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PRACTICAL NUTRITION MANAGEMENT FOR GRAPEVINES

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GRAPEVINE NUTRITION – SOME IMPORTANT DRIVERS

- Vine establishment
- Early production
- Yield
- Grape quality and wine style
- Economics
- Sustainability

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SOME BASIC PRINCIPLES

- **Macronutrients and micronutrients**
- **How do plants take up nutrients?**
  - Active roots. Roots need water and air to function.
  - Water is needed for nutrient uptake from soil
  - Nutrient mobility in soil
  - Foliar nutrient sprays
- **Nutrient mobility in plants**
  - Nutrient storage
  - Deficiency symptoms
  - Application method
- **Potential yield determines fertiliser inputs**

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NUTRITION MANAGEMENT

- **The 4 R's of nutrition management**
  - Applying the **R**ight rate of the **R**ight product at the **R**ight time in the **R**ight place.
- **Determining which nutrients you need to apply**
  - Decision making tools
  - Potential yield determines fertiliser inputs
- **Choosing a fertiliser**
- **Determining when to apply the fertiliser - timing**
- **Deciding on how you wish to apply the fertiliser**

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DECISION MAKING TOOLS

- **Visual assessment**
  - Vigour and leaf colour
  - Deficiency or toxicity symptoms
- **Soil analysis**
  - Indicates the amount of nutrient available to a plant in the soil
- **Plant analysis**
  - Measures the actual nutrient status of a plant at a particular point in time
- **Nutrient budgets**
  - Predicting nutrient requirements based on crop estimates
  - Can be less useful as often not targeting maximum yield

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VIGOUR & LEAF COLOUR

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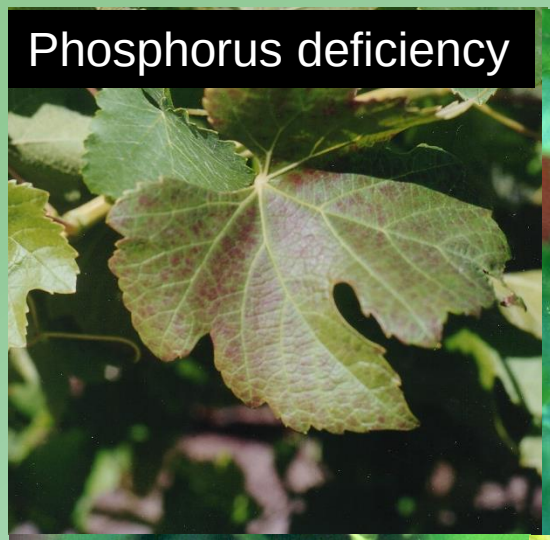
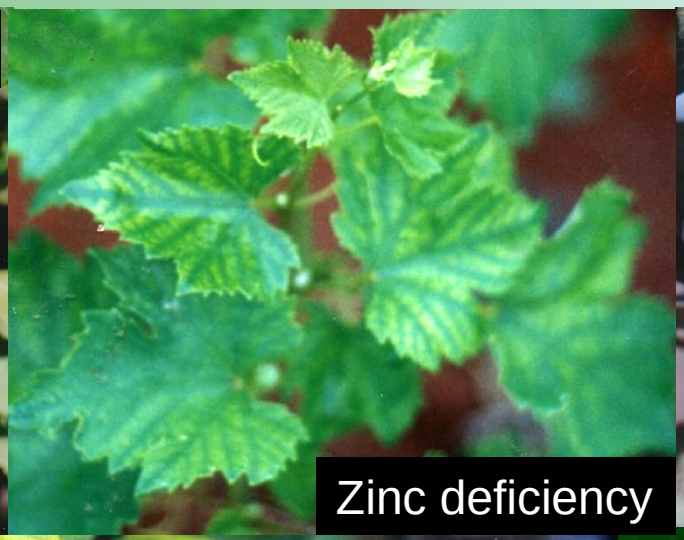
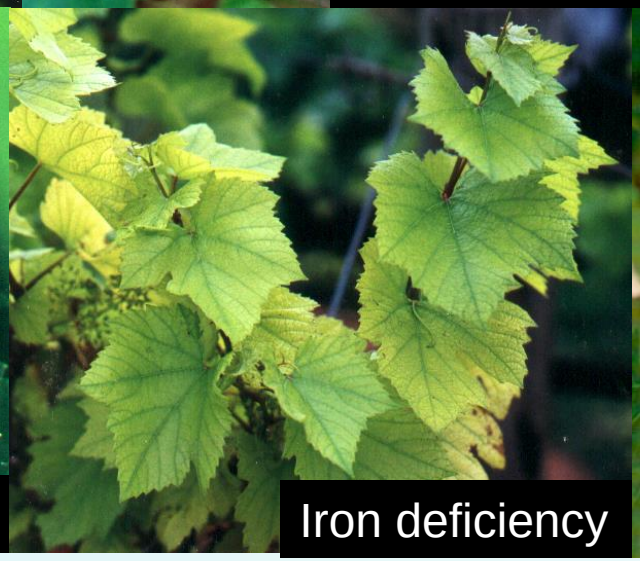
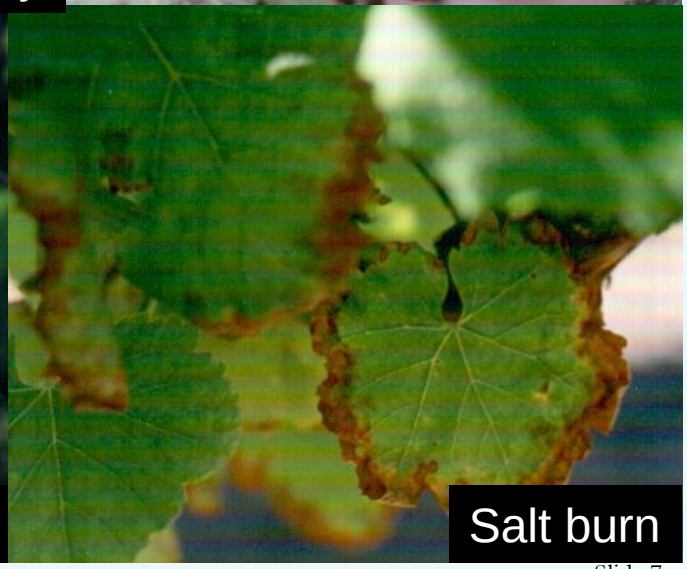
DEFICIENCY & TOXICITY SYMPTOMS









