USE OF FOLIAR APPLICATIONS OF PHOSPHONATE FUNGICIDE TO CONTROL PHYTOPHTHORA ROOT ROT IN AVOCADOS

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- **Phytophthora root rot is a significant root disease of avocados growing in all states of Australia and throughout New Zealand**

- **Infection causes a decline in tree health with an associated loss in yield and fruit quality**

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- **In 1987 a 20% formulation of mono-dipotassium phosphonate (Fosject®) was registered for trunk injection or as a 0.1% foliar spray to control Phytophthora root rot**

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- Good commercial control has been achieved with 1-2 trunk-injection treatments/year
- The 0.1% foliar spray has not given good control of root rot in mature, fruiting trees
- Increased labour costs have made trunk-injection an expensive management procedure

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- **The development of new technology for phosphonate application was commission by the Australian avocado industry in 1997**
- **Soil application through fertigation**
- **Foliar application with formulations of increased concentrations**

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- **Soil application was discarded due to:**
  - **Leaching**
  - **Rapid oxidation (PO_3 → PO_4)**
  - **Potential increased phosphonate tolerance**

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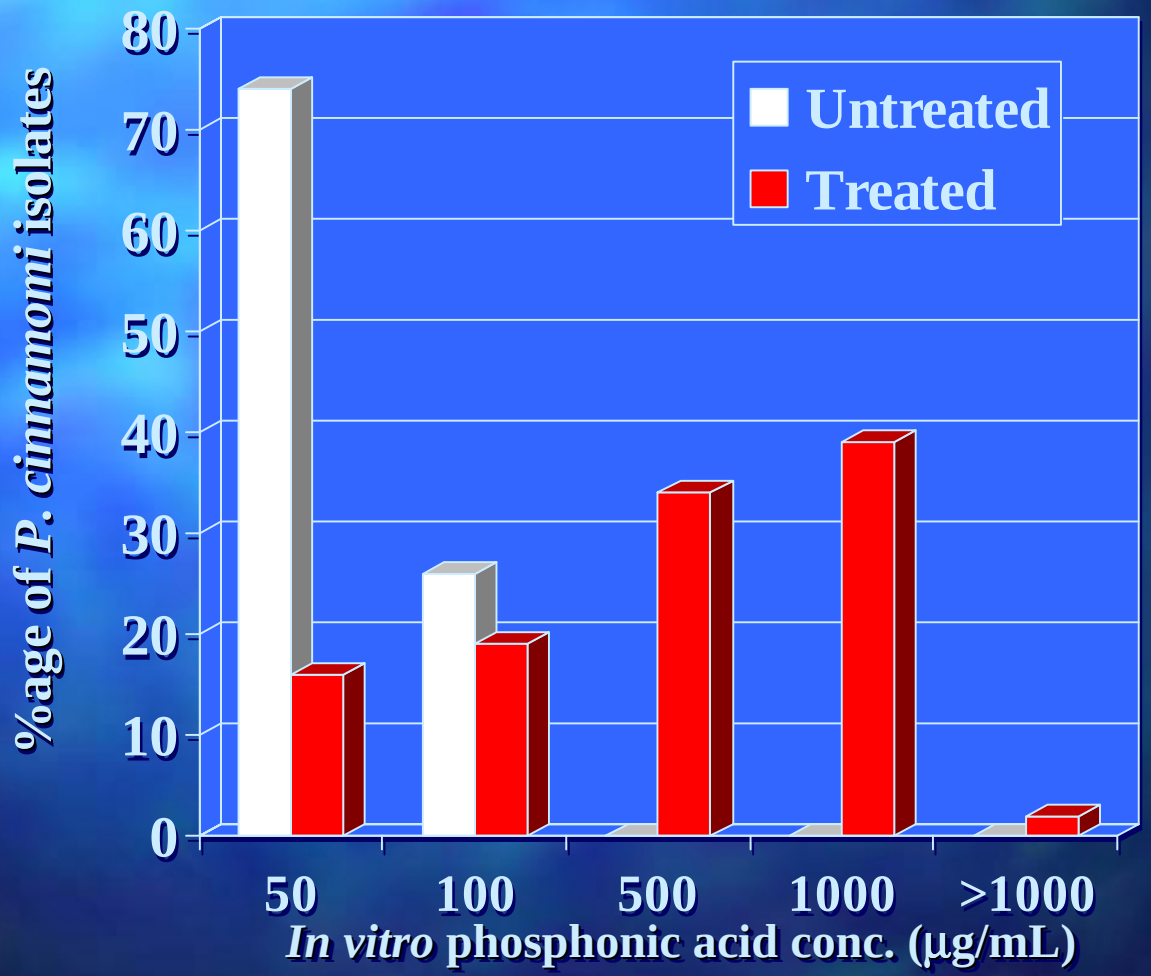
Tolerance of *P. cinnamomi* to Phosphonic Acid



Source: Duvenhage (1994); Weinert *et al.* (1997)

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In this paper we describe results from research into foliar application of new formulations of Phosphonate fungicide

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The research into foliar-applied phosphonate has examined:

- Phytotoxicity
- Efficacy
- Fruit residues
- Withholding periods
- Application methodology
- Phosphonate storage

