New Nitrogen Budget for Cherry

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UCANR

Nitrogen is essential for productivity but when managed poorly N results in environmental problems.

Whenever there is a challenge, there is also an opportunity…

…Improving the Efficiency of Nitrogen use will Reduce Production Costs, Reduce Pruning and Reduce Environmental Impact.

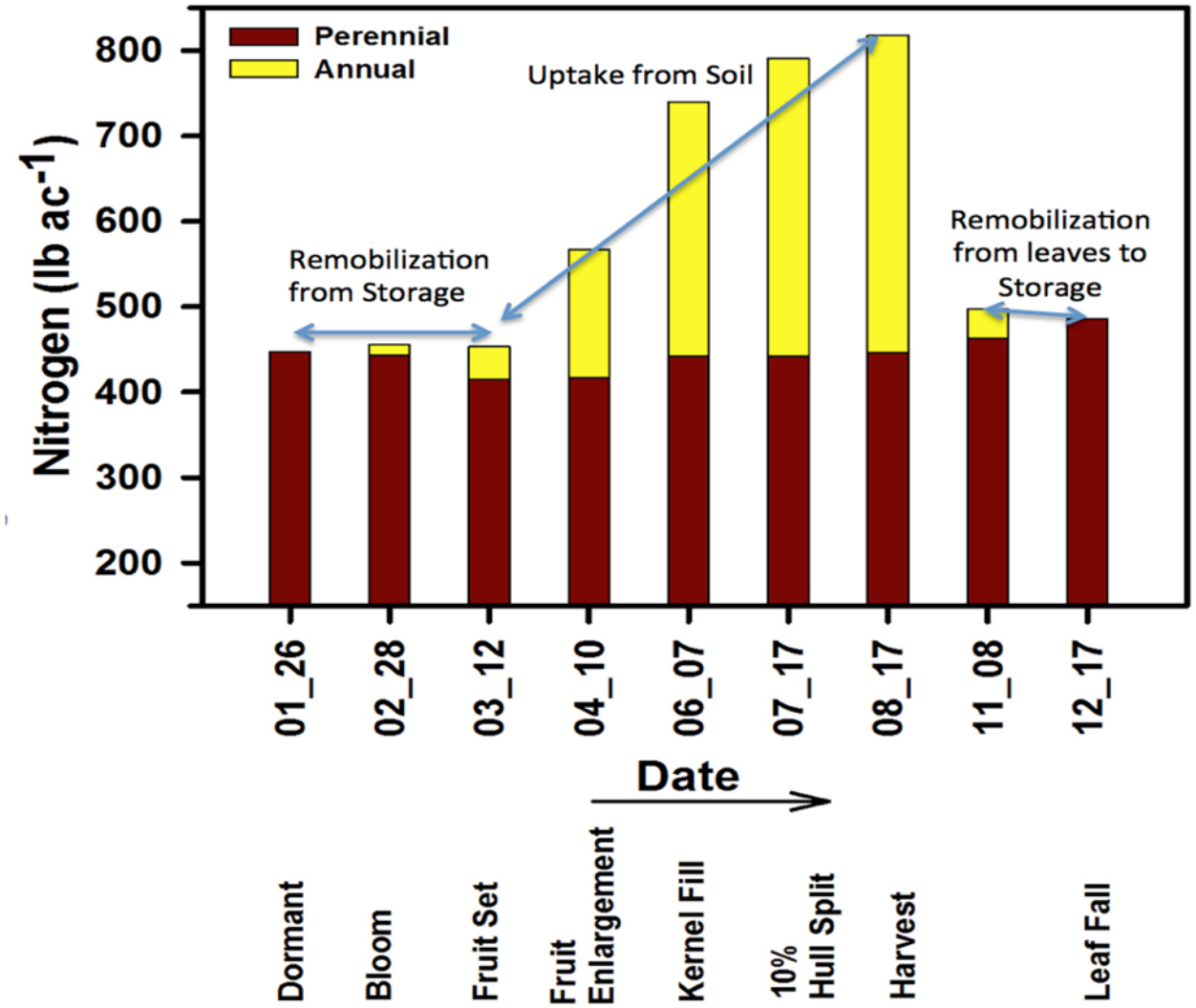
Efficient Nitrogen Management - The 4 R's

- 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.

