University of California

Nitrogen Management Training

for Certified Crop Advisers

Nitrogen Management in Deciduous Fruit and Grapes

UC Cooperative Extension | University of California Agriculture and Natural Resources

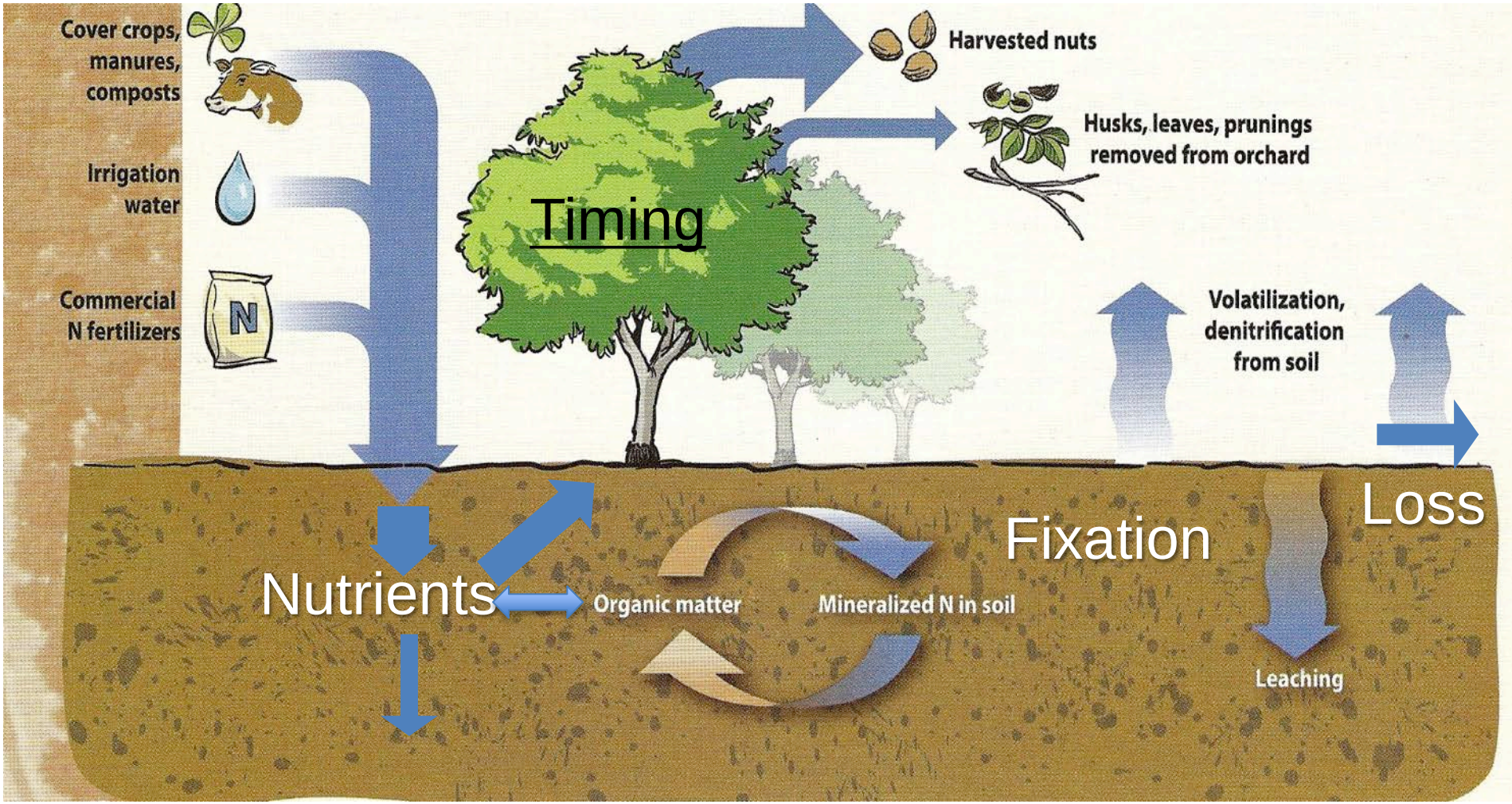
Efficient Nitrogen Management
-the 4 R's-

- Apply the Right Rate
  - Match supply with tree demand (all inputs- fertilizer, organic N, water, soil).
- Apply at the Right Time
  - Apply coincident with tree demand and root uptake.
- Apply in the Right Place
  - Ensure delivery to the active roots.
  - Minimize movement below root zone
- Using the Right Source and Monitoring
  - Maximize uptake, maximize response and minimize loss.

