Cornell **Cropware**

**A Nutrient Management Planning Tool**

Greg Albrecht

Quirine Ketterings, Caroline Rasmussen, Vijay Durbal, and Karl Czymmek

Cornell University – University of Wisconsin Video Conference

October 14, 2003
Name – Cornell Cropware

Purpose

- Crop, manure, fertilizer, and soil nutrient management plan development in accordance with the NRCS 590 Nutrient Management Standard

- Aid in whole farm nutrient management as a component of the Cornell University Nutrient Management Planning System (cuNMPS)
  - Cornell Net Carbohydrate and Protein System (CNCPS)
  - Cornell Cropware
Development Stage

- A tool was needed for nutrient management plan development in accordance with the NRCS 590 Standard
- Cropware version 1.0 released in August 2001
  - Funded by NYS NRCS, NYS Dept. of Agriculture & Markets, and NYS Dept. of Environmental Conservation
- Version 2.0 released in July 2003
  - Based on feedback gained through workshops and extensive use in the field by planners
  - Funded by NYS NRCS
Developed and delivered through….

Nutrient Management Spear Program (NMSP)

An extension, research and teaching program for environmentally and agronomically sound nutrient management in field crop and dairy farm systems.

Department of Crop and Soil Sciences
Cornell University
Descriptive Information

Contacts – Nutrient Management Spear Program (NMSP)

Cropware Team

- Quirine Ketterings
  - Assistant Professor
- Caroline Rasmussen
  - Research Support Spec.
- Vijay Durbal
  - Programmer
- Greg Albrecht
  - Extension Associate
- Karl Czymmek
  - Sr. Extension Associate

http://nmsp.css.cornell.edu
Contacts – Nutrient Management Spear Program (NMSP)

For Cropware Info and Support:
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607-255-1723
Caroline Rasmussen
cnr2@cornell.edu
607-255-2875

http://nmsp.css.cornell.edu
Scale and Focus

Cornell Cropware aims to help people develop nutrient management plans according to the NRCS 590 Nutrient Management Standard

**Meaning…..**

- Follow Land Grant University guidelines
- Account for nutrients from all sources
- Plan manure applications based on crop nutrient requirements
- Apply the NY Phosphorus Runoff Index for each field
- Apply the Nitrate Leaching Index for each field
- Develop plans that consider all of the above factors across the entire farm
Basic Nutrient Management Planning Flow

Allocate Manure and Fertilizer to Fields

Characterize Manure-Based Nutrient Sources
Characterize Field-Based Nutrient Factors
Characterize Crop Rotations
Characterize Landscape Features

Calculate Crop Nutrient Requirements

Allocate Manure and Fertilizer to Fields

Calculate Nutrient Balances
Calculate Nutrient Loss Risks
Calculate Manure Inventories

Met crop nutrient requirements?
Minimal nutrient loss risks?
Utilized all manure on farm?

Feasible?

Evaluate

Record Implementation
Implement Plan
Publish and Deliver Plan

If OK

If No
Tool Application

Users – Public and private sector planners, extension educators, farmers, teachers and students

Format – Cropware is a stand-alone, windows-based tool developed in Visual Basic 6

Documentation – Extensive, built-in Help Section

- Program operation
- Underlying science
- Tutorials covering program operation, science, and on-farm logistics
Knowledge and Data Transferability

Where applicable?

- Crop nutrient guidelines are based on a NYS, soil-specific database of yield potentials, fertilizer use efficiencies, and soil and sod N credits
- Organic N mineralization and ammonia volatilization rates for manure are based on NYS research
- NY Phosphorus Runoff Index
- NY Nitrate Leaching Index
Knowledge and Data Transferability

Data Sharing – Cropware version 2.0 saves and outputs data in a MS Access compatible file format, allowing links to:

- GIS
- Many other databases (*.mdb, *.xls, *.dbf, etc.)

