(8) Nutrient rates & timing

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NSW DEPARTMENT OF PRIMARY INDUSTRIES

Section 8

- Nutrient accumulation rates
- Nutrient timing

Nutrient Accumulation Rates

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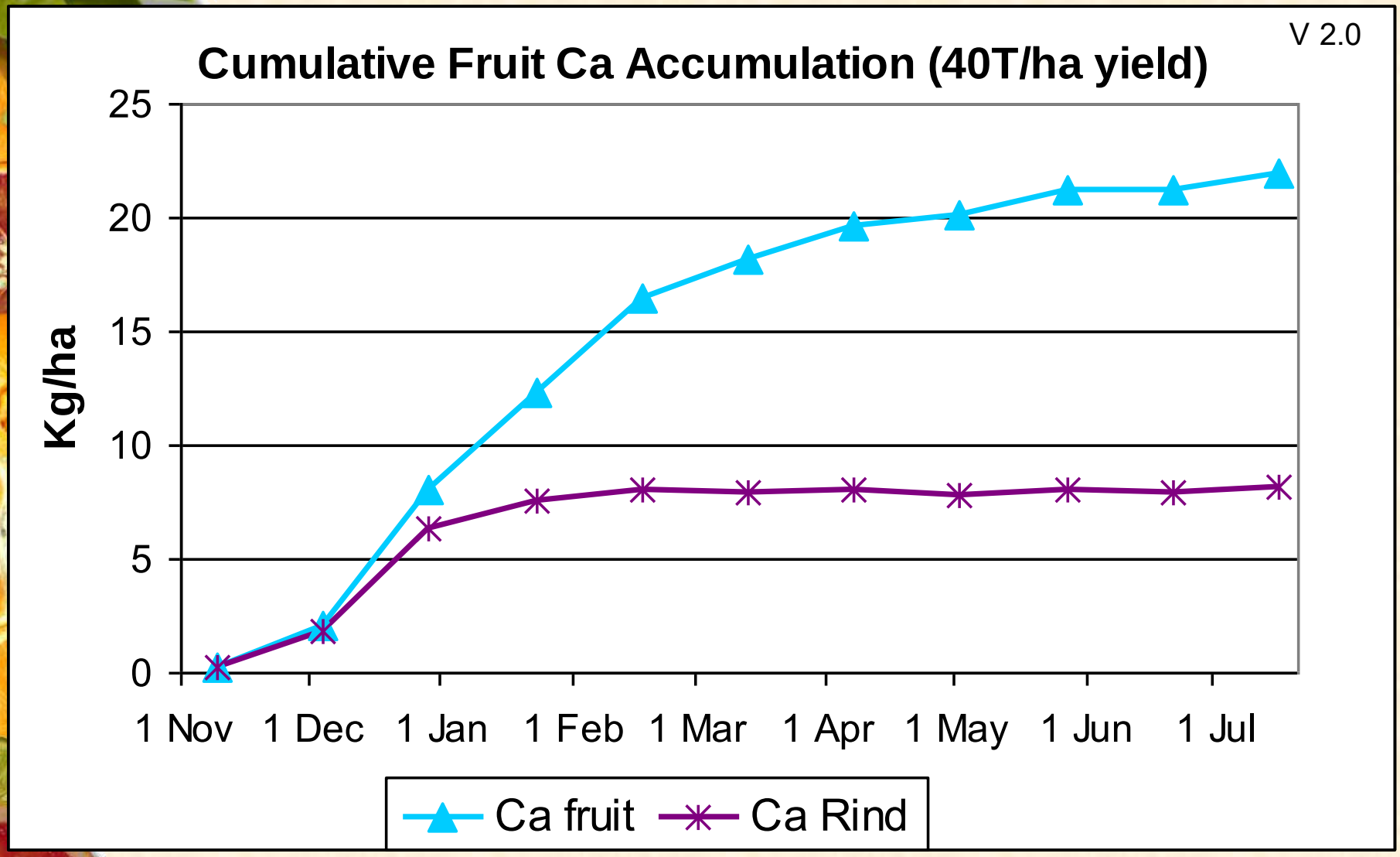
Nutrient Accumulation Charts