The 4 R's are specific to every orchard each year.

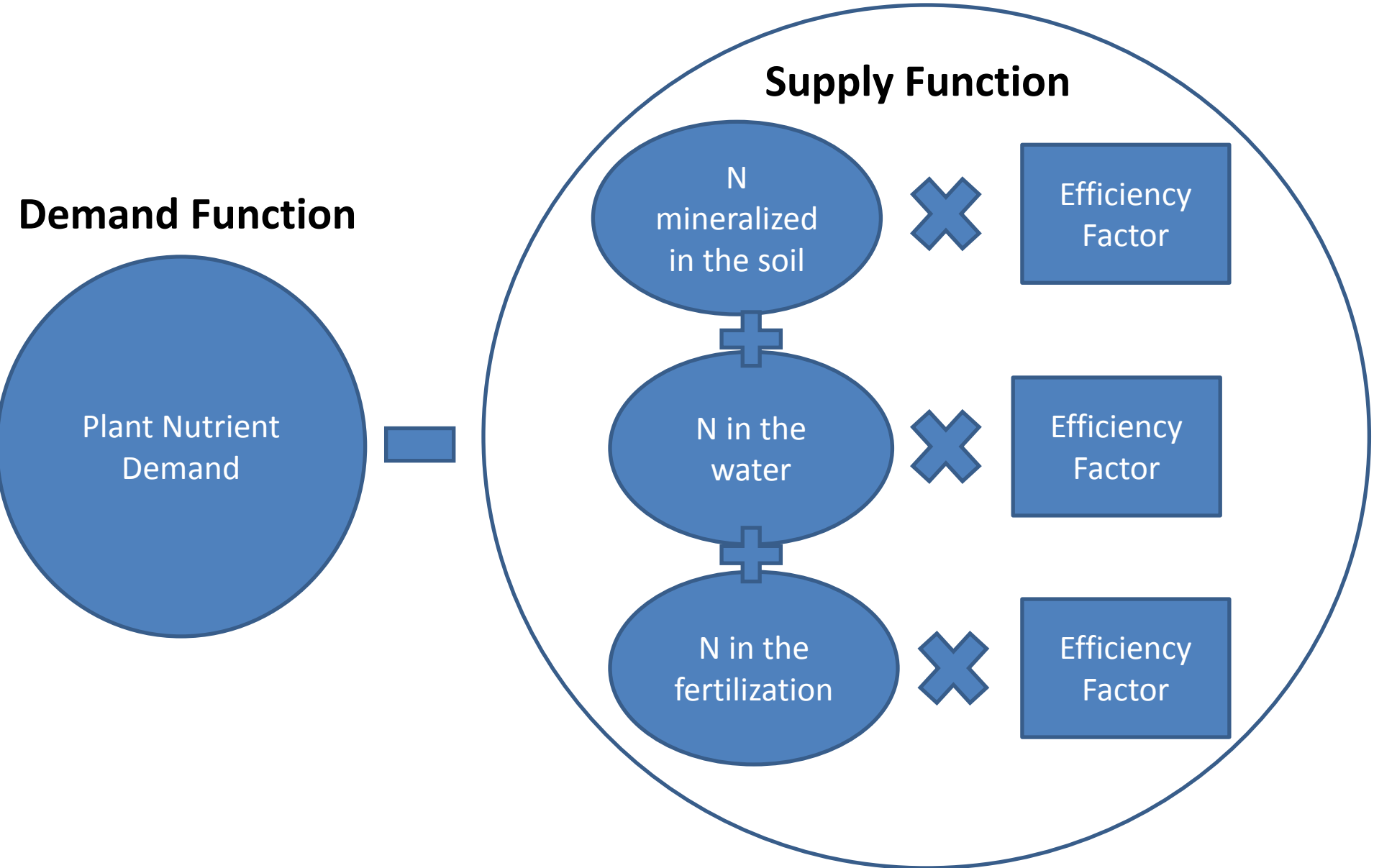
Optimizing N Use in Tree Crops

Supply (Rate) = Demand (Amount and Timing)



