

# RESULTS FROM TWO TRIALS PERFORMED WITH A 1-METHYLCYCLOPROPENE TREE SPRAY APPLICATION DURING THE 2022 SEASON

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## ABSTRACT

This report deals with the second year of trials performed with a 1-methylcyclopropene (1-MCP) tree spray application (Harvista, Agrofresh). One trial each was performed in, respectively, a low altitude 'Maluma Hass' orchard and a high altitude 'Hass' orchard. The results firstly confirmed the previous year's findings that the application effectively slows down the postharvest ripening of avocado fruit. There were again indications that the product may possibly be used at a lower rate than is registered for apples. It was further confirmed that the effects of the 1-MCP fade as the period from application to harvest increases. In contrast with present and past trials conducted in low altitude orchards ( $\pm 700$  metre above sea level), we found the 1-MCP spray to result in larger fruit when applied to the late season high altitude 'Hass' orchard ( $\pm 1\ 500$  metre above sea level). It is foreseen that the spray will ultimately be used for more than just the presently studied applications.

## INTRODUCTION

Previous trials have shown that a 1-methylcyclopropene (1-MCP) tree spray (Harvista, Agrofresh) slows down the postharvest ripening of avocado fruit (Kruger *et al.*, 2022). It was also found that the period from spraying to harvest influences the intensity of the postharvest ripening inhibition effect and that a lower application rate than that registered for apples may possibly be used on avocados.

The present report deals with two trials that were performed during the 2022 season. The first was done in a low altitude (early season) 'Maluma Hass' orchard and the second in a high altitude (late season) 'Hass' orchard.

The aims were:

- 1) to confirm the previously recorded postharvest ripening inhibition effects,
- 2) to establish whether a fruit enlargement effect similar to that described for apples may be attained on avocado fruit and,
- 3) to determine whether grey pulp is inhibited to the same extent as with the postharvest 1-MCP formulation (SmartFresh, Agrofresh).

## MATERIALS AND METHODS

### Early season, low altitude, 'Maluma Hass' trial

This trial was conducted in a low altitude 'Maluma

Hass' orchard ( $\pm 700$  metre above sea level) in the Mooketsi area. 'Maluma' has a high metabolic rate and ripens satisfactory during the early season.

Three application rates; namely 0, 50 and 150 g ai/ha, were applied during the third week of December 2021. Each treatment comprised of five replicates consisting of three trees each.

Forty fruit per replicate were sampled after five weeks and then at three-week intervals (8, 11 and 14 weeks after spraying) thereafter. Twenty of the fruit were directly ripened, while the remaining 20 fruit were stored for three weeks at 5 °C before being ripened at 20 °C.

The mass and period required to reach the ready to eat stage was established for each fruit after which it was dissected and the incidence and intensity of physiological and pathological disorders determined.

### High altitude, late season, 'Hass' trial

This trial was conducted in a high altitude ( $\pm 1\ 500$  metre above sea level) 'Hass' orchard in the Magoebaskloof area. 'Hass' orchards established at this altitude are highly productive but mature later than those found at lower altitudes.

Three application rates (0, 50 and 150 g ai/ha) were applied during the third week of June 2022 and each treatment again comprised of five replicates

containing three trees each. In this case, however, the first fruit were sampled three weeks after spraying and then at three-week intervals (6, 9 and 12 weeks) thereafter. During the first three sampling dates, 20 fruit were sampled per replicate. Ten of these were directly ripened and the remaining 10 stored for one month at 6 °C before being ripened at 20 °C. On the last sampling date (twelve weeks after spraying) all remaining fruit were harvested. Half of these (52-240 fruit per replicate) were directly ripened while the other half were stored for one month at 6 °C before being ripened at 20 °C.

The mean number of days required to reach the ready to eat stage and the mass and quality of the fruit were then measured.

## RESULTS

### Low altitude, early season, 'Maluma Hass' trial

The ripening results of the directly ripened fruit are shown in Tables 1-4. The number of days for the first control fruit to reach the ready to eat stage decreased as the fruit matured. This was also the case with the 1-MCP treated fruit, but the reductions in threshold periods and ranges were also influenced by the application rate and the length of the period between the 1-MCP application and sampling.

The ripening results of the stored fruit are shown in Tables 5-8. From the first harvest date onwards, the control samples contained fruit that were already ripe upon removal from cool storage (thus representing soft landings). The threshold periods and ranges were again dose dependent and steadily decreased as the period from spraying to sampling increased.

No fruit size differences occurred between the treatments.

The quality of the fruit was excellent, and the incidences of physiological and pathological disorders were negligible.

### High altitude, late season, 'Hass' trial

The ripening results of the directly ripened fruit are shown in Tables 9-12. From the results it may be deduced that the number of days for the first control fruit to reach the ready to eat stage decreased as the fruit matured. This also applied to the 1-MCP treated fruit, but the decrease in ripening period was also influenced by both the application rates as well as the periods between spraying and sampling. By week 12, all treatments gave fairly similar results.

The ripening results of the stored fruit are shown in Tables 13-16. From the first harvest date onwards, the control samples contained fruit that were already ripe upon removal from cold storage (thus representing soft landings). During weeks 3, 6, and 9, there was a definite dose effect in that the 150 g ai/ha treatment took longer to ripen than the 50 g ai/ha treatment. By week 12, however, the effects of the 1-MCP treatments had faded and all the treatments

contained ripe fruit as from day 1.

The quality of the fruit was again good and the incidences of physiological and pathological disorders were negligible.

