Fluid Technology Roundup

Fluid Fertilizer Opportunities In Modern Production Systems

Rich Recker
Nachurs Sales Agronomist
Systems Approach

Soil Structure
Fertilizer Utilization
Nutrient Balance
Placement
There are six major soil basics that govern the welfare of the soil-plant system and are controllable by the grower.

These soil basics listed in their relative order of importance are:

- Soil aeration
- Soil water
- Crop residue decay
- Plant nutrient availability
- Heat
- Time
## Ingredients of a 300 bu/A Corn

<table>
<thead>
<tr>
<th>Ingredient</th>
<th>Amount (Seed and Stover)</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO₂</td>
<td>390,000 semi-trailer loads of air (1,300 loads/bu)</td>
</tr>
<tr>
<td>Glucose</td>
<td>30,000 lbs (100 lbs/bu)</td>
</tr>
<tr>
<td>Water</td>
<td>1,500,000 gal (5,000 gal/bu)</td>
</tr>
<tr>
<td>Nutrients in Seed and Stover</td>
<td>• 450 lbs (1.5 lbs/bu) Nitrogen (33% left in stover)</td>
</tr>
<tr>
<td></td>
<td>• 180 lbs (0.6 lb/bu) Phosphorus (42% left in stover)</td>
</tr>
<tr>
<td></td>
<td>• 390 lbs (1.3 lbs/bu) Potassium (80% left in stover)</td>
</tr>
<tr>
<td></td>
<td>• 63 lbs (0.21 lb/bu) Calcium (90% left in stover)</td>
</tr>
<tr>
<td></td>
<td>• 48 lbs (0.16/lb bu) Sulfur (56% left in stover)</td>
</tr>
<tr>
<td></td>
<td><strong>1,131 Total Pounds</strong></td>
</tr>
</tbody>
</table>
# Ingredients of a 100 bu/A Soybeans

<table>
<thead>
<tr>
<th>Ingredient</th>
<th>Amount (Seed and Stover)</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO2</td>
<td>4,000 semi-loads of air/bu</td>
</tr>
<tr>
<td>Glucose</td>
<td>301,080 lbs (301 lbs/bu)</td>
</tr>
<tr>
<td>Water</td>
<td>1,350,000 gal (13,500 gal/bu)</td>
</tr>
<tr>
<td><strong>Nutrients in Seed and Stover</strong></td>
<td></td>
</tr>
<tr>
<td>• Pounds 550 lbs (5.5 lbs/bu) Nitrogen (24% left in Stover)</td>
<td></td>
</tr>
<tr>
<td>• 120 lbs (1.2 lbs/bu) Phosphorus (29% left in Stover)</td>
<td></td>
</tr>
<tr>
<td>• 240 lbs (2.4 lbs/bu) Potassium (41% left in Stover)</td>
<td></td>
</tr>
<tr>
<td>• 170 lbs (1.7 lbs/bu) Calcium (88% left in Stover)</td>
<td></td>
</tr>
<tr>
<td>• 45 lbs (0.45 lb/bu) Sulfer (56% left in Stover)</td>
<td></td>
</tr>
<tr>
<td>• <strong>1,125 Total</strong></td>
<td></td>
</tr>
</tbody>
</table>
Functions of the Plant Root System

- Make Nutrients Available
- Anchor the Plant
- Absorb Water
- Take up Nutrients
- Store Sugars
- Produce Plant Growth Regulators
- Interact with Soil Microbes
- Nodulation Site (legumes)
NUTRIENT USES IN THE PLANT

CALCIUM--
--promotes root formation & growth
--improves plant vigor & stalk strength
--improves nodulation

MAGNESIUM--
--is part of each chlorophyll molecule
--assists in translocation of P and starches in plant

PHOSPHORUS--
--stimulates early growth
--stimulates root growth
--promotes seed production

ZINC--
--builds growth regulators
--important for chlorophyll production
--essential for seed maturity

POTASSIUM--
--essential for N metabolism
--promotes root growth & stalk strength

IRON--
--the energy element
--necessary for P.S. and chlorophyll

SULFUR--
--necessary in chlorophyll production
--essential for certain amino acids
--promotes nodule formation

BORON--
--starch producer
--promotes maturity and seed development
--involved in N and carbohydrate metabolism

MANGANESE--
--involved with enzyme systems in plant
--helps break down carbohydrates & metabolize nitrogen

COPPER--
--amino acid converter
--important in plant reproduction stage
--important role in respiration

ALL NUTRIENTS ARE IMPORTANT!!
Nutrient Uptake

Cations are:
- urea (nitrogen) $\text{NH}_2$
- ammonium (nitrogen) $\text{NH}_4$
- potassium $\text{K}$
- calcium $\text{Ca}$
- magnesium $\text{Mg}$
- iron $\text{Fe}$
- zinc $\text{Zn}$
- copper $\text{Cu}$
- manganese $\text{Mn}$
- cobalt $\text{Co}$

Anions are:
- nitrates (nitrogen) $\text{NO}_3$
- phosphates (phosphorus) $\text{H}_2\text{PO}_4$
- sulfates $\text{SO}_4^{2-}$
- carbonates $\text{CO}_3$
- bicarbonates $\text{HCO}_3$

