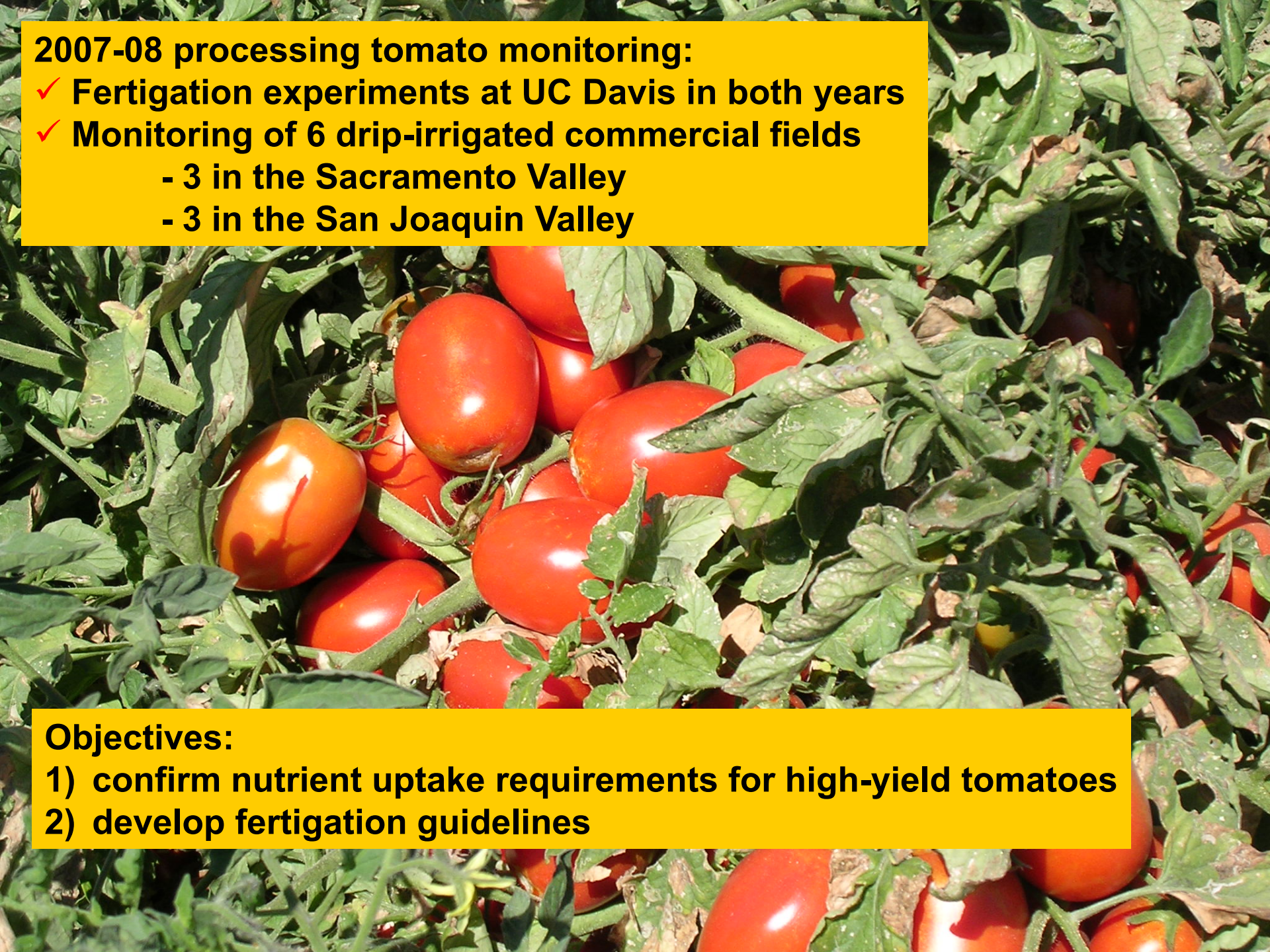
Developing practical fertility monitoring tools for tomatoes

