University of California

Nitrogen Management Training

for Certified Crop Advisers

COMPETENCY AREA 5

Nitrogen Budgeting 1

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Goals of this module

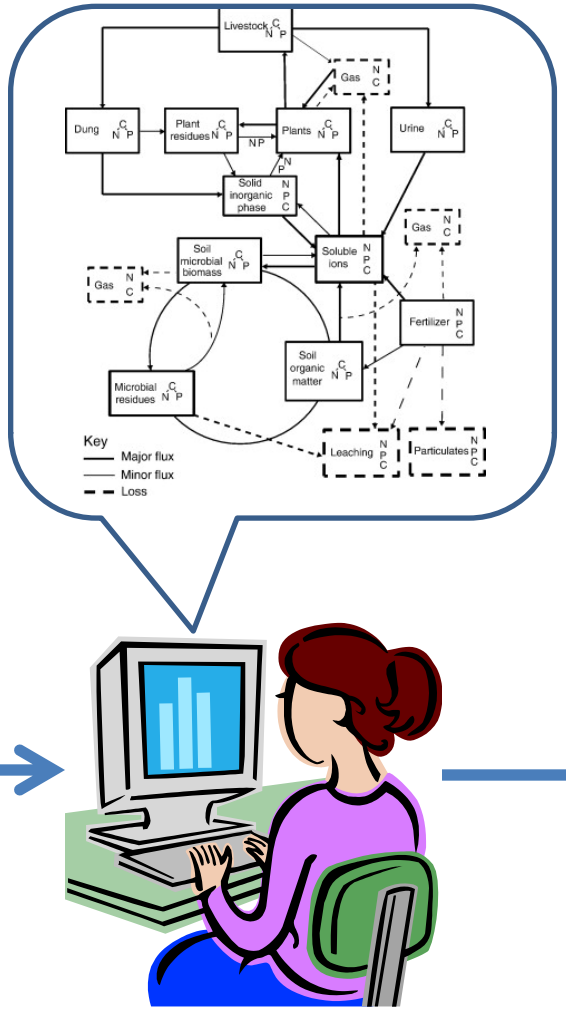
- Provide definitions of key terms
- Help you understand the main concepts of N budgeting
- Help you choose the best N budgeting method for your situation
- Compare agronomic N budgets with the N management worksheet required by the Irrigated Lands Regulatory Program

Purposes of crop N budgeting

- Planning tool for crop management
- Encourages a systematic approach
- Tool for adaptive management: What is working? What needs to be changed?
- Long-term tracking of crop N use efficiency
- Provides data for use in reports required by the Irrigated Lands Regulatory Program

What N budgeting is not

Input:
"How much N is needed for 6 tons of corn in Fresno County?"



Output:
192.3 lbs N/acre

Definitions

Crop N requirement:

1. Amount of N required to achieve maximum yield.
2. Amount of N that must be applied to achieve maximum yield.

Better:
Crop N fertilizer requirement

Related terms:

- **crop N demand**
- **crop N need**

Definitions

Crop N uptake:

Amount of N taken up or absorbed by plants during a specified time period (also **crop N consumption** or **absorption**).

Crop N harvest removal:

Amount of N in harvested parts

N harvest index:

N harvest removal / N uptake

Three elements of all N budgets

N BUDGET		
Crop N Requirement		
1 Recommended available N:		
2 Yield target:		
3 Total required available N		
Non-fertilizer N inputs, credits, adjustments		
4 N in irrigation water		
5 Residual soil nitrate-N		
6 Available N from manure, compost		
7 Total non-fertilizer credits		
Planned N fertilizer application		
8 Planned total fertilizer N applied		

Sink term:

Crop N Requirement or N removal

Three elements of all N budgets

N BUDGET	
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Source terms:
Non-fertilizer credits and adjustments

