Bunch quality and fertility of *Vitis vinifera* L. cv. Prime as affected by gibberellic acid (GA_3) and s-abscisic acid (s-ABA)

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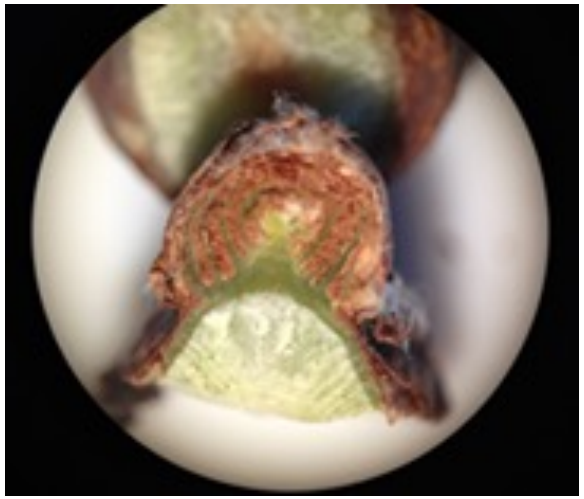

Presentation Layout

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- Introduction
- Aims and Objectives
- Material and Methods
- Results
- Conclusion & Recommendations
- Acknowledgements

Introduction

- **Prime is the second largest table grape cultivar exported from South Africa [SATI, 2023]**

- **Natural bunch characteristics of Prime:**
  - ✓ **sets well-filled bunches with small round berries**
  - ✓ **high occurrence of shot berries**

- **Prime requires intensive bunch preparation actions**
  - ✓ **chemical thinning (GA_3) + manual berry removal**
  - ✓ **GA_3 is also used to increase berry size**

Introduction:
Problem statement

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1) **Bunch preparation actions by hand is costly**

(2) **Some research results and observations from industry linked GA_3 treatments to:**

- **decreased fertility**
- **decreased bunch quality (smaller bunches)**

This led to the need to evaluate GA_3, and other PGRs as alternatives, for thinning and berry size improvement of Prime

Introduction:
Industry Expectations

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- **Identification of PGR treatments/application methods that will result in:**
  - ✓ Meeting bunch quality export requirements
  - ✓ Maintaining grapevine fertility over time

- **Providing producers with scientific data regarding the efficacy of different GA_3 application techniques**

- **Obtaining data on the efficacy of GA_3 + s-ABA,**
  to be used to extend the registration of s-ABA as a table grape thinning agent.

Introduction: Literature Review

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Author/s	Cultivars	Number of seasons' data presented	Stretching treatment/s dosage range (g.ha^{-1},/ g.acre^{-1}/ppm)	Thinning treatments dosage range (g.ha^{-1}/, g.acre^{-1}/ppm)	Sizing treatment/s dosage range (g.ha^{-1}/, g.acre^{-1}/ppm)	Application method	Volume of spraying	Main negative effect reported
Lynn&Jensen (1966)	Thompson Seedless	1	N/A	10,20,25,50,100 ppm	N/A	Spray	50 galon/acre	↑shot berries, 25,50,100ppm
Badir (1990)	Crimson Seedless	N/A	N/A	N/A	1×40ppm	Spray	0.5 mg. L^{-1}	↑berry shatter
Orth (1990)	Muscat Seedless	2	N/A	10, 20 ppm	N/A	Spray, Dipping	N/A	delay BB, ↓no of IP
Wolf (1994)	Sultanina	2	N/A	N/A	2 × 40 ppm	spray	N/A	delayed ripening, blemishes
Dokloozlian (2000)	Crimson Seedless	1	N/A	>0.40 g. ha^{-1}	>8.09 g.ha^{-1}	Spray	N/A	foliar toxicity,↓BB & fertility
Dokloozlian (2001)	Crimson Seedless	2	N/A	2 g. ha^{-1}	2 g.ha^{-1}	spray	1800 L. ha^{-1}	↑shot berries↓ cluster weight
Peacock (2003)	Ruby Seedless	N/A	N/A	1×25 g.L^{-1}	30-40g. ha^{-1}	Spray	N/A	↓fertility
Schultz (2004)	Riesling	2	50 ppm	N/A	N/A	spray	500 L.ha^{-1}	↓ yield
Formolo (2010)	BRS Clara Seedless	1	N/A	30+30 mg. L^{-1}	60 mg. L^{-1}	Spray	N/A	↓TSS
Mollitor (2012)	Sauvignon Blanc	1	N/A	10 ppm	N/A	Spray	200 ml	↓no of IP, cluster length
Ora (2015)	Thompson Seedless	2	121 µL	N/A	90 µm	Spray and Dip	N/A	N/A
Van der Vyver (2016)	Prime	2	N/A	2 ppm	15 g. ha^{-1}	Dip, Spray	250,500,1000 L. ha^{-1}	↓fertility
Yasoub Shiri (2020)	Yaghoot	1	N/A	40 mg. L^{-1}	N/A	Spray	1l/ sample	inhibit flowering
Ozer 2021	Muscat Seedless	1	N/A	40 ppm	40 ppm	Spray	20 mg. L^{-1}	weakened pedicel & berry attachment

