Essential Criteria for Conducting N Fertility Testing in Sunflower

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NSA Project: “Gauging Oilseed & Confectionary Sunflower N Response in the TX High Plains (Project 11-P02)

- Deep soil sampling to 6’ if we can get it
- Timing for both at-plant and in-season N applications
- Confectionary and oilseed
- Assessment of yield and quality parameters
- Calculation of crop value
NSA Project: “Gauging Oilseed & Confectionary Sunflower N Response in the TX High Plains (Project 11-P02)

- 32-0-0 applied with a knife rig at 0, 40, 80, 120, and 160 lbs. N/A

- **Lubbock:** 92 lbs. nitrate-N/A in top 5’, but only 13 lbs. N at 0-6 (range 58-131 lbs. of nitrate-N; %OM = 0.4%)
  - If all N were used, enough for 1,800 lbs./A yield

- **Etter:** 61 lbs. nitrate-N/A in top 5’ (range 44-97 lbs. of nitrate-N; %OM = 0.6%)

- Goal was testing with < 40 lbs. of nitrate-N/A

- Furrow irrigation!
Yield Results, 2012 (Lbs./A)
Not a Suitable Test Situation

- Terminate project until low N site can be obtained under sprinkler irrigation
- For research we need to isolate sunflower N response to applied N
- Furrow irrigation diminishes known contribution/effect—to an unknown degree—of existing N in the field
- So what am I left with?—I am not sure!
Contributors to Initial Discussion

- Dr. Dave Mengel, soil fertility & soil test lab director, Kansas State Univ., dmengel@ksu.edu
- Dr. Dave Franzen, Extension soil specialist, North Dakota State Univ., david.franzen@ndsu.edu
- Dr. Ron Gelderman, soil fertility, South Dakota State Univ., Ronald.Gelderman@sdstate.edu
- Dr. Ray Ward, Ward Laboratories, Kearney, Nebraska, rayward@wardlabs.com
- Dr. Lucas Haagm K-State Research & Extension, lhaag@ksu.edu
Considerations

- Significant N research suggests that higher end N applications may not be returning economic value in sunflower.
- N fertility tests for sunflower are often “flat,” e.g., there is limited response to N.
- Sunflowers get faulted—or worse—for removal (mining!) of deep soil N to the detriment of the succeeding crop.
- High N applications can cause an issue with high water tables (Nebraska)…
  - …but might be a solution to removal of deep subsoil nitrate-N that may otherwise reach the water table.
Deep Soil Sampling
The Long-time Standard

- Sunflower fertility recommendations of 5 lbs. of nitrogen per 100 lbs. of yield goal

- This is not necessarily the sunflower N requirement

- Given this Standard, how do we adjust it (if at all) for soil nitrate-N? And to what depth?
  - And for soil type, soil organic matter, previous crop?
Bradyrhizobium nodules
Nitrogen Fertility & Soil Testing

- You can’t get something from nothing (at least not for very long)
- Sunflower N fertility, ~5 lbs. N per 100 lbs. of yield goal—combined source from soil and fertilizer N
  - Soil N value dependent upon depth of soil sample
  - Texas A&M lab calculation:
    - N = (yield goal X 2) - (2 X ppm N for 0-6”)
    - N = (yield goal X 2) - (all profile N, 24”deep or more)
  - Subsoil N in Texas is credited a 100%, e.g. for “all practical purposes” deduct it fully from applied N
**PROFILE SOIL SAMPLE INFORMATION FORM**

Please submit this completed form and payment with samples. Mark each sample bag with your unique sample identification and ensure that it corresponds with the sample identification written on this form. *See sampling and mailing instructions on the back of this form. (PLEASE DO NOT SEND CASH)

**SUBMITTAL AND INVOICE INFORMATION:** This information will be used for all official invoicing and communication.

<table>
<thead>
<tr>
<th>Name</th>
<th>County where sampled</th>
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**CLIENT NAME:** Client name will only be included with information above on result reports.

