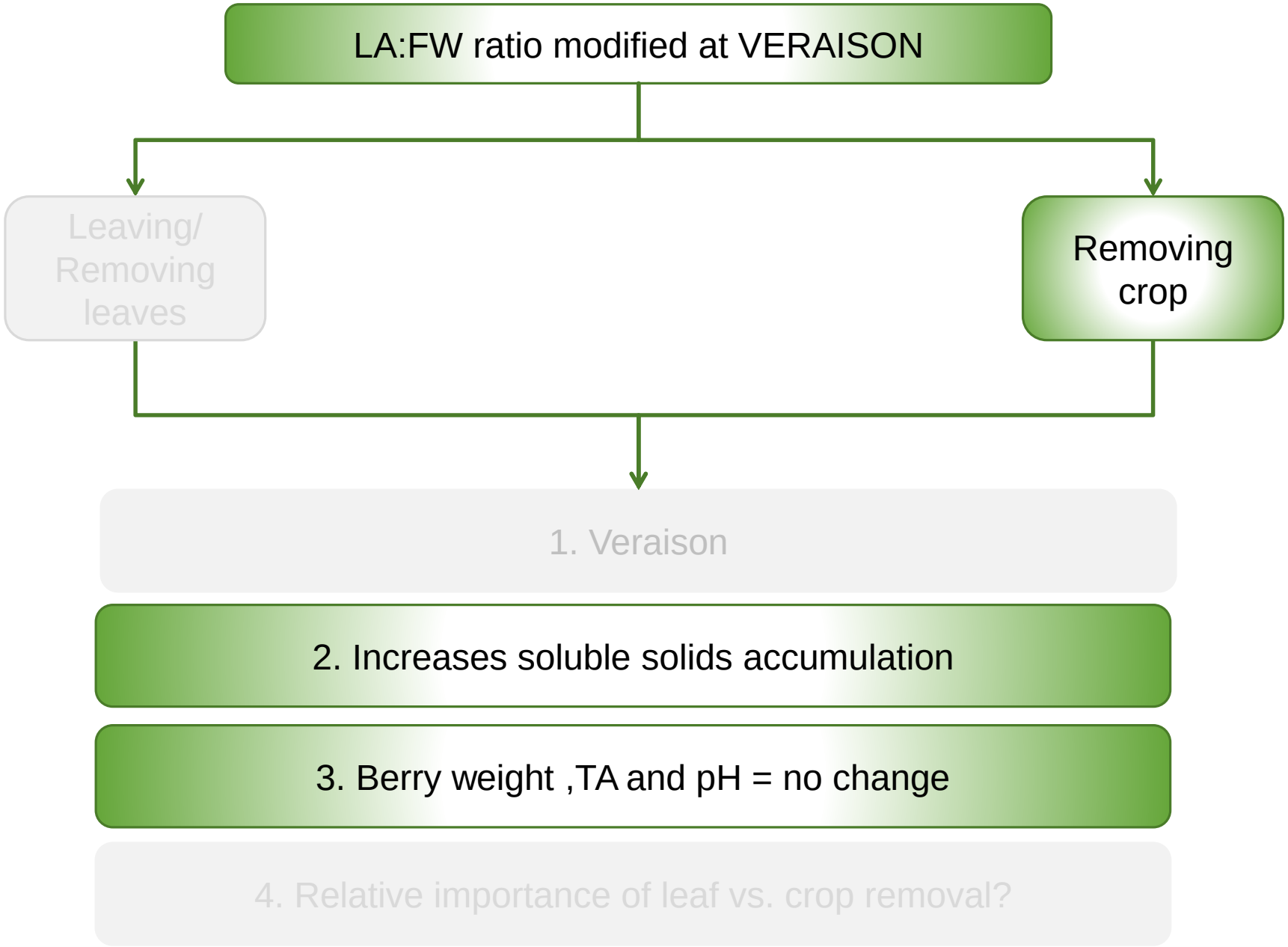


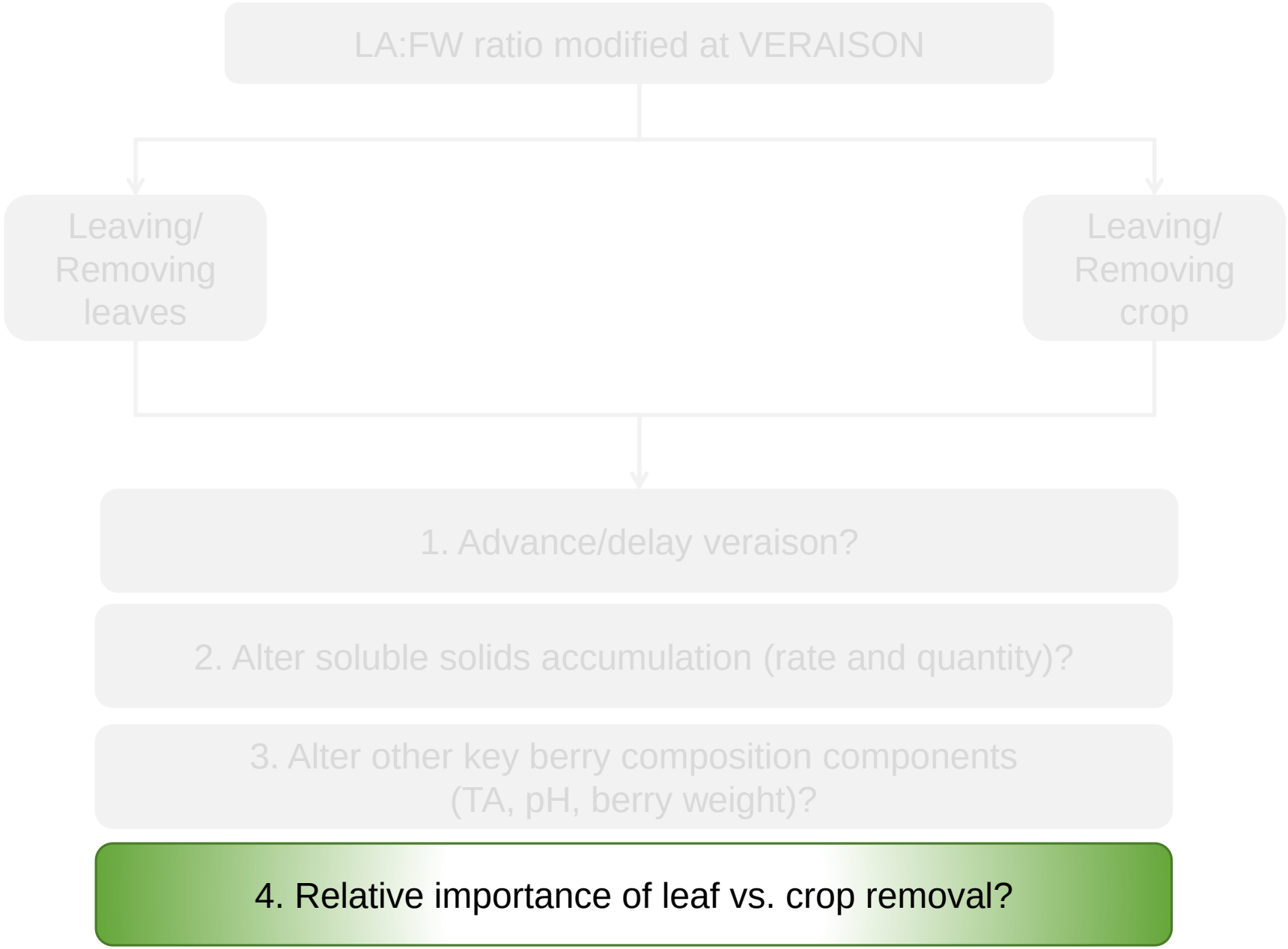
LA:FW modifications at veraison: effects on TA and pH






LA:FW ratio modified at VERAISON
Removing leaves
Leaving/ Removing crop
1. Veraison
2. Reduces soluble solids accumulation
3. Berry weight ,TA and pH = no change
4. Relative importance of leaf vs. crop removal?


LA:FW ratio modified at VERAISON
Leaving/ Removing leaves
Removing crop
1. Veraison
2. Increases soluble solids accumulation
3. Berry weight ,TA and pH = no change
4. Relative importance of leaf vs. crop removal?