Applying at the Right Rate and Time: ALMOND

- When during the season should I apply my N and how much?
- Need to:
  - Understand fruit development and N demand
  - Know the shape of nitrogen demand through the season
  - Know when uptake from the roots occurs
  - Know how much N is required for growth
  - Know the periods of higher leaching potential

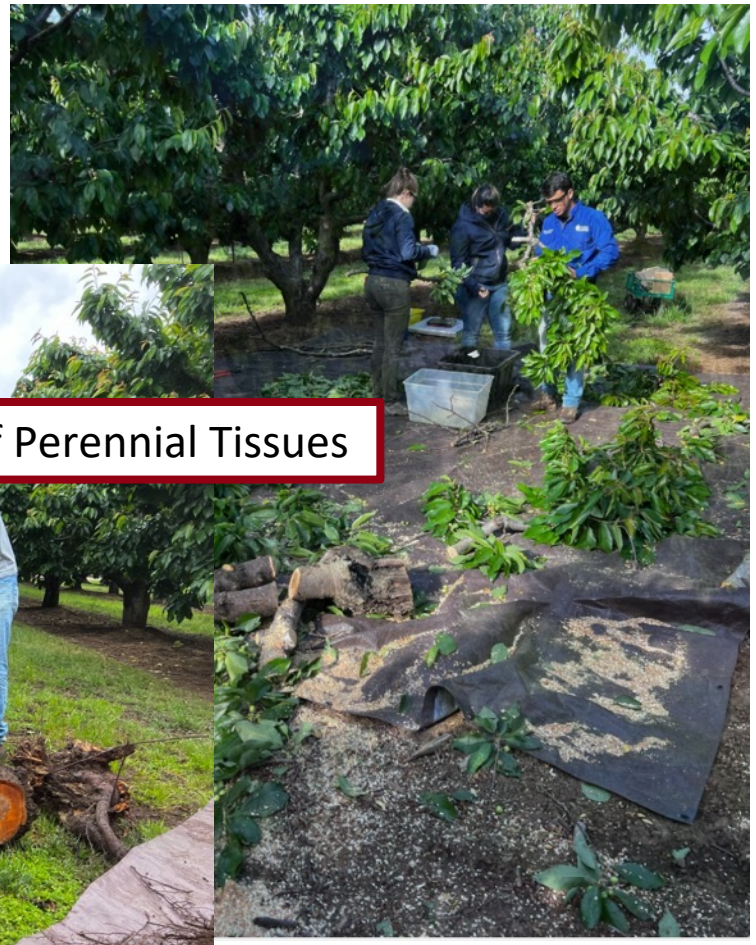


The objectives of the project are:

I. Develop nutrient demand curves to guide the quantity and time of fertilizer application in cherry. Repeat for most representative cultivars and production systems.

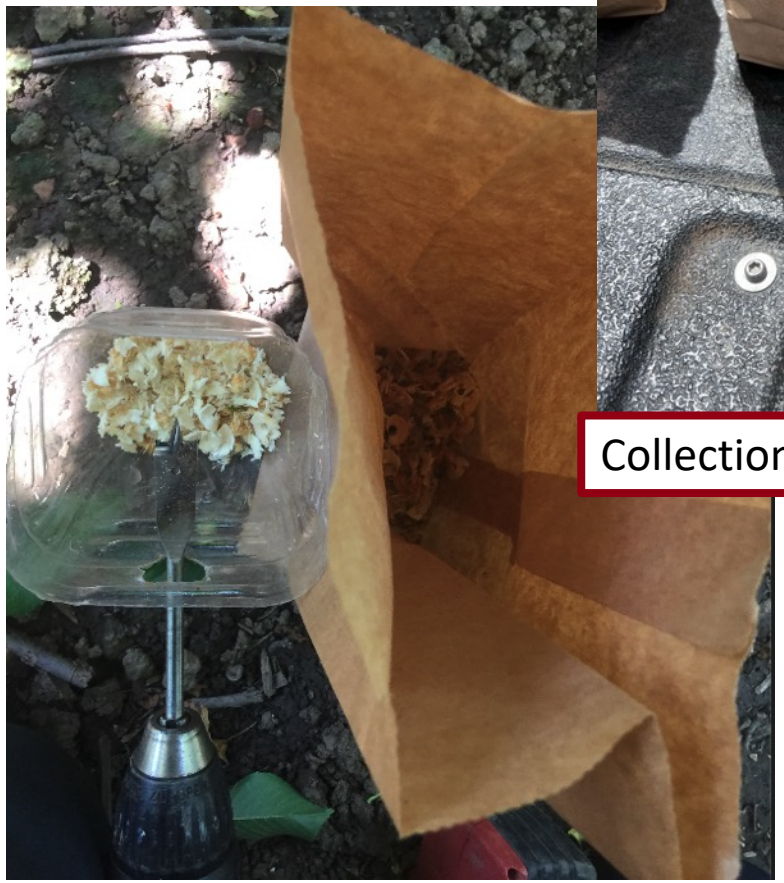
II. Develop and extend nutrient Best Management Practices (BMP) for cherry cultivars.

