Soil fertility management for fresh market tomato and pepper production

Typical nutrient uptake:

- 25 ton/acre pepper crop
- 40 ton/acre tomato crop

	lbs per acre		
	N	P_2O_5	K_2O
pepper	200 - 260	40 - 60	240 - 320
tomato	200 - 250	60 - 80	300 - 350

Each ton of additional fruit has approximately:

- ✓ 3 lb N
- ✓ 1 lb P_2O_5
- ✓ 4-5 lb K_2O

Phosphorus requirement :

Common soil tests for P availability :

Olsen (bicarbonate) test - extraction in sodium bicarbonate at pH 8.5
best method if soil pH > 6.5

Bray test - extraction in dilute acid
useful in acidic soil (pH < 6.5)

Bray values much higher than Olsen in most cases

Is P application always necessary ?
What application rate is reasonable ?

Soil P availability requirement :

High	Low
Lettuce	
Pepper	
	Tomato

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What application rate is reasonable ?

Soil P availability requirement :

High — **Low**

Lettuce

Pepper

Tomato

60 PPM

20 PPM ← **Agronomic threshold (Olsen test)**

Pepper :

Olsen P level	Response to applied P
< 20 PPM	positive response guaranteed
20 - 40 PPM	positive response possible, especially in cold soil
> 40 PPM	positive crop response unlikely

Fresh tomato :

Olsen P level	Response to applied P
< 10 PPM	positive response guaranteed
10 - 20 PPM	positive response likely, especially in cold soil
> 20 PPM	positive crop response unlikely

Application rate ?

- limit application to crop removal rate in fields with high soil P
- rates > 120-150 lb P_2O_5/acre questionable, regardless of soil test level

Nitrogen management :

- Crop N uptake is predictable by growth stage

lb N per acre per day:

< 1

4 - 5

< 3

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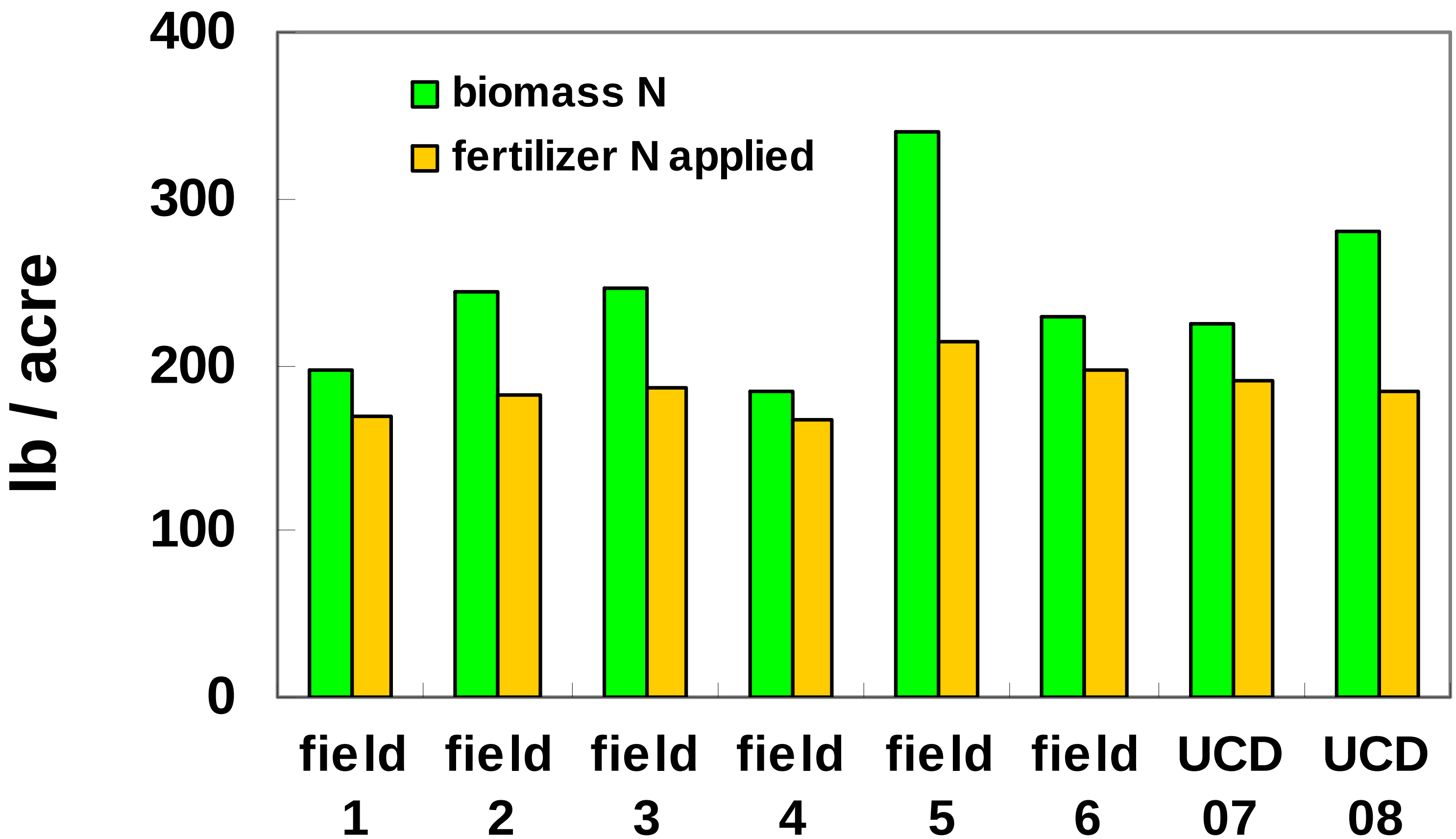
- **Not all N needs to come from fertilizer application:**
  - **residual soil NO_3-N can be substantial**