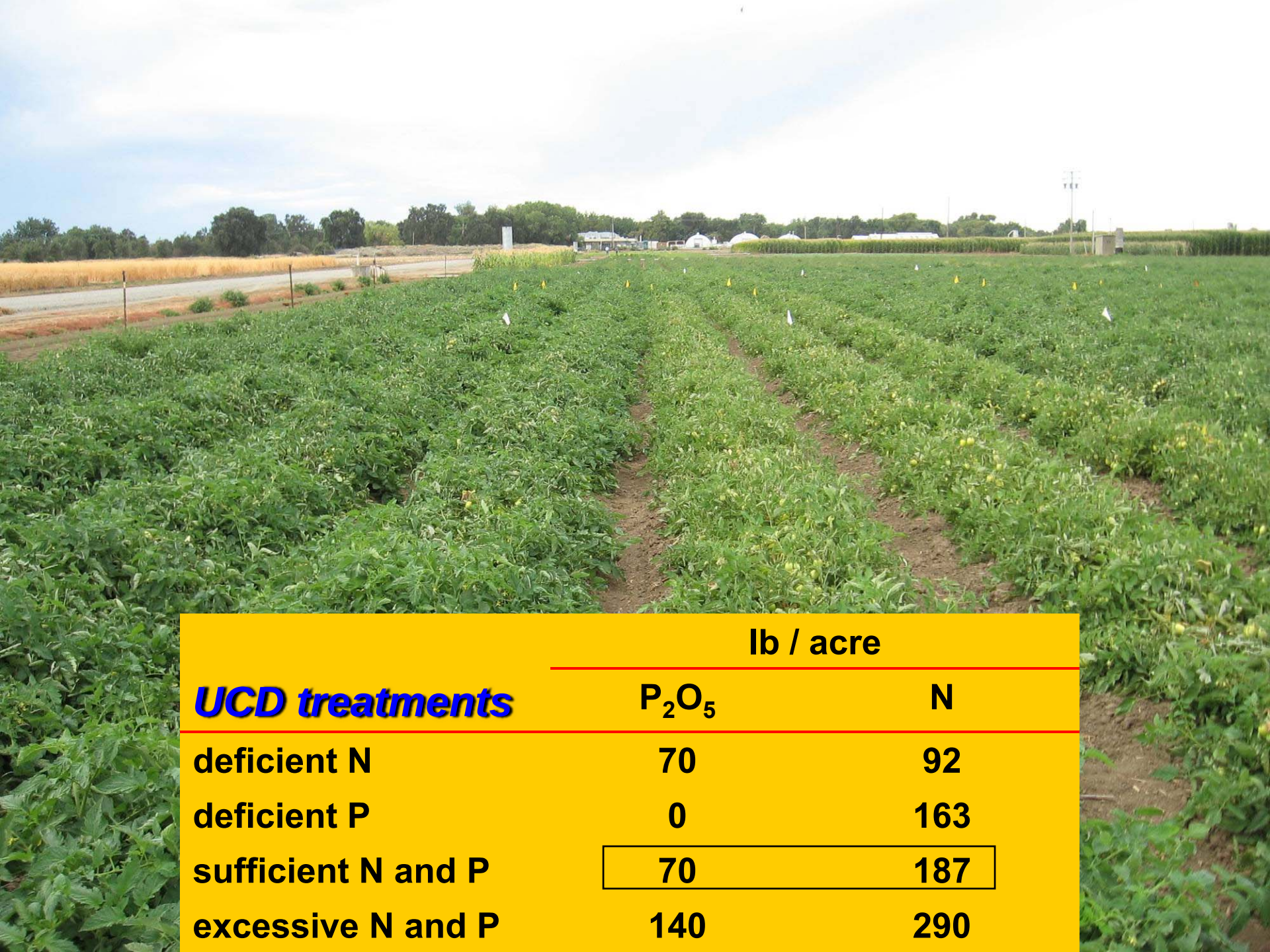


2007-08 processing tomato monitoring:

- ✓ **Fertigation experiments at UC Davis in both years**
- ✓ **Monitoring of 6 drip-irrigated commercial fields**
  - **3 in the Sacramento Valley**
  - **3 in the San Joaquin Valley**

Objectives:

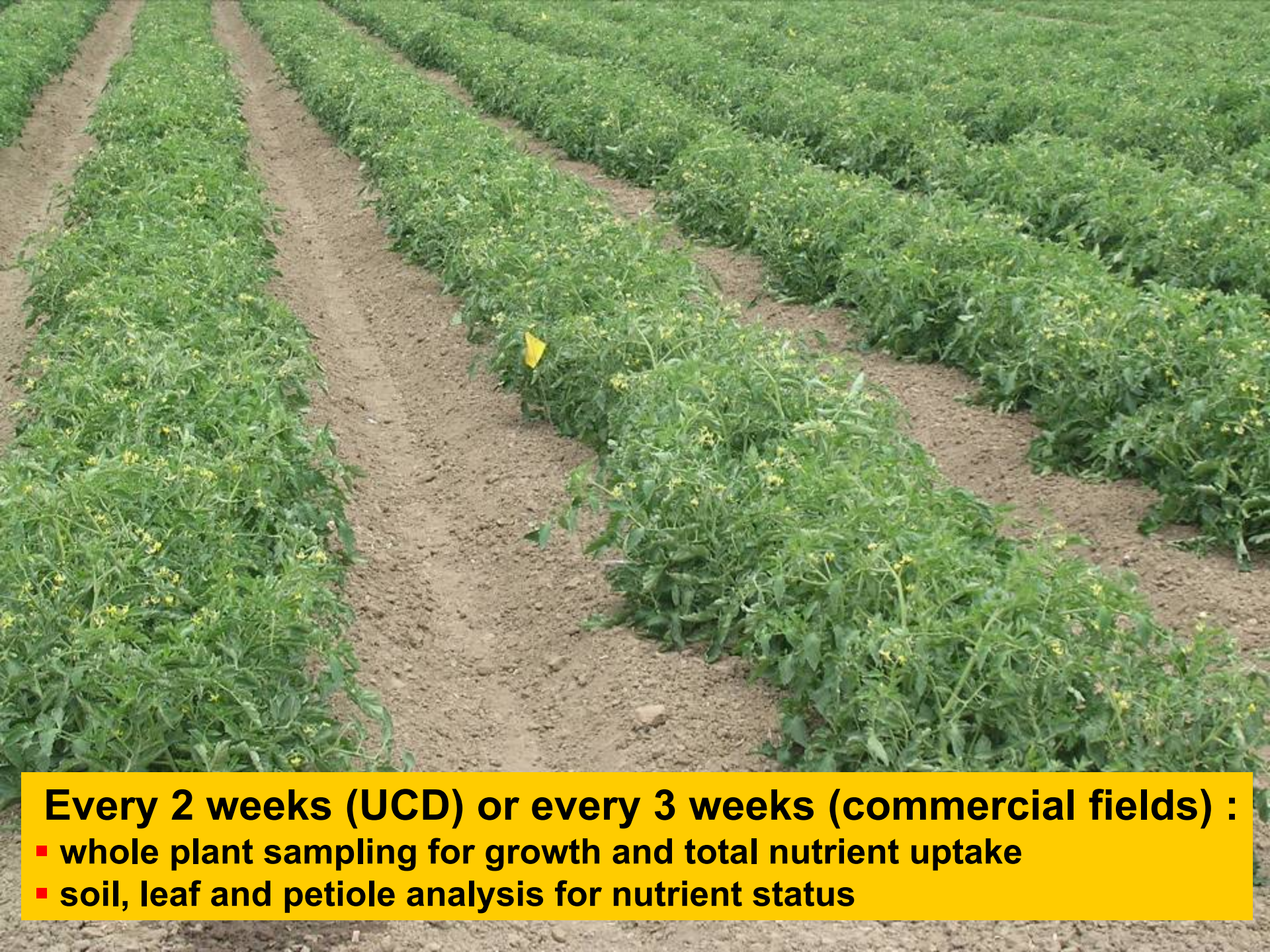
1) **confirm nutrient uptake requirements for high-yield tomatoes**
2) **develop fertigation guidelines**