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SOIL ANALYSIS

- **Soil analyses provide a measure of the amount of nutrient available to a plant in the soil**
- **Each nutrient is present in the soil in various forms**
  - Soluble (in the soil solution)
  - Loosely held (exchangeable or slowly dissolving)
  - Tightly held (slowly exchangeable or very slowly dissolving)
  - Insoluble (component of soil minerals)
- **Due to variation in the soil, you can not take a soil sample from just anywhere in the orchard**
  - Adjust sampling to suit the question being asked

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SOIL ANALYSIS

- **Nutrient concentrations**
  - Know your analysis method
- **Soil pH**
  - Influences the form and availability of nutrient in soil (e.g. aluminium in acidic soils)
  - Nitrogen fertiliser use and acidification
  - Lime requirements
- **Sodicity and soil structural problems**
  - Gypsum requirements
- **Salinity**
  - Leaching irrigations, irrigation management

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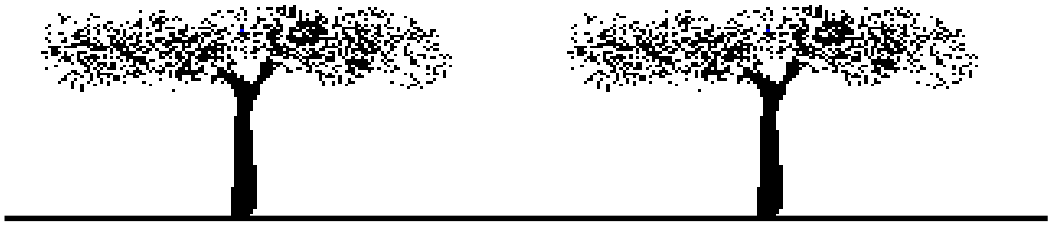
PHOSPHORUS DISTRIBUTION



