E.E. Muir & Sons
AUSTRALIAN OWNED • SINCE 1927

DECCO®
WE CREATE SMART PROTECTION

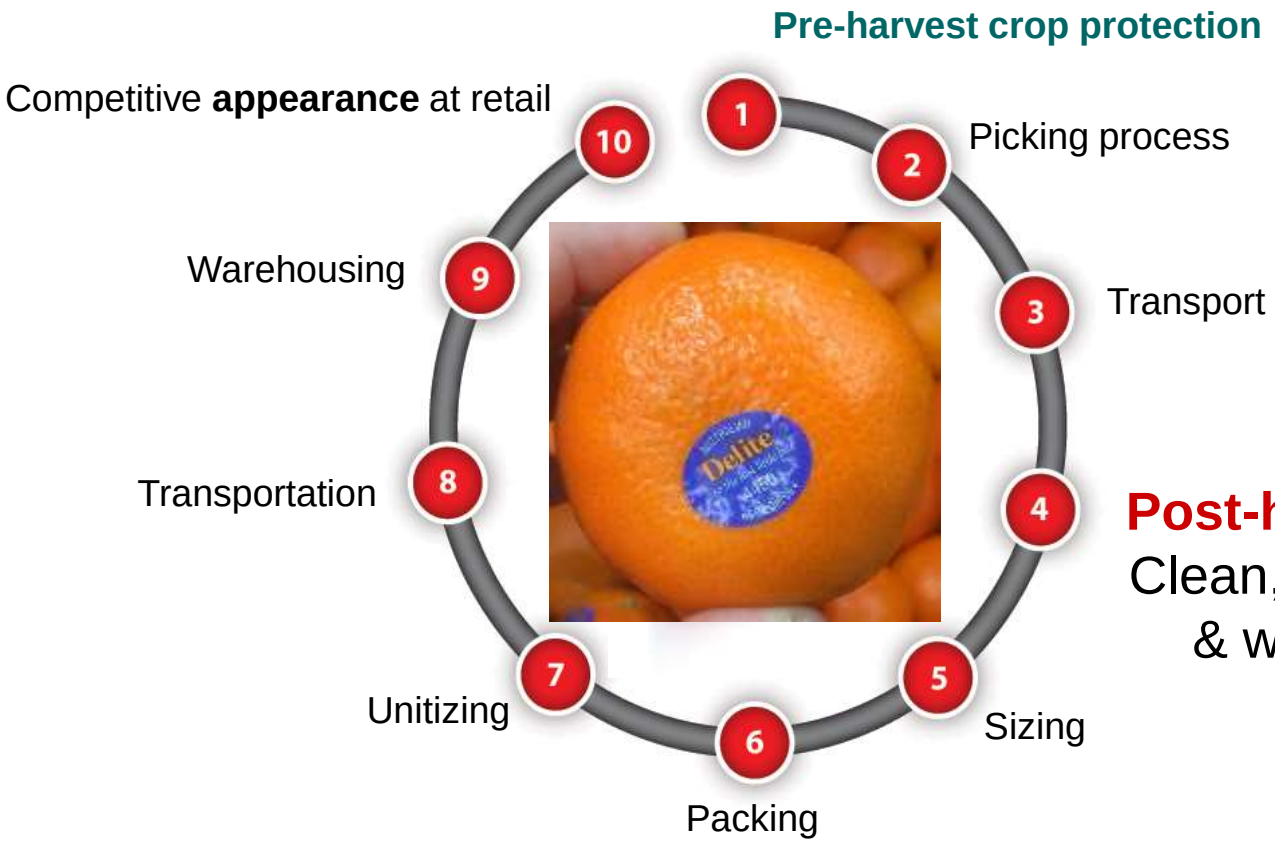
E.E. Muir & Sons
AUSTRALIAN OWNED • SINCE 1927

E.E. Muir & Sons P/L

- **Australian distribution partners for leading global suppliers of PH products;**
  Decco US, Syngenta & Janssen PMP
- **Quality / proprietary Brands**
- **Best (global) technical advice**
- **New Product development**
- **Testing and analysis services**

PH Fungicides - A key Stage in a Complete System

“Consumers buy with their eyes”



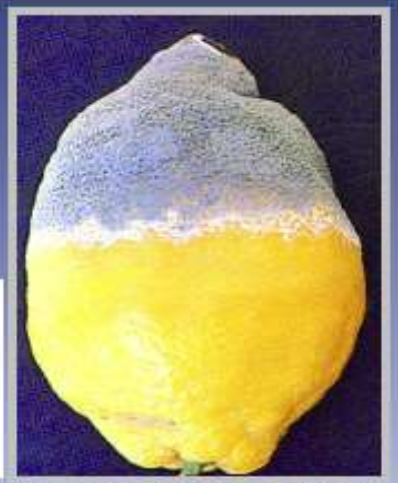
Post-harvest processing
Clean, sanitise, **fungicide**
& wax Applications

E.E. Muir & Sons
AUSTRALIAN OWNED · SINCE 1927

Citrus – Major post harvest rots

Major postharvest decays of citrus

Green mold caused by *Penicillium digitatum* (most important on citrus)



Blue mold caused by *P. italicum* and green mold

Penicillium soilage

Penicillium spp. and *G. citri-aurantii* are wound pathogens

Sour rot caused by *Geotrichum citri-aurantii*

PH FUNGICIDES – Issues?