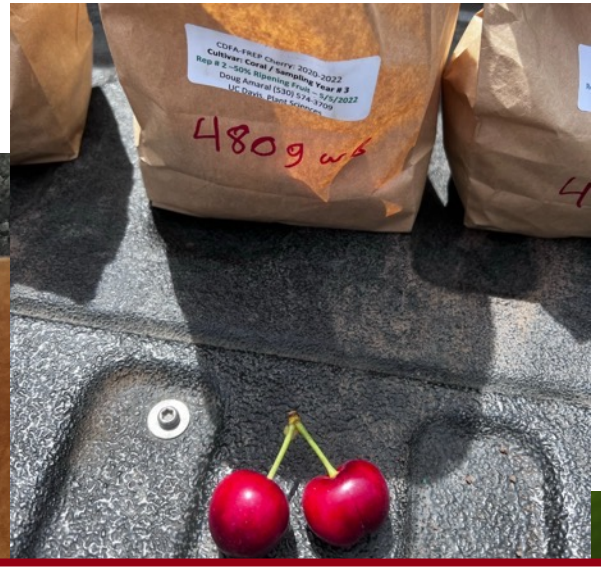
How do we monitor our trees?



Tree Excavation, Partitioning, and Analysis of Perennial Tissues

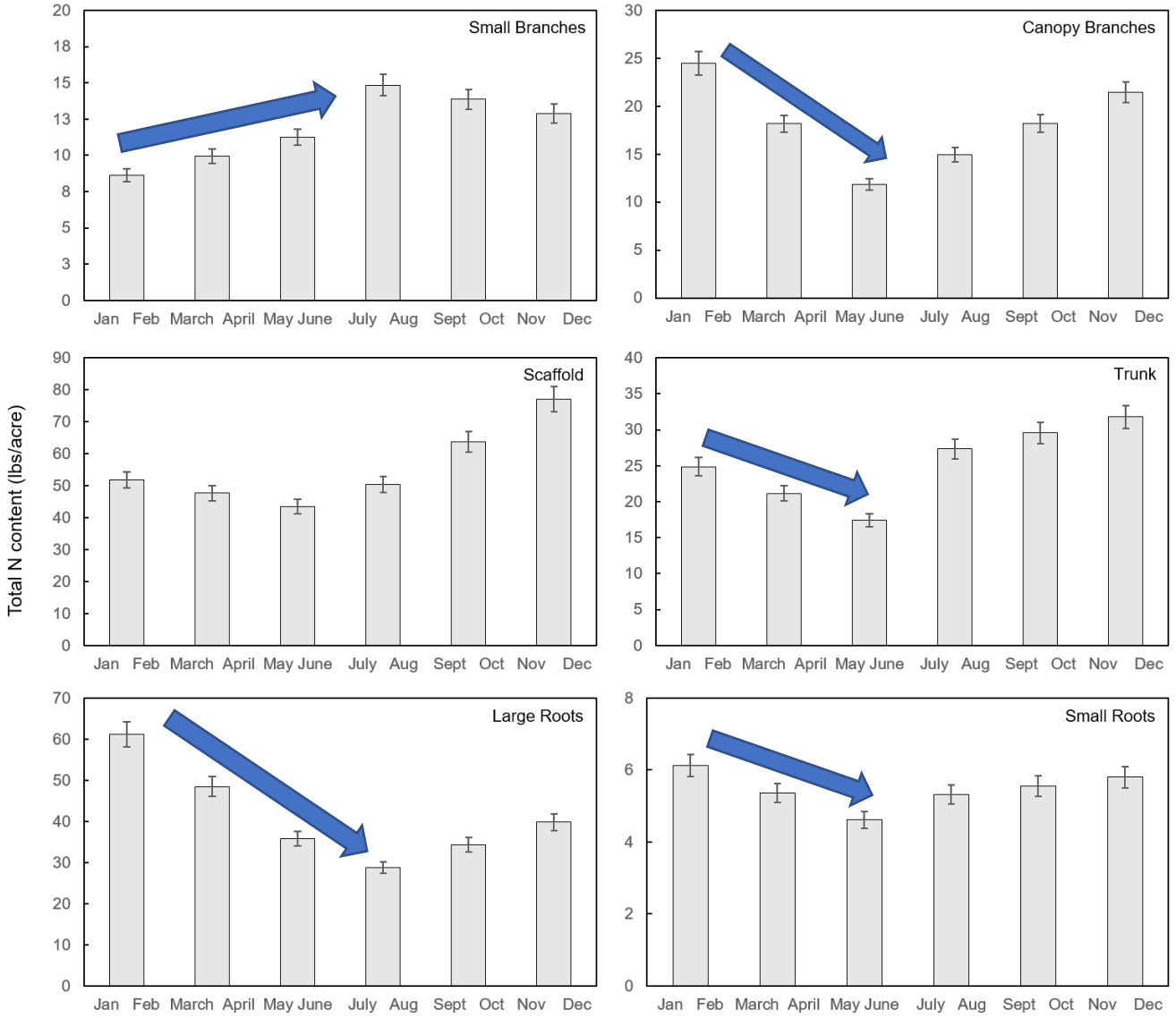
How do we monitor our trees?