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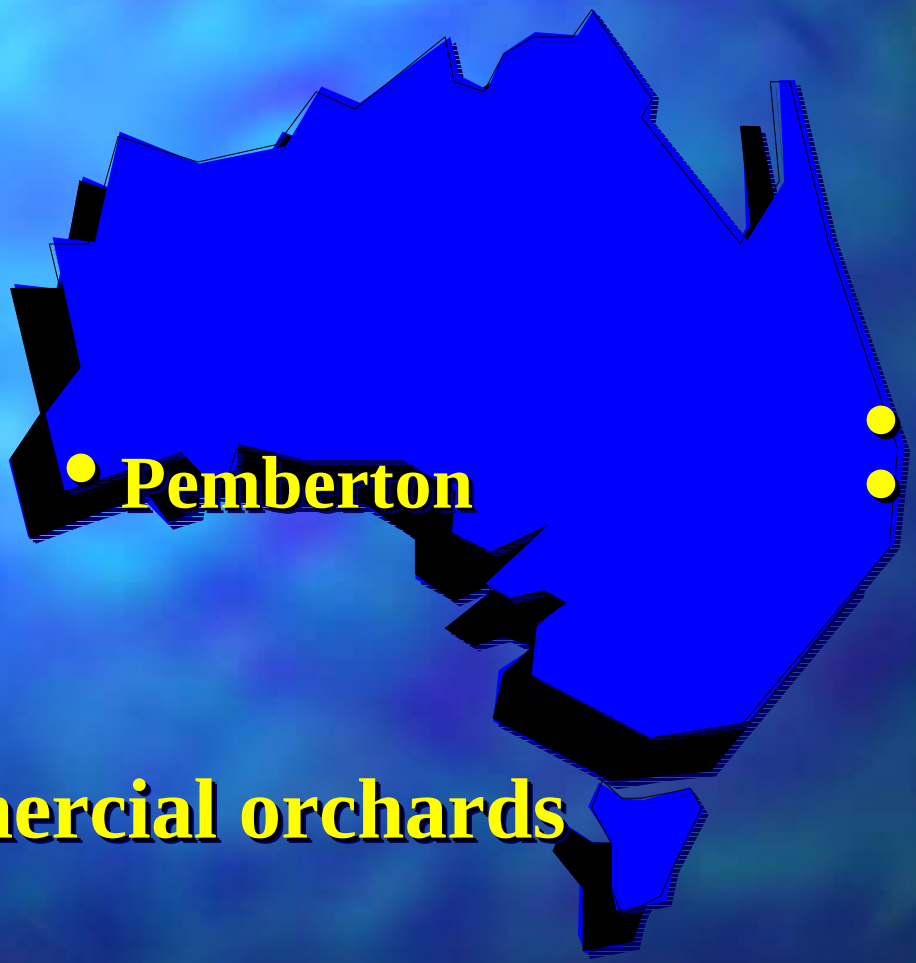
Experimental Sites



- Commercial orchards
- Hass

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Experimental Treatments

- Foliar 0.1% phosphonate
- Foliar 0.5% phosphonate with pH adjusted
- Foliar 1.0% phosphonate with pH adjusted
- Trunk-injected phosphonate (20 & 40%)

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Phytotoxicity

- Previous problems with foliar-applied Aliette®
- Higher concentrations of product being evaluated
- Suitability for use as a tank-mix with other pesticides

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Phytotoxicity

- 0.5% safer than 1.0%
- Tank mix at pH 7.2
- No surfactant or stickers
- No copper hydroxide
- Do not apply as a tank mix with other pesticides

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Efficacy

- Improvement in tree health (0 -10 scale)
- Phosphonic acid root concentration (20-50 mg/kg_{fw})

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Tree & Root Health after PO_3 Sprays (1999)

Treatments	Root mass (1-3)	% healthy roots	Tree health (0-10)
Untreated	1.7	50.0	2.8
Worm casts	1.3	74.5	3.8
PO_3 at 0.1%	2.3	73.0	2.0
PO_3 at 0.5%	2.5	91.0	1.6
PO_3 at 1.0%	2.3	90.0	1.6
Injected PO_3	2.5	85.0	1.0

Duranbah (1999)

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Improvement in Tree Health Following Foliar Phosphonate

Treatments	Health Improvement (0-10)
Control	-2.8 [a]
PO_3 @ 0.1%	-0.4 [b]
PO_3 @ 0.25% + Bion	1.6 [c]
PO_3 @ 0.5%	1.6 [c]
PO_3 @ 0.5% + Bion	1.0 [c]
PO_3 @ 1.0%	1.6 [c]
Trunk-injected PO_3 @ 20%	1.2 [c]

Childers (1999/00)

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Root PO_3 Conc. 2 & 4 Weeks after Spraying

Trunk injection is 138% more efficient than spray application

Maleny (1999)