MRL's / Residue Issues

- ***Export markets***

Application & Rates

(Monitor & Measure)

Resistance Issues

- **Groups 1, 2, 3 (???)**

 # Use new products & rotate

New Products ***(program in)***

- **Scholar (FLUDI)**
- **Philabuster (Dual A.I.)**
- **Others? (Chairman)**

E.E. Muir & Sons
AUSTRALIAN OWNED • SINCE 1927

CITRUS - PH FUNGICIDES

- **PHILABUSTER**
  - **Imazalil + Pyrimethanil**
    - **Group 3 + 9**
- **SCHOLAR**
  - **Fludioxonil**
  - **Group 12**
- **Imazalil**
  - **Fungaflor / ImazaCure, etc.**
  - **Group 3**
- **Thiabendazole (TBZ)**
  - **Tecto (Group 1)**
- **Panoctine**
  - **Guazatine (Grp. M7)**

E.E. Muir & Sons
AUSTRALIAN OWNED • SINCE 1927

DIFFERENCE BETWEEN FUNGICIDES & SANITISERS

- **FUNGICIDES are <u>specific</u> in that they only control fungi (*E.g. Fungaflor targets Blue & Green Mould (Penicillium spp.)* and they also control fungi over extended periods, even if fungus is present after treatment**
- **SANITISERS are <u>non specific</u> and control fungi, bacteria and yeasts**

  E.g. Chlorine or PAA in a wash water
- **Sanitisers are highly reactive and kill pathogens in the water on contact**
- **Once inactivated they provide no residual protection on the fruit**
- **Sanitisers keep the water clean and pathogen free but don't provide extended disease control. Very Important for food safety.**

Citrus – PH Fungicides-Aust.

Product	Group	Active Ingredient	Label Rate Per 100L	Diseases controlled
Scholar LIQUID	**12**	**Fludioxonil**	**260 - 520 ml (600 ppm)**	Blue mould *(P. italicum)* Green mould *(P. digitatum)* **Diplodia Stem End Rot**
Philabuster LIQUID	**3 & 9**	**Imazalil + Pyrimethanil**	**200 ml (400ppm each A.I.)**	Blue mould *(P. italicum)* Green mould *(P. digitatum)*
Fungaflor 500 LIQ. (ImazaCure, etc.)	**3**	**Imazalil**	**100ml (500 ppm)**	Blue mould *(P. italicum)* Green mould *(P. digitatum)*
Fungaflor 750 SG (ImazaCure, etc.)	**3**	**Imazalil**	**68g (500 ppm)**	Blue mould *(P. italicum)* Green mould *(P. digitatum)*
Panoctine	**M7**	**Guazatine**	**130 ml (500 ppm)**	Blue mould *(P. italicum)* Green mould *(P. digitatum)* **Sour Rot (Geotrichum. Spp.)**
Tecto SC Vorlon	**1**	**Thiabendazole**	**200 ml (1000 ppm)**	Blue mould *(P. italicum)* Green mould *(P. digitatum)* **Stem End Rot**

Current and future postharvest fungicides for decay control of citrus - Australia

M7

Guazatine

e.g. Panoctine

Benzimidazoles (1)

Thiabendazole

e.g. Tecto

(TBZ)

SI-imidazoles (3)

Imazalil (IMZ)

(Fungaflor, ImazaCure & Philabuster – combo (IMZ + PYR)

Phenylpyrroles (12)

Fludioxonil

Scholar

Registered

SI-triazoles

Propiconazole

Chairman Soon ?

Anilinopyrimidines (9)

Pyrimethanil

(Philabuster)

