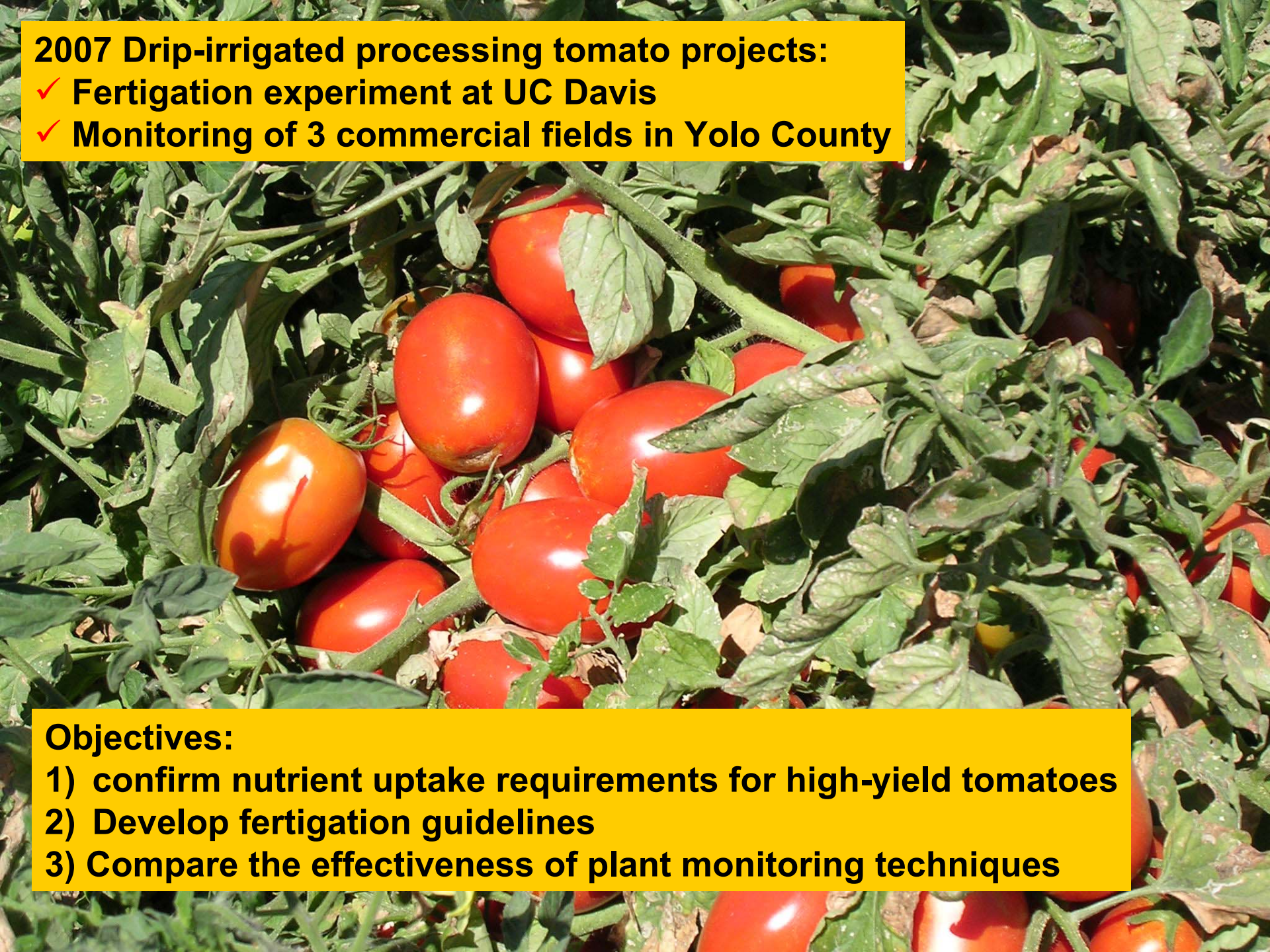

Nutrient management for drip-irrigated tomato production



2007 Drip-irrigated processing tomato projects:

- ✓ **Fertigation experiment at UC Davis**
- ✓ **Monitoring of 3 commercial fields in Yolo County**

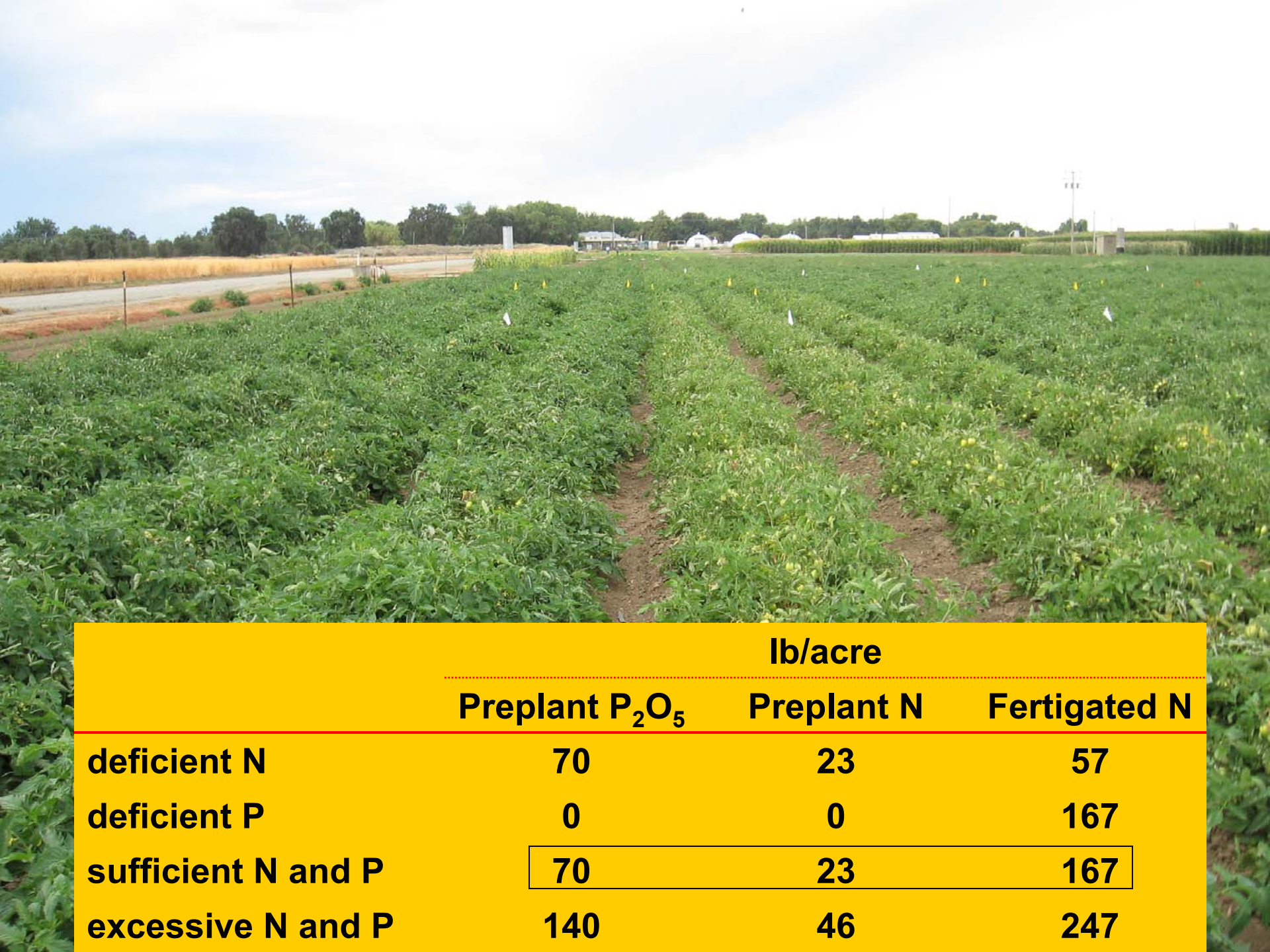
Objectives:

