The Benefits of Monitoring Phosphorous Acid in the Roots of Avocados

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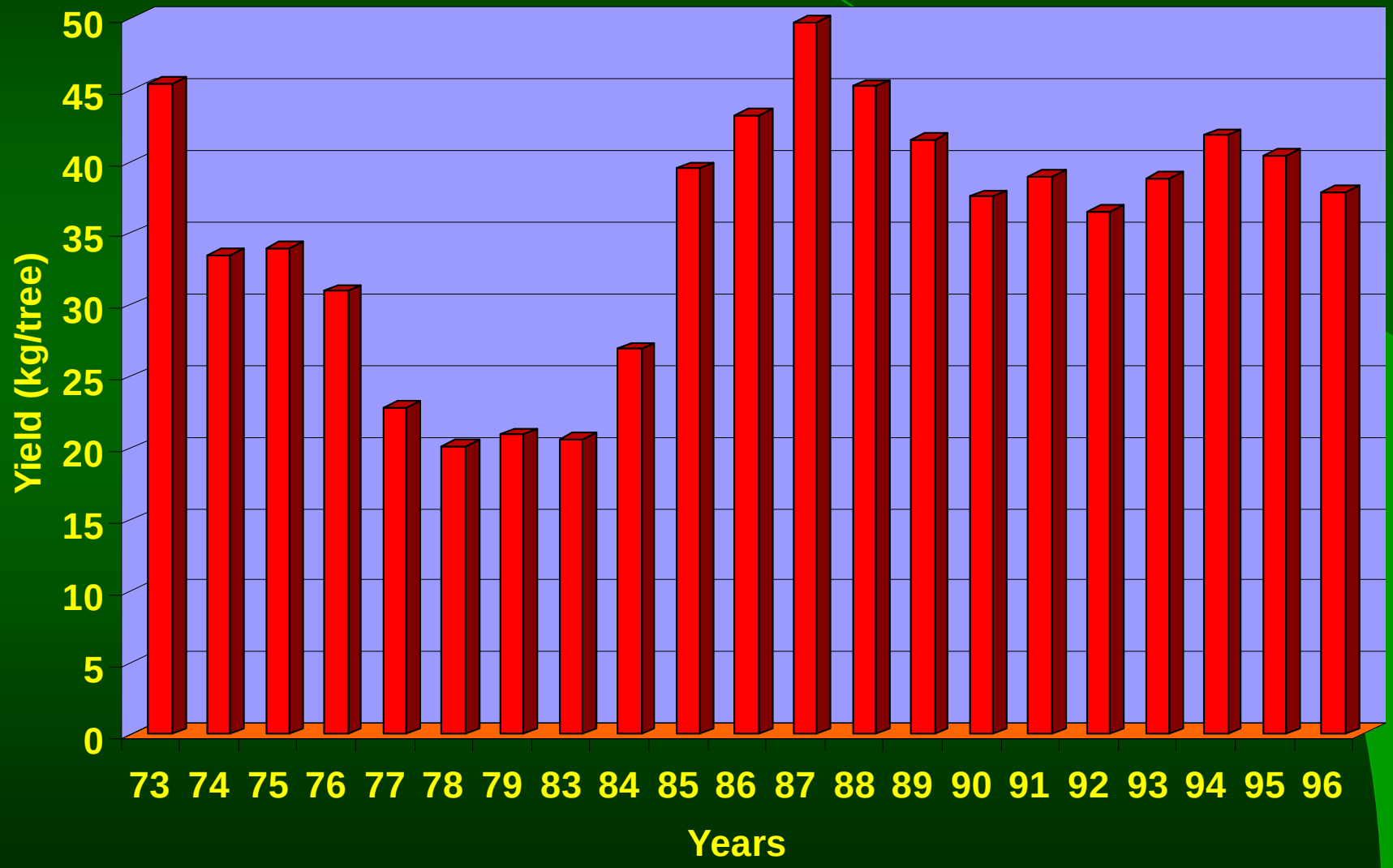
GLT Horticultural Services Pty.Ltd.

- History of *Phytophthora* management in the Australian avocado industry
- Factors influencing Phosphonate levels in roots
- The Monitoring Service
- The Future

Phytophthora management in the Australian Industry

- Cultural Activities – Mulch & Stumping

Australian Average Production Per Tree



Phytophthora management in the Australian Industry

- Cultural Activities – Mulch & Stumping
- Metalaxyl
- Phosphorous Acid
  - Aliette®
  - Potassium Phosphonate
    - ✓ Trunk Injection
    - ✓ Foliar Spray

Management strategies for integrated control of Phytophthora root rot.

- Select a site with free draining soil
- Obtain disease-free trees from an ANVAS accredited nursery
- Plant on broad-based mounds to divert excess water in periods of heavy rain
- Maintain a pH in the range most favoured by avocados – 5.0 to 5.5

Management strategies for integrated control of Phytophthora root rot.

- Maintain a mulch cover of fibrous materials in the canopy zone
- Maintain an even moisture level rather than allowing extremes in wetting and drying
- Maintain a high but balanced level of soil calcium
- Use a strategically applied fungicide program

Phosphorous Acid

- Phosphorous acid moves passively with the flow of sugars and nutrients through the tree in both an upward (xylem) and downward (phloem) direction
- Moves to organs of strongest sink strength
- During season fruit and leaves are at times a stronger sink than roots
- Limited lateral movement
- Works by stimulating plant defence and is mildly fungi toxic

AGRI-FOS®

Systemic Fungicide
(200 g/L Phosphorous Acid)

Crop	Treatment Method	Rates
Avocado	*Injection*	*Trunk injection skeletal trees 1st year 15mls undiluted product / metre of canopy diameter*
	Foliar	*2.5 – 3.0 mls / l*

AGRICHEM
Your liquid solution for quality

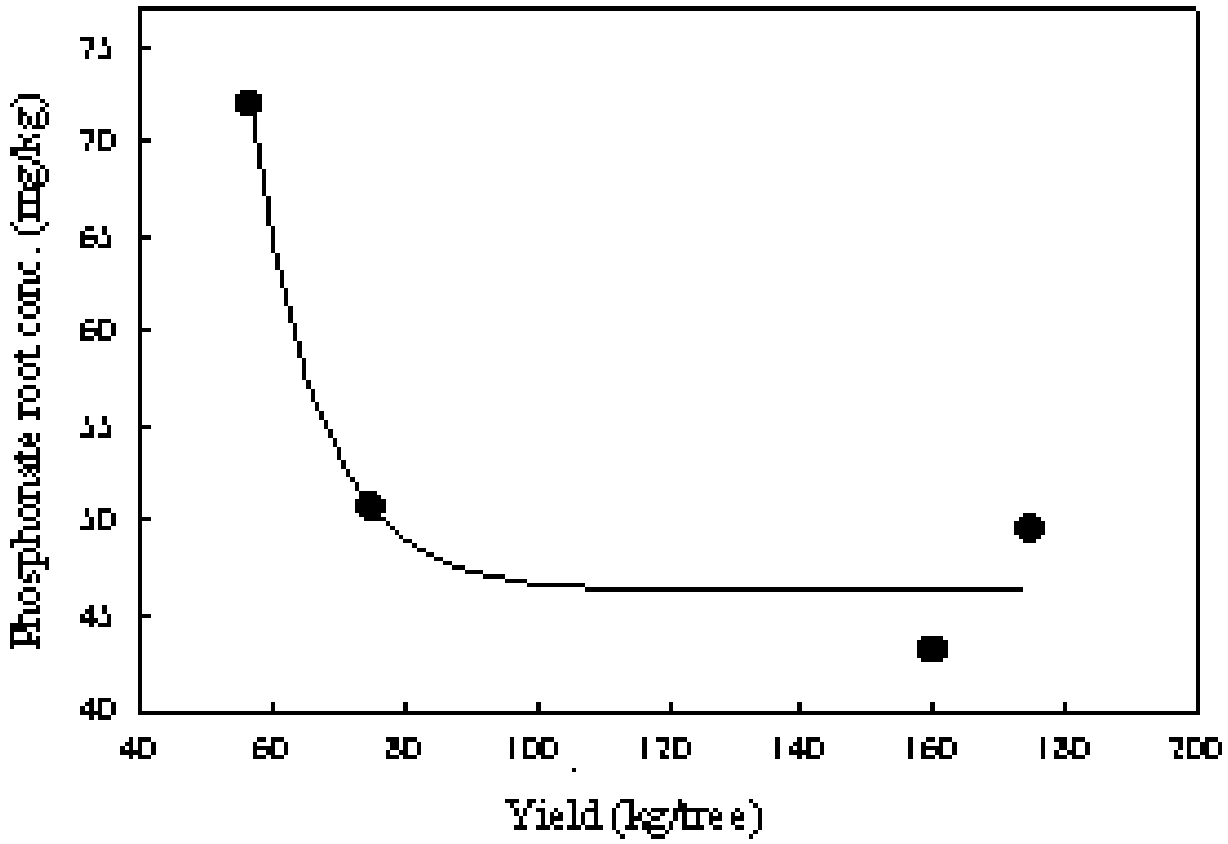
Factors influencing Phosphonate levels in roots

- Crop Load
- Application method
- Application volume
- Season
- Rootstock
- Location