UCD treatments	lb / acre	
	P_2O_5	N
deficient N	70	92
deficient P	0	163
sufficient N and P	70	187
excessive N and P	140	290

Commercial fields :

Field	Texture	Exchange K (PPM)	Olsen P PPM	Variety	lb / acre applied N	P_2O_5	K_2O
1	loam	114	4	H 2601	169	14	24
2	clay loam	138	16	AB 5	181	14	18
3	clay loam	110	11	AB 2	186	90	33
4	clay loam	231	6	AB 2	166	32	0
5	clay loam	182	6	H 2401	196	67	0
6	clay loam	439	29	H 8004	214	53	0



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

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

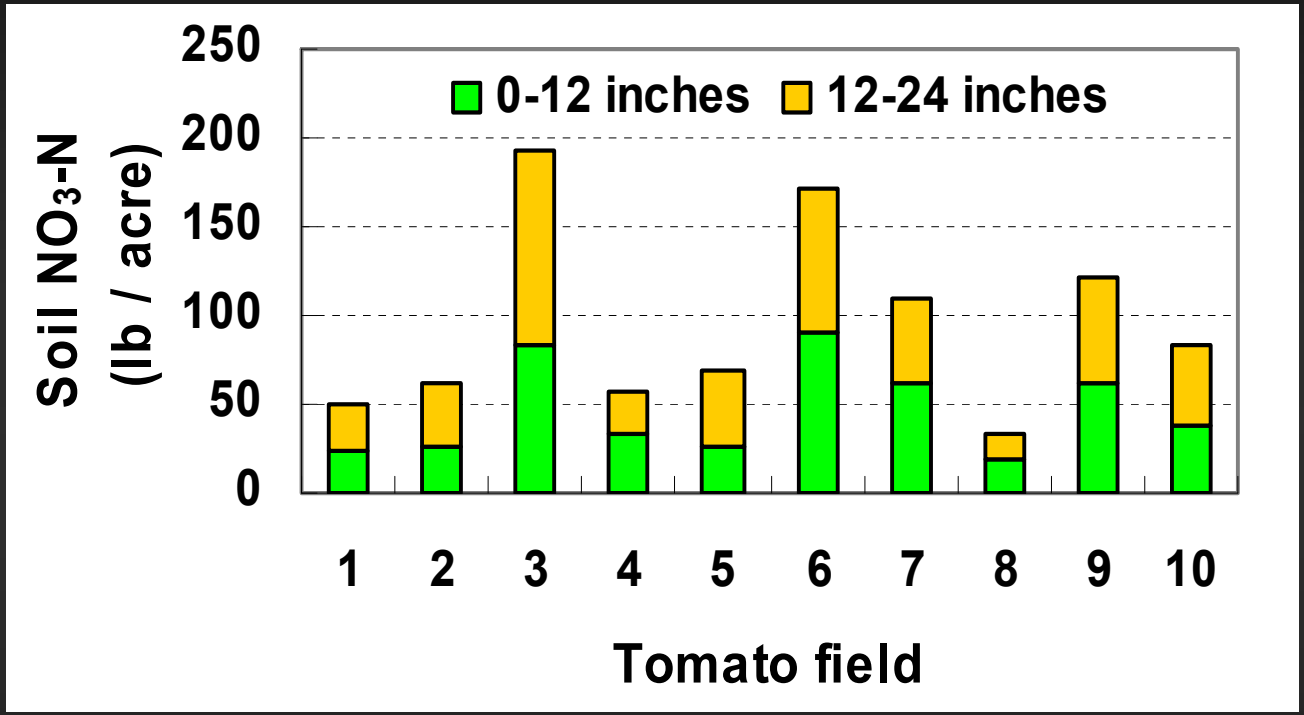
Nitrogen dynamics :

	Fruit yield	Nitrogen (lb/acre)		
	(tons/acre)	applied	total uptake	removed with fruit
Field 6	71	214	341	231
UCD 08	70	183	271	179
UCD 07	61	190	224	171
Field 3	59	186	245	179
Field 2	51	181	243	171
Field 4	51	166	183	131
Field 5	49	196	229	162
Field 1	45	169	191	136
average	57	186	241	170

Sources of non-fertilizer N :