1) **confirm nutrient uptake requirements for high-yield tomatoes**
2) **Develop fertigation guidelines**
3) **Compare the effectiveness of plant monitoring techniques**

Treatments at UCD:

- **deficient N**
- **deficient P**
- **sufficient N and P**
- **excessive N and P**

AB 2 and Heinz 9780
3 replications per treatment



	lb/acre		
	Preplant P_2O_5	Preplant N	Fertigated N
deficient N	70	23	57
deficient P	0	0	167
sufficient N and P	70	23	167
excessive N and P	140	46	247

Commercial fields :

- **All low soil P (< 15 PPM) and low soil K (< 140 PPM)**
- **Conservative in-season fertigation of 160-175 lb N, < 30 lb K**

Every 2 weeks (UCD) or every 3 weeks (commercial fields) :

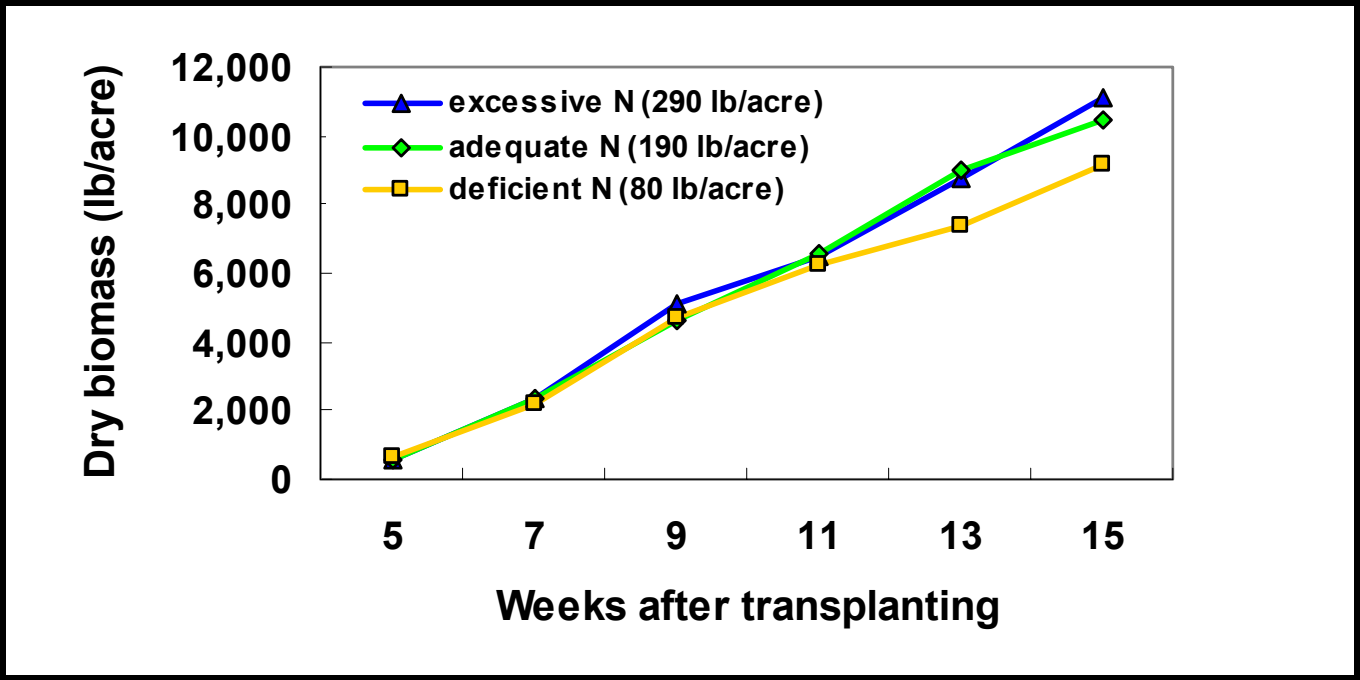
- **whole plant sampling for growth and total nutrient uptake**
- **soil, leaf and petiole analysis**

	Fruit yield (tons/acre)	Crop nutrient uptake (lb/acre)		
		N	P	K
UCD sufficient N & P	58			
Field 1	45			
Field 2	51			
Field 3	59			