Registered

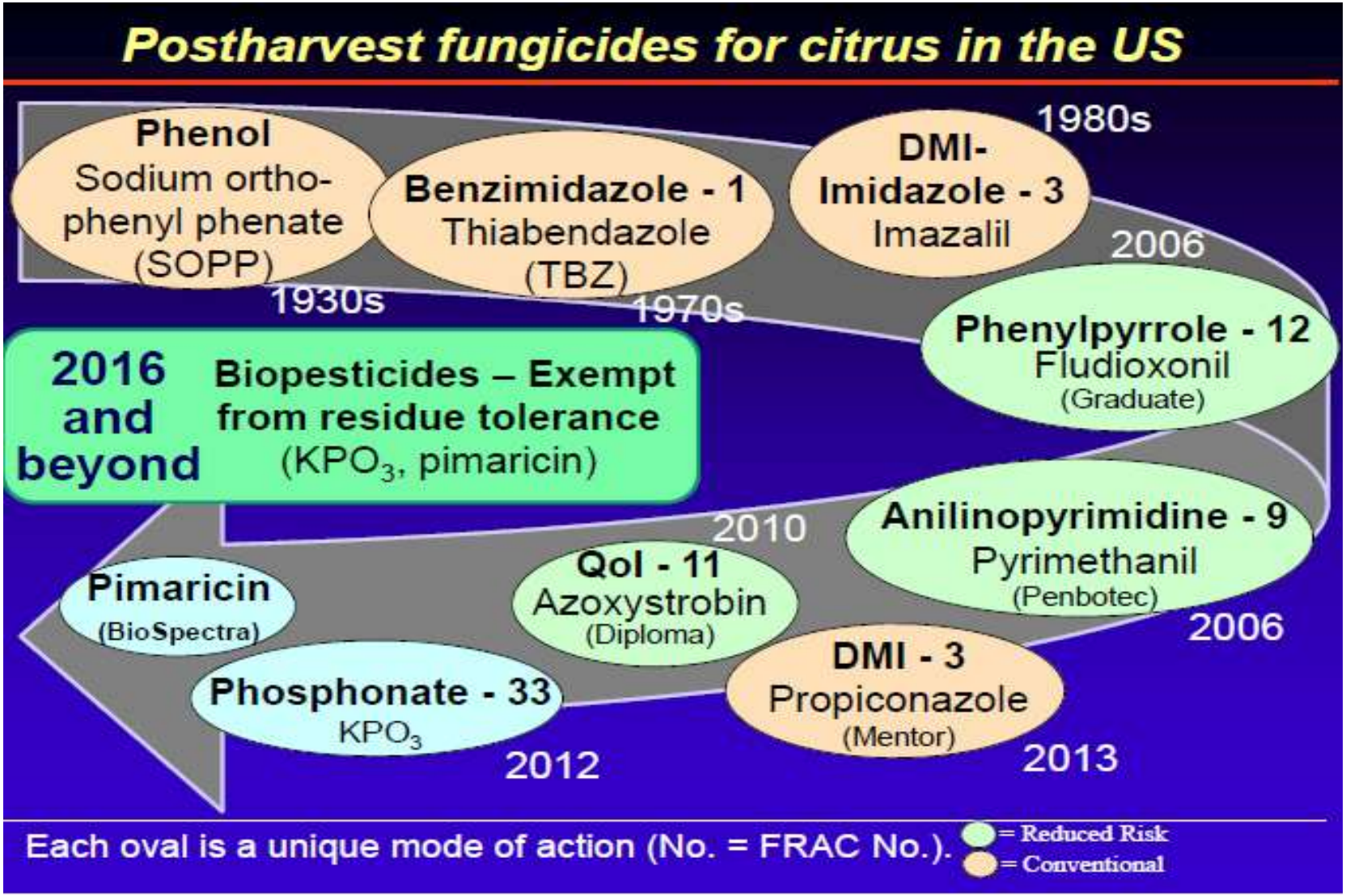
Qols

Azoxystrobin ?

Future?

- Reduced risk fungicides

Post Harvest Fungicide evolution & development



Spectrum of activity of postharvest fungicides on citrus

Fungicide Trade name	Active ingredient	Efficacy Penicillium decay	Efficacy Penicillium sporulation	Efficacy Sour
Fungaflor	Imazalil	++*	++*	-
Tecto	Thiabendazole	++*	+/++*	-
Diploma	Azoxystrobin	+++	+/++	-
Scholar	Fludioxonil	+++	+++	-
Penbotec	Pyrimethanil	+++	+	-
Propiconazole	--	+++	++	+++

* NOTE - Efficacy against decay dependent on sensitive of *Penicillium* spp. Populations, which will be variable.

+++ = high, ++ = moderate, + = low efficacy

Decayed Fruit – Fungicide Resistance = Poor Control

E.E. Muir & Sons
AUSTRALIAN OWNED · SINCE 1927

PHILABUSTER® 400 SC

Broad regulatory approvals

Support & service

Strong anti-resistance tool

High level of efficacy and broad spectrum

Curative and preventive activity

Worldwide MRLs available

JANSSEN PMP

Postharvest treatments of lemons for management of green mold

Untreated control

Heated soda ash

Philabuster 350/350 flooder
+ Imazalil 500 CDA

Graduate A+ 300/300 flooder

Graduate A+ 600/600 flooder

The study was conducted at Saticoy Lemon Packing. Fruit were wound-inoculated with *P. digitatum*. Aqueous fungicide flooder treatments were preceded by a heated soda ash treatment and were followed by either a fungicide CDA treatment (in D202) or by a hand spray with diluted D202.

Done in cooperation with a Sunkist Packinghouse, Syngenta Crop Protection, and UPI-Decco in Ventura Co.

Citrus use

Bulk dip, flood etc 200 mL/100 L water	Use as bulk dip, flood or drench for 30 seconds. 200 mL/100 L of water provides 400 ppm of each active constituent.
Non-return spray 0.5-1.0 L/100 L water	Use as a non-return spray before waxing. 1 L/100 L of water provides 2000 ppm of each active constituent. Use higher rates when previous disease history is high.
In wax treatment 1.0 - 1.5 L/100 L wax	Apply in wax (without further dilution in water) using conventional waxing equipment. Do not 'top up' wax. 1.5 L/100L of wax provides 3000 ppm of each active constituent. Use higher rates when previous disease history is high.

JANSSEN PMP
PRESERVATION AND MATERIAL PROTECTION
a division of Janssen Pharmaceutica NV

E.E. Muir & Sons
INNOVATORS IN AGRIBUSINESS

What is SCHOLAR ?

- A new broad spectrum postharvest fungicide
- Unique mode of action (no known cross resistance)
- Broad disease spectrum across range of crops
- Long residual activity
- Provides sporulation control, reducing the spread of disease in the packinghouse and during shipment
- Low use rates
- Compatible with most waxes
- Suited to most postharvest application systems
- Stable in chlorine and heat and wide pH range

syngenta

Flexibility in application methods

Flexible application

- Drench
- Dip/bin filler
- Flood
- Spray
- Heated option

Can be mixed in

- Water
- Wax / oil
- Aqueous wax /oil emulsion

Compatible with chlorine and other sanitizers

SCHOLAR may be applied as a post-harvest dip, drench, flood or spray in citrus or as a dip or drench in pome/stone fruit and Mangoes (refer to label).

Effect of Scholar on Lemon Storage

58 days old fruit – With Scholar

63 days old fruit – Without Scholar

Chairman Fungicide Trials

E.E. Muir & Sons
AUSTRALIAN OWNED • SINCE 1927

Citrus Rot Management – Propiconazole MRL's

Top Export Markets	Propiconazole MRL, ppm	Additional MRL Information
USA	8	
Codex	Review in 2017	Citrus group CXL anticipated 3Q2018
1. Canada	8	
2. Japan	0.05	FA designation anticipated 2019[a]
3. Korea	6[b]	
4. Australia	7	
5. Hong Kong	CXL	Codex deferral anticipated
6. China	CXL?	No import tolerance process, possible conversion from Codex when established
7. New Zealand	Current 0.1 default	Defer to Codex in absence of domestic MRL
8. Chile	0.05	
9. Philippines	CXL	Codex deferral anticipated
10. Mexico	8	
Other Countries of Interest:		
EU	6	