	15	25	15
Phosphorus fertiliser ripped in at planting	100	4	100
	4	4	4

Remaining root zone at native phosphorus levels

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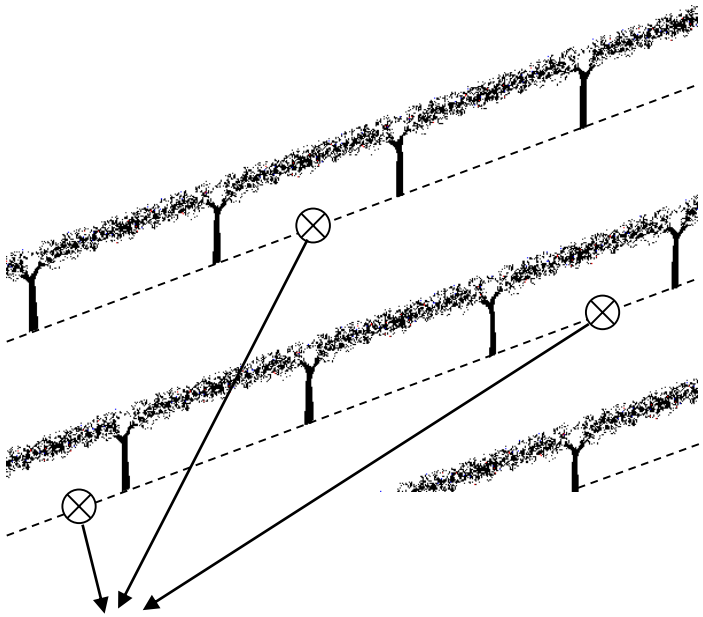
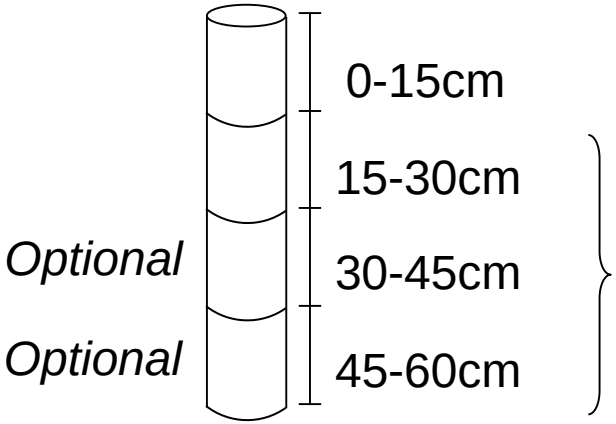
DO I NEED FERTILISER FOR THE VINES?



Sample from undervine bank. Not directly under drippers.



Topsoil - composite of 20-30 cores.

Each other depth interval - composite of 6-10 cores.

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EXAMPLE SOIL ANALYSIS DATA

Element or Test	Topsoil	Subsurface
Depth - (cm)	0-15	15-30
$pH_{calcium\ chloride}$	6.2	7.4
Organic carbon - (%)	0.18	0.16
Colwell Phosphorus (P) - (mg/kg)	24	5
Colwell Potassium (K) - (mg/kg)	166	256
Extractable Sulfur (S) - (mg/kg)	21	2
Exchangeable Calcium (Ca) - (meq/100 g)	4.98	6.44
Exchangeable Magnesium (Mg) - (meq/100 g)	1.21	0.94
Exchangeable Potassium (K) - (meq/100g)	0.4	0.28
Exchangeable Sodium (Na) - (meq/100 g)	0.09	0.1
Cation exchange capacity - (meq/100 g)	6.7	7.8
Exchangeable sodium percentage	1	1
DTPA Extractable Copper (Cu) - (mg/kg)	1.3	0.4
DTPA Extractable Zinc (Zn) - (mg/kg)	2.5	1.2
DTPA Extractable Manganese (Mn) - (mg/kg)	9.8	7.2
DTPA Extractable Iron (Fe) - (mg/kg)	8.6	9.5
Extractable Boron (B) - (mg/kg)	0.5	1.5
Extractable Aluminium (Al) - (mg/kg)	< 0.20	< 0.20
EC_e - (dS/m)	2.1	1.6
Chloride - (mg/kg)	10	10
Calcium Carbonate - (%)	<0.3	0.44

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PLANT ANALYSIS

- **Plant analysis provides a snapshot of the nutrient status of a plant at a particular point in time**
- **With regular sampling, plant analysis is an excellent monitoring tool**
- **Correct sampling is critical. Compromises are made when selecting which plant part to sample.**
  - Mobile nutrients would be best assessed in older leaves (e.g. Nitrogen, Phosphorus, Potassium)
  - Immobile nutrients would be best assessed in younger leaves or shoot tips (e.g. Calcium, Zinc, Iron)
  - Nutrients/toxicants that build up in the leaf blades during the life of the leaf would be best assessed in the older leaf blades (e.g. Boron, Chloride)