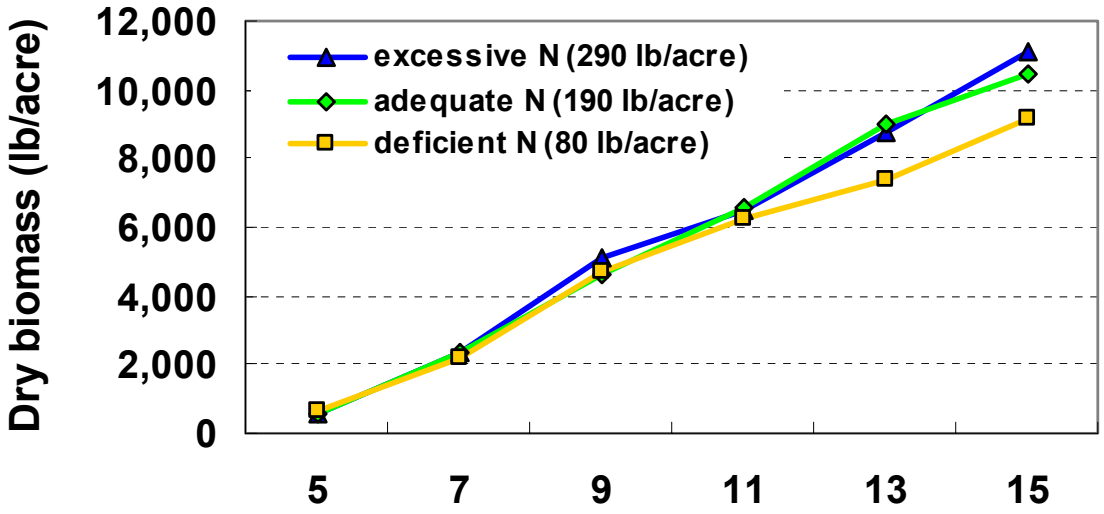
	Fruit yield (tons/acre)	Crop nutrient uptake (lb/acre)		
		N	P	K
UCD sufficient N & P	58	210		
Field 1	45	200		
Field 2	51	240		
Field 3	59	250		

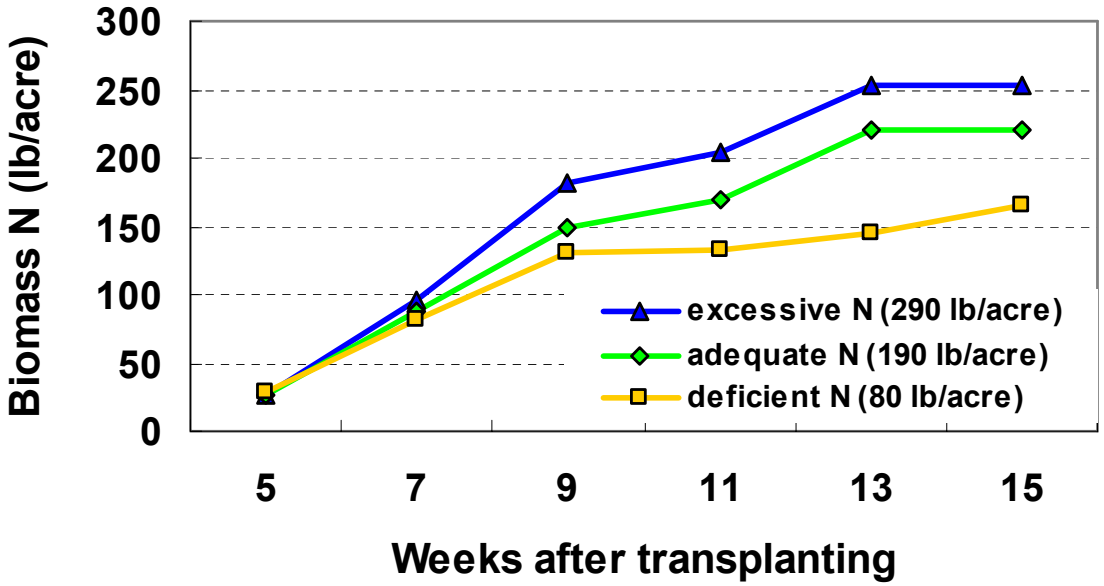
	Fruit yield	Crop nutrient uptake (lb/acre)		
	(tons/acre)	N	P	K
UCD sufficient N & P	58	210	34	
Field 1	45	200	25	
Field 2	51	240	27	
Field 3	59	250	34	

	Fruit yield (tons/acre)	Crop nutrient uptake (lb/acre)		
		N	P	K
UCD sufficient N & P	58	210	34	320
Field 1	45	200	25	160
Field 2	51	240	27	190
Field 3	59	250	34	230