Collection, Separation and Analysis of Annual Tissues

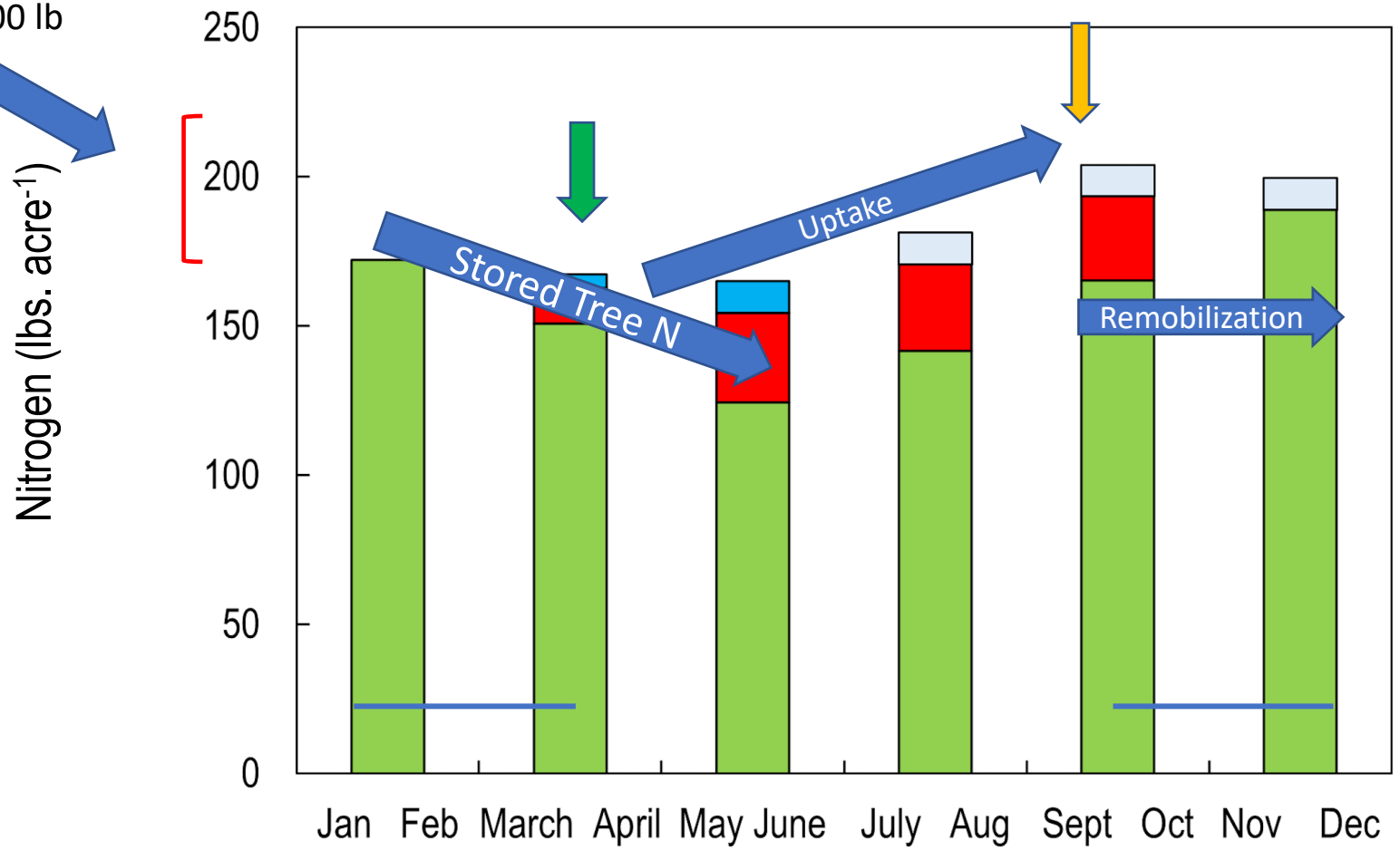
Seasonal trends in Nitrogen partitioning in perennial organs :Bing



The overall average is weighted for the number of observations in all trials (n = 27).

Total and Annual Dynamics of N in Mature Cherry Tree (this example was a 4,000 lb. Bing crop)

37 lbs. total N increment (28 lbs growth, 4,000 lb fruit)



Fruits
Harvested Fruits
Leaves and Flowers
Perennial

Periods of no N uptake.

Beginning of N uptake.

Completion of N uptake.