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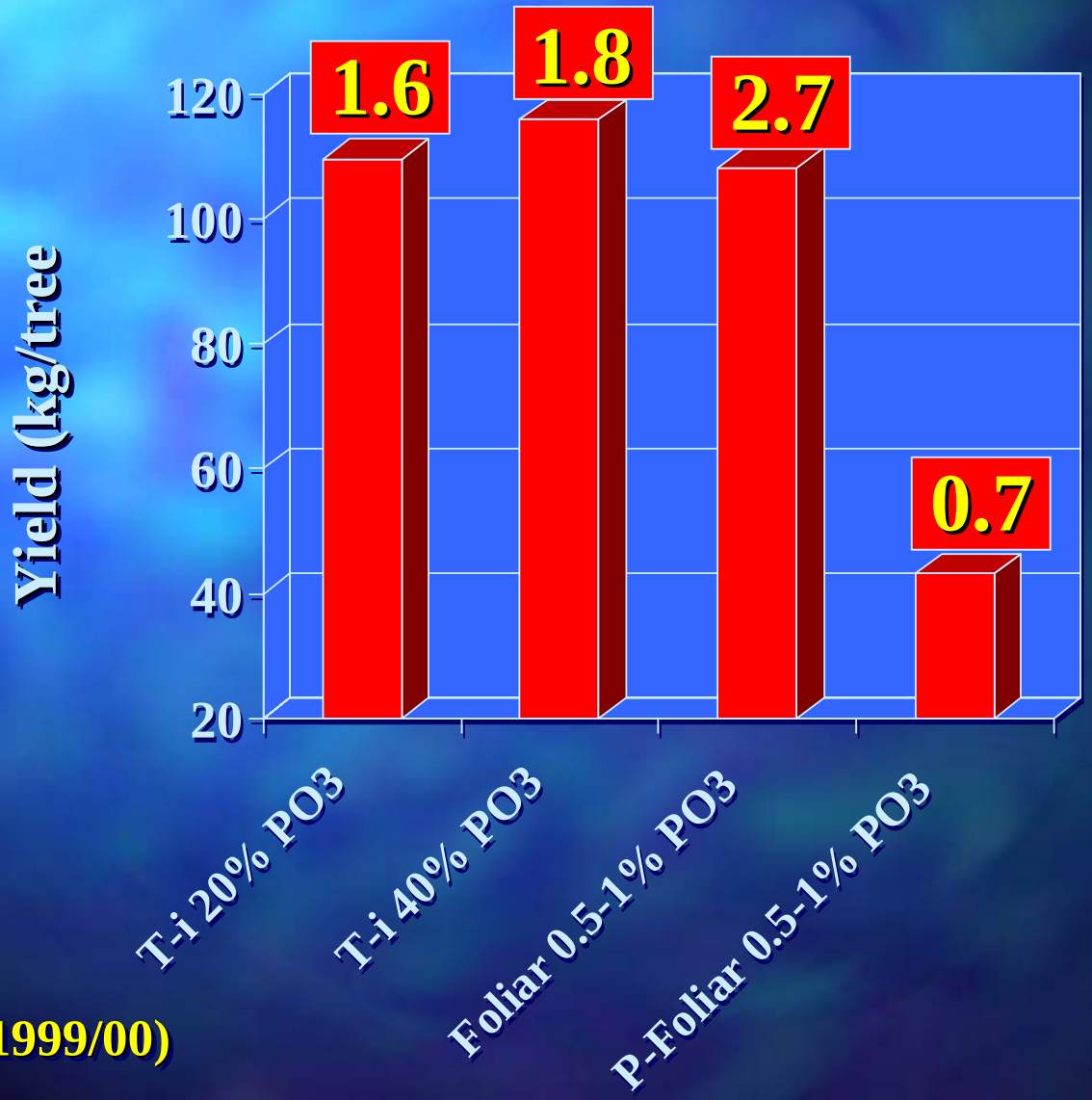
Effect of Phosphonate on Hass Yield



Pemberton (1999/00)

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Fruit Residues

- Maximum Residue Level (MRL) for avocados in Australia is 100 mg/kg - it varies between countries
- Fruit residues are influenced by:
  - Time of application

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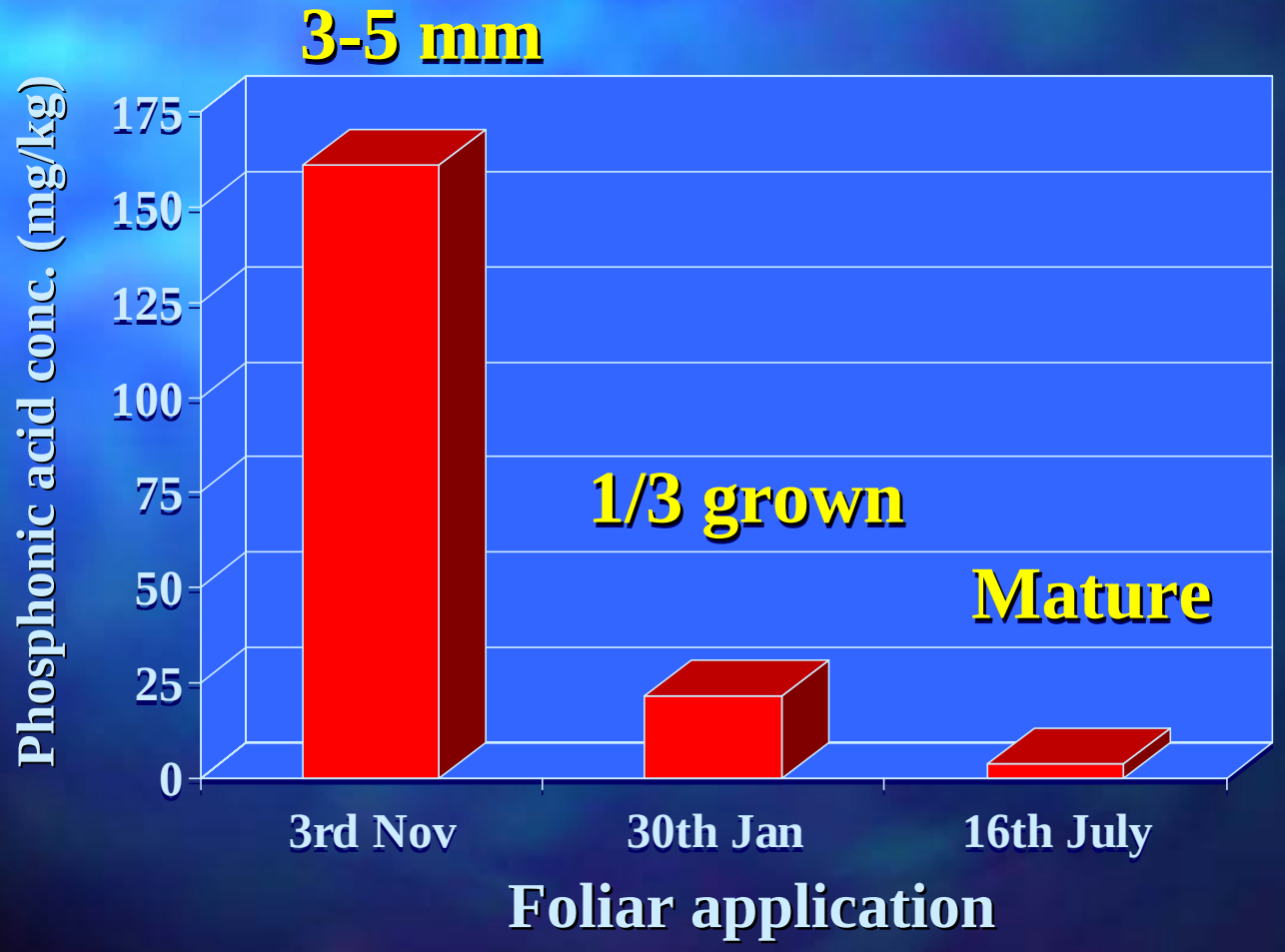
Fruit Residues