In contrast with the previous trials conducted in lower altitude orchards, a fruit size difference was recorded in this high-altitude block. During the 12-weeks study period, the control treatment gained mass at a rate of about 6.5 gram per week, while the 1-MCP treatments gained approximately 8.5 gram per week (Fig. 1). The size increases brought about by the 1-MCP applications were further discernible when plotting the size distribution profiles of the treatments (Fig. 2).

With apples, where the fruit ripen on the branch, a size increase is attainable when exercising the option to hang Harvista treated fruit for an extended period on the tree (Crouch, 2022). In the present study, we recorded a size increase in the later maturing, high altitude 'Hass' orchard when sampling the treated fruit on the same date as the control fruit. It is important that these size-related results be viewed in context of our current hypothesis that the superior performance of high-altitude orchards in terms of yield, taste, and reactivity to thinning is related to the annual energy cycle of the trees (Kruger *et al.*, 2023).

The above fruit size aspect will be considered when conducting further studies. Trials will also be performed in orchards that are more susceptible to grey pulp. A number of potential phenology-based manipulations will also be investigated and we foresee that the spray may ultimately be used for more than just the presently studied applications.

## Acknowledgements

The authors would like to thank SAAGA for financial support, ZZZ for technical assistance, and Mark Pen-ter of the ARC-TSC for editing the manuscript.

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**Table 3:** Ripening profiles of 'Maluma' avocado fruit that were sprayed with the 1-MCP tree spray at two application rates during the third week of December 2021 and sampled eleven weeks later. The fruit were thereafter directly ripened at 20 °C until the ready to eat stage was reached. The ripening period was then recorded, followed by quality analyses

Rate (g ai/ ha)	Rep	Ripe fruit per day (%)																													
		D 6	D 7	D 8	D 9	D 9	D 9	D 10	D 10	D 11	D 12	D 13	D 14	D 15	D 16	D 17	D 18	D 19	D 20	D 21	D 22	D 23	D 24	D 25	D 26	D 26	D 26	D 30			
0	1								15	15	20	15	10	10																	
0	2								10	10	20	15	10	15	5																
0	3						5	10	15	15	10	15	10	5																	
0	4							10	15	15	15	20	15	10																	
0	5							15	5	10	20	15	10	15	10																
<b>Mean</b>							<b>1</b>	<b>12</b>	<b>12</b>	<b>15</b>	<b>16</b>	<b>16</b>	<b>12</b>	<b>12</b>	<b>4</b>																
50	1											10	5	15	10	15	15	5	15	10	5	15	10								
50	2												5	10	15	10	20	15	5	10	10										
50	3										5	10	15	10	10	20	15	10	5												
50	4										10	15	10		5	10	10	15	10	10	5										
50	5											5	5	10	5	15	15	15	10	5	5	10									
<b>Mean</b>											<b>3</b>	<b>6</b>	<b>7</b>	<b>10</b>	<b>9</b>	<b>12</b>	<b>16</b>	<b>13</b>	<b>10</b>	<b>8</b>	<b>3</b>	<b>3</b>									
150	1											10	5	15	10	10	15	10	15	10											
150	2											10	15	15		10	5	15	5	10	15										
150	3										5	15	10	15	10	15	5	15	10												
150	4											10	15	15	10	10		15	10	5	10										
150	5													15	15	10	5	10	15	10	10	5									
<b>Mean</b>											<b>1</b>	<b>2</b>	<b>10</b>	<b>9</b>	<b>14</b>	<b>9</b>	<b>10</b>	<b>7</b>	<b>12</b>	<b>8</b>	<b>9</b>	<b>8</b>	<b>1</b>								



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**Table 4:** Ripening profiles of 'Maluma' avocado fruit that were sprayed with the 1-MCP tree spray at two application rates during the third week of December 2021 and sampled fourteen weeks later. The fruit were thereafter directly ripened at 20 °C until the ready to eat stage was reached. The ripening period was then recorded, followed by quality analyses

Rate (g ai/ ha)	Rep	Ripe fruit per day (%)																															
		D 6	D 7	D 8	D 9	D 5	D 6	D 7	D 8	D 9	D 10	D 11	D 12	D 13	D 14	D 15	D 16	D 17	D 18	D 19	D 20	D 21	D 22	D 23	D 24	D 25	D 26	D 24	D 25	D 26	D 30		
0	1		15	15	20	15	10	15	10																								
0	2			15	15	20	20	15	10	5																							
0	3			5	20	15	15	20	10																								
0	4			10	15	15	10	20	10	15	5																						
0	5		5	15	15	10	15	10	20	10																							
<b>Mean</b>	<b>1</b>	<b>1</b>	<b>9</b>	<b>16</b>	<b>15</b>	<b>15</b>	<b>15</b>	<b>16</b>	<b>11</b>	<b>1</b>	<b>1</b>																						
50	1					5	10	5	10	15	10	20	15	10																			
50	2				15	10	20	15	15	10	5	10																					
50	3			5	10	10	15	10	20	10	15		5																				
50	4			5	15	10	15	15	10	10	10	5	5																				
50	5					10	15	10	10	15	15		10	5	10																		
<b>Mean</b>		<b>2</b>	<b>8</b>	<b>9</b>	<b>15</b>	<b>11</b>	<b>13</b>	<b>12</b>	<b>11</b>	<b>7</b>	<b>7</b>	<b>3</b>	<b>2</b>																				
150	1					5	15	10	15	10	5	10	15	15																			
150	2					5		15	10	15	20	10	10	10																			
150	3								10	15	10	10	15	20	15	5																	
150	4					5	5	10	15	15	20	15	10		5																		
150	5					5		10	15	10	15	15	5	10																			
<b>Mean</b>		<b>2</b>	<b>3</b>	<b>9</b>	<b>14</b>	<b>12</b>	<b>14</b>	<b>13</b>	<b>9</b>	<b>9</b>	<b>14</b>	<b>13</b>	<b>9</b>	<b>9</b>																			





