
Improving nitrogen efficiency in lettuce production

2009 field trials of Pre-sidedress Soil Nitrate Testing (PSNT)

All fields selected had at least 20 PPM soil NO_3-N prior to first sidedress (≈ 80 lb NO_3-N / acre)

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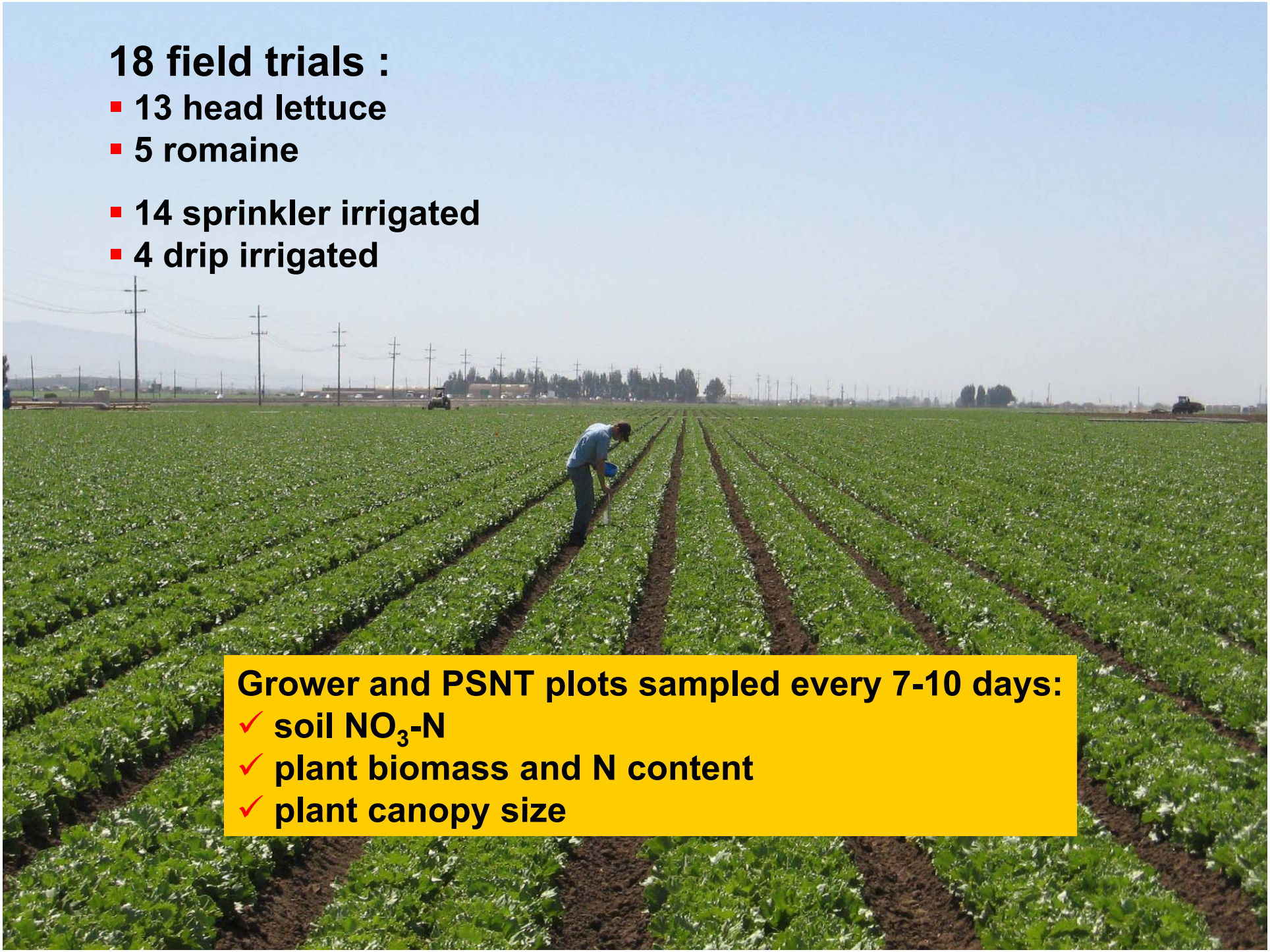
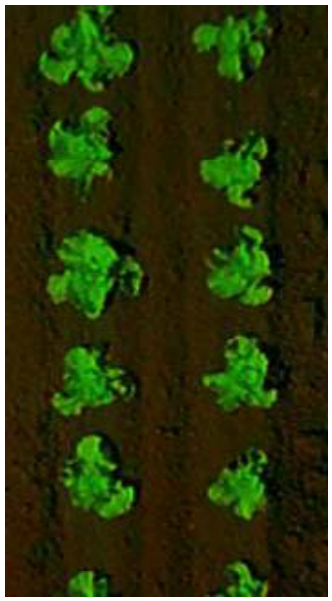
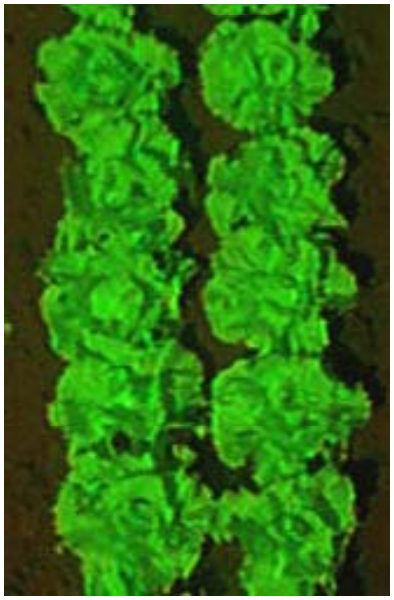
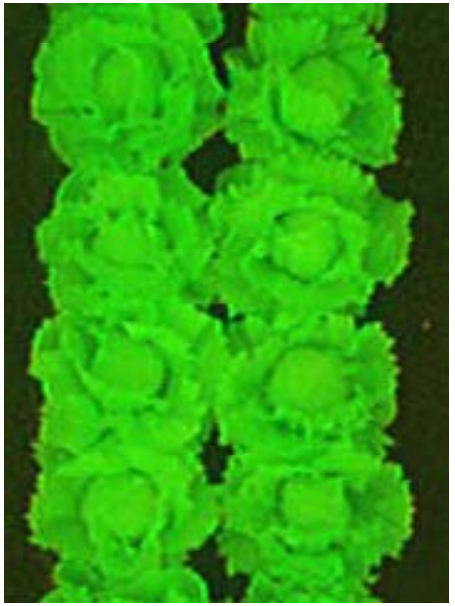
What percentage of fields tested qualified for the program ?
✓ more than half of first crop fields
✓ all second crop fields