Time of Application



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Fruit Residues

- Maximum Residue Level (MRL) for avocados in Australia is 100 mg/kg
- Fruit residues are influenced by:
  - Time of application
  - Crop load

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Fruit Residues

Crop Load

Mean Phosphonic Acid Residue in Fruit 52.8 mg/kg

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Withholding Period

- Requirement of NRA
- Establishes minimum time between treatment and harvest

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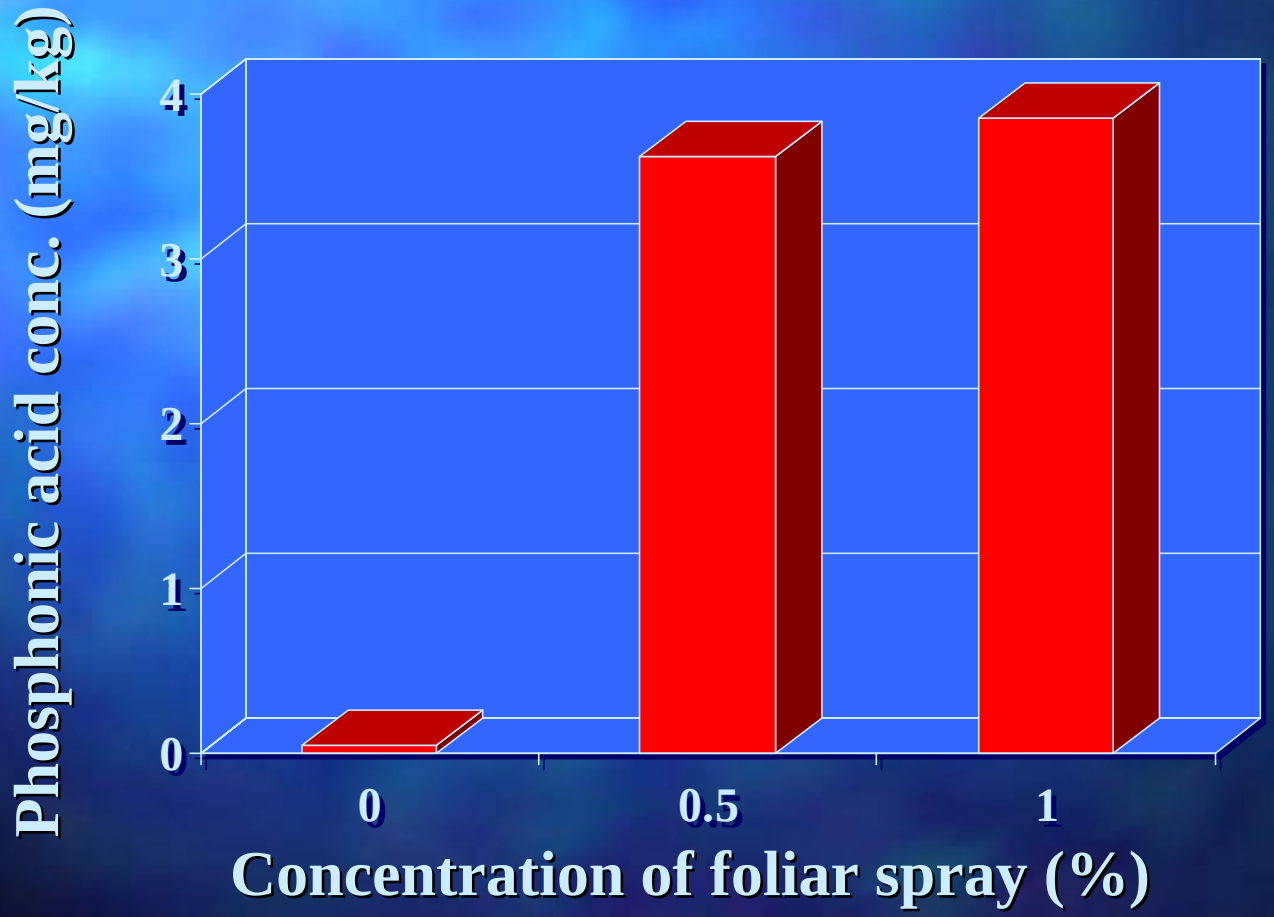
Mature Fruit PO_3 Concentration after Spraying Phosphonate