- Data sourced from local and overseas research
  - Needs more data to understand variation in Australian conditions
- **Guide only**
  - Estimates are made on leaf drop/leaf flush
  - Data is variable, “rubbery”. An average was taken from a number of sources and one can easily expect a 10% variation
    - i.e. some data show K accumulation slightly higher than N
    - Orchard using high fertiliser rates will have more nutrients in fruit
  - Does not account for field application nutrient leaching losses & recycling
    - N – 15%-50% leaching losses
    - Nutrient recycling depend where leaves fall and time to decay

Fruit & Leaf Nutrient Accumulation kg/ha

Yield T/ ha	20	30	40	50	60	70
N	59	75	90	106	122	133
P	7	9	10	12	13	15
K	45	61	78	94	111	127
Ca	71	77	82	88	93	99
Mg	10	11	12	14	15	17

(Falivene, 2006)

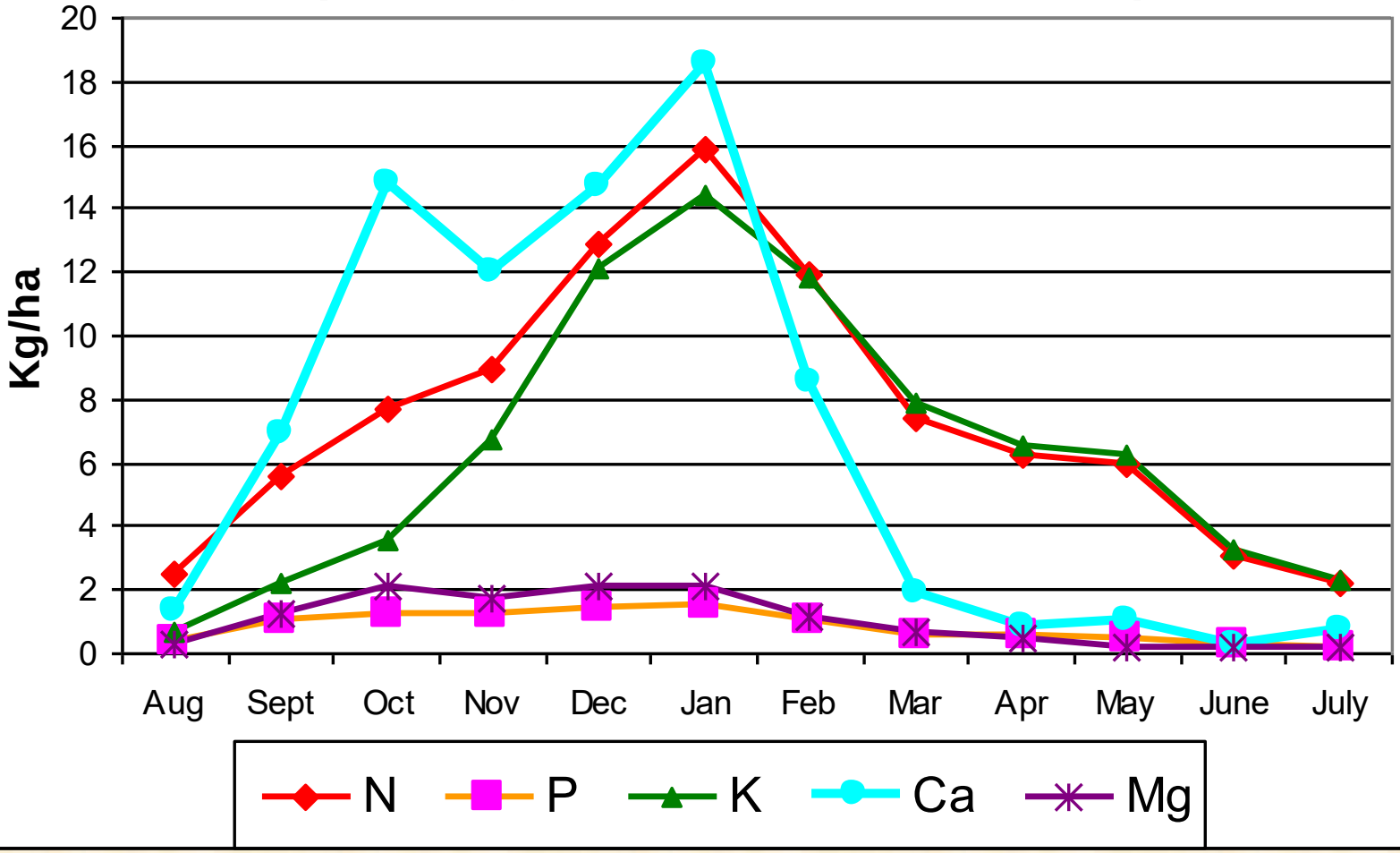

V 2.0
Cumulative Fruit Ca Accumulation (40T/ha yield)
Kg/ha
25
20
15
10
5
0
1 Nov
1 Dec
1 Jan
1 Feb
1 Mar
1 Apr
1 May
1 Jun
1 Jul
Ca fruit
Ca Rind

Ca in into fruit chart comments

- The accumulation of calcium into the rind ceases at the end of cell division (end of Dec)
- Calcium continues to accumulate in the pulp as the fruit expands

Monthly Nutrient Accumulation (leaf & fruit)
(40T/ha yield, mature navel orchard)