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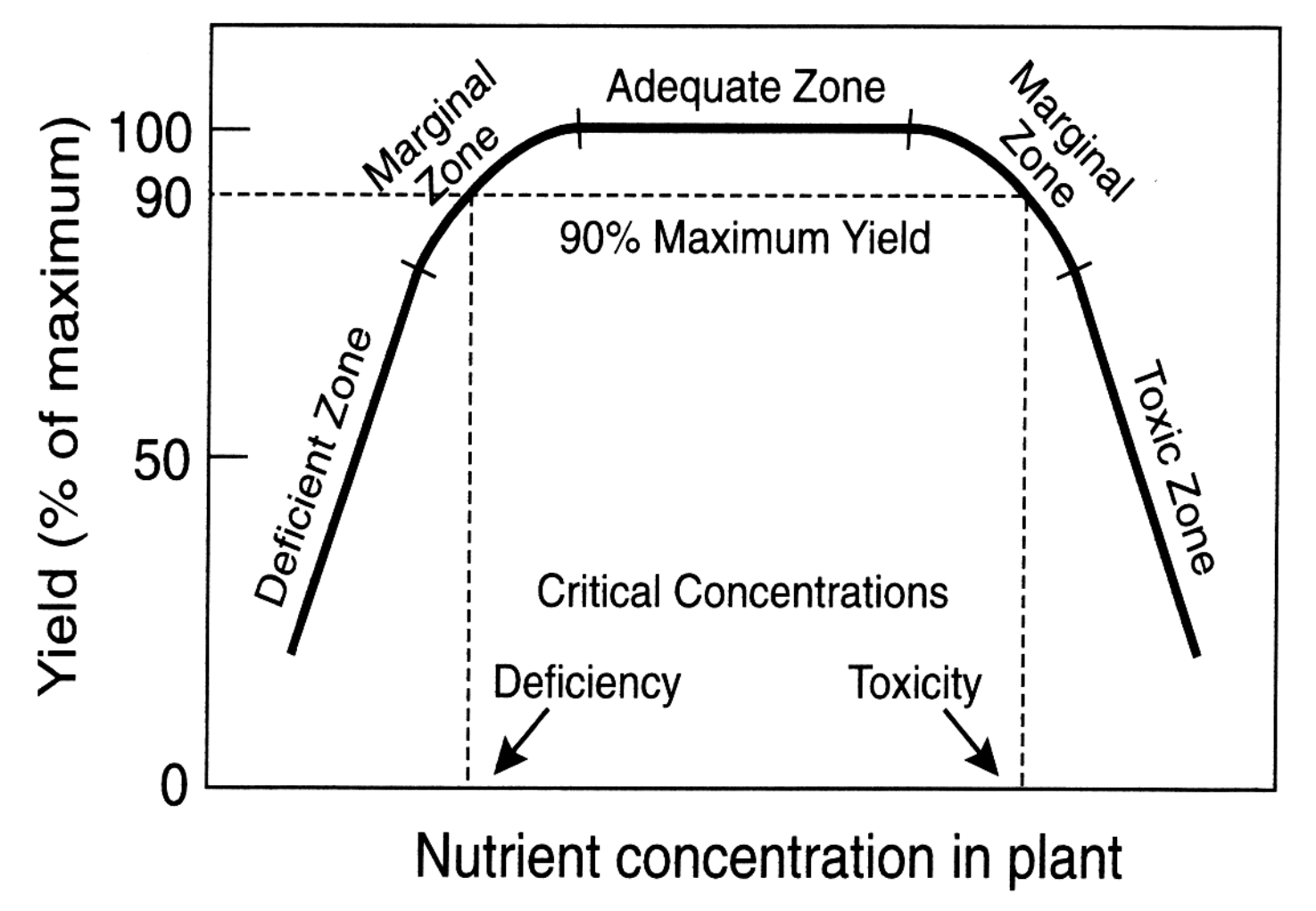
NUTRIENT RESPONSE CURVE