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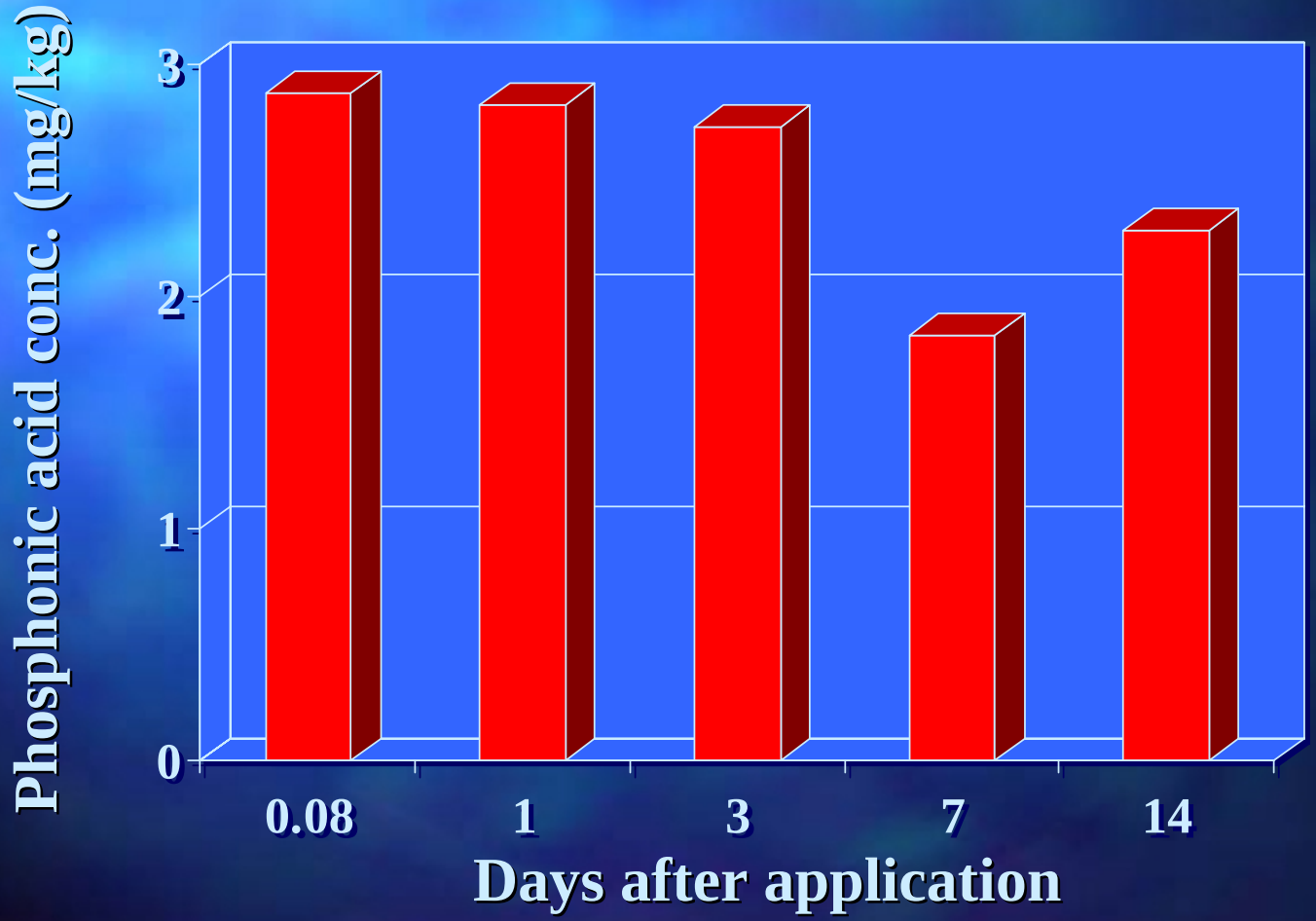
Mature Fruit PO_3 Concentration after Spraying Phosphonate



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Application Methodology

Low volume (600 L/ha)

High volume (1500 L/ha)

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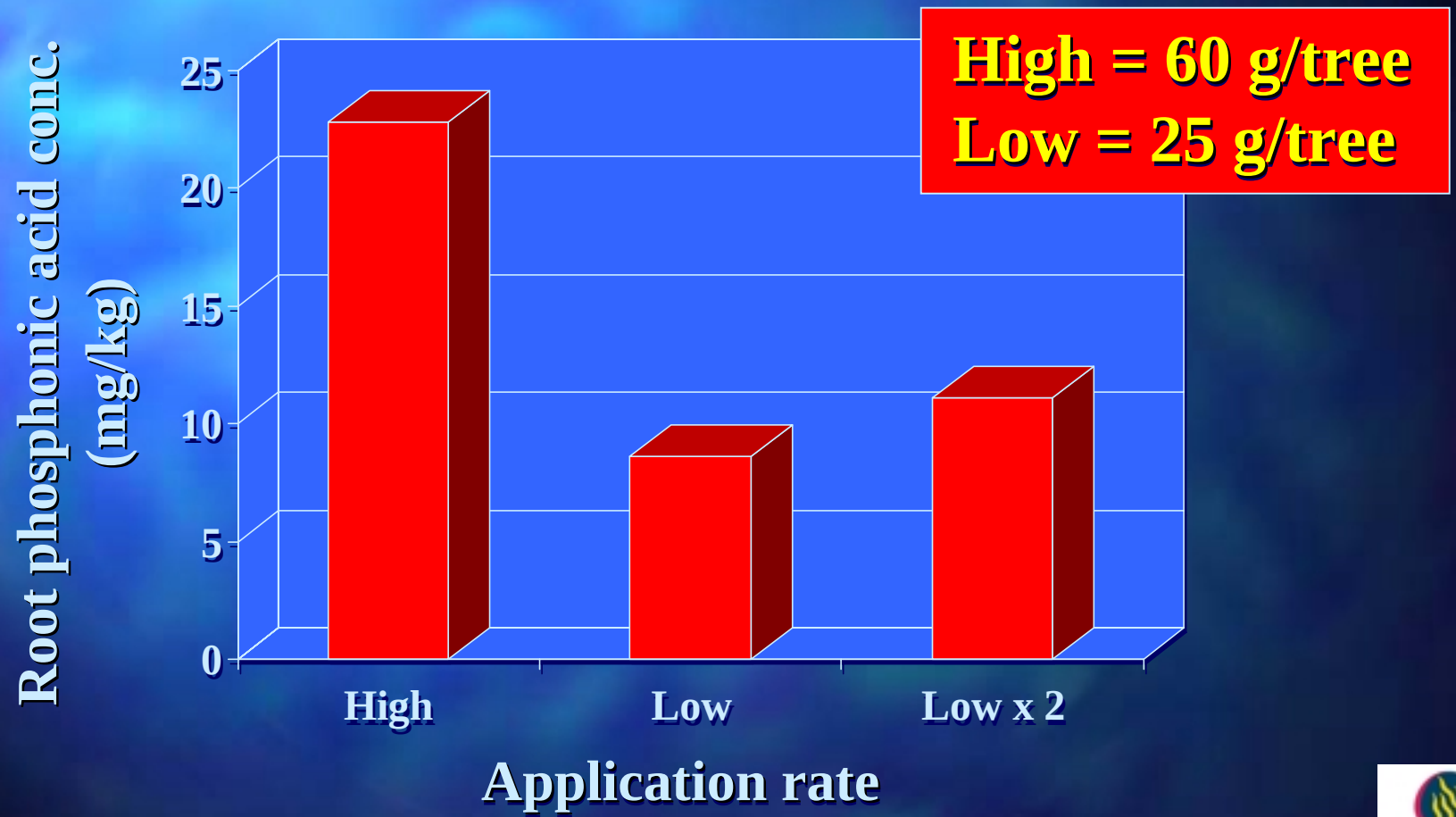
High vs Low Volume Application