Three elements of all N budgets

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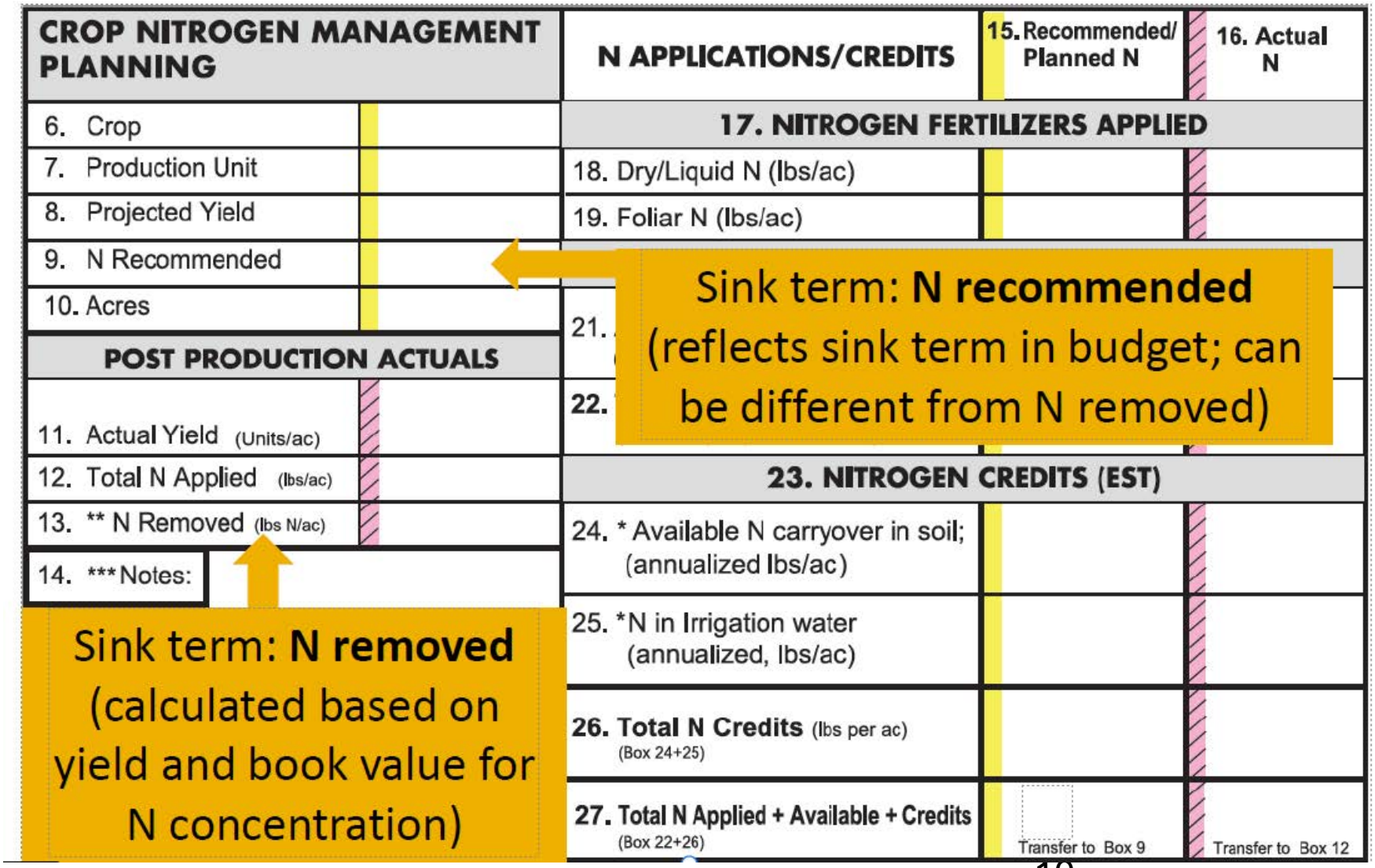
Closing source term:
N fertilizer application

Nitrogen management worksheet



Nitrogen management worksheet

CROP NITROGEN MANAGEMENT PLANNING	
6. Crop	
7. Production Unit	
8. Projected Yield	
9. N Recommended	
10. Acres	
POST PRODUCTION ACTUALS	
11. Actual Yield (Units/ac)	
12. Total N Applied (lbs/ac)	
13. ** N Removed (lbs N/ac)	
14. ***Notes:	