Kathy Kelley-Anderson et al: ANR Pub # 21623

The Right Rate Equation



N Demand

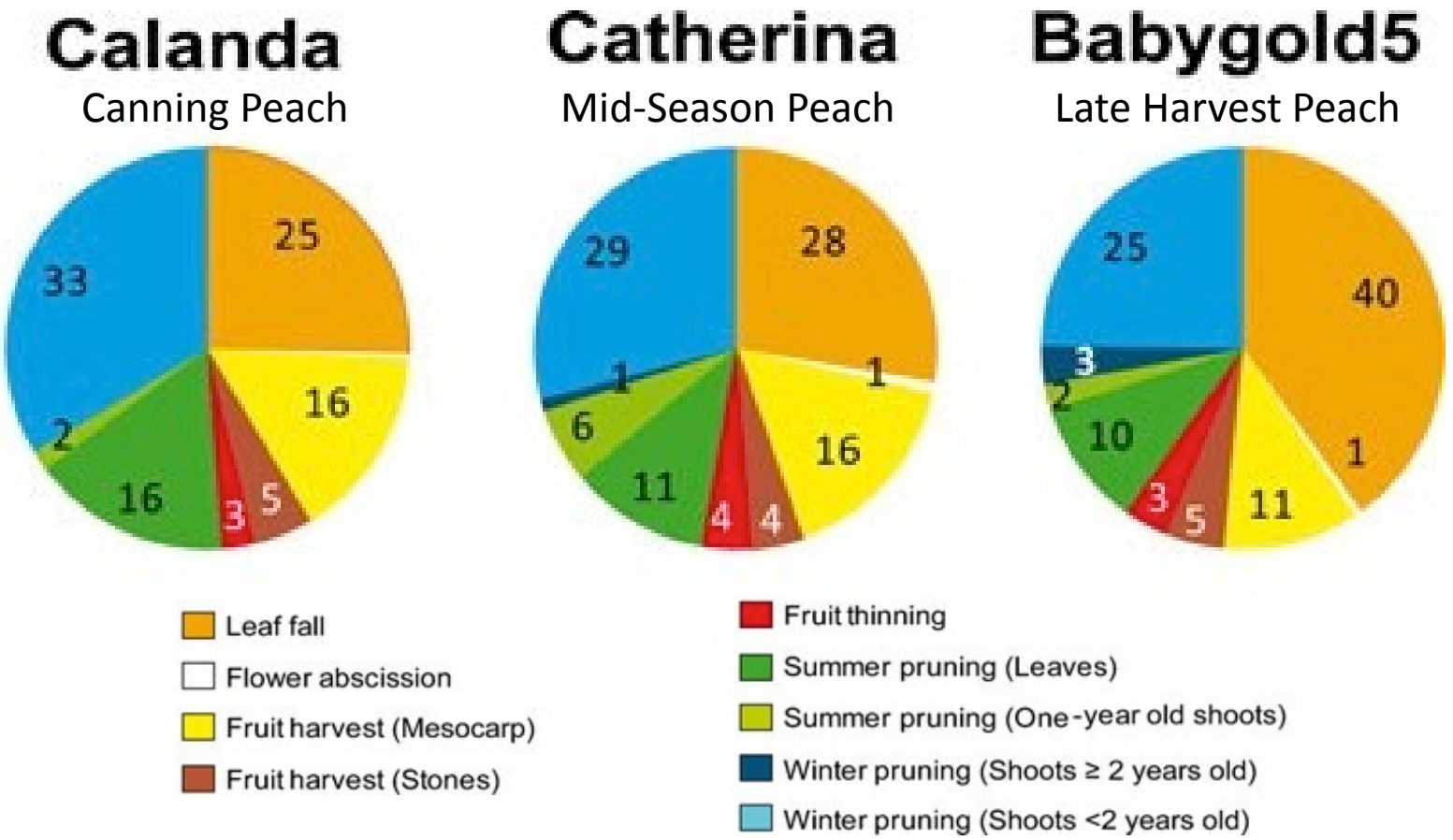
Peach, Cherry, Apricot,
Apple, Pear

N Partitioning:
Peach Experiment

El-Jendoubi, H, Abadia, J, Abadia, A (2013) Assessment of nutrient removal in bearing peach trees (Prunus persica L. Batsch) based on whole tree analysis. *Plant and Soil* **369**, 421-437.

