



FINAL SUMMARY REPORT

Road testing of key best practices for control of Glomerella in apples;

- 1. Choice of fungicide**
- 2. Spray volume used**
- 3. Timing to start spraying**

by comparison of Dithane at dilute and concentrate water volumes with Delan, Fontelis Sercadis, Luna Sensation, Pristine, Belanty, Flint and Seguris Flexi in Sundowner and Granny Smith apples at Stanthorpe, Qld, 2023-24

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SUMMARY

At Pozieres, Queensland, in the 2023-24 season the two fungicides registered for control of Glomerella (*Glomerella cingulata*) Dithane 750 WG and Delan 700 WG and seven unregistered fungicides Fontelis 200 SC, Sercadis 300 SC, Luna Sensation 500 SC, Pristine 380 SC, Belanty 75 SC, Flint 500 WG and Seguris Flexi 125 EC were applied to Sundowner and Granny Smith variety apple trees for the control of Glomerella.

All fungicides were applied at registered rates. A program of four applications of the fungicides Delan at 18 g/100 L, Fontelis at 175 mL/100 L, Sercadis at 20 mL/100 L, Luna Sensation at 30 mL/100 L, Pristine at 40 g/100 L, Belanty at 80 mL/100 L, Flint at 10 g/100 L and Seguris Flexi at 80 mL/100 L were applied commencing in early November and compared with Dithane at 200 g/100 L at dilute, 2X concentrate and 3X concentrate water volumes commencing in early-November. All treatments were also compared with a program of Dithane applications commencing in late-November, mid-December and late-December and to untreated control trees.

Four applications were made to all fungicide treatments except that of the Dithane treatment that commenced in late-December which received only three applications as the trial was overrun with Glomerella prior to the fourth application, so the decision was made to cease any further spraying.

The average application interval for treatments commencing in; early-November was 18.7 days, late-November 15.3 days, mid-December 12 days and late-December 11 days. The average dilute water application volume was 1,440 L/ha, the 2X concentrate water volume was 702 L/ha and the 3X concentrate water volume was 477 L/ha.

Twenty one days after the third application of fungicides (21DAA3) fruit on trees were assessed for Glomerella symptoms and again at 13DAA3, 1DAA5, 9DAA5 and 18DAA6. At 18DAA6 fallen Sundowner fruit had been removed from trees and from under trees by the grower however as the Granny Smith fruit remained it was assessed for Glomerella infection. On seven occasions during the course of the trial leaves and fruit were observed for phytotoxicity symptoms.

Conclusions

- The efficacy of Dithane and Delan, which are both registered for the control of Glomerella in apples was confirmed in a high pressure season.
- Dithane was more effective for the control of Glomerella in apples when applied at dilute spray volumes (1X) and 2X concentrate than when applied at 3X concentrate water volumes.
- When Dithane applications commenced in either early-November or late-November they were more efficacious for the control of Glomerella in apples than when they commenced in mid-December or late-December.
- No control of Glomerella in apples was provided by the fungicides unregistered for this disease; Fontelis, Sercadis, Luna Sensation, Pristine, Belanty, Flint and Seguris Flexi.
- No phytotoxicity symptoms were observed on apple leaves or fruit from any of the applied fungicides during the trial period.

INTRODUCTION

Aims

Apple growers don't always know the efficacy spectrum of newer fungicides on Glomerella, so may be applying fungicides mixtures that may not be necessary. To gain insight some fungicides that are not registered for Glomerella control (Fontelis, Sercadis, Luna Sensation, Pristine, Belanty, Flint and Seguris Flexi) were compared to some that are registered and provide good control eg Delan, Mancozeb. The opportunity was also taken to compare dilute and semi-concentrate spray volumes and some key timings to commence fungicide applications.

