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Return fertility of *Vitis vinifera L.* as affected GA_3, GA_{4+7} and GA_3 plus s-abscisic acid (ABA)

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Introduction

- Gibberellic acid (GA_3), is the most widely used plant growth regulator in table grape production, applied for stretching, thinning, and berry sizing.
- GA_3 applications involving direct bud contact through full-cover sprays have been linked to decreased fertility.
- For some cultivars poor response to GA_3 thinning treatment has been reported
- Abscisic acid (s-ABA), a plant bioregulator used to improve colour, has recently been registered as a thinning agent for table grapes.
- Two studies were conducted between 2015 and 2022 to evaluate the impact of thinning and/or sizing treatments with GA_3 and potential alternatives on fertility.

Aim (Study 1)

Identify whether GA_{4+7} could be used as a thinning agent for cultivars that do not react well to GA_3 for thinning, without affecting return fertility.

Methodology:
Experimental Site

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- **Project conducted over one season (2015/16 – 2016/17);**
- ARC Infruitec-Nietvoorbij experimental farm in De Doorns, Hex River Valley
- Sunred Seedless
  - Planted in 2000
  - Grafted on Ramsey rootstock
  - Trained onto Trentina trellis system
  - 3.0 m x 1.8 m spacing
  - East – West row direction
  - Micro sprinkler irrigation
  - Standard viticultural practices applied

Methodology:
Treatments & application techniques

- Randomized block design
- Nine treatments with four replicates
- At each replicate:
  - Four vines
  - Two central vines used as data vines
- Two GA formulations
  - Standard GA_3 rates
  - Different GA_{4+7} rates
- Two application times
  - 10% berry set
  - Berry set

Treatment code	Treatment	Rate	Phenological stage and application date
T1	Untreated control	No thinning application	
T2	GA3	5 ppm	Early application. (10 % Berry set on 31 October 2015)
T3	GA4+7	7.5 ppm	
T4	GA4+7	15 ppm	
T5	GA4+7	30 ppm	
T6	GA4+7	60 ppm	Late application (Berry set on 4 November 2015)
T7	GA4+7	120 ppm	
T8	GA4+7	60 ppm	
T9	GA4+7	No thinning application	

Fertility assessment

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Actual fertility

- Prior to flowering (Oct 2016)
    - Done in vineyard after bud break, when shoots with bunches were visible, before crop control was applied.



Results - Actual fertility

- Commercially acceptable bud break percentages (>80%) in all treatments
- Actual fertility recorded for 5ppm GA_3 and 15 ppm GA_{4+7} treatments on half long bearers was significantly lower compared to the untreated control
- Actual fertility of all treatments > 1 bunch per sprouted bud

Treatment applied in Oct-Nov 2015		Bud break (Oct-16) (%)	Actual fertility (Oct-16)		
			Average no. of bunches per node		No. of bunches per vine
			Half-long bearer (9 nodes)	Spur (3 nodes)	
T1	Untreated control	97.05 ab	1.54 a	1.38 a	133.00 a
T2	5 ppm GA3 (10% BS)	100.00 a	1.34 b	1.17 a	114.88 b
T3	7.5 ppm GA4+7 (10% BS)	98.61 ab	1.41 ab	1.28 a	122.38 ab
T4	15 ppm GA4+7 (10% BS)	94.44 ab	1.34 b	1.26 a	117.75 ab
T5	30 ppm GA4+7 (10% BS)	94.44 ab	1.38 ab	1.42 a	125.50 ab
T6	5 ppm GA3 (BS)	100.00 a	1.47 ab	1.36 a	128.13 ab
T7	7.5 ppm GA4+7 (BS)	91.67 b	1.37 ab	1.18 a	116.56 b
T8	15 ppm GA4+7 (BS)	100.00 a	1.47 ab	1.35 a	128.13 ab
T9	30 ppm GA3 (BS)	97.22 ab	1.50 ab	1.34 a	129.38 ab
Mean		97.05	1.43	1.30	123.97
LSD p=0.05		6.92	0.19	0.30	15.81

Conclusion & Recommendation

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5 ppm GA_3 (10%BS) and 15 ppm GA_{4+7} (10%BS) treatments are not recommended.



GA_{4+7} could be evaluated further as a thinning agent for table grapes.



This study was conducted over only one season and repeating the trial and treatments over more seasons could have contributed to verifying preliminary results.

Introduction:
Problem statement (Study 2)

- Research and observations from industry linked GA_3 treatments to decreased fertility

Introduction:

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Previous studies: Effect of GA_3 on fertility and bunch characteristics

Author/s	Cultivars	Number of seasons' data presented	Stretching treatment/s dosage range (g.ha^{-1},/ g.acre^{-1}/ppm)	Thinning treatments dosage range (gha, g/acre/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
Claassen (2020)	Sunred Seedless	2	N/A	5 ppm	5 ppm	Spray	13L.ha^{-1}	↓fertility
Ozer 2021	Muscat Seedless	1	N/A	40 ppm	40 ppm	Spray	20 mg. L^{-1}	weakened pedicel & berry attachment

Aims

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1.To verify whether:

- GA_3 treatments applied at recommended dosages negatively affect fertility
- GA_3 berry sizing treatments using different application techniques (volumes) negatively impact fertility

2.To evaluate:

- the impact of GA_3 + s-ABA thinning treatment on fertility.