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<tr>
<th>Name</th>
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This form is only for paired (surface and subsurface) profile sample submittal. All subsurface samples must have a corresponding surface soil. If submitting non-profile samples, use form D-494.

<table>
<thead>
<tr>
<th>Payment (DO NOT SEND CASH)</th>
</tr>
</thead>
<tbody>
<tr>
<td>☐ Check</td>
</tr>
<tr>
<td>☐ Money Order (keep your M.O. receipt)</td>
</tr>
<tr>
<td>☐ Credit Card – requires additional form*</td>
</tr>
</tbody>
</table>

Amount Paid $ Make Payable to: Soil Testing Laboratory Credit card payment forms can be downloaded at [http://soiltesting.tamu.edu](http://soiltesting.tamu.edu)

**SAMPLE INFORMATION (Required)**

<table>
<thead>
<tr>
<th>Laboratory # (For Lab Use)</th>
<th>Your Sample I.D.</th>
<th>Acreage Represented</th>
<th>Previous lime/fertilizer</th>
<th>What are you growing?</th>
<th>Requested analyses</th>
<th>How is forage used?</th>
</tr>
</thead>
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This subsurface sample/surface sample listed above.

**Sampling Depth:**

- ☐ 0-12”
- ☐ 0-18”
- ☐ 0-24”

[Diagram of form with arrows pointing to specific sections]
Development of sound nutrient management programs involves knowledge of a wide range of information. Soil test records are an important piece of required information, but other factors such as soil moisture conditions, land ownership/tenure, crop and cropping sequence, pest management, cultural practices are based on surface soil samples collected to a depth of six inches. We suggest collecting a sample from the 0 to 24 inch depth for N, S and Cl recommendations and a separate 0- to 6-inch sample for pH, P, K, Zn, Fe and B soil test determinations.

For lime, the recommended lime rate should be
The results of a 7-year study conducted at the USDA-ARS Central Great Plains Research Station, Akron, Colo., indicated that sunflowers require 6 to 7 pounds of nitrogen for every 100 pounds of production.

An increase from “standard” recommendation of 50 lbs. N per 100 lbs. of yield goal.

Presence of subsoil nitrate may be why producers are getting by with the latter N rate.
# Sunflower Nitrogen Recommendations

Fertilizer N Required At Various Yield and Soil Organic Matter Levels Assuming Profile N Test Is Not Used (includes 30 Lb N/A residual default)\(^1\)

<table>
<thead>
<tr>
<th>Yield Goal (Lb/A)</th>
<th>Soil Organic Matter Content (%)</th>
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<tbody>
<tr>
<td></td>
<td>1.0</td>
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<tr>
<td>1,000</td>
<td>25</td>
</tr>
<tr>
<td>1,500</td>
<td>63</td>
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<tr>
<td>2,000</td>
<td>100</td>
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<tr>
<td>2,500</td>
<td>138</td>
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<tr>
<td>3,000</td>
<td>175</td>
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\[ N_{Rec} = (\text{Yield Goal} \times 0.075) - (\% \text{ SOM} \times 20) - \text{Profile N} - \text{Manure N} - \text{Other N Adjustments} + \text{Previous Crop Adjustments} \]

\(^1\) Total N requirements presented include only Yield Goal and Soil Organic Matter Adjustments assuming profile N test not used. N rate should be adjusted for Previous Crop, Manure, and Other Appropriate N Rate Adjustments (see N rate adjustments for warm-season crops).

