Avocado Tree Growth Cycle

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This session

- What is a growth cycle?
- Why are growth cycles important?
- The dynamic nature of the growth cycle
- How you can use it as a powerful management tool
- Case studies
- Interactive discussion

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Tree Growth Cycle (Phenology)

- Crop phenology is simply the seasonal change in growth that occurs over a reproductive cycle

- With tree crops it is an annual cycle

- Once identified it gives the opportunity to recognise competitive interactions between various components of the tree

- It can be developed and used as a management tool

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Avocados Have A Predictable Annual Cycle

… flowering

…fruit maturation

…fruit set

…root growth

…shoot growth

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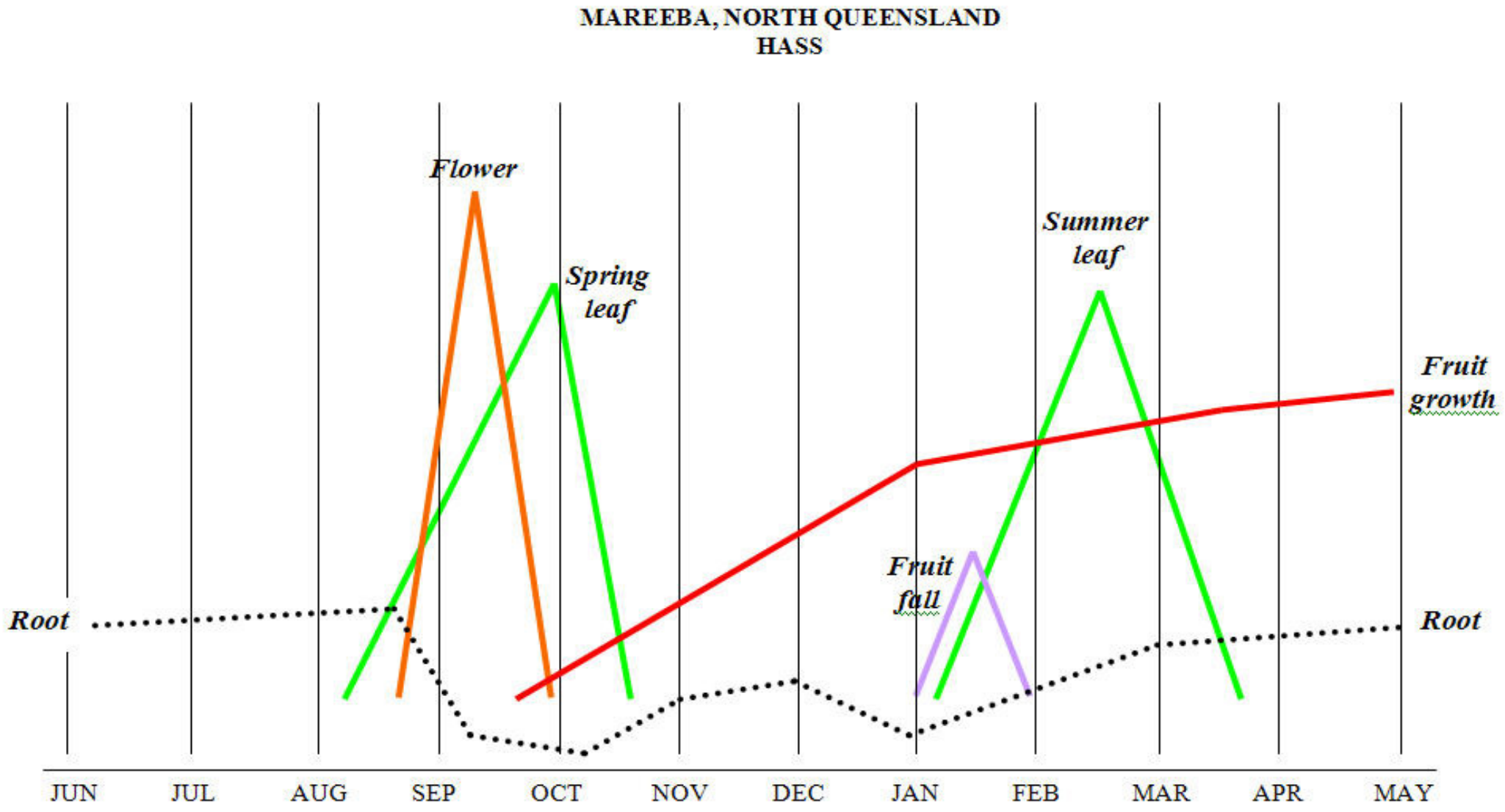
The Annual Cycle



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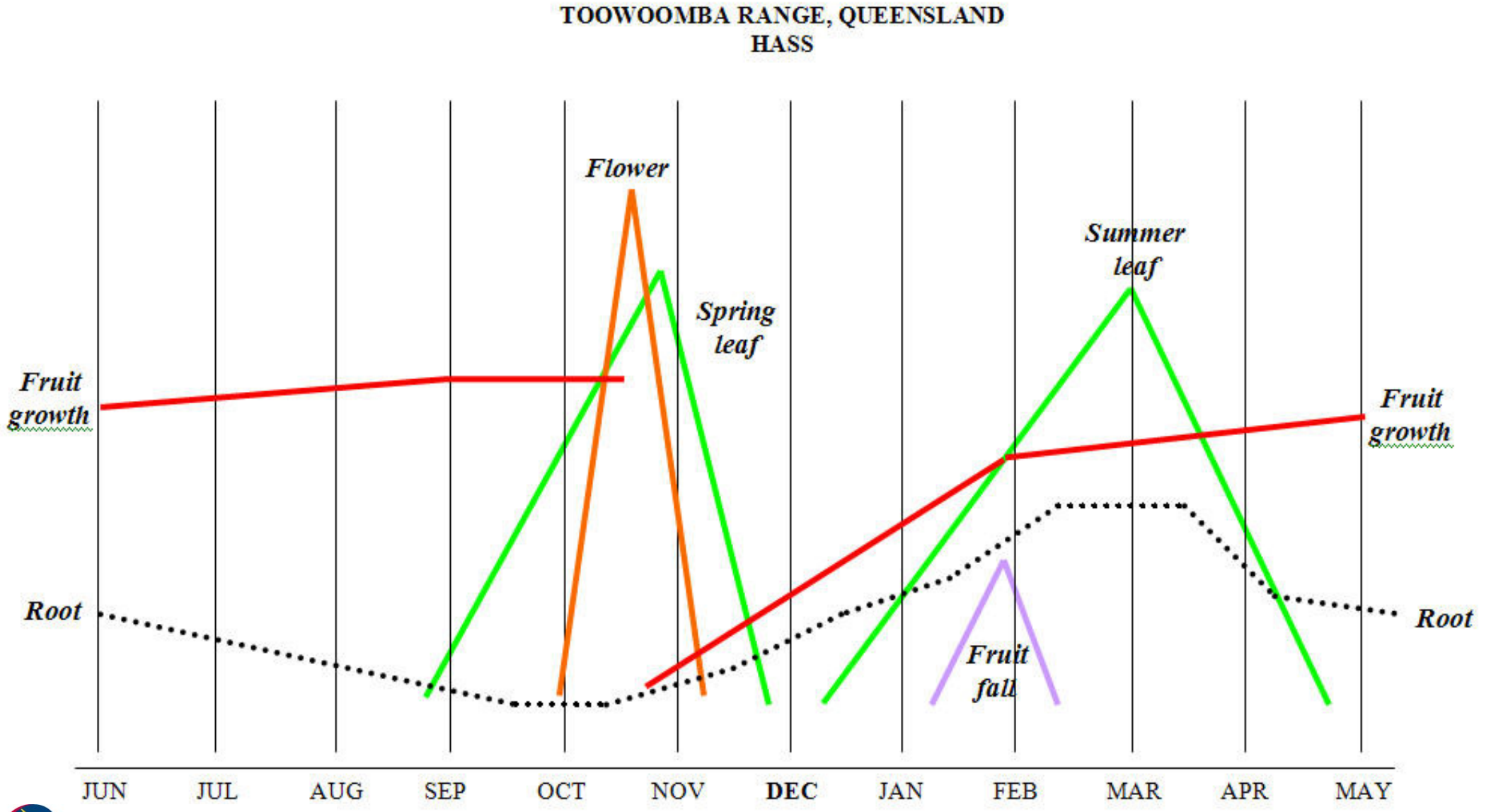
The Annual Cycle