LA:FW ratio modified at VERAISON
Leaving/ Removing leaves
Leaving/ Removing crop
1. Advance/delay veraison?
2. Alter soluble solids accumulation (rate and quantity)?
3. Alter other key berry composition components (TA, pH, berry weight)?
4. Relative importance of leaf vs. crop removal?

Leaf versus crop removal

- Crop removal increased TSS accumulation
- Reduced yield can compensate for source limitation (reduced LA)
- Combination of reduced LA and no crop removal = slowest rates

LA:FW modifications: comparing timing of modification

- Decreased LA at fruitset

  = biggest effect

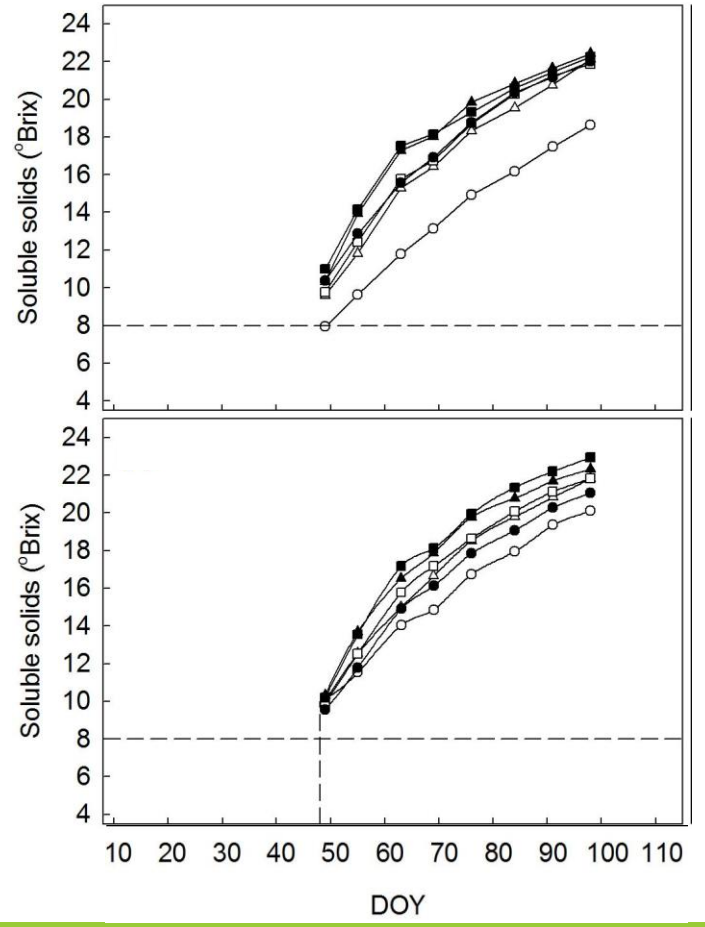
- Crop removal at either time

  - TSS modified, TA no change

    TSS:TA ratio modified

Fruitset

Veraison



What's in it for Pinot noir?

Increasing temperatures:

- Can LA:FW ratio manipulations delay development so ripening may occur at the same time as current practices and 'quality' maintained?

What’s in it for Pinot noir?

