Nitrogen Management in Corn

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Tulare, CA
March 12, 2014
This training covers grain and silage corn production on fields that are not part of a dairy operation. Dairy farming systems, which rely more heavily on manure N sources than non-dairy systems, must meet a more stringent N target.
To start off, a quick review of corn growth and development.

Images presented here are from.....

**Corn Growth & Development**
Iowa Stat University Extension PMR 1009

$15 for publication
$5 for Kindle or iPad/iPhone
# Growth Stages of Corn

**Vegetative Stages**

<table>
<thead>
<tr>
<th>Stage</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>VE emergence</td>
<td></td>
</tr>
<tr>
<td>V1 first leaf</td>
<td></td>
</tr>
<tr>
<td>V2 second leaf</td>
<td></td>
</tr>
<tr>
<td>V3 third leaf</td>
<td></td>
</tr>
<tr>
<td>V(n) nth leaf</td>
<td></td>
</tr>
<tr>
<td>VT tasseling</td>
<td></td>
</tr>
</tbody>
</table>

A leaf is counted once the blade is expanded and the collar is visible.
The “sneaky” part is that as the corn plant matures, we “lose” 5 - 6 nodes & their leaves to the developing root system.
With the appearance of the silks, the plant switches from vegetative to reproductive growth.
### Growth Stages of Corn

<table>
<thead>
<tr>
<th>Vegetative Stages</th>
<th>Reproductive Stages</th>
</tr>
</thead>
<tbody>
<tr>
<td>VE emergence</td>
<td>R1 silking</td>
</tr>
<tr>
<td>V1 first leaf</td>
<td>R2 blister</td>
</tr>
<tr>
<td>V2 second leaf</td>
<td>R3 milk</td>
</tr>
<tr>
<td>V3 third leaf</td>
<td>R4 dough</td>
</tr>
<tr>
<td>V(n) nth leaf</td>
<td>R5 dent</td>
</tr>
<tr>
<td>VT tasseling</td>
<td>R6 physiological maturity</td>
</tr>
</tbody>
</table>

- The "black layer" or "black line" is a good indicator of physiological maturity.
Corn Dry Matter: about 51% grain vs 49% stover

Corn Nitrogen: 50 - 60% grain vs 40% - 50% stover

Grain draws from both soil and remobilization from stalk and lower leaves
N in grain comes from:

- 2/3 new N from soil
- 1/3 remobilized from leaves & stalks

32 - 34% of total N uptake occurs during grain fill.
Two approaches for N fertilization

Typical fertilizer rates

What’s “typical?”
   Wide range of scenarios
   Impossible to make a “one size fits all” recommendation

Not a lot of studies on corn & forages
Rate trials without knowing if leaching was significant may not be helpful
Typical corn grain fertilization, Yolo area

Brittan recommended total application rates of 200 to 275 lbs N/acre on mineral soils, depending on plant population and previous crop.

This is in line with a trial carried out at Davis, where an average grain yield of 6.4 tons/acre) was produced with 200 lbs N/acre.

Doubling the N rate had no effect on yield or grain protein content.
Typical corn grain fertilization, Yolo area

N in P fertilizer (10-34-0 or 11-52-0) is often sufficient for a starter

10 to 15 lbs total at planting

Concentrated salts can be toxic to seedlings...band several inches below and to the side of seed row
Typical corn grain fertilization, Yolo area

Single large sidedress application 150 to 170 lbs N
IF low leaching risk

Sidedress around 1 ft high and stay 8 to 15 inches away from the plants to avoid root pruning and injury from ammonia.

Banded fertilizer depending on placement in bed in furrow-irrigated corn may move sideways with water and be less subject to leaching than with basin irrigation.
Typical corn silage/grain fertilization, Tulare area

Total application rates of 200 to 275 lbs N/acre depending on plant population and previous crop.

N in P fertilizer (10-34-0 or 11-52-0) is often sufficient for a starter, 10 to 15 lbs total at planting.

(Banded fertilizer depending on placement in bed in furrow-irrigated corn may move sideways with water and be less subject to leaching than with basin irrigation. Concentrated salts can be toxic to seedlings...band several inches below and to the side of seed row)
Typical silage/grain corn fertilization, Tulare area

Common: sidedress of 100-150 lbs followed by one or more water-run applications of 35-50 lb N

(Sidedress around 1 ft high and stay 8 to 15 inches away from the plants to avoid root pruning and injury from ammonia.)