- To evaluate Dithane 700 WG and Delan 700 WG, which are both registered for the control of Glomerella (*Glomerella cingulata*) in Sundowner and Granny Smith variety apples.
- To compare Dithane applied at 1X dilute, 2X concentrate and 3X concentrate water volumes for the control of Glomerella in apples.
- To compare a program of Dithane applications commencing at either early-November, late-November, mid-December or late-December for the control of Glomerella in apples.
- To evaluate Fontelis 200 SC, Sercadis 300 SC, Luna Sensation 500 SC, Pristine 380 SC, Belanty 75 SC, Flint 500 WG and Seguris Flexi 125 EC for the control of Glomerella in apples.
- To compare industry standard fungicides registered for Glomerella control (Dithane and Delan) to fungicides registered for diseases other than for Glomerella (Fontelis, Sercadis, Luna Sensation, Pristine, Belanty, Flint and Seguris Flexi).
- To evaluate the crop safety of all fungicides on apple leaves and fruit.

Disease

Glomerella (*Glomerella cingulata*) also known as bitter rot.

MATERIALS AND METHODS

Treatment list

No.	Product *	Active ingredient (ai)	Rate	
			Product (per 100 L)	Active ingredient (g ai/100 L)
1	Untreated control	-	Nil	Nil
2	Delan 700 WG		18 g	12.6
3	Dithane 750 WG (1X)	mancozeb	200 g	150
4	Dithane 750 WG (2X)	mancozeb	400 g	150
5	Dithane 750 WG (3X)		600 g	300
6	Dithane 750 WG	mancozeb	200 g	150
7	Dithane 750 WG	mancozeb	200 g	150
8	Dithane 750 WG	mancozeb	200 g	150
9	Fontelis 200 SC	penthiopyrad	175 mL	35
10	Sercadis 300 SC		20 mL	6
11	Luna Sensation 500 SC	fluopyram trifloxystrobin	30 mL	15
12	Pristine 380 SC	boscalid pyraclostrobin	40 g	15.2
13	Belanty 75 SC		80 mL	6
14	Flint 500 WG	trifloxystrobin	10 g	5
15	Seguris Flexi 125 EC	isopyrazam	80 mL	10

* Note that just Dithane and Delan were used as standard fungicides registered for Glomerella control so as to limit the size/complexity of the trial. Ziram and Polyram are also registered for Glomerella control.

The selection of the seven newer fungicides not registered for Glomerella control were made by the apple growers advising the project.

Treatment timings

Timing	02/11/23	23/11/23	14/12/23	28/12/23	08/01/24	19/01/24
1						
2	Delan	Delan	Delan	Delan		
3	Dithane	Dithane	Dithane	Dithane		
4	Dithane 2X	Dithane 2X	Dithane 2X	Dithane 2X		
5	Dithane 3X	Dithane 3X	Dithane 3X	Dithane 3X		
6		Dithane	Dithane	Dithane	Dithane	
7			Dithane	Dithane	Dithane	Dithane
8				Dithane	Dithane	Dithane
9	Fontelis	Fontelis	Fontelis	Fontelis		
10	Sercadis	Sercadis	Sercadis	Sercadis		
11	Luna Sensation	Luna Sensation	Luna Sensation	Luna Sensation		
12	Pristine	Pristine	Pristine	Pristine		
13	Belanty	Belanty	Belanty	Belanty		
14	Flint	Flint	Flint	Flint		
15	Seguris Flexi	Seguris Flexi	Seguris Flexi	Seguris Flexi		

To control black spot and powdery mildew the DMI fungicide Systhane was applied to treatments T6, T7 and T8 prior to the commencement of the Dithane applications and also to T1 (the untreated control) on the 02/11/23, 23/11/23 and 14/12/23.

RESULTS AND DISCUSSION

The commercial apple orchard was chosen because a heavy infection of *Glomerella* (*Glomerella cingulata*) was observed at the site in the previous growing season (Photos 1 and 2). The orchard had Granny Smith and Sundowner trees in close proximity so the trial was split by replicate across these two varieties.