Aims and Objectives

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Aims:

To verify whether:

- GA_3 treatments applied at recommended dosages negatively affect bunch quality and fertility of Prime
- GA_3 berry sizing treatments using different application techniques, negatively impact bunch quality and fertility of Prime

To evaluate GA_3 + s-ABA as thinning agent

Objectives:

Establish the effect of:

- GA_3 and GA_3+ s-ABA thinning treatments on bunch quality
- GA_3 and GA_3+ s-ABA thinning treatments on fertility
- GA_3 application techniques (Volumes) for berry sizing treatments on bunch quality and fertility

Methodology: Experimental Site

- Project conducted over three seasons (2018/19 – 2020/21);
  MSc study conducted in the 2nd and 3rd seasons (2019/20 – 2020/21)
- Newgro farm, Kanoneiland, Orange River Region (Northern Cape)
- 5-year-old *Vitis vinifera* L. cv. Prime block
  - Grafted on Ramsey rootstock
  - 4.66 ha
  - Vines spaced 3.3m × 1.8m, East-West row direction
  - Gable trellis system
  - Micro sprinkler irrigation system
  - Standard viticultural practices for the cultivar and region

Methodology: Experimental layout

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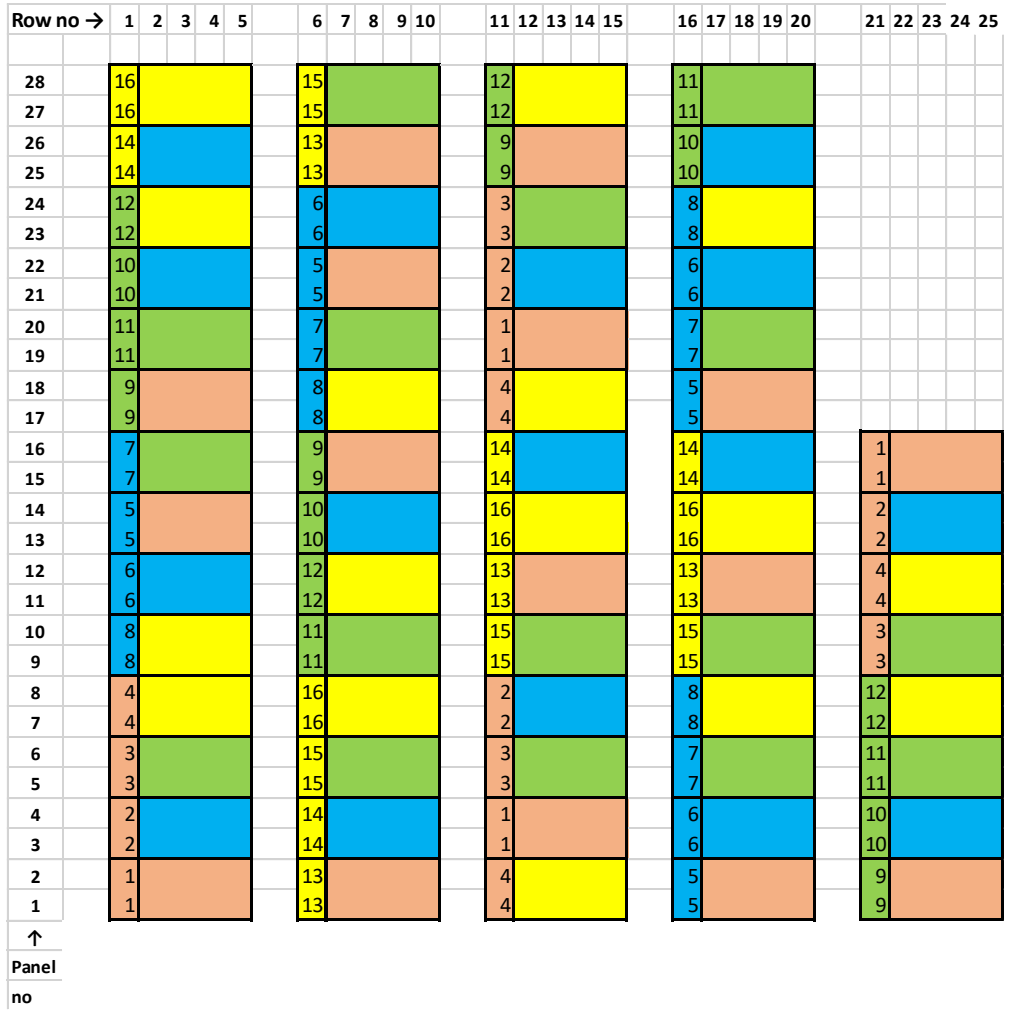
- **Fully randomised split-plot design:**
  Main plots = thinning treatments
  split-plots = berry sizing treatments