18 field trials :
13 head lettuce
5 romaine
14 sprinkler irrigated
4 drip irrigated
Grower and PSNT plots sampled every 7-10 days:
✓ soil NO_3-N
✓ plant biomass and N content
✓ plant canopy size

Plant canopy development to estimate irrigation requirements:



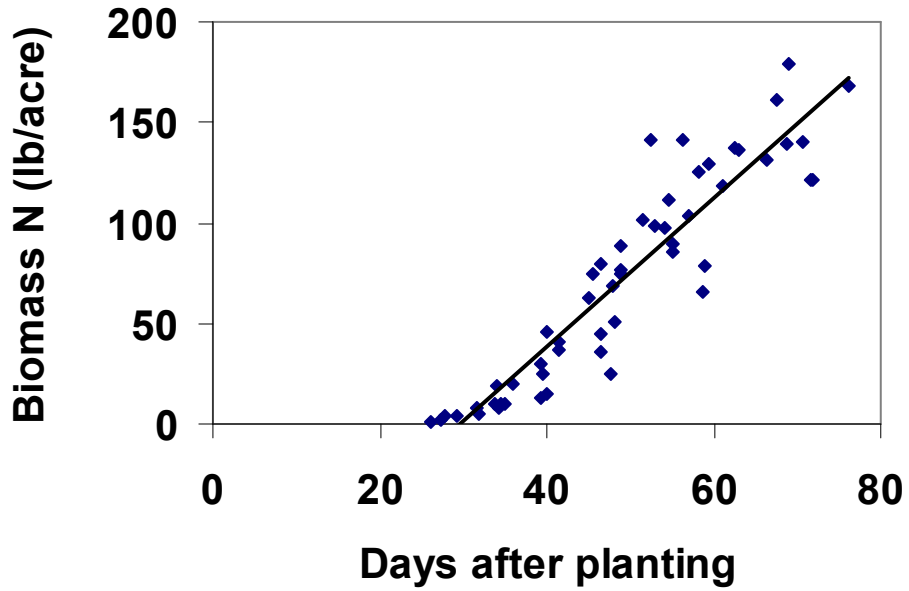





Harvest data:
✓ Hand harvest from UCD subplots
✓ Commercial yields from Dole crews

Crop N uptake :