Not all crop N comes from fertilizer :

2007-08 processing tomato field survey :



Soil N availability can be measured, or inferred

Excessive N application can be both an agronomic problem, and an environmental problem :

- **Environmental targets for N concentration in groundwater is 10 PPM NO_3-N; for surface water may be as low as 1 PPM**
- **Any water that escapes a fertilized field is likely to greatly exceed environmental targets**

Irrigation efficiency and N management :

- at common soil NO_3-N levels during the season, one inch of leaching may carry 20-30 lb NO_3-N/acre out of the root zone

Potassium management :

- Crop K uptake is predictable by growth stage

lb N per acre per day:

< 1

4 - 7

< 4

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- Crop K uptake is predictable by growth stage

lb N per acre per day:

< 1

4 - 7

< 4

- Moderate (pepper) to high (tomato) K requirements
- majority of K ends up in fruit
- leaf K declines to ‘feed’ the fruit; that’s why deficiency shows late

Evaluating soil K supply :

- 'exchangeable' K, usually expressed as PPM
- K as a % of base exchange

  [milliequivalent of K / (meq Ca + Mg + Na + K)] x 100

Soil test K interpretation :

- fields > 200 PPM exchangeable K, and > 3% of base exchange, do not require K fertilization
- soils < 150 PPM, or < 2% of base exchange, should be fertilized
- K fertilization is most effective during fruit set and early fruit development

Crop monitoring options

In-season soil nitrate testing :

✓ high root zone soil NO_3-N concentration (> 20 PPM) indicate that additional N application can be postponed

Soil nitrate testing most useful early in the season

Petiole testing as a management tool ?

- high NO_3-N or PO_4-P concentration guarantees *current* sufficiency, but does not project far into the future