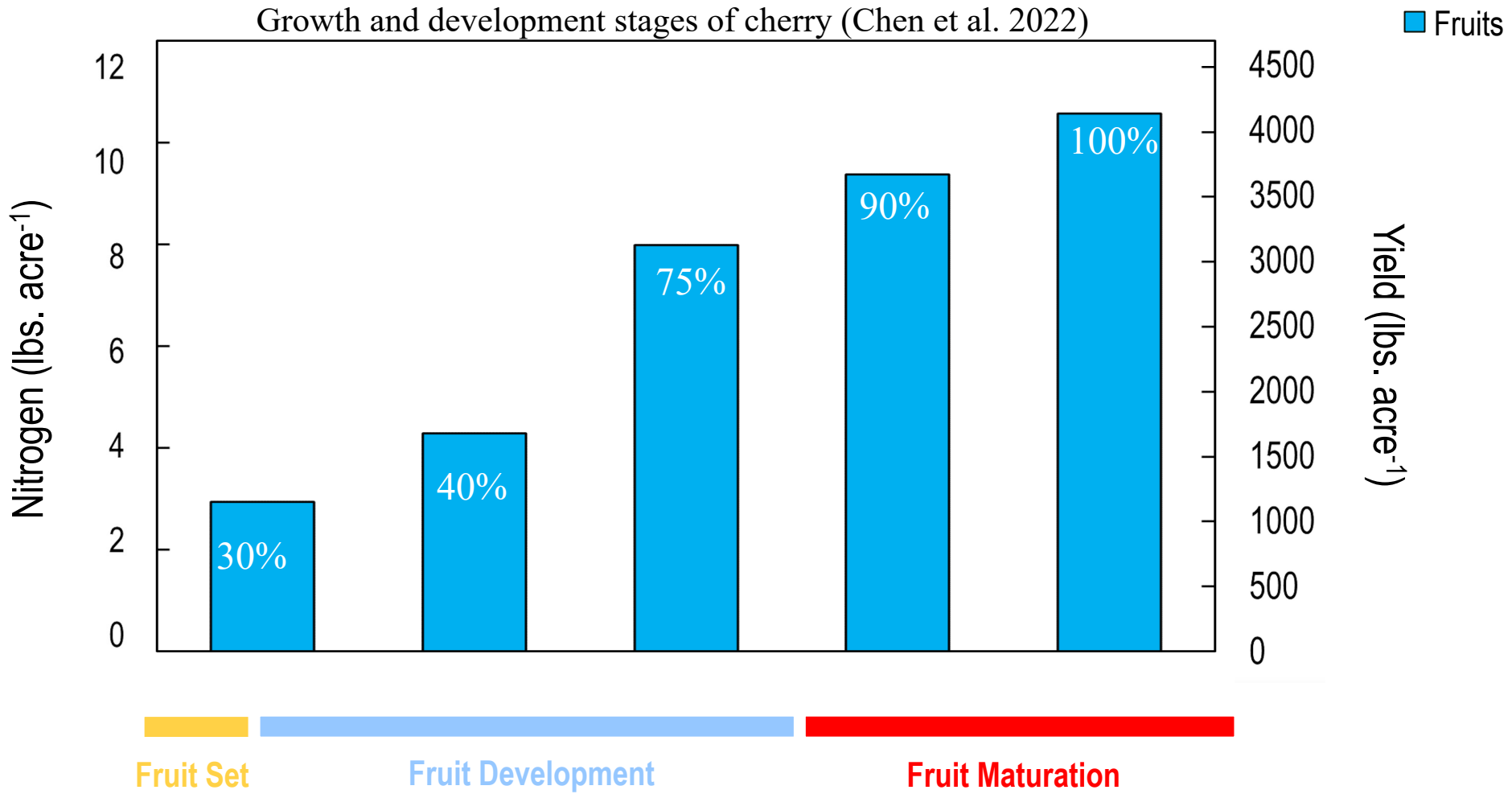
Note: Commencement of uptake coincides with 50% leaf out.