Summer, north Salinas



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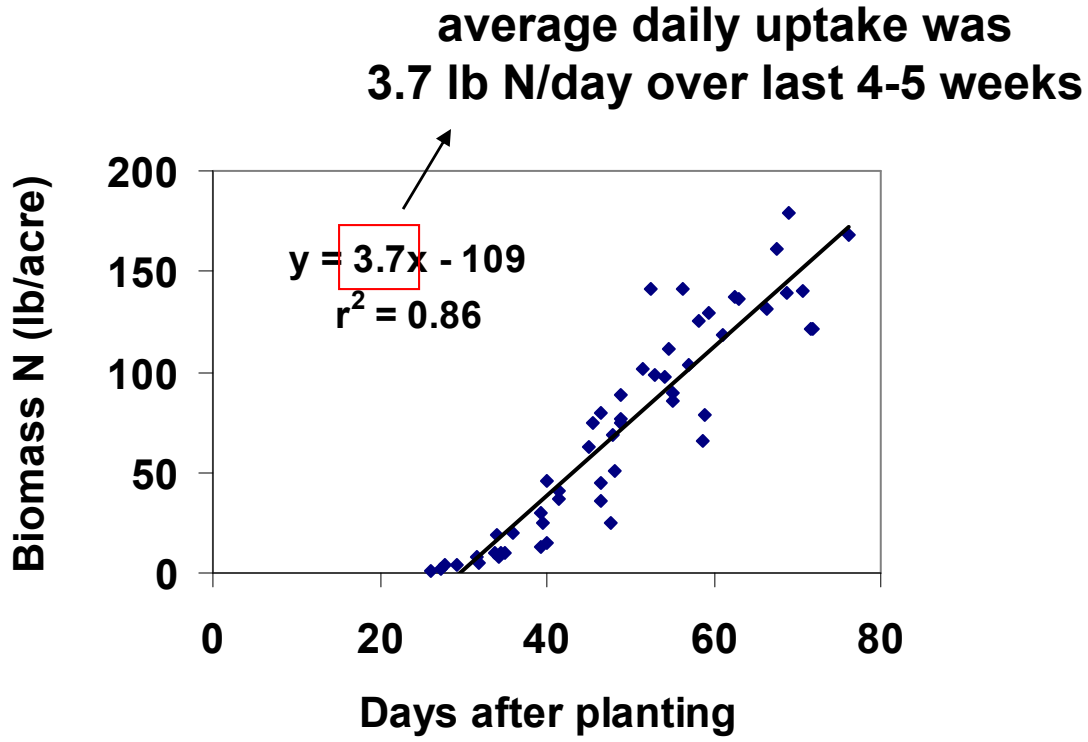
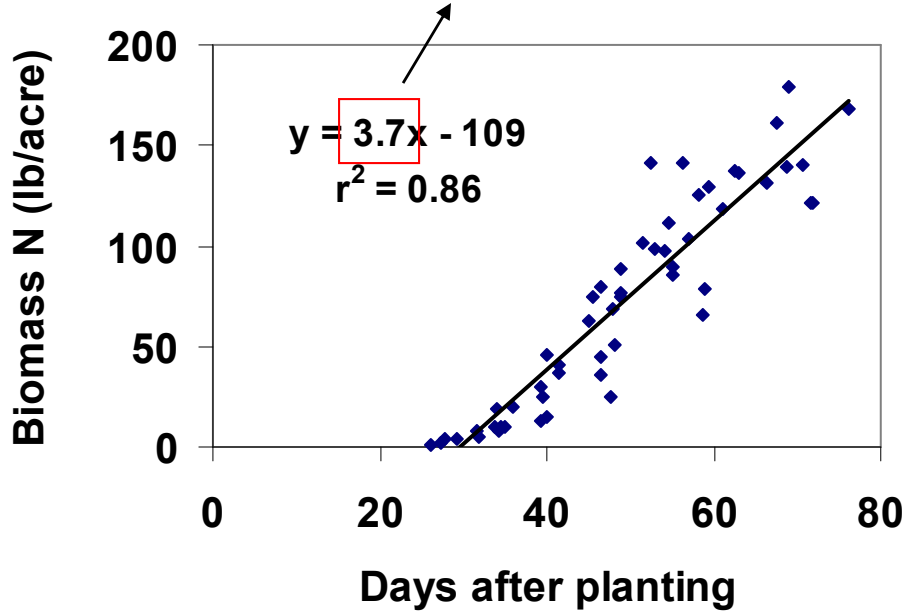


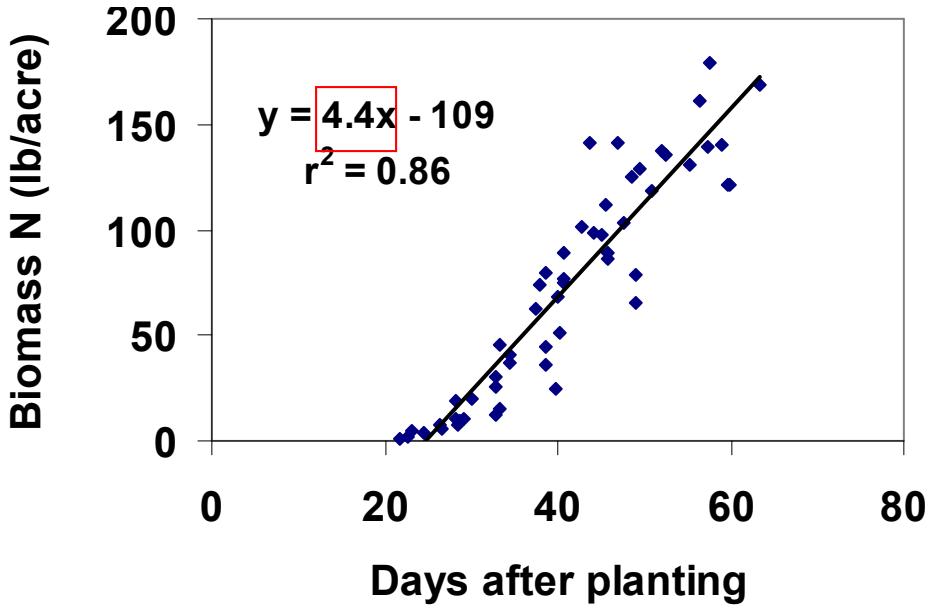
Crop N uptake :