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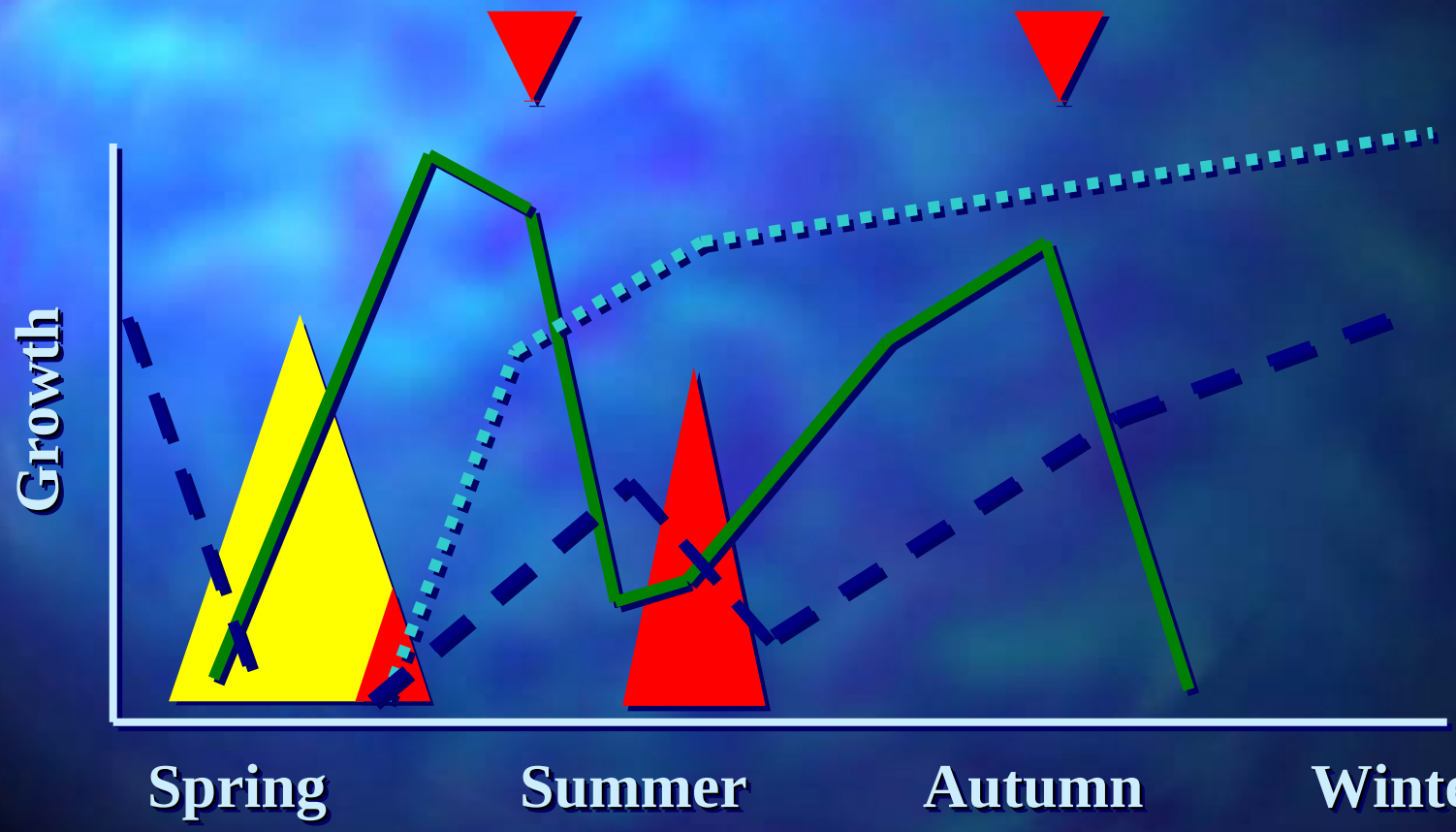
Application Methodology

