Organic Nitrogen Sources for Vegetable Crops

Mark Gaskell, Farm Advisor
University of California Cooperative Extension,
624 West Foster Rd.
Santa Maria, CA 93455
Background and overview

- Fertilization is the most expensive cultural practice of organic vegetable growers in California.

- Compost and green manure cover crops have long been the basis for organic fertilization regimes.

- Mineralization of N from compost and cover crops can be quite variable and depend upon the type of material, time of year, cultural practices.
Compost and cover crops

- Still some of more economical forms of N despite their limitations
- Often sighted as slow release N sources
  - later N release not useful for the succeeding crop
- Synchrony of N release is critical limitation
- Legumes release N more quickly than grasses
Residual NO₃-N (ppm)

Date

19-May 2-Jun 16-Jun 30-Jun 14-Jul 28-Jul 11-Aug

+ GM  - GM
Weeks

Rate of N Mineralization or Crop N Uptake

Crop Demand

Fertilizer Mineralization

Cover Crop Mineralization

Cover Crop Incorporation

Soil organic matter mineralization

Weeks

Rate of N Mineralization or Crop N Uptake
Pattern of release from pre-plant incorporated N sources may not adequately match crop need for N

- Release of N for 6-8 weeks - temperature? - then returns to soil background levels
- Chilean nitrate used in some programs - severe restrictions
- Other potential organic fertilizer N sources evaluated - vary in N cost and N mineralization rate.
- Materials evaluated include: seabird guano, liquid fish, pelleted chicken manure, feather meal, corn meal, blood meal, liquid soybean meal among others.
Residual Soil Nitrate-N (ppm) vs. Date and N Applied (lb/A)
Residual Soil Nitrate-N (ppm)

N Applied (kg/ha)

Date

Feather Meal

5/11  5/25  6/8  6/22  7/6  7/12  8/3  8/17

296

208

120

0
When does N come available?
Feather better than compost

Residual Nitrate-N (ppm)

Date


Compost Feather Zero

180 lb N / A
Date

- 19-May
- 2-Jun
- 16-Jun
- 30-Jun
- 14-Jul
- 28-Jul
- 11-Aug

Residual Nitrate N (ppm)

- Feather+GM
- Feather-GM
- Comp+GM
- Comp-GM
- O-GM

208 lb N / A
Materials vary in cost and efficacy so green manure and compost are still important for pre-plant application.
<table>
<thead>
<tr>
<th>Product</th>
<th>Temp (°F)</th>
<th>1 week</th>
<th>4 weeks</th>
<th>8 weeks</th>
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<tbody>
<tr>
<td>Pelleted poultry manure</td>
<td>59</td>
<td>4</td>
<td>16</td>
<td>21</td>
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<td></td>
<td>77</td>
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<td>23</td>
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<td>49</td>
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<td>Fish powder</td>
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<td>61</td>
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<td></td>
<td>77</td>
<td>48</td>
<td>60</td>
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<tr>
<td>Feather meal</td>
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<tr>
<td></td>
<td>77</td>
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<td>64</td>
<td>63</td>
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<tr>
<td>Blood meal</td>
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<td>41</td>
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<td>64</td>
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<td></td>
<td>77</td>
<td>51</td>
<td>67</td>
<td>70</td>
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<td>Organic fertilizer</td>
<td>% of initial N</td>
<td>lb / ton</td>
<td>$ / ton</td>
<td>$ / lb available N</td>
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<tr>
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<td>173</td>
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<td>221</td>
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</table>

(Hartz and Johnston, 2006)
Liquid N Sources

- Variation in types, costs of materials. Variation in suitability for micro-irrigation.

- Sieve sizing or grind size critical for use in drip and micro-irrigation systems and this will affect value as N source.
  - does N stay behind the filter with organic matter?

- Some organic growers choose to use cheap tape and replace with each vegetable crop but this avoids problem of N availability.

- Additional work needed
Other organic fertilizer problem areas

- lack uniformity
- bulky,
- unstable,
- inconsistency --> hidden management costs
- higher cost and variability for research

- Liquid organic N sources for use in micro irrigation systems - can be some of most cost effective but additional disadvantages associated with N that is removed by filters.
Summary

- Green manure crops or pre-plant compost are the most economical organic sources of N but many crops need supplemental N.

- Diverse organic amendments available as N nutrient sources but bulk, uniformity, stability problems slow development of reliable response data.

- Other N amendments - feather meal, guano, liquid fish, among others - vary widely in N availability but are more efficient than compost for later season N side dressing.

- Liquid organic fertilizers are also variable. Smaller particle sizes necessary for micro-irrigation should aid N availability.
Yield effects?
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Pepper yield in response to increasing N application

- Often no differences in total yield - even in cases where relatively high NO$_3$-N in soil.

- Increasing yield of early peppers or extra-large peppers have been observed in response to increasing rates of N as feather meal. No increase from compost - even at higher rates of N.
  - related to higher soil NO$_3$-N

- Yield of early and extra large peppers reached max. yield with 100 lb N/A with prior GM crop but without prior GM crop, required 200 lb / A.
$R^2 = 0.59^{**}$

Cabbage Yield (lb/plot)

Nitrogen Applied (lb/A)
Soil and Tissue Nitrogen and Fall Cabbage Yield Associated with Varying Rates of Nitrogen Applied as Different Organic Sources

- Seven types of organic fertilizers - feather meal (13% N), blood meal (14% N), liquid fish waste (6% N), a micronized liquid feather meal (4% N), a micronized feather / blood meal (13% N) for injection as a liquid suspension, and the two micronized materials with an added microbial inoculant - were each applied to fall cabbage at N rates of 0, 90, 180 lb A.<sup>1</sup> Weekly residual soil nitrate N (SNN) was proportional to applied N rate much of the season and varied from 5 to over 70 ppm. Marketable yield ranged from 8000 to 33,300 lb A.<sup>1</sup> The SNN was highest with the liquid fish waste most weeks and marketable cabbage yield was also highest following application of 180 lb A.<sup>1</sup> of liquid fish waste. A positive marketable yield response to increasing rates of applied N was also observed for the other organic N materials.