✓ **Soil residual NO_3-N :**

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



✓ **Soil organic N mineralization :**

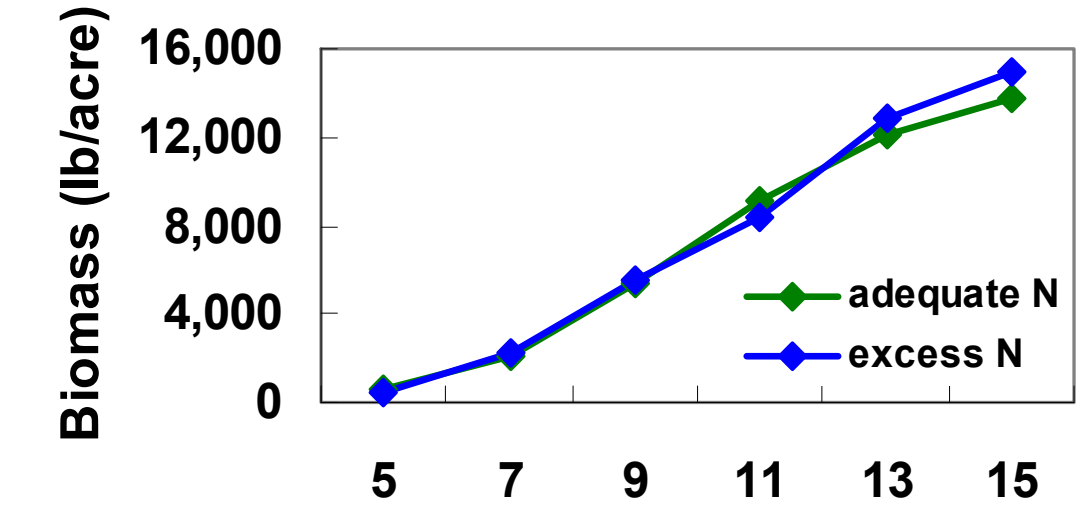
≈ 1-2 % of soil organic N is mineralized during a summer season

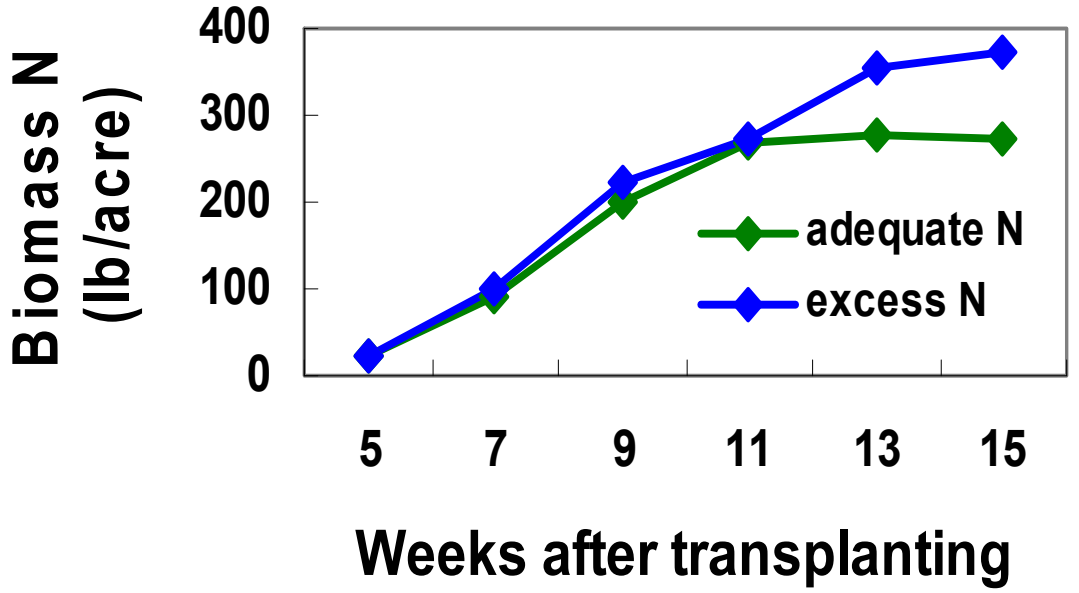
≈ 30-60 lb N/acre in soil with 1% organic matter