Completion coincides with early leaf senescence

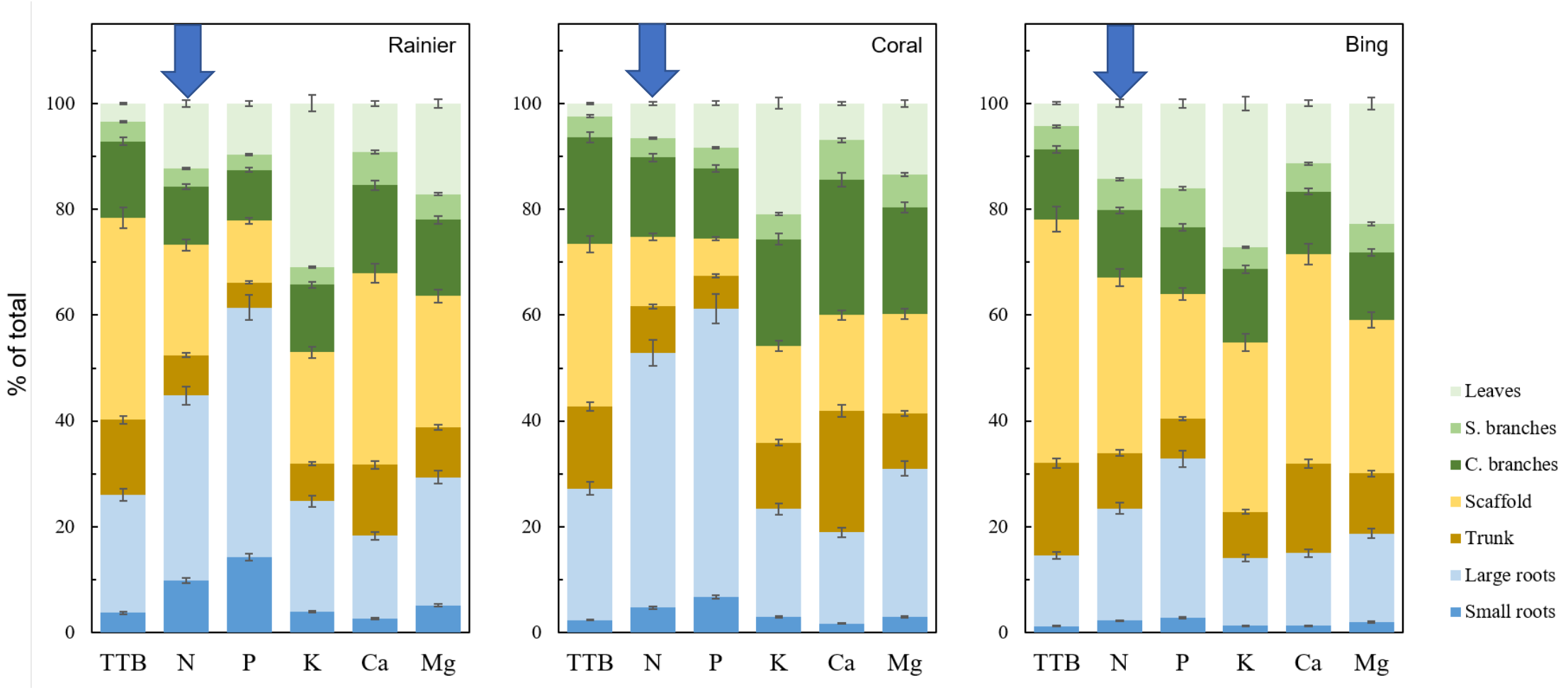
Representative data for cherry cultivar "Bing".

Cherry Fruit Development

Growth and development stages of cherry (Chen et al. 2022)



Tree biomass and nutrient content (June): Focus on N



Tree partitioning (% of total) of total tree biomass (TTB) and macronutrients (N, P, K, Ca, and Mg) content. Data refer to cherry cultivars “Rainier”, “Coral”, and “Bing”. Bars represent standard errors.

