University of California

Nitrogen Management Training

for Certified Crop Advisers

MODULE 7 ~ PART 1

Nitrogen management in annual crops

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Goals of this module

- Part 1:
  - Provide considerations for optimizing N management in annual rotations
  - Understand how to evaluate crop N needs
- Part 2:
  - Understand in-season tools that can be used to improve NUE in annual systems

The Goal: Improve Nitrogen Use Efficiency (NUE)

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- Be realistic in estimating crop N requirements
- Time your applications according to crop demand
  - Apply to meet crop N uptake
  - Use in season testing when applicable
- Account for all N sources
  - residual soil NO_3-N
  - Irrigation water NO_3-N
- Reduce loss by controlling irrigation efficiently

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Determining Annual Crop Nitrogen Needs:

- Start low:
  - Use lower side of recommended rates as a starting point
  - You can add more but not subtract
- Consider N uptake requirement based on yield potential
- Adjust for field-specific factors
- Monitor the field during the season
  - soil or leaf sampling

Estimating Crop N Requirements: N removed

Nitrogen concentrations in harvested plant parts - A literature overview

Daniel Geisseler

2016

Table 2: Overview of N concentrations in harvested plant parts of vegetables.

Commodity	N in harvested plant parts		# of observations		CV (%)	Page
			California	Total		
Asparagus	**5.85**	lbs N/ton of fresh spears	2	19	14.0	68
Beans, green (snap beans)	**5.78**	lbs/ton of fresh weight	1	122	25.7	70
Broccoli	**11.2**	lbs N/ton of fresh weight	15	46	20.4	72
Carrots	**3.29**	lbs/ton of fresh weight	1	167	22.4	74
Corn, sweet	**7.17**	lbs/ton of fresh ears	0	50	13.1	76
Cucumbers	**2.16**	lbs/ton of fresh weight	1	10	17.4	78
Garlic	**15.1**	lbs/ton of fresh weight	1	12	19.5	80
Lettuce, Iceberg	**2.63**	lbs/ton of fresh weight	45	68	16.7	82
Lettuce, Romaine	**3.62**	lbs/ton of fresh weight	14	26	13.7	84
Melons, Cantaloupe	**4.87**	lbs/ton of melons	1	31	15.5	86
Melons, Honeydew	**2.95**	lbs/ton of melons	1	12	22.1	88
Melons, Watermelons	**1.39**	lbs/ton of melons	1	6	23.9	90
Onions	**3.94**	lbs/ton of fresh weight	13	45	19.7	92
Pepper, Bell	**3.31**	lbs/ton of fresh weight	6	40	7.9	94
Potatoes	**6.24**	lbs/ton of fresh weight	5	64	13.6	96
Pumpkin	**7.36**	lbs/ton of fresh weight	1	13	10.1	98
Squash	**3.67**	lbs/ton of fresh weight	11	74	22.4	100
Sweet potatoes	**4.74**	lbs/ton of fresh weight	11	23	16.8	102
Tomatoes, fresh market	**2.61**	lbs/ton of fresh weight	1	34	16.5	104
Tomatoes, processing	**2.73**	lbs/ton of fresh weight	24	24	11.1	106

Estimating Crop N Requirements: N partitioning

A collaboration between

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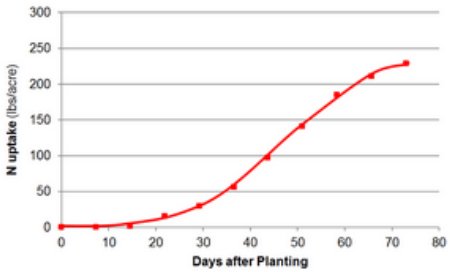
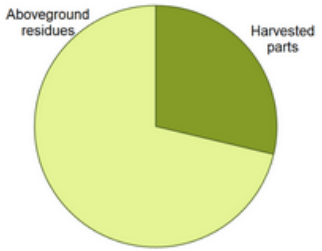
Cauliflower Uptake and Partitioning

Seasonal N Uptake



The N uptake curve is based on data from eight summer-planted commercial cauliflower fields in the Salinas Valley [3].

Nitrogen Partitioning



Less than one third of the total aboveground N is removed with the harvested parts [1,2].

Nitrogen Removed at Harvest

Cauliflower yield and N removed at harvest from different studies.