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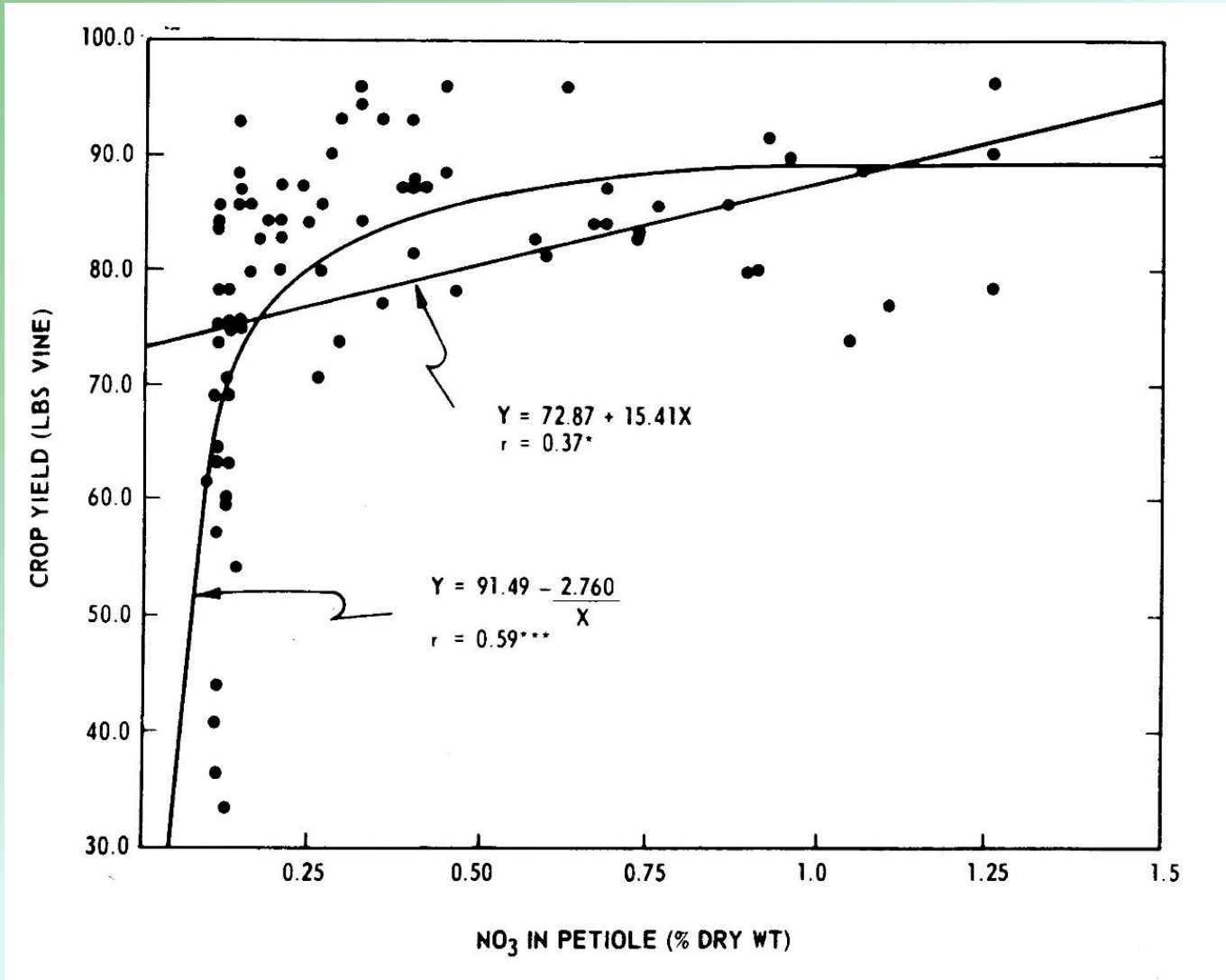
NOT AIMING FOR MAXIMUM YIELD



Kliewer & Cook (1974)

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PLANT ANALYSIS

- **It is important to collect leaf or plant tissue samples of the correct age and type so that the results can be compared to known standards**
- **Research has shown which parts of the vine are the most reliable indicators of nutrient status. The most common samples taken are;**
    - Petioles at flowering
    - Leaf blades at veraison
- **What about sap analysis?**

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EXAMPLE PETIOLE ANALYSIS DATA

	Standards	0.8 - 1.1 %	500 - 1200 mg/kg	0.25 - 0.5 %	1.8 - 3.0 %	1.2 - 2.5 %	> 0.4 %	No standards	< 0.5 %	< 1.0 - 1.5 %	> 26 mg/kg	30 - 60 mg/kg	6 - 11 mg/kg	> 30 mg/kg	35 - 70 mg/kg
Variety	**Test Variation**	**N** (%)	**NO_3-N** (mg/kg)	**P** (%)	**K** (%)	**Ca** (%)	**Mg** (%)	**S** (%)	**Na** (%)	**Cl** (%)	**Zn** (mg/kg)	**Mn** (mg/kg)	**Cu** (mg/kg)	**Fe** (mg/kg)	**B** (mg/kg)
Chardonnay	Grapes-petiole	0.92	660	**0.14**	2.12	1.46	0.38	0.07	0.03	0.21	52	***164***	6	**30**	32
Shiraz	Grapes-petiole	0.71	**157**	**0.19**	*3.4*	1.59	0.41	0.1	0.08	0.83	42	*68*	9	**24**	33
Semillon	Grapes-petiole	0.83	850	**0.16**	*3.42*	1.45	0.41	0.09	0.06	0.61	36	*83*	8	**25**	32
Merlot	Grapes-petiole	*1.42*	***2481***	0.23	2.49	1.84	0.64	0.12	0.02	0.15	59	***149***	7	**27**	31

Values high *Values marginally high* Values adequate Values marginally low **Values low**

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PLANT ANALYSIS – SUMMARY

- **Not perfect for nitrogen**
- **When spray contamination is present, it is not possible to say that a nutrient is *not* needed.**
- **Plant tissue analysis of some kind will continue to be an important tool to assist growers to make better fertiliser decisions**
- **When a particular sampling method and standards are chosen, it is worth understanding their particular strengths and weaknesses**
- **Plant analysis should be used as one tool amongst many**

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NUTRIENT BUDGETS

- **Predicting fertiliser requirements based on target yields, nutrient content of grapes and nutrient recovery**
- **Requires nutrient content of harvested product (grapes, leaves etc.)**
- **Need to allow for vegetative growth and efficiency of uptake**
- **Retrospective nutrient budgets – an excellent review tool**

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NUTRIENT REMOVAL - GRAPES

NUTRIENT	Quantity removed per tonne of grapes
Nitrogen	1.2 to 2.4kg
Phosphorus	~ 0.6kg
Potassium	1.6 to 5kg

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BREAK TIME!