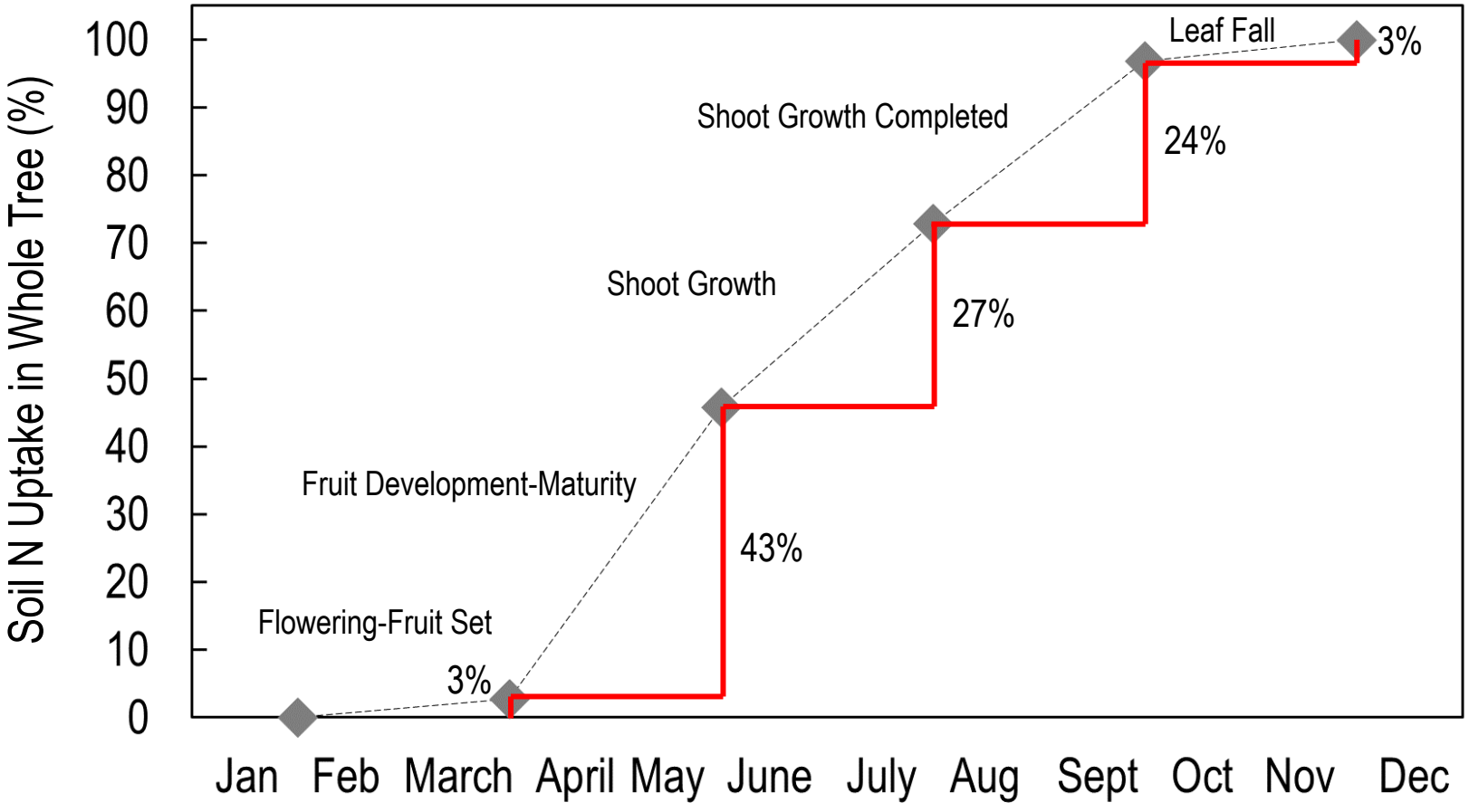
Nitrogen removal in cherry cultivars

Variety	*Removal at harvest (lbs N/1000 lbs of fruits DW)*
Rainier	2.74
Coral	2.73
Bing	2.32
Weighted Average	**2.59**

	Tree development (lbs N/acre)*
Rainier	28.99
Coral	28.41
Bing	27.51
Weighted Average	**28.30**

**Planting density of 202 trees per acre.*

Total and Annual Dynamics of N in Mature Cherry Tree



Representative data for cherry cultivar “Bing”.

Total and Annual Dynamics of N in Mature Cherry Tree

Total Tree N:

- Fruits are an important sink for nutrients and the pattern of nutrient accumulation through the season is largely driven by the pattern of fruit growth with 50 to 75% of total N demand from fruit set to harvest. ‘Growth’ N demand is fairly constant once trees reach maturity

- Fertilizer rate decisions in cherry orchards should be based on nutrient export in expected yield and tree growth, fertilizer application timings should be based upon the pattern of nutrient accumulation in fruits and during canopy development post harvest.

Perennial N:

- N accumulation was rapid until the end of August in all cultivars, then continued at a much lower rate.

- No net accumulation of N after late October/early November.

- From December to February the amounts of N present in the tree canopy remained stable.

Nutrient Uptake Efficiency (NUE)

202 trees per acre and 10,000 lbs. of fruit per acre

Fruit N accumulation	26 lbs. of N per acre
202 trees per acre	28 lbs of N per acre
Total fruit and biomass	54 lbs of N per acre

80% N uptake efficiency

54 lbs/0.8 = 67 lbs per acre N requirement
(10,000 lb yield)

Improving Nutrient Uptake Efficiency (NUE)

202 trees per acre	4,000 lbs. of fruit per acre
Fruit N accumulation	10 lbs. of N per acre
202 trees per acre	28 lbs of N per acre
Total fruit and biomass	38 lbs of N per acre

80% N uptake efficiency

38 lbs/0.8 = 48 lbs per acre N requirement

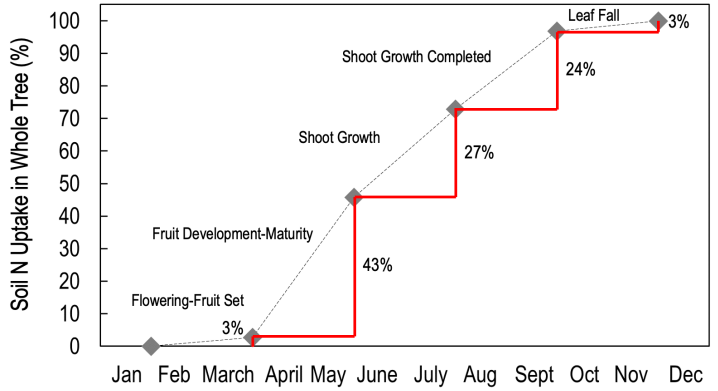
Tree Demand, When to Apply, How efficient.

Tree Demand

Rainier 2.7 of N for each 1000 lbs fruit
Coral 2.7 of N for each 1000 lbs fruit
Bing 2.3 of N for each 1000 lbs fruit

*plus 28 lbs average growth requirement (root, branches, leaf).

When to apply =
follow demand curve.



How to Apply: Manage application/irrigation to keep N in the root zone.