Source: Syngenta

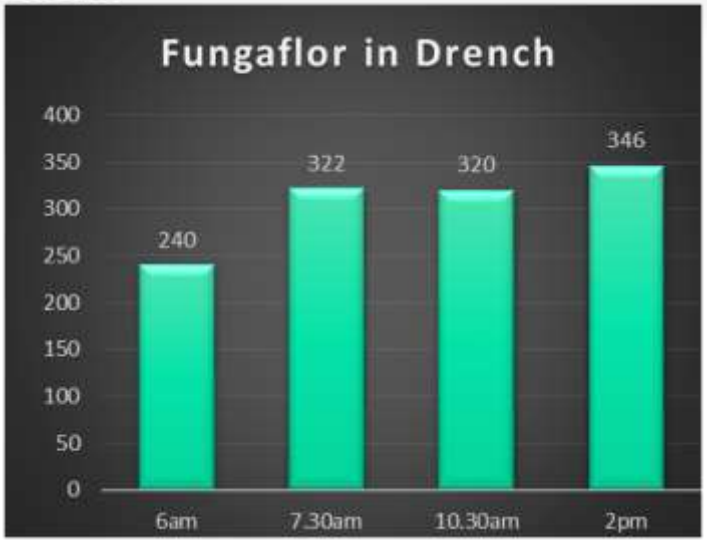
Fungicide Application

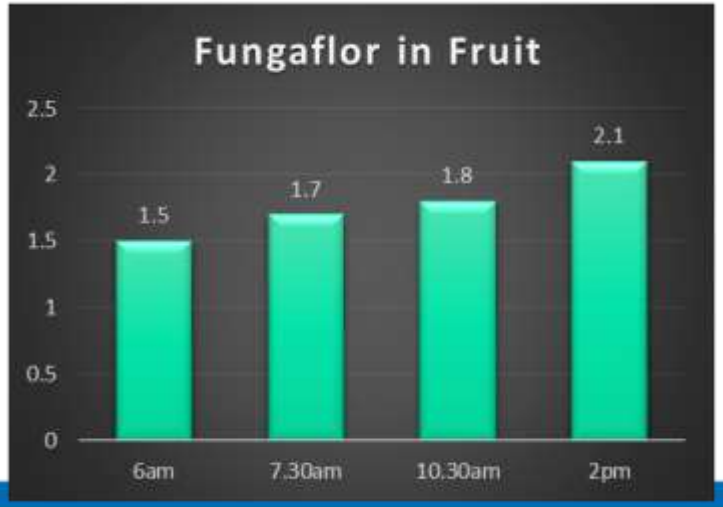
Trends in US & OZ Citrus Industry

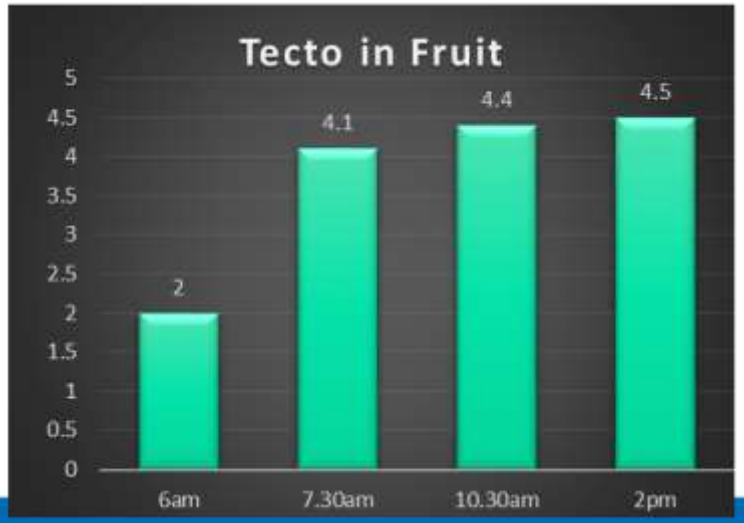
Moving toward heated fungicide applications