\(^2\) A minimum fertilizer N application of 30 Lb N/A may be appropriate for early crop growth and development.
Kansas State Adjustments

- Numerous adjustments for N recommendations for all crops
- Subsoil Nitrate-N from down to 24” and deeper credited at 90%+ to sunflower N requirement
- Soil test lab uses 50 lbs. N per 100 lbs. of yield goal

N Rec = [[YG \times 0.065 \text{ pounds nitrogen per pound of yield}] \times STA] - PCA - PYM - PSNT - (Nmin)

- N Rec: Fertilizer nitrogen recommended in pounds per acre
- YG: A realistic yield goal in pounds per acre
- STA: Soil texture adjustment (1.1 for sandy soils less than 1.0 percent organic matter, 1.0 for other soils)
- PCA: Previous crop adjustment [use Table 2 for previous legumes, 20 pounds for fallow (if no profile N test) and 0 for all other previous crops]
- PYM: Previous years manure (50 pounds for last year, 20 pounds for 2 years ago and 0 for no manure history)
- PSNT: Profile nitrogen soil test results where:

  **Surface:**
  ppm nitrogen \times 0.3 \times \text{depth, inches} = \text{pounds per acre}

  **Subsoil:**
  ppm nitrogen \times 0.3 \times \text{depth, inches} = \text{pounds per acre}

  Total Profile nitrogen = \text{pounds per acre}

**Note:** If profile nitrogen test is not run, use 30 pounds per acre as a default value for PSNT.

- Nmin: Estimate of nitrogen mineralized from soil organic matter. Credit 30 pounds of nitrogen for every 1 percent of soil organic matter in the top 6 inches of soil.
North Dakota Fertilizer Recommendation Tables and Equations

D.W. Franzien
NDSU Extension Soil Specialist

The following soil test recommendation tables are based on field research data obtained in North Dakota, South Dakota, western Minnesota region. Recent research has shown that more productive areas of fields require less fertilizer, particularly N, than less productive areas of the field because they tend to be higher in organic matter and have a higher seasonal moisture content. This means, in theory, less fertilizer is needed.
NDSU Soil Test Form N Suggestions

Depths to sample – Opposite each test (see below) are the depths required to make a recommendation for that nutrient. For example, a phosphorus recommendation requires a 0-6” sample, while a nitrogen recommendation requires at least a 0-6” and a 6-24” or a 0-24” sample. Place each 0-6”, 6-24” 0-24” or 24-48” composite sample in a separate container.

Check tests requested  | Depths required for a recommendation
---------------------------------|--------------------------------------------------
Nitrogen                        | 0-6” and 6-24” or 0-24” and 24-48” if interested in deep N
Phosphorus                      | 0-6”
Potassium                       | 0-6”
pH                               | 0-6”

For lab use only

Fee paid  ____________
If deeper sampling is conducted to refine recommendations for … sunflower…, the following adjustments would apply:

- If the amount of Nitrate-N in the 2-4’ depth is more than 30 lbs. Nitrate-N/A, reduce the N recommendation by 80% of the amount > 30 lbs. Nitrate-N/A.

- Nitrogen rec. = 0.05 X yield – Soil Test N – Prev Crop Credit
Confection Sunflower 2012-2013 Total Known Available N vs Yield

\[ y = -0.0152x^2 + 6.4033x + 1182.2 \]
\[ R^2 = 0.1021 \]

Blue line represents the present sunflower N recommendation of N rec = Yield \times 0.05.
Essential Criteria for Conducting N Fertility Testing in Sunflower

- Subsoil N testing to a minimum of 4’, and preferably 5’ and even 6’
  - Post-crop re-testing of soil N?
  - Measurement of organic matter contribution
  - Measurement of in-season NH4+ exchange?
- A decision on when to time the applications
- Couple sunflower N fertility testing with at least one external validation technique
  - GreenSeeker, chlorophyll SPAD meter, NDVI reflectance, etc.
Consensus for N Recs for Sunflower

- Emphasis on soil N testing to the extent possible/practical.
- It is incumbent on researchers & extension personnel to derive a recommendation that will do the best job of compensating for the lack of soil test N, especially below 24”, but even for no soil N data below 6”.
  - This will involve predictive assumptions to get sunflower producers “in the ballpark” for their sunflower crop when they don’t have soil test N data, no reason info. on potential soil organic matter N contribution, etc.
- Soil N recommendations for sunflower may need to be “regrettably simple” in order aid producers.