V 2.0



Nutrient timing & rates theories and options

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Citrus Phenological Cycle

Growth Flush

Spring | Summer | Autumn

Root Growth

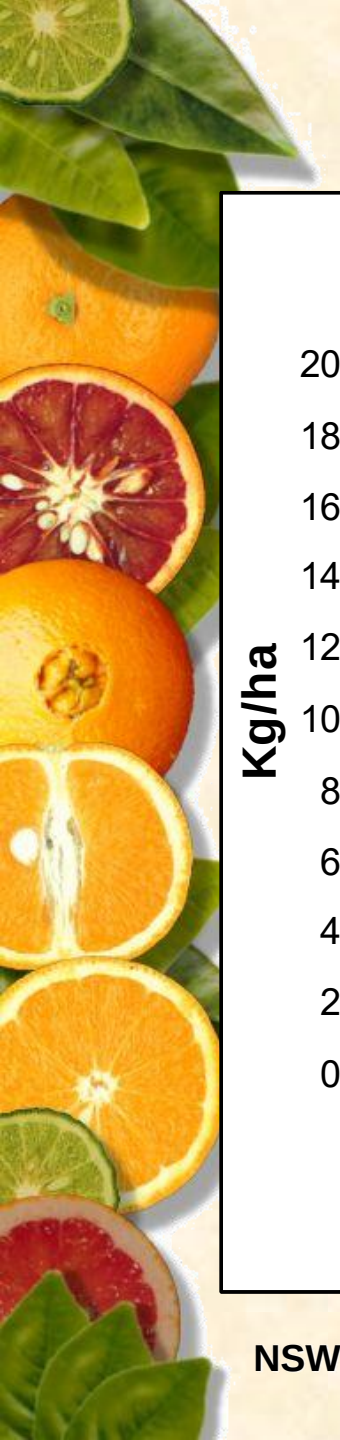
Root flush | Root flush

Fruit Growth

Cell Division | Cell Expansion | Matur-ation

Floral initiation | Bud Burst | Flower & set

Jun July Aug Sept Oct Nov Dec Jan Feb Mar Apr May



Monthly Nutrient Accumulation (leaf & fruit)
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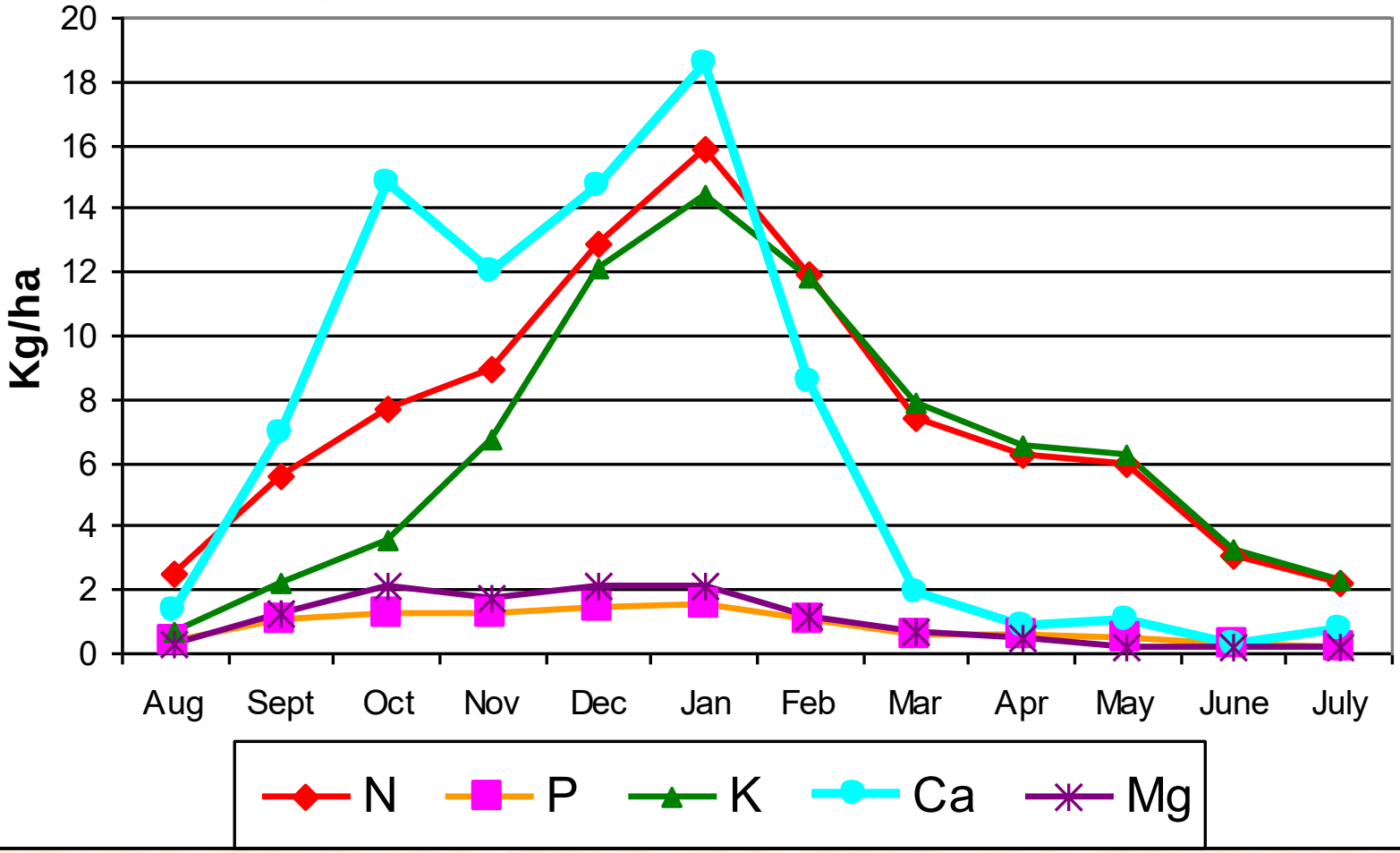

Nitrogen

- Generally applied Aug to February
- Common rates vary : 120-160kg/ha mature orange trees
- Although accumulated till harvest, should not apply after February as it may interfere with fruit colouring
  - Clay soils may need to stop N application earlier whilst sandy soils may need to continue a little longer
  - Soil solution is a good guide to residual soil N levels
- Young trees require a higher ratio of N to K & P
  - General recommendation is 50g of N per tree per year of age
  - Good results of proportional fertigation with high rates (i.e. 120kg/ha or 50 - 75g N per tree per year of age), but must be careful not to burn roots with excessive rates
    - High EC and excessive N seen in soil solution analysis from poor N management of high rates (EC 5ds/m & NO3 1200ppm)