**Table 5:** Ripening profiles of 'Maluma' avocado fruit that were sprayed with the 1-MCP tree spray at two application rates during the third week of December 2021 and sampled five weeks later. The fruit were thereafter stored for three weeks at 6 °C before being ripened at 20 °C until the ready to eat stage was reached. The ripening period was then recorded, followed by quality analyses

Rate (g ai/ ha)	Rep	Ripe fruit per day (%)																	
		D1	D2	D3	D4	D5	D6	D7	D8	D9	D10	D11	D12	D13	D14	D15	D16	D17	D18
0	1	5	15	10	15	20	20	15											
0	2	10	15	10	20	15	15												
0	3	10	5	15	10	20	20	15	5										
0	4		15	15	10	20	15	15	10										
0	5	5	10	15	10	10	20	15	10	5									
<b>Mean</b>	<b>6</b>	<b>12</b>	<b>13</b>	<b>13</b>	<b>17</b>	<b>18</b>	<b>15</b>	<b>5</b>	<b>1</b>										
50	1					5	15	10	10	15	20	15	10						
50	2						10	10	15	20	15	10	15	5					
50	3					5	5	15	15	10	15	20	15						
50	4						5	10	20	15	15	10	15	5	5				
50	5						10	10	15	10	20	15	15	15	5				
<b>Mean</b>					<b>1</b>	<b>1</b>	<b>9</b>	<b>11</b>	<b>15</b>	<b>14</b>	<b>17</b>	<b>14</b>	<b>14</b>	<b>2</b>	<b>1</b>	<b>1</b>			
150	1								5	10	5	15	15	20	15	10	5		
150	2									5	15	10	20	15	15	10	5	5	
150	3								5	10	20	15	15	20	5				
150	4								10	5	10	15	10	15	15	10	5	5	
150	5									15	10	15	20	15	15	5			
<b>Mean</b>							<b>1</b>	<b>1</b>	<b>5</b>	<b>9</b>	<b>12</b>	<b>14</b>	<b>16</b>	<b>17</b>	<b>13</b>	<b>7</b>	<b>3</b>	<b>2</b>	

**Table 6:** Ripening profiles of 'Maluma' avocado fruit that were sprayed with the 1-MCP tree spray at two application rates during the third week of December 2021 and sampled eight weeks later. Unfortunately, the cold room malfunctioned thus invalidating the results

Rate (g ai/ ha)	Rep	Ripe fruit per day (%)																		
		D1	D2	D3	D4	D5	D6	D7	D8	D9	D10	D11	D12	D13	D14	D15	D16	D17	D18	
0	1																			
0	2																			
0	3																			
0	4																			
0	5																			
	<b>Mean</b>																			
50	1																			
50	2																			
50	3																			
50	4																			
50	5																			
	<b>Mean</b>																			
150	1																			
150	2																			
150	3																			
150	4																			
150	5																			
	<b>Mean</b>																			

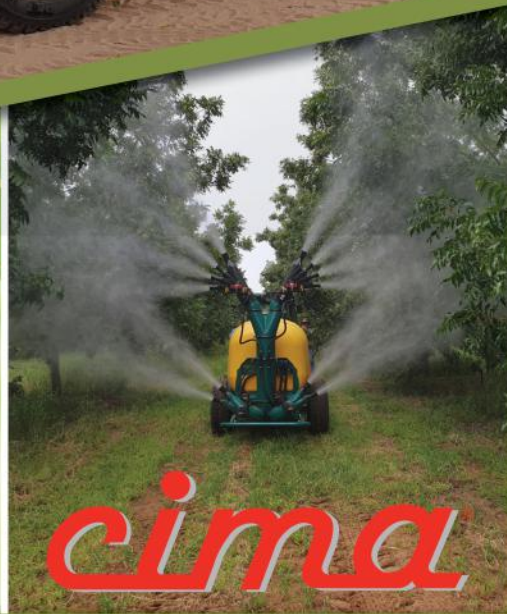
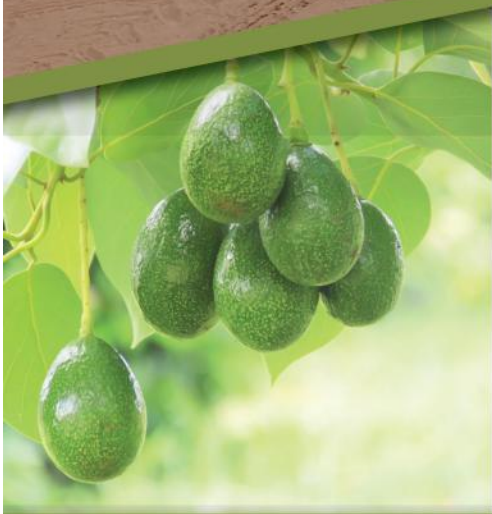
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**Table 7:** Ripening profiles of 'Maluma' avocado fruit that were sprayed with the 1-MCP tree spray at two application rates during the third week of December 2021 and sampled eleven weeks later. The fruit were thereafter stored for three weeks at 6 °C before being ripened at 20 °C until the ready to eat stage was reached. The ripening period was then recorded, followed by quality analyses