Treatment Timing



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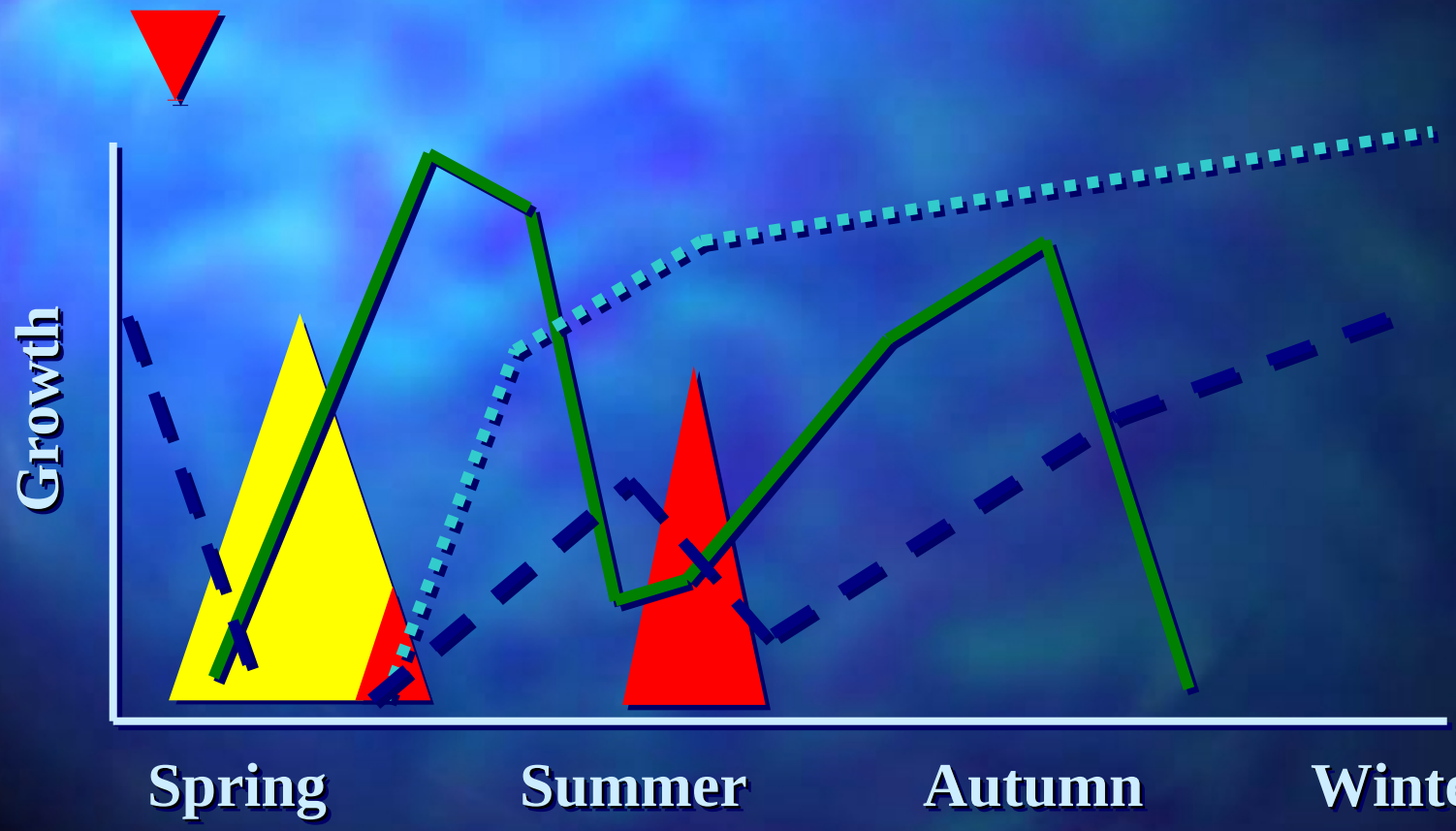
Application Methodology

Treatment Timing



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Application Methodology

Treatment Timing

- Phosphonic acid is phytotoxic to pollen germination and growth
- > 400 mg/kg PA in flowers reduces the number of pollen tubes reaching the ovaries
- Yield reduction may occur

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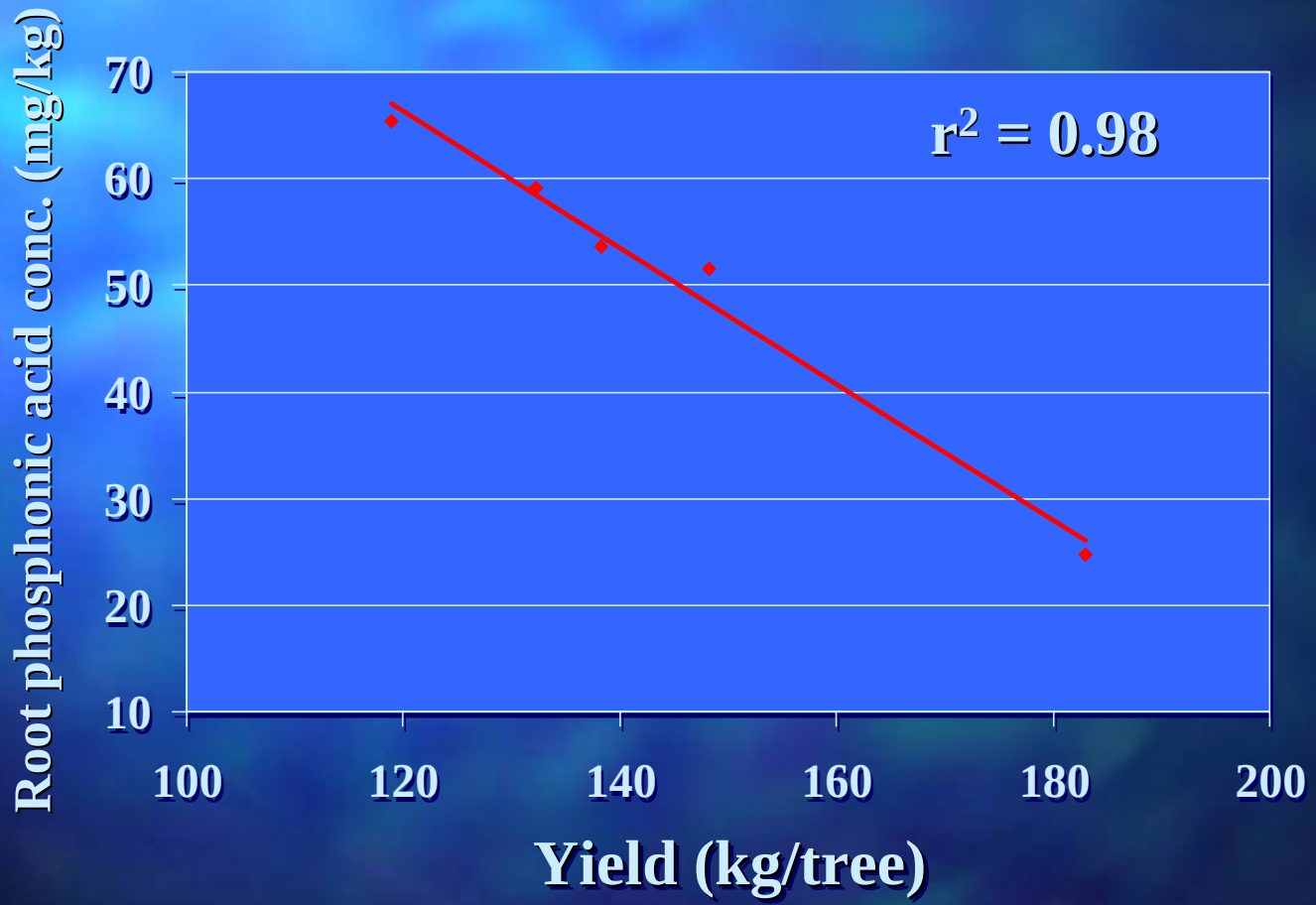
Crop Load Affects Root Phosphonic Acid Concentration