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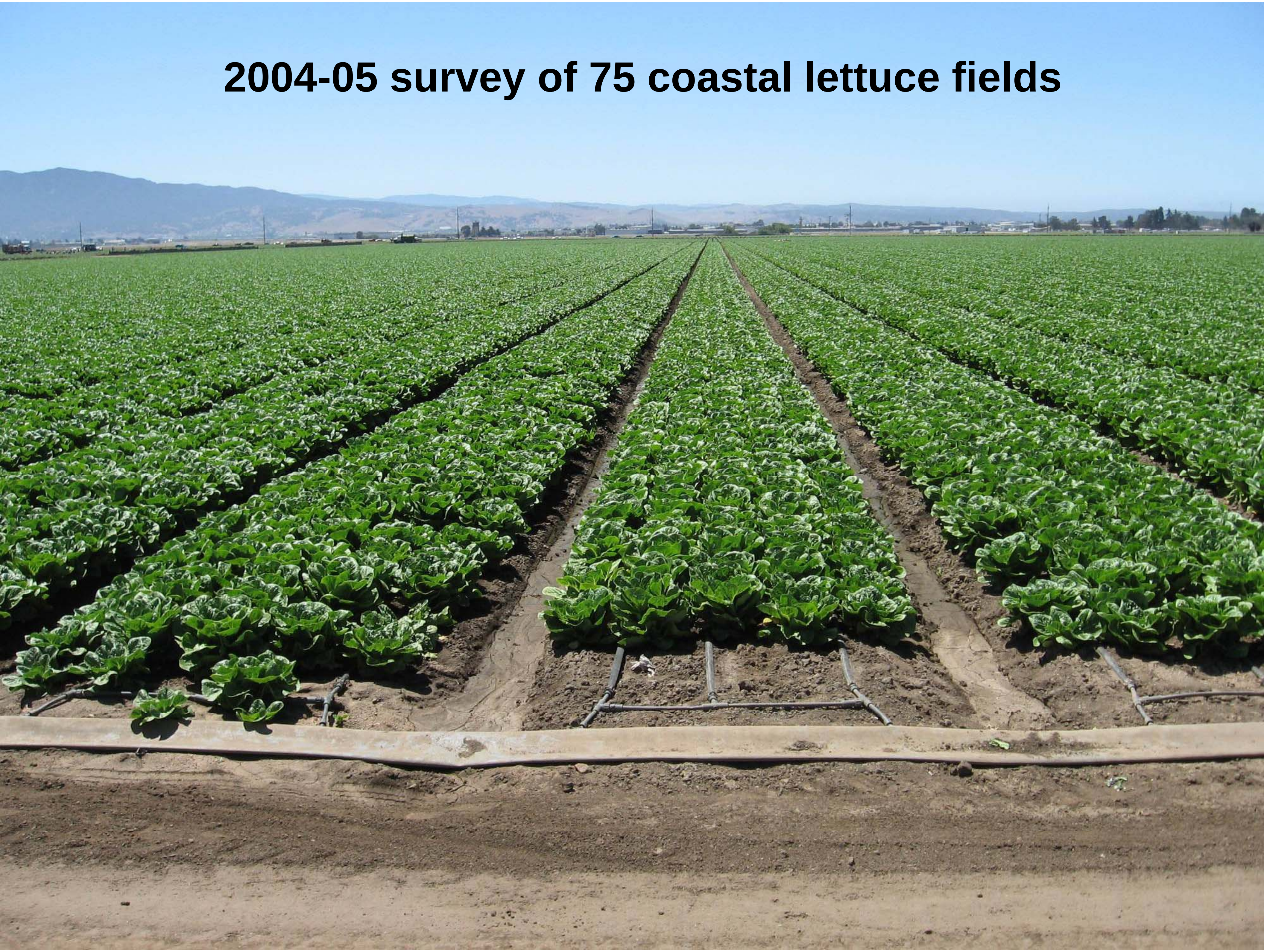
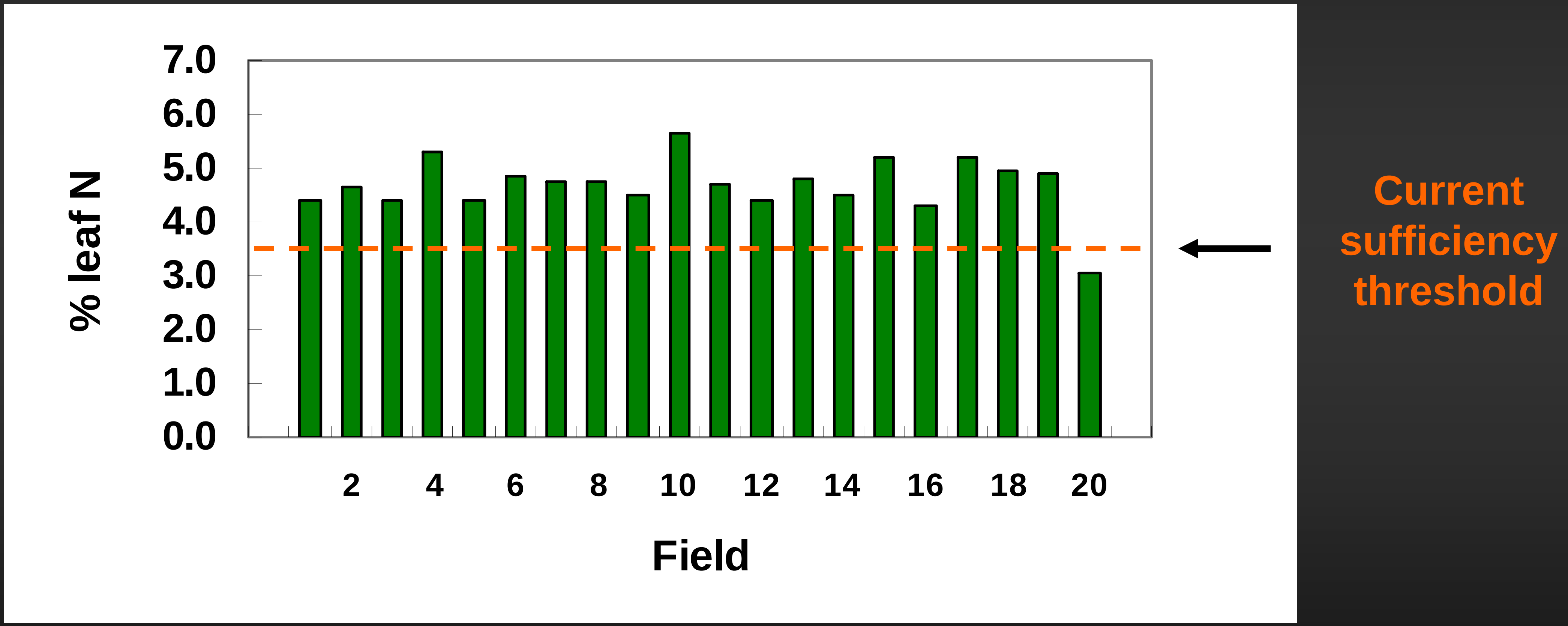
- high NO_3-N or PO_4-P concentration guarantees *current* sufficiency, but does not project far into the future
- lower NO_3-N or PO_4-P concentration *does not prove deficiency*