Crop Load

- Confirmed early research

Crop Load

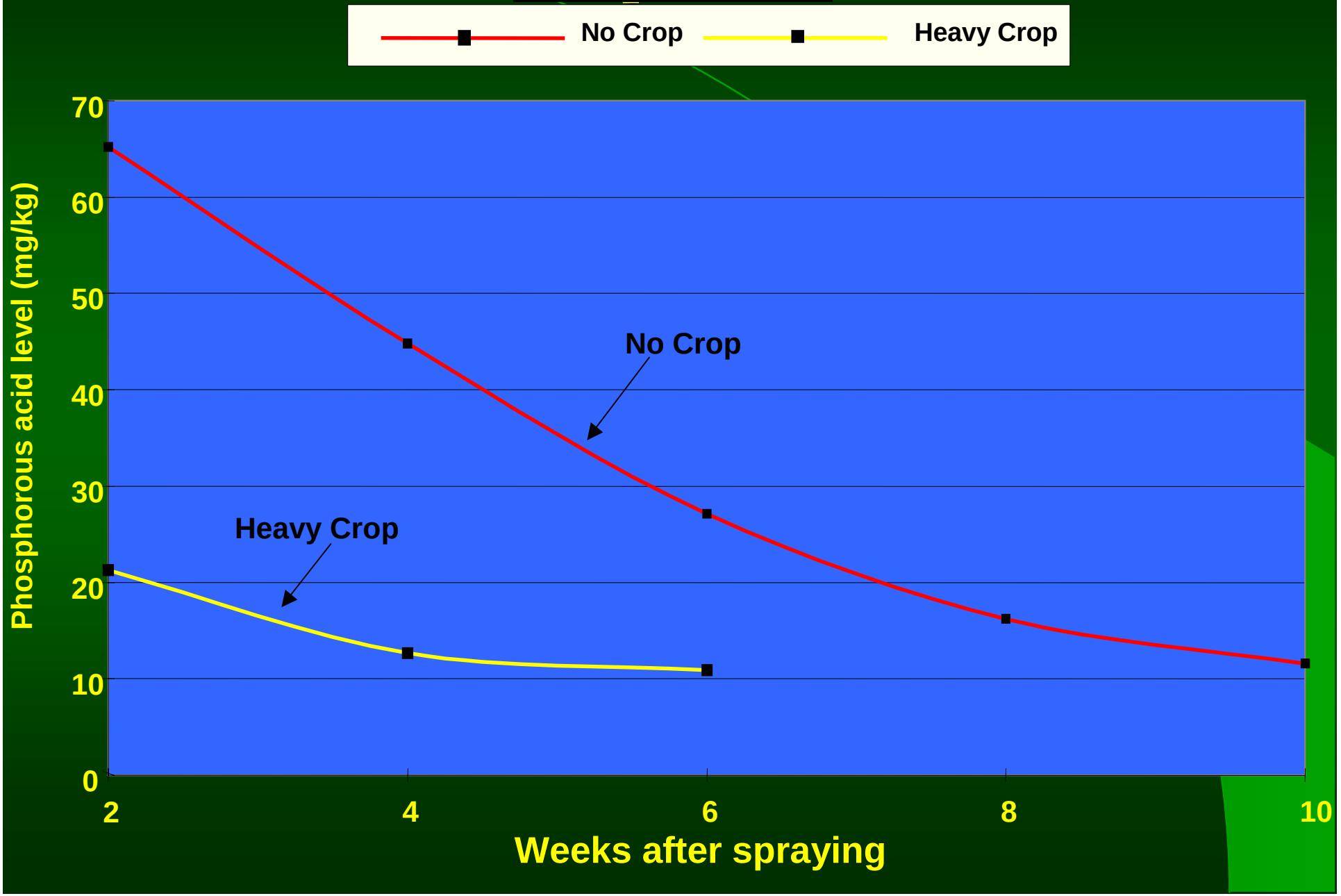


Dr. A.W. Whiley

Crop Load

- Confirmed early research
- Function of the sink strength
- Single spray
- Dose - 12.5 mL / L (400g / L Phosphorous acid)
- Similar volume applied
- Similar physiological stage

Crop Load


No Crop
Heavy Crop
70
60
50
40
30
20
10
0
Phosphorous acid level (mg/kg)
No Crop
Heavy Crop
2
4
6
8
10
Weeks after spraying

Application Method

Trial

- Hass on Mexican seedling rootstock
- Spray concentration 12.5 mL / L

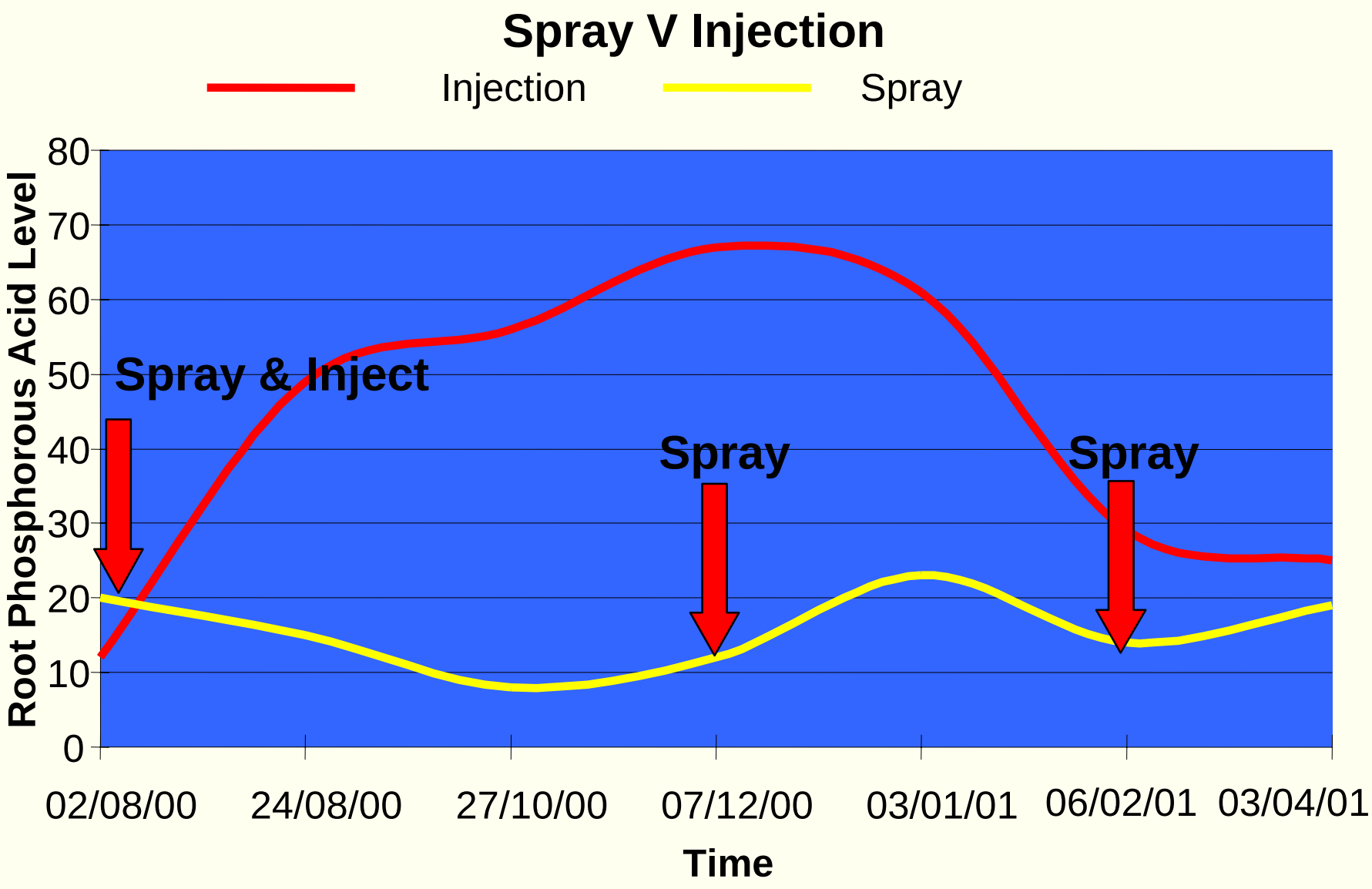
(400g/ kg Phosphorous acid buffered to pH 7.2)

- Volume - 370 L / Ha or 3 L / tree - 02/08/00
- Volume - 1,000 L / Ha or 9 L / tree – 11/12/00 & 06/02/01
- Injection – 15mL / m drip diameter

(200g/kg Phosphorous acid)