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CHOOSING A FERTILISER - SOME CONSIDERATIONS

- **Price - Calculate the cost of actual nutrient in a fertiliser**
- **Single element vs. multi-element fertilisers**
- **Liquid, soluble solid, solid fertilisers**
- **Risk of leaching or loss to atmosphere**
- **Soil acidification**
- **In some circumstances, a more expensive form of fertiliser should be used**
  - EDDHA-chelated iron in calcareous soils

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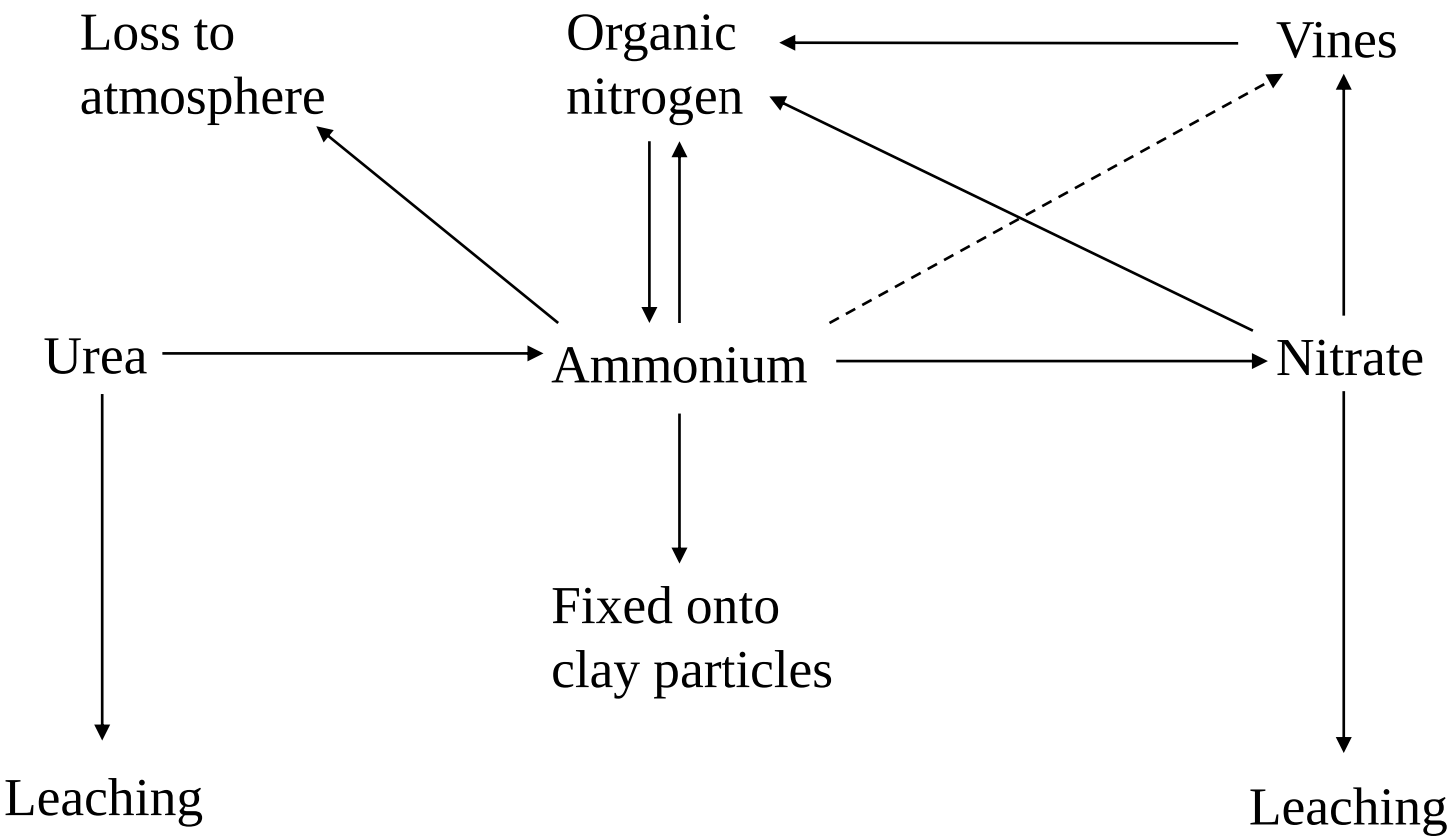
SIMPLIFIED NITROGEN CYCLE



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SOIL pH CHANGES – DRIP IRRIGATED VINEYARDS