Rate (g ai/ ha)	Rep	Ripe fruit per day (%)																	
		D1	D2	D3	D4	D5	D6	D7	D8	D9	D10	D11	D12	D13	D14	D15	D16	D17	D18
0	1		10	15	15	15	20	15	10										
0	2	10	10	15	15	20	15	15											
0	3	5	10	15	15	20	15	10	10										
0	4	10	15	5	15	20	20	10	5										
0	5	10	20	15	10	15	15	5	10										
<b>Mean</b>	<b>7</b>	<b>13</b>	<b>13</b>	<b>14</b>	<b>18</b>	<b>17</b>	<b>11</b>	<b>7</b>											
50	1				5	15	20	20	15	15	10								
50	2			10	5	15	10	20	15	15	10								
50	3				10	10	20	15	20	10	10	5							
50	4				5	15	10	20	15	15	10	10							
50	5			5	15	20	15	15	10	15	5								
<b>Mean</b>				<b>3</b>	<b>8</b>	<b>15</b>	<b>15</b>	<b>18</b>	<b>15</b>	<b>14</b>	<b>9</b>	<b>3</b>							
150	1			5	10	10	20	15	10	15	5	10							
150	2			10	15	15	20	15	15	10									
150	3		10	15	20	20	15	10	10										
150	4				15	10	15	20	15	15	10								
150	5			5	20	15	20	20	10	5		5							
<b>Mean</b>			<b>2</b>	<b>7</b>	<b>16</b>	<b>14</b>	<b>18</b>	<b>16</b>	<b>12</b>	<b>9</b>	<b>3</b>	<b>3</b>							



**Table 8:** Ripening profiles of 'Maluma' avocado fruit that were sprayed with the 1-MCP tree spray at two application rates during the third week of December 2021 and sampled fourteen weeks later. The fruit were thereafter stored for three weeks at 6 °C before being ripened at 20 °C until the ready to eat stage was reached. The ripening period was then recorded, followed by quality analyses

Rate (g ai/ ha)	Rep	Ripe fruit per day (%)																	
		D1	D2	D3	D4	D5	D6	D7	D8	D9	D10	D11	D12	D13	D14	D15	D16	D17	D18
0	1	5	10	15	15	20	15	15	5										
0	2	10	15	10	15	20	15	15											
0	3	10	20	10	15	15	10	10	10										
0	4	10	15	10	20	15	15	5	10										
0	5	10	15	10	15	15	20	15											
	<b>Mean</b>	<b>9</b>	<b>15</b>	<b>11</b>	<b>16</b>	<b>17</b>	<b>15</b>	<b>12</b>	<b>5</b>										
50	1		5	10	15	20	20	15	10	5									
50	2		10	15	10	20	15	15	15										
50	3	10	5	15	15	20	15	15		5									
50	4		10	15	15	20	15	15	10										
50	5	5	15	10	10	20	15	15	10										
	<b>Mean</b>	<b>3</b>	<b>9</b>	<b>13</b>	<b>13</b>	<b>20</b>	<b>16</b>	<b>15</b>	<b>9</b>	<b>2</b>									
150	1		10	10	10	20	20	15	10		5								
150	2		5	10	15	20	20	10	10	10									
150	3		10	15	10	20	10	5	10	10	10								
150	4		5	15	15	20	10	15	15		5								
150	5		5	15	15	15	20	10	15		5								
	<b>Mean</b>		<b>7</b>	<b>13</b>	<b>13</b>	<b>19</b>	<b>16</b>	<b>11</b>	<b>12</b>	<b>4</b>	<b>5</b>								

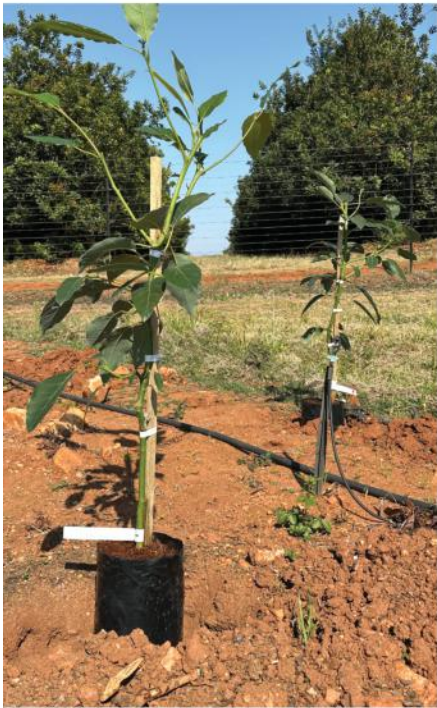
**Table 9:** Ripening profiles of 'Hass' avocado fruit from a high-altitude orchard that was sprayed with the 1-MCP tree spray at two application rates during the third week of June 2022 and sampled three weeks later. Each fruit was directly ripened at 20 °C and the time period required to reach the ready to eat stage was recorded

Application rate	Replicate no	Ripe fruit per day (%)																											
		D 6	D 7	D 8	D 9	D 10	D 11	D 12	D 13	D 14	D 15	D 16	D 17	D 18	D 19	D 20	D 21	D 22	D 23	D 24	D 25	D 26	D 27	D 28					
0	1					10	20	10	30	10																			
	2						10	20	10	30	10	20																	
	3						10		10	30	10	20	10	10															
	4							10		20	30	20	10		10														
	5					10	10			20	10	20	10																
	<b>Mean</b>				<b>2</b>	<b>6</b>	<b>8</b>	<b>12</b>	<b>20</b>	<b>14</b>	<b>14</b>	<b>2</b>	<b>2</b>																
50	1																												
	2																												
	3																												
	4																												
	5																												
	<b>Mean</b>																												
150	1																												
	2																												
	3																												
	4																												
	5																												
	<b>Mean</b>																												





