WISCONSIN CORN AND SOYBEAN RESPONSES TO FERTILIZER PLACEMENT IN CONSERVATION TILLAGE SYSTEMS

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THOUGHTS ON FERTILIZER PLACEMENT FOR CONSERVATION TILLAGE

- BROADCAST SHOULD BE INCORPORATED
  - Positional availability
  - Environmental concerns

- POSITIVES FOR BANDING
  - Greater nutrient use efficiency
  - Supply other nutrients
  - Overcome incorporation concerns

- NEGATIVES FOR BANDING
  - Slows planting operation
  - Cost of planter attachments
  - Existing high soil tests
WISCONSIN RESEARCH SHOWS RESPONSE TO ROW-PLACED FERTILIZER

- MONCRIEF, 1981
  - Response in ridge-till greater than moldboard and chisel at low soil test K

- WOLKOWSKI, 1989
  - Greater response to K on compacted soil

- Bundy and Widen, 1992
  - Demonstrated importance of complete fertilizer

- Bundy and Andraski, 1999
  - Response likely if soil test K <140 ppm

- WOLKOWSKI, 2000
  - Response in no-till and strip-till, not chisel
RESPONSE OF CORN TO ROW-APPLIED FERTILIZER AT ARLINGTON, WIS.

MONCRIEF, 1981 (8+21+10 /a)
ROW FERTILIZER RESPONSE ON COMPACTED SOILS

**Potassium Affected Most**
- Compaction reduces porosity
- Lowers soil oxygen
- $O_2$ needed for root respiration and active uptake
RESPONSE OF CORN TO ROW-APPLIED K ON A SILTY CLAY LOAM SOIL (3 yr. avg.)

Oshkosh, Wis. (45 lb K₂O/a)
## SELECTED FACTORS AFFECTING STARTER RESPONSE FROM 100 ON-FARM TRIALS

<table>
<thead>
<tr>
<th>FACTOR</th>
<th>Pr&gt;F</th>
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<tbody>
<tr>
<td>Phosphate rate</td>
<td>0.91</td>
</tr>
<tr>
<td>Surface residue</td>
<td>0.87</td>
</tr>
<tr>
<td>Soil texture</td>
<td>0.77</td>
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<tr>
<td>Soil test P</td>
<td>0.63</td>
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<tr>
<td>Potash rate</td>
<td>0.36</td>
</tr>
<tr>
<td>Soil test K</td>
<td>0.05</td>
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<tr>
<td>Corn RM</td>
<td>0.05</td>
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Bundy and Andraski, (1999)
INTERACTIVE EFFECT OF TILLAGE AND ROW FERTILIZER, ARLINGTON, 1994-1996

WOLKOWSKI, 2000 (7+22+8/a)
ROW FERTILIZER PLACEMENT CONSIDERATIONS FOR CONSERVATION TILLAGE - SUMMARY

- **USE A COMPLETE MATERIAL**
  - Relatively small rates are effective

- **RESPONSE INCREASES WITH COMPACTION**
  - Avoid compaction as overall yield is lower

- **RELATED TO SOIL TEST K, RM, PLANTING DATE**
  - Recipe for failure: Full season hybrid, planted late, on low K testing soils

- **TILLAGE INTERACTION**
  - Response more likely in high residue, undisturbed systems
SOME UNANSWERED QUESTIONS

STRIPE-TILL
Designed for fall operation in fragile residue crops
Easily add dry or liquid fertilizer attachments

ROTATIONS
First-year corn after alfalfa or soybean
ARLINGTON LONG-TERM ROTATION-TILLAGE-FERTILIZATION STUDY

- **ROTATION AND TILLAGE TREATMENT SINCE 1997**
  - Fertilizer treatments installed 2001

- **ROTATION**
  - Cont. corn, soybean/corn, corn/soybean

- **TILLAGE**
  - Chisel/field cultivator, strip-till, no-till

- **FERTILIZER PLACEMENT**
  - None, fall broadcast, 2 x 2, deep (strip-till only)
  - 18+46+60

- **MEASURE EMERGENCE, EARLY GROWTH, YIELD**
SURFACE RESIDUE AS AFFECTED BY ROTATION AND TILLAGE, ARLINGTON, WIS., 2001

Pr>F: R ≪0.01; T ≪0.01; R*T =0.08
MAIN EFFECTS OF ROTATION, TILLAGE, AND FERTILIZER ON CORN STAND, ARLINGTON, WIS., (2 YEAR AVG.)

