NITROGEN BUDGET WORKSHEET FOR ORGANIC CROP PRODUCTION

Companion worksheet to “Building a Nitrogen Budget for Organic Crop Production”

Margaret Lloyd¹, Patricia Lazicki², Evelyn Smith², Daniel Geisseler², Joji Muramoto³, Richard Smith¹

¹ University of California Cooperative Extension
² University of California, Davis, Department of Land, Air and Water Resources
³ University of Santa Cruz, Department of Environmental Studies+

1. Crop N Uptake

Estimate the crop N demand

A. _________ lbs N/A  A. Total N value (or range) provided by a reliable source (Fig. 2)

B. _________ Tons/A  B. Yield associated with the above N value (Fig. 2)

C. _________ Tons/A  C. Your predicted yield

D. _________ lbs N/A  D. Total N demand based on your predicted yield

\[
\text{D. Total N demand based on your predicted yield} = \frac{\text{C. predicted yield}}{\text{total N uptake/T (Fig. 2)}}
\]

Timing for N demand

- Consider soil moisture, soil temperature and timing of crop demand when deciding which materials will be added and when (Fig. 3).
- Become familiar with the crop uptake curve in order to understand the timing of N demand

2. Available N from Soil Organic Matter

A common rule of thumb is that during a summer growing season, about 2% of the total soil N becomes available (often ~50-100 lbs N/acre).

E. _________ lbs/A  E. Estimated N from SOM  Reference figure 4. A typical release rate will likely be from 50-100 lbs N/acre/season in the top 1’ of soil.

Estimate your SOM release based on the history of cover cropping, compost amendments and N management. For soils with a long history of building soil organic matter, estimate a higher N release and for those with a shorter history of soil building, estimate N release on the lower end. In addition, warm season production should have higher numbers than cool season production.

3. Available N from Cover Crops and Crop Residues

3.1 N fixation from leguminous cover crops

The amount of N legumes contribute depends on several factors including the species, how thick the stand is, and at what stage it is terminated.
F. ________ lbs/A  F. Estimate legume biomass dry weight
Use your own information of biomass dry weight, or reference UC SAREP cover
crop database. When referencing another source providing a range, consider your
own scenario regarding crop density and crop height/maturity to select a number
in the range. For example, if a crop is terminated earlier, at 50% of maturity, select
a number on the lower end of the range. More dense and longer production times
will likely fall on the higher end of the range.

G. ________ %  G. Percent N in cover crop
Use your own information from a sample sent to a lab, or reference UC SAREP
cover crop database.

H. ________ lb N/A  H. Total N from cover crop (Fig. 5)
\[
\frac{\text{F. x G.}}{\text{H.}}
\]

I. ________ lbs N/A  I. Total N from cover crop available this season
It’s estimated that about 4-30% of cover crop N is directly used by the next crop.
Use a lower % N when material is left on the surface and not incorporated or when
the soil is drier. Use an intermediate % for legume-cereal mixes. Use a higher %
when the cover crop is terminated at optimum growth.

\[
\frac{\text{H. x 4-30%}}{\text{I.}}
\]

3.2 Available N from Previous Crop
This is only relevant for crops planted within ±4 weeks after previous crop termination and incorporation.

J. ________ Tons/A  J. Previous crop yield

K. ________ lbs N/A  K. Expected crop residue
The amount of N expected to be in the residues can be adjusted for the actual
expected yield by multiplying the actual yield by the value in column 2, lbs N/ton yield (Fig. 6).

\[
\frac{\text{J. x |lb N/ton|}}{\text{K.}}
\]

4. Available N from Organic Amendments

4.1 Compost
Most compost companies will provide an analysis of the compost material which will include the total % N
and C:N ratio.

L. ________ C:N ratio  L. Identify the C:N ratio of the compost

M. ________ % N  M. Total % N of compost

N. ________ lbs/A  N. Application rate (1 T = 2000 lbs)

O. ________ lbs N/A  O. Estimated total N from compost added to field

\[
\frac{\text{M. x N.}}{\text{O.}}
\]
Composts are estimated to release 0-30% of total N in the first year (Fig. 7). Plant based composts can initially tie up N whereas manure-based composts have more N available. Take a look at figure 8 to see the correlation between C:N ratio and available nitrogen.

\[
\text{O.} \times \frac{0-30\%}{\text{P.}} = \text{__________}
\]

4.2 Granular fertilizers

\[
\text{Q.} \times \frac{\% \text{N}}{\text{R.}} = \text{S.}
\]

\[
\text{S.} \times \frac{\text{R.}}{40-90\%} = \text{T.}
\]

4.3 Liquid fertilizers

\[
\text{U.} \times \frac{\text{V.}}{\text{W.}} = \text{X.}
\]

Liquid fertilizers are estimated to release all available N in the season, so an expected 100% availability (Fig. 7).

5. Interpreting Soil and Water Tests

5.1 Interpreting soil tests

The amount of N in lbs/acre can be calculated by multiplying this number by a factor of 3-4 for every foot of soil, depending on the soil density, with low values for very high organic matter and clay soils and higher values for more compacted or very sandy soils. A commonly used factor for agricultural soils is 3.6

\[
\text{Y.} \times \frac{\text{A.}}{\text{B.}} = \text{C.}
\]

Liquid fertilizers are estimated to release all available N in the season, so an expected 100% availability (Fig. 7).
5.2 Sampling water for testing

To convert NO$_3$-N concentration in the water to lbs N/acre, NO$_3$-N concentration reported in ppm is multiplied by 0.227 and by the number of acre-inches of water applied. For example, for 1 acre-inch of water containing 10 ppm nitrate-N: (10 ppm) x (1 acre-inch) x (0.227) = 2.27 lbs N are applied per acre.

Z. \[ \text{Z. Contribution from irrigation water based on water test result} \]

A. Convert ppm to lbs N/A \[ \frac{\text{ppm}}{\text{NO}_3^-\text{N}} \times 0.227 = \frac{\text{lbs N}}{\text{A}} \]

B. Estimate total water use \[ \text{acre-inches} \times \frac{\text{lbs N}}{\text{A}} = \text{Z.} \]

THE BUDGET

<table>
<thead>
<tr>
<th>DEMAND</th>
<th>lbs N/A</th>
</tr>
</thead>
<tbody>
<tr>
<td>D. Crop Demand</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>BASELINE</th>
<th>lbs N/A</th>
</tr>
</thead>
<tbody>
<tr>
<td>E. SOM contributions</td>
<td></td>
</tr>
<tr>
<td>I. Cover Crop</td>
<td></td>
</tr>
<tr>
<td>K. Previous Crop</td>
<td></td>
</tr>
<tr>
<td>Y. Residual soil N</td>
<td></td>
</tr>
<tr>
<td>Z. Irrigation Water</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>AMMENDMENT N CONTRIBUTIONS</th>
<th>lbs N/A</th>
</tr>
</thead>
<tbody>
<tr>
<td>P. Compost</td>
<td></td>
</tr>
<tr>
<td>T. Granular fertilizer</td>
<td></td>
</tr>
<tr>
<td>X. Liquid fertilizer</td>
<td></td>
</tr>
</tbody>
</table>