N APPLICATIONS/CREDITS	15. Recommended/ Planned N	16. Actual N
17. NITROGEN FERTILIZERS APPLIED		
18. Dry/Liquid N (lbs/ac)		
19. Foliar N (lbs/ac)		
20. ORGANIC MATERIAL N		
21. Available N in Manure/Compost (lbs/ac estimate)		
22. Total N Applied + Available (lbs per ac) (Box 18+19+21)		
23. NITROGEN CREDITS (EST)		
24. * Available N carryover in soil; (annualized lbs/ac)		
25. *N in Irrigation water (annualized, lbs/ac)		
26. Total N Credits (lbs per ac) (Box 24+25)		
27. Total N Applied + Available + Credits (Box 22+26)	Transfer to Box 9	Transfer to Box 12

Source term: **Non-fertilizer credits and adjustments**

Nitrogen management worksheet

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14. ***Notes:		26. **Total N Credits** (lbs per ac) (Box 24+25)		
		27. **Total N Applied + Available + Credits** (Box 22+26)	Transfer to Box 9	Transfer to Box 12

Closing source term: **N fertilizer application** (dry, liquid, foliar)

Worksheet differs from N budget

The two methods answer different questions:

- Agronomic N budget:
  - What is an appropriate N application rate to achieve the expected yield and maximize N use efficiency?

- Worksheet:
  - How does N applied compare to N removed?
  - How does N applied/N removed ratio compare with other fields and across years?

The worksheet can help improve N management

- Compiled data from an entire region can help evaluate your N management.
  - Comparison with other growers
  - Long-term trends

Important to keep in mind:

- N applied/N removed ratio is crop specific
- N removed per ton of yield can vary from one year to the next ⇨ Average N applied/N removed ratio of several years should be used.

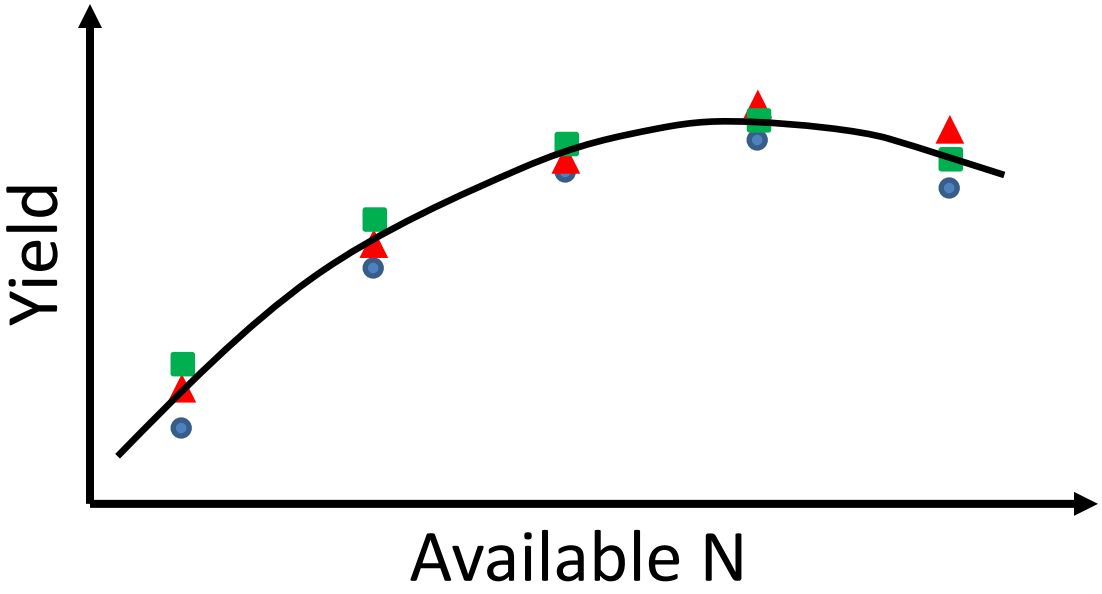
Method 1: Yield based N requirement

N BUDGET	Grain corn, Field B	
Crop N Requirement	lbs N/acre	
1 Recommended available N: 40 lbs N/ton		
2 Yield target: 5 tons/acre		
3 Total required available N (line 1 x line 2)		200
Non-fertilizer N inputs, credits, adjustments		
4 N in irrigation water	23	
5 Residual soil nitrate-N	52	
6 This season's manure, compost, cover crop available N	0	
7 Total adjustments (sum of lines 4-6)		75
Planned N fertilizer application		
8 Total fertilizer N to apply (line 3 – line 7)		125

Available N includes all N sources.