  16 treatment combinations
  with 4 replicates for each treatment

  Each replicate = 2 panels
  (6 vines per panel,
  2 central vines used as data vines)



Methodology: Treatments & application techniques

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Treatment no	Colour code		Thinning application **(from 10% set/ 110% flowering)** (1 ppm GA_3 = 1 g GA_3/1000 L = 2.5g ProGibb®/1000 L) Dosage per ha: 1 g GA_3/ha = 2.5g ProGibb®/ha	Berry sizing application **(7-8 mm berry + 8-10 mm berry)** 20 ppm GA_3 = 20 g GA_3/1000 L = 50g ProGibb®/1000 L) Dosage per ha: 20 g GA_3/ha for all treatments
1			No thinning	2 x 20 ppm GA_3 (dipping)
2			No thinning	2 x 20 ppm GA_3 (ESS 90L/ha)
3			No thinning	2 x 20 ppm GA_3 (Cima 250 L/ha)
4			No thinning	2 x 20 ppm GA3 (Cima 500 L/ha)
5			1 ppm GA_3 (10% set + 3 days later)	2 x 20 ppm GA_3 (dipping)
6			1 ppm GA_3 (10% set + 3 days later)	2 x 20 ppm GA_3 (ESS 90L/ha)
7			1 ppm GA_3 (10% set + 3 days later)	2 x 20 ppm GA_3 (Cima 250 L/ha)
8			1 ppm GA_3 (10% set + 3 days later)	2 x 20 ppm GA3 (Cima 500 L/ha)
9			1 ppm GA_3 (x5 at 3 day intervals)	2 x 20 ppm GA_3 (dipping)
10			1 ppm GA_3 (x5 at 3 day intervals)	2 x 20 ppm GA_3 (ESS 90L/ha)
11			1 ppm GA_3 (x5 at 3 day intervals)	2 x 20 ppm GA_3 (Cima 250 L/ha)
12			1 ppm GA_3 (x5 at 3 day intervals)	2 x 20 ppm GA3 (Cima 500 L/ha)
13			1 ppm GA_3 + 400 ppm ABA (10% set) + 1 ppm GA_3 3 days later)	2 x 20 ppm GA_3 (dipping)
14			1 ppm GA_3 + 400 ppm ABA (10% set) + 1 ppm GA_3 3 days later)	2 x 20 ppm GA_3 (ESS 90L/ha)
15			1 ppm GA_3 + 400 ppm ABA (10% set) + 1 ppm GA_3 3 days later)	2 x 20 ppm GA_3 (Cima 250 L/ha)
16			1 ppm GA_3 + 400 ppm ABA (10% set) + 1 ppm GA_3 3 days later)	2 x 20 ppm GA_3 (Cima 500 L/ha)

Methodology: Application techniques

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A. Dipping, B. treatments preparation, C. Cima mist blower spray pump & D. ESS (electrostatic)spray pump

Methodology:
Measurements - Bunch quality at harvest

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Bunch length and mass
(NO bunch shortening/ NO berry removal applied)

Bunch compactness and berry size distribution

- **upper 4 laterals of each data bunch** (6 bunches/data vine)
  - length
  - no of berries per cm lateral - three size categories:
    - normal (≥ 16 mm)
    - small (< 16 mm)
    - Xsmall/ shot berries (< 10 mm)

Berry size (mass, diameter) of 100 Normal berries per replicate

Juice analyses (not reported)