UCD sufficient and excessive N & P treatments

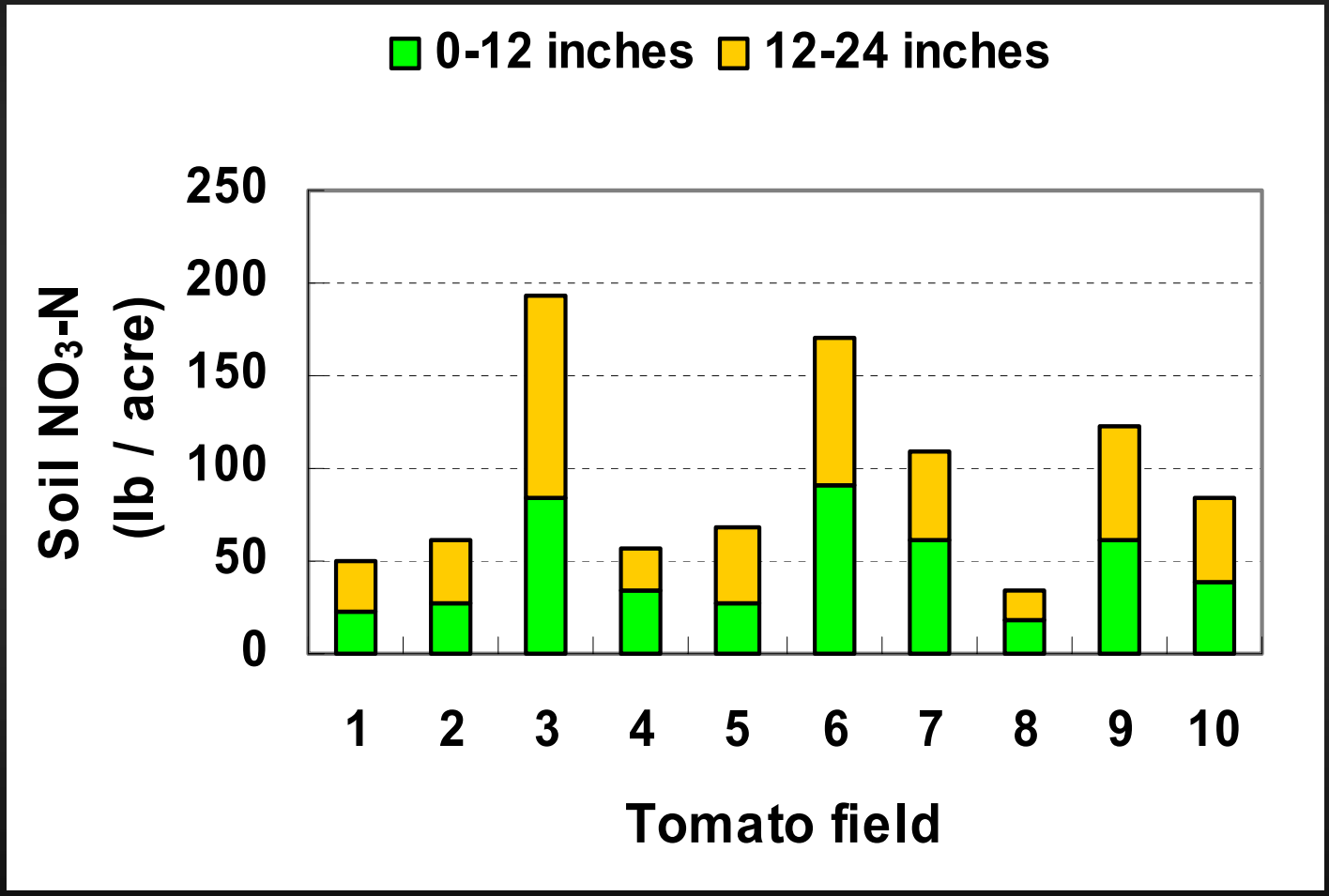




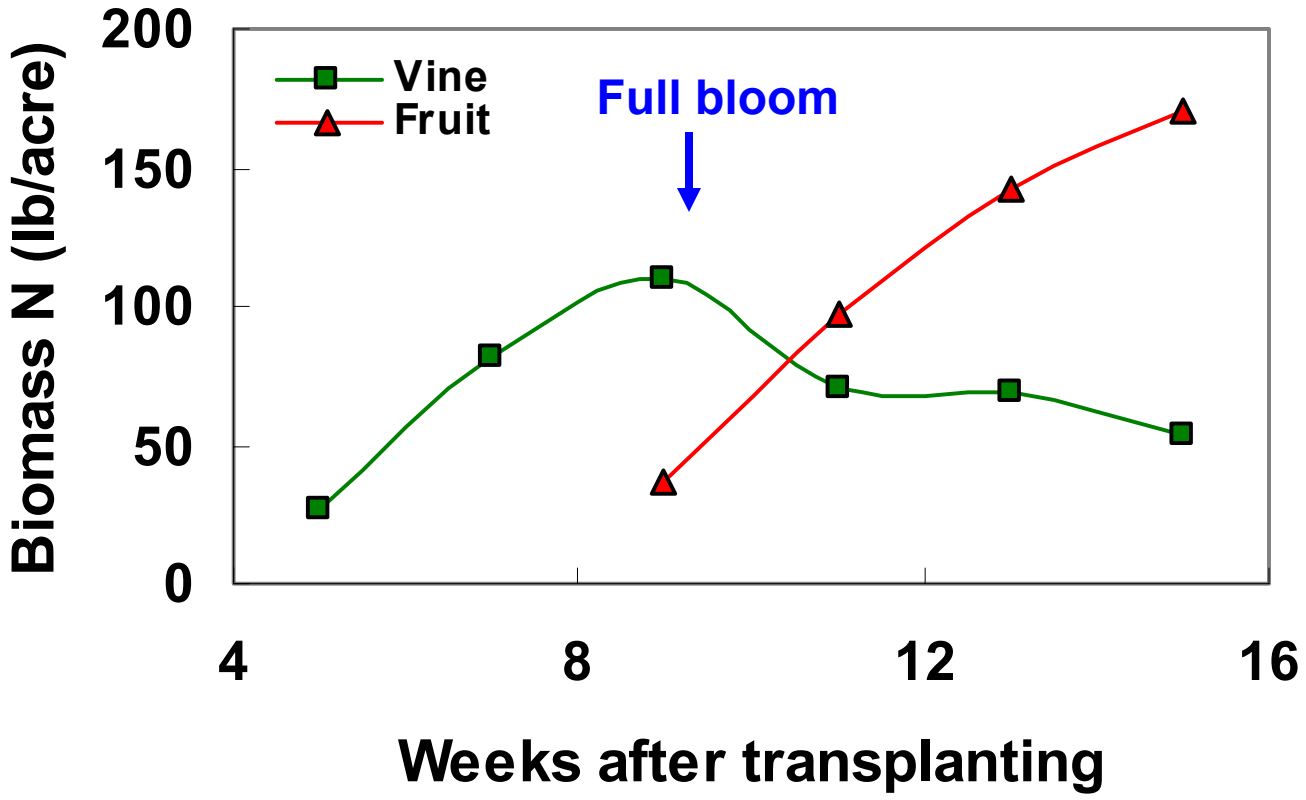
UCD sufficient and excessive N & P treatments

In-season soil sampling :

Post-thinning soil NO_3-N in Valley tomato fields :