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**Table 10:** Ripening profiles of 'Hass' avocado fruit from a high-altitude orchard that was sprayed with the 1-MCP tree spray at two application rates during the third week of June 2022 and sampled six weeks later. Each fruit was directly ripened at 20 °C and the time period required to reach the ready to eat stage was recorded

Application rate	Replicate no	Ripe fruit per day (%)																						
		D 6	D 7	D 8	D 9	D 10	D 11	D 12	D 13	D 14	D 15	D 16	D 17	D 18	D 19	D 20	D 21	D 22	D 23	D 24	D 25	D 26	D 27	D 28
0	1					10	20	10	30	10	10	10												
	2				10	20	10	10	20	20	10													
	3				10	20	30	20	10	10														
	4					10	20	10	30	20		10												
	5							10	20	20	30	10	10											
	<b>Mean</b>				<b>4</b>	<b>12</b>	<b>16</b>	<b>12</b>	<b>22</b>	<b>16</b>	<b>10</b>	<b>4</b>	<b>4</b>											
50	1							10			10	20	20	10	20	10								
	2								10	20	20	20	10	20										
	3								10	10	20	10	20		10									
	4								10	20	10	20	20		10	10								
	5								10	10	10	20	20	10	20									
	<b>Mean</b>							<b>6</b>	<b>10</b>	<b>10</b>	<b>16</b>	<b>20</b>	<b>14</b>	<b>10</b>	<b>12</b>	<b>2</b>								
150	1										10			20	10	20	20	10						
	2									10	20	10	20	10	10	20								
	3										10			10	10	20	10	20						
	4										10	10	20	20	20		20							
	5										10			10	20	10	20	20	10					
	<b>Mean</b>									<b>4</b>	<b>10</b>	<b>16</b>	<b>6</b>	<b>14</b>	<b>14</b>	<b>16</b>	<b>14</b>	<b>16</b>	<b>8</b>					





**Table 11:** Ripening profiles of 'Hass' avocado fruit from a high-altitude orchard that was sprayed with the 1-MCP tree spray at two application rates during the third week of June 2022 and sampled nine weeks later. Each fruit was directly ripened at 20 °C and the time period required to reach the ready to eat stage was recorded

Application rate	Replicate no	Ripe fruit per day (%)																										
		D 6	D 7	D 8	D 9	D 10	D 11	D 12	D 13	D 14	D 15	D 16	D 17	D 18	D 19	D 20	D 21	D 22	D 23	D 24	D 25	D 26	D 27	D 28				
0	1			10	20	10	10	20	10	20	20	10																
	2				10	10	20	20	30	10																		
	3		10	20	10	20	10	20		10																		
	4			20	10	20	20	20	10																			
	5			10	20	10	10	20	20		10																	
	<b>Mean</b>		<b>2</b>	<b>12</b>	<b>14</b>	<b>14</b>	<b>14</b>	<b>20</b>	<b>16</b>	<b>6</b>	<b>2</b>																	
50	1			10	10	20	10	20	20		10																	
	2						10	10	10	20	20	20	20	10														
	3					10	20	10	10	20	20	10																
	4					10	10	20	20	10	20	10																
	5					10	20	10	20	20	10	10																
	<b>Mean</b>				<b>2</b>	<b>4</b>	<b>12</b>	<b>12</b>	<b>16</b>	<b>16</b>	<b>12</b>	<b>16</b>	<b>8</b>	<b>2</b>														
150	1								10	20	20	20	10	10		10												
	2								10	20	10	20	10	20		10	20											
	3					10			10		20	20	20	10	10		10	20										
	4					10	10	20	20		20	10	10	20	10	20		10	20									
	5								10	10	20	20	20	10	10		20	20	10	10								
	<b>Mean</b>					<b>4</b>	<b>6</b>	<b>14</b>	<b>10</b>	<b>10</b>	<b>14</b>	<b>10</b>	<b>12</b>	<b>16</b>	<b>10</b>	<b>10</b>	<b>12</b>	<b>16</b>	<b>10</b>	<b>10</b>	<b>10</b>	<b>12</b>	<b>6</b>					

**Table 12:** Ripening profiles of 'Hass' avocado fruit from a high-altitude orchard that was sprayed with the 1-MCP tree spray at two application rates during the third week of June 2022 and sampled twelve weeks later. Each fruit was directly ripened at 20 °C and the time period required to reach the ready to eat stage was recorded

Application rate	Replicate no	Ripe fruit per day (%)																											
		D 6	D 7	D 8	D 9	D 10	D 11	D 12	D 13	D 14	D 15	D 16	D 17	D 18	D 19	D 20	D 21	D 22	D 23	D 24	D 25	D 26	D 27	D 28					
0	1																												
	2			8	15	15	23	8	15		8	8																	
	3	8	11	14	17	20	18	9	3																				
	4		9	11	20	23	17	12	8	2																			
	5	4	12	15	13	18	12	14	9	3																			
	<b>Mean</b>	<b>3</b>	<b>8</b>	<b>12</b>	<b>16</b>	<b>19</b>	<b>17</b>	<b>11</b>	<b>9</b>	<b>1</b>	<b>2</b>	<b>2</b>	<b>0</b>																
50	1		4	8	14	18	10	12	17	9	5	3																	
	2		11	32	26	16	5	11																					
	3		4	7	13	16	15	16	10	11	6	1	0																
	4			7	11	20	26	24	9	4																			
	5		4	11	15	18	13	16	14	7	2																		
	<b>Mean</b>	<b>4</b>	<b>13</b>	<b>16</b>	<b>18</b>	<b>14</b>	<b>16</b>	<b>10</b>	<b>6</b>	<b>3</b>	<b>1</b>	<b>0</b>																	
150	1			10	12	16	20	18	16	6	1	1																	
	2		11	16	16	15	16	12	10	4		1																	
	3		7	16	13	21	24	10	6	3																			
	4		8	16	27	24	16	10																					
	5				8	17	15	14	14	14	9	7	3																
	<b>Mean</b>	<b>5</b>	<b>11</b>	<b>15</b>	<b>18</b>	<b>18</b>	<b>13</b>	<b>9</b>	<b>5</b>	<b>2</b>	<b>2</b>	<b>1</b>																	