Reports are also exportable in *.rtf file format for inclusion in word processed documents
Knowledge and Data Transferability

Inputs

- **Producer and planner information**
  - Name, address, field names and size etc.
Farm/Producer Information

Producer Name  Grace D. Paddock  FAX  333-333-3333

Farm Name  Mighty Acres  E-Mail  Paddock@mightyacres.com

Address  27 Breakwire Road  Watershed  Susquehanna River Basin

City, State, Zip  Greenville, NY, 11111  County  CORTLAND

Phone  333-333-3333  Township  HARFORD

Planner Information

Planner Name  Russell Low  Phone  777-777-7777

Company  CNMP ASAP  FAX  777-777-7777

Address  10 Recycling Way  E-Mail  cnmp@cnmpasap.com

City, State, Zip  Cleanville, NY, 10000

First Plan Year  2003
Knowledge and Data Transferability

**Inputs**

- **Producer and planner information**
  - Name, address, field names and size etc.
- **Library of crop rotations and fertilizer materials**
Rotation Name: 3 Corn Silage, 3 Alfalfa

Rotation Crops:
- Yr 1: COS
- Yr 2: COS
- Yr 3: COS
- Yr 4: ALE
- Yr 5: ALT
- Yr 6: ALT

Establishment:
- ABE: Alfalfa-Trefoil-Grass
- AGE: Alfalfa-Grass Mix
- ALE: Alfalfa

Established:
- ABT: Alfalfa-Trefoil-Grass
- AGT: Alfalfa-Grass Mix
- ALT: Alfalfa

Annual Crops:
- BSP: Barley-Spring
- BSS: Barley-Spring w/Legume
- BUK: Buckwheat

Vegetables & Misc.:
- ASP: Asparagus
- BDR: Beans - Dry
- BET: Beets

Buttons:
- Create New Rotation
- Delete Current Rotation
Knowledge and Data Transferability

**Inputs**

- **Producer and planner information**
  - Name, address, field names and size etc.

- **Library of crop rotations and fertilizer materials**

- **Manure quantities, analyses, and storage capacities**
Plan Year: 2003

Choose Waste Source:
- Main Barn

Manure Source Data:
- Waste Source Units: tons, gallons
- Manure Density: 8.34 lbs/gal
- Animal Units: 880

Choose Species:
- Dairy Cattle
- Beef Cattle
- Poultry
- Swine
- Sheep
- Horses

Estimate Waste Available for Application in 2003:
- Amount at Start of Plan Year: 150,000 gal
- Plus Amount Added to System Annually: 3,904,556 gal

Use one of these buttons to estimate the amount of waste added to this source in the plan year:
- Estimate Using Farm Records
- Estimate Using Animal Parameters
- Estimate Using Number and Average Weight of Manure Applications

Less Amount Exported from System Annually: 0 gal
Equals Annual Waste Available for Application: 4,054,556 gal
Knowledge and Data Transferability

Inputs

- **Producer and planner information**
  - Name, address, field names and size etc.
- **Library of crop rotations and fertilizer materials**
- **Manure quantities, analyses, and storage capacities**
- **Field Information**
  - Soil information
Plan Year: 2003
Field ID: 1070-21

Field Data:
- Field Name: C2
- Acres: 12.0
- County: CORTLAND
- Township: HARFORD
- Soil Name: VALOIS
- Present or Past Sod: 1-25% Legume
- Tillage Depth: 1-7 Inches
- Artificial Drainage: None
- Corn Yield Potential (bushels/acre @ 85% dry): 130
- Highly Erodible Land
- Use Cornell Estimated Yield Value.
Knowledge and Data Transferability

**Inputs**

- **Producer and planner information**
  - Name, address, field names and size etc.

- **Library of crop rotations and fertilizer materials**

- **Manure quantities, analyses, and storage capacities**

- **Field Information**
  - Soil information
  - Soil nutrient analyses
    - Cornell Morgan soil test results
    - Conversions for Brookside, Spectrum, A&L, and UVM soil test results
      (ME, NH, MA, and CT conversions available and could be included)
<table>
<thead>
<tr>
<th>Lab ID</th>
<th>CNAL</th>
<th>Extraction Method</th>
<th>Morgan</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sample Date</td>
<td>12/31/99</td>
<td></td>
<td></td>
</tr>
<tr>
<td>pH **</td>
<td>6.9</td>
<td>Fe</td>
<td>3 lbs/acre</td>
</tr>
<tr>
<td>P **</td>
<td>43 lbs/acre</td>
<td>Mn</td>
<td>25 lbs/acre</td>
</tr>
<tr>
<td>K **</td>
<td>420 lbs/acre</td>
<td>Zn</td>
<td>1.7 lbs/acre</td>
</tr>
<tr>
<td>Al</td>
<td>41 lbs/acre</td>
<td>Organic Matter</td>
<td>3.4 (%)</td>
</tr>
<tr>
<td>Ca</td>
<td>3940 lbs/acre</td>
<td>Pre Side-Dress N Test (PSNT)</td>
<td>0 ppm</td>
</tr>
<tr>
<td>Mg</td>
<td>375 lbs/acre</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