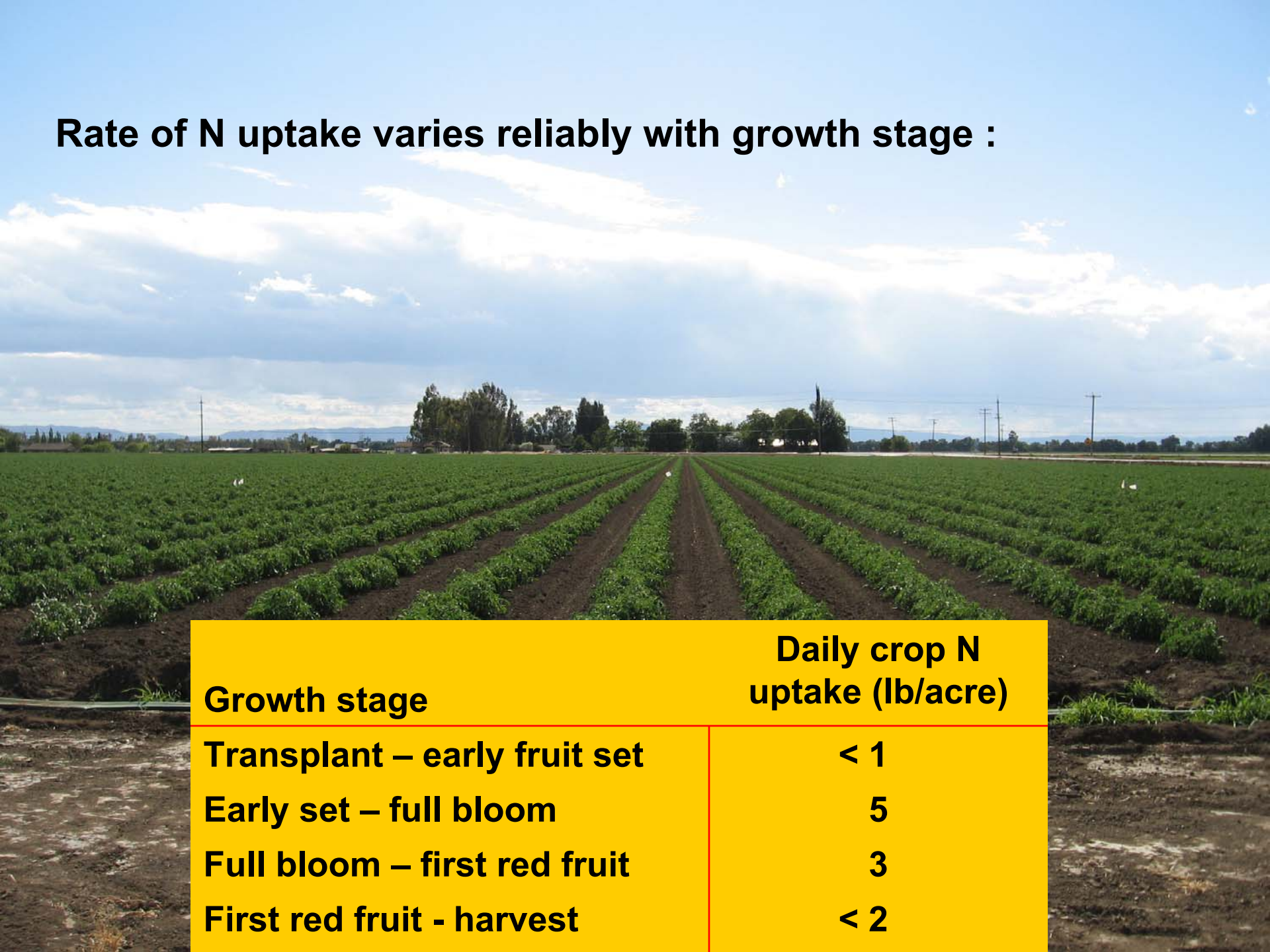


N uptake and partitioning over time :



UCD sufficient N treatment

Rate of N uptake varies reliably with growth stage :



Growth stage	Daily crop N uptake (lb/acre)
Transplant – early fruit set	< 1
Early set – full bloom	5
Full bloom – first red fruit	3
First red fruit - harvest	< 2

Implications for N management :

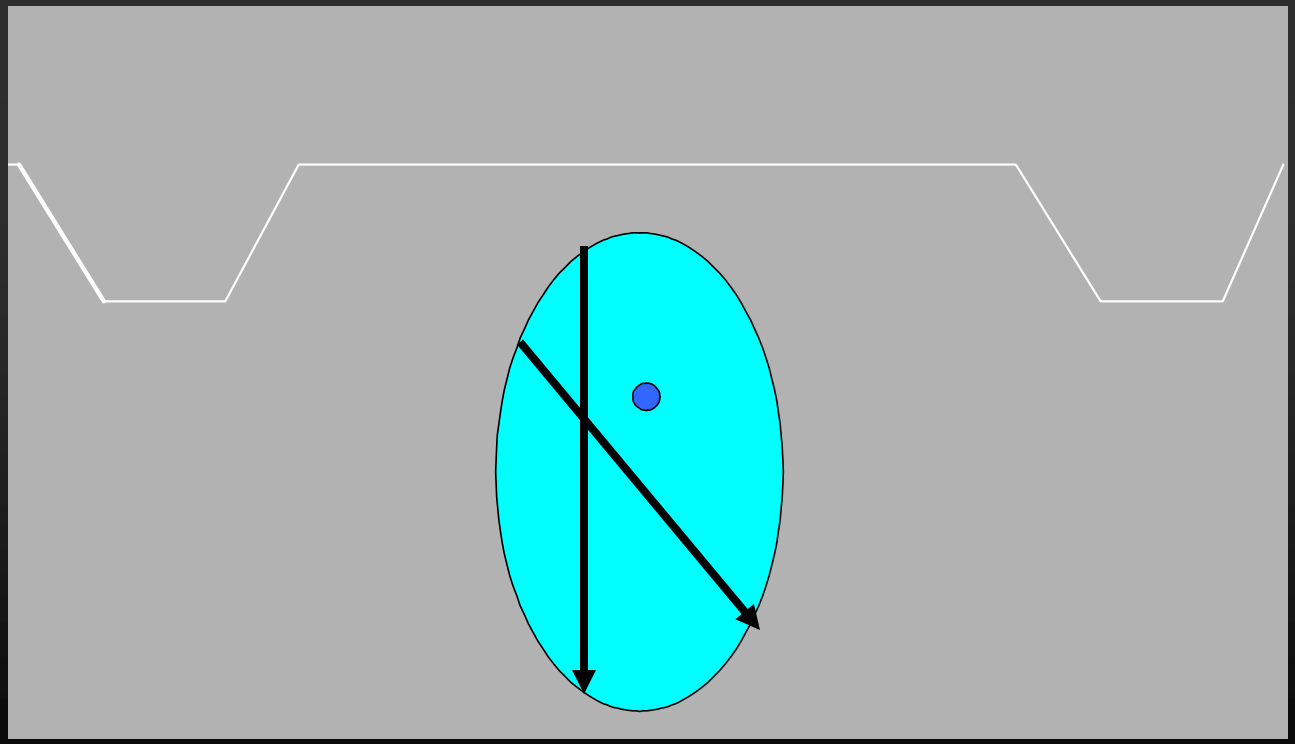
- ✓ crop N demand is predictable
  - concentrate N fertigation from early set through full bloom
- ✓ not all N needs to come from fertilizer
  - seasonal N rates > 200 lb/acre seldom justified, less needed in high NO_3-N residual fields

Growth stage	Duration (weeks)	N fertigation rate *no more than* (lb/acre/week)
2 weeks post-transplant - early fruit set	2-3	10
early fruit set - full bloom	3-4	30-35
full bloom - early red fruit	2-3	20-25

P management :