Heated Fungicide Example
Constant auto dosing

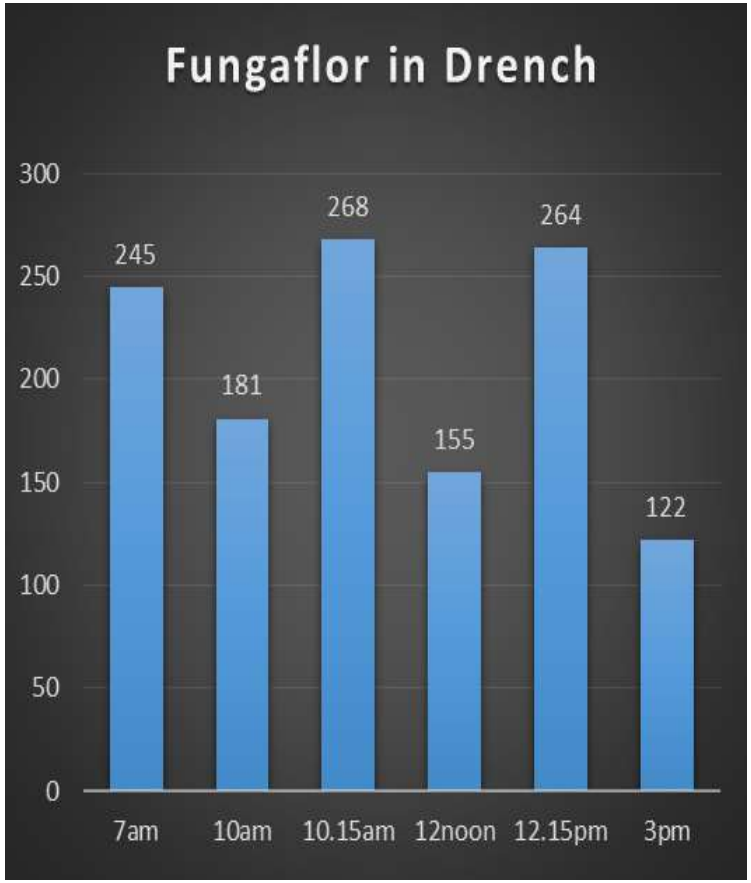
E.E. Muir & Sons

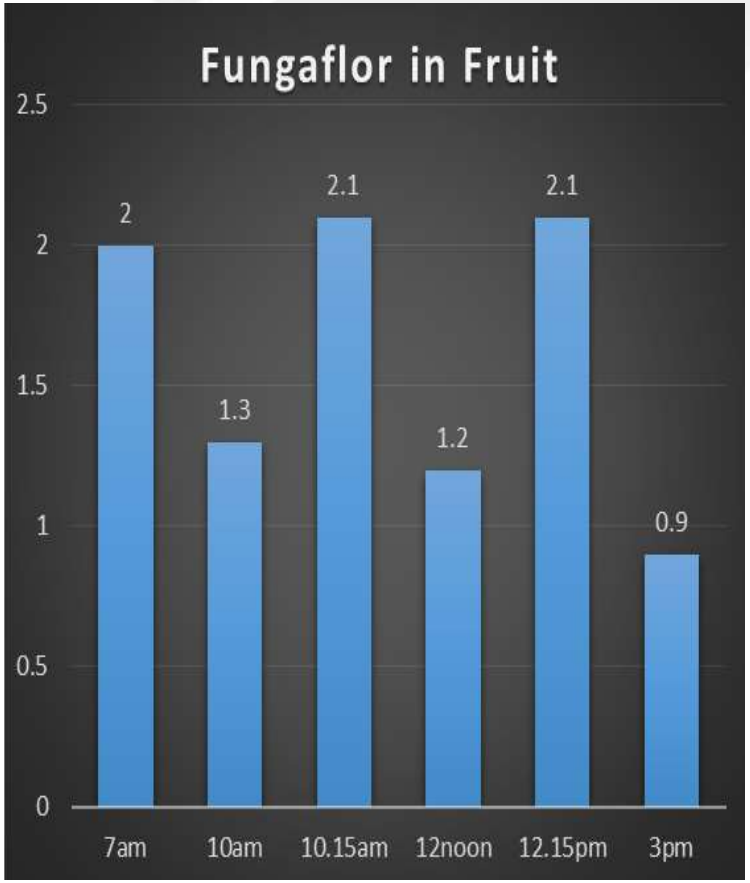




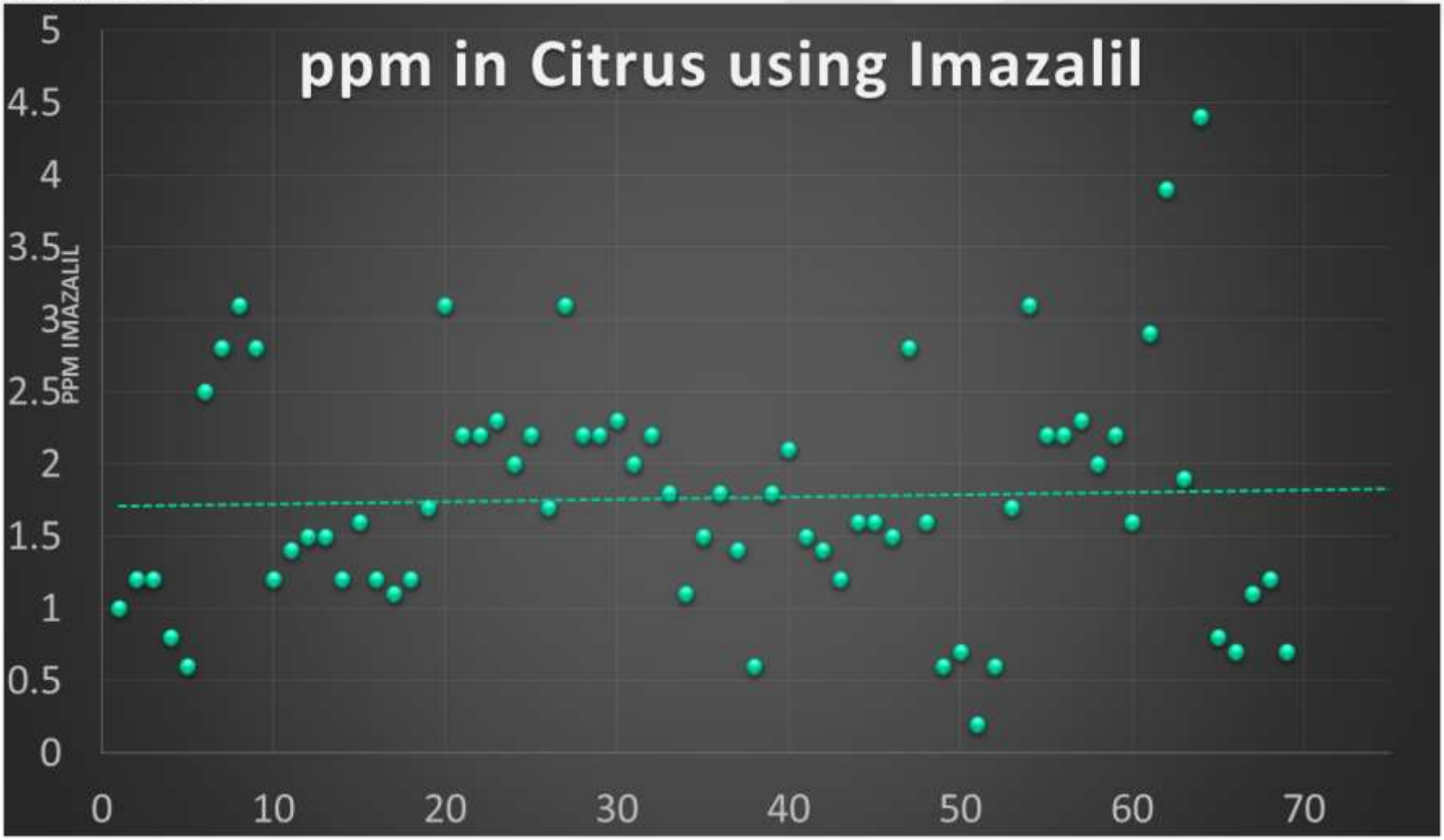


Manual Dosing - Recharge





Imazalil on Fruit in ppm



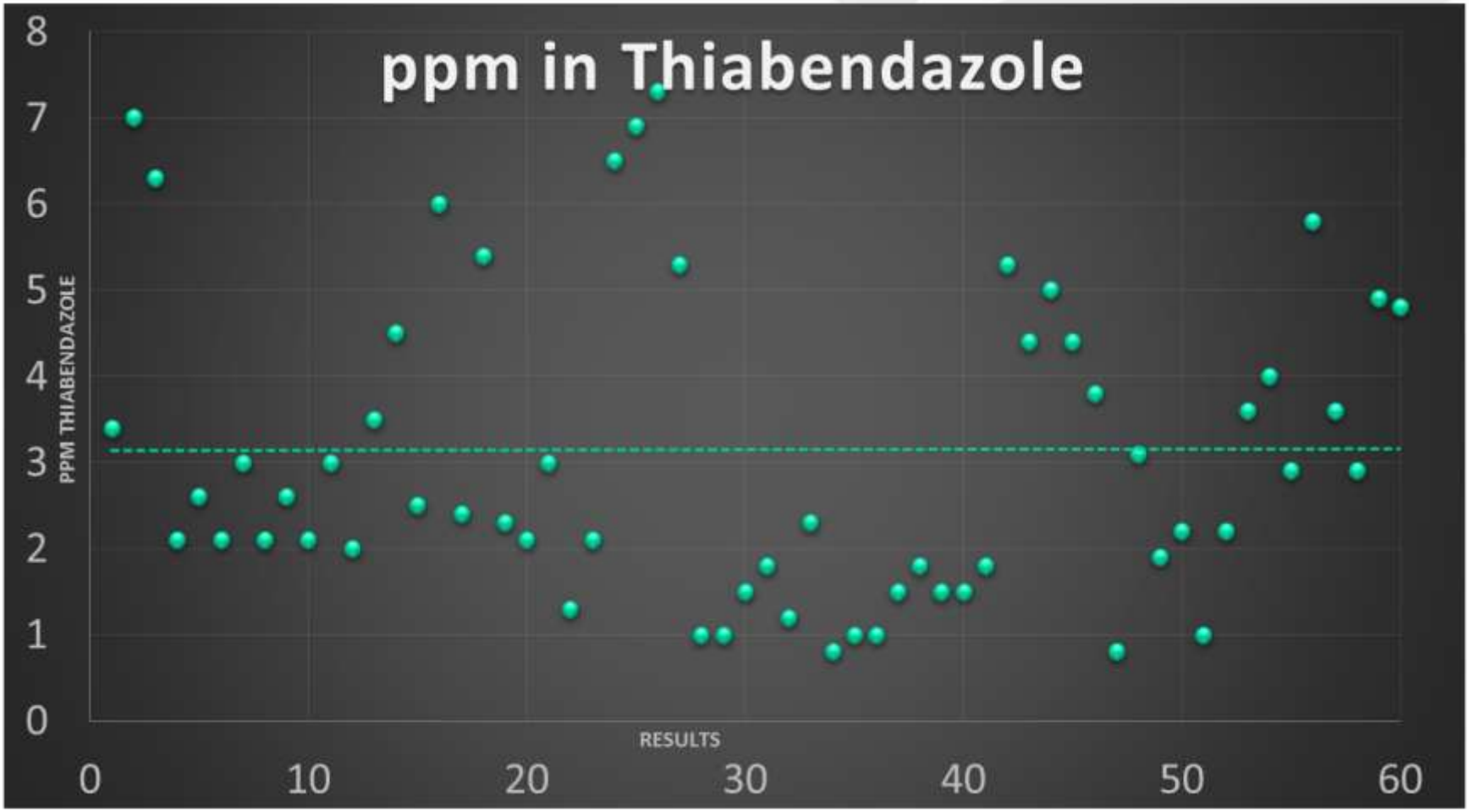
E.E. Muir & Sons

Imazalil on Fruit

- Results were taken from Oranges & Mandarins
- Many Citrus Packers are getting around 2ppm of Imazalil on their Fruit when sending for Export
- Although some concerning Results under 1ppm (potential for resistance and poor control)
- 2 results getting close to Maximum 5ppm MRL
- Consistent LOW results can bring on Resistance more quickly and result in poor control.
- Again MRL's are VERY Important to the Industry. Regular or Auto dosing will help control the levels of Fungicide on the Fruit.
- Monitor and measure levels in drench and on fruit