** Required Soil Test Data Entry
Knowledge and Data Transferability

Inputs

- **Producer and planner information**
  - Name, address, field names and size etc.

- **Library of crop rotations and fertilizer materials**

- **Manure quantities, analyses, and storage capacities**

- **Field Information**
  - Soil information
  - Soil nutrient analyses
    - Cornell Morgan soil test results
    - Conversions for Brookside, Spectrum, A&L, and UVM soil test results
      (ME, NH, and MA conversions available and could be included)
  - **Crop rotations**
### Current Crop
- Corn-Silage

### Previous Crops
- Year 2002: Corn-Silage
- Year 2001: Corn-Silage
- Year 2000: Corn-Silage

### Rotation
- 4 Corn Silage, 5 Alfalfa

### Future Crops
- Year 2004: Alfalfa
- Year 2005: Alfalfa
- Year 2006: Alfalfa

### Crop Rotation

<table>
<thead>
<tr>
<th>Year</th>
<th>Crop</th>
</tr>
</thead>
<tbody>
<tr>
<td>2000</td>
<td>COS</td>
</tr>
<tr>
<td>2001</td>
<td>COS</td>
</tr>
<tr>
<td>2002</td>
<td>COS</td>
</tr>
<tr>
<td>2003</td>
<td>COS</td>
</tr>
<tr>
<td>2004</td>
<td>ALE</td>
</tr>
<tr>
<td>2005</td>
<td>ALT</td>
</tr>
<tr>
<td>2006</td>
<td>ALT</td>
</tr>
<tr>
<td>2007</td>
<td>ALT</td>
</tr>
<tr>
<td>2008</td>
<td>ALT</td>
</tr>
<tr>
<td>2009</td>
<td>COS</td>
</tr>
<tr>
<td>2010</td>
<td>COS</td>
</tr>
<tr>
<td>2011</td>
<td>COS</td>
</tr>
<tr>
<td>2012</td>
<td>COS</td>
</tr>
<tr>
<td>2013</td>
<td>ALE</td>
</tr>
<tr>
<td>2014</td>
<td>ALT</td>
</tr>
<tr>
<td>2015</td>
<td>ALT</td>
</tr>
<tr>
<td>2016</td>
<td>ALT</td>
</tr>
<tr>
<td>2017</td>
<td>ALT</td>
</tr>
</tbody>
</table>
Knowledge and Data Transferability

**Inputs**

- **Producer and planner information**
  - Name, address, field names and size etc.

- **Library of crop rotations and fertilizer materials**

- **Manure quantities, analyses, and storage capacities**

- **Field Information**
  - Soil information
  - Soil nutrient analyses
    - Cornell Morgan soil test results
    - Conversions for Brookside, Spectrum, A&L, and UVM soil test results (ME, NH, and MA conversions available and could be included)
  - **Crop rotations**
  - **Manure and fertilizer application information**
### Plan Year: 2002

<table>
<thead>
<tr>
<th>Source Name</th>
<th>Test Description</th>
<th>Quantity Applied</th>
</tr>
</thead>
<tbody>
<tr>
<td>Primary Application</td>
<td>Heifer/Mat/Dry</td>
<td>Heifer/Mat/Dry</td>
</tr>
<tr>
<td>Secondary Application</td>
<td>None</td>
<td></td>
</tr>
</tbody>
</table>

### Plan Year: 2001

<table>
<thead>
<tr>
<th>Source Name</th>
<th>Test Description</th>
<th>Quantity Applied</th>
</tr>
</thead>
<tbody>
<tr>
<td>Primary Application</td>
<td>Main Barn</td>
<td>Main Barn</td>
</tr>
<tr>
<td>Secondary Application</td>
<td>None</td>
<td></td>
</tr>
</tbody>
</table>
### Crop Summary