2008 UCD N response :

adequate N = 183 lb/acre
= 70 tons/acre

excess N = 286 lb N/acre
= 71 tons/acre

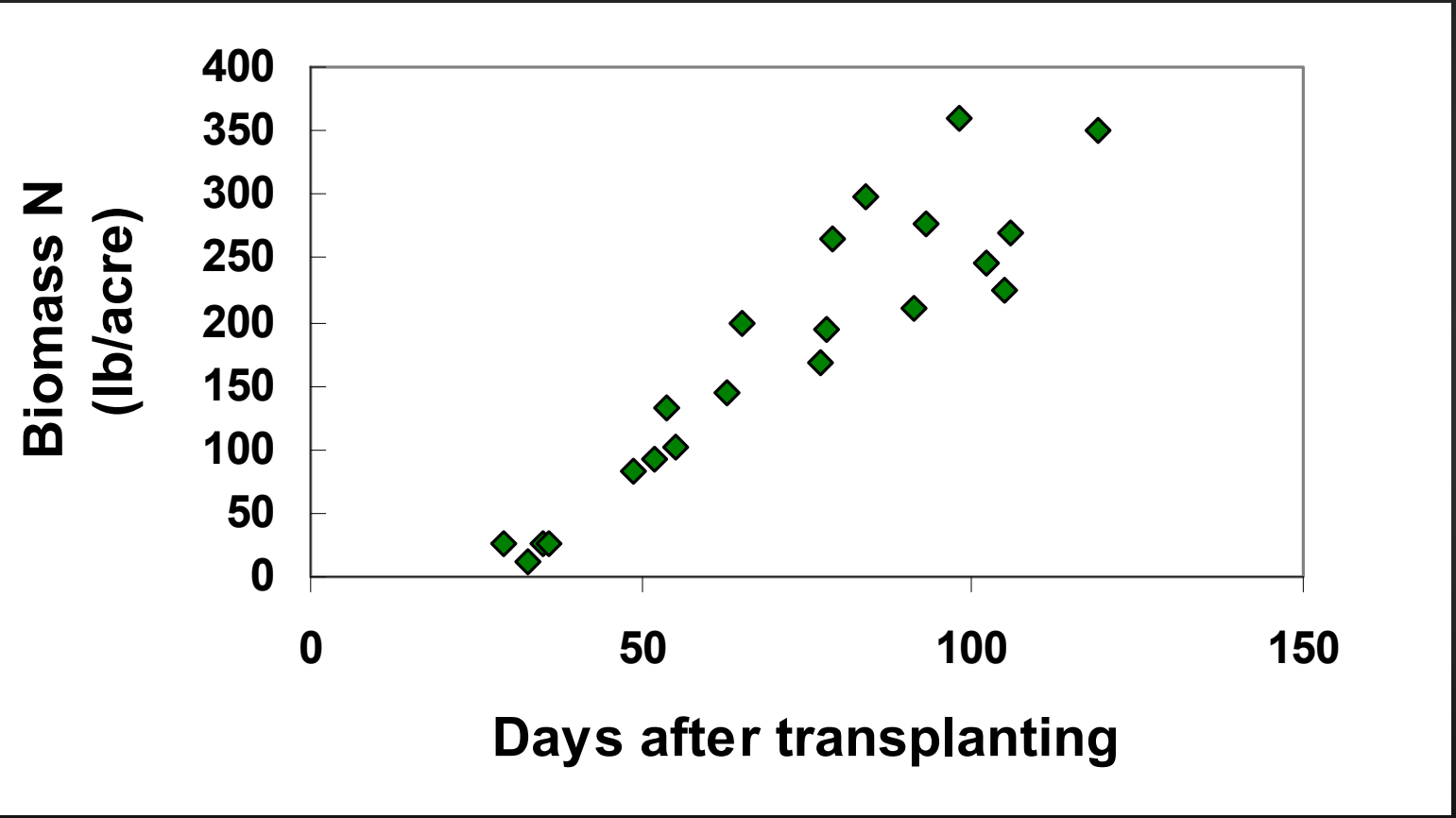




N fertigation ended in week 11

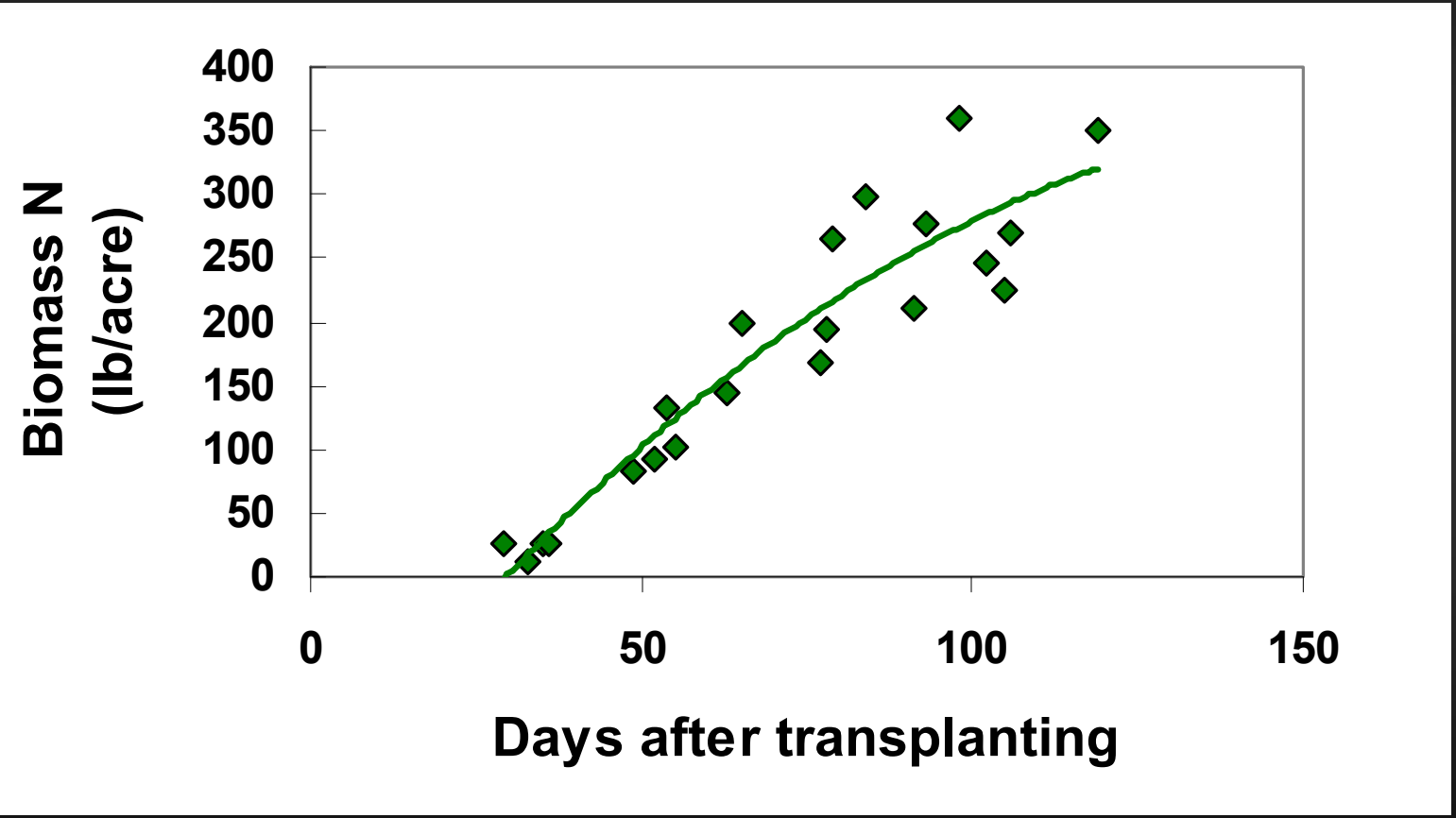
Efficient N fertigation management

N uptake of the 4 highest yielding fields :