Methodology:
Experimental Site

- **Project conducted over three seasons (2018/19 – 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:
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)

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

16 treatment combinations
with 4 replicates for each treatment

Each $_{\text{replicate}}$ **= 2 panels**
6 vines per panel,
2 central vines used as data vines

Methodology:
Measurements - Actual Fertility

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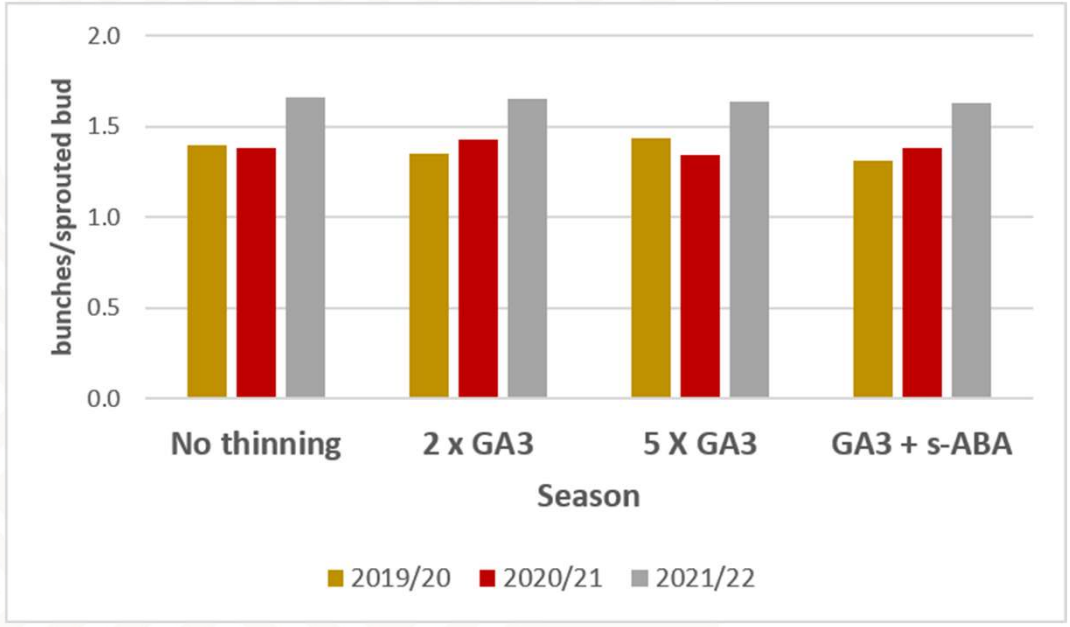
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Actual fertility

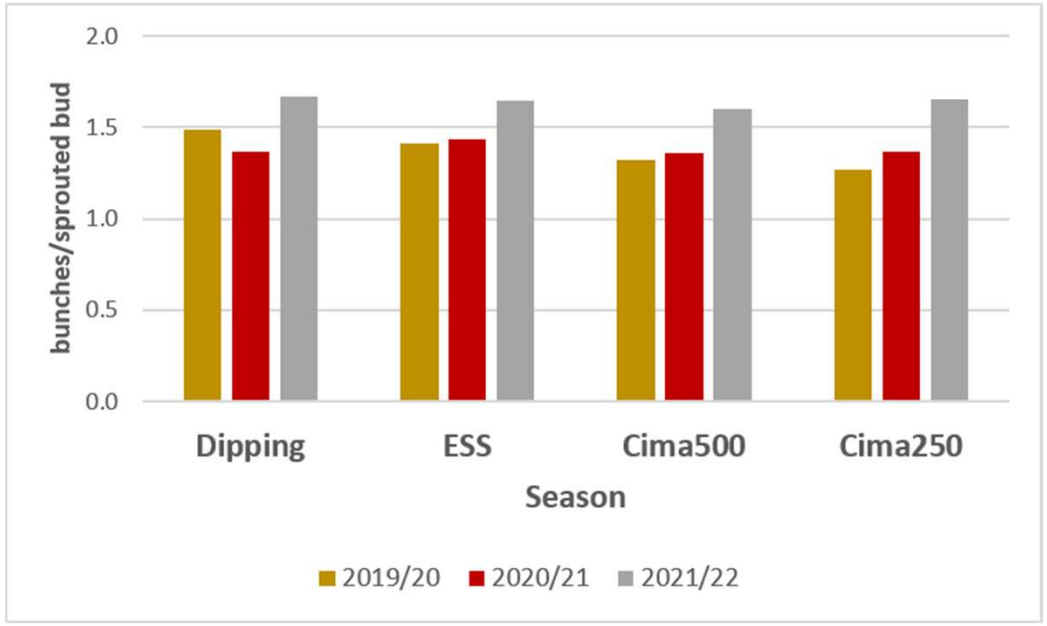
- Assessed in the vineyard before crop control was applied.



Results- Actual Fertility



[No significant differences. {One-way ANOVA, P<0.05]



[No significant differences. {One-way ANOVA, P<0.05]

Results Summary

- GA_3 thinning and berry sizing treatments applied at the recommended dosages, did not negatively impact fertility.

- Fertility was not negatively affected by any thinning treatment
  (GA_3; GA_3 + s-ABA)

- None of the application techniques had a negative impact on fertility

- At least 1 bunch per sprouted bud was obtained for all treatments

Recommendations

Thinning Treatment

- 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

Sizing Treatment

- Any of the application techniques evaluated (dipping, electrostatic spray pump, the Cima 250 and 500 L/ha mist blower spray pump) can be used for sizing treatments in table grapes without any negative impact on fertility.

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forward together
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Thank you
Enkosi
Dankie