average daily uptake was
3.7 lb N/day over last 4-5 weeks

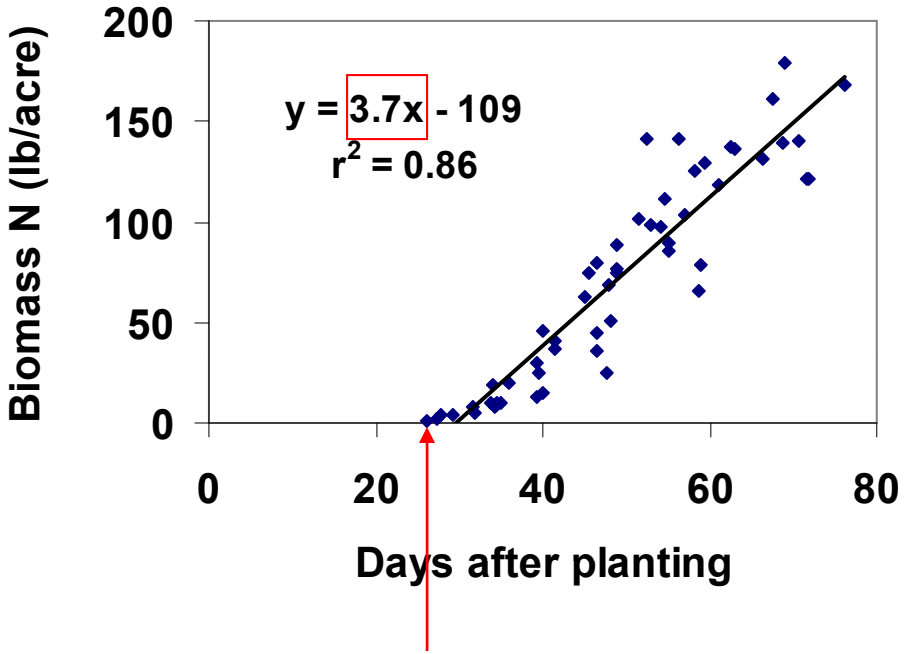
Summer, north Salinas



Summer, Soledad



Crop N uptake :



Grower's first sidedress from 48 - 127 lb N/acre

Averaged across fields :

	Yield (lb / acre)	
	Total fresh wt (UCD harvest)	Dole harvest weight
Grower	88,700	37,300
PSNT	88,100	37,400
PSNT as a % of grower	99	100

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2008 Dole trials showed PSNT yields 98% of grower yield across 18 fields

What about plant color ?

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	Relative color readings	
	Head	Romaine
PSNT	82	223
Grower	84	230
PSNT as a % of grower	97	97

What about N effects on product quality ?

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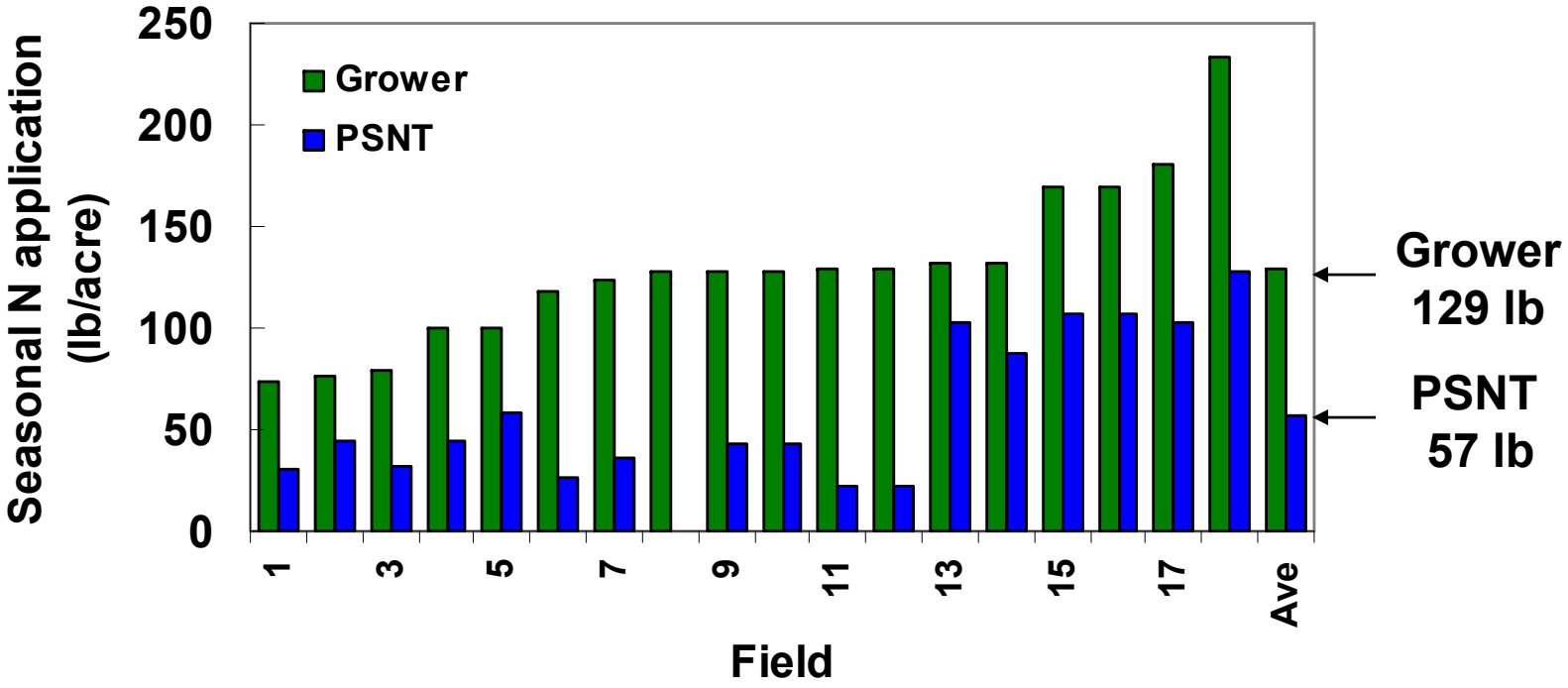
No evidence that lower N rate reduced postharvest shelf life