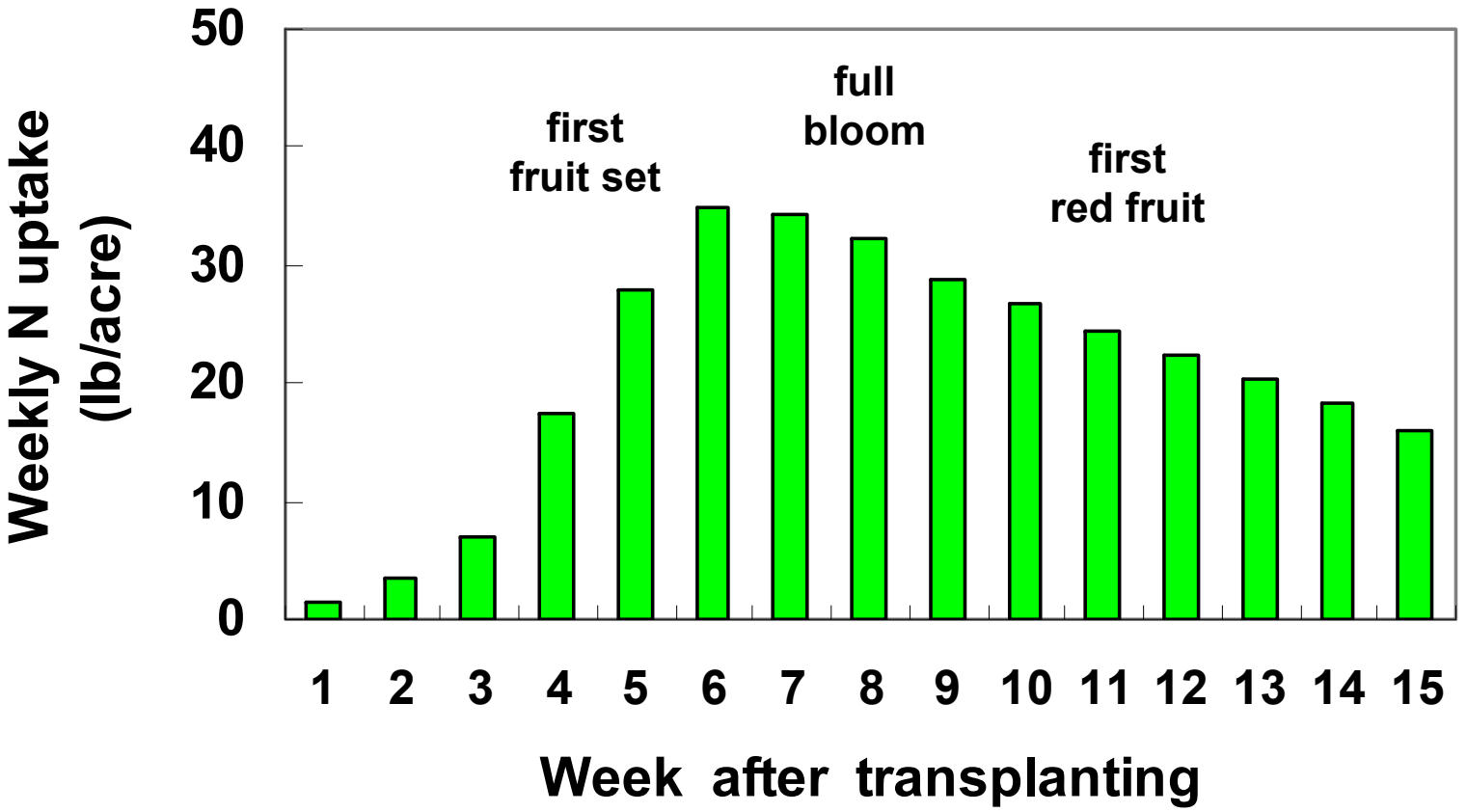


Efficient N fertigation management

N uptake of the 4 highest yielding fields :



Crop N uptake rate :



What is a reasonable N fertigation template ?