- **Last Year:** Corn-Silage
- **This Year:** Corn-Silage
- **Next Year:** Alfalfa

### Fertilizer Data

<table>
<thead>
<tr>
<th>Fertilizer #1 - Name</th>
<th>App. Rate</th>
<th>Timing</th>
<th>Application Method</th>
</tr>
</thead>
<tbody>
<tr>
<td>20-10-0</td>
<td>100 lbs/acre</td>
<td>May-Aug</td>
<td>Subsurface Banded</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Fertilizer #2 - Name</th>
<th>App. Rate</th>
<th>Timing</th>
<th>Application Method</th>
</tr>
</thead>
<tbody>
<tr>
<td>Urea Ammonium Nitrate</td>
<td>18</td>
<td>May-Aug</td>
<td>Subsurface Banded</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Fertilizer #3 - Name</th>
<th>App. Rate</th>
<th>Timing</th>
<th>Application Method</th>
</tr>
</thead>
<tbody>
<tr>
<td>None</td>
<td>0 gal/acre</td>
<td>May-Aug</td>
<td>Subsurface Banded</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Fertilizer #4 - Name</th>
<th>App. Rate</th>
<th>Timing</th>
<th>Application Method</th>
</tr>
</thead>
<tbody>
<tr>
<td>None</td>
<td>0 gal/acre</td>
<td>May-Aug</td>
<td>Subsurface Banded</td>
</tr>
</tbody>
</table>
Knowledge and Data Transferability

Inputs

- **Producer and planner information**
  - Name, address, field names and size etc.

- **Library of crop rotations and fertilizer materials**

- **Manure quantities, analyses, and storage capacities**

- **Field Information**
  - Soil information
  - Soil nutrient analyses
    - Cornell Morgan soil test results
    - Conversions for Brookside, Spectrum, A&L, and UVM soil test results (ME, NH, and MA conversions available and could be included)
  - Crop rotations
  - Manure and fertilizer application information
  - Various P and N Index inputs
    - Manure and fertilizer application rate, timing and method, RUSLE, flow distance to stream, stream type, precipitation, soil, etc.
**Plan Year** 2003

**Field ID** 1070-21

**Create Field**  
**Re-Order Fields**

**Field Data**

- **Soil Erosion - RUSLE (tons/acre)**: 2.0
- **Predominant Flow Distance to Blue Line Stream or Equivalent**: 100.0 (ft)

**Manure Use**

**Soil Test**

**Crop Data**

**Manure Use**

**Past Manure Use**

**Fertilizers**

**PI Factors**

**Proximate Waterbody Type**: Perennial

**Soil Drainage Class**: Well Drained

**Flooding Frequency**: Rare/None

**Concentrated Flows?**  

**Copy Field**

**Delete Field**
Knowledge and Data Transferability

Inputs

- **Producer and planner information**
  - Name, address, field names and size etc.

- **Library of crop rotations and fertilizer materials**

- **Manure quantities, analyses, and storage capacities**

- **Field Information**
  - Soil information
  - Soil nutrient analyses
    - Cornell Morgan soil test results
    - Conversions for Brookside, Spectrum, A&L, and UVM soil test results (ME, NH, and MA conversions available and could be included)
  - Crop rotations
  - Manure and fertilizer application information
  - Various P and N Index inputs
    - Manure and fertilizer application rate, timing and method, RUSLE, flow distance to stream, stream type, precipitation, soil, etc.