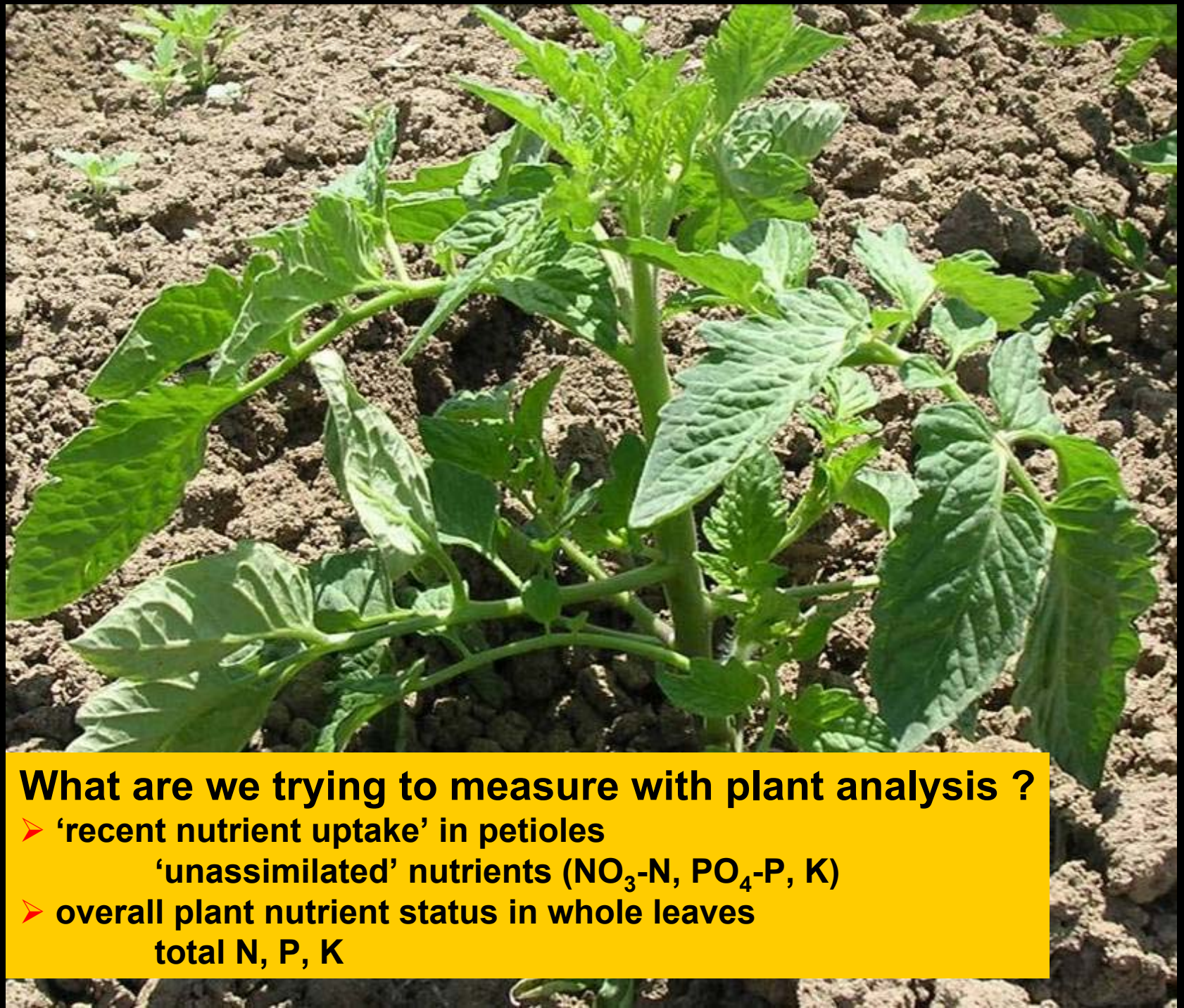
- ✓ **soil test threshold ≈ 20-25 PPM Olsen P**
- ✓ **for buried drip fields soil test the major root zone (6-18” depth)**
- ✓ **with appropriate preplant, in-season fertigation seldom necessary**

Soil sampling with buried drip :



K management :

- ✓ soil test K threshold harder to pin down
  - soils < 150 PPM likely to require K fertigation
  - soils up to 250 PPM may require fertigation if CEC or Mg is high
- ✓ use tissue analysis to guide K fertigation program

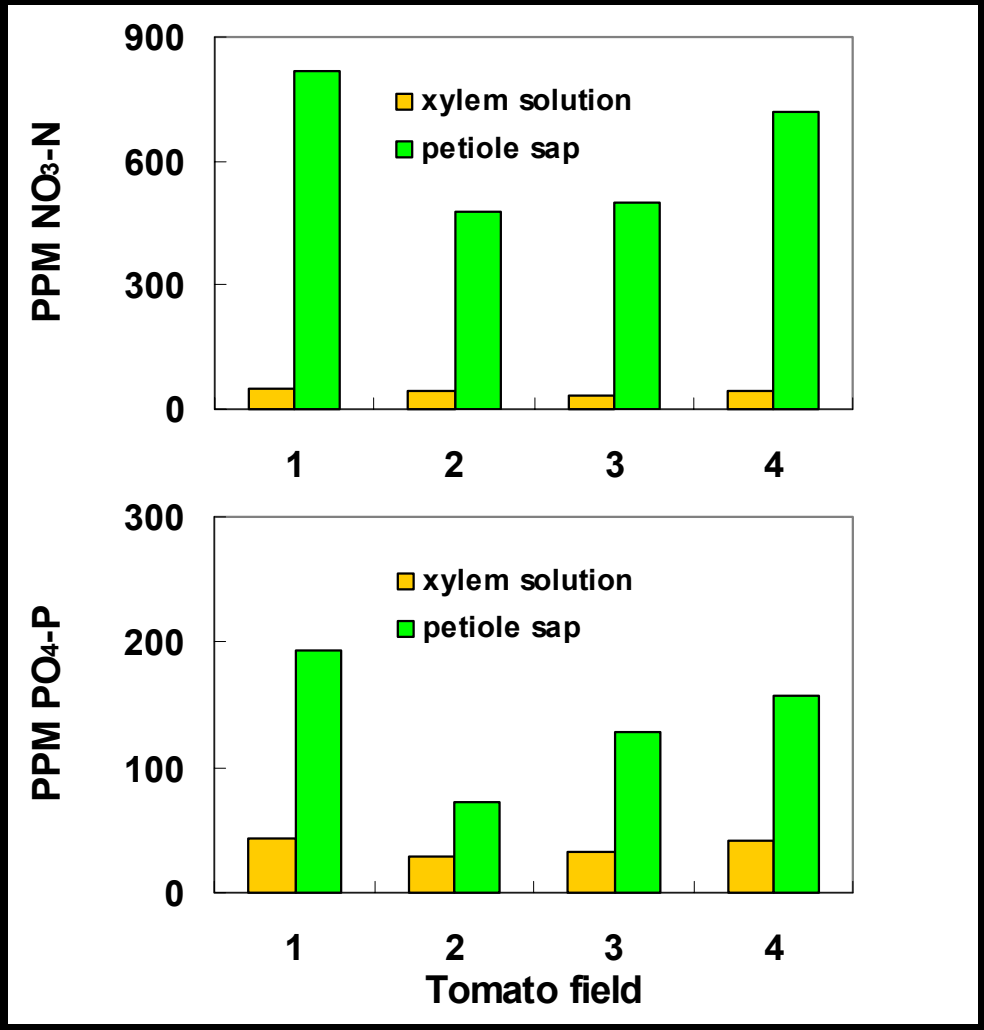


What are we trying to measure with plant analysis ?