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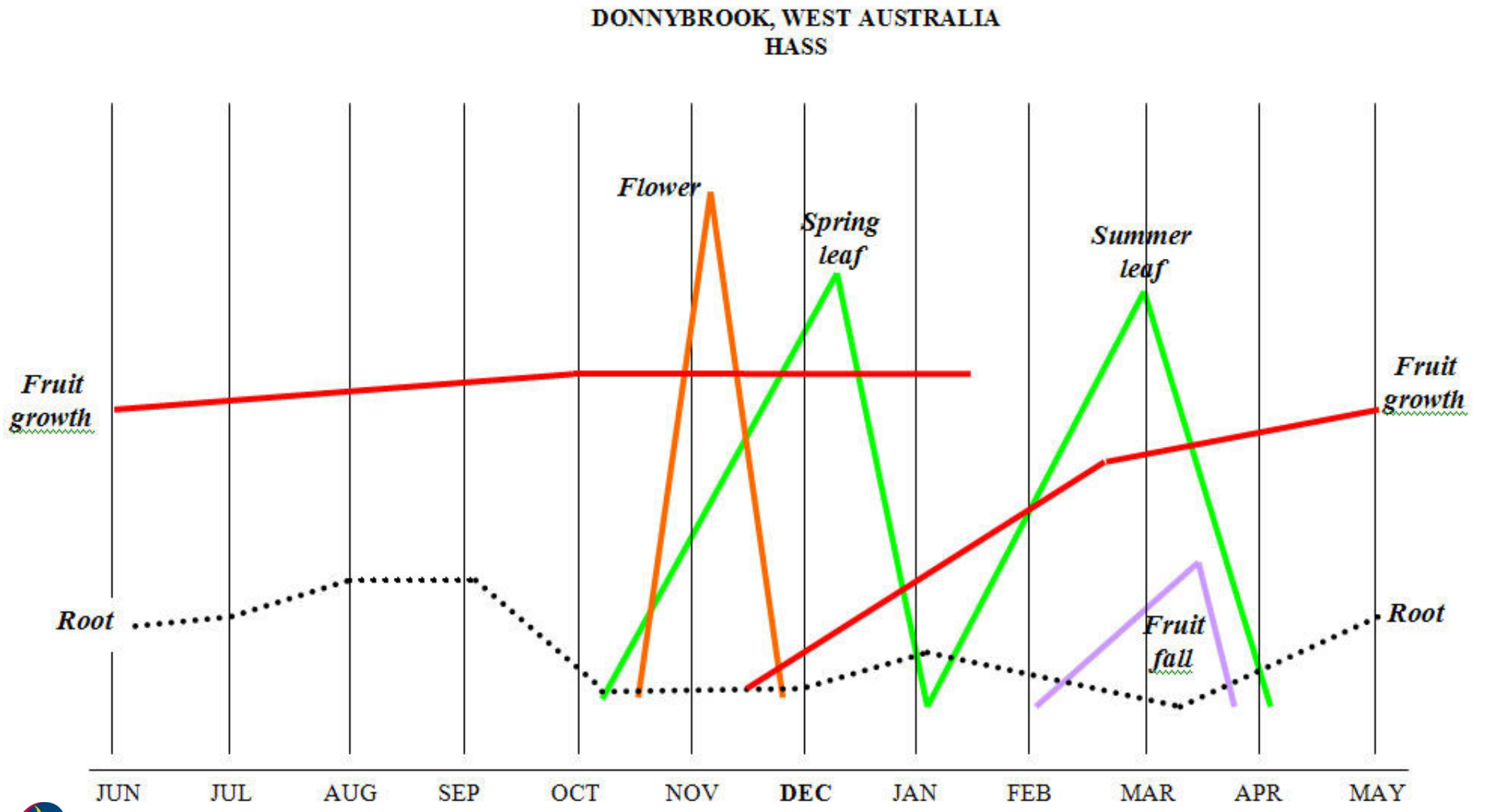
The Annual Cycle



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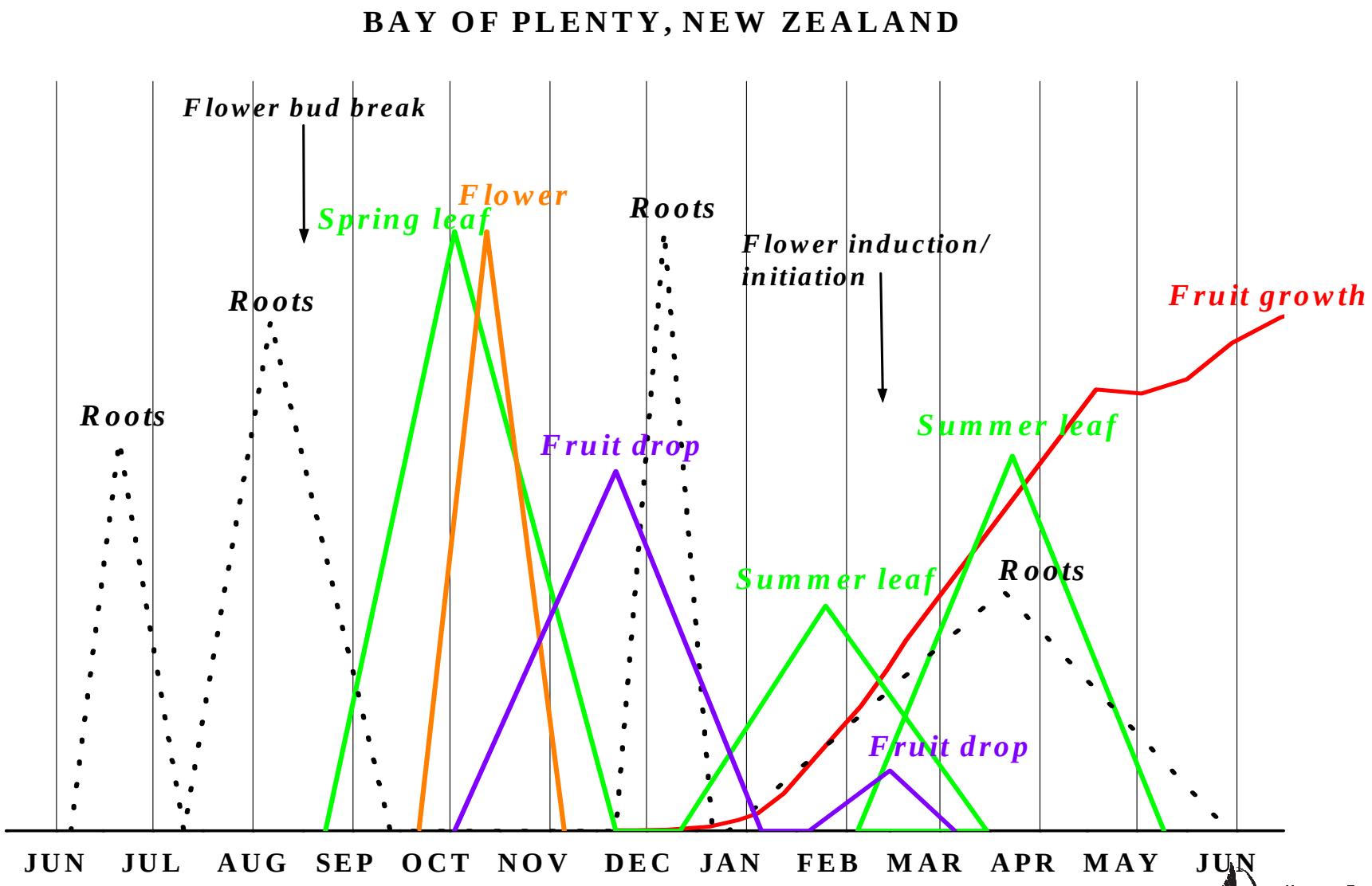
The Annual Cycle