- **Manure, fertilizer, and lime plan for next year**
**Manure Summary**

<table>
<thead>
<tr>
<th></th>
<th>Total Tons</th>
<th>Total Gal</th>
<th>Main Barn</th>
<th>Heifer/Mat/Dry</th>
<th>Hutches</th>
</tr>
</thead>
<tbody>
<tr>
<td>Manure Available For Application</td>
<td>4883.00</td>
<td>4,054,556</td>
<td>4,054,556</td>
<td>4568.00 tons</td>
<td>315.00 tons</td>
</tr>
<tr>
<td>Manure Allocated</td>
<td>4920.00</td>
<td>3,892,500</td>
<td>3,892,500</td>
<td>4820.00 tons</td>
<td>300.00 tons</td>
</tr>
<tr>
<td>Manure Balance</td>
<td>-37.00</td>
<td>162,056</td>
<td>162,056</td>
<td>-52.00 tons</td>
<td>15.00 tons</td>
</tr>
</tbody>
</table>

**Field Nutrient Balance**

<table>
<thead>
<tr>
<th>Field ID</th>
<th>N Balance (lbs/acre)</th>
<th>P2O5 Balance (lbs/acre)</th>
<th>K2O Balance (lbs/acre)</th>
<th>Phosphorus Index (DP/PP)</th>
<th>Leaching Index</th>
<th>Lime Requirement (tons 100% ENV Lime/acre)</th>
<th>User Selected Lime Requirement (tons/acre)</th>
</tr>
</thead>
<tbody>
<tr>
<td>B1</td>
<td>4</td>
<td>66</td>
<td>181</td>
<td>50 / 50</td>
<td>5</td>
<td>0.6</td>
<td>0.6</td>
</tr>
<tr>
<td>B2</td>
<td>12</td>
<td>46</td>
<td>120</td>
<td>4 / 6</td>
<td>9</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>B3</td>
<td>21</td>
<td>66</td>
<td>161</td>
<td>6 / 31</td>
<td>5</td>
<td>1.3</td>
<td>1.3</td>
</tr>
<tr>
<td>B4</td>
<td>-3</td>
<td>40</td>
<td>172</td>
<td>15 / 11</td>
<td>5</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>B5</td>
<td>7</td>
<td>66</td>
<td>181</td>
<td>57 / 57</td>
<td>5</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>B6</td>
<td>8</td>
<td>-5</td>
<td>0</td>
<td>11 / 11</td>
<td>5</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>B7</td>
<td>5</td>
<td>28</td>
<td>90</td>
<td>19 / 16</td>
<td>5</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>B8</td>
<td>16</td>
<td>66</td>
<td>181</td>
<td>27 / 28</td>
<td>5</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>B9</td>
<td>6</td>
<td>71</td>
<td>181</td>
<td>24 / 19</td>
<td>5</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>B10</td>
<td>9</td>
<td>70</td>
<td>192</td>
<td>17 / 13</td>
<td>5</td>
<td>0.6</td>
<td>0.6</td>
</tr>
<tr>
<td>B11</td>
<td>22</td>
<td>24</td>
<td>49</td>
<td>29 / 37</td>
<td>5</td>
<td>0.6</td>
<td>0.6</td>
</tr>
<tr>
<td>B12</td>
<td>9</td>
<td>65</td>
<td>172</td>
<td>16 / 21</td>
<td>5</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>C1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>54 / 54</td>
<td>9</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>C2</td>
<td>-11</td>
<td>10</td>
<td>0</td>
<td>49 / 55</td>
<td>9</td>
<td>0.0</td>
<td>0.0</td>
</tr>
</tbody>
</table>
Knowledge and Data Transferability

Inputs

- **Producer and planner information**
  - Name, address, field names and size etc.

- **Library of crop rotations and fertilizer materials**

- **Manure quantities, analyses, and storage capacities**

- **Field Information**
  - Soil information
  - Soil nutrient analyses
    - Cornell Morgan soil test results
    - Conversions for Brookside, Spectrum, A&L, and UVM soil test results (ME, NH, and MA conversions available and could be included)
  - Crop rotations
  - Manure and fertilizer application information
  - Various P and N Index inputs
    - Manure and fertilizer application rate, timing and method, RUSLE, flow distance to stream, stream type, precipitation, soil, etc.