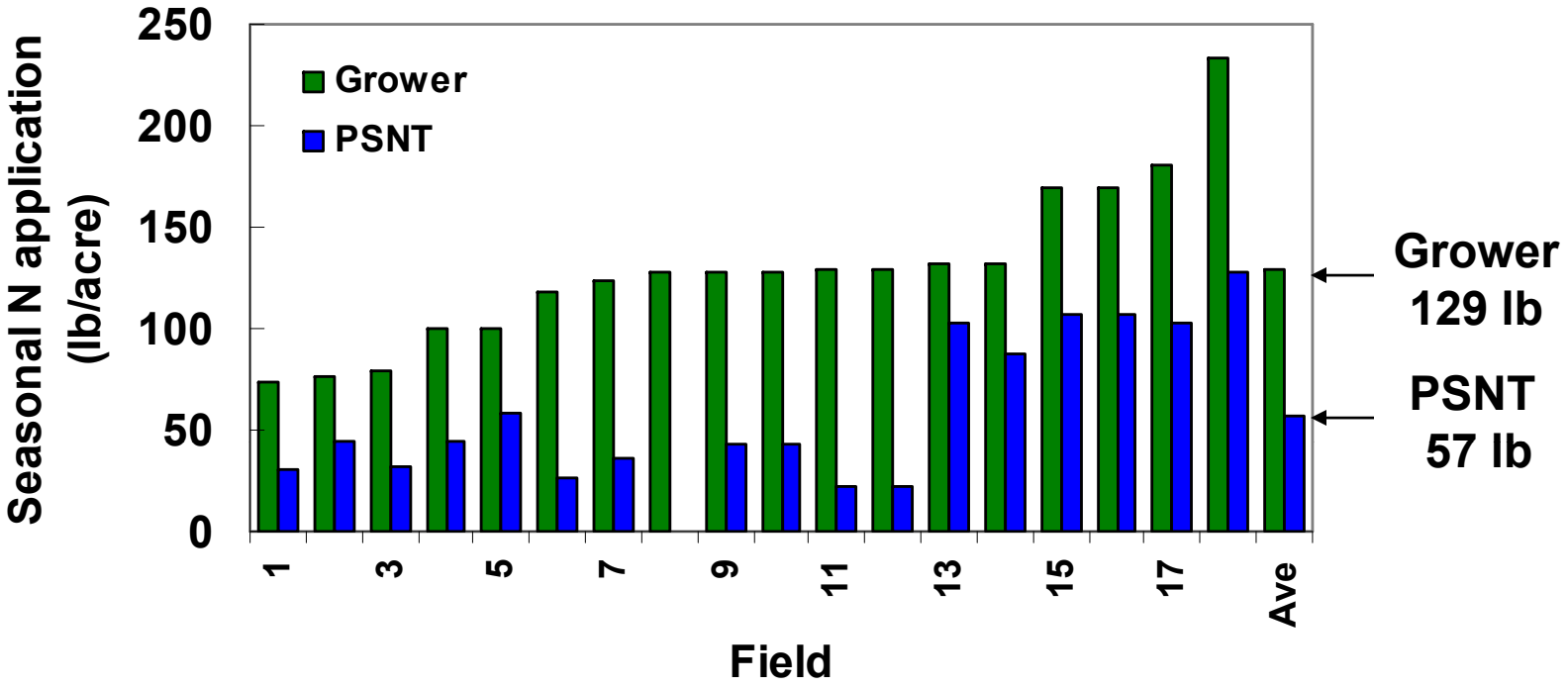
N application :



Range of grower N applications:
High of 233 lb/acre seasonal total, low of 73 lb/acre