Less common: preplant with one large sidedress of 170-200 + lbs N
Typical corn silage fertilization, Turlock/Hilmar area

Total application rates of 250 to 300 lbs N/acre depending expected yield and N removal, and amount of N that is in manure form.

P starter is common, especially in colder soils. Minimal N (10 to 15 lbs total) at planting, may or may not be needed depending on temperature and manure history. Sometimes ammonium sulfate is spread prior to planting to provide both N and S.
**Typical corn silage fertilization, Turlock/Hilmar area**

Water run N in 4 to 6 split applications depending on total number of expected irrigations.

Typical is 50 units of anhydrous or UN32 in each of first 5 crop irrigations.

No more than 20 - 30 units on very small corn.

No more than 80 units in any one irrigation.

Shanked UN32 sometimes used on heavier soils.

Time so there is sufficient N for rapid growth prior to tasselling. Reserve some N for grain fill.
corn N fertilization strategies

1. Typical fertilizer rates
   typical is relative
   affected by leaching

2. N budget
   now need to consider also
   potential yield (N removal)
   previous crop residue/soil organic N
   irrigation water nitrate
   in addition to
   applied N commercial and manure
Nitrogen budget

N removal/crop uptake as starting point

adjust for N additions from irrigation and soil N

compensate for expected losses & inefficiencies
1. How much nitrogen does the crop need?
Nitrogen required for the crop – silage corn

For silage and hay crops, the N removed is similar to N “utilized”

**SILAGE CORN**

From the **harvested** portion (IPNI)

1 ton corn silage (67%) – 9.7 lbs N
30 T would be 291 lbs N

From Western Fertilizer Handbook, 8th ed.)

“**utilized**“ by the crop

1 ton silage corn– “utilizes” 8.3 lb N
30 T would be 250 lb N

Or you can calculate uptake after the fact to use in the future.
Silage Total Removal

Lbs dry matter/A x % N
Lbs dry matter/A x % protein/6.25

Tons/A @ 70% x % protein x .96

30 Tons/A x 8.5% x .96 = 245 lbs N/acre

Adequate sampling for moisture and nutrients is critical.
Hay Total Removal

Lbs dry matter/A x % N

Lbs dry matter/A x % protein/6.25

Tons/A @ 10% x % protein x 2.88
Nitrogen required for the crop – grain corn

How much is needed for the crop as a starting point before subtracting various sources of N? Removal in grain is less than utilized by crop.

Expected N removal – grain is only about 50-60% the N utilized by the crop

GRAIN CORN
From the harvested portion (IPNI)
1 ton corn grain – 25 lbs N
6 T would be 150 lbs N

From Western Fertilizer Handbook, 8th ed.)
“utilized” by the crop
1 ton grain corn – “utilizes” 48 lb N
6 T would be 288 lb N

Karlen paper: 42 lbs per ton @ 15.5 % moisture
Nitrogen removal – grain corn

Lbs dry matter/acre x % N
Lbs dry matter/acre x % protein/6.25

1. calculate dry matter factor

15.5% moisture
100 – 15.5 = 84.5% dry matter
84.5/100 = .845

2. calculate pounds/acre dry matter

6.5 Tons/A x 2000 = 13,000 lbs/acre
13,000 x .845 = 10,985 lbs/acre dry matter

3. calculate % N from % protein

9% protein = 9 ÷ 6.25 = 1.44% N

4. calculate lbs/acre N removal in grain

10,985 x .0144 = 159 lbs N/acre removed
Nitrogen removal – grain corn

Lbs dry matter/acre x % N
Lbs dry matter/acre x % protein/6.25

Shortcut for 15.5 % moisture grain:

Tons/acre @ 15.5% moisture x % protein x 1.13
= lbs N/acre removed

6.5 tons/acre x 9% protein x 1.13
= 159 lbs N/acre removed
Nitrogen removed by crop – grain corn

Tons/acre @ 15.5% moisture x % protein x 1.13
Lbs dry matter/acre x % protein/6.25
Lbs dry matter/acre x % N