Infected fruit were first observed on 14/12/23 which was twenty-one days after the second application of fungicides (21DAA2) and infection was present in untreated control trees, trees that received Dithane 750 WG at 3X concentrate spraying, trees that had later start dates for Dithane and in all the trees that were receiving fungicides not registered for *Glomerella* control; Fontelis 200 SC, Sercadis 300 SC, Luna Sensation 500 SC, Pristine 380 SC, Belanty 75 SC, Flint 500 WG and Seguris Flexi 125 EC. Note that treatments 7 and 8 had yet to receive any Dithane sprays at this assessment timing (Tables 1 and 3, Photos 3 and 4).

Thirteen days later fruit were inspected (13DAA3) again and there was some *Glomerella* infection present on fruit from trees that received all programs. The weather in this period was very favourable for diseases with eight wet days in the 13 day period. Likewise in the next 13 day interval to the assessment on 09/01/24 (1DAA5) there were 10 wet days and infection increased on most trees.

At the assessment eight days later infection had ‘blown out’ on untreated control trees to 20.8 % of fruit. Differences were statistically significant at this assessment and the best control was on trees treated with Delan starting in early November, Dithane at dilute or 2X water volumes started in early November and Dithane started in late November (Tables 1 to 4, Figures 1 to 3).

The assessment on 06/02/24 which was 18DAA6 some 31 % of fruit on untreated control trees were infected, with an average of 22.5 infected fallen fruit under untreated trees. This assessment was just of Granny Smith trees and the best performing fungicide was Dithane applied at dilute or 2X water volumes commencing in early November, which confirms the previous assessments. Some caution should be used in interpreting on-tree infection alone at this stage as infected fruit was falling readily and may have made the results ‘on-tree’ look better than they were (Table 5, Photos 5 and 6).

Leaves and fruit were inspected on seven occasions during the trial period for any phytotoxicity symptoms and none were observed.

Table 1. Percent fruit with Glomerella, 21DAA2 and 13DAA3

Rating Data Type				% fruit with Glomerella	
Rating Date				14/12/23	27/12/23
Days After Application Number				21DAA2	13DAA3
	Treatment	Commenced		1 [#]	2
1	Untreated Control			1.3	3.2
2	Delan	Early Nov	700 WG 18 g/100 L	0.0	0.4
3	Dithane (1X)		750 WG 200 g/100 L	0.0	0.8
4	Dithane (2X)		750 WG 400 g/100 L	0.0	1.0
5	Dithane (3X)		750 WG 600 g/100 L	1.3	1.9
6	Dithane	Late Nov	750 WG 200 g/100 L	0.6	1.9
7	Dithane	Mid Dec	750 WG 200 g/100 L	8.0	7.0
8	Dithane	Late Dec	750 WG 200 g/100 L	0.2	0.8
9	Fontelis	Early Nov	200 SC 175 mL/100 L	0.8	1.1
10	Sercadis		300 SC 20 mL/100 L	1.0	1.7
11	Luna Sensation		500 SC 30 mL/100 L	6.3	5.1
12	Pristine		380 WG 40 g/100 L	1.3	2.1
13	Belanty		75 SC 80 mL/100 L	0.4	1.7
14	Flint		500 WG 10 g/100 L	2.1	3.4
15	Seguris Flexi		125 EC 80 mL/100 L	3.6	5.3
LSD P=0.05				NA	NA
Treatment Prob(F)				0.323	0.575

DAA: Days after application # Refers to relevant column of ARM statistical analysis table in Appendix ii