Site	Sample location	Soil pH ($CaCl_2$)
Riverland	Mid row 0-15cm deep	8.0
	Vine row under drippers 0-15 cm deep	6.5
Padthaway	Mid row 0-15cm deep	7.2
	Vine row under drippers 0-15 cm deep	7.6

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TIMING

- **Critical growth stages**
  - Preflowering zinc foliar nutrient sprays
  - Nutrient uptake patterns
- **Soil temperature**
- **Rain events**
- **Fertigation and leaching**

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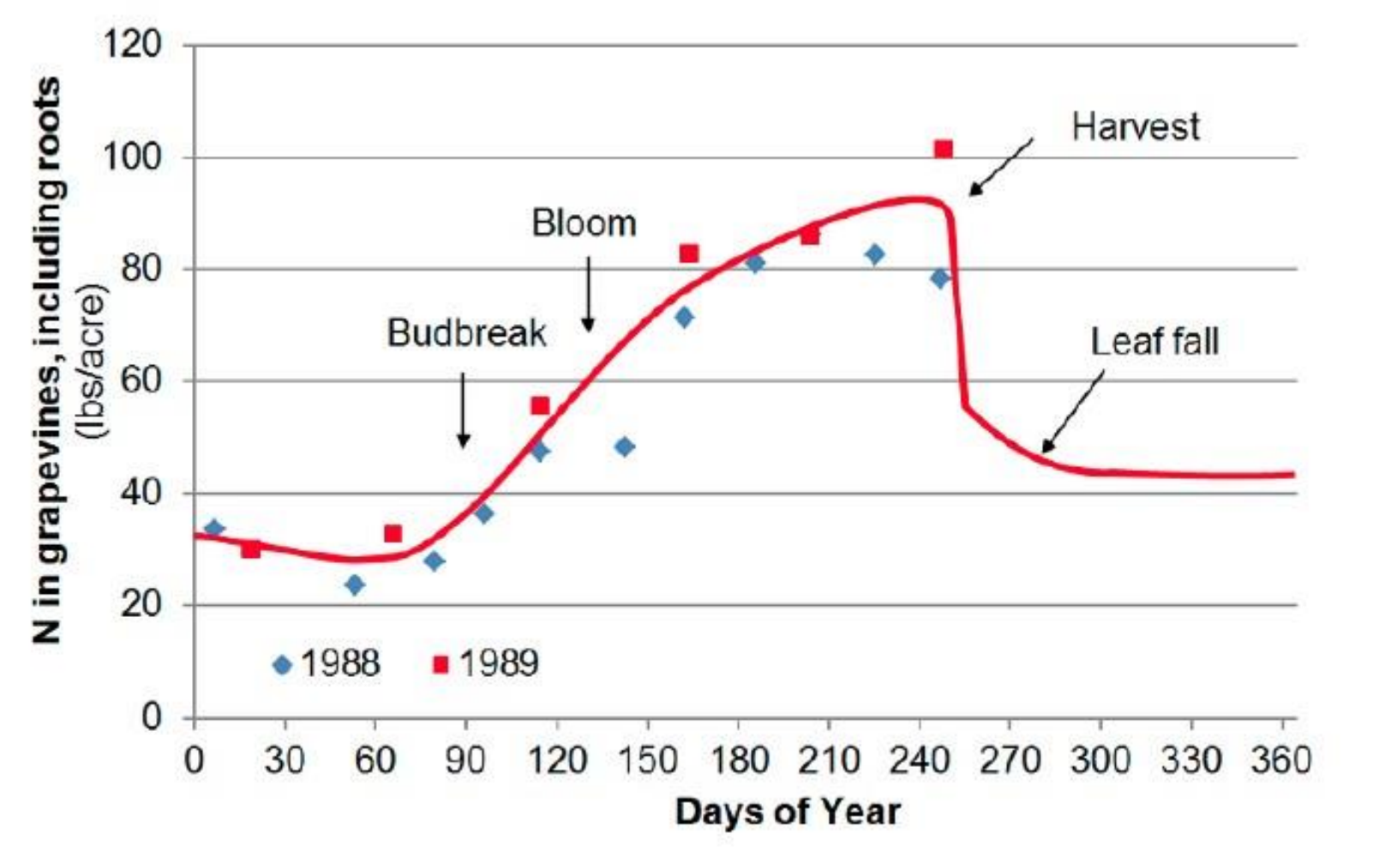
SEASONAL NITROGEN CONTENT
Thompson Seedless in Fresno