Study location	Years	Marketable yield (lbs/acre)	Marketable yield (cwt/acre)	N application rate (lbs/acre)	Aboveground N (lbs/acre)	Harves (lbs/
Central Coast	2012-13	17,577	160	306	277	6
Germany	1996-97	---	---	270	264	9

Estimating Crop N Requirements: Yield Potential

- **Tomato Example:**
  - **fruit averages about 2.5-3.1 lb N/ton (average 3.0 lb N/ton)**
- **Fruit typically represents about 2/3 of total crop N uptake**

	Approximate lb /acre		
Yield goal	**N uptake *requirement****	**N in harvested fruit**	**N in residue**
50 ton	**225**	**150**	**75**
60 ton	**270**	**180**	**90**
70 ton	**315**	**210**	**105**

N uptake requirement can vary by about 90 lb N/A for a difference of 20 tons of yield.

Estimating Crop N Requirements: Yield Potential

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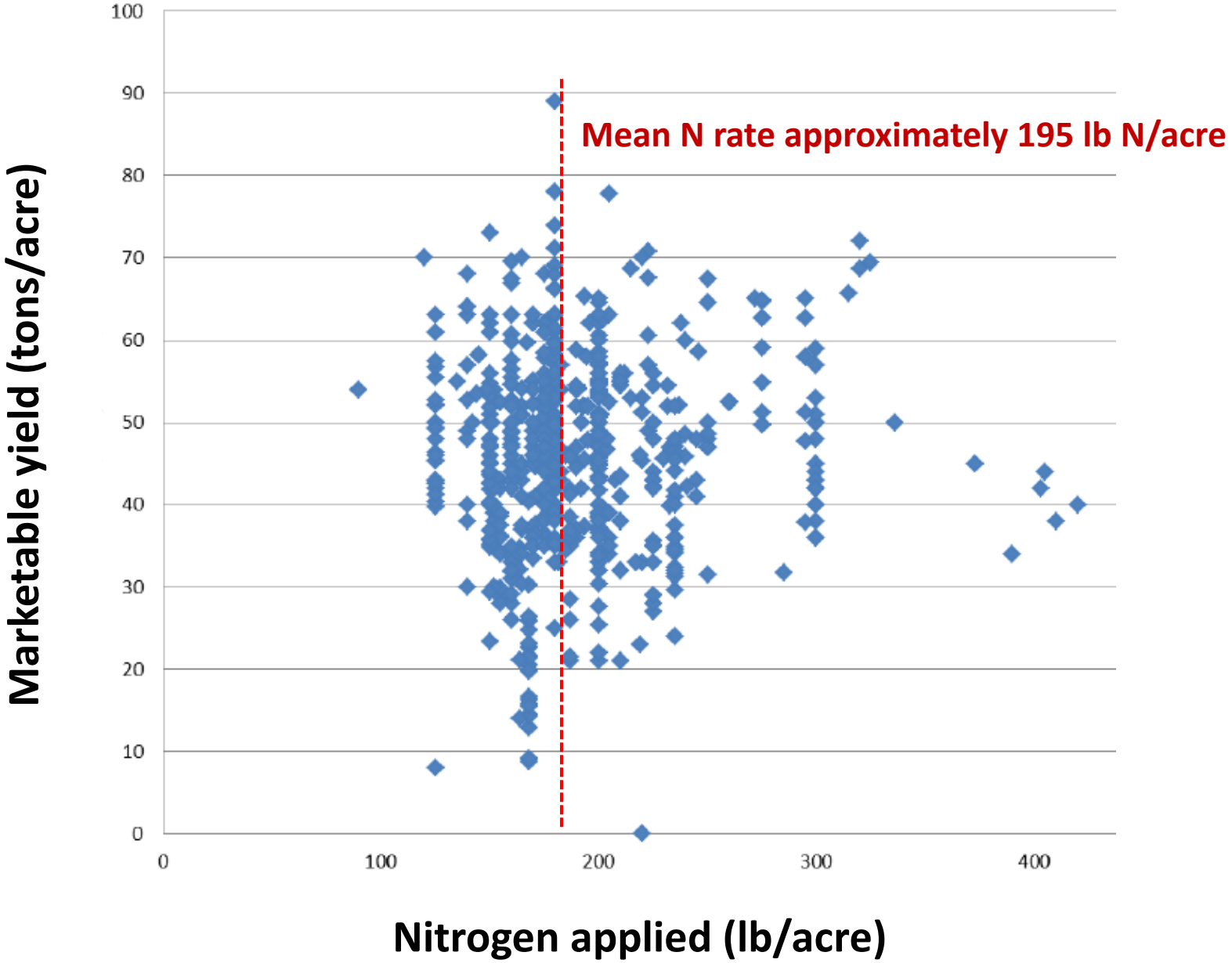
** Based on commercial field monitoring, some luxury consumption included*

N uptake requirement does not mean N fertilizer requirement!