10,985 x .0144 = 159 lbs N/acre removed

Nitrogen required for the crop – grain corn

grain is about 50-60% the N utilized by the crop

Divide by .6 to .5 to get N utilized by the crop

159 ÷ .6 = 264 lbs N/acre for crop
159 ÷ .5 = 316 lbs N/acre for crop
Nitrogen budget

N removal/crop uptake as starting point

adjust for N additions from irrigation and soil N

compensate for expected losses & inefficiencies

highly dependent on soil type, irrigation, etc.

because knowing if leaching of N is significant is critical in a tightly managed system
**Corn N Budget**

**Silage Corn N uptake – 250 lbs N uptake**

**Assets**
- Starting N in soil
- From irrigation water
- From applied manure
- From background soil organic

<table>
<thead>
<tr>
<th>Source</th>
<th>Value</th>
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</thead>
<tbody>
<tr>
<td>soil test</td>
<td>41</td>
</tr>
<tr>
<td>calculate from ET</td>
<td>48</td>
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<tr>
<td>table value</td>
<td>23</td>
</tr>
<tr>
<td>total assets</td>
<td>112</td>
</tr>
</tbody>
</table>

**Losses**
- Leaching etc.

<table>
<thead>
<tr>
<th>Loss</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Expected losses</td>
<td>50</td>
</tr>
</tbody>
</table>

**Total N uptake**

- 250

**Add extra for losses**

- + 50

**Total needed**

- 300

**Total N needed**

- 300

**Subtract assets**

- 112

**Total to apply**

- 188
Simple nitrogen budgets don’t consider timing
Corn & Forage N Budgets

1. How much nitrogen does the crop need?

2. What losses are expected?
Nitrate Leaching
San Joaquin Valley

- 12 sampling events
- mainly light soils:
  - sand (6)
  - loamy sand (2)
  - sandy loam (3)
  - loam (1)
- soil sampled to 3 or 4 feet just prior to and just after a freshwater irrigation

<table>
<thead>
<tr>
<th>Depth</th>
<th>Layer</th>
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</thead>
<tbody>
<tr>
<td>0 to 6 in.</td>
<td>Yellow</td>
</tr>
<tr>
<td>6 to 12 in.</td>
<td>Orange</td>
</tr>
<tr>
<td>12 to 24 in.</td>
<td>Orange</td>
</tr>
<tr>
<td>24 to 36 in.</td>
<td>Light Blue</td>
</tr>
<tr>
<td>36 to 48 in.</td>
<td>Dark Blue</td>
</tr>
</tbody>
</table>
Nitrate-N losses (lbs/acre) from a single freshwater irrigation

N. San Joaquin Valley
silage corn
1st irrigation
6.7 ac-in
fine sandy loam

<table>
<thead>
<tr>
<th>Soil layer depth and thickness (inches)</th>
<th>June 22</th>
<th>June 23</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-6</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6-15</td>
<td></td>
<td></td>
</tr>
<tr>
<td>15-24</td>
<td></td>
<td></td>
</tr>
<tr>
<td>24-36</td>
<td></td>
<td></td>
</tr>
<tr>
<td>36-48</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Nitrate-N losses (lbs/acre) from a single freshwater irrigation

N. San Joaquin Valley
silage corn
1st irrigation
6.7 ac-in
fine sandy loam

12 sites
loam, sandy loam & sand
Avg. over 50% loss of N from top 2 ft of soil
5 to 7 inch irrigations
Typical scenarios:

- Minimal leaching
- Leaching pre and first irrigations
- Leaching all or most irrigations
Estimating leaching potential

Online tools
NLEAP
ENVIRO-GRO

ET based irrigation scheduling

Rough estimate

ET ac-inches vs total amount applied
• For a quick evaluation of how much leaching potential, compare total water applied to the ET needs of the crop
Estimating leaching and irrigation N contribution

- Most of N and water uptake is in the top 2 ft. for corn. Roots may be found deeper but usually are not doing much

- Depending on location, time of planting, corn variety, and weather, ET of corn can range from 21-27 in.

Information on corn ET can be found at:
http://ucmanageddrought.ucdavis.edu/Agriculture/Crop_Irrigation_Strategies/Corn/
Estimating leaching and irrigation N contribution

1st step: compare ET crop to applied water

ET corn: 21
Irrig ac-in: 34

If leaching is not a huge issue can credit all or most of the irrigation water nitrate.