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Why is the Avocado Tree Growth Cycle Important?

- Best timing of management activities
  - Fertiliser, Phytophthora control, Water
- Gives an understanding of what may happen when there are problems

  e.g., Late hanging fruit can alter the flowering, growth flushes and starch in the tree
- Greater understanding of how the tree grows
- Lead to greater grower innovation in tree management

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Photos of the same tree October 2007 and 2008

The Two Year Growth Cycle

Why two years?

- The timing of phenological events can change from year to year
- The strength of the phenological event can also depend on what has happened in the previous year
- It is cumulative influences in the previous two years that determine the crop that is harvested

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Flower Induction/Initiation on Spring flush

Orchard	Time	Previous crop
One	April	Regular
Two	early February	Off year
Three	early March	Off 2 years

- As much as six weeks difference between orchards
- Could affect timing of fertiliser and pruning

Source: NZ Annual Research Report 2006

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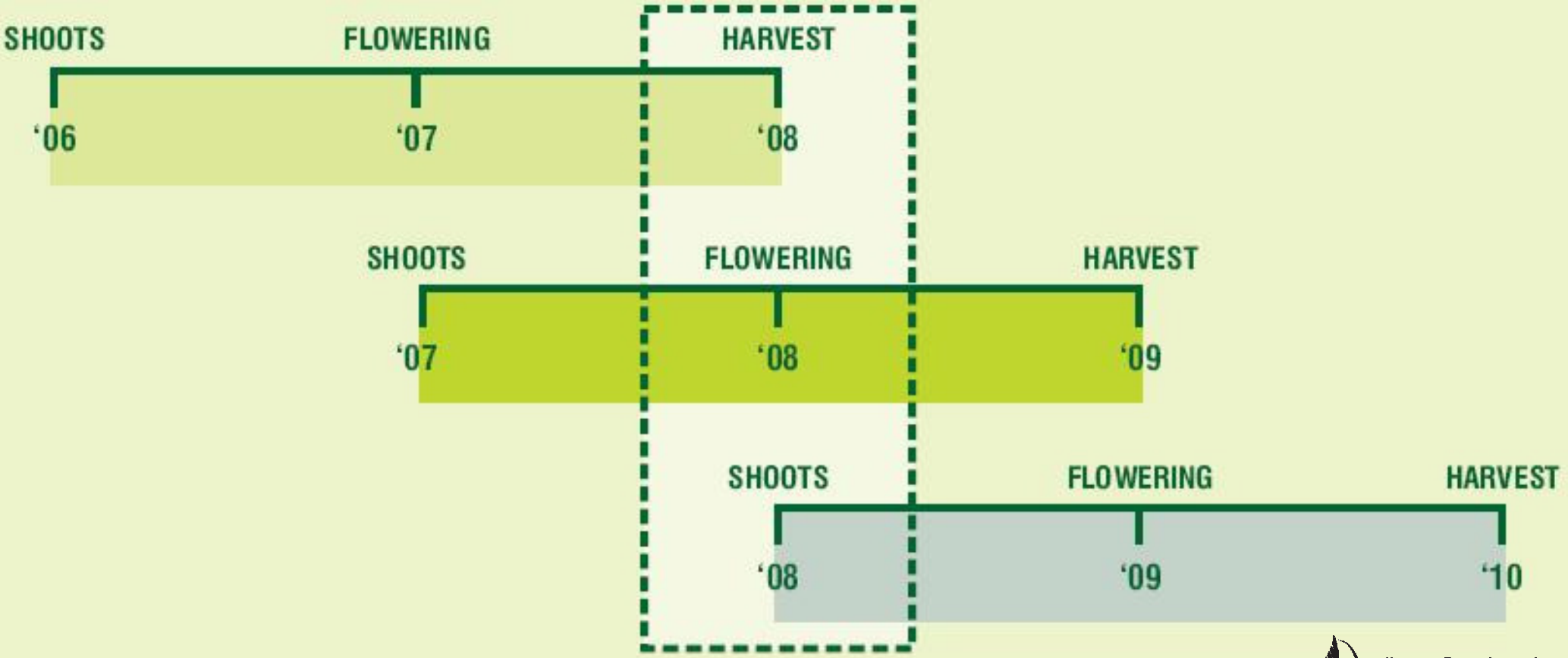
Three threads come together

General timeline for fruit production from shoots to harvest.



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Alternate Bearing Cycle

New Zealand Avocado Growers' Association

Avocado Tree Phenology Chart

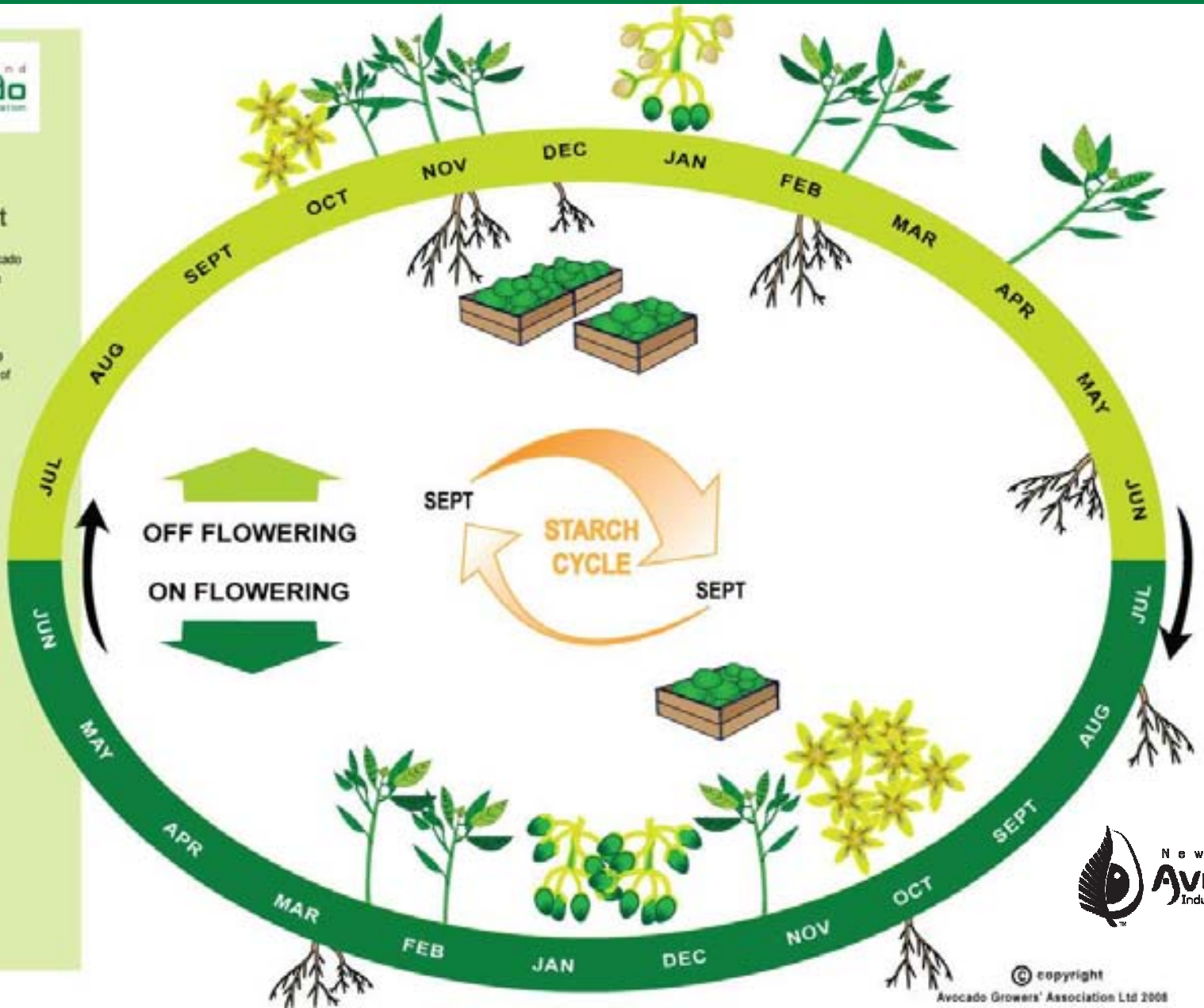
This chart shows the general avocado tree phenology over one complete alternate bearing cycle under New Zealand conditions.