2004-05 survey of 75 coastal lettuce fields



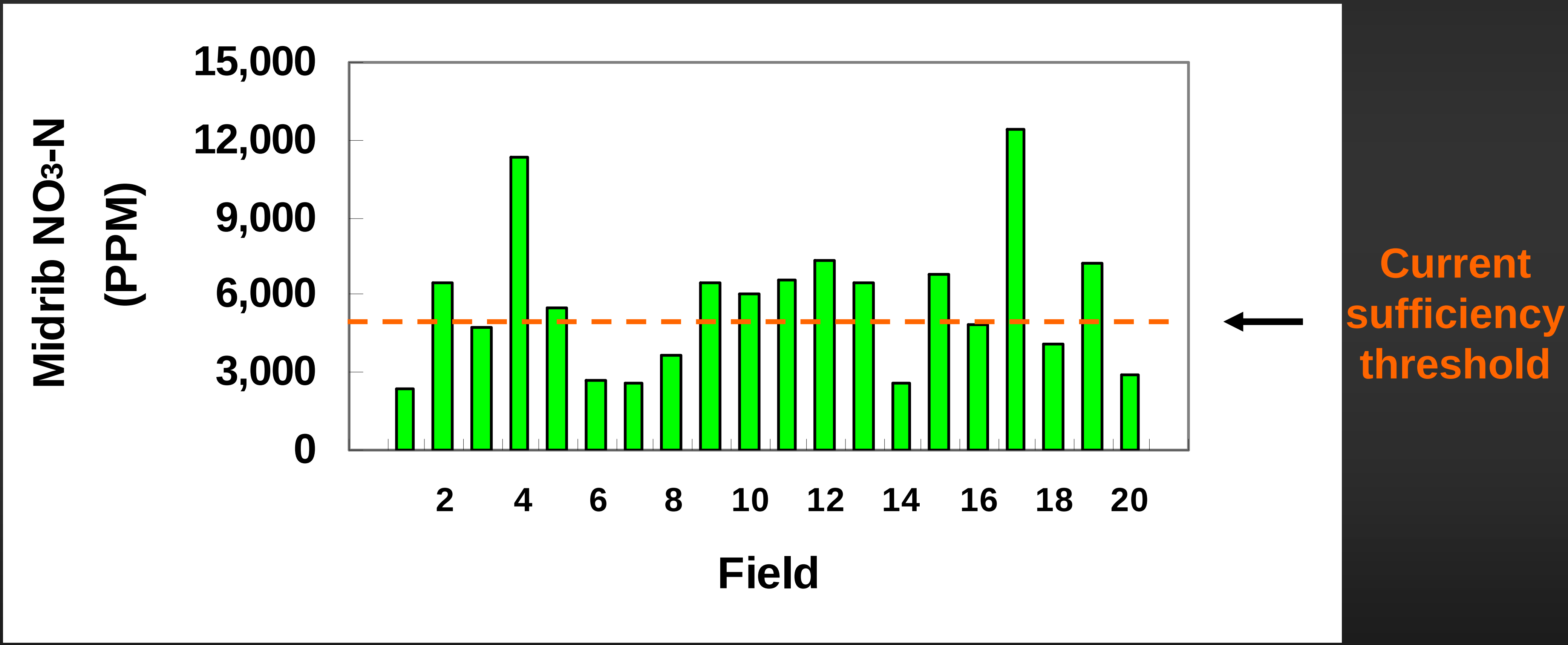
at early heading stage :

Leaf total N of the 20 *highest yielding fields* …



at early heading stage :

Midrib NO_3-N of the 20 *highest yielding fields* …



Tissue sampling in processing tomato :