If applied is greater than ET, credit only ET ac-in

N concentration (mg/L) x 1000 gals x .008345 = lbs N/acre
N concentration (mg/L) x ac-in x .22625 = lbs N/acre

21 ac-in x 10 mg/L x .22625 = 47.5 lbs N from irrigation N
• For a quick evaluation of how much leaching potential, compare total water applied to the ET needs of the crop

• Or compare the amount of water applied in an individual irrigation with the amount of available water that that soil can hold when the irrigation is applied

• *If water applied greatly exceeds the holding capacity of that soil, consider the impact of N leaching!*
More than maximum: definitely suspect leaching
In between: might have leaching
Less than: need more information to determine leaching

<table>
<thead>
<tr>
<th></th>
<th>ac-inches per foot of soil</th>
<th>ac-inches in 30&quot; root zone</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sand</td>
<td>0.5 - 0.7</td>
<td>1.3 - 1.8</td>
</tr>
<tr>
<td>Fine sand</td>
<td>0.7 - 0.9</td>
<td>1.8 - 2.3</td>
</tr>
<tr>
<td>Loamy sand</td>
<td>0.7 - 1.1</td>
<td>1.8 - 2.8</td>
</tr>
<tr>
<td>Loamy fine sand</td>
<td>0.8 - 1.2</td>
<td>2.0 - 3.0</td>
</tr>
<tr>
<td><strong>Sandy loam</strong></td>
<td><strong>0.8 - 1.4</strong></td>
<td><strong>2.0 - 3.5</strong></td>
</tr>
<tr>
<td>Loam</td>
<td>1 - 1.8</td>
<td>2.5 - 4.5</td>
</tr>
<tr>
<td>Silt loam</td>
<td>1.2 - 1.8</td>
<td>3.0 - 4.5</td>
</tr>
<tr>
<td>Clay loam</td>
<td>1.3 - 2.1</td>
<td>3.3 - 5.3</td>
</tr>
<tr>
<td>Silty clay</td>
<td>1.4 - 2.5</td>
<td>3.5 - 6.3</td>
</tr>
<tr>
<td>Clay</td>
<td>1.4 - 2.4</td>
<td>3.5 - 6.0</td>
</tr>
</tbody>
</table>
Typical leaching scenarios:

- Minimal leaching
- Leaching pre and first irrigations
- Leaching all or most irrigations
Typical scenarios:

**Minimal leaching**

- Good flexibility in N application timing
- Movement of N from surface to roots when using manures
- Utilization of filtered solids when using pressurized systems
- Salt build up
- Concentration of N in leachate
Typical scenarios:

**Leaching pre and first irrigations only**

- N banking possible part of the year
- One or two higher dose applications are feasible
- Easier to utilize manures effectively
- Accounting for previous crop residues can be important
- Soil and/or tissue tests more useful
Early season shanked/injected application vs. water-run applications later

Potential leaching losses balanced with application non-uniformity
Typical leaching scenarios:

- Minimal leaching
- Leaching pre and first irrigations
- Leaching all or most irrigations
Obvious approach to reducing N leaching:

Improve irrigation efficiency so water doesn’t move past roots
Obvious approach to reducing N leaching:

Increase irrigation efficiency so water doesn’t move past roots

This may be the preferred approach for some operators
Pressurized systems

High capital costs

Long term/whole farm use on dairies may need to be in conjunction with new solids & salt management technologies

Parcel size and shape limits use of sprinklers in N. SJV
Ways to minimize deep percolation with surface irrigation

– Reduce field length
– Increase the flow rate so water moves faster
– Increase slope
– Make the soil surface smoother
– Use pulsed, or surge irrigation
Two basic approaches to reducing N leaching:

1. Improve irrigation efficiency so water doesn’t move past roots

2. Strategic timing of applications so there is a minimal amount of nitrate in the soil during leaching events
Nitrogen Transformations in the Soil

- **Organic nitrogen**
  - **mineralization**
  - **Ammonium (NH₄-N)**
    - **nitrification**
    - **Nitrate (NO₃-N)**
Soil surface

Root Zone & beyond

Ground water

NH₄-N  Org-N  NO₃-N
Two basic approaches to reducing N leaching:

A. Improve irrigation efficiency so water doesn’t move past roots

B. Strategic timing of applications so there is a minimal amount of nitrate in the soil during leaching events
Corn & Forage N Budgets

1. How much nitrogen does the crop need?
2. What losses are expected?
3. When does the crop need the nitrogen?
8 leaves

Early tassel

6 to 10 lbs N per day or more needed during this 10 day period!