2013 Survey of processing tomato growers indicates that there is a wide range in N applied and tomato yields/A:



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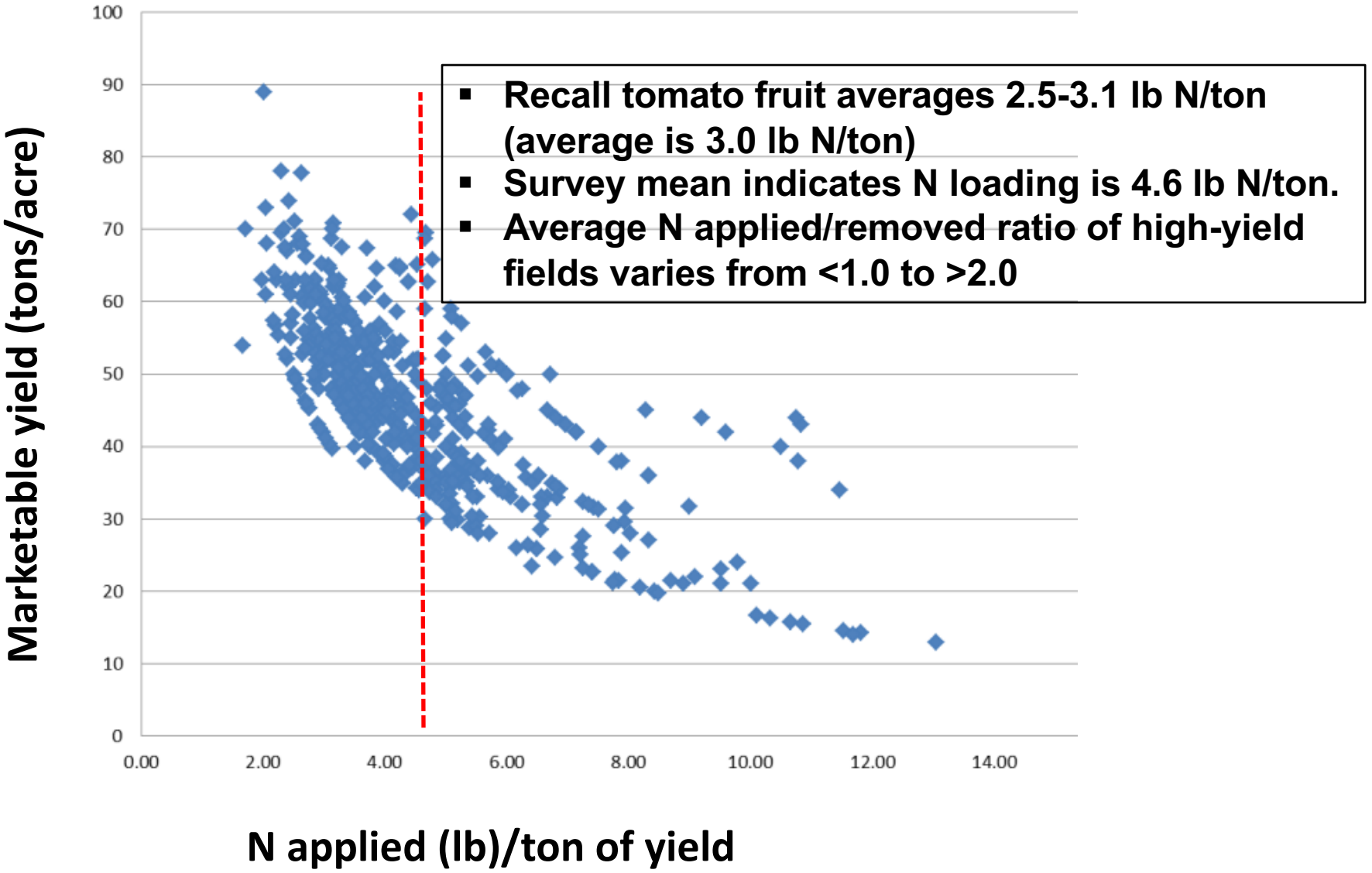

Individual fields can differ widely in nitrogen uptake even when tomato yields are similar indicating that plants are taking up more N than needed

	Fruit yield (tons/acre)	Crop N uptake (lb/acre)
Field 1	53	244
Field 2	56	366
Field 3	58	289
Field 4	58	293

'Luxury consumption'

- nutrient uptake that neither increases yield nor improves product quality
- often 10-20% of the total crop N uptake, occasionally more