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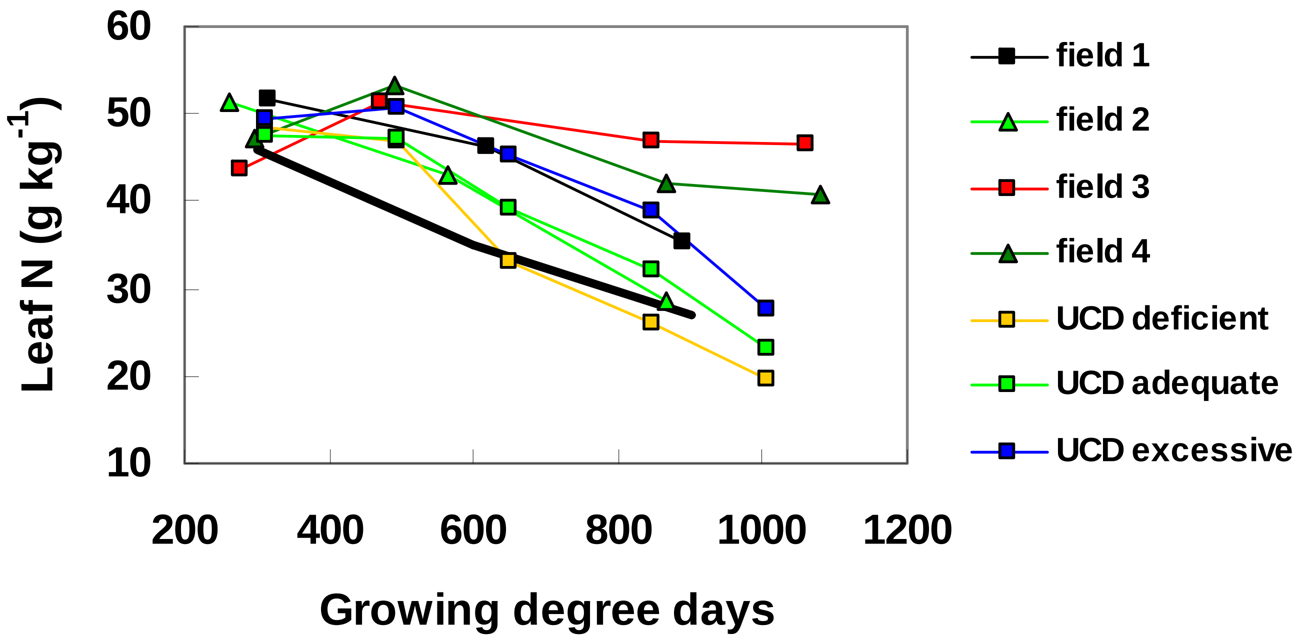