- Heavy crop load

Application Method

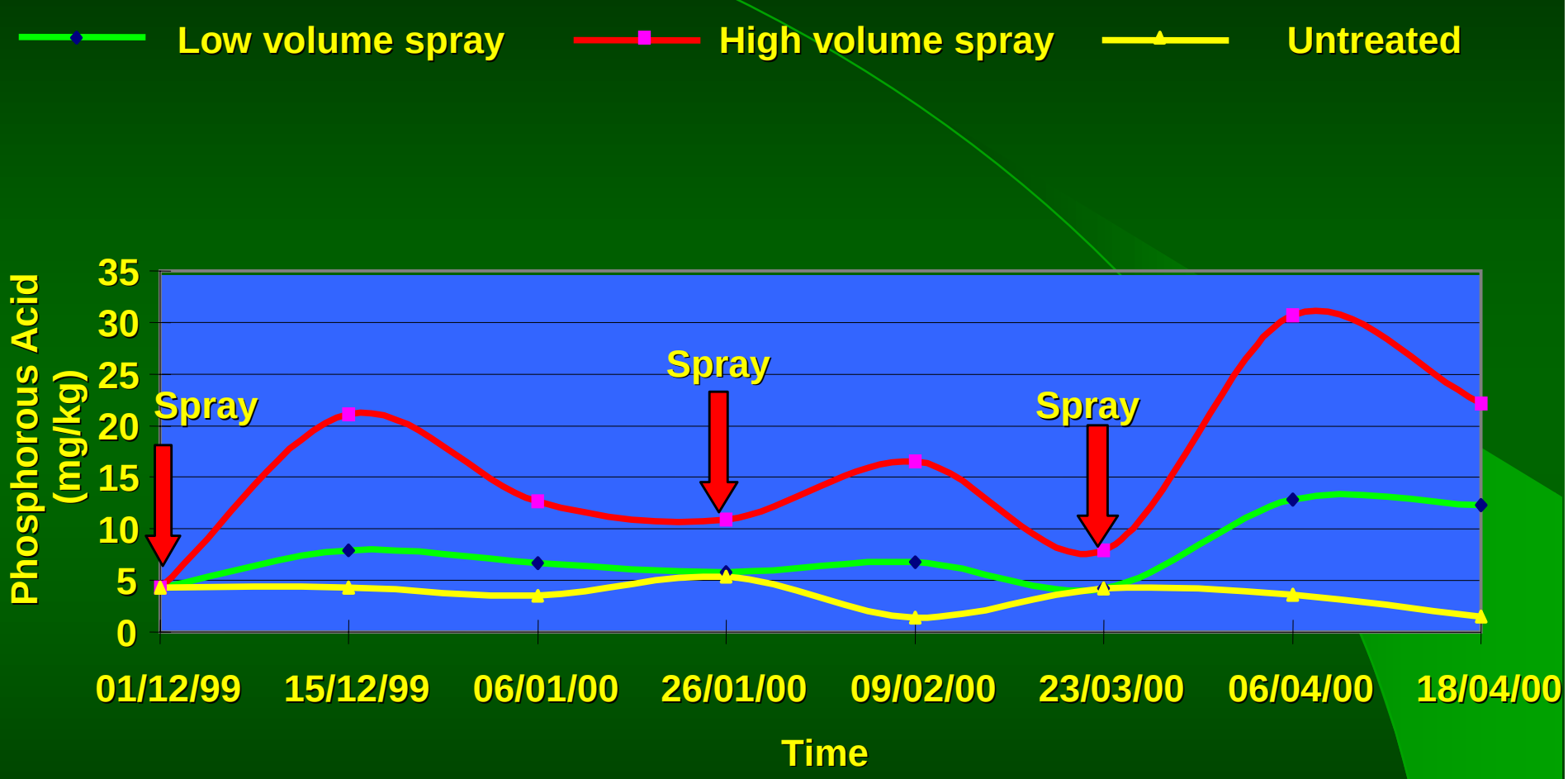


Spray Volume

Trial

- Hass on Guatemalan seedling rootstock
- Spray concentration 12.5 mL / L
(400g/ kg Phosphorous acid buffered to pH 7.2)
- High volume - 1500 L / Ha or 12 L / tree
- Low volume - 615 L / Ha or 5 L / tree

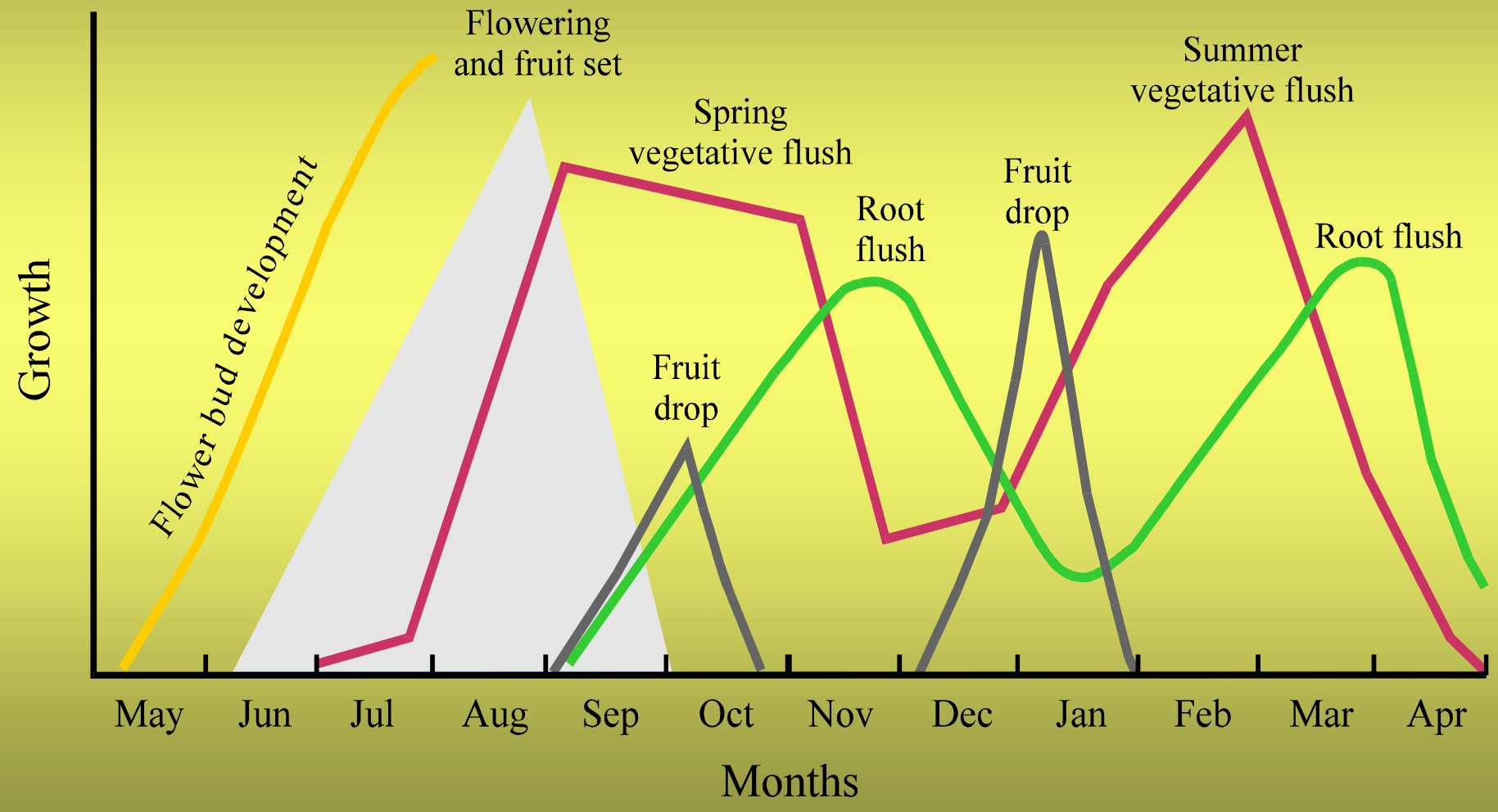
Spray Volume



Seasonal Differences

- Need a clear understanding of the tree physiology
- Timing of events varies between regions
- The magnitude and pattern of the events varies