N Partitioning: Peach Experiment Results

% N requirements through the season in three peach varieties:



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N Partitioning: Peach Experiment Results

	'Calanda' Canning	'Catherina' Mid-season	'Babygold5' Late-harvest
Orchard age (years)	14	14	14
Density (trees/acre)	500	670	670
Yield (tons/acre)	13.5	3.88	3.97
Storage (lbs N/acre)	10.6	5.98	6.46
*Demand (lbs N/acre)	152	61.5	58.3
Flowers/thinned fruit	4.59	2.96	2.40
Summer prunings	13.3	10.6	7.20
Harvested fruit	31.1	12.4	9.14
Leaf litter	38.4	17.0	23.3
Winter prunings	64.3	27.2	16.3

*Demand equals flowers and thinned fruits, summer prunings, harvested fruit, leaf litter and winter prunings

El-Jendoubi, H, Abadia, J, Abadia, A (2013) Assessment of nutrient removal in bearing peach trees (Prunus persica L. Batsch) based on whole tree analysis. *Plant and Soil* **369**, 421-437.

N Demand and Timing: Peach

- In O'Henry peach, the first 25-30 days of the growing season are supplied exclusively by N storage from perennial tissues
- After that, about 0.89 lbs N per acre per day are taken up by the trees after the spring flush until harvest.
- After harvest, a positive net N storage occurs as a result of a large decrease in the N demand from growth
- Much of the N that is taken up by the tree is returned to the soil as leaf litter and prunings.

Rufat, J, DeJong, TM (2001) Estimating seasonal nitrogen dynamics in peach trees in response to nitrogen availability. *Tree Physiology* 21, 1133-1140.