There are major differences in tree growth, flowering and the amount of fruit to harvest in each year.

Key points:
In the 'off' flowering year a large crop is harvested but flowering and fruit set are poor.
Shoot growth is strong.
Starch is built up.

In the 'on' flowering year a small crop is harvested but flowering and fruit set are very good.
Shoot growth is weak.
Starch is not built up.

Breaking the alternate bearing cycle requires intervention so the trees in the 'on' flowering year have fewer flowers and grow more shoots than would be usual.



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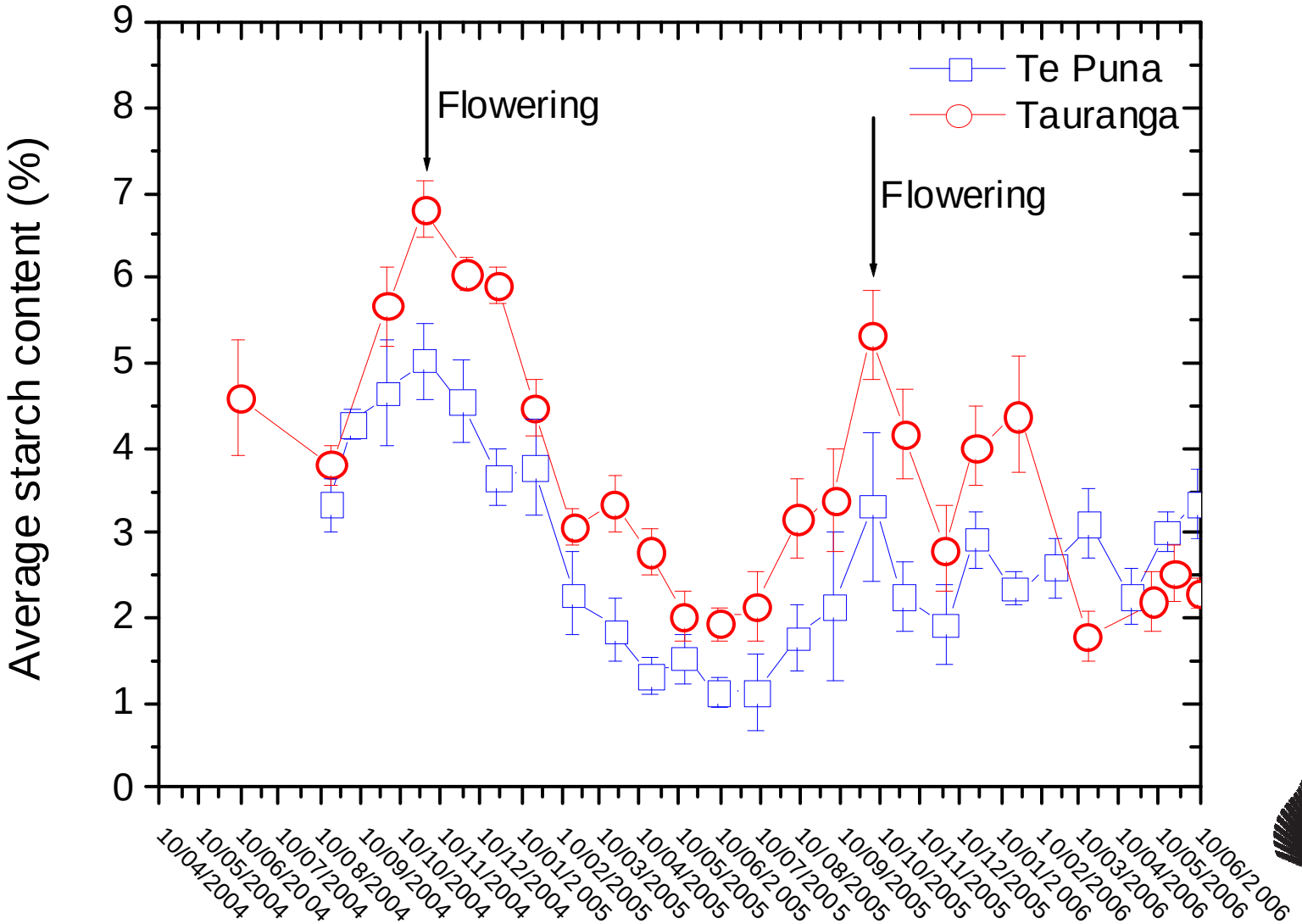
The Starch Cycle