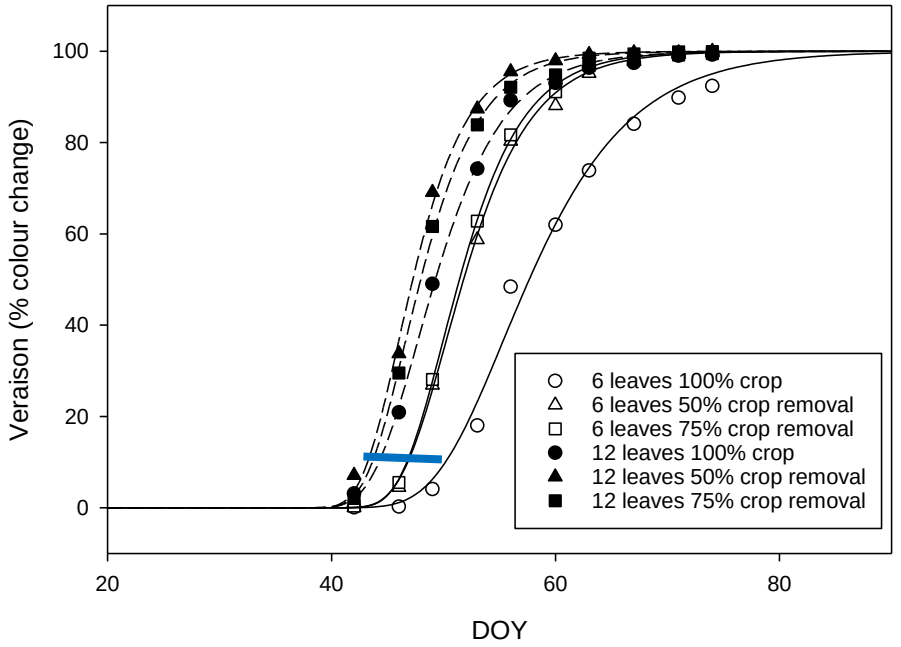
In cooler climates:

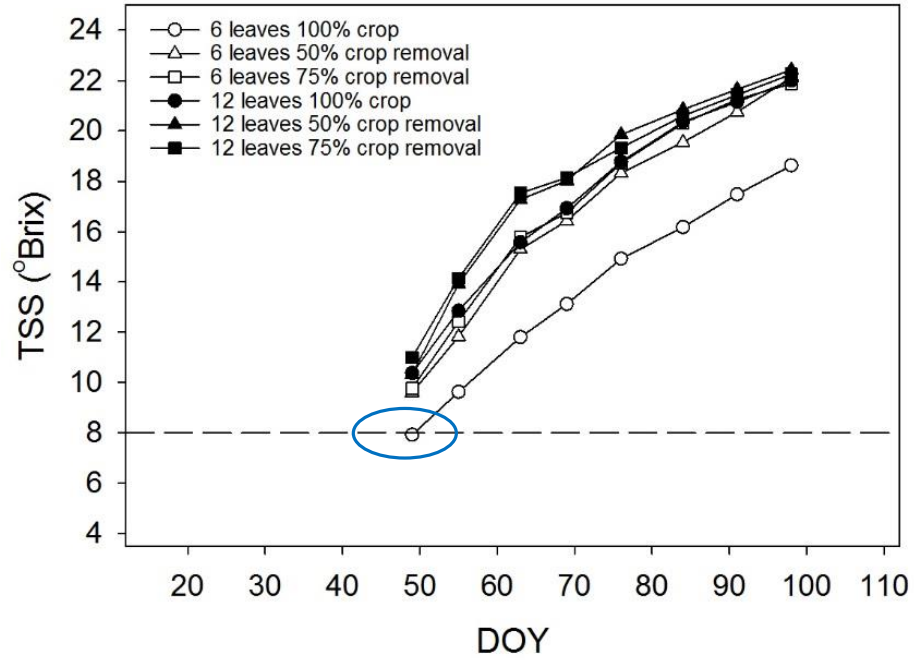
- Can within season LA:FW ratio manipulations be used to reach targets on time in cooler seasons? How?

1 week at veraison

→

≥ 2 weeks at harvest





How much to trim?
How much crop to remove?