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Field 1	53	244
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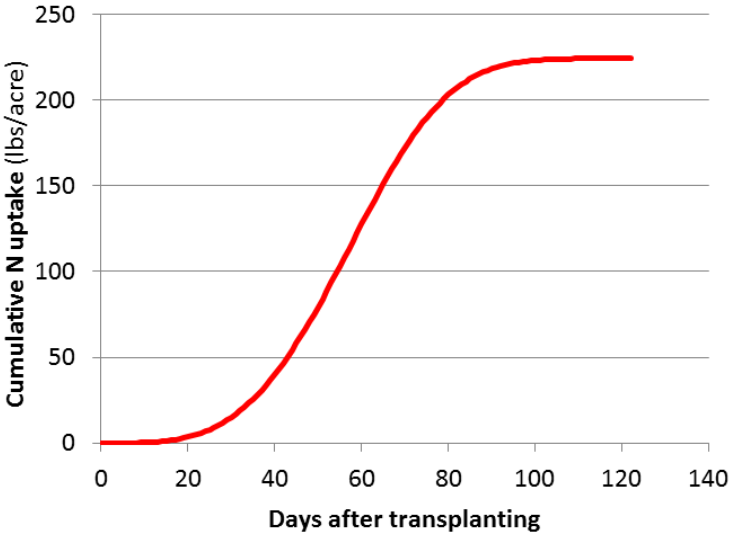
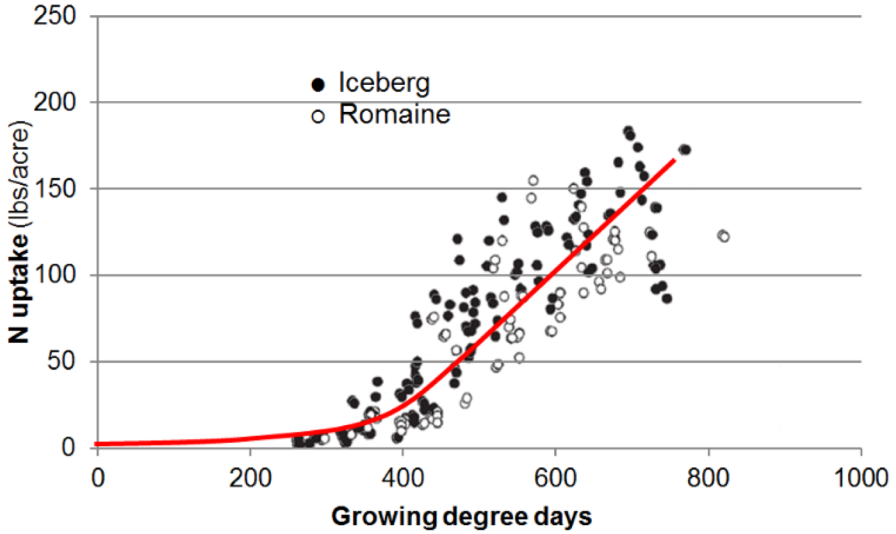
Tomato plant partitioning: ~2/3 is in harvestable plants

N uptake starts slowly in annual crops and leading to a steep increase during peak vegetative growth