Table 2. Percent fruit with Glomerella, 1DAA5 and 9DAA5

Rating Data Type							% fruit with Glomerella	
Rating Date							09/01/24	17/01/24
Days After Application Number							1DAA5	9DAA5
Treatment		Commenced					3	4
1	Untreated Control						7.4	20.8 abcd
2	Delan	Early Nov	700	WG	18	g/100 L	0.4	3.2 de
3	Dithane (1X)		750	WG	200	g/100 L	0.2	0.8 e
4	Dithane (2X)		750	WG	400	g/100 L	0.4	0.8 e
5	Dithane (3X)		750	WG	600	g/100 L	1.3	3.8 cde
6	Dithane	Late Nov	750	WG	200	g/100 L	0.6	1.1 de
7	Dithane	Mid Dec	750	WG	200	g/100 L	5.1	7.4 cde
8	Dithane	Late Dec	750	WG	200	g/100 L	5.0	18.7 abcde
9	Fontelis	Early Nov	200	SC	175	mL/100 L	1.9	7.4 cde
10	Sercadis		300	SC	20	mL/100 L	3.6	8.2 bcde
11	Luna Sensation		500	SC	30	mL/100 L	12.0	34.3 a
12	Pristine		380	WG	40	g/100 L	8.0	30.7 a
13	Belanty		75	SC	80	mL/100 L	4.2	15.2 abcde
14	Flint		500	WG	10	g/100 L	9.5	23.0 abc
15	Seguris Flexi		125	EC	80	mL/100 L	7.4	27.8 ab
LSD P=0.05							NA	19.8
Treatment Prob(F)							0.239	0.008

Means followed by the same letter are not significantly different at the 5 % level according to least significant difference (LSD) test.

Table 3. Number of Glomerella spots per fruit 21DAA2 and 13DAA3

Rating Data Type					Number of Glomerella spots per fruit			
Rating Date					14/12/23	27/12/23		
Days After Application Number					21DAA2	13DAA3		
	Treatment	Commenced			5	6		
1	Untreated Control				0.02	0.06		
2	Delan	Early Nov	700	WG	18	g/100 L	0.00	0.00
3	Dithane (1X)		750	WG	200	g/100 L	0.00	0.01
4	Dithane (2X)		750	WG	400	g/100 L	0.00	0.01
5	Dithane (3X)		750	WG	600	g/100 L	0.03	0.04
6	Dithane	Late Nov	750	WG	200	g/100 L	0.02	0.05
7	Dithane	Mid Dec	750	WG	200	g/100 L	0.20	0.14
8	Dithane	Late Dec	750	WG	200	g/100 L	0.00	0.01
9	Fontelis	Early Nov	200	SC	175	mL/100 L	0.02	0.01
10	Sercadis		300	SC	20	mL/100 L	0.02	0.02
11	Luna Sensation		500	SC	30	mL/100 L	0.15	0.21
12	Pristine		380	WG	40	g/100 L	0.02	0.02
13	Belanty		75	SC	80	mL/100 L	0.01	0.02
14	Flint		500	WG	10	g/100 L	0.05	0.04
15	Seguris Flexi		125	EC	80	mL/100 L	0.08	0.07
LSD P=0.05					NA		NA	
Treatment Prob(F)					0.268		0.586	

Table 4. Number of Glomerella spots per fruit, 1DAA5 and 9DAA5

Rating Data Type							Number of Glomerella spots per fruit		
Rating Date							09/01/24	17/01/24	
Days After Application Number							1DAA5	9DAA5	
	Treatment	Commenced					7	8	
1	Untreated Control						0.40	1.22	bcd
2	Delan	Early Nov	700	WG	18	g/100 L	0.00	0.13	d
3	Dithane (1X)		750	WG	200	g/100 L	0.00	0.06	d
4	Dithane (2X)		750	WG	400	g/100 L	0.00	0.06	d
5	Dithane (3X)		750	WG	600	g/100 L	0.02	0.26	cd
6	Dithane	Late Nov	750	WG	200	g/100 L	0.01	0.01	d
7	Dithane	Mid Dec	750	WG	200	g/100 L	0.07	0.24	cd
8	Dithane	Late Dec	750	WG	200	g/100 L	0.07	0.72	bcd
9	Fontelis	Early Nov	200	SC	175	mL/100 L	0.05	0.59	bcd
10	Sercadis		300	SC	20	mL/100 L	0.09	0.53	cd
11	Luna Sensation		500	SC	30	mL/100 L	0.81	3.37	a
12	Pristine		380	WG	40	g/100 L	0.23	2.37	ab
13	Belanty		75	SC	80	mL/100 L	0.09	1.26	bcd
14	Flint		500	WG	10	g/100 L	0.38	1.63	abcd
15	Seguris Flexi		125	EC	80	mL/100 L	0.12	1.99	abc
LSD P=0.05							NA	1.79	
Treatment Prob(F)							0.455	0.014	