Nitrogen

- Can disappear in soil quickly in certain situations and trees are starved
  - Leaching can wash away 70% of N
  - Optimum soil solution levels are 20-80ppm Nitrate-N
- Soil solution analysis best guide to N needs

Potassium

- Most loams reported to have good levels ???
  - Soil solution analysis & soil tests ???
  - Not sure if soil can supply peak demand (fruit fill) or can the tree uptake fast enough?
  - Fertigation targeted application during main fruit fill (Dec-Feb) may provide fruit size benefit
- KNO3 sprays Oct-Dec help boost K
  - Foliar more responsive than soil applied in some situations – (soil Ca antagonism ?)
  - Option 5% early Dec & 3% in Jan
- Local application rates 0-200kg/ha/yr (soil + foliar)
  - Need to conduct local trials : soil 50-400kg/ha
- Overseas data suggest leaf K levels at least ~1.2%

Phosphorus

- Required in very low levels
- Soil can fix P quickly if spread over broad area
- Banding of super is best, but take time to penetrate and most will be fixed
  - Apply 5 years of needs in one application (i.e. 700kg/ha single super)
- Moderate rates 20-40kg/ha/annum
- Antagonism Zn !

Calcium

- Most loam/clay soils have good levels
  - Leached sandy soils may be deficient
  - Soil solution analysis, leaf tests & soil tests will provide a better indication
- Calcium is related to albedo breakdown, but trials to-date show no cures by simply applying more calcium

Magnesium

- Rarely applied as a soil fertiliser
  - deficiencies are not common
  - Most deficiencies are controlled with foliar sprays
- Some advanced proportional fertigation programs apply a some Mg (i.e. 10-20kg/ha)
  - However highly dependant on soil
    - i.e. grower with high soil Mg levels applies no Mg

Micronutrients

- Most micro nutrients are needed during leaf flush
  - Best applied via foliar sprays (see foliar spray section)
  - Chelated forms have best chance if soil application to alkaline soils (i.e. Fe)

Combined program

- Observations of drip irrigated properties that annually apply a combination of nutrients (NPK) have healthier trees
  - Smaller soil volume more responsive to applied fertiliser
    - May partially overcome some soil fixation issues with P & K
- Some sprinkler growers have also benefited
  - Sandy soils may respond to fertigation P & K however clay soils may have too much of a buffering or fixing effect may need different strategies (i.e. banding)
- Different situations (soil types: soil test, leaf test, clay vs sand etc) require differing amounts/ratios (no recipe !!!!) – customised common sense program!

Frequency of application

- More frequent applications have less impact on inducing temporary imbalances
  - Sprinkler : soil is able to buffer infrequent high dose fertiliser application rates to an extent (i.e. 3 x year)
  - Drip : reduced soil volume of drip is more susceptible to imbalances and EC “slugs” from high dose single applications and leaching – split application best
    - Soil solution analysis provide a good indication
  - If leaching occurs (rainfall), do not washout a major proportion of mobile nutrients in soil (i.e. N)
  - Can adjust to suit crop stages and provide options for changes during the season

Application timing

- Monthly nutrient removal rates is a guide but do not follow exactly – other factors
- Example only
  - Need to make for your situation

	N	P	K
Pre flower	35%	10%	10%
Cell Division	25%	45%	20%
Cell Expansion	35%	25%	60%
Maturation	5%	10%	10%

Application method & fertiliser type

- Include foliar sprays in total program
  - Foliar quick response and avoid some root nutrient uptake antagonism issues
  - Effectiveness - assess amount of foliar hitting target (leaves) and falling onto soil profile
- Be aware of acidic effect of some fertilisers
- Write it down in a plan & check progress regularly.

References

- Falivene S. 2006. Citrus crop nutrient accumulation rates. NSW DPI fact sheet