40%
When is N taken up?

2/3 before tasselling

1/3 grain fill
### Nitrogen uptake by corn grown for silage
(above ground portions only, 8.5% protein at harvest)

<table>
<thead>
<tr>
<th>stage</th>
<th>GDU</th>
<th>% total N uptake per period</th>
<th>30 tons/acre</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>lbs N/acre used each</td>
<td>lbs N/acre used before</td>
</tr>
<tr>
<td>V4</td>
<td>305</td>
<td>3%</td>
<td>9</td>
</tr>
<tr>
<td>V8</td>
<td>422</td>
<td>5%</td>
<td>14</td>
</tr>
<tr>
<td>V12</td>
<td>571</td>
<td>14%</td>
<td>36</td>
</tr>
<tr>
<td>VT</td>
<td>753</td>
<td>40%</td>
<td>102</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>161</td>
</tr>
<tr>
<td>R1</td>
<td>909</td>
<td>5%</td>
<td>13</td>
</tr>
<tr>
<td>R2</td>
<td>1140</td>
<td>5%</td>
<td>13</td>
</tr>
<tr>
<td>R5</td>
<td>1490</td>
<td>32%</td>
<td>83</td>
</tr>
<tr>
<td>R6</td>
<td>1598</td>
<td>0.2%</td>
<td>0.6</td>
</tr>
<tr>
<td>total</td>
<td></td>
<td>100%</td>
<td>257</td>
</tr>
</tbody>
</table>


32 - 34% of total N uptake occurs during grain fill.
Leaching all or most irrigations

- Multiple low dose applications are necessary
- System must allow for low N application rates through irrigation system (important if using lagoon water)
- Good irrigation uniformity is necessary
- Difficult to utilize organic N
- May need to consider N needed for root growth
- Use soil and/or tissue test results cautiously
Keys to N Fertilization of Corn

Goal: have nitrogen available in soil when the crop needs it & avoid having too much if leaching is likely

• Know the potential to leach N
• Understand uptake patterns
• Strategically time N applications
Corn & Forage N Budgets

1. How much nitrogen does the crop need?
2. What losses are expected?
3. When does the crop need the nitrogen?
4. What form(s) is the nitrogen in?
Forms of nitrogen

Irrigation water

Calculate amount from concentration and volume

Some may move past roots
Nitrogen in Irrigation water

10 mg/L x 34 acre-inches x .226 = 77 lbs/A

30% of a 250 lb/acre removal
Organic form nitrogen

Releases slowly over years
Table values (% per year)

more than one crop per year
carry over from one year to the next
multiple applications

Rate depends on temperature and material type
1. How much nitrogen does the crop need?
2. What losses are expected?
3. When does the crop need the nitrogen?
4. What form(s) is the nitrogen in?
5. Will the proposed budget meet the N needs of the crop throughout the season?
Major considerations:

- Organic N release from multiple applications
- How much irrigation water N to credit
- N lost during leaching events
Forage systems may need to consider both crops