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**Table 13:** Ripening profiles of 'Hass' avocado fruit that were sprayed with the 1-MCP tree spray at two application rates during the third week of June 2022 and sampled three weeks later. The fruit were hereafter stored for four weeks at 6 °C before being ripened at 20 °C until the ready to eat stage was reached. The ripening period was then recorded

Application rate	Replicate no	Ripe fruit per day (%)																	
		D 1	D 2	D 3	D 4	D 5	D 6	D 7	D 8	D 9	D 10	D 11	D 12	D 13	D 14	D 15	D 16	D 17	D 18
0	1		20	20	30	10	20												
	2	20	20	30	10	10													
	3	10	20	20	10	10	20	10											
	4	20	20	20	20	20													
	5	10	20	10	20	10		20	10										
	<b>Mean</b>	<b>12</b>	<b>20</b>	<b>20</b>	<b>18</b>	<b>12</b>	<b>10</b>	<b>6</b>	<b>2</b>										
50	1						10	20	30	20	10		10						
	2						10		20	30	10	10	10	10	10				
	3						10		20	30	10	20							
	4						10	20	10	20	20	10		10					
	5						10	10	20	10	20	10	10			10			
	<b>Mean</b>						<b>2</b>	<b>10</b>	<b>10</b>	<b>20</b>	<b>22</b>	<b>14</b>	<b>10</b>	<b>4</b>	<b>4</b>	<b>4</b>			
150	1								20	10	10	20	20			20			
	2							10		20	10		20	10	10	10	10	10	
	3								10	10	10	20	20	20	10	10			10
	4								20	10	10	20	20	10	10		10		10
	5								10	20	10	20	10	10	10		20		
	<b>Mean</b>								<b>2</b>	<b>12</b>	<b>14</b>	<b>10</b>	<b>16</b>	<b>16</b>	<b>8</b>	<b>8</b>	<b>8</b>	<b>4</b>	<b>2</b>



**Table 14:** Ripening profiles of 'Hass' avocado fruit that were sprayed with the 1-MCP tree spray at two application rates during the third week of June 2022 and sampled six weeks later. The fruit were hereafter stored for four weeks at 6 °C before being ripened at 20 °C until the ready to eat stage was reached. The ripening period was then recorded

Application rate	Replicate no	Ripe fruit per day (%)																	
		D 1	D 2	D 3	D 4	D 5	D 6	D 7	D 8	D 9	D 10	D 11	D 12	D 13	D 14	D 15	D 16	D 17	D 18
0	1		9	13	9	22	13	16	18										
	2	20	10	20	10	10	20		10										
	3	30	20	10		20	20												
	4	10	20	10	10	20	10	20											
	5		20	20	40	10		10											
	<b>Mean</b>	<b>12</b>	<b>16</b>	<b>15</b>	<b>14</b>	<b>16</b>	<b>13</b>	<b>9</b>	<b>6</b>										
50	1						20	20	10	10	20	20							
	2					10	10		30	10		20	10	10					
	3					10	10	20	10	20	10	10	10						
	4						10	20	10	20	30	10							
	5			10	10	10	20	20	10	20									
	<b>Mean</b>			<b>2</b>	<b>2</b>	<b>6</b>	<b>14</b>	<b>16</b>	<b>14</b>	<b>16</b>	<b>12</b>	<b>10</b>	<b>6</b>	<b>2</b>					
150	1							20	10	20	20	20	20		10				
	2								10	20	10	10		20		10	20		
	3								10	10	20	20	10	10	10	10	10		
	4							10	20	10		20	10	10	10	10			
	5							10	10	20	20	10	10	10	10	10	10		
	<b>Mean</b>							<b>8</b>	<b>12</b>	<b>16</b>	<b>14</b>	<b>12</b>	<b>10</b>	<b>8</b>	<b>8</b>	<b>4</b>	<b>8</b>		

**Table 15:** Ripening profiles of 'Hass' avocado fruit that were sprayed with the 1-MCP tree spray at two application rates during the third week of June 2022 and sampled nine weeks later. The fruit were hereafter stored for four weeks at 6 °C before being ripened at 20 °C until the ready to eat stage was reached. The ripening period was then recorded

Application rate	Replicate no	Ripe fruit per day (%)																	
		D 1	D 2	D 3	D 4	D 5	D 6	D 7	D 8	D 9	D 10	D 11	D 12	D 13	D 14	D 15	D 16	D 17	D 18
0	1	10	20	10	20	10	10	20											
	2	10	20	10	20	20	10	10											
	3	20	20	20	20	20													
	4	10	20	10	20	30	10												
	5	20	10	20	20		20	10											
	<b>Mean</b>	<b>14</b>	<b>18</b>	<b>14</b>	<b>20</b>	<b>16</b>	<b>10</b>	<b>8</b>											
50	1			10	20	10	20	10	20	10									
	2				20	20	10	30	10	10									
	3	10		10	20	20	10	20	10										
	4		10	10	30	10	20		20										
	5			20	30	10	10	20	10										
	<b>Mean</b>	<b>2</b>	<b>2</b>	<b>10</b>	<b>24</b>	<b>14</b>	<b>14</b>	<b>14</b>	<b>16</b>	<b>14</b>	<b>4</b>								
150	1				10					20	10	10	20						
	2					10	20	20		10	10	20		10					
	3						10	20	10	20	10		10	10	10				
	4					20	10	20	10		20	10	10						
	5						10	10	20	10		10	20	10					
	<b>Mean</b>				<b>4</b>	<b>6</b>	<b>14</b>	<b>16</b>	<b>8</b>	<b>12</b>	<b>10</b>	<b>10</b>	<b>12</b>	<b>4</b>	<b>4</b>				