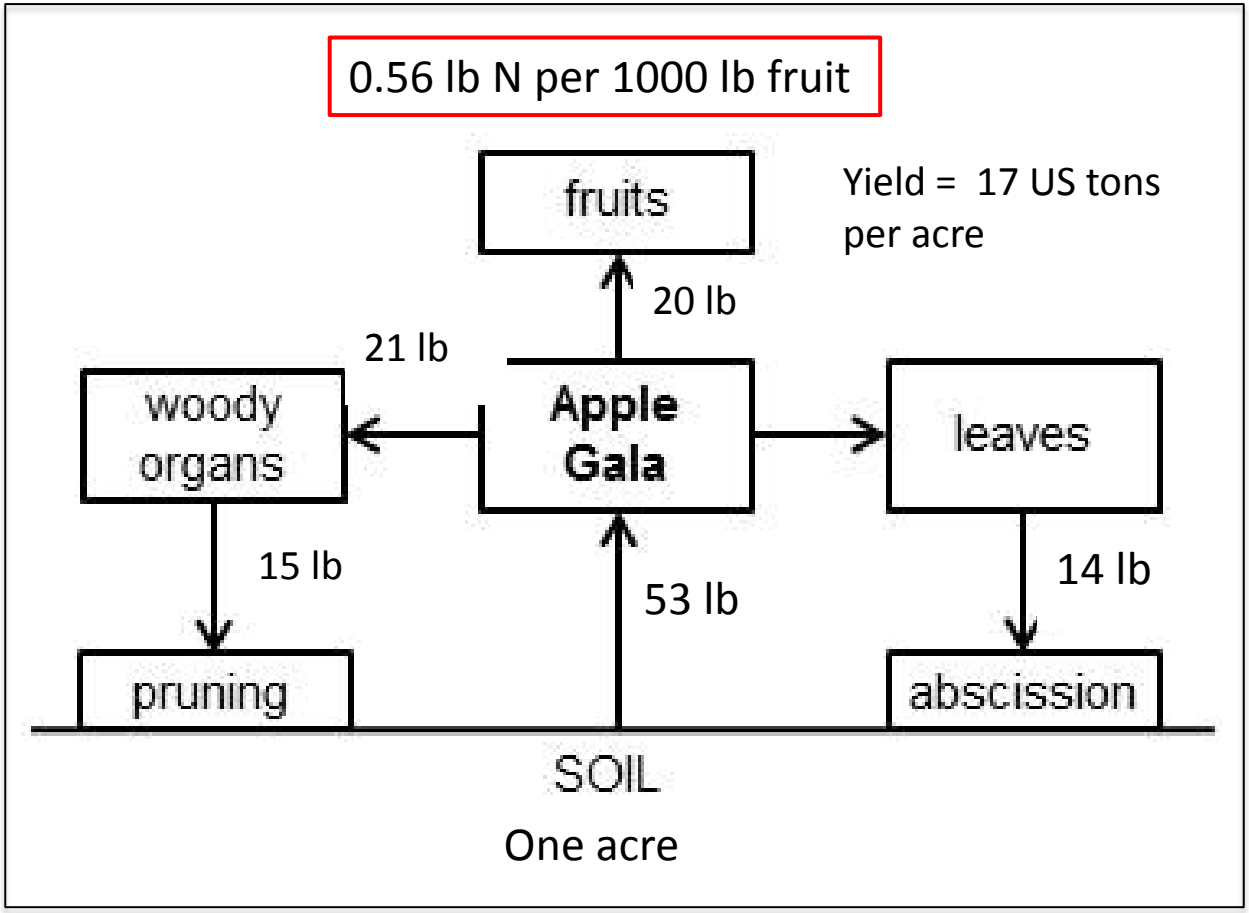
Summary: Peach

- Only 15-20% of total N demand is allocated to harvested fruit, overall demand is significantly lower than in nuts.
- Proportionately larger demand for N in leaves, thinned fruit, and perennial structures.
- The rate at which N in leaves, prunings, and thinnings is available for uptake in subsequent seasons remains uncertain and the rate of release and efficiency of N recycling from returned leaves/prunings/thinnings are determined by management, irrigation and soil conditions.
- Current best estimate is that 50% of N in leaves, prunings, and thinnings becomes available in the first year, with a subsequent 50% in the second year and so on. The majority of N release from these sources occurs in spring as soil OM mineralizes

N Demand and Timing: Cherry, Apricot, Apple, Pear

- Data on crop offtake is available for apple and sweet cherry
  - Apple 0.5 - 0.6 lbs N per 1000 lbs fruit
  - Sweet cherry 2.0 - 2.35 lbs N per 1000 lbs fruit
- Data on uptake patterns for these crops is currently not available, though it can be inferred that the patterns will resemble peach: (Worth showing peach curve?)
  - Early season demand (until 80% leaf expansion) is met by stored N
  - Timing of leaf and fruit development will determine timing of uptake
  - Information on when N is allocated to perennial storage is inadequate.

N Accumulation and Partitioning: Apple



Apple

Tagliavini, M. and Scandellari, F. 2013.