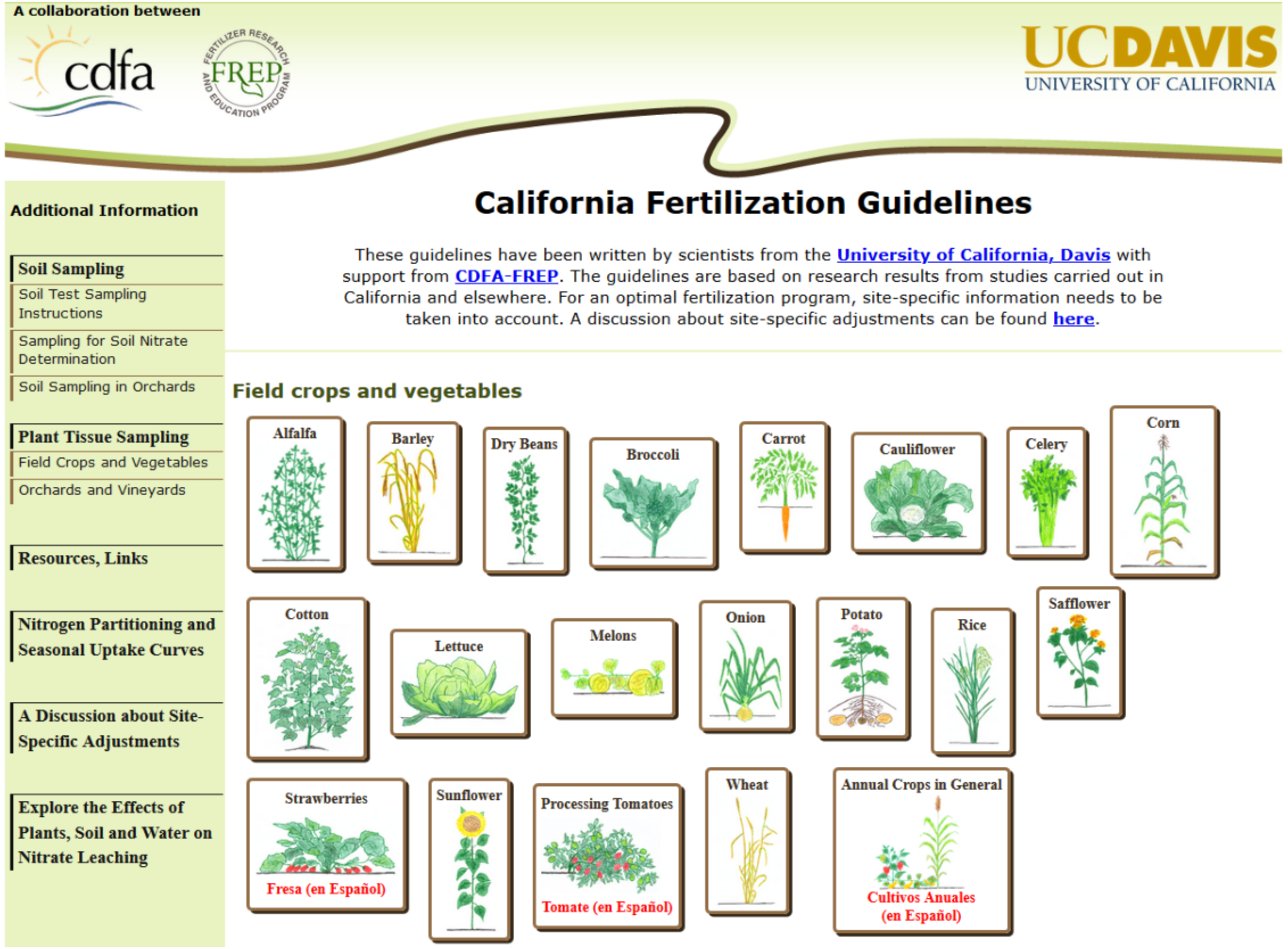
Method 1: Yield based N requirement

Based on N rate trials



- Inefficiency built into crop N requirement
- Site-specific adjustments only needed when different from research sites

Finding recommended nitrogen application rates



Available at: http://geisseler.ucdavis.edu/Guidelines/Home.html

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Set a realistic yield goal.

Setting a realistic yield goal

- **Maximum yield**
- **Average yield**
  - Using a rolling average
  - Adjusting the past average by dropping exceptional years
  - Adjusting the past average by a fixed percentage
- **Using yields from variety trials or county averages**

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1 acre-inch of water with 10 ppm of nitrate-N contains 2.3 lbs N/acre.

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1 ppm NO_3-N = 3.5-4 lbs N per acre-foot

Example:
0-1 ft → 8 ppm
1-2 ft → 5 ppm

Total:
52 lbs N/acre

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Nitrogen management worksheet

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6. Crop	Corn
7. Production Unit	tons/ac
8. Projected Yield	5
9. N Recommended	200 lbs/ac
10. Acres	
POST PRODUCTION ACTUALS	
11. Actual Yield (Units/ac)	
12. Total N Applied (lbs/ac)	
13. ** N Removed (lbs N/ac)	