- Manure, fertilizer, and lime plan for next year

- On farm logistical considerations
Knowledge and Data Transferability

Outputs

- A spatial and temporal plan for manure, fertilizer, and lime applications in-line with the NRCS 590 Standard
### Fertilizer and Manure Management Report

<table>
<thead>
<tr>
<th>Field ID</th>
<th>Field Name</th>
<th>Crop</th>
<th>Acres</th>
<th>Manure Application</th>
<th>Manure App Timing</th>
<th>Fertilizer Application (Qty/Acre)</th>
<th>Lime Req</th>
<th>Latest Soil Sample</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>B1</td>
<td>867-1C</td>
<td>COS2</td>
<td>21.0</td>
<td>Manure: 7,000 gal/acre</td>
<td>Nov-Jan</td>
<td>125 lbs 17-28-0</td>
<td>0.6</td>
<td>10/24/08</td>
<td></td>
</tr>
<tr>
<td>B2</td>
<td>867-1F</td>
<td>GRT2</td>
<td>14.0</td>
<td>Manure: 7,000 gal/acre</td>
<td>May-Aug</td>
<td>0.0</td>
<td>8/26/08</td>
<td></td>
<td></td>
</tr>
<tr>
<td>B3</td>
<td>867-1DE</td>
<td>COS3</td>
<td>22.0</td>
<td>Manure: 7,000 gal/acre</td>
<td>Feb-Apr</td>
<td>100 lbs 20-10-0</td>
<td>1.3</td>
<td>10/30/08</td>
<td></td>
</tr>
<tr>
<td>B4</td>
<td>867-1B</td>
<td>CBT2</td>
<td>10.0</td>
<td>Manure: 7,000 gal/acre</td>
<td>May-Aug</td>
<td>0.0</td>
<td>8/26/08</td>
<td></td>
<td></td>
</tr>
<tr>
<td>B5</td>
<td>867-1B</td>
<td>COS4</td>
<td>12.0</td>
<td>Manure: 7,000 gal/acre</td>
<td>Nov-Jan</td>
<td>100 lbs 20-10-0</td>
<td>0.0</td>
<td>10/30/08</td>
<td></td>
</tr>
<tr>
<td>B6</td>
<td>867-1A</td>
<td>COS1</td>
<td>24.0</td>
<td>Manure: 7,000 gal/acre</td>
<td>Nov-Jan</td>
<td>125 lbs 17-28-0</td>
<td>0.0</td>
<td>12/31/99</td>
<td></td>
</tr>
<tr>
<td>B7</td>
<td>867-9</td>
<td>GRT19</td>
<td>6.0</td>
<td>Manure: 3,500 gal/acre</td>
<td>May-Aug</td>
<td>0.0</td>
<td>10/30/08</td>
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<tr>
<td>B8</td>
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<td>Manure: 7,000 gal/acre</td>
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<td>13.0</td>
<td>Manure: 20 tons/acre</td>
<td>Feb-Apr</td>
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<tr>
<td>C1</td>
<td>1070-31</td>
<td>ALTS</td>
<td>15.0</td>
<td>Manure: 0 gal/acre</td>
<td>Sep-Oct</td>
<td>100 lbs 20-10-0</td>
<td>0.0</td>
<td>9/13/90</td>
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<tr>
<td>C2</td>
<td>1070-21</td>
<td>COS4</td>
<td>12.0</td>
<td>Manure: 0 gal/acre</td>
<td>Sep-Oct</td>
<td>18 gal Urea Ammonium Nitrate</td>
<td>0.0</td>
<td>12/31/99</td>
<td></td>
</tr>
<tr>
<td>1070-21</td>
<td>C2</td>
<td>COS4</td>
<td>12.0</td>
<td>Manure: 0 gal/acre</td>
<td>Sep-Oct</td>
<td>18 gal Urea Ammonium Nitrate</td>
<td>0.0</td>
<td>12/31/99</td>
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</tbody>
</table>
Knowledge and Data Transferability

Outputs

- A spatial and temporal plan for manure, fertilizer, and lime applications in-line with the NRCS 590 Standard
- New York P Index and N Leaching Index
- Nutrient balances across farm and per field
# Nutrient Management Plan