- ‘recent nutrient uptake’ in petioles
  ‘unassimilated’ nutrients (NO_3-N, PO_4-P, K)
- overall plant nutrient status in whole leaves
  total N, P, K

Does petiole analysis really show ‘recent’ nutrient uptake ?

2007 Processing tomato monitoring, early fruit set



Conclusion :

- most petiole NO_3-N and PO_4-P are already stored in plant cells,
  and therefore the concentration is as dependent on the rate of conversion to organic forms as on soil nutrient supply

2007 UCD fertigation trial

Limitations of petiole analysis :

✓ plants stockpile small amounts of unassimilated nutrients,
so petiole concentrations can change rapidly

UCD excess N treatment :

	lb/acre		
Growth stage	Total plant N content	Total plant NO_3-N content	N uptake/day
Early bloom	28	3	1
Mid fruit set	89	11	4

Whole leaf analysis :

Advantages:

- ✓ Correlates with whole plant nutrient status

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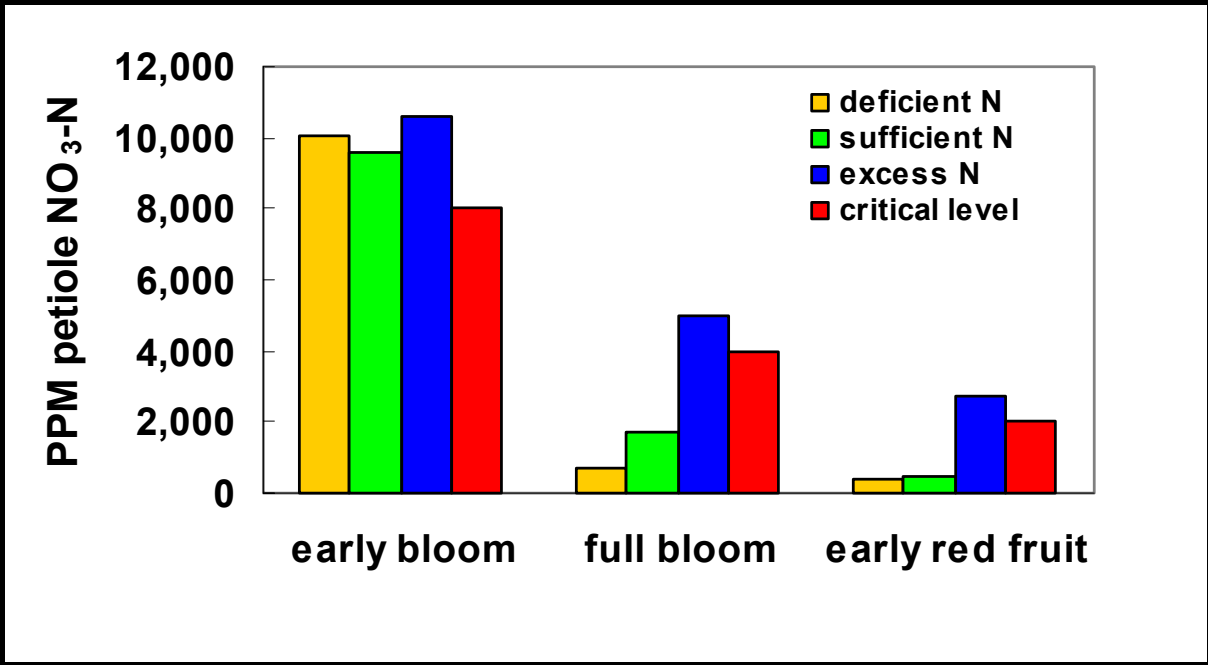
Excess N treatment :

	lb/acre		
Growth stage	Total plant N content	N uptake/day	Daily uptake as % of biomass N
Early bloom	28	1	4
Mid fruit set	89	4	4

High leaf N can indicate sufficient biomass N to accommodate 7+ days of crop growth

Comparing petiole and whole leaf analysis :