Avocado Phenology Cycle



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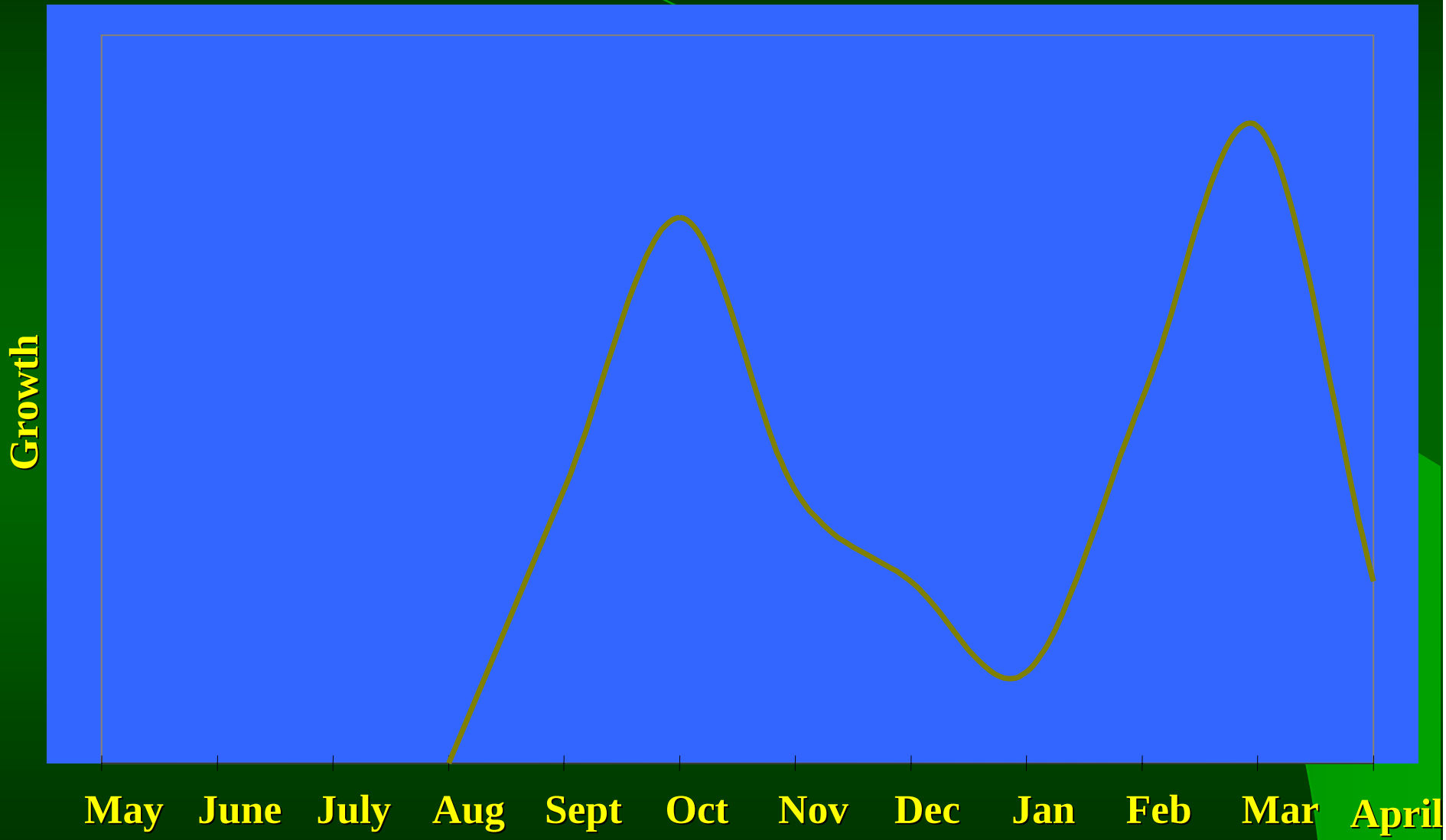
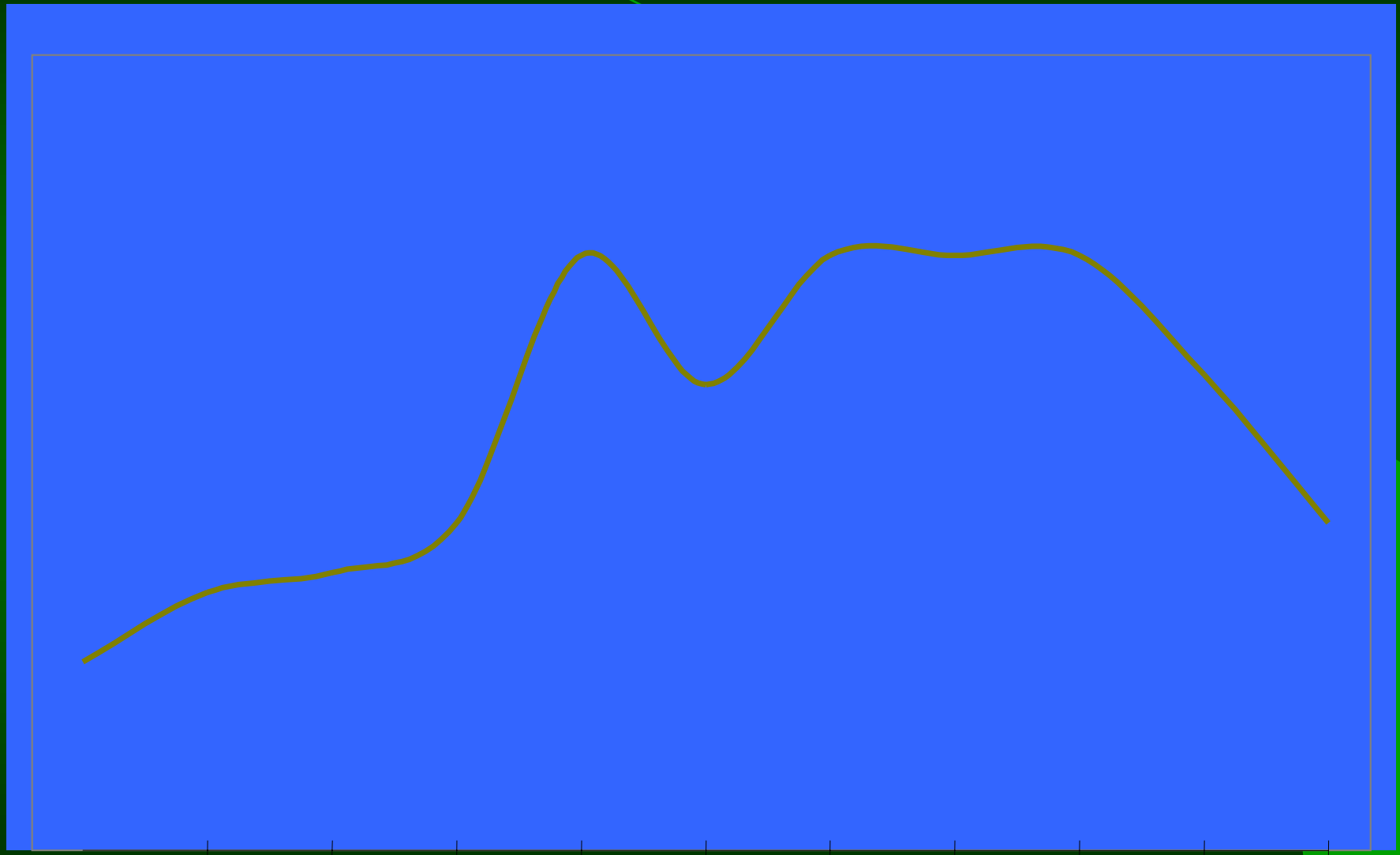
Root Flush