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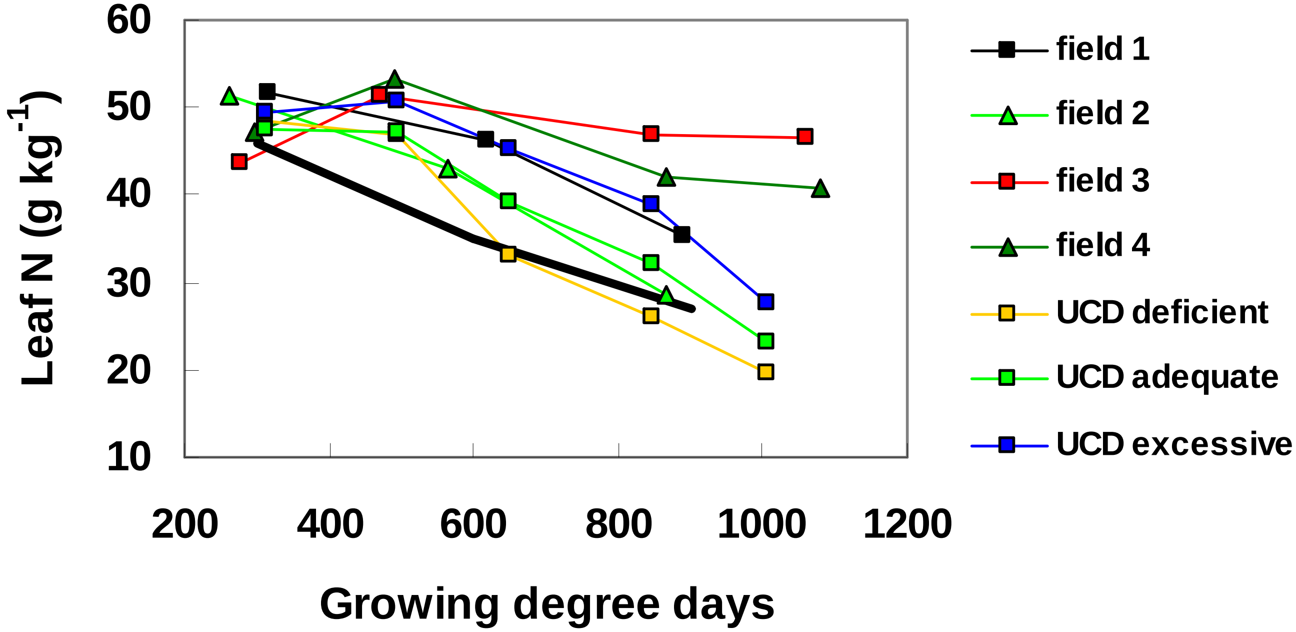