Range of PSNT applications:
High of 127 lb/acre seasonal total, low of 0 lb/acre

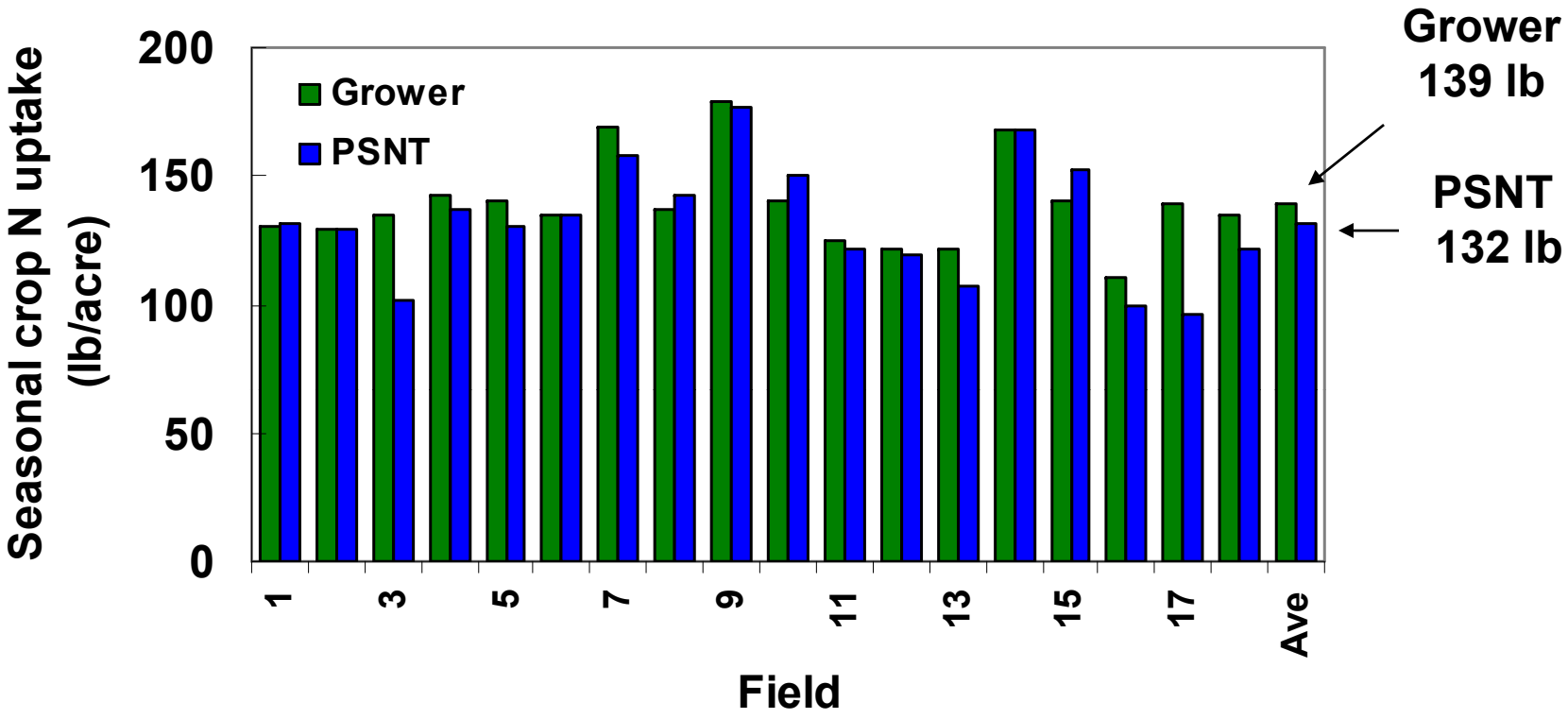
N application :



In perspective …

- ✓ in 1996-2000 PSNT trials, growers averaged 213 lb N/acre
- ✓ in 2004-05 field survey, growers averaged 164 lb N/acre

Crop N uptake :



Nitrogen balance :

In pounds per acre :

	N applied	N uptake
Grower	129	139
PSNT	57	132

‘extra’ N comes from:

- ✓ Soil residual N
- ✓ Soil organic matter mineralization
- ✓ Irrigation water

Nitrogen balance :

In pounds per acre :

	N applied	N uptake
Grower	129	139
PSNT	57	132
difference	72	7

} Extra N applied in grower plots was *highly inefficient*

Nitrogen balance :

In pounds per acre :

	N applied	N uptake	N removed in harvest
Grower	129	139	70
PSNT	57	132	66

about half of biomass N remains as residue

Nitrogen balance :

In pounds per acre :