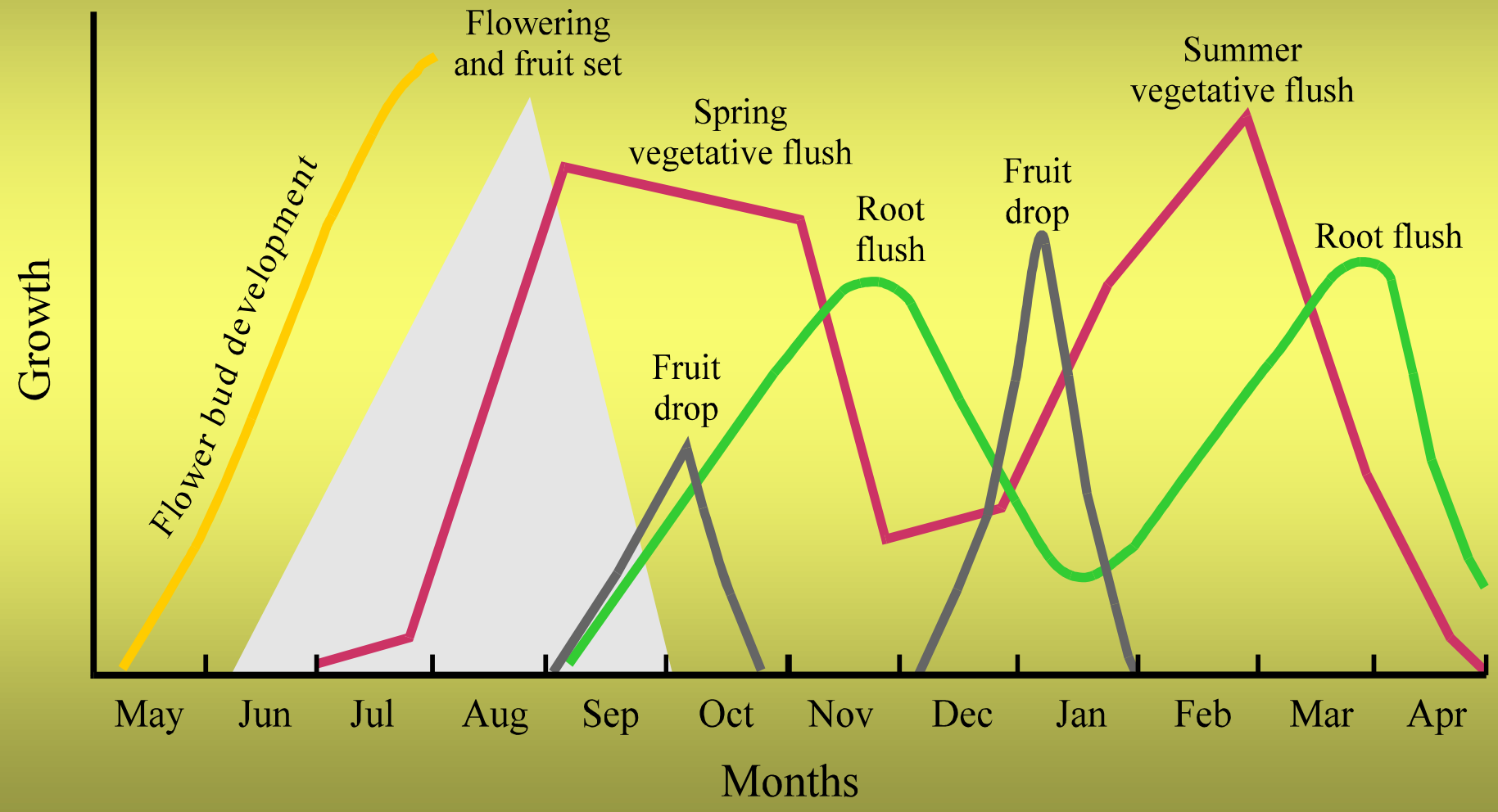
Root Ratings - Pemberton



Seasonal Differences

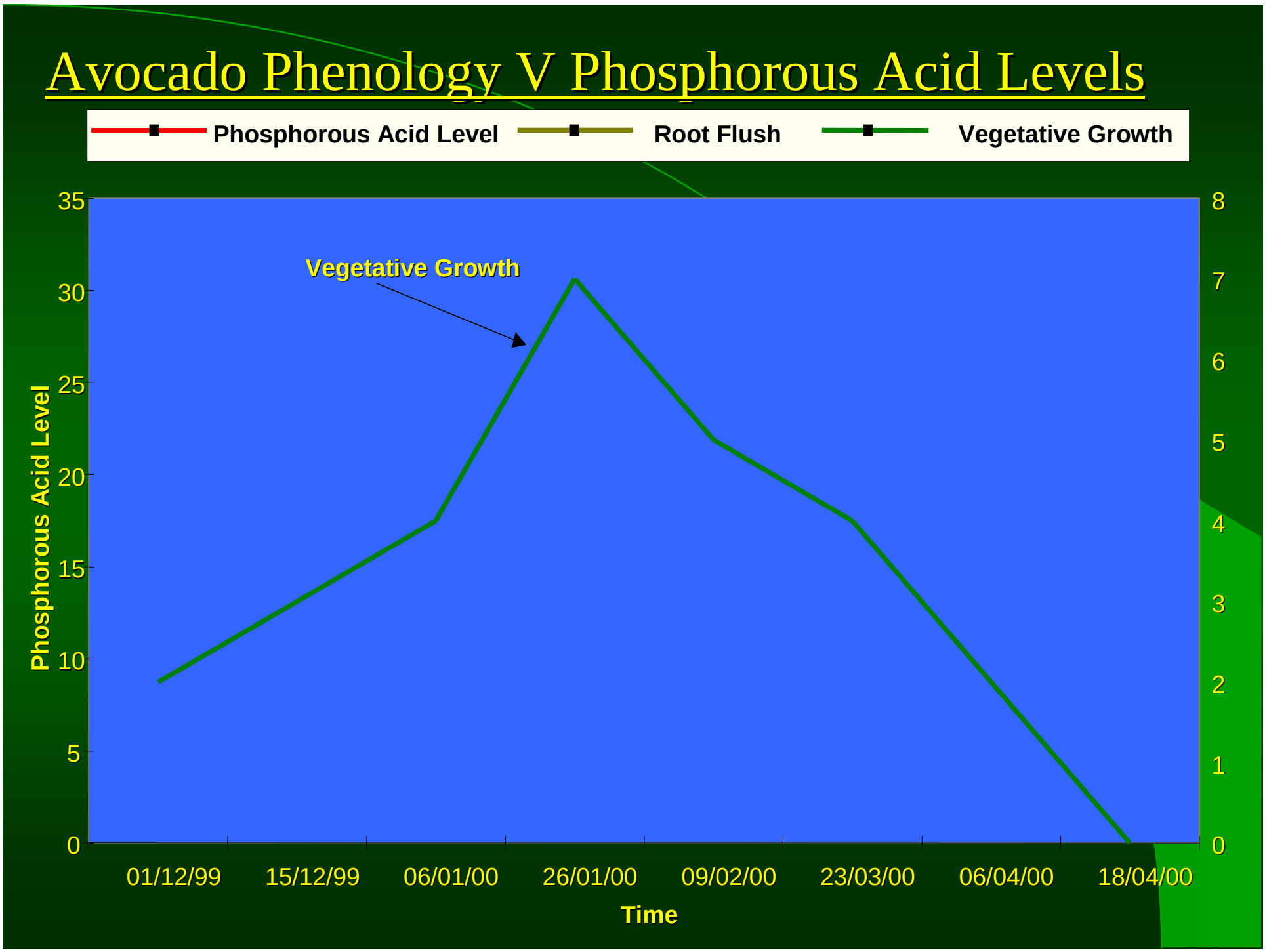
- Need a clear understanding of the tree physiology
- Timing of events varies between regions
- The magnitude and pattern of the events varies
- Spray concentration 12.5 mL / L
(400g/ kg Phosphorous acid buffered to pH 7.2)
- High volume - 1500 L / Ha or 12 L / tree
- Heavy crop load