Goal: have nitrogen available in soil when the crop needs it & avoid having too much if leaching is likely
<table>
<thead>
<tr>
<th>Event</th>
<th>Event date</th>
<th>material type</th>
<th>ammon N lbs/A</th>
<th>organic N lbs/A</th>
<th>nitrate N lbs/A</th>
<th>irrig ac-inches</th>
</tr>
</thead>
<tbody>
<tr>
<td>initiation date</td>
<td>3 May 14</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>s pplnt 1</td>
<td>5 May 14</td>
<td>Dairy Cow Manure</td>
<td>180</td>
<td></td>
<td>18</td>
<td>8.0</td>
</tr>
<tr>
<td>s pre irrig</td>
<td>10 May 14</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>summer planting</strong></td>
<td><strong>20 May 14</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>s 1st irrig</td>
<td>19 Jun 14</td>
<td></td>
<td>11</td>
<td></td>
<td>7</td>
<td>5.0</td>
</tr>
<tr>
<td>s 2nd irrig</td>
<td>29 Jun 14</td>
<td></td>
<td>7</td>
<td></td>
<td>7</td>
<td>3.0</td>
</tr>
<tr>
<td>s 3rd irrig</td>
<td>9 Jul 14</td>
<td></td>
<td>7</td>
<td></td>
<td>7</td>
<td>3.0</td>
</tr>
<tr>
<td>s 4th irrig</td>
<td>19 Jul 14</td>
<td></td>
<td>7</td>
<td></td>
<td>7</td>
<td>3.0</td>
</tr>
<tr>
<td>s 5th irrig</td>
<td>29 Jul 14</td>
<td></td>
<td>7</td>
<td></td>
<td>7</td>
<td>3.0</td>
</tr>
<tr>
<td>s 6th irrig</td>
<td>9 Aug 14</td>
<td></td>
<td>7</td>
<td></td>
<td>7</td>
<td>3.0</td>
</tr>
<tr>
<td>s 7th irrig</td>
<td>19 Aug 14</td>
<td></td>
<td>7</td>
<td></td>
<td>7</td>
<td>3.0</td>
</tr>
<tr>
<td>s 8th irrig</td>
<td>29 Aug 14</td>
<td></td>
<td>7</td>
<td></td>
<td>7</td>
<td>3.0</td>
</tr>
<tr>
<td><strong>summer harvest</strong></td>
<td><strong>10 Sep 14</strong></td>
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<td></td>
<td></td>
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<td></td>
</tr>
</tbody>
</table>

Create irrigation schedule for entire season
### UCCE Nitrogen Ledger Calculator

**Event** | **Event date** | **Material mineralization type** | **ammon N lbs/A** | **organic N lbs/A** | **irrig nitrate N lbs/A** | **irrig ac-inches**
---|---|---|---|---|---|---
**date 1** | 3 May 14 | | | | | |
**s plant 1** | 4 May 14 | Dairy Cow Manure | | 180 | | |
**s pre irrig** | 6 May 14 | | | | 18 | 8.0 |
**summer planting** | 16 May 14 | | | | | |
**s 1st irrig** | 12 Jun 14 | | | | 11 | 5.0 |
**s 2nd irrig** | 22 Jun 14 | | | | 7 | 3.0 |
**s 3rd irrig** | 2 Jul 14 | | | | 7 | 3.0 |
**s 4th irrig** | 12 Jul 14 | | | | 7 | 3.0 |
**s 5th irrig** | 22 Jul 14 | | | | 7 | 3.0 |
**s 6th irrig** | 1 Aug 14 | | | | 7 | 3.0 |
**s 7th irrig** | 11 Aug 14 | | | | 7 | 3.0 |
**s 8th irrig** | 21 Aug 14 | | | | 7 | 3.0 |
**summer harvest** | 29 Aug 14 | | | | | |

**N removal** = 250

**10 mg/L x .226 x 8 ac-in = 250 lbs/A expected crop uptake**
## Nitrogen Ledger Calculator

### Event Log

<table>
<thead>
<tr>
<th>Event</th>
<th>Event date</th>
<th>material type</th>
<th>ammon N lbs/A</th>
<th>organic N lbs/A</th>
<th>nitrate N lbs/A</th>
<th>irrig ac-inches</th>
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</table>

### Totals

- 258 lbs/A
- 180 lbs/A
- 78 lbs/A
- 34 ac-inches

**Estimate water and nitrate amounts**

250 lbs/A expected crop uptake
Nitrogen Ledger Calculator

Calculates organic N mineralization, N lost to leaching, and compares crop need with N remaining in soil.
Brown shading is lbs available N/acre in soil & the green is daily corn N uptake

| Event         | Event date | material type          | ammon N lbs/A | organic N lbs/A | nitrate N lbs/A | irrig ac-
inches | lbs/A soil N leached | crop N this period | avail N this period | mineralized N this period |
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Crop N Summary:

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<th>Total N Avail</th>
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Note: The table and graph data are derived from the provided information and may require further interpretation for complete understanding.
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**Totals**

|                    | 408                   | 100                 | 230                 | 78                        | 34.0                       |
|--------------------|-----------------------|--------------------|---------------------|----------------------------|

**Nitrogen Summary**

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<th>Crop</th>
<th>Exp'd Removal</th>
<th>Total Avail</th>
<th>Total Applied</th>
<th>Compnt Ratio</th>
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Annual

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<td>102</td>
<td>1.0</td>
<td>74/14</td>
<td>169</td>
</tr>
</tbody>
</table>

**lfs/A nitrate leached:** 47

**N Summary** | **Field Info** | **N Detail**
41 lbs N/ac

Leaching from preirrigation

added 18 irrig N

lost 29 leached N

-9

Yipes!
Out of N!