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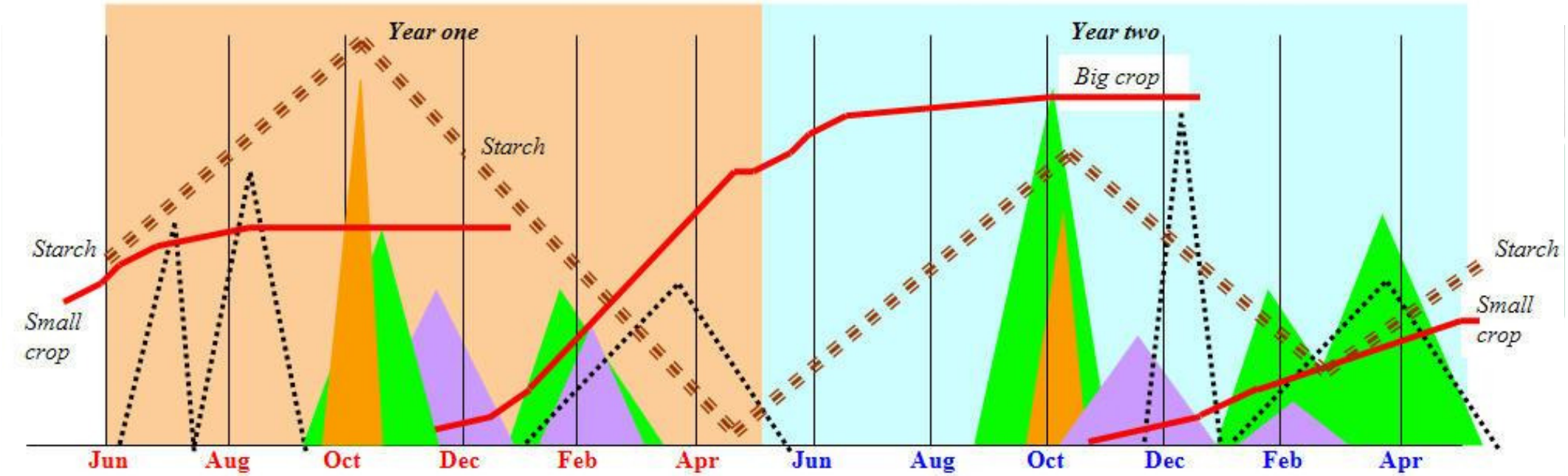
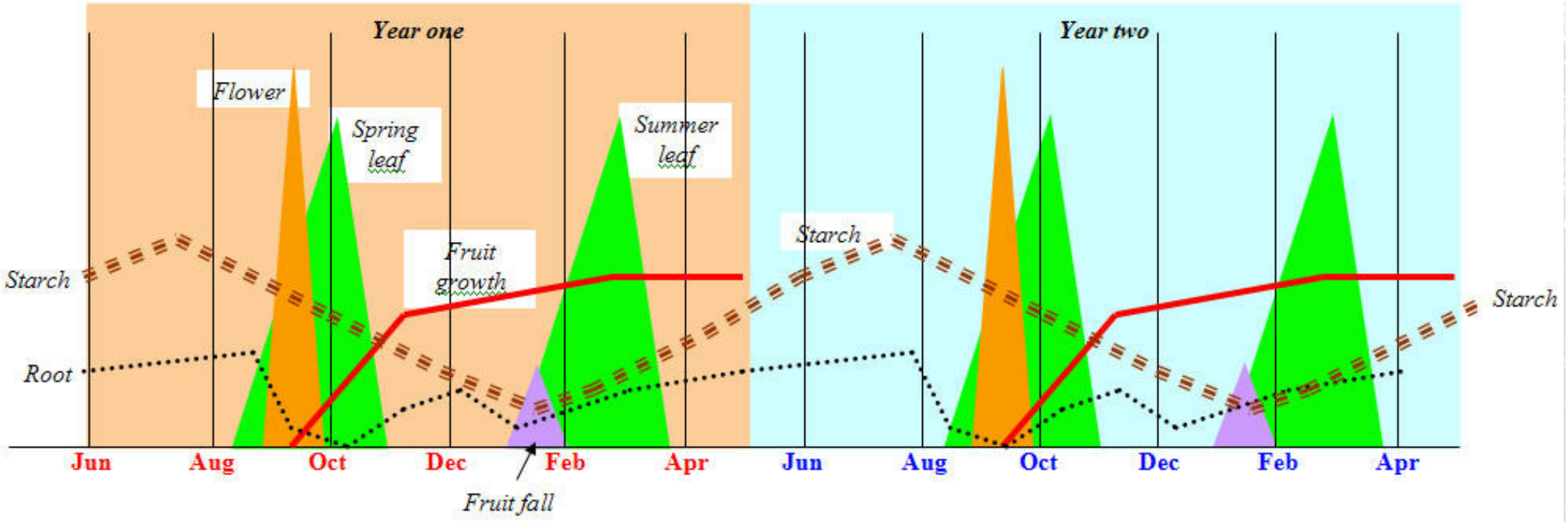
Two year growth cycle and starch levels for cold climate (New Zealand), "on" year followed by "off" year



Two year growth cycle and starch levels for warm climate (Mareeba)



Achieving The Right Balance

- Correct timing will help you achieve the optimum balance between:-
  - leaf growth – fruiting - root growth
- This balance will achieve:-
  - good fruit set, but also . . .
  - adequate leaf canopy ("***the factory***") and root growth ("***raw materials supply route***") to feed the fruit and set the tree up for the next year

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The Concept Of The “Sink”

- When part of the plant (e.g. fruit) is actively growing it acts as a “sink” for resources such as sugars, water, minerals, chemicals . . .
- Whilst this part of the tree is the primary “sink” it takes priority over other parts of the tree in attracting these resources

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Some Management Practices

Where Correct Timing In Relation To The Growth Cycle Is Critical . . .

- Water
- Phosphorous acid
- Calcium
- Sunny®
- Cincturing

- Nitrogen
- Minimal nitrogen (NZ?)
- Boron

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Case Studies

- Timing of phosphorous acid
- Timing of calcium fertiliser
- Timing of SUNNY®

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CORRECT TIMING OF PHOSPHOROUS ACID APPLICATION

- Refer to the growth cycle and look for when the roots are the primary “sink”
- Roots are a strong “sink” when there is little leaf, flowering or fruit development taking place
- Generally two opportunities per year, one is better than the other
- Other points to consider:
  - Potential phytotoxicity of phosphorous acid to feeder roots
  - MRLs in fruit

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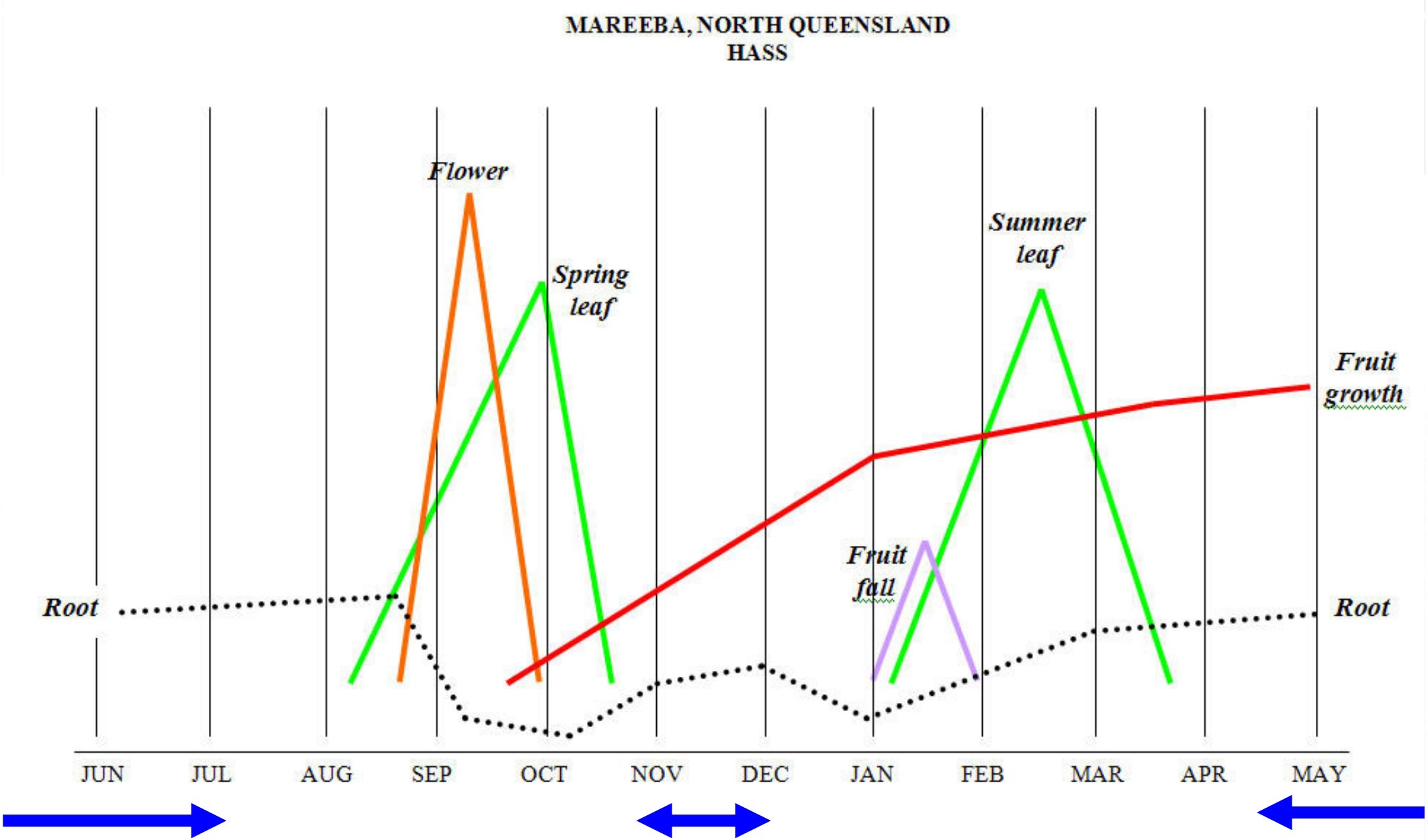