Maleny (1999)

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Phosphonate Storage

- Claims made that phosphonate deteriorated in storage after 90 days
- Phosphonate oxidises from PO_3 to PO_4
- Investigated stability of phosphonate in sealed containers that were filled or half-filled and stored for 6 months

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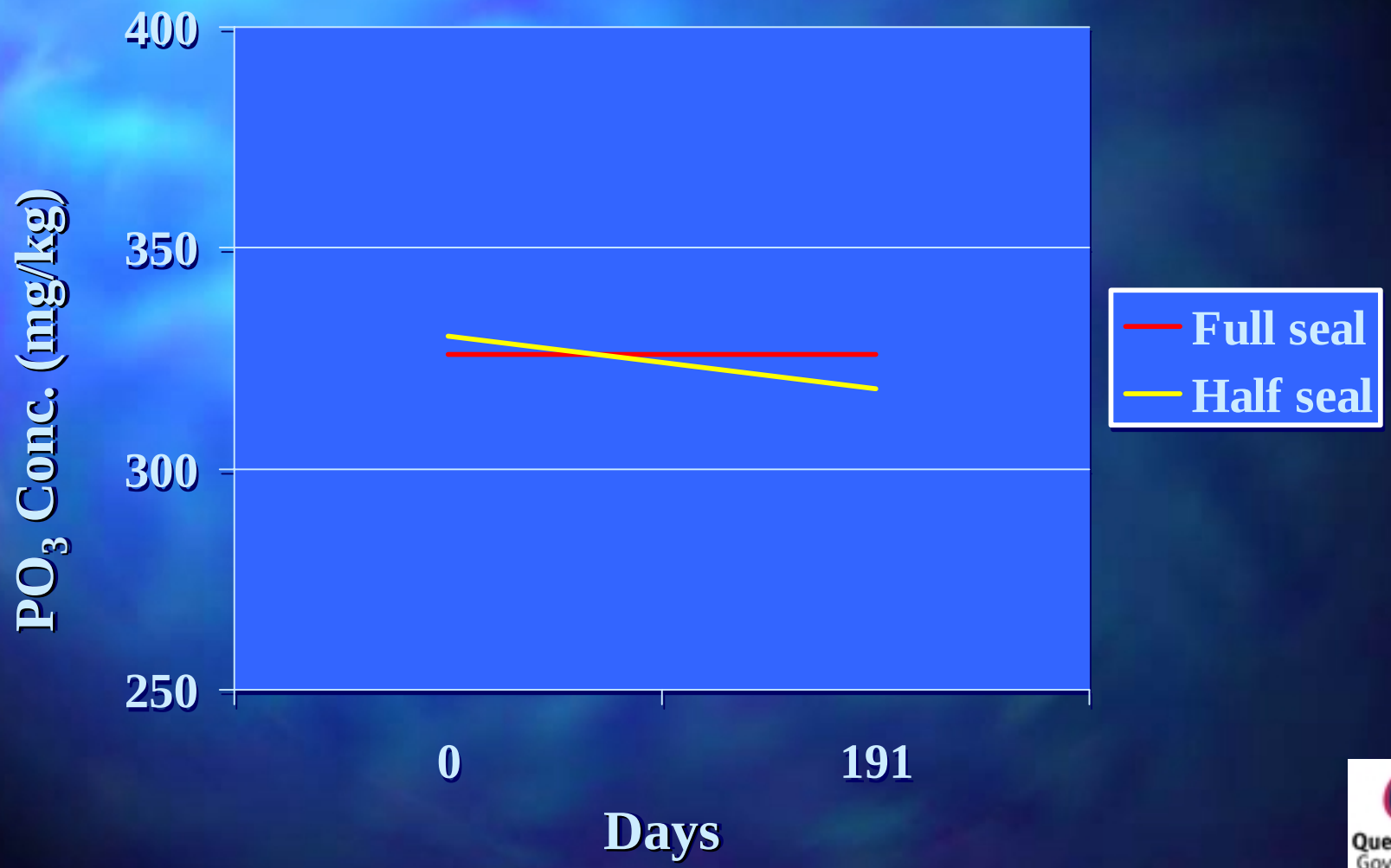
Phosphonate Storage



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Conclusions

- Foliar applied phosphonate at 0.5% a.i. will give commercial control of Phytophthora root rot in mature trees
- Application frequency will vary depending on numerous factors and may be managed through monitoring phosphonic acid in roots

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Conclusions

- To reduce the risk of phytotoxicity
  - Don’t add wetting agent or spreader
  - Use copper oxychloride for anthracnose control
  - The tank solution should be adjusted to pH 7.2
  - Don’t mix with other pesticides

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Conclusions

- Spring and summer flush maturity are the two most effective treatment times
- It is the number of grams of product applied per tree that is critical in providing protection
- Phosphonate fungicide is a stable product provided it is stored in a sealed container

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