2007 UCD :



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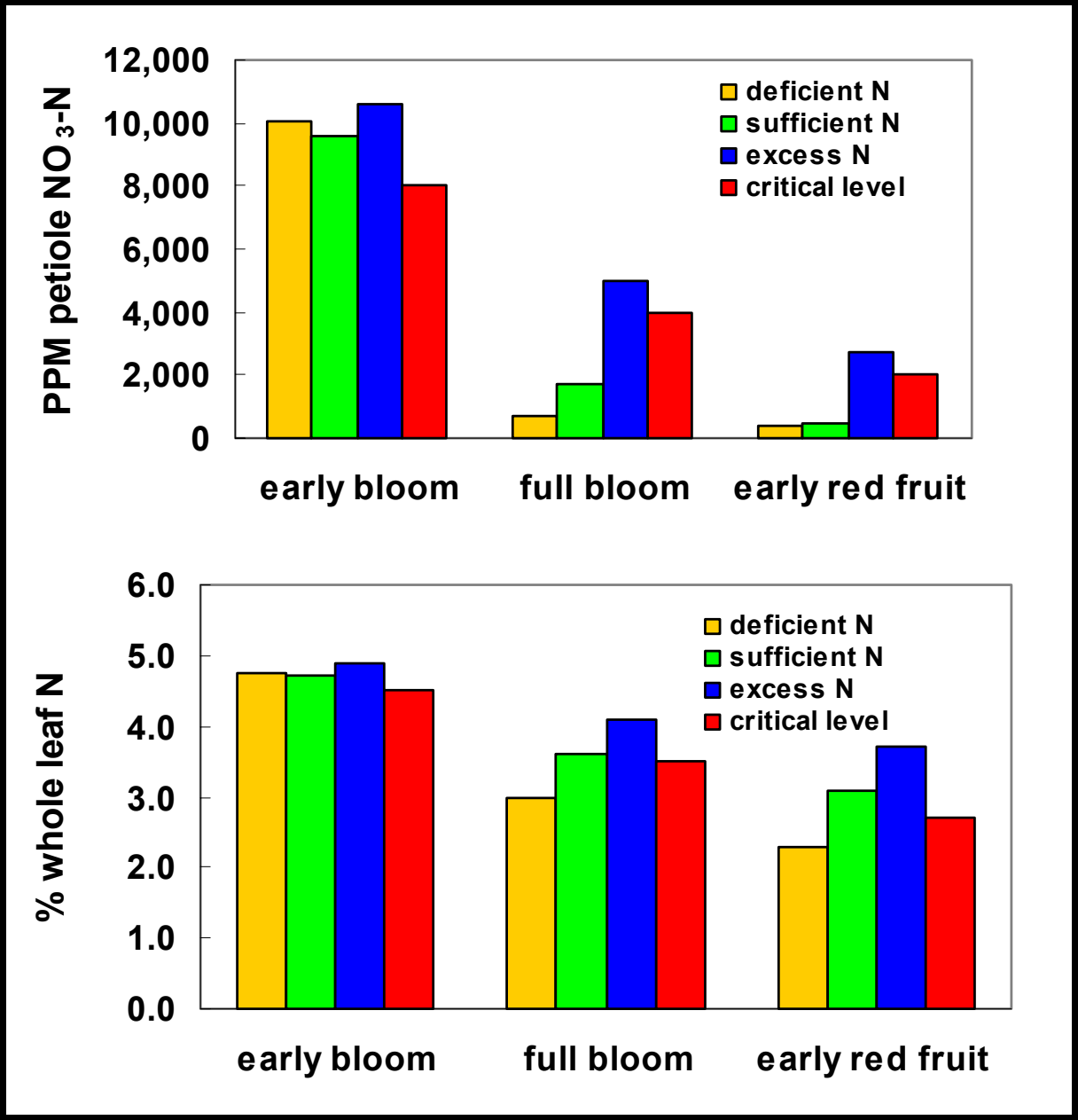
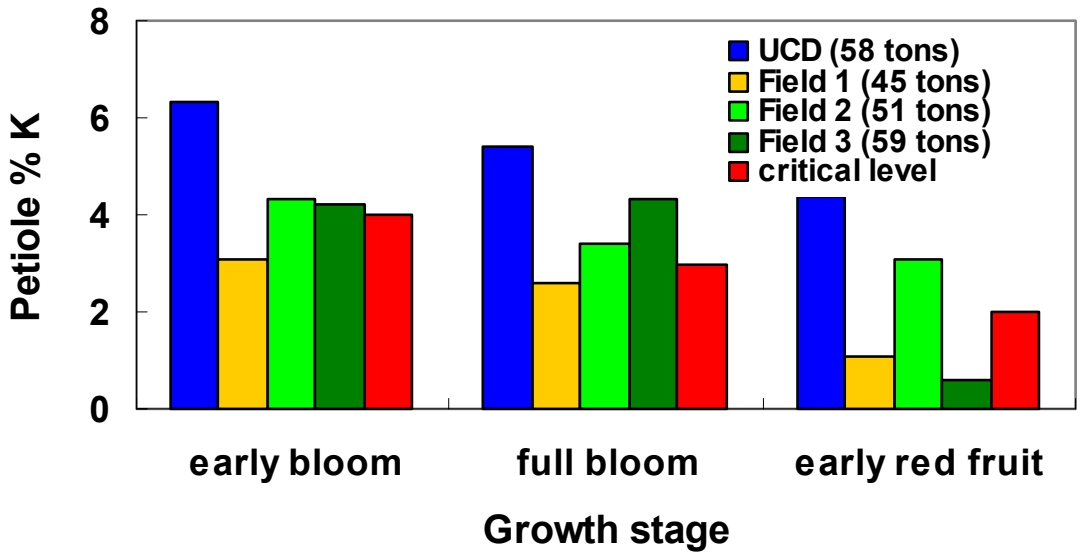
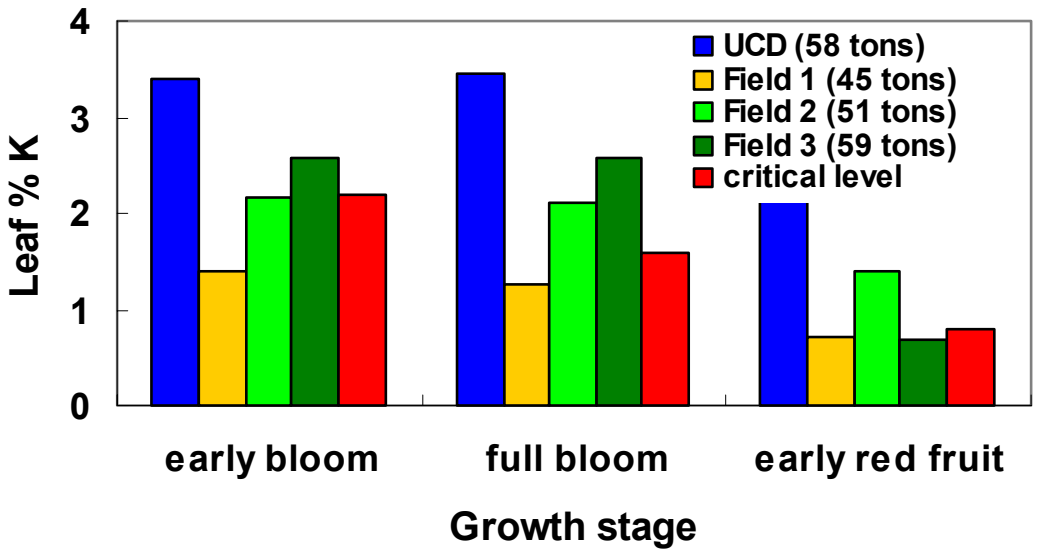


Comparing petiole and whole leaf analysis :

2007
Commercial fields





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- ✓ current petiole NO_3-N and PO_4-P sufficiency levels are too high
- ✓ petiole analysis can document current sufficiency, but nothing more
- ✓ leaf analysis for total N and P is more stable, more reliable measure of crop nutrient status
- ✓ crop K status can be estimated by either tissue test