- Total Soluble Solids (TSS)
- Titratable Acid (TA) & pH

Methodology: Measurements - Fertility

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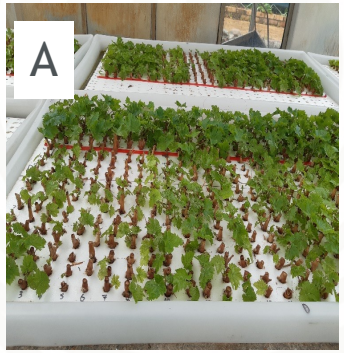
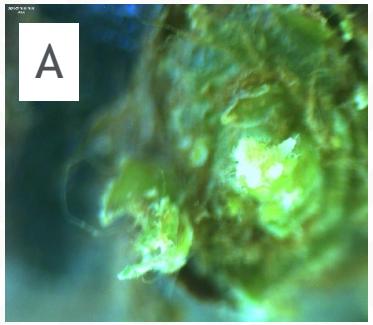
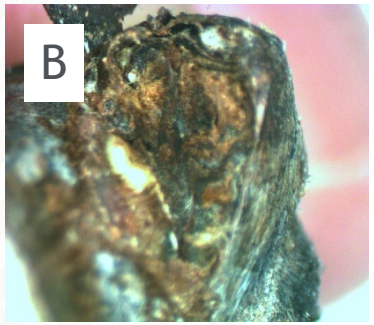
Potential Fertility

✓ **Forced budding (In glasshouse)**



✓ **Bud dissection in the laboratory**





Actual Fertility

✓ **Assessed at two calendar dates in the vineyard**

- **after bud break (bunches visible)**
- **before crop control was applied**

Results: Bunch quality
Bunch Length

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		#Sizing Treatment				
Season	***Thinning treatments**	**Dipping (mm)**	**ESS (mm)**	**C250 (mm)**	**C500 (mm)**	**Mean**
19/20	No Thin	20.9 a	20 **a**	21.7 **a**	20.4 **a**	**20.56a**
	GA_3 x 2	20.7 a	19.1 **a**	19.7 **a**	19.8 **a**	
	GA_3 x 5	20.7 a	21.1 **a**	21.2 **a**	20.4 **a**	
	GA_3 + ABA	20.3 a	22 **a**	19.8 **a**	21 **a**	
	Mean	**20.7 X**	**20.6 X**	**20.6 X**	**20.4 X**	
20/21	No Thin	19.4 a	20.3 **a**	19.6 **a**	19.6 **a**	**20.17a**
	GA_3 x 2	21.0 a	19.9 **a**	20.4 **a**	20.2 **a**	
	GA_3 x 5	20.7 a	20.9 **a**	19.6 **a**	20.4 **a**	
	GA_3 + ABA	19.4a	20.2 **a**	20.7 **a**	20.5 **a**	
	Mean	**20.1X**	**20.3 X**	**20.1 X**	**20.2 X**	

Results: Bunch quality
Bunch Compactness

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Season	treatment	Number of berries per cm of lateral length (Mean/Season)
19/20	No Thin	2 a
	GA_3 x 2	1.5 b
	GA_3 x 5	1.6 b
	GA_3 + s- ABA	1.5 b
	Mean	1.7 A
20/21	No Thin	2 a
	GA_3 x 2	1.6 b
	GA_3 x 5	1.6 b
	GA_3 + s- ABA	1.7 ab
	Mean	1.7 A