Avocado Phenology Cycle

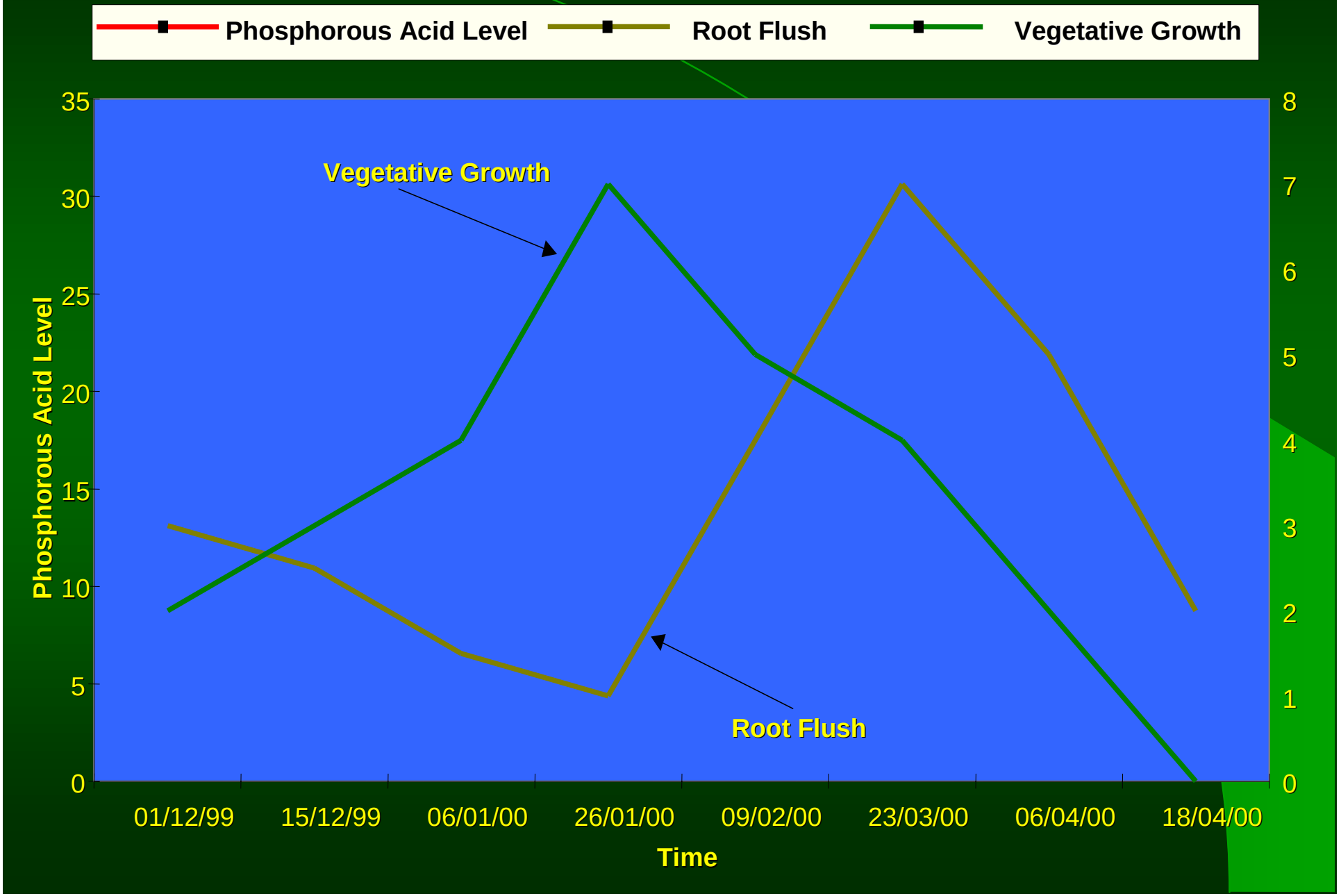


Dr. A. W. Whiley

Avocado Phenology V Phosphorous Acid Levels



Avocado Phenology V Phosphorous Acid Levels



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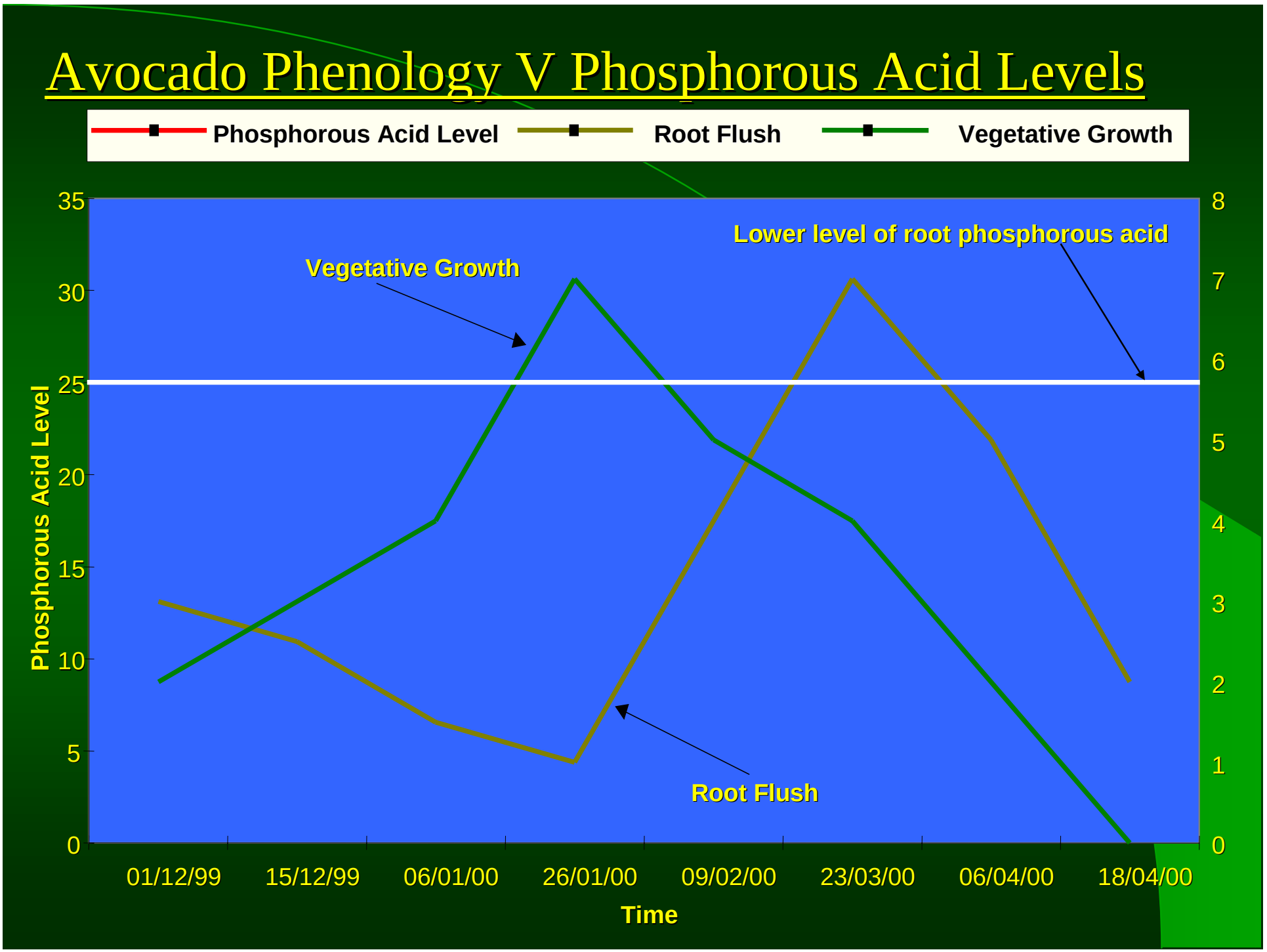

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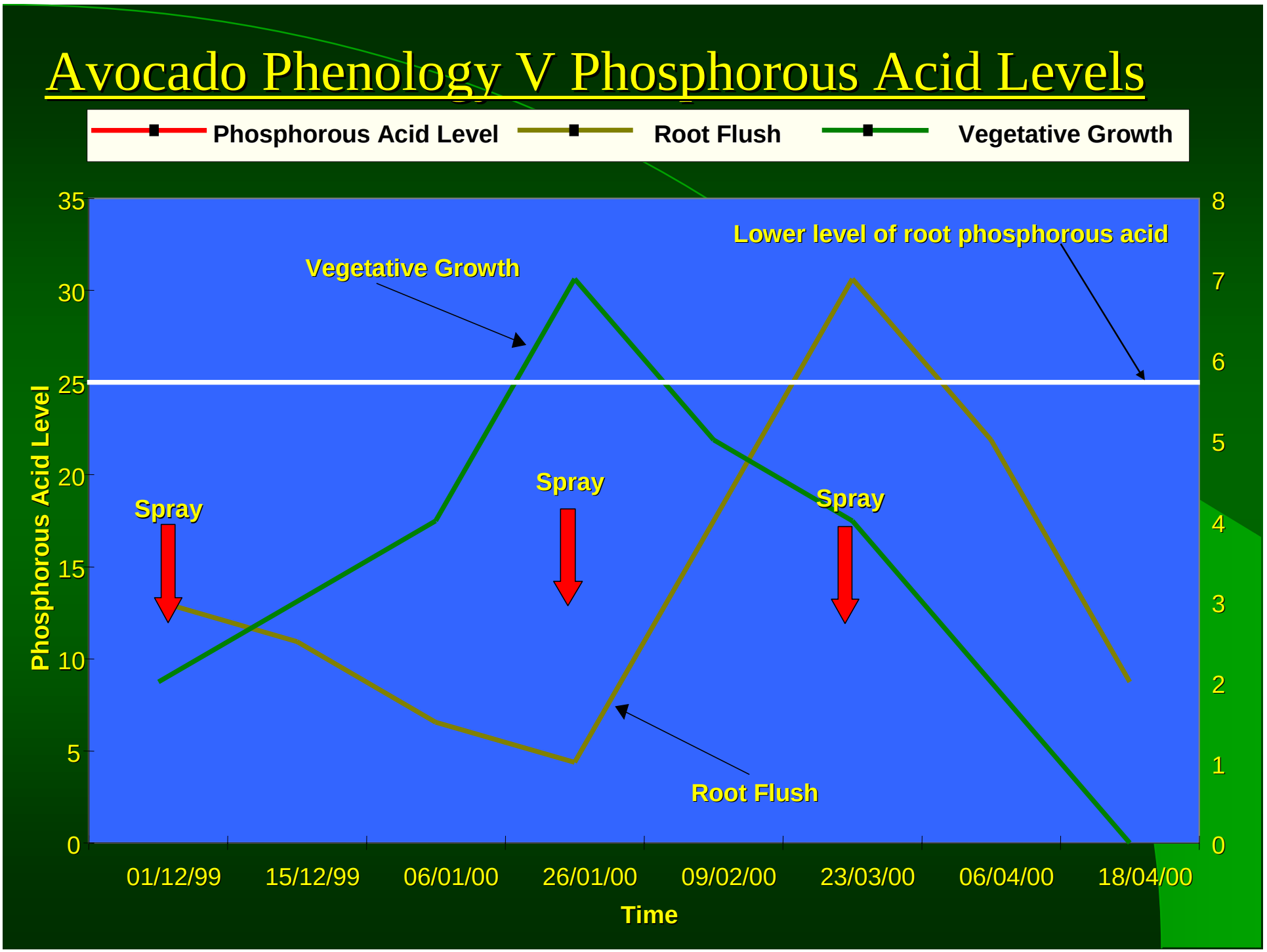
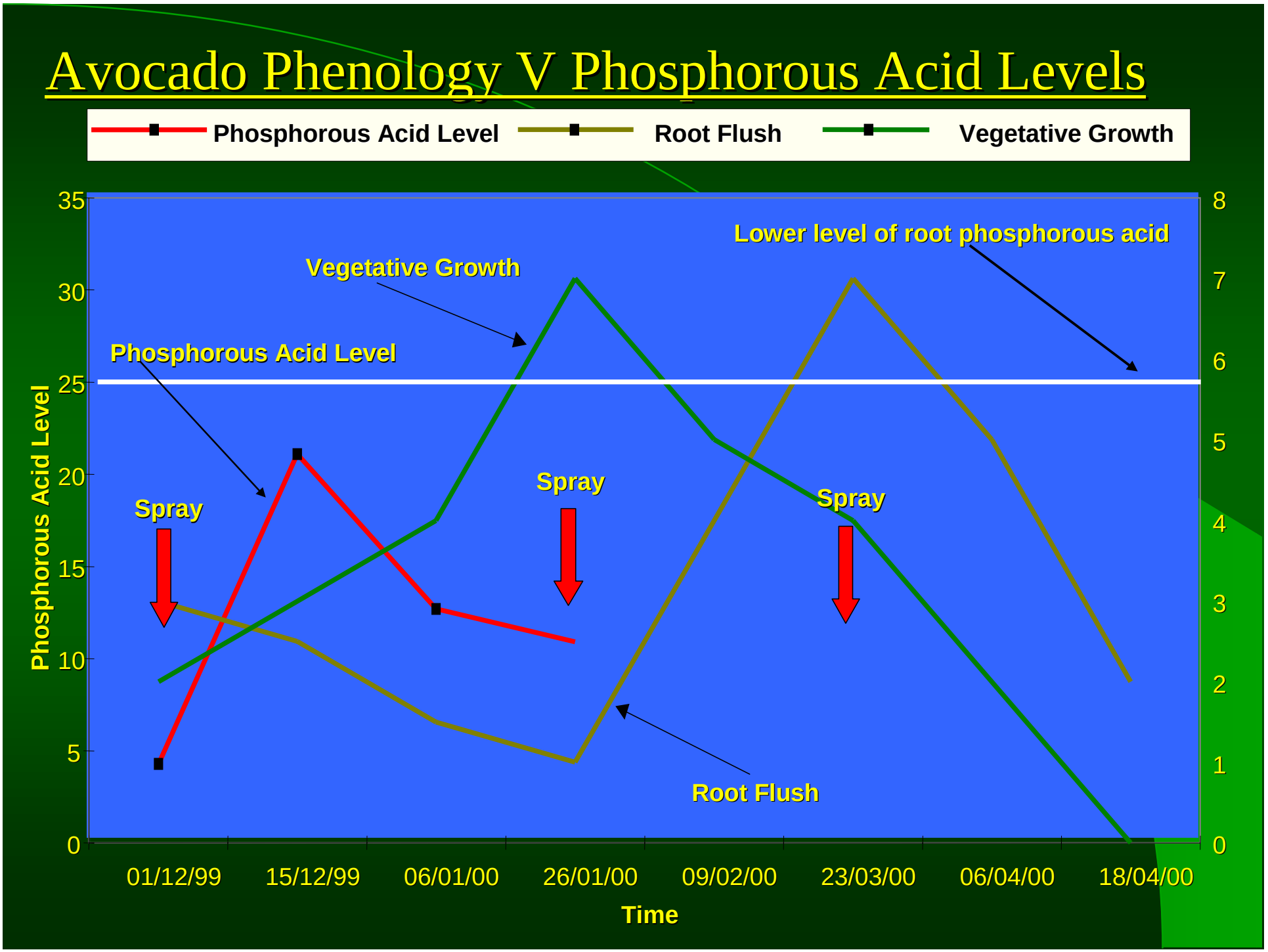