Critical application times for phosphorous acid for *Phytophthora* root rot control

Calcium Fertiliser Application For Optimising Fruit Content

- Refer to the growth cycle and look for when the fruit is the primary “sink”
- Calcium is taken up via the water stream and distributed in the plant wherever water goes
- Fruit have stomata for about the first 6-8 weeks of their development, then they close up permanently forming the lenticels
- Whilst the stomata in the fruit are still open water moves through the fruit depositing calcium there – this is therefore the most critical time for accumulating calcium in fruit

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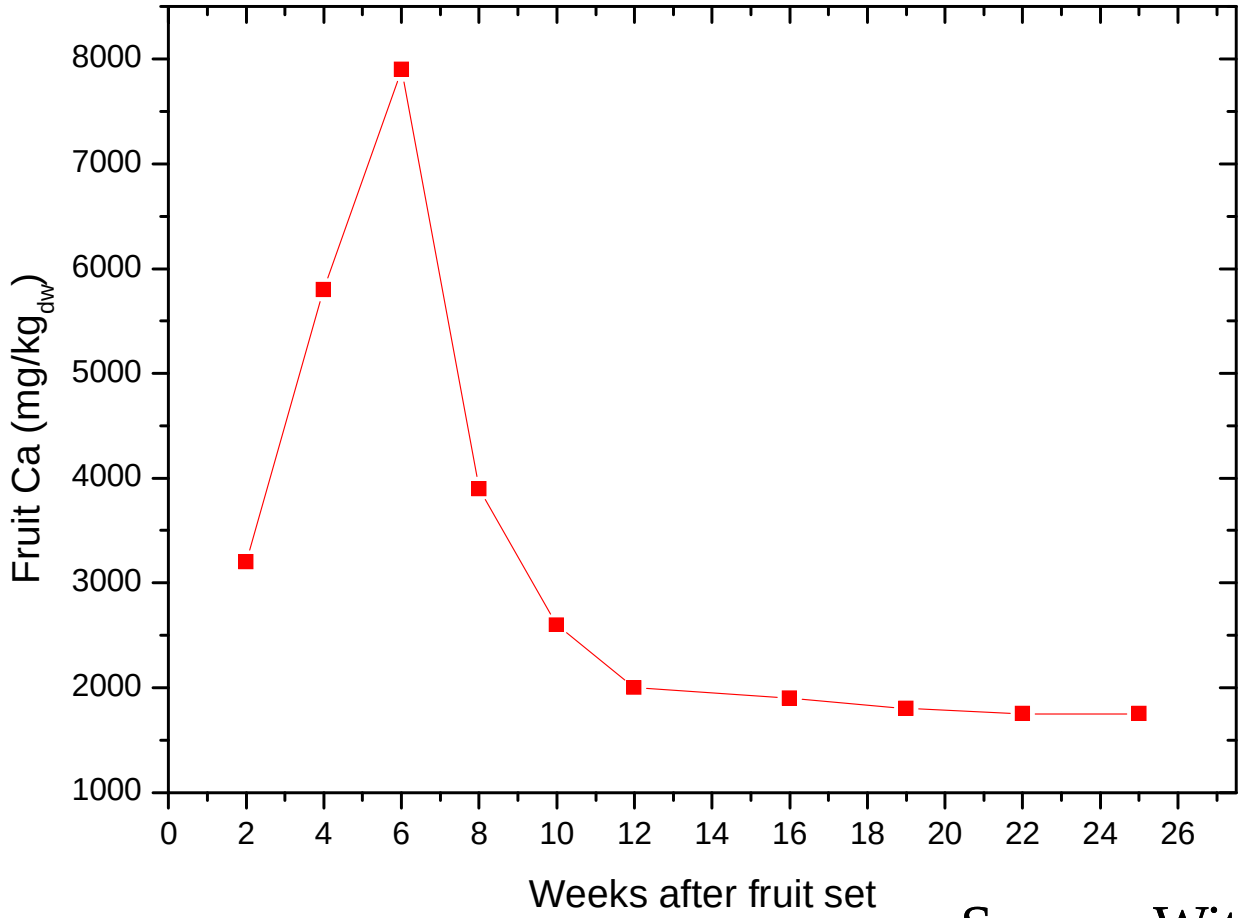
Uptake Of Calcium Into Fruit



Source: Witney et al. (1990)