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7. Production Unit	tons/ac
8. Projected Yield	5
9. N Recommended	200 lbs/ac
10. Acres	
POST PRODUCTION ACTUALS	
11. Actual Yield (Units/ac)	5.2
12. Total N Applied (lbs/ac)	200
13. ** N Removed (lbs N/ac)	
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Nitrogen removal data

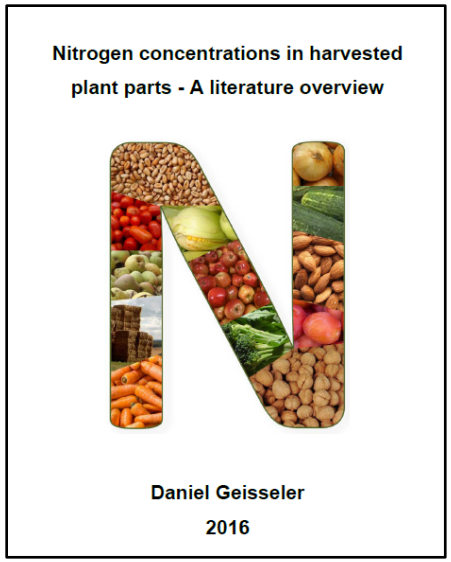

Table 1: Overview of N concentrations in harvested plant parts of field crops.

Commodity	N in harvested plant parts	
Alfalfa - Hay	**62.3**	lbs N/ton @ 12% moisture
Alfalfa - Silage	**24.0**	lbs N/ton @ 65% moisture
Barley - Grain	**33.6**	lbs N/ton @ 12% moisture
Barley - Straw	**15.4**	lbs N/ton @ 12% moisture
Beans, dry - Blackeye	**73.0**	lbs N/ton @ 12% moisture
Beans, dry - Garbanzo	**67.2**	lbs N/ton @ 12% moisture
Beans, dry - Lima	**72.3**	lbs N/ton @ 12% moisture
Corn - Grain	**24.0**	lbs N/ton @ 15.5% moisture

Available at:
http://geisseler.ucdavis.edu/Geisseler_Report_2016_12_02.pdf

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Partial Nitrogen Balance:

(eq 1) % Crop Recovery = $\frac{125}{200} = 63\%$

(eq 2) Applied/Removed = $\frac{200}{125} = 1.60$

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Course materials available at:

ciwr.ucanr.edu/NitrogenManagement

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