Crop N uptake

Irrig water N

N release from manure

added 100 lbs N fertilizer in 2nd irrig

Brown shading is lbs available N/acre in soil & the green is daily corn N uptake
Use in-season monitoring to confirm results
Soil & Tissue Testing for Corn Nitrogen Management

Little work has been conducted in CA on soil and tissue testing for nitrogen management in corn.

Information to be presented is based on work primarily from the mid-west and has not been evaluated in UC trials to evaluate their usefulness under CA conditions and management.

The tests have limitations that must be considered.
Soil Analyses

Pre-Plant nitrate test (PPNT)
Pre-Sidedress nitrate test (PSNT)

Challenges in using these tests:

• Spatial variability – need representative samples

• Turn around time from the lab (there are some quick tests)

• Will the nitrate be there after an irrigation?

• If nitrate is coming from mineralization of an organic source, how much and how quickly will more nitrate be available?

Details on these tests can be found at [http://apps.cdfa.ca.gov/frep/docs/Corn.html](http://apps.cdfa.ca.gov/frep/docs/Corn.html)
Plant Tissue Analysis Guidelines for Nitrogen in Corn

<table>
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<tr>
<th>Growth Stage</th>
<th>Plant Part to Sample</th>
<th>Sufficiency Range %</th>
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</thead>
<tbody>
<tr>
<td>Early Season (6-16 inches)</td>
<td>Whole plant</td>
<td>3.5 – 5.0</td>
</tr>
<tr>
<td>Midgrowth (3-6 ft)</td>
<td>First fully developed leaf: third leaf from top</td>
<td>3.5 – 4.0</td>
</tr>
<tr>
<td>Tasseling</td>
<td>Leaf opposite and below the primary ear</td>
<td>2.8 – 3.8</td>
</tr>
<tr>
<td>Silking</td>
<td>Leaf opposite and below the primary ear</td>
<td>2.0 – 3.0</td>
</tr>
</tbody>
</table>

Challenges:
Provide current status and may not be very predictive
Getting samples back in time to correct a problem

Details on these tests can be found at [http://apps.cdfa.ca.gov/frep/docs/Corn.html](http://apps.cdfa.ca.gov/frep/docs/Corn.html)
Leaf Greenness Tests

Chlorophyll meter
Canopy reflectance meters

Challenges

• Corn varieties don’t have the same greenness levels
• Need a well fertilized strip in the field for comparison
• A lot of leaves may need to be sampled

Details on these tests can be found at http://apps.cdfa.ca.gov/frep/docs/Corn.html
For end of season evaluation of corn program:

**Corn Stalk Nitrate Test at end of season**

- Take samples from ¼ milk line to 3 weeks post black layer.
- Samples are 8 inch portion of the stalks (from 8-16 inches above soil surface).
- Analyze for nitrate.
- Guidelines can indicate if there was excess nitrogen at the end of the season.
- Can help in planning in the next year.

Doesn’t measure how much nitrate might have leached past the root zone. Might indicate the potential for residual N that could be leached or could provide N for subsequent crop.

Details on these tests can be found at [http://apps.cdfa.ca.gov/frep/docs/Corn.html](http://apps.cdfa.ca.gov/frep/docs/Corn.html)
1. How much nitrogen does the crop need?
2. What losses are expected?
3. When does the crop need the nitrogen?
4. What form(s) is the nitrogen in?
5. Will the proposed budget meet the N needs of the crop throughout the season?
6. Use in-season monitoring to confirm results
Assets:

• Nitrate in irrigation water
• Mineralized N from organic sources this year & previous
• N fertilizer residual from previous crop

Losses:

• Leaching with rainfall or irrigation
• Denitrification

Goal:

• Have N in soil when crop needs it
• Don’t have N in soil when it can be lost
Keys to N Fertilization of Corn

• Not enough to know total amount of N but must have N when the crop needs it.

• Timing of N applications must consider leaching
Questions?