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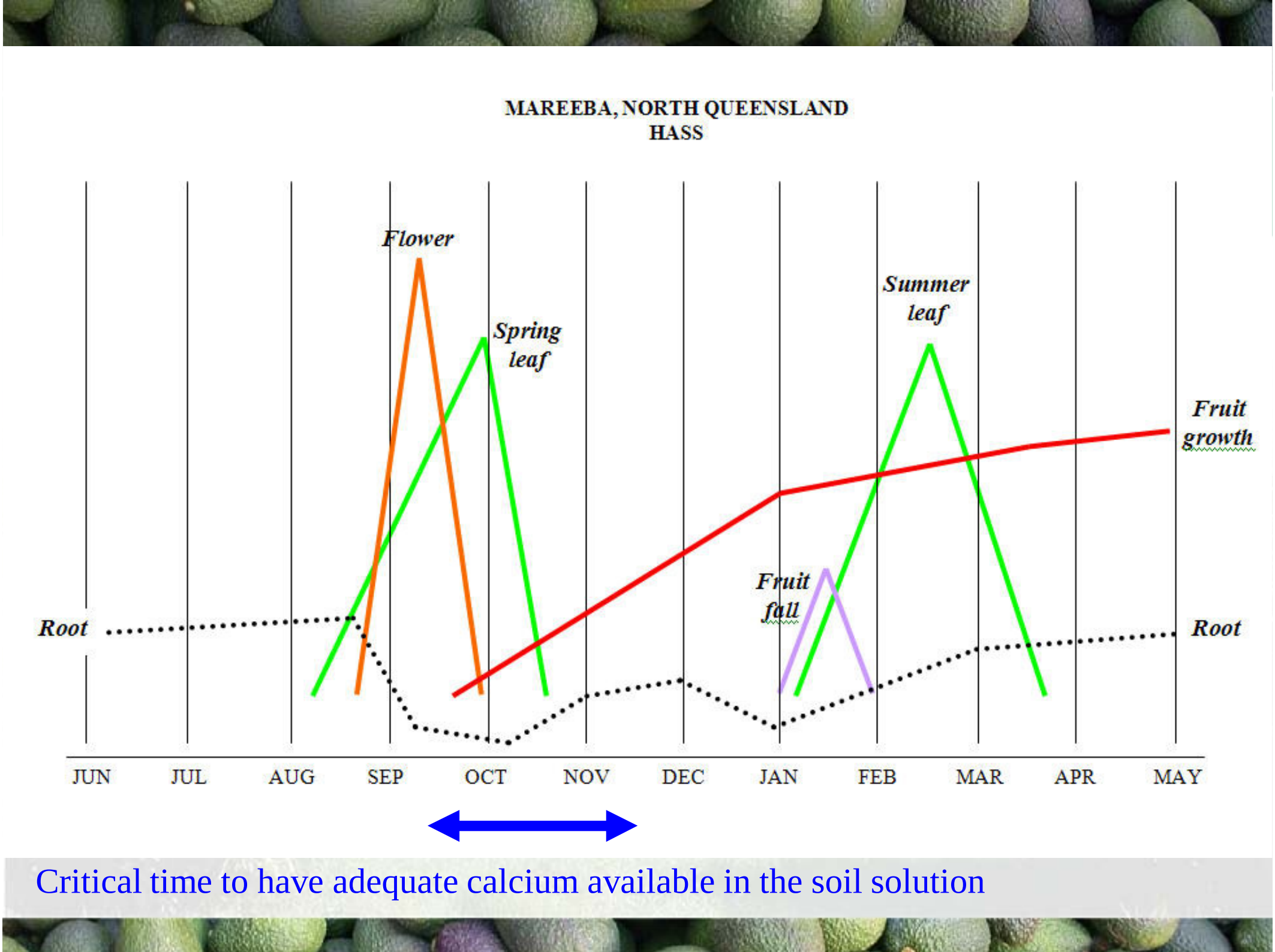

Critical time to have adequate calcium available in the soil solution

Correct Timing Of Sunny® For Improving Fruit Set And Size

- There is a fine balance at flowering time between resources being directed towards fruit set or leaf growth
- Excessive nitrogen in the plant at this time can swing the balance in favour of vegetative growth at the expense of fruit set
- Sunny® is a plant growth substance that suppresses shoot growth and swings the balance towards fruit set
- Refer to the growth cycle and consider the turning point for this resource allocation

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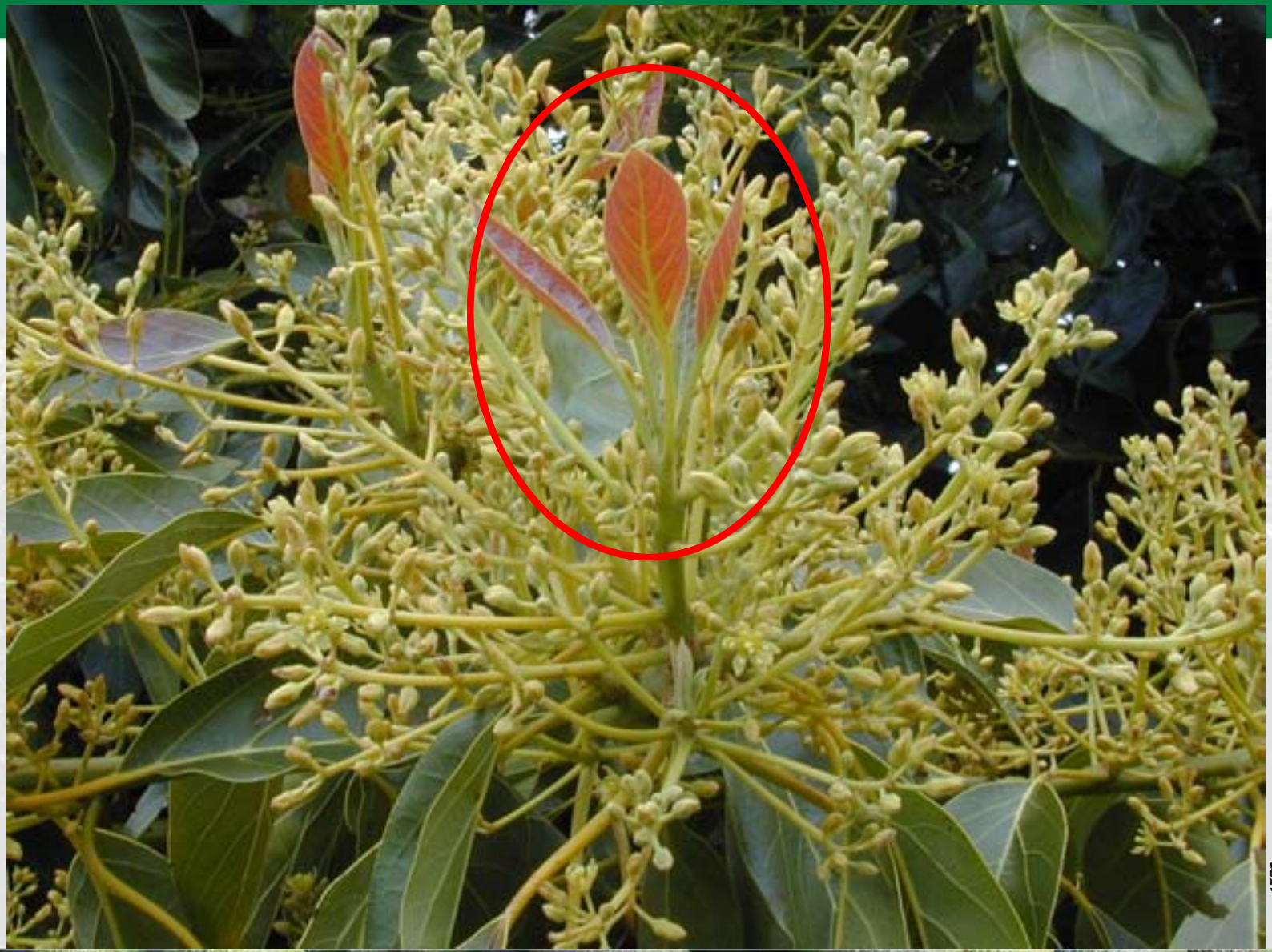
FRUIT vs. SHOOT competition