E.E. Muir & Sons

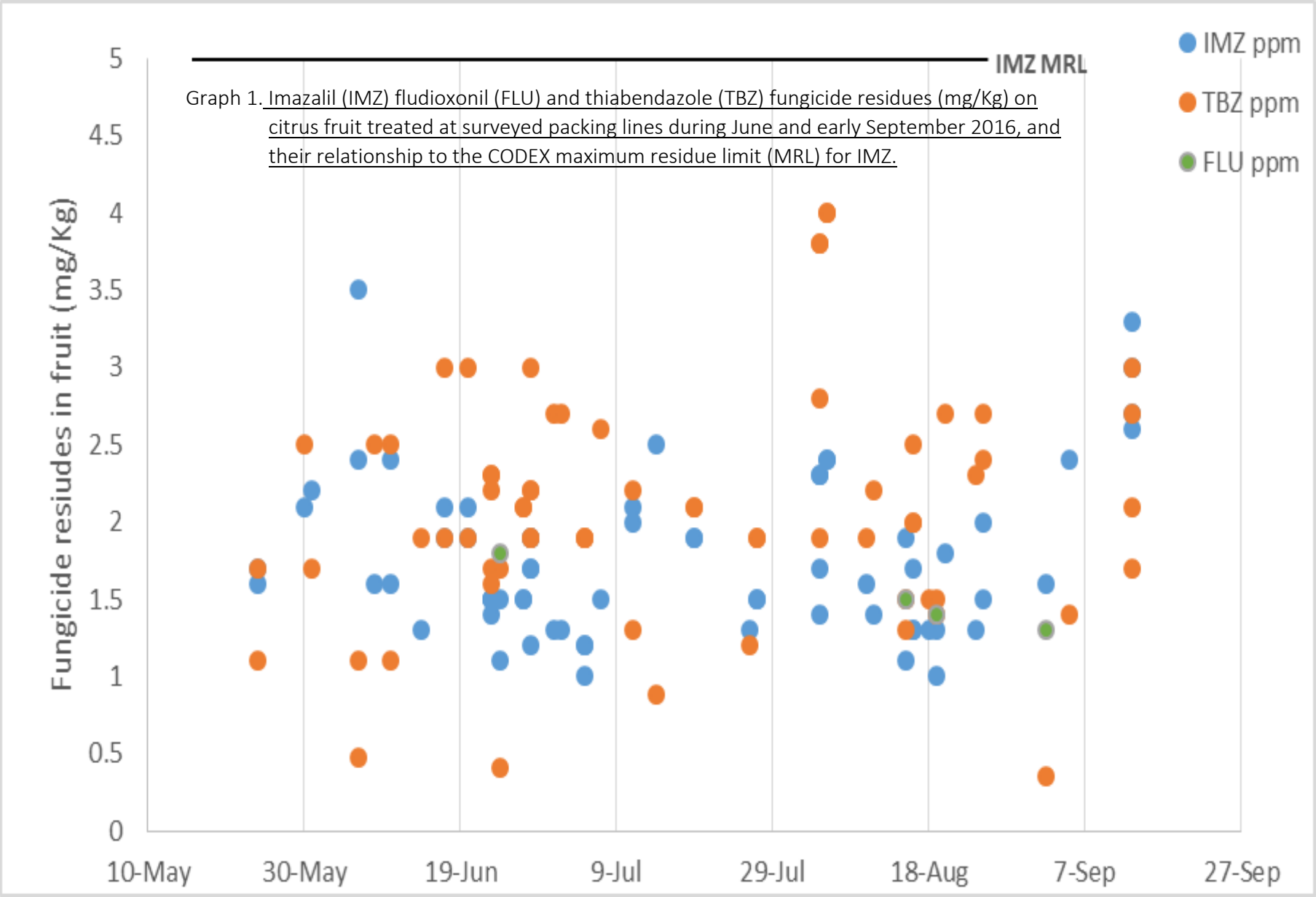
ppm in TBZ (Thiabendazole)



E.E. Muir & Sons

TBZ - Thiabendazole on Fruit

- Results from Oranges & Mandarins.
- Results ranging from 1ppm to 8ppm.
- With potential resistance to TBZ you may need higher fruit residues (ppm) later in the season to achieve control.
- Consider rotations with other Fungicides and mixtures



Graph 1. Imazalil (IMZ) fludioxonil (FLU) and thiabendazole (TBZ) fungicide residues (mg/Kg) on citrus fruit treated at surveyed packing lines during June and early September 2016, and their relationship to the CODEX maximum residue limit (MRL) for IMZ.