Plant Root

Absorption

Release

$\text{H}^+$ Hydrogen Ion (Decreases pH)

$\text{OH}^-$ Hydroxide Ion (Increases pH)
Role of Soil Organisms

Generalized Flow Diagram for the Synthesis of the Bacterial Cell Components


Source: Soil Biology Primer. Soil and Water Conservation Society
Managing Soil Fertility
“Basic 3” In Fertility Management

Nutrient Management =

- Balance
- Placement
- Recovery
## Plant Analysis

<table>
<thead>
<tr>
<th>SAMPLE ID</th>
<th>REPORT OF ANALYSIS (PERCENT)</th>
<th>REPORT OF ANALYSIS (PARTS PER MILLION)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N</td>
<td>P</td>
</tr>
<tr>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CORN-5</td>
<td>3.73</td>
<td>0.43</td>
</tr>
<tr>
<td>3107498 (NORM)</td>
<td>3.70</td>
<td>0.38</td>
</tr>
<tr>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CORN-5</td>
<td>3.64</td>
<td>0.35</td>
</tr>
<tr>
<td>3107498 (NORM)</td>
<td>3.70</td>
<td>0.38</td>
</tr>
<tr>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CORN-5</td>
<td>3.97</td>
<td>0.31</td>
</tr>
<tr>
<td>3107500 (NORM)</td>
<td>3.70</td>
<td>0.38</td>
</tr>
<tr>
<td>3P</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CORN-5</td>
<td>2.97</td>
<td>0.34</td>
</tr>
<tr>
<td>3107502 (NORM)</td>
<td>3.70</td>
<td>0.38</td>
</tr>
<tr>
<td>4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CORN-5</td>
<td>4.09</td>
<td>0.33</td>
</tr>
<tr>
<td>3107503 (NORM)</td>
<td>3.70</td>
<td>0.38</td>
</tr>
</tbody>
</table>

D or Deficient  L or Low  S or Sufficient  H or High  E or Excessive
# Plant Nutrients absorbed by 180 bu/A Corn Crop

## Corn Growth in 25 Day Periods

<table>
<thead>
<tr>
<th>Seedling</th>
<th>Rapid Growth</th>
<th>Silking</th>
<th>Grain Fill</th>
<th>Maturity</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="Image1" alt="Corn Seedling" /></td>
<td><img src="Image2" alt="Corn Rapid Growth" /></td>
<td><img src="Image3" alt="Corn Silking" /></td>
<td><img src="Image4" alt="Corn Grain Fill" /></td>
<td><img src="Image5" alt="Corn Maturity" /></td>
</tr>
</tbody>
</table>

## Pounds of Plant Nutrients Taken up by Corn:

<table>
<thead>
<tr>
<th>Nutrient</th>
<th>Seedling</th>
<th>Rapid Growth</th>
<th>Silking</th>
<th>Grain Fill</th>
<th>Totals</th>
<th>Stover</th>
<th>Grain</th>
</tr>
</thead>
<tbody>
<tr>
<td>N</td>
<td>19</td>
<td>84</td>
<td>75</td>
<td>48</td>
<td>14</td>
<td>240</td>
<td>104</td>
</tr>
<tr>
<td>P(_2)O(_5)</td>
<td>4</td>
<td>27</td>
<td>36</td>
<td>25</td>
<td>8</td>
<td>100</td>
<td>24</td>
</tr>
<tr>
<td>K(_2)O</td>
<td>22</td>
<td>104</td>
<td>72</td>
<td>36</td>
<td>6</td>
<td>240</td>
<td>188</td>
</tr>
</tbody>
</table>

## Percentage of Plant Nutrients Taken up by Corn:

<table>
<thead>
<tr>
<th>Nutrient</th>
<th>Seedling</th>
<th>Rapid Growth</th>
<th>Silking</th>
<th>Grain Fill</th>
<th>Totals</th>
<th>Stover</th>
<th>Grain</th>
</tr>
</thead>
<tbody>
<tr>
<td>N</td>
<td>8</td>
<td>35</td>
<td>31</td>
<td>20</td>
<td>6</td>
<td>100</td>
<td></td>
</tr>
<tr>
<td>P(_2)O(_5)</td>
<td>4</td>
<td>27</td>
<td>36</td>
<td>25</td>
<td>8</td>
<td>100</td>
<td></td>
</tr>
<tr>
<td>K(_2)O</td>
<td>9</td>
<td>44</td>
<td>31</td>
<td>14</td>
<td>2</td>
<td>100</td>
<td></td>
</tr>
</tbody>
</table>
Vertical Tillage System
Builds Rootability and The Soil Bio-digester

Second Year

CO₂  O₂
Gas Diffusion Channel  Lateral Expansion Joints
Lateral Drainage into Slots
Fragile Compaction Pan
Vertical Tillage System
Builds Rootability and The Soil Bio-digester

Third Year

CO₂ → O₂

Gas Diffusion Channel

Lateral Expansion Joints

Lateral Drainage into Slots

Fragile Compaction Pan
Farming the Zone

“Improving the Physical Status of Soil”

• Fertilizer Banding
  – Nutrient concentration and plant uptake is optimized when fertilizer is banded.

Corn – Foliar
2 1/2 gal SRN
12 Pods at node

09/02/2005
Questions
or
Comments

Thanks for Your Attention