N Demand

Grape Varieties

N Demand and Partitioning: Red Globe

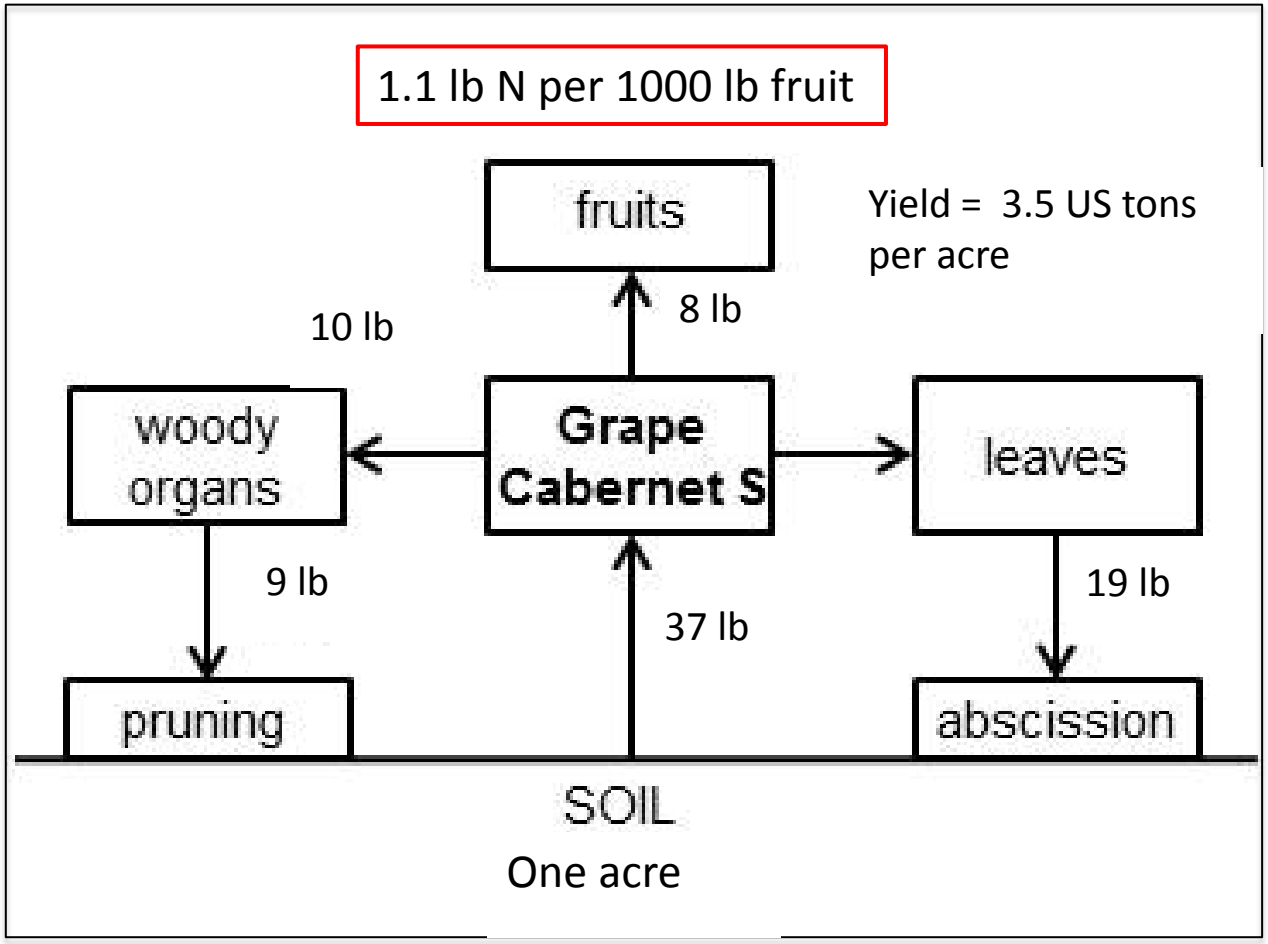
Table 1. Nitrogen accumulation and distribution lbs/acre in various parts of grape plants.

	Sampling date						
Plant part	March 30	May 10	June 30	Aug. 20	Sept. 30	Nov. 30	Net accumulated N
Leaves	-	2.6	16.7	26.8	31.2	-	31.2
Fruits	-	-	5.5	18.2	28.7	-	28.7
New shoots	3.9	-	17.9	19.4	25	25	25
Branch	5.1	4.4	4.7	5.3	5.5	6.2	2.3
Trunk	18	5.1	5.2	5.5	5.9	6.4	1.3
Roots	27	15.8	11.6	12.6	17.6	20.4	2.4
Total plant		27.8	61.6	87.8	114	58	91

Note: Net accumulated N in leaves, fruits, and new shoots equal to total accumulated in the last sampling. Net accumulated N in branches, trunks and roots equal to N accumulation in the last sampling value minus N accumulation in the first sampling value.