Avocado Phenology V Phosphorous Acid Levels



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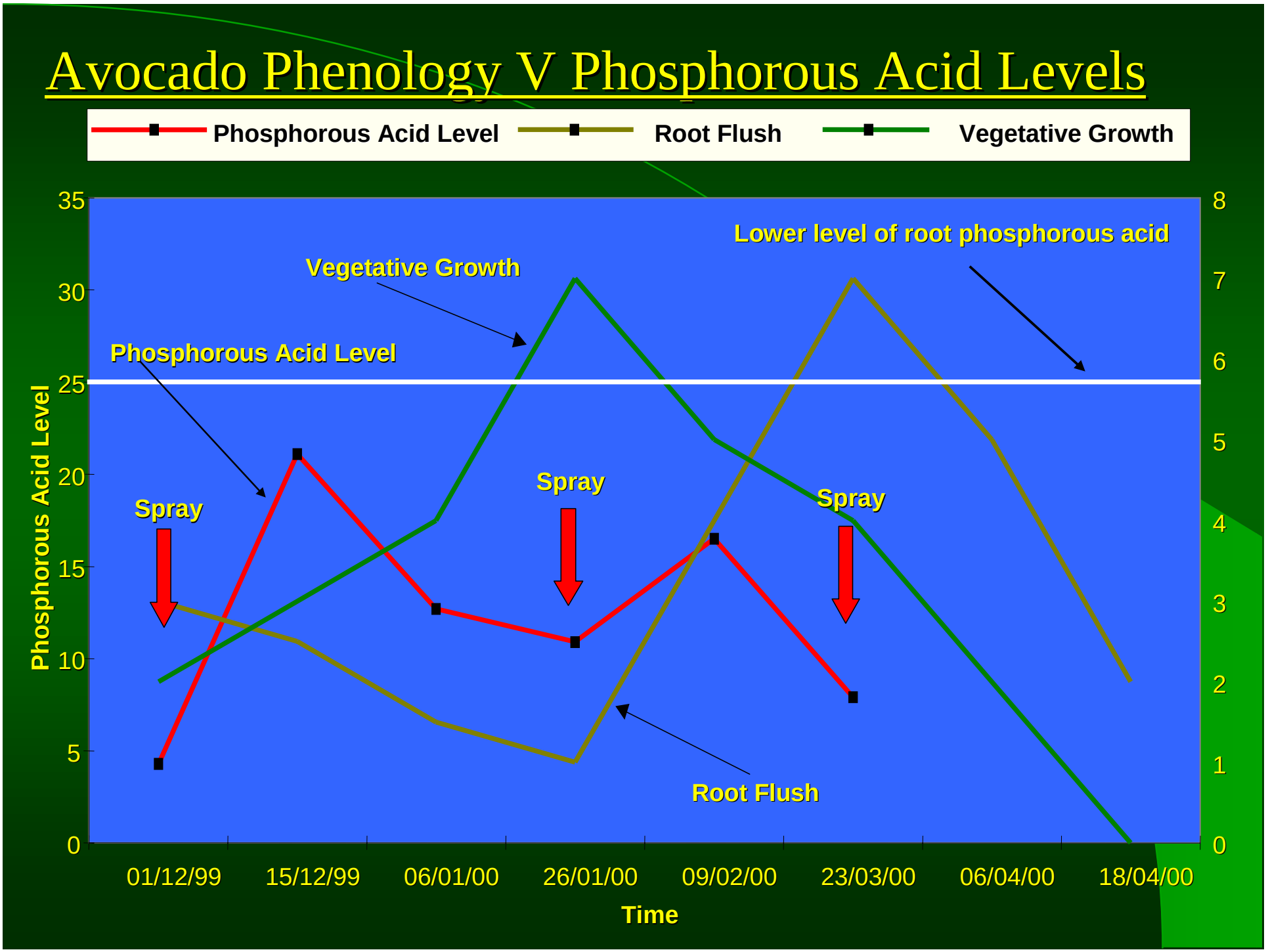
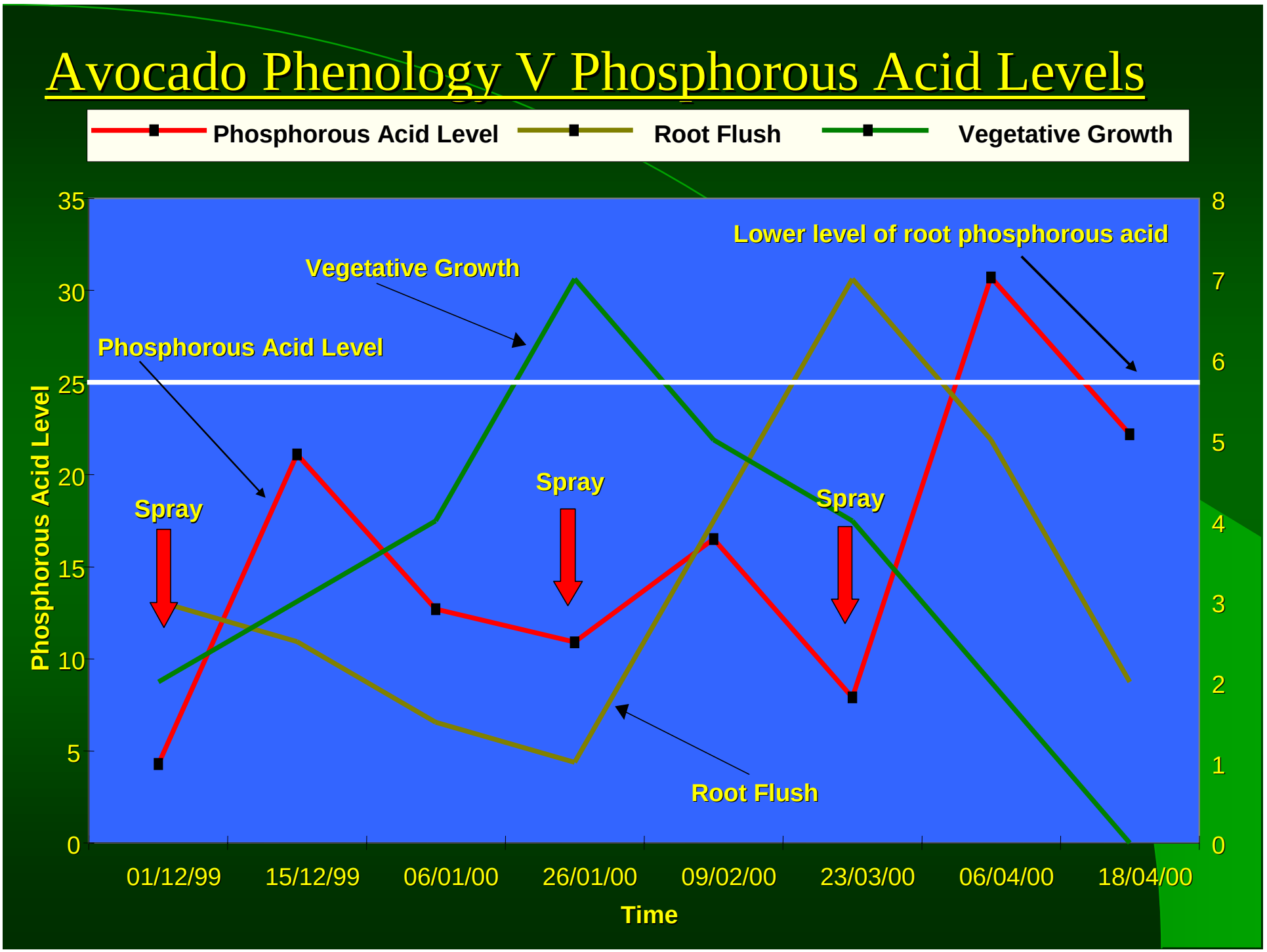