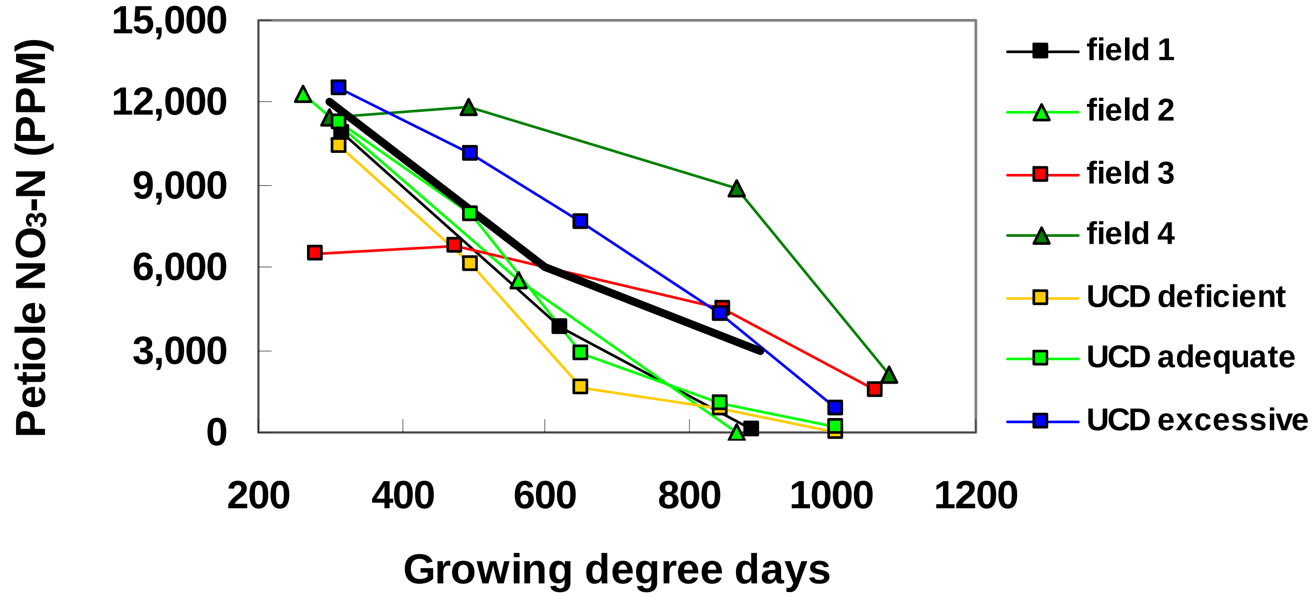
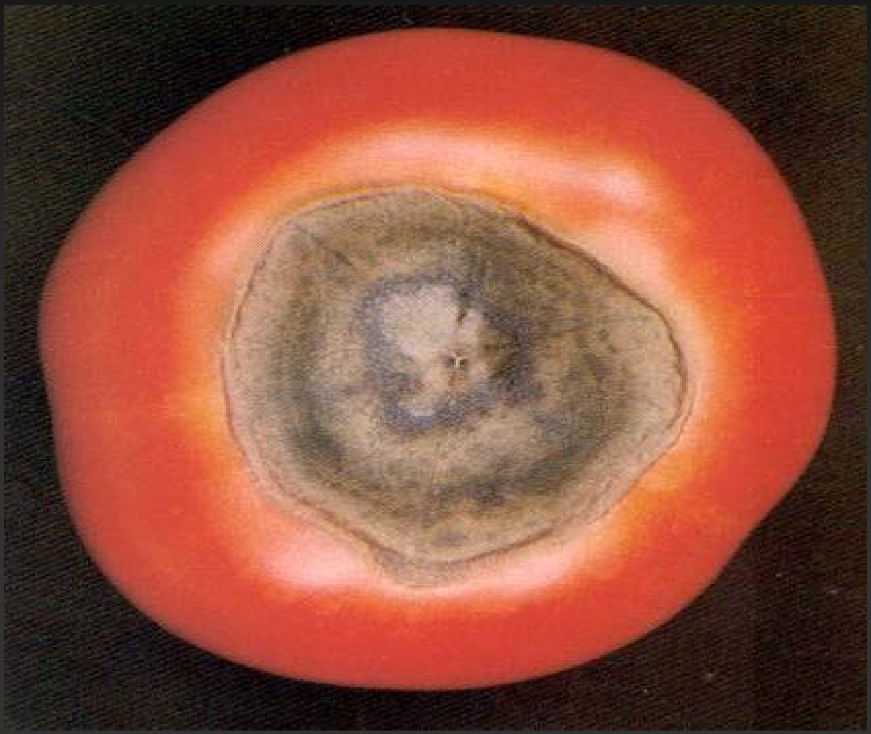
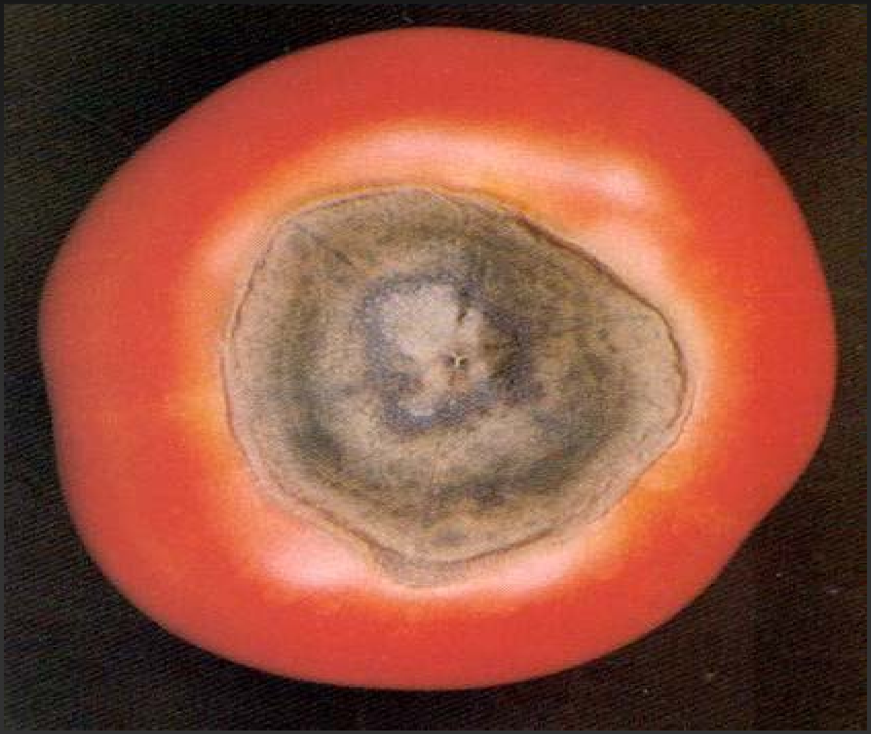