Table 5. Glomerella infected on-tree and fallen fruit (Granny Smith only), 18DAA6

Rating Data Type							Glomerella infected fruit		
							% on tree		number of fallen
Rating Date							06/02/24		
Days After Application Number							18DAA6		
Treatment		Commenced					23		24
1	Untreated Control						31.0	ab	22.5
2	Delan	Early Nov	700	WG	18	g/100 L	13.0	c	0.0
3	Dithane (1X)		750	WG	200	g/100 L	9.0	c	0.0
4	Dithane (2X)		750	WG	400	g/100 L	9.5	c	0.5
5	Dithane (3X)		750	WG	600	g/100 L	16.5	bc	0.0
6	Dithane	Late Nov	750	WG	200	g/100 L	12.0	c	0.5
7	Dithane	Mid Dec	750	WG	200	g/100 L	12.5	c	1.5
8	Dithane	Late Dec	750	WG	200	g/100 L	14.0	c	10.0
9	Fontelis	Early Nov	200	SC	175	mL/100 L	15.0	bc	10.5
10	Sercadis		300	SC	20	mL/100 L	17.5	bc	9.0
11	Luna Sensation		500	SC	30	mL/100 L	13.0	c	2.5
12	Pristine		380	WG	40	g/100 L	39.5	a	17.0
13	Belanty		75	SC	80	mL/100 L	9.5	c	1.0
14	Flint		500	WG	10	g/100 L	20.0	bc	7.5
15	Seguris Flexi		125	EC	80	mL/100 L	17.5	bc	5.5
LSD P=0.05							16.1		NA
Treatment Prob(F)							0.050		0.366

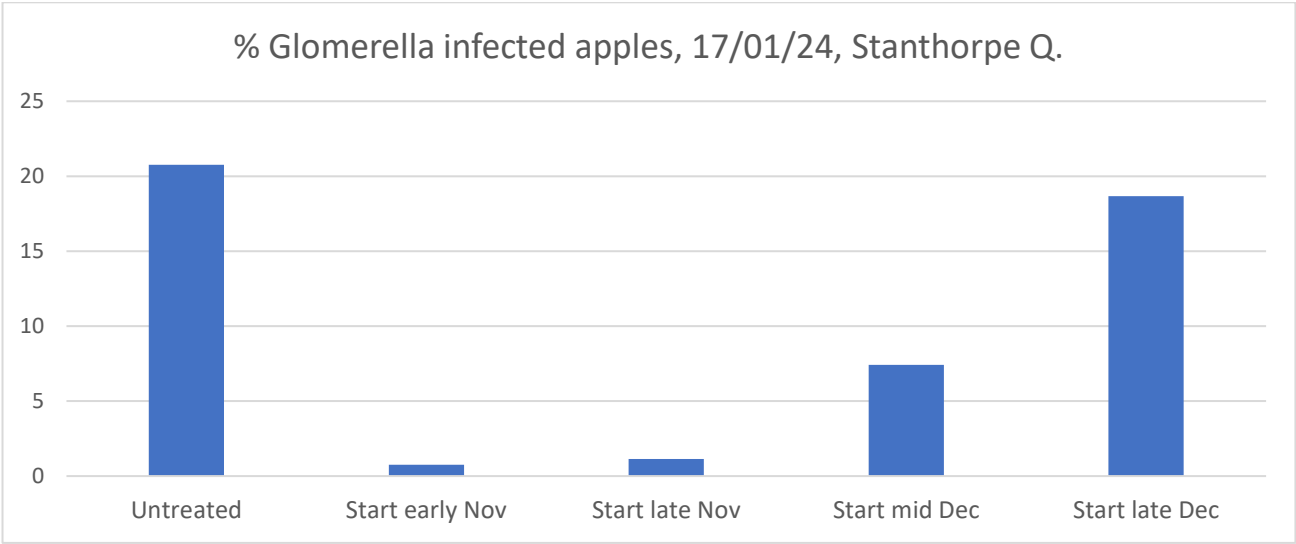


Figure 1. Effect of starting time of fungicide.