Results: Bunch Quality
Berry size

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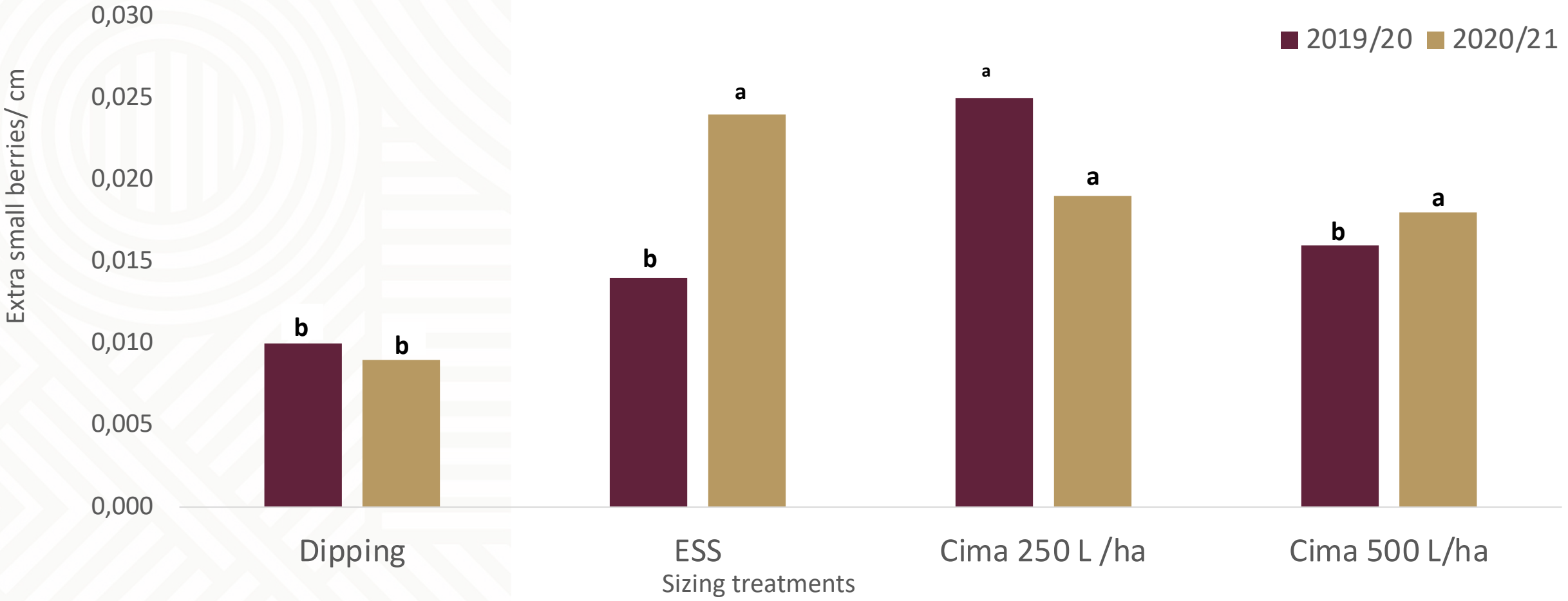
Berry Size:

- ✓ ESS (90 L.ha^{-1}) resulted in significantly higher berry mass and diameter (2019/20)
- ✓ Dipping resulted in larger berry mass than 250 L.ha^{-1} & 500 L.ha^{-1} and larger diameter than all spray applications (2020/21)
- ✓ Commercially acceptable berry size (>18 mm diameter & $\geq$ 6 g mass) obtained with all treatments

	Berry mass (g)		Berry diameter (mm)		Berry length (mm)
Sizing treat-ments	**2019/20**	**2020/21**	**2019/20**	**2020/21**	**2019/20**
Dipping	6.46 b	6.20 a	19.92 b	20.54 a	25.24 b
ESS	7.17 a	5.94 ab	20.49 a	19.88 b	26.19 a
C250	6.44 b	5.58 bc	19.98 b	19.06 bc	25.74 ab
C500	6.42 b	5.46 bc	19.89 b	19.16 bc	25.43 b
LSD p≤0.05	0.37	0.48	0.37	0.55	0.65

Results: Bunch Quality
Occurrence of shot berries



Results: Fertility
Potential fertility (Forced budding)