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

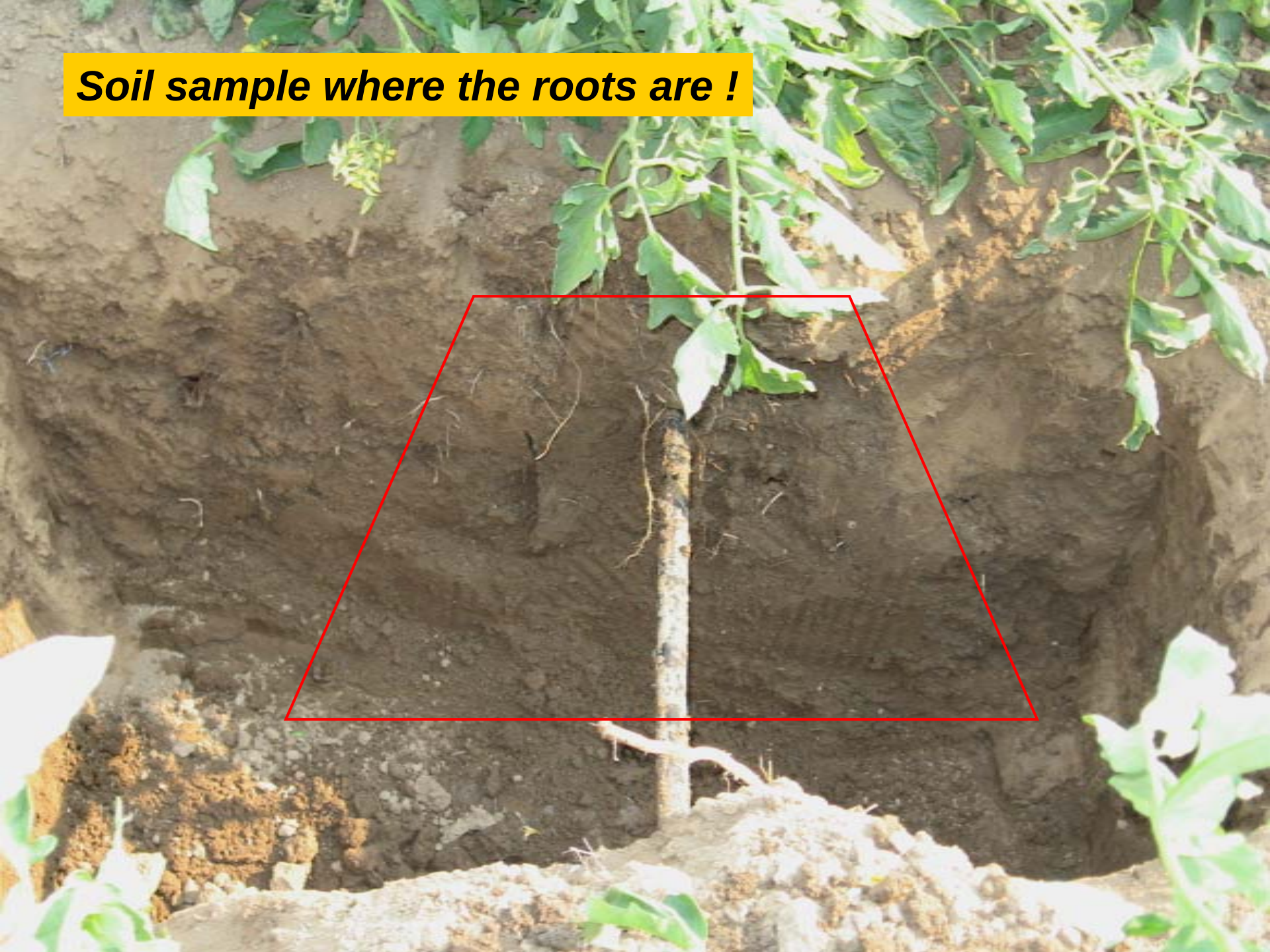
* Not all plant N uptake comes from fertilizer

Phosphorus dynamics :

	Fruit yield	Phosphorus (lb P_2O_5 equivalent/acre)		
	(tons/acre)	applied	total uptake	removed with fruit
Field 6	71	53	107	81
UCD 08	70	70	98	72
UCD 07	61	70	84	67
Field 3	59	90	79	60
Field 2	51	14	63	42
Field 4	51	32	81	60
Field 5	49	67	70	53
Field 1	45	14	58	42
average	57	51	80	60

P management :

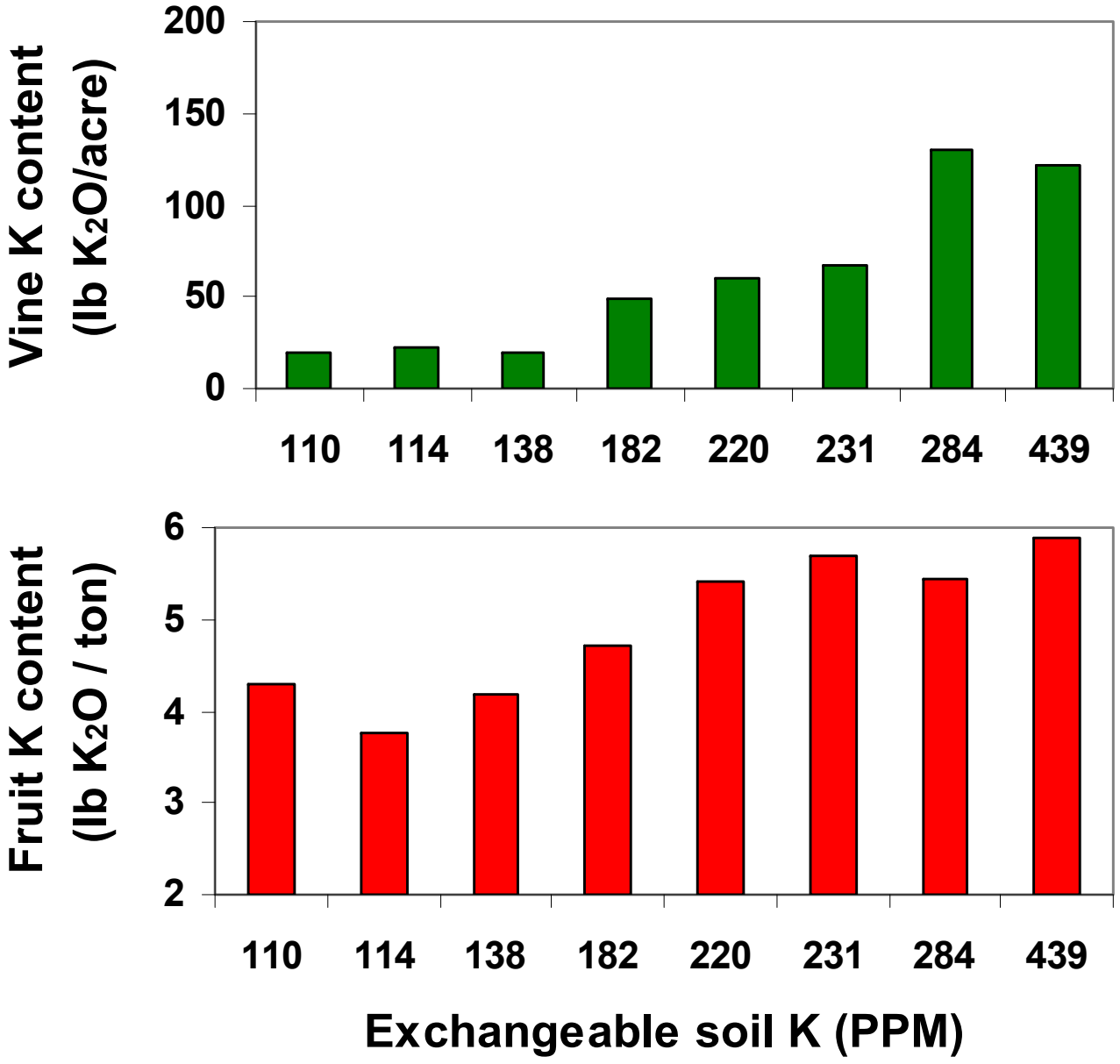
- ✓ **yield response threshold ≈ 20 PPM Olsen P**
- ✓ **for buried drip fields soil test the major root zone**


Soil sample where the roots are !