# LEOLA CLONAL ROOTSTOCK



## OVERVIEW

Good results with Hass & Gem®

PRODUCTION



ROOT ROT TOLERANCE



VIGOR



SALINITY TOLERANCE



DENOMINATION 'Merensky 6'

TRADEMARK Leola®

ORIGIN

Westfalia Fruit Breeding Programme

OWNERSHIP

Westfalia Fruit & SAAGA



## PRODUCTION PERFORMANCE

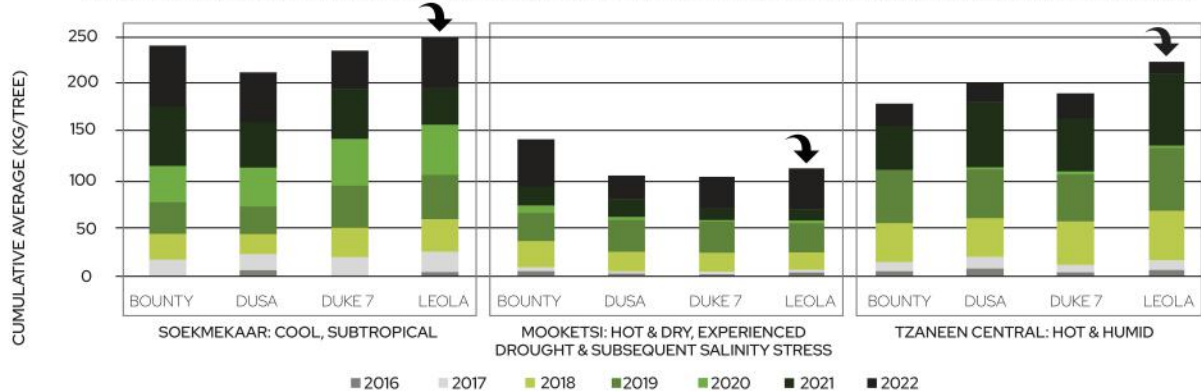
Leola® grafted with Hass and tested across several locations in South Africa, California and Peru has delivered high yields and boasted excellent tree health, making it a good candidate for any new and replant developments.

Leola® grafted to other leading commercial cultivars has also demonstrated competitive or superior yields when compared to other industry standard clonal rootstocks. Good tolerance to *Phytophthora cinnamomi* has also been demonstrated when Leola® is planted in infested soils.



## HASS ON LEOLA® - PERFORMANCE IN SOUTH AFRICA

CUMULATIVE HASS YIELD OF THREE FORMAL TRIALS CONDUCTED IN SOUTH AFRICA UNDER VARYING GROWING CONDITIONS

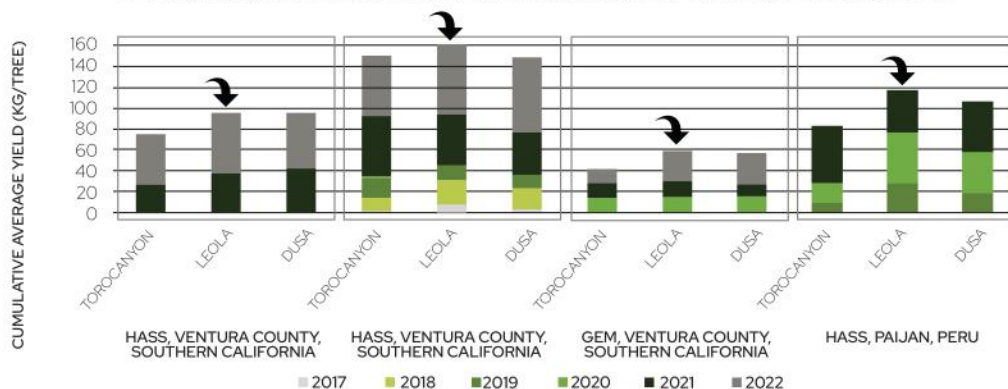


In a range of additional trials conducted in several provinces, Leola® proved to be a good rootstock for not only Hass, but also other varieties



## LEOLA® - PERFORMANCE INTERNATIONALLY

CUMULATIVE AVERAGE YIELD BY ROOTSTOCK FOR A RANGE OF TRIALS IN THE USA AND PERU



Westfalia Fruit launches Leola® with pride and confidence, and with great expectation that this rootstock will make a major contribution to the avocado world by delivering good and consistent yields