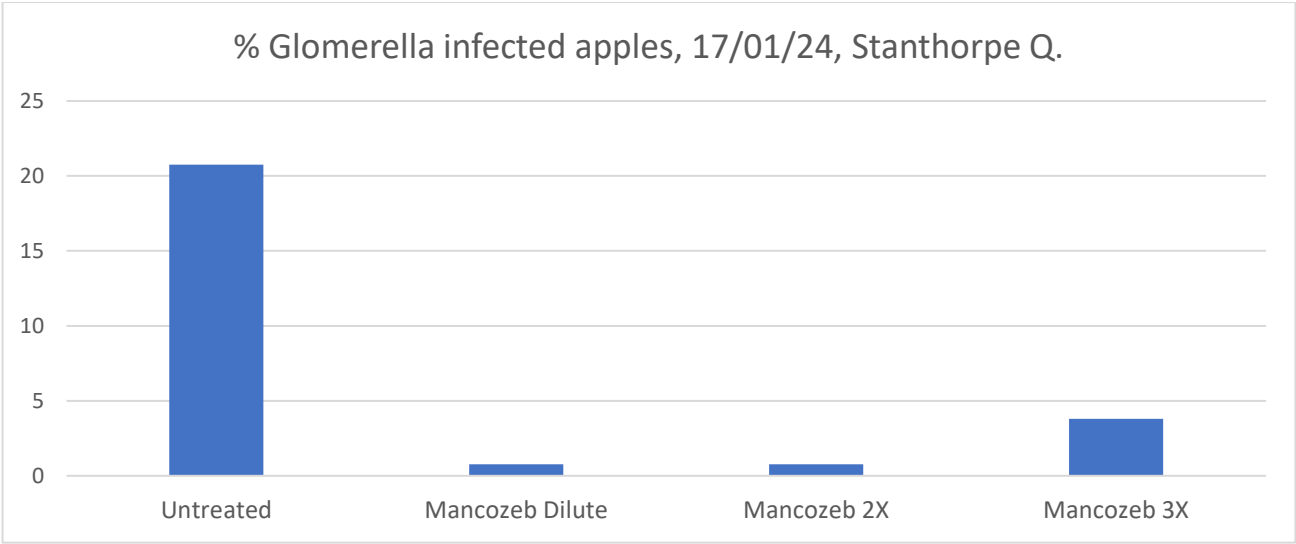


Figure 2. Effect of spray volume of fungicide.