STAND (plt/a)

- CC
- $S_bC$
- CH
- ST
- NT
- NONE
- BDCT
- 2 x 2
- DEEP

NS, NS 0.03, 0.87 0.03, 0.65
MAIN EFFECTS OF ROTATION, TILLAGE, AND FERTILIZER ON DRY MATTER 45 DAP, ARLINGTON, WIS., 2001

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<tr>
<th>Treatment</th>
<th>Dry Matter (g/plt)</th>
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<tbody>
<tr>
<td>CC</td>
<td>0.02</td>
</tr>
<tr>
<td>SbC</td>
<td>0.26</td>
</tr>
<tr>
<td>CH</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td>ST</td>
<td></td>
</tr>
<tr>
<td>NT</td>
<td></td>
</tr>
<tr>
<td>NONE</td>
<td></td>
</tr>
<tr>
<td>BDCT</td>
<td></td>
</tr>
<tr>
<td>2 x 2</td>
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</tr>
<tr>
<td>DEEP</td>
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MAIN EFFECTS OF ROTATION, TILLAGE, AND FERTILIZER ON P UPTAKE 45 DAP, ARLINGTON, WIS., 2001
MAINT EFFECTS OF ROTATION, TILLAGE, AND FERTILIZER ON K UPTAKE 45 DAP, ARLINGTON, WIS., 2001

![Bar graph showing K uptake (mg/plt) for different treatments: CC, SB, CH, ST, NT, NONE, BDCT, 2x2, DEEP. The values are 0.56, 0.04, and <0.01 for DEEP.](image-url)
EFFECT OF ROTATION, TILLAGE, AND FERTILIZER ON TISSUE K CONCENTRATION
45 DAP, ARLINGTON, WIS., 2001

<table>
<thead>
<tr>
<th></th>
<th>CC</th>
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<tbody>
<tr>
<td></td>
<td>CH</td>
<td>ST</td>
</tr>
<tr>
<td>NONE</td>
<td>2.23</td>
<td>2.37</td>
</tr>
<tr>
<td>BDCT</td>
<td>2.35</td>
<td>2.19</td>
</tr>
<tr>
<td>2 x 2</td>
<td>2.85</td>
<td>3.26</td>
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Pr>F: R =0.03; T=0.11; F =<0.01; R*T*F =0.10
INITIAL INCREMENTAL SOIL TEST P AND K

- Field historically chisel plowed
- Uniform fertility management in CC and SbC
- Why is there a difference in early K in SbC

Bar chart showing soil test (ppm) for P and K in different soil layers for the year 1997.
SOIL TEST K AS AFFECTED BY ROTATION, TILLAGE, AND FERTILIZATION, 2002

CONTINUOUS CORN

NO FERTILIZER

18+46+60 BDCT
SOIL TEST K AS AFFECTED BY ROTATION, TILLAGE, AND FERTILIZATION, 2002

SOYBEAN/CORN

SOIL TEST K (ppm)

NO FERTILIZER

18+46+60 BDCT
POSSIBLE EXPLANATION FOR ROTATIONAL SOIL TEST K DIFFERENCE (1997-2001)

Differential Removal in Grain
- Assume corn grain 0.3% K; soybean grain 17% K
- 180 and 50 bu/a yield levels for past five years
- 5 yr corn = 155 lb K$_2$O/a removed
- 3 yr corn/2 year soybean = 200 lb K$_2$O/a removed

Stover Contribution
- Assume corn stover contains 150 lb K$_2$O/a; soybean stover 50 lb K$_2$O/a
- 5 yr corn = 750 lb K$_2$O/a deposited
- 3 yr corn/2 year soybean = 550 lb K$_2$O/a deposited

Likely a Combination of Each
- Does this make first-year corn more responsive than continuous corn?
RESPONSE OF CORN TO TILLAGE AND FERTILIZER PLACEMENT, ARLINGTON, WIS. 2001-2002

CONTINUOUS CORN
SUMMARY

- STARTER FERTILIZER STILL A RECOMMENDED PRACTICE
  - Pay attention to soil test, maturity, planting date, tillage, etc.
  - Use complete materials

- ROW PLACED FERTILIZER PROVIDES EARLY RESPONSE
  - Broadcast and deep not utilized in early season

- UNFERTILIZED SbC ROTATION HAS LOWER SURFACE K
  - Combination of increased K removal and stover K addition

- FIRST-YEAR CORN APPEARS MORE RESPONSIVE TO ROW FERTILIZER THAN CONTINUOUS CORN