Processing tomatoes



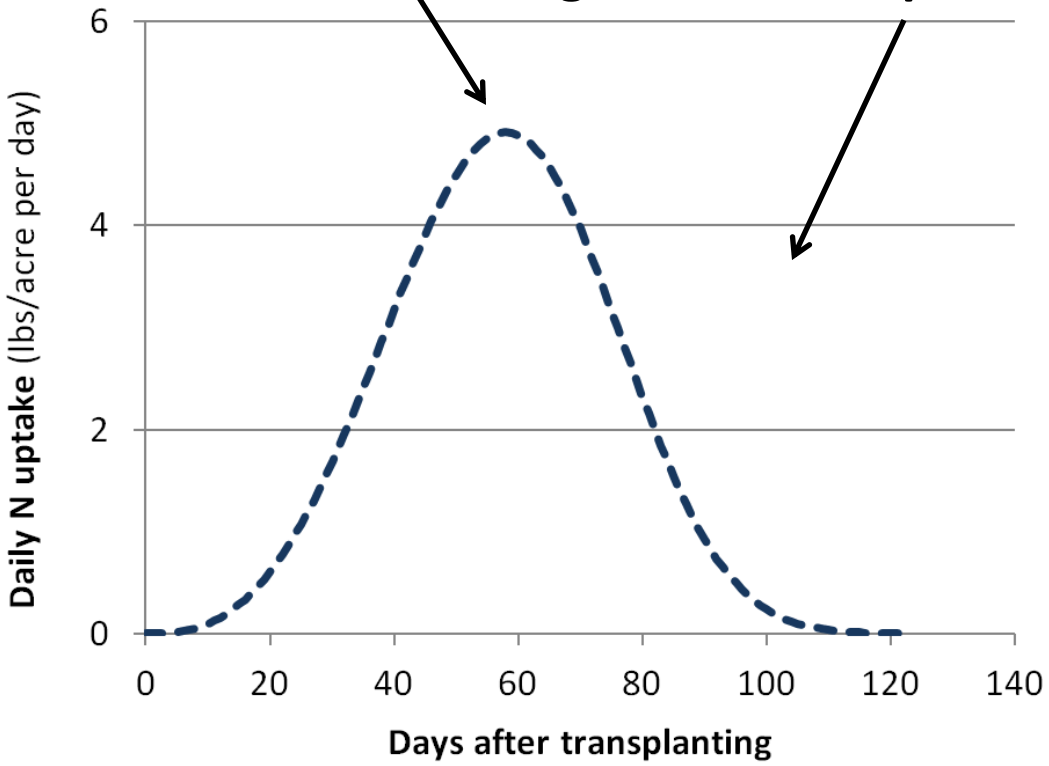
Lettuce



Geisseler et al., under review; Bottoms et al., 2012

Vegetative crops typically harvested near peak N uptake rate because harvested portion is maximized after peak vegetative growth

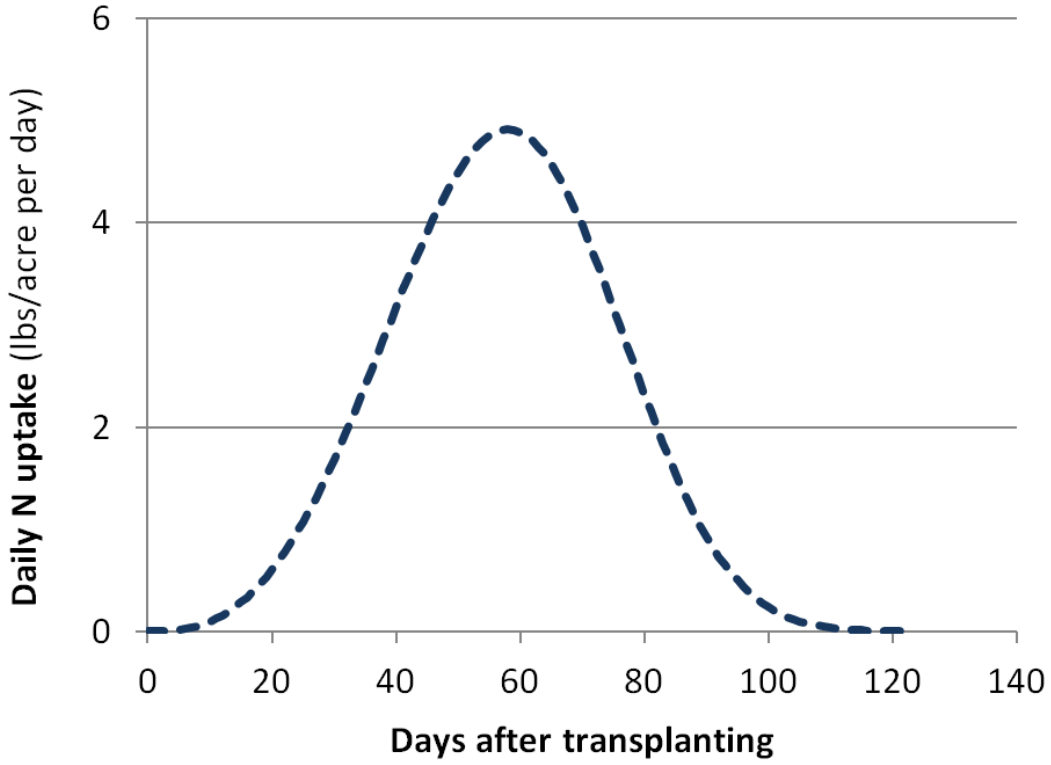
Fruiting crops typically harvested after peak N uptake rate because plants need time to set fruit after vegetative growth is complete



Crops are limited by their ability to take up N per day.

Typical peak N uptake rates for vegetable crops:

- 3-4 lb / acre / day in cool conditions
- 4-6 lb / acre / day in warm conditions



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Course materials available at:

ciwr.ucanr.edu/NitrogenManagement

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