Avocado Phenology V Phosphorous Acid Levels



Fruit sink strength

- "Moves to organs of strongest sink strength "
- Early fruit development is a strong metabolic sink
- Unwanted fruit residues
- MRL – Australia - 100 mg/kg
- MRL – USA - 25 mg/kg
- MRL – New Zealand - 100 mg/kg

Effect of time of foliar application

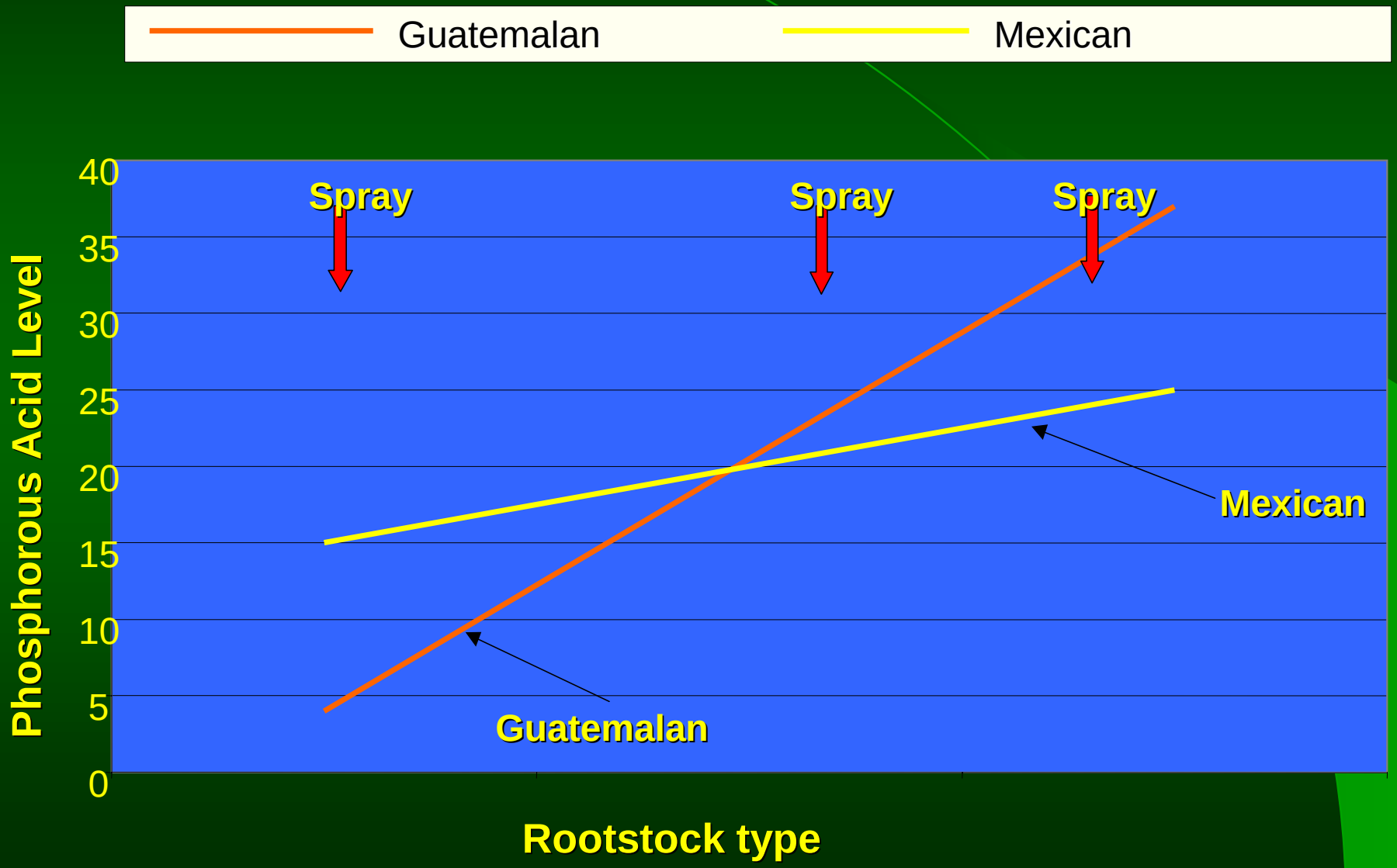
Date of application	Stage of fruit development	Fruit phosphorous acid conc. (mg/kg)
3rd November	Early growth (3 – 5 mm diameter)	160.8
30th January	About 1/3 grown	21.6
16th July	Fully mature	3.7

Dr. A.W. Whiley, unpublished results

Observed Rootstock Effects

- Very limited data
- 3 sprays
- Spray concentration 12.5 mL / L
(400g/ kg Phosphorous acid buffered to pH 7.2)
- Similar volume
- Sprayed on the same days

Observed Rootstock Effects



Locational Differences

- Largest differences noted between NQ & WA
- Complex – Physiology plays a big part
- Consistently occurring over many samples

Locational Differences

Comparative Conditions	Location	
	North Queensland	SW West Aust
Rootstock	Guatemalan	Guatemalan
Crop load	Low	Low
Tree health rating	Healthy	Healthy
Tree height (m)	2.0	2.0
Tree diameter (m)	4.0	2.0
Tree volume (m^3)	25.0	6.3
Volume phosphonate applied / application (ml)	63.0	25.0
Volume phosphonate applied / m^3. (ml)	2.5	3.9
Number of applications	4.0	1.0
Date(s) applied	13/10, 4/11, 23/11, 11/12	20/12
Days from last application to sampling	43.0	41.0
Root phosphorous acid concentration (mg/kg)	**31.0**	**65.0**

Summary of Observations

- Rootstock – limited data
- Application method
  - ✓ Injection – stronger peak – longer persistence
  - ✓ Foliar – lower peaks – short persistence
  - ✓ Foliar – Spray efficiency
- Volume of foliar applications is critical
- Phenology – Critical to fully understand

Summary of Observations

- Crop load - critical – early development
- Location – Complex

The Monitoring Service

Aim:

- Optimize the usage of Phosphorous acid
- Prolong the benefits of Phosphorous acid to the avocado industry

Phytophthora cinnamomi sensitivity to Phosphorous Acid

H_3PO_3 Concentration *(µg/ml)*	Treated [1]	Treated [2]
50	16	74
100	19	26
500	34	0
1000	29	0
>1000	2	0

[1]Isolates recovered from the roots of avocado trees that had been treated with phosphonate fungicides applied as either a foliar spray or a soil drench for 10 years.
[2]Isolates recovered from the roots of avocado trees that had never been treated with phosphonate fungicides.

Weinert *et al.* (1997).

The Monitoring Service

Aim:

- Optimize the usage of Phosphorous acid
- Prolong the benefits of Phosphorous acid to the avocado industry
- Maximise application efficiency
- Reduce costs through unnecessary applications
- Maximizing yield by minimizing the effects of *Phytophthora*

Sampling

- 3g of feeder roots from representative trees in the block (2 – 3 roots from 20 – 25 trees)

Sampling

Sampling

- 3g of feeder roots from representative trees in the block (2 – 3 roots from 20 – 25 trees)
- Establish a base level of phosphorous acid
- Resample 2 weeks after spray application
- Developing a database to customize treatments down to a block level

Crop Details

Variety	**Rootstock**	**Irrigation Type**	**Tree Age**
Tree Health	**Crop Load**	**Tree Height**	**Canopy Diameter**
Root Health	**Soil Type**	**Tree Spacing**	**Calcium Applications**
Mulch Type	**Mulch Thickness**	**Application Method**	**Injection Volume**
Spray Rate	**Volume / Hectare**	**Volume / Tree**	**Application Dates**

Sample analysis is provided by:

Interpretations in New Zealand:

Avo Systems Ltd
Subtropical Fruit Consulting Specialist

Interpretations in Australia:

G.L.T. Horticultural Services Pty Ltd

The Future

- Phosphorous acid is the only cost effective and reliable tool to manage *Phytophthora*
- Any replacement would be far more expensive and probably not as efficient
- Fungal loss of sensitivity is a reality – Mode of action "may" save us.
- Use practices need to be optimized - Monitoring
- Totally integrate all our *Phytophthora* management practices

The Future

- Develop a greater understanding of the natural defence resistance mechanisms.

- Work towards the development of the "ultimate"

A rootstock that is resistant to or tolerant of *Phytophthora* which is capable of producing large volumes of high quality fruit.

Acknowledgements

- Agrifood Technology
- Participating growers
- Dr. Tony Whiley and team