	N applied	N removed in harvest	N 'balance'
Grower	129	70	+ 59
PSNT	57	66	- 9

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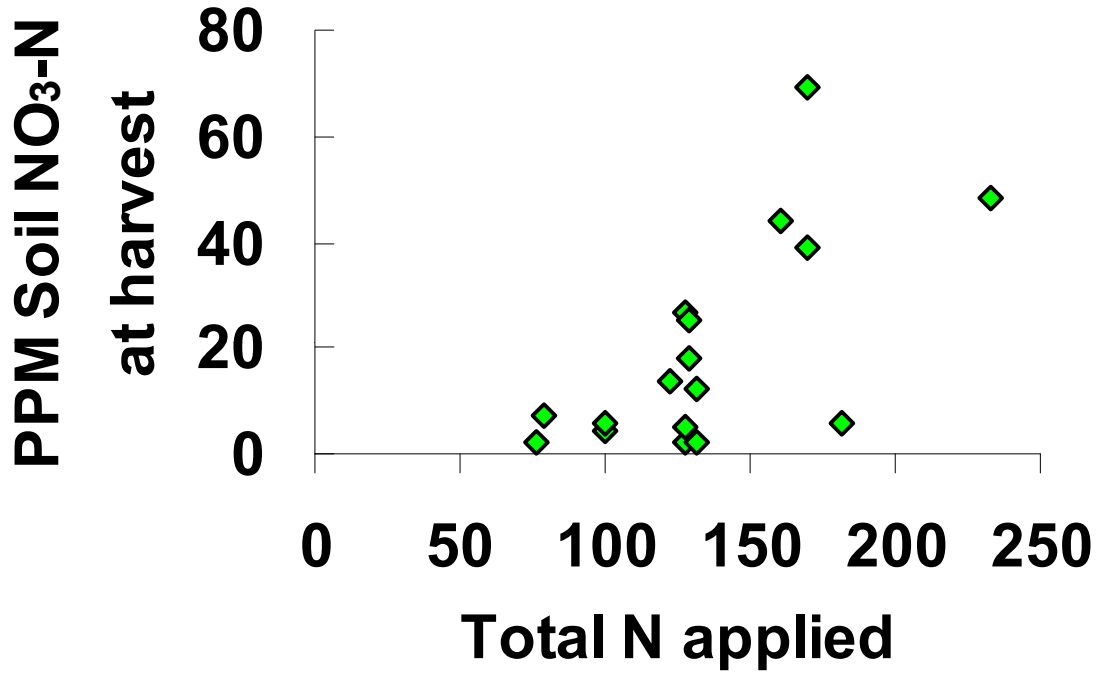
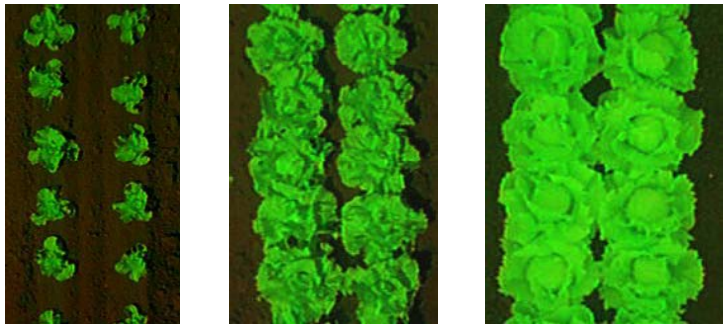
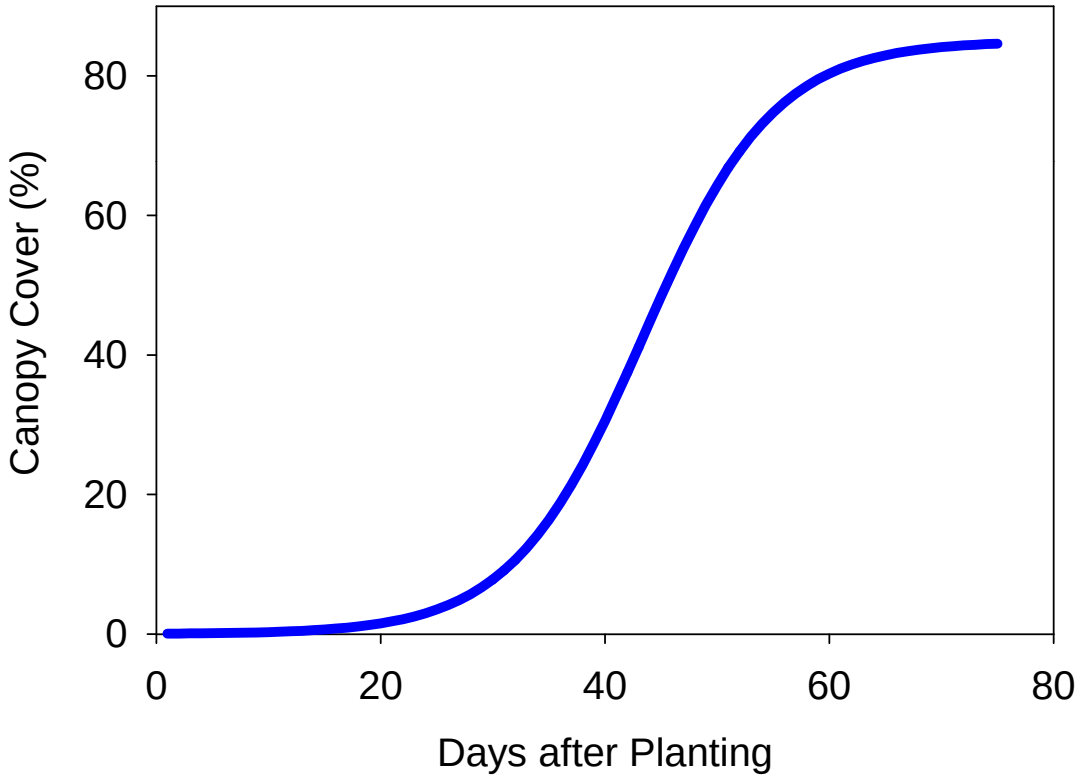
- ✓ in a double crop system even conservative fertilization can lead to significant N loss potential
- ✓ non-fertilizer N must be considered when formulating fertility plans