Extreme trimming…

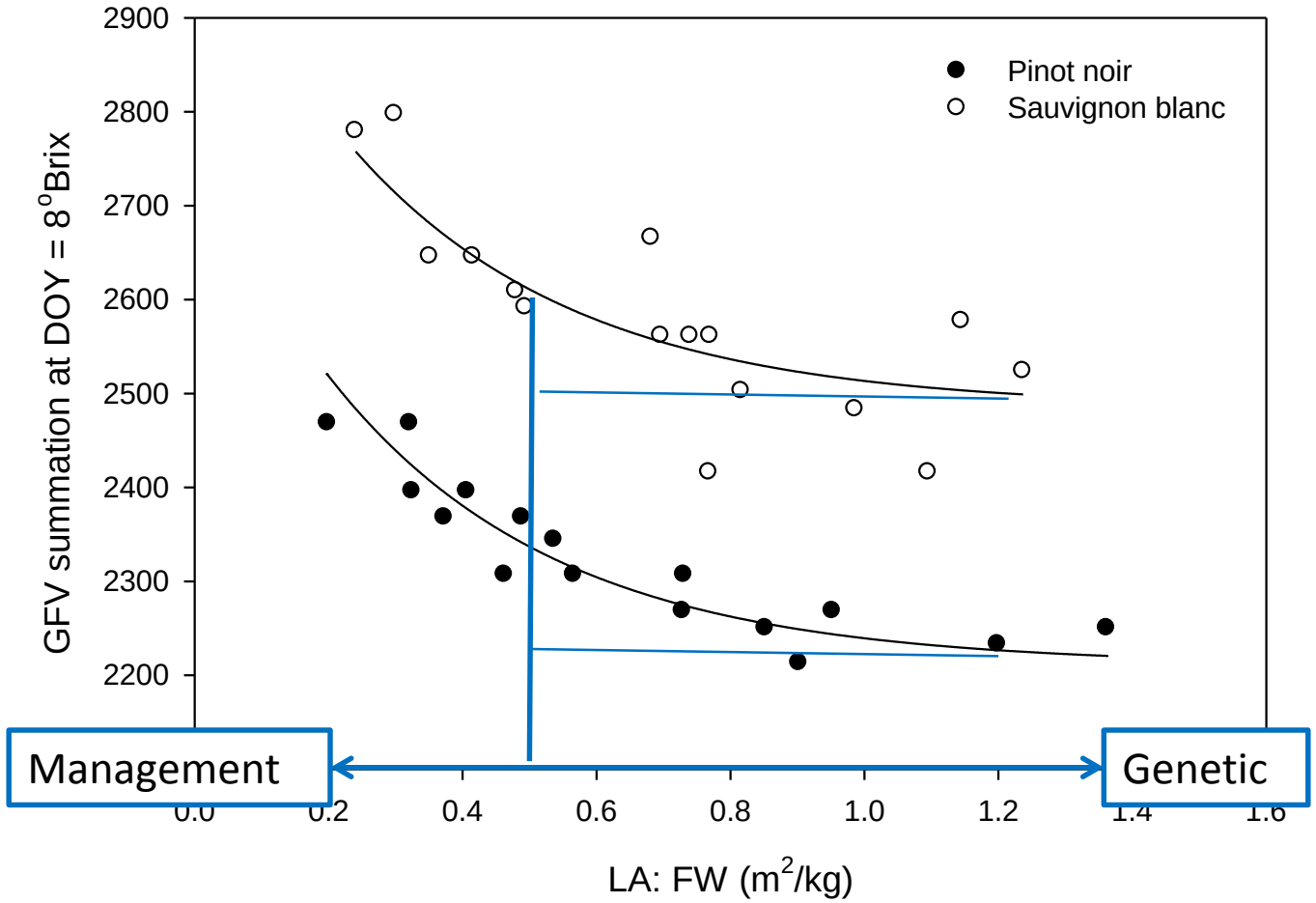
LEAVES	3	6	9	12	15	18
CROP	Full crop					
	50% crop removed					

Range of LA:FW ratios by trimming and crop removal

Reducing the LA:FW to 0.5 m^2/ kg

1 week's delay at average temperature of 18°C

50% crop removal



Application for Pinot noir

- Can delay phenology and ripening to achieve same targets

- Need to consider:
  - Impact on other berry components (as illustrated with no change on TA)
    - Aroma, colour, flavour

      →β damascenone, β ionone , Anthocyanins (e.g. malvidin-3-glucoside)

  - Laterals- not considered here (removed)
  - Carry on effects to the next year – reserve carbohydrates
  - Site specificity- yield and baseline rates before LA:FW modifications

Acknowledgements

- Mark Krstic for the invitation
- Michael Trought
- Rainer Hofmann
- Cornelis van Leeuwen
- Andrew McLachlan
- AGMARDT
- Team at Plant and Food Marlborough and Palmerston North
- Team at Bordeaux-Sciences Agro-ISVV
- Pernod Ricard NZ Ltd, Andrew Naylor, John Argyle and team at Brancott Estate.
- The Foundation for Research Science and Technology (Designer Grapevines - CO6X0707)
- New Zealand Wine Growers

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