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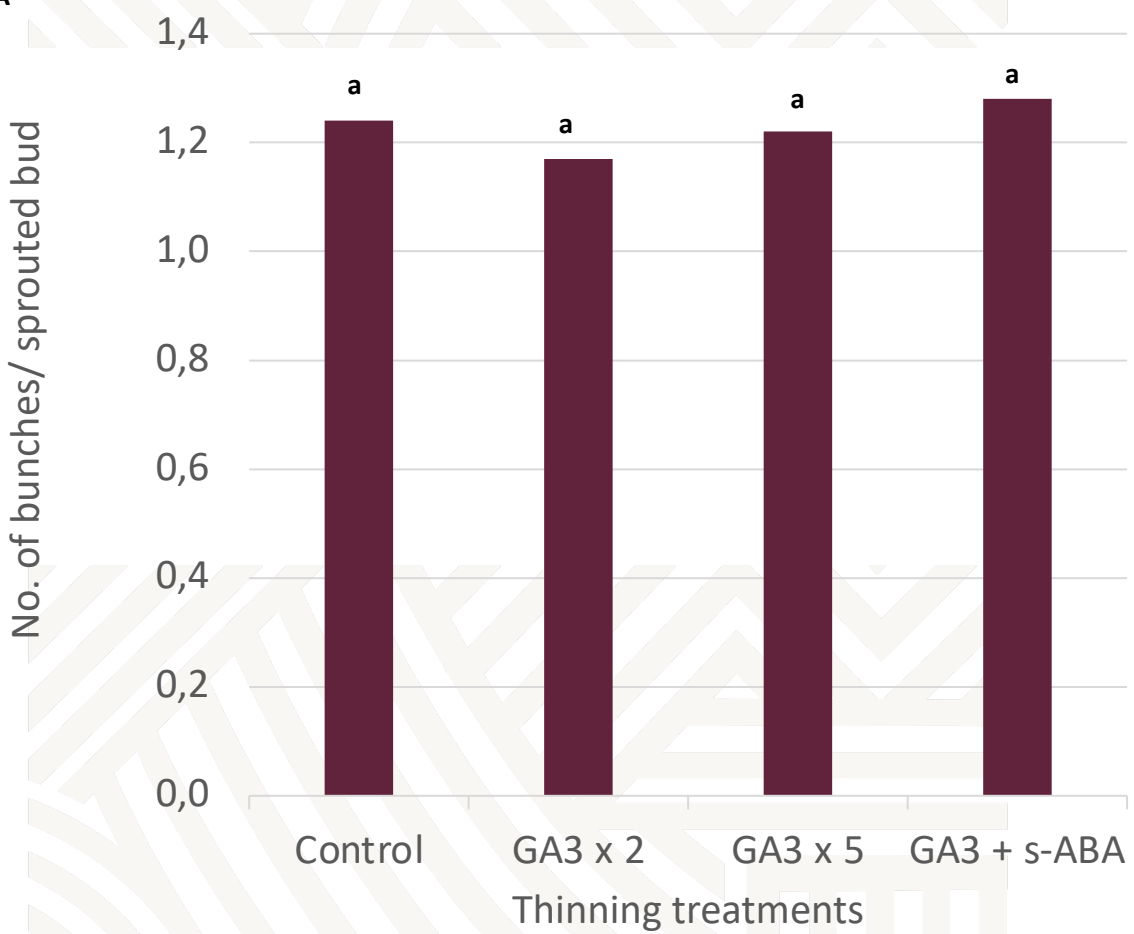
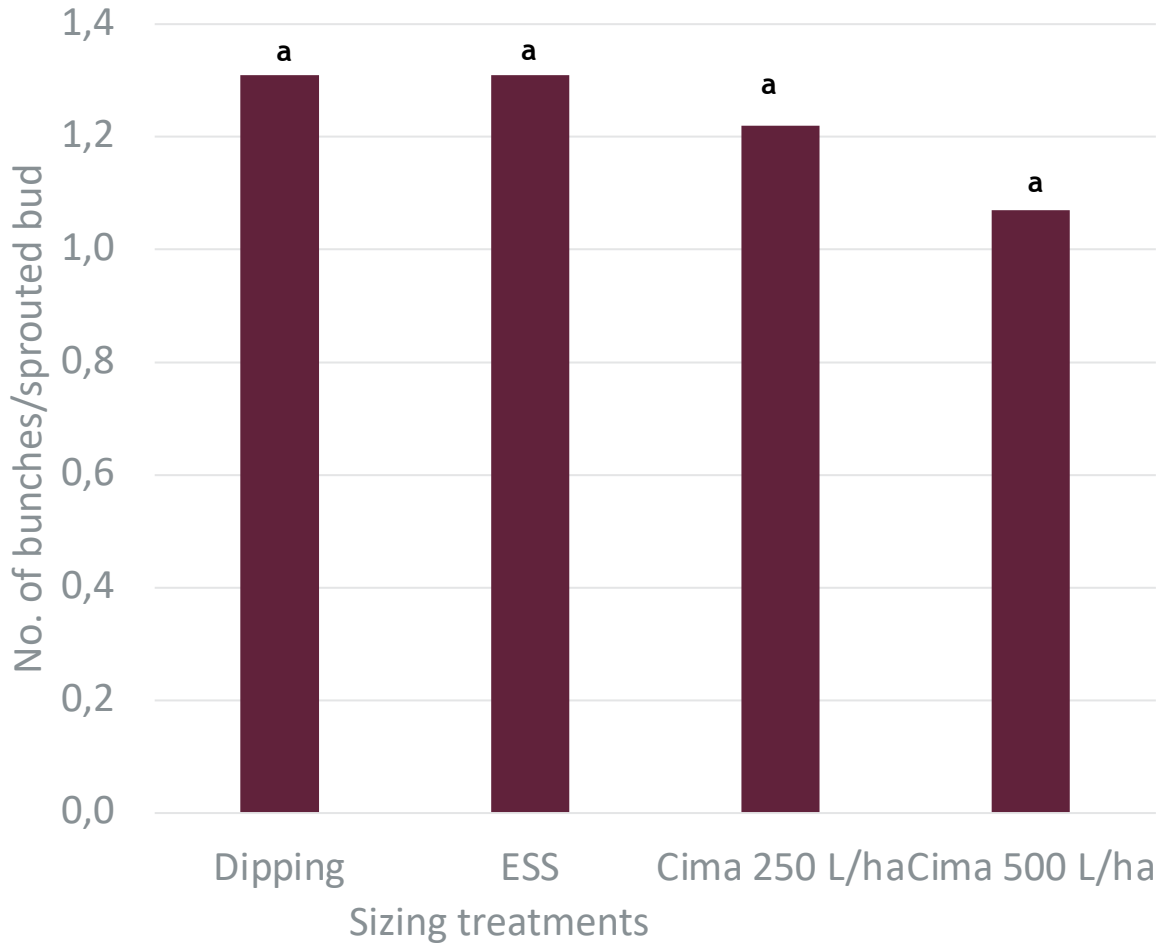
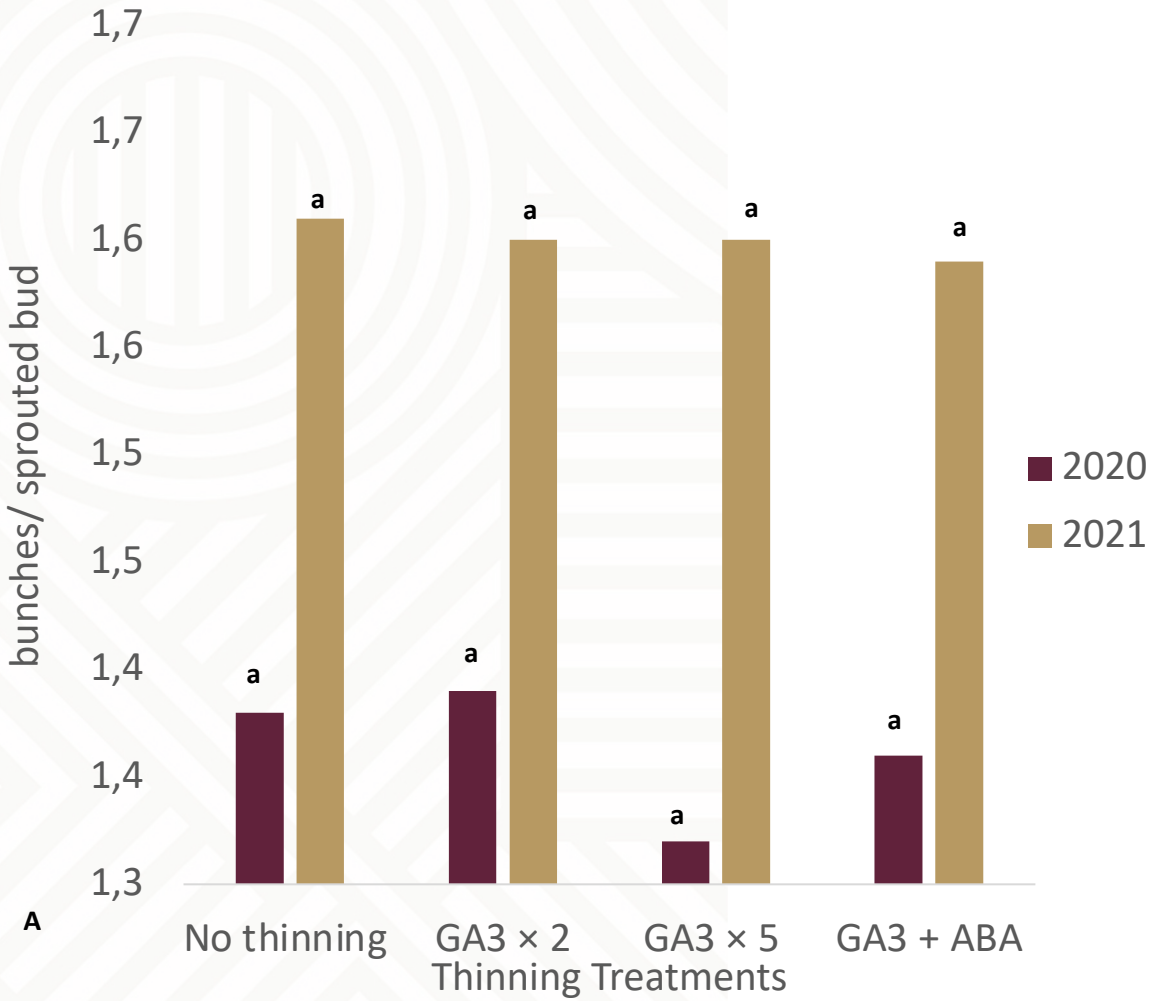
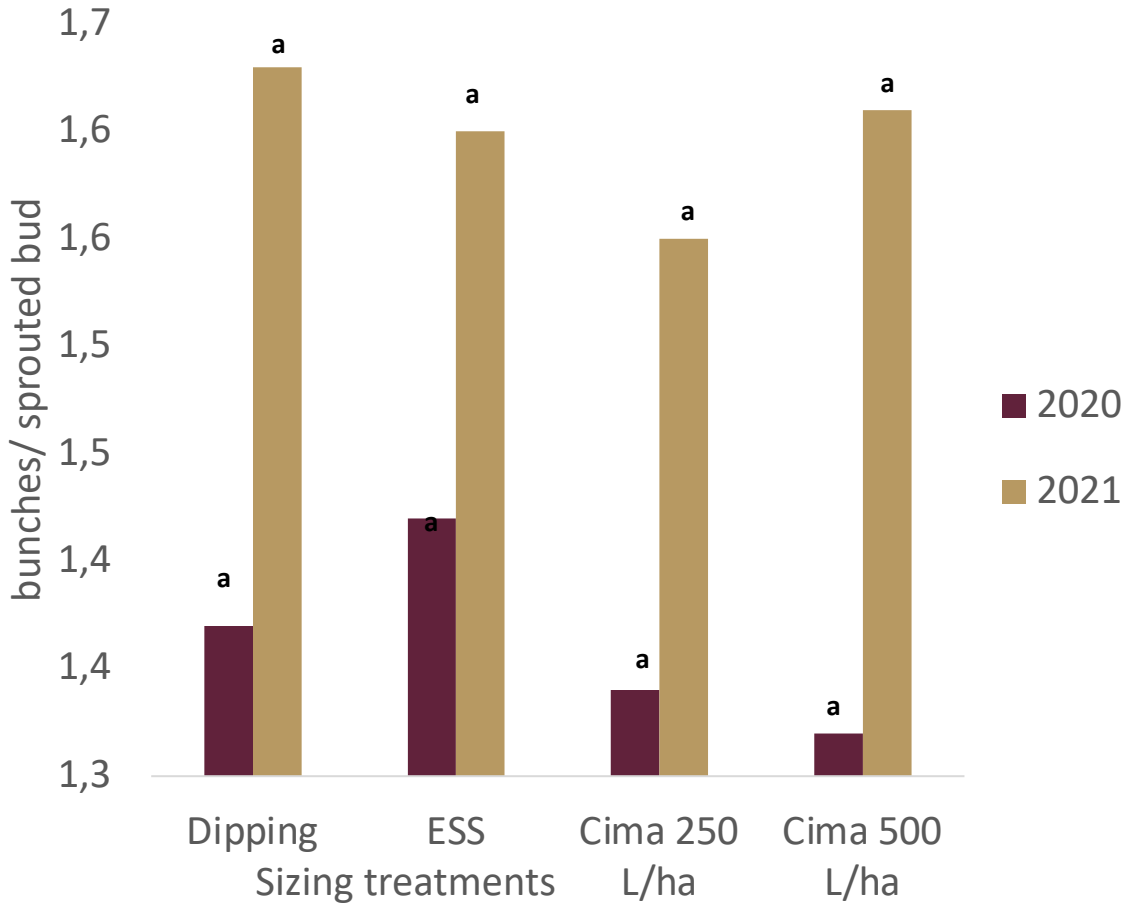




Results: Fertility
Actual Fertility





Conclusion

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- GA_3 thinning and berry sizing treatments applied at the recommended dosages, do not negatively impact bunch quality and fertility of Prime
- Bunch quality and fertility of Prime was not negatively affected by any thinning treatment (GA_3; GA_3 + s-ABA)
- None of the application techniques (volumes) had a negative impact on bunch quality or fertility
- At least 1 bunch per sprouted bud was obtained for all treatments
- All treatments resulted in commercially acceptable berry size (>18 mm diameter & > 6g mass)
- Dipping and ESS (90 $L.ha^{-1}$) resulted in the largest berry size

Recommendations

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Thinning

- For vineyards with even bud break 2× 1 ppm GA_3 could be applied
- For vineyards with uneven bud break 5× 1 ppm GA_3 could be applied
- GA_3 + s-ABA could be evaluated further as thinning agent for table grapes

Berry Sizing

- All evaluated application techniques could be used for berry sizing
  - ✓ Dipping could be used if the producer has a sufficient number of skilled workers
  - ✓ Any of the three spray techniques (volumes) could be used if dipping is too costly and not practical

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SATI
South African Table Grape Industry

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