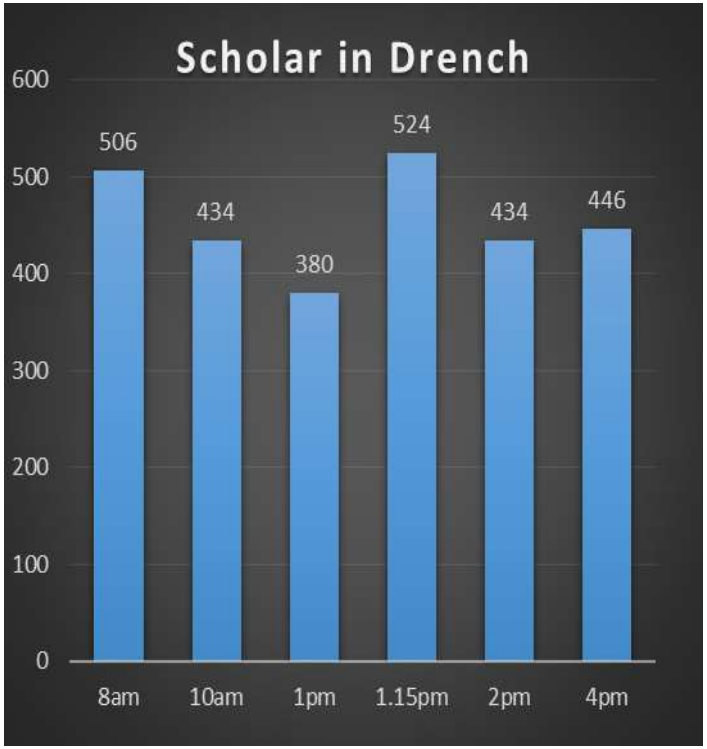
Scholar – Fludioxonil

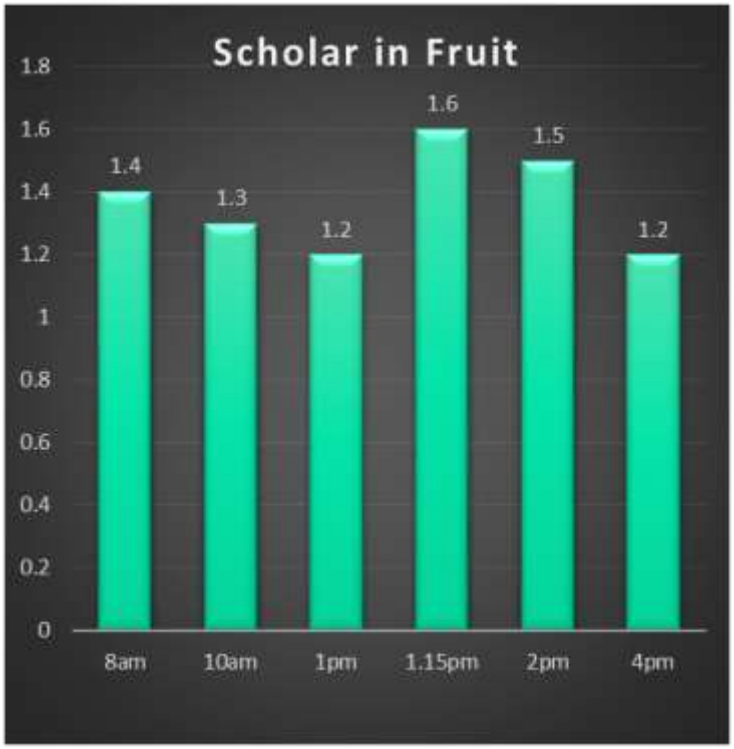
Strip Out Trial – 1st Test

Topped up & re-charged at 1pm

Label rate plus 10% Recharge

Aim – to maintain drench rates to produce fruit residue of 1.0 - 1.5 ppm





Scholar (Fludioxonil) Trial – 2nd Run

7.30am Filled Tank

360L Water & added 1100ml Scholar & 360ml Imazalil

Start up at 7.45am Fruit Running

9am – Added 50ml Scholar & 18ml Imazalil

Morning Break 9.45 till 10am

10am – Added 50ml Scholar & 18ml Imazalil

11am – Added 50ml Scholar & 18ml Imazalil

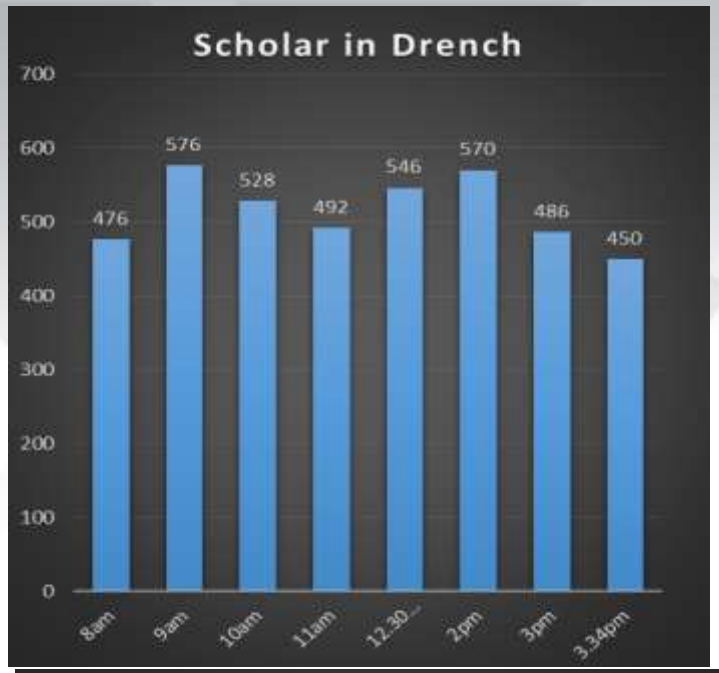
Lunch Break 12 till 12.30pm

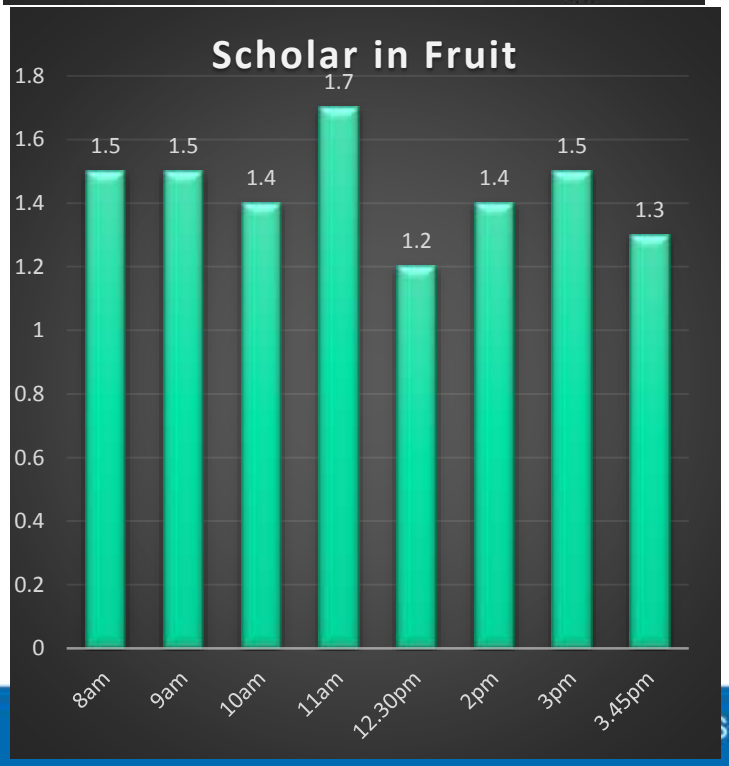
12.30pm – Top Up Water 200lts & added 520ml Scholar & 200ml Imazalil

2pm – Added 50ml Scholar & 18ml Imazalil

3pm – Added 50ml Scholar & 18ml Imazalil

Fungicide strip out or Recharge rate was 15% of Label Rate.





E.E. Muir & Sons

Summary of Scholar Trial

- Mixing & Agitation is critical to achieve correct drench concentrations.
- With the Heating of the Fungicide uptake in the Fruit is good.
- Scholar/FLUDI was measured around 400ppm to 500ppm in Drench which typically produced between 1.0 to 1.5ppm in the Fruit.
- Initial Mix was at 310ml/100lts = 710ppm but only got to approx. 500ppm in drench tests, so mixing and agitation needs to be improved.
- Regular Recharging & Top Up or auto dosing will even out the residues on the Fruit.
- Safe MRL for export citrus is Critical to the Industry.