<table>
<thead>
<tr>
<th>Field ID</th>
<th>Field Name</th>
<th>Acres</th>
<th>2003 Crop</th>
<th>Residual Soil N</th>
<th>Residual Manure N</th>
<th>Total N</th>
<th>P205</th>
<th>K20</th>
<th>Total Nutrients Required (B/a)</th>
<th>Nutrients From Applied Manure (B/a)</th>
<th>Nutrients From Fertilizer (B/a)</th>
<th>Nutrients Balance (B/a)</th>
<th>PT (DVPF)</th>
<th>L1</th>
</tr>
</thead>
<tbody>
<tr>
<td>B1</td>
<td>867.10</td>
<td>25.0</td>
<td>18</td>
<td>24</td>
<td>0</td>
<td>54</td>
<td>53</td>
<td>57</td>
<td>131</td>
<td>21</td>
<td>0</td>
<td>42</td>
<td>86</td>
<td>69</td>
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<tr>
<td>B2</td>
<td>867.15</td>
<td>34.0</td>
<td>10</td>
<td>20</td>
<td>0</td>
<td>54</td>
<td>53</td>
<td>57</td>
<td>131</td>
<td>21</td>
<td>0</td>
<td>42</td>
<td>86</td>
<td>69</td>
</tr>
<tr>
<td>B3</td>
<td>867.10</td>
<td>24.0</td>
<td>8</td>
<td>16</td>
<td>0</td>
<td>54</td>
<td>53</td>
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<td>131</td>
<td>21</td>
<td>0</td>
<td>42</td>
<td>86</td>
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<tr>
<td>B4</td>
<td>867.15</td>
<td>34.0</td>
<td>10</td>
<td>20</td>
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<td>54</td>
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<td>57</td>
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<td>10</td>
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<td>53</td>
<td>57</td>
<td>131</td>
<td>21</td>
<td>0</td>
<td>42</td>
<td>86</td>
<td>69</td>
</tr>
</tbody>
</table>

**Manure Available for Application:**
- Total N: 4,683.00
- Total K: 4,034,590
- Manure Required: 4,683.00
- Manure Applied: 4,683.00
- Manure Balance: 0

The above table provides a detailed nutrient management plan for each field, including the necessary nutrients and their application methods. The plan is designed to ensure balanced nutrient input and output, promoting sustainable agricultural practices.
Knowledge and Data Transferability

Outputs

- A spatial and temporal plan for manure, fertilizer, and lime applications in-line with the NRCS 590 Standard
- New York P Index and N Leaching Index
- Nutrient balances across farm and per field
- Crop acreages across the rotation for the whole farm
# Crop Plan Summary

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
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<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
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<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Corn</td>
<td>490</td>
<td>473</td>
<td>579</td>
<td>599</td>
<td>529</td>
<td>561</td>
<td>532</td>
<td>526</td>
<td>582</td>
<td>572</td>
<td>542</td>
<td>521</td>
<td>463</td>
<td>474</td>
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<tr>
<td>Corn Silage</td>
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<td>473</td>
<td>579</td>
<td>599</td>
<td>529</td>
<td>561</td>
<td>532</td>
<td>526</td>
<td>582</td>
<td>572</td>
<td>542</td>
<td>521</td>
<td>463</td>
<td>474</td>
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<tr>
<td>Total Hay Crop</td>
<td>717</td>
<td>734</td>
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<td>608</td>
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<td>646</td>
<td>675</td>
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<td>625</td>
<td>635</td>
<td>665</td>
<td>686</td>
<td>744</td>
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<td>Legume Hay</td>
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<td>345</td>
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<td>259</td>
<td>277</td>
<td>194</td>
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<td>237</td>
<td>296</td>
<td>283</td>
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<td>Mixed Hay</td>
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<td>234</td>
<td>294</td>
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<td>177</td>
<td>164</td>
<td>187</td>
<td>233</td>
<td>277</td>
</tr>
<tr>
<td>Grass Hay</td>
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<td>162</td>
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<td>206</td>
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<td>218</td>
<td>218</td>
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<td>206</td>
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<td>New Seedings*</td>
<td>88</td>
<td>132</td>
<td>90</td>
<td>91</td>
<td>156</td>
<td>83</td>
<td>157</td>
<td>120</td>
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<td>115</td>
<td>176</td>
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<td>132</td>
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<td>1207</td>
<td>1207</td>
<td>1207</td>
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<td></td>
</tr>
</tbody>
</table>

* Note: Acres of New Seedings are also included in the Hay acreages above.
Knowledge and Data Transferability