Calcium disorders :

- **symptoms develop because insufficient Ca is moved into actively growing cells during fruit development**

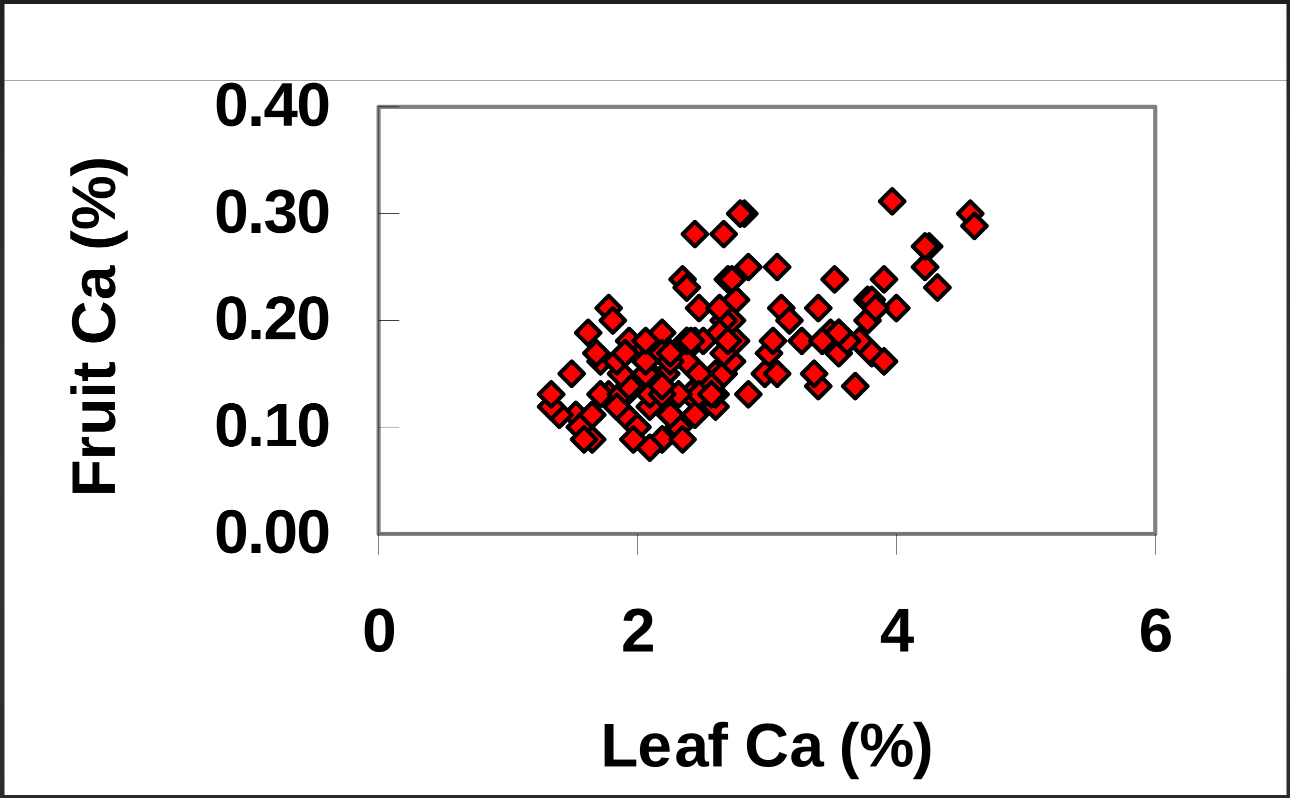


Calcium disorders :

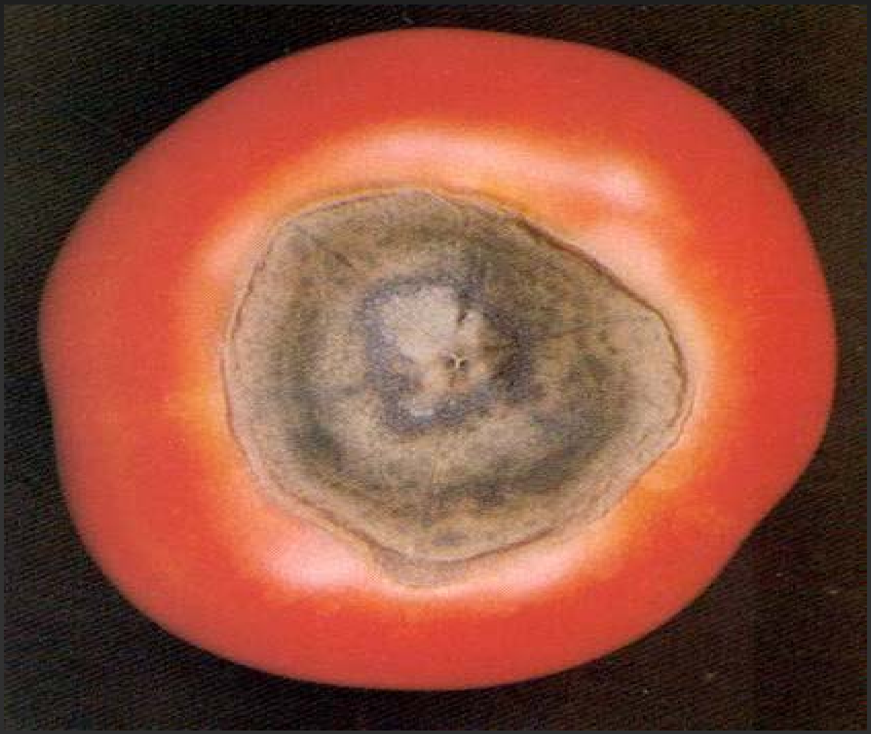
- symptoms develop because insufficient Ca is moved into actively growing cells during fruit development
- origin of the problem is the inefficient way plants move Ca into fruit; soil Ca limitation seldom the primary problem

Calcium doesn't move into fruit easily :

Processing tomato fruit quality survey, 140 fields :



- Ca moves in transpirational flow in xylem, so leaf Ca is high
- Ca does not move in phloem, so fruit Ca is low; surface wax on fruit makes foliar application questionable



What can be done to minimize calcium disorders ?

- ✓ ***prevent water stress***
- ✓ **avoid high ammonium levels during early fruit development**