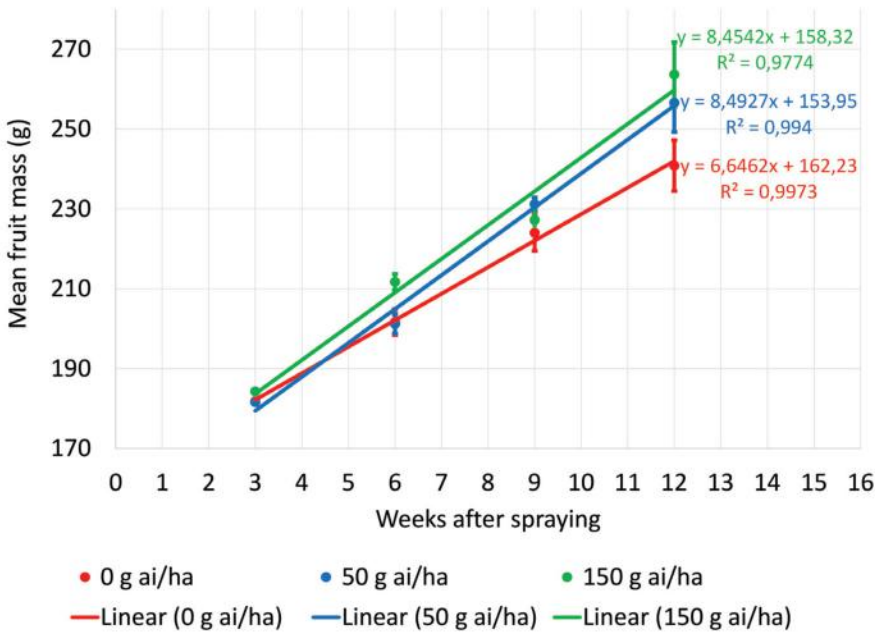


**Table 16:** Ripening profiles of 'Hass' avocado fruit that were sprayed with the 1-MCP tree spray at two application rates during the third week of June 2022 and sampled twelve weeks later. The fruit were hereafter stored for four weeks at 6 °C before being ripened at 20 °C until the ready to eat stage was reached. The ripening period was then recorded

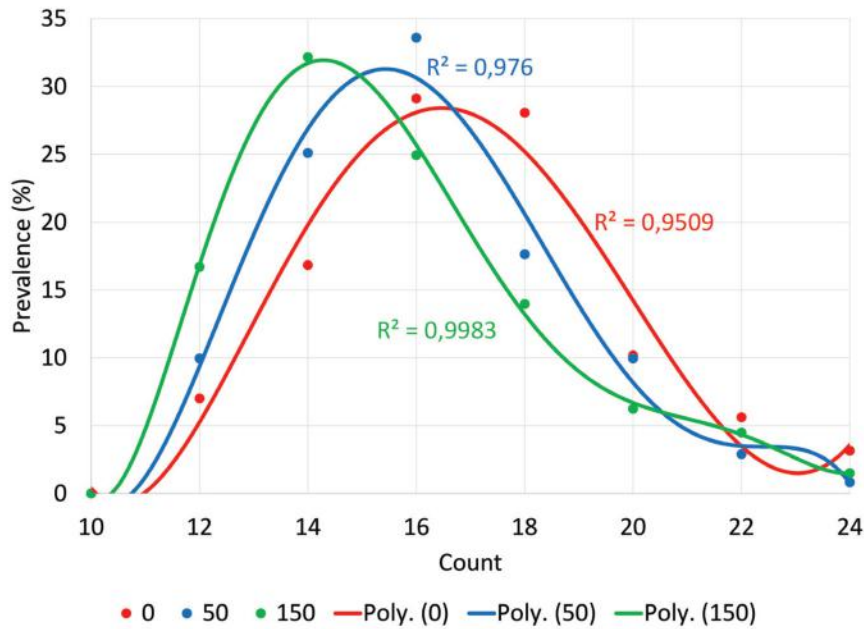
Application rate	Replicate no	Ripe fruit per day (%)																	
		D 1	D 2	D 3	D 4	D 5	D 6	D 7	D 8	D 9	D 10	D 11	D 12	D 13	D 14	D 15	D 16	D 17	D 18
0	1	5	9	18	14	20	15	18	2										
	2	6	10	14	13	16	23	11	8										
	3																		
	4	14	21	14	21	7	14	7											
	5	8	12	17	15	23	20	5											
	<b>Mean</b>	<b>8</b>	<b>13</b>	<b>16</b>	<b>16</b>	<b>16</b>	<b>18</b>	<b>10</b>	<b>2</b>										
50	1	4	7	16	14	18	19	15	6										
	2	7	11	15	19	24	15	8	2										
	3	4	9	13	17	12	16	16	9	5									
	4	10	15	15	10	15	15	10	5	5									
	5	5	8	11	18	16	16	16	17	7	2								
	<b>Mean</b>	<b>6</b>	<b>10</b>	<b>14</b>	<b>15</b>	<b>17</b>	<b>16</b>	<b>13</b>	<b>6</b>	<b>2</b>									
150	1	6	10	19	17	21	19	8											
	2	3	8	10	11	15	18	18	12	5									
	3	2	10	10	15	16	17	12	17	1									
	4		6	12	10	12	15	23	16	6									
	5	6	4	15	16	18	22	13	6										
	<b>Mean</b>	<b>3</b>	<b>7</b>	<b>13</b>	<b>14</b>	<b>16</b>	<b>18</b>	<b>15</b>	<b>10</b>	<b>2</b>	<b>0</b>								







**Figure 1:** Mean mass gain of 'Hass' avocado fruit from a high-altitude orchard that was sprayed with the 1-MCP tree spray during the third week of June 2022 and then sampled at three-week intervals over a twelve-week period. The sample size of the first three dates was 10 fruit per replicate. All remaining fruit were removed on week 12 and the sample sizes varied between 52 and 240 fruit per replicate. (The vertical bars represent the standard errors of the mean values.)



**Figure 2:** Count profiles of 'Hass' avocado fruit from a high-altitude 'Hass' orchard that was sprayed with the 1-MCP tree spray during the third week of June 2022 and sampled twelve weeks later.