Outputs

- A spatial and temporal plan for manure, fertilizer, and lime applications in-line with the NRCS 590 Standard
- New York P Index and N Leaching Index
- Nutrient balances across farm and per field
- Crop acreages across the rotation for the whole farm
- Fertilizer costs (Fertilizer Shopping List)
08-Oct-03

Fertilizer Shopping List

<table>
<thead>
<tr>
<th></th>
<th>2003</th>
</tr>
</thead>
<tbody>
<tr>
<td>Urea Ammonium Nitrate</td>
<td>Amt: 1.615 gal, Cost: $1,517</td>
</tr>
<tr>
<td>Urea</td>
<td>Amt: 1.2 tons, Cost: $228</td>
</tr>
<tr>
<td>Muriate of Potash</td>
<td>Amt: 0.4 tons, Cost: $62</td>
</tr>
<tr>
<td>Monopotassium Phosphate</td>
<td>Amt: 3.6 tons, Cost: $819</td>
</tr>
<tr>
<td>17-20-0</td>
<td>Amt: 5.4 tons, Cost: $1,096</td>
</tr>
<tr>
<td>20-10-0</td>
<td>Amt: 25.6 tons, Cost: $5,074</td>
</tr>
<tr>
<td>Total Fertilizer Cost</td>
<td>---, Cost: $8,798</td>
</tr>
<tr>
<td>Lime*</td>
<td>Amt: 410.3 tons, Cost: ---</td>
</tr>
</tbody>
</table>

* Tons of 100% ENV Lime
Tool Limitations

Limits to Wider Use

- **Beyond NYS**
  - NYS specific nutrient guidelines and risk indices

- **Within NYS (and beyond)**
  - Need for more experience in agronomy and nutrient management planning by users
    - Need for a more simple tool for “Level I” nutrient management planning
  - Lack of crop record keeping systems
  - Need for economic analysis capability
Tool Limitations

Technical Weaknesses

- Data intensive
- Better integration with GIS
- More decision making capacity on the Allocation screen
- Current scientific knowledge can always be improved
  - Nutrient guidelines with double crops and cover crops
  - Mineralization of organic N over season
  - Ammonia N availability
  - N and P risk indices
  - Etc.
Useful in Reducing Nutrient Load to the Environment?

Quality of results / Confidence level

- Garbage in / garbage out
- Based on the cumulative knowledge packaged in the Cornell nutrient guidelines
  - Has increased recognition of “all nutrient sources”
    » Sod, manure, soil, and, of course, fertilizer
  - Along with other efforts, has increased recognition of higher risk management / situations
  - Continuous improvement
Useful in Reducing Nutrient Load to the Environment?

Field validation

- Cornell nutrient guidelines are based on field experimentation
  - Evaluation of guidelines and risk indices is on-going

- No formal Cropware survey, but through…
  - User input during development and testing
  - 28 formal Cropware workshops
  - 12 small group consultations
  - Over 400 phone / email support events

…we’ve learned about and improved upon many weaknesses
Useful in Reducing Nutrient Load to the Environment?

**Cropware Users**
- NRCS, SWCD, Extension educators, private planners, farmers, teachers, students
- ~300 registered copies
- ~125 regular users
- ~600 nutrient management plans
Use Relative to Regulatory Requirements

Regulations addressed?

- Component of CAFO regulations
  - NRCS 590 Standard
- Publicly funded nutrient management plans
  - NRCS 590 Standard
Use Relative to Regulatory Requirements

Does Cropware produce a Nutrient Management Plan?
Future Plans

Software Development

- Data integration with crop record keeping software, NRCS Customer Tool Kit, CNCPS, and farm accounting software
- Integration with a crop rotation and crop inventory planning tool
- Streamline data integration with Geographic Information Systems (GIS)
- Continue to improve user interface for efficient farm characterization, plan development, and report generation
- Data transfer with acquisition/monitoring devices (PDAs, yield monitors, etc.)
Future Plans

Areas for Further Research

- Nitrate Leaching Index
- Phosphorus Runoff Index
- Crop nutrient guidelines
- Nitrogen volatilization losses
- Organic nitrogen mineralization and uptake rates
- Nutrient guidelines/credits for cover crop and double crop systems
Thank you!

http://nmsp.css.cornell.edu