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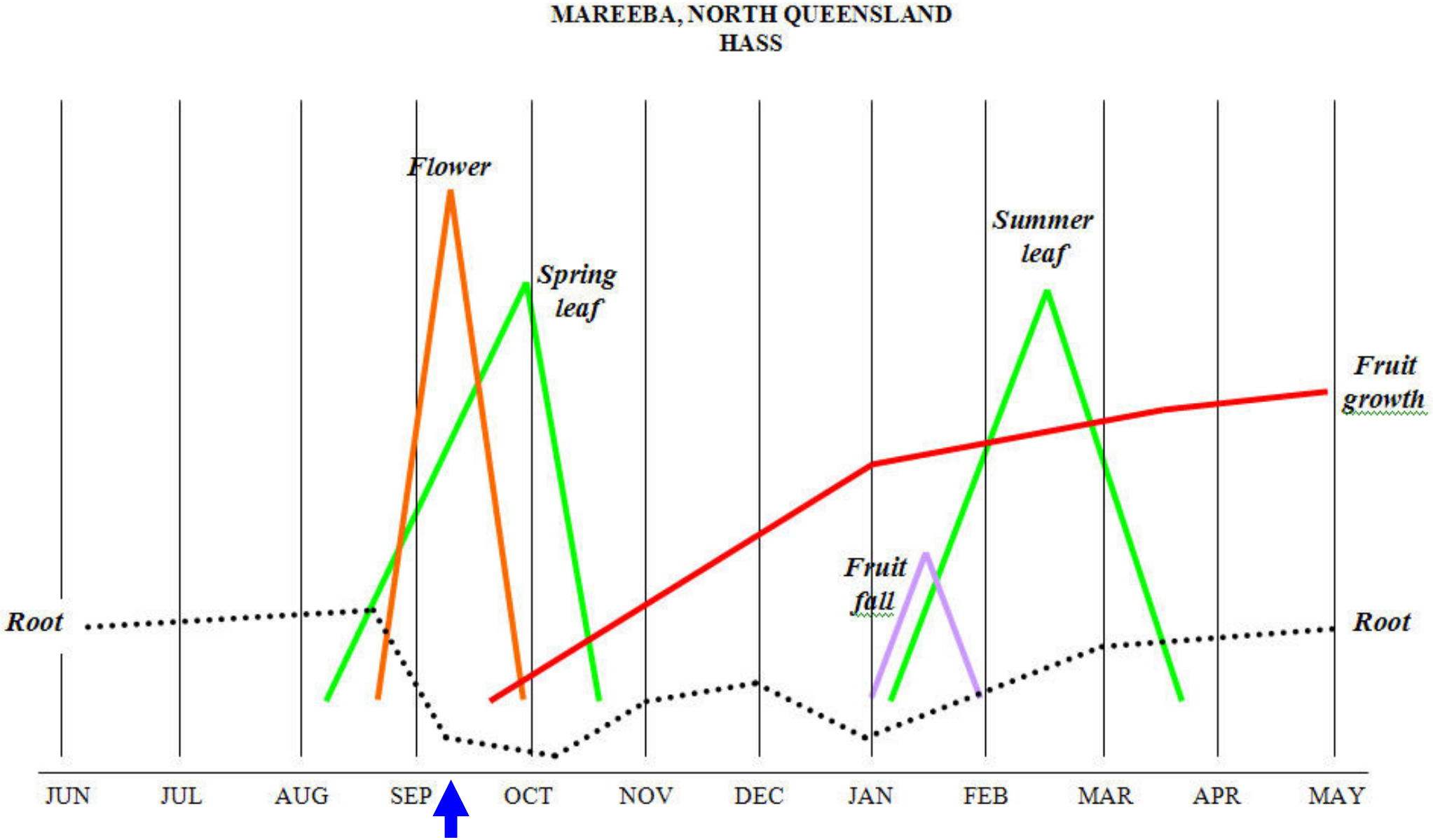
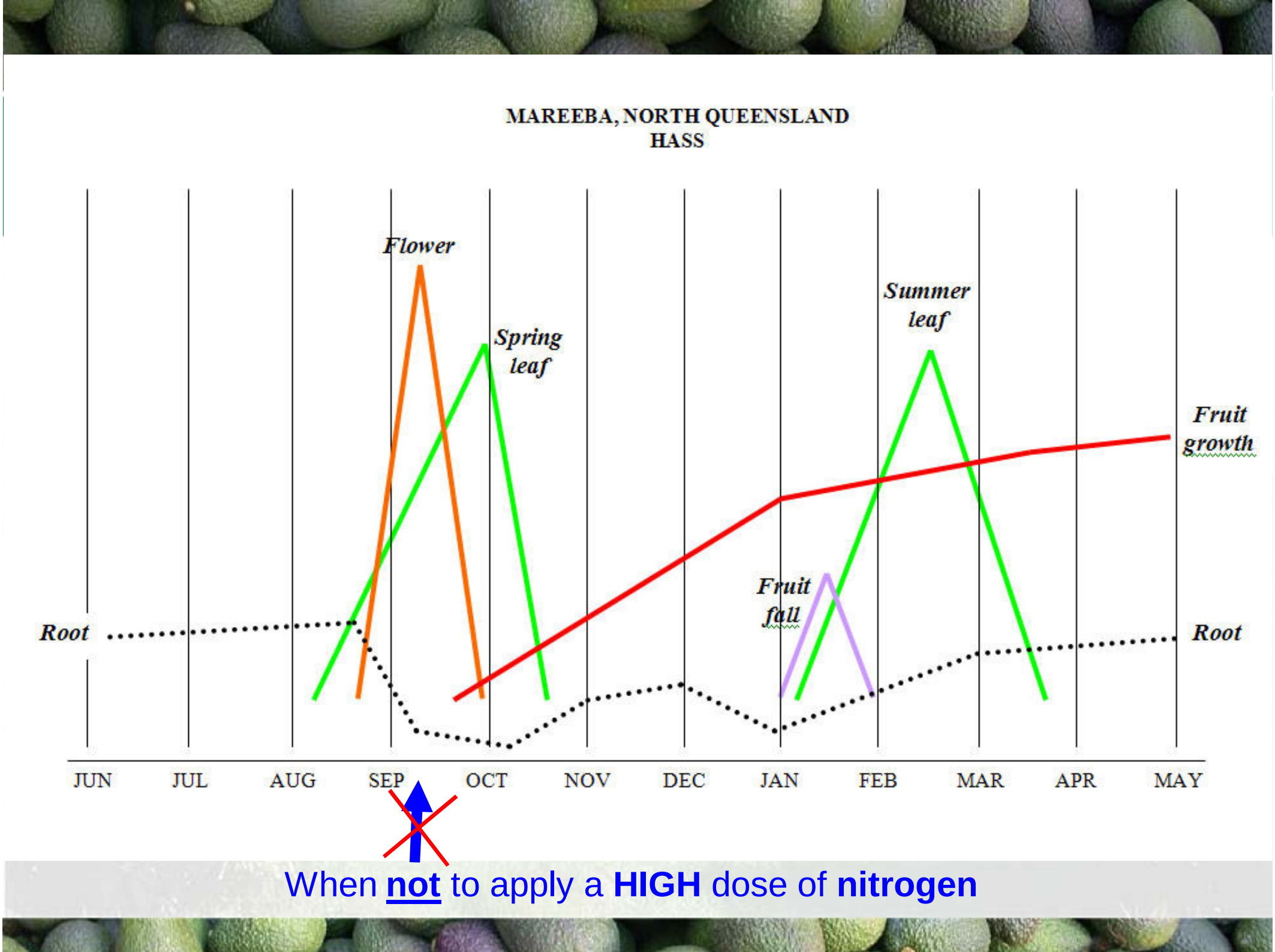
FRUIT vs. SHOOT competition

Sunny®

Dr. A. W. Whiley



Critical time to apply Sunny® (when 50% of the flowers on the tree have opened and before more than 10% of the spring shoots have begun to grow)



When **not** to apply a **HIGH** dose of **nitrogen**

Grower Exercises 1

Where on the growth cycle would you pick as the most appropriate time(s) to apply the following:-

- Water
- Phosphorous acid
- Calcium
- Sunny®
- Cincturing
- Nitrogen
- Minimal nitrogen (NZ?)
- Boron

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Grower Exercises 2

Based on your knowledge of the growth cycle what does it mean for the tree when:-

- There is a frost – winter, over flowering?
- The fruit is hung late before harvest?
- There are changes in the timing of phenological events?

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Acknowledgements

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HAL
Know-how for Horticulture™

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KEY
BUD BREAK
FLOWER
LEAF
FRUIT THINNING
FRUIT
ROOT
JUN
JUL
AUG
SEP
OCT
NOV
DEC
JAN
FEB
MAR
APR
MAY