Tong et al. 2010

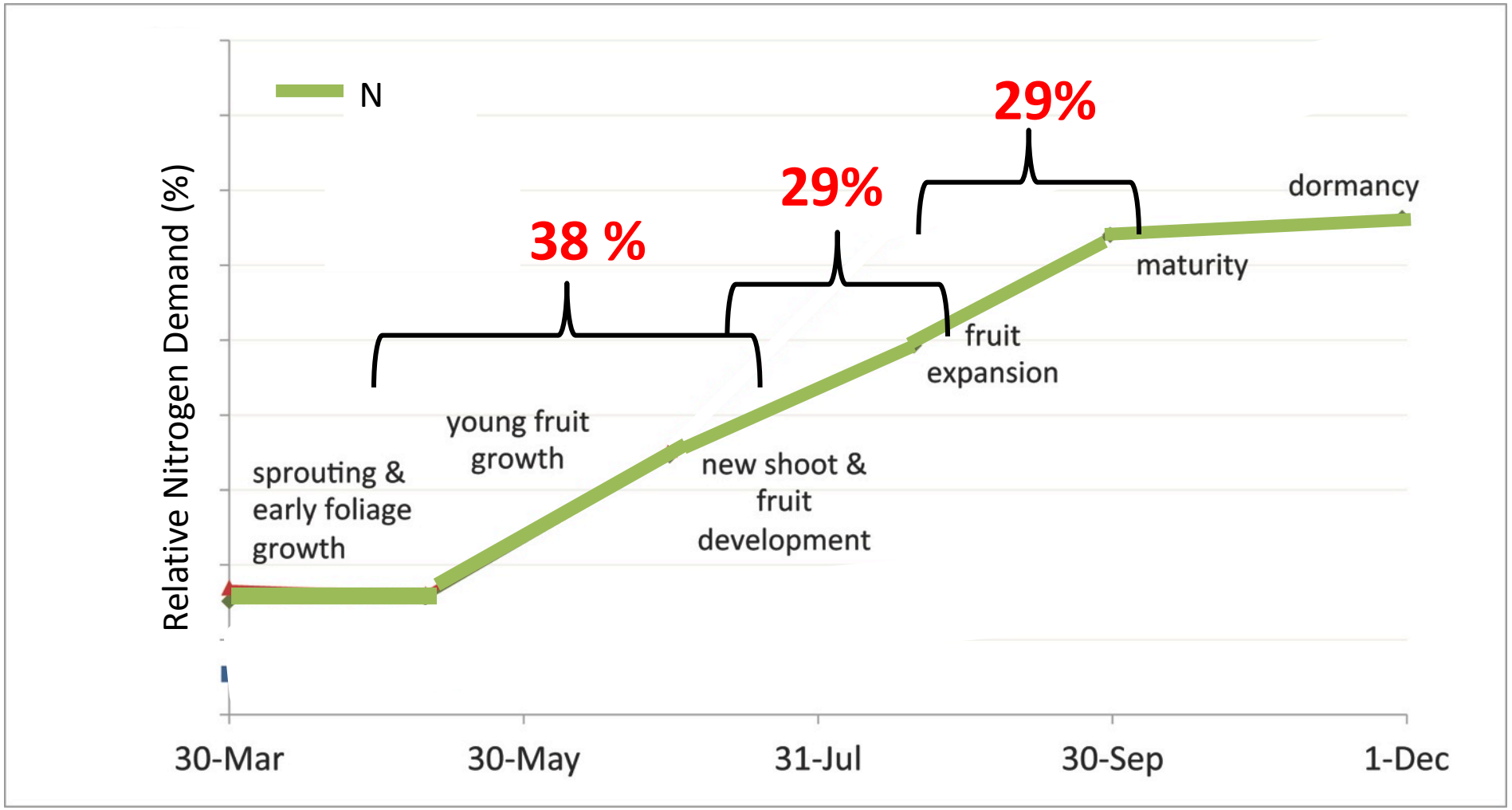
N Partitioning: Grape



Grape 'Cabernet'

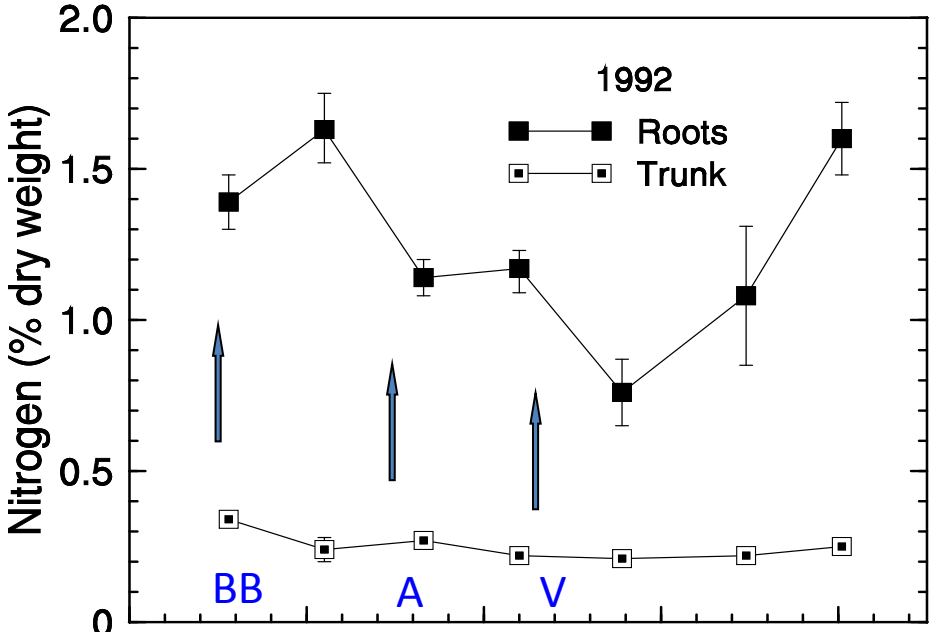
Tagliavini, M. and Scandellari, F. 2013.