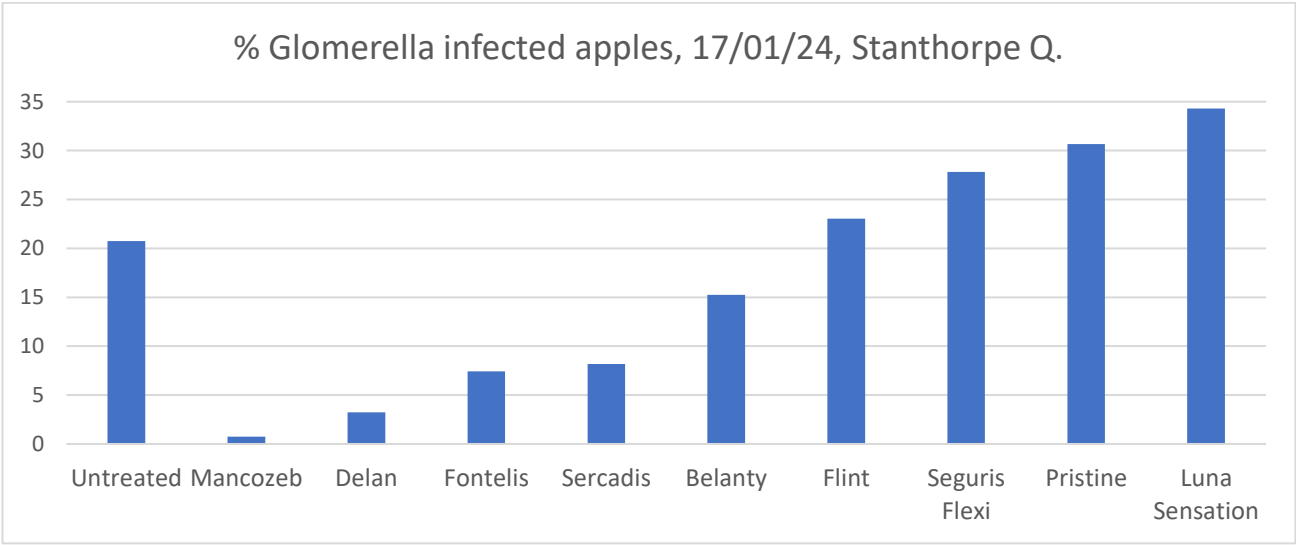


Figure 3. Efficacy of 2 registered and 7 unregistered fungicides on Glomerella.

PHOTOGRAPHS



Photo 1. Granny Smith site, 02/11/23 (0DAA1)



Photo 2. Sundowner site, 02/11/23 (0DAA1)



Photos 3 and 4. Glomerella on fruit, 14/12/23 (21DAA2)



Photos 5 and 6. Glomerella infected fruit, 06/02/24 (18DAA6)

APPENDICES

Appendix i. Trial details

Site details

Grower	XXXXXX Orchards
Location	Pozieres QLD 4352
Crop	Apples
Variety	Sundowner and Granny Smith
Rootstock	Sundowner - M.26 Granny Smith - seedling
Trial design	Randomised complete block
Replications	Four
Plot size	Sundowner – 2 trees Granny Smith – 2 trees
Tree spacing	1.6 m
Row spacing	4.0 m
Tree height	4.0 m
Tree density (per hectare)	1,562
Tree age	20+ years old
Irrigation type	Under-tree drippers
Hail netted	Yes

Application details

Application equipment			
Equipment	Stihl backpack mist blower		
Spray volume	Average (1X) dilute (T2, T3 and T6 to T15): 1,440 L/ha Average (2X) concentrate (T4): 702 L/ha Average (3X) concentrate (T5): 477 L/ha		
Method	The dilute applications were made to just before the point of run-off		
Treatment Applications			
Application number	1	2	3
Dates	02/11/23	23/11/23	14/12/23
Days after application no.	0DAA1	21DAA1	21DAA2
Times	6:30 am	6:30 am	3:40 pm
Treatments applied	2 to 5 and 9 to 15	2 to 6 and 9 to 15	2 to 7 and 9 to 15
Spray volume (L/ha)	1X - 1,331 2X - 650 3X - 445	1X - 1,429 2X - 673 3X - 478	1X - 1,538 2X - 761 3X - 498
Temperature (°C)	17.1	15.8	18.0
Relative humidity (%)	59	91	81
Cloud cover (%)	20	100	70
Wind direction	NE	NE	NE
Wind speed (km/h)	2.4	2.3	1.9
Fruit size (mm)	10 - 20	20 - 30	30 - 40
Application number	4	5	6
Dates	28/12/23	08/01/24	19/01/24
Days after application no.	14DAA3	11DAA4	11DAA5
Times	6:00 am	7:00 am	8:00 am
Treatments applied	2 to 15	6 to 8	7 and 8
Spray volume (L/ha)	1X - 1,460 2X - 722 3X - 488	1X - 1,365	1X - 1,611
Temperature (°C)	13.6	17.9	23.6
Relative humidity (%)	91	92	79
Cloud cover (%)	0	100	5
Wind direction	-	NE	SW
Wind speed (km/h)	0.0	2.4	1.2
Fruit size (mm)	40 - 50	50 - 55	60 - 70

Meteorological data from Applethorpe for the period of the trial are included as Appendix iii to this report. The trial site was situated 12.4 km north-west of Applethorpe.