Potassium dynamics :

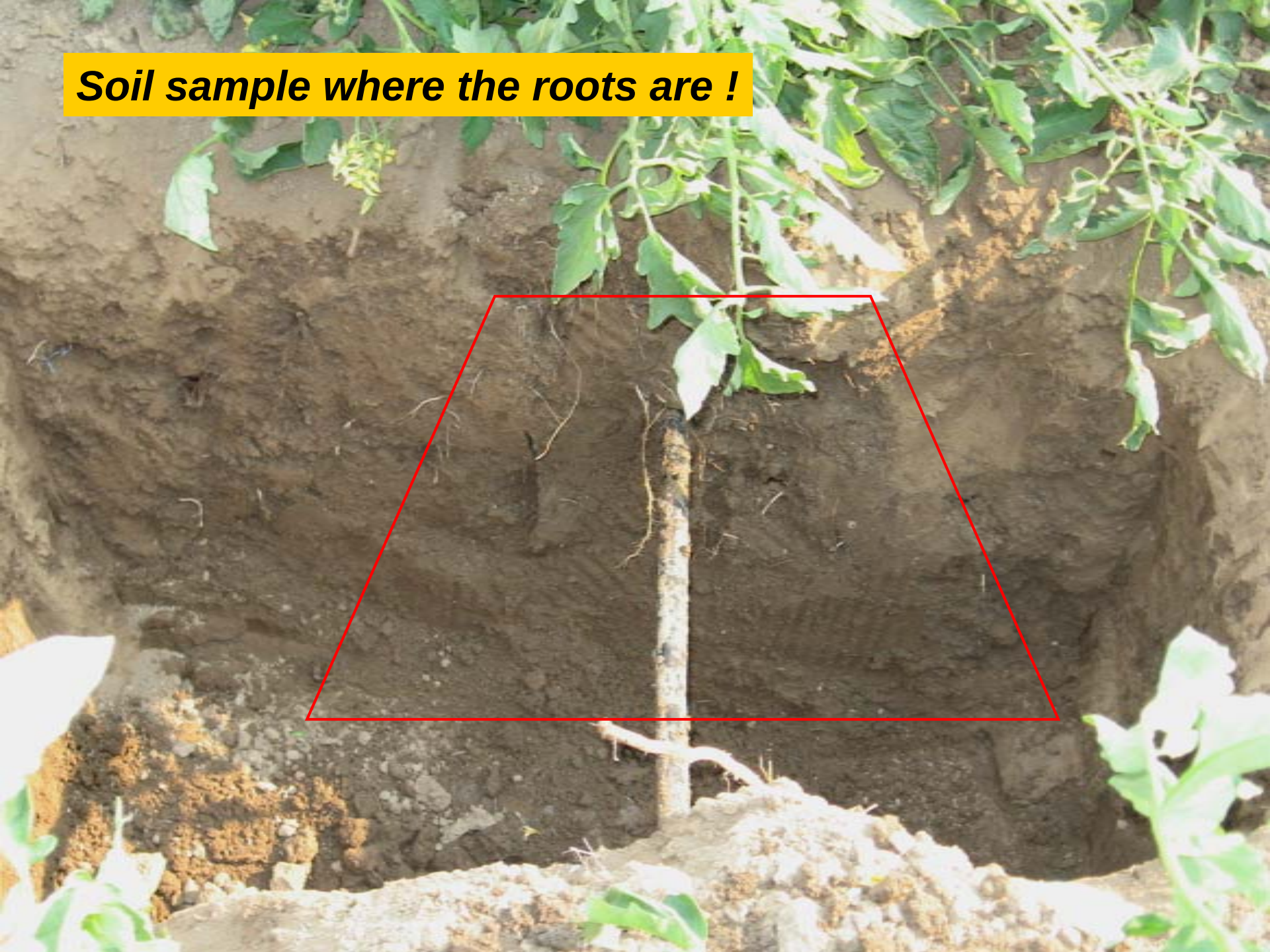
	Fruit yield	Potassium (lb K_2O equivalent/acre)		
	(tons/acre)	applied	total uptake	removed with fruit
Field 6	71	0	541	419
UCD 08	70	0	511	381
UCD 07	61	0	418	358
Field 3	59	33	273	253
Field 2	51	18	233	213
Field 4	51	0	357	290
Field 5	49	0	280	231
Field 1	45	24	192	169
average	57	9	351	289

At harvest …


Vine K content
(lb K_2O/acre)
200
150
100
50
0
110
114
138
182
220
231
284
439
Fruit K content
(lb K_2O / ton)
6
5
4
3
2
110
114
138
182
220
231
284
439
Exchangeable soil K (PPM)

K management :

- ✓ **approximate yield response threshold**
  - **soils < 150 PPM likely to respond to K fertigation**
  - **soils up to 250 PPM potentially responsive**
- ✓ **current practices degrade soil K fertility**


Soil sample where the roots are !

How and when to apply K ?

- ✓ in soil with K fixation capacity, fertigation is best
- ✓ best timing is during fruit set