Williams 1991

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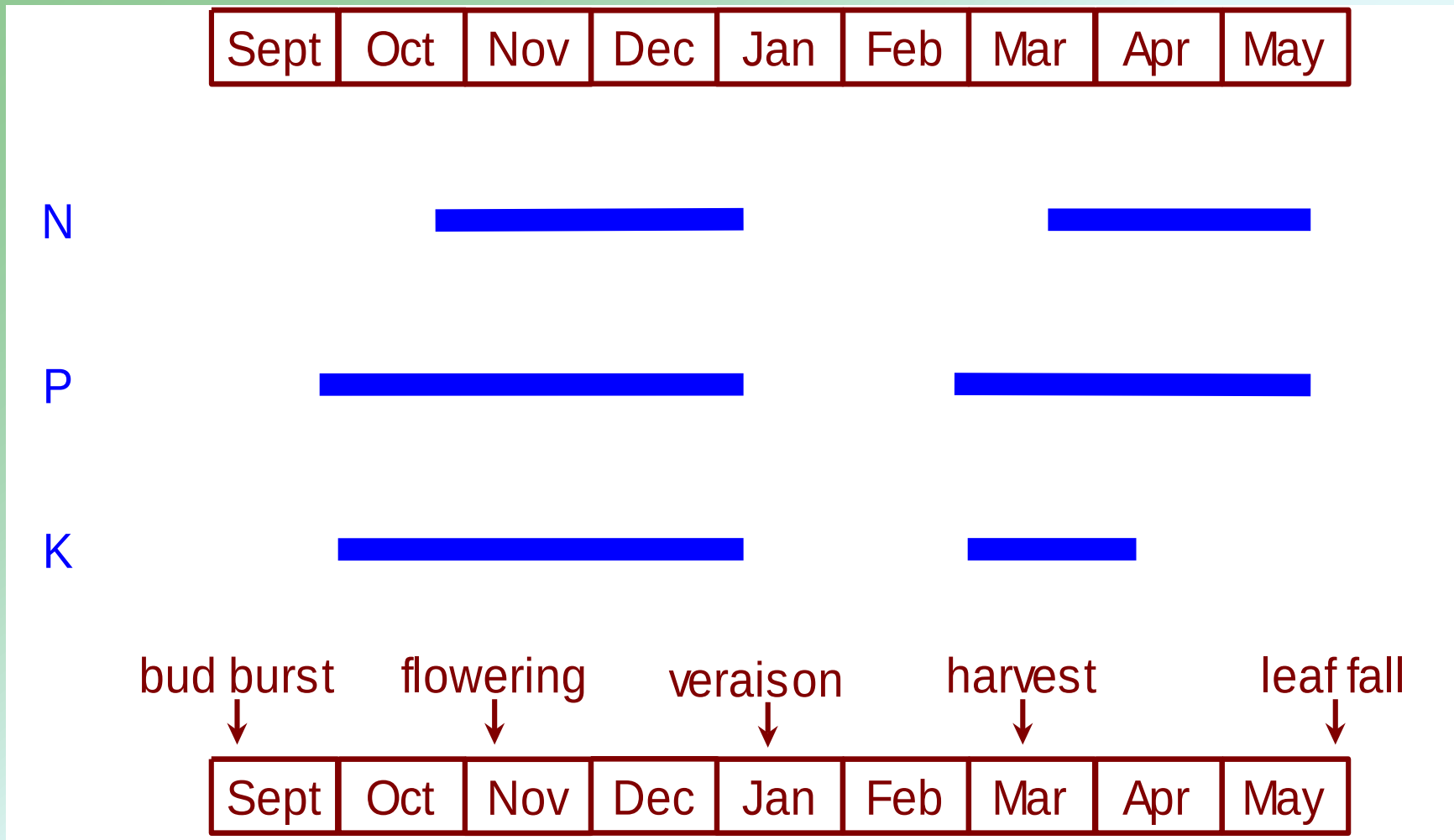
SEASONAL NUTRIENT UPTAKE VIA ROOTS - GRAPES



Adapted from Conradie (1980, 1981) and Coombe (1988)

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FERTILISER APPLICATION METHODS

- **Fertigation**
  - Targeted application to roots
  - Nutrients rapidly available
- **Foliar nutrient sprays**
  - Targeted and timing specific application
- **Banded or broadcast**
  - Does not require irrigation
  - Aiming to boost soil reserves
  - Requires rain to wash into soil

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PUTTING IT ALL TOGETHER

- **Develop nitrogen, phosphorus and potassium fertiliser budgets based on target yields and nutrient uptake patterns**
- **Use visual assessments of vigour and crop load during the season and adjust fertiliser budgets accordingly**
- **Apply micronutrient foliar sprays (zinc, manganese, boron etc.) at appropriate times**
- **Use regular soil analysis to check soil nutrient reserves, pH, sodicity and salinity**
- **Use petiole analysis at flowering to monitor the actual nutrient status of the trees**
- **Review the fertiliser program with retrospective nutrient budgets along with soil and petiole analysis results**