Appendix ii. Meteorological details

Year: 2023

Location: Applethorpe, Queensland

	November				December			
	Activity	Min °C	Max °C	mm	Activity	Min °C	Max °C	mm
1		12.6	20.5	0.0		12.0	27.2	0.0
2	Treat	11.1	23.5	0.0		15.2	24.7	0.0
3		10.3	20.8	0.0		10.5	28.3	0.0
4		11.6	25.0	9.0		13.1	29.8	0.0
5		12.4	20.2	32.2		16.1	29.0	0.0
6		10.8	20.8	0.6		13.3	33.3	0.0
7		9.5	22.7	0.2		16.5	33.3	0.0
8		11.2	22.8	0.0		15.0	30.9	0.0
9		10.4	22.1	0.6		17.0	31.0	0.0
10		12.6	24.6	0.4		13.8	27.4	0.0
11		10.8	25.6	5.6		14.6	27.3	0.0
12		10.2	29.0	0.0		14.2	27.3	0.0
13		14.0	30.3	0.0	Assess	16.0	27.6	0.0
14		13.2	30.2	0.0	Assess & treat	18.0	30.1	0.0
15		13.8	30.3	0.0		18.1	31.9	0.0
16		15.5	30.3	0.0		16.5	32.5	0.0
17		16.3	27.6	2.8		17.2	34.2	0.0
18		10.1	24.3	0.0		17.5	32.1	0.0
19		7.5	26.5	0.0		18.6	27.8	1.0
20		14.6	19.9	9.0		16.3	24.7	41.0
21		14.2	24.6	55.6		16.9	21.7	0.2
22		17.0	24.8	0.0		15.4	23.0	21.6
23	Assess & treat	14.9	22.0	16.8		12.6	26.9	0.2
24		14.2	23.7	0.0		14.7	26.4	28.6
25		14.3	19.1	0.0		14.5	29.4	17.0
26		13.6	24.2	3.6		15.7	28.3	5.0
27		12.7	26.6	0.0	Assess	16.5	28.5	5.2
28		15.4	21.9	10.6	Treat	12.3	29.2	0.0
29		15.7	25.7	5.0		12.1	30.4	0.0
30		14.4	25.3	0.0		16.3	28.7	0.4
31						14.4	26.3	0.8
Total				152.0				121.0

Year: 2024	Location: Applethorpe, Queensland
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	January				February			
	Activity	Min °C	Max °C	mm	Activity	Min °C	Max °C	mm
1		16.7	20.8	1.2		16.0	26.6	0.0
2		15.9	23.8	2.8		15.3	31.0	0.0
3		12.6	26.0	0.8		17.5	28.8	0.0
4		15.3	28.9	0.2		19.7	30.7	0.0
5		17.7	25.1	2.6		19.9	29.4	0.0
6		15.7	23.2	0.2	Assess	18.2	30.2	0.0
7		14.9	23.7	0.4				
8	Assess & treat	16.5	25.1	0.2				
9	Assess	19.3	25.9	4.2				
10		18.3	28.7	17.8				
11		18.8	26.8	2.4				
12		16.1	25.5	1.4				
13		17.7	26.4	0.4				
14		14.8	27.2	0.2				
15		17.9	26.8	0.0				
16		17.7	24.2	0.4				
17	Assess	17.7	27.9	0.4				
18		19.9	27.3	6.2				
19	Assess & treat	16.1	28.9	15.8				
20		19.1	26.1	0.2				
21		19.3	31.2	0.0				
22		19.5	34.6	0.0				
23		16.9	21.3	2.8				
24		14.4	28.0	0.0				
25		13.9	32.4	0.0				
26		14.3	31.5	0.0				
27		23.3	31.8	0.0				
28		20.4	30.0	22.8				
29		20.8	26.3	0.4				
30		19.6	24.4	17.2				
31		17.8	26.2	0.2				
Total				101.2				0.0