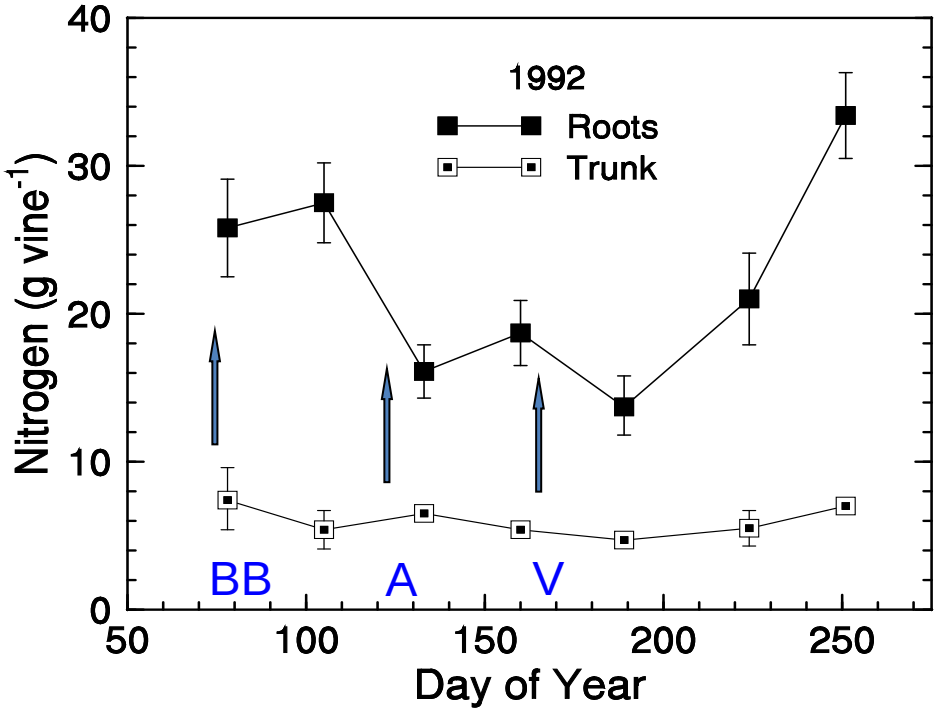
N Demand Timing: Table Grape, Red Globe



Tong et al. 2010

Modified from 4R Plant Nutrition: A Manual for Improving the Management of Plant Nutrition, 2012 IPNI





N Demand Timing & Partitioning:

Thompson Seedless

KEY:

BB = budbreak
A = anthesis (flowering)
V = veraison (berry softening)
H = fruit harvest

N Partitioning After Harvest: Thompson Seedless

Amount of N in the vine at harvest (9/5) and at the end of the growing season (EOS) when all leaves have fallen from the vine

Date	Clusters	Leaves	Stems	Fruiting canes	Trunk	Roots
	----------	----------	----------	(lb N/acre)	----------	----------
9/5	32.0	30.0	11.1	2.2	7.0	18.8
EOS	-	15.6	12.1	2.5	11.1	31.7
Remobilized N	---	**-14.4**	+1.0	+0.3	**+4.1**	**+12.9**

Note: Bottom row is the change in N from harvest to end of season (EOS)
Values above are equivalent to lbs per acre.

Total N Removed: Multiple Table Grape Varieties

‘Flame Seedless’	181 lb N/acre
‘Scarlet Royal’	160 lb N/acre
‘Crimson Seedless’	91 lb N/acre

Note: Total N demand is the sum of the N in leaves, stems and clusters. Differences in total N at harvest is based on a harvest dates and differences in leaf and stem biomass.

24 ton/acre yield

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