✓ **Higher N application leads to higher residual soil NO_3-N**

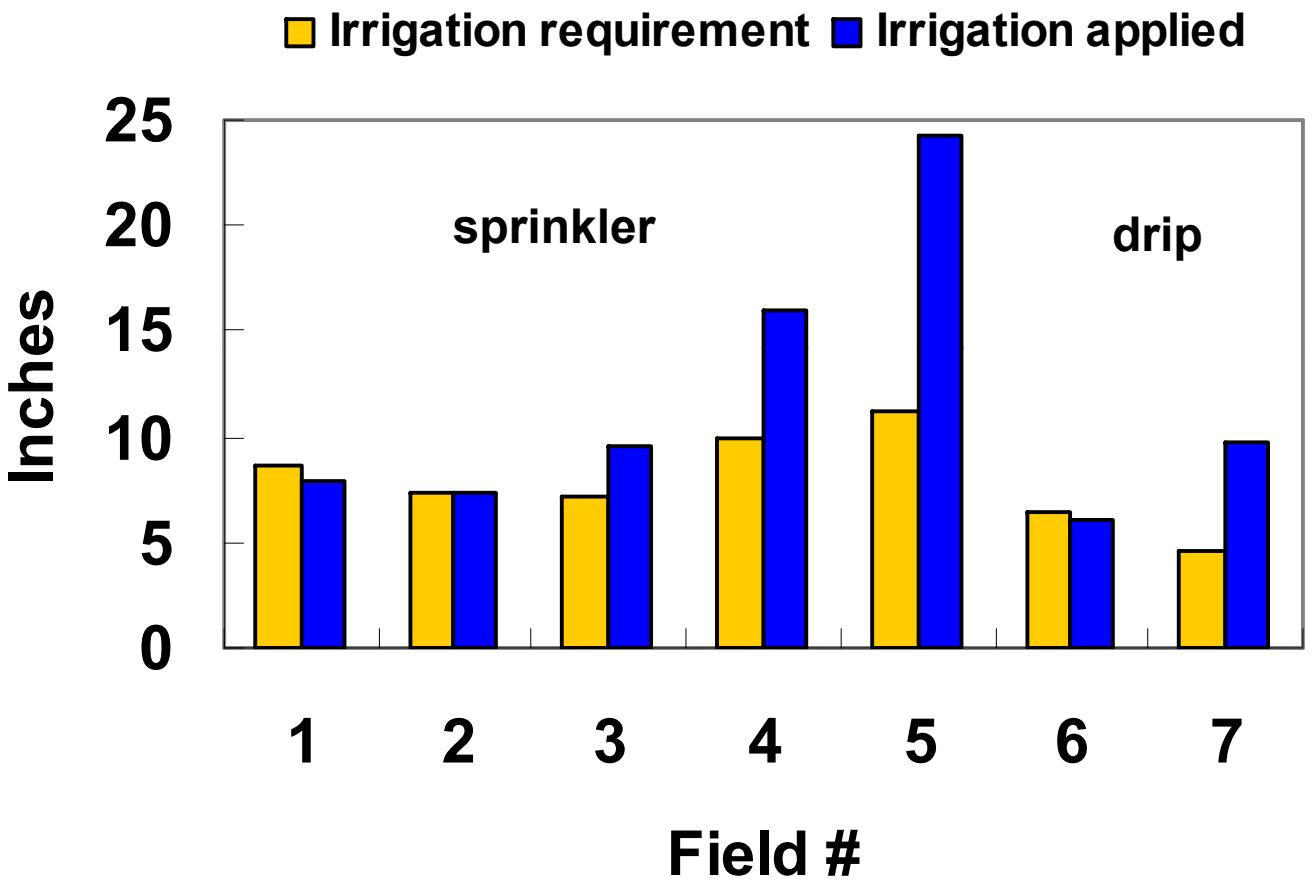
Irrigation requirements:





Irrigation requirements average ≈ 8 - 11 inches per lettuce crop

Irrigation efficiency varies widely :



N efficiency is tied to irrigation efficiency :

Each inch of in-season leaching can carry a significant amount of NO_3-N / acre out of the root zone

Fertilizer cost savings:

- ✓ average fertilizer cost reduction of about $60/acre for PSNT approach

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- ✓ **Uptake efficiency of sidedress N diminishes quickly once crop need is met**

In summary:

- ✓ Lettuce N uptake is predictable, and a large sidedressing at thinning is the least efficient way to apply N
- ✓ Irrigation requirement is predictable, but field irrigation management is highly variable
- ✓ Uptake efficiency of sidedress N diminishes quickly once crop need is met
- ✓ **N balance is always going to be negative, the trick is to minimize the difference**

How can PSNT best be used ?

- ✓ Skip sidedress at thinning, retest later
- ✓ Half rate sidedress at thinning if no retest and no second sidedress