How efficient can we be if we do everything well = 80% NUE

Conclusions: Managing Nitrogen in Cherry

Base your fertilization rate on realistic, orchard specific yield, account for all N inputs and adjust in response to spring nutrient and yield estimates.

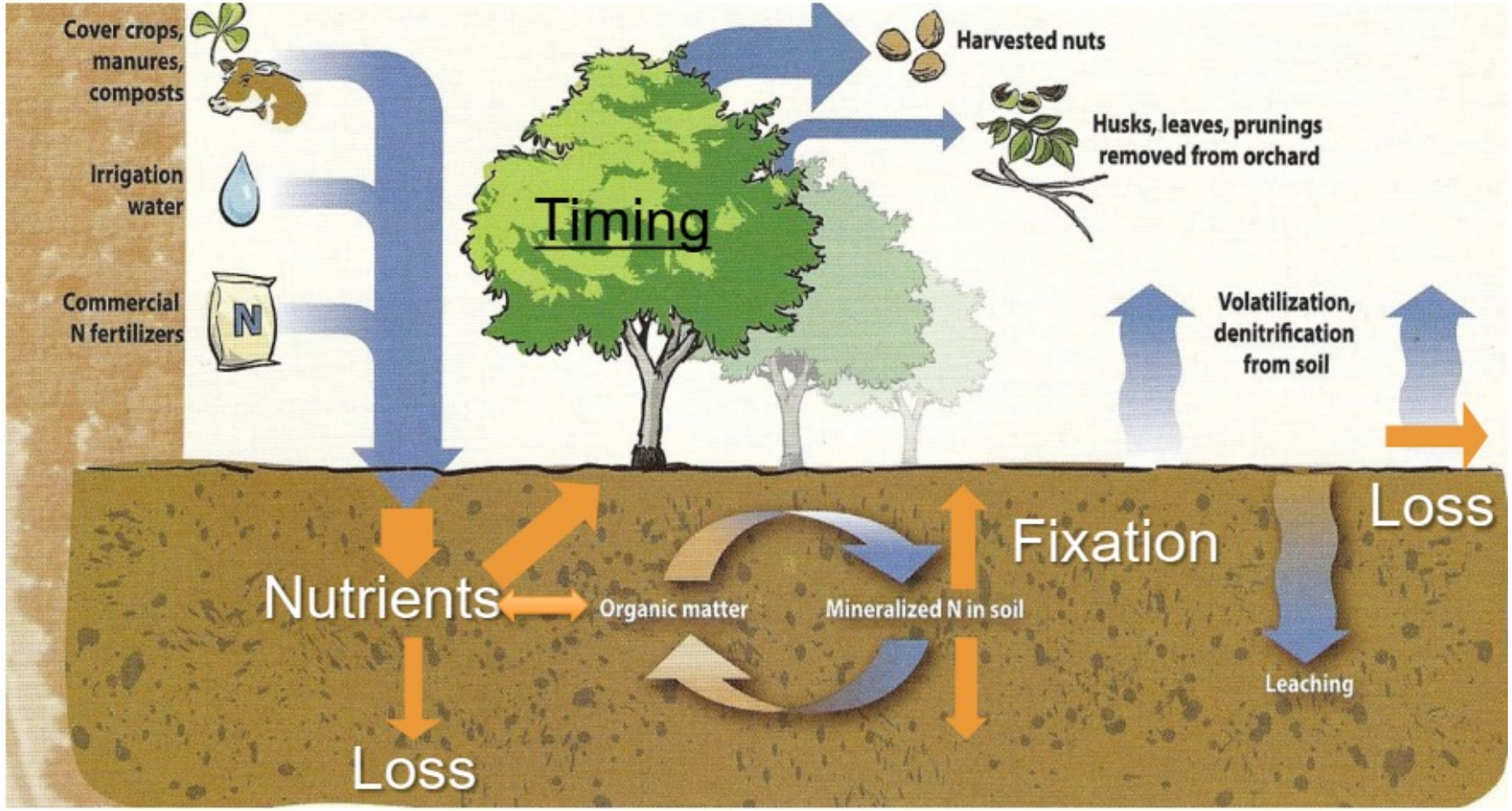
- Make a preseason fertilizer plan based on expected yield LESS the N in irrigation and other N inputs.
  **1000 lb fruit removes up to 2.7 lb N depending on cultivar.*
  + 28 lbs acre for tree growth

- Estimate yields as early as possible.
- Determine N in irrigation water and residual N in soil
- ADJUST AS NEEDED
- Time application to match demand in as many split applications as feasible.
- At harvest review yields and adjust post harvest fertilization accordingly.
- Optimize everything to maximize efficiency

Every field, every year, is a unique decision.

Optimizing N Use in CA Tree Crops

Supply (Rate) = Demand (Amount and Timing)



Kathy Kelley-Anderson et al: ANR Pub # 21623

Acknowledgements

Growers and cherry industry for material as well as providing human resources for the experiment.

Thank you!

Questions?