Know Your Yields!
Importance of Accurate Yield Records for Nitrogen Management Algorithms for Corn

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Outline

• New York Agriculture
  • The case for agriculture and environmental management
  • Corn for grain and corn for silage
• Breaking the yield ceiling
• Yield monitors (calibrating and cleaning of data!)
• Initial work on active sensors
• The need for zone based management
• On-farm research networks
• Wrap-up
Dairy farming is important to NY
- 35,000 farm operations
- 625,000 milking cows
- ~600 CAFOs
- 3rd in milk production
- 3rd in corn silage production

485,000 acres in corn grain
495,000 acres in corn silage
161 bu/acre and 18 ton/acre in 2017
CAFOs have nutrient management plans

https://www.nass.usda.gov/Quick_Stats/Ag_Overview/stateOverview.php?state=NEW%20YORK
Keeping Clear Water Clean

New York Aquifer Map
Reduce N and P Loss to the Chesapeake Bay Watershed

Chesapeake Bay Model delivery factors.

Source: Chesapeake Bay Program.
Corn Yields over Time in New York

- Corn grain (bu/acre): $y = 0.1198x - 223.69$, $R^2 = 0.83871$
- Corn silage (ton/acre): $y = 1.4105x - 2704.2$, $R^2 = 0.9266$
THANK YOU!

2011, 2013 (2017 started wet, ended really well)
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2013-2014 Yield Potential Study Results

30% <90% of YP, 36% ± 10% of YP, 25% >110% of YP

\[ y = 0.5568x + 66.342 \]
\[ R^2 = 0.50846 \]

\[ y = -0.018x^2 + 5.223x - 242.91 \]
\[ R^2 = 0.78368 \]

\[ y = -0.0079x^2 + 2.9744x - 142.96 \]
\[ R^2 = 0.84618 \]
2013-2014 Yield Potential Study Results

36 fields only!!

N applied / N removed (lb/lb)

Yield (bu/acre at 15% moisture)

- Red squares: Yield < 90% of Yield Potential
- Blue diamonds: Yield between 90 and 110% of Yield Potential
- Green triangles: Yield > 110% of Yield Potential
Yield Stability Map

Corn yield data on farms can be used to develop field yield stability classifications:

- Q1. High yield, low variability
- Q2. High yield, high variability
- Q3. Low yield, high variability
- Q4. Low yield, low variability

Each triangle is one field with 3+ years of data.
• Timing and amount of rainfall, field drainage, impacted corn yield.

• Fields in Q1: 36-40 lbs P/acre Morgan and 2.9-3.2% organic matter.

• For improved yields: Increase organic matter, improve drainage, and provide optimal soil fertility.
Biological Buffer Capacity
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Yield Monitors – Can We Trust Them?

When calibrations are done regularly, forage yield monitors can provide an accurate and precise measure of yield.

- **Moisture sensors:**
  - within 3.7 % for alfalfa/grass
  - 3.0 % of DM for corn silage

- **Flow sensors:**
  - ± 0.2 tons/acre for alfalfa
  - ± 0.5 tons/acre for corn silage

Published in 2016
So Once We Calibrate, Are We Good to Go?

• Data cleaning is extremely important
  • Comparable data across fields, farms, for both grain and silage.
• Standardized protocols were not available
• Firms and farms differ in how much and how well they clean data of errors
• This can result in large errors from field to field, from farm to farm, and from year to year…making data a lot less valuable for individual farms
• Reliable cleaning needed to build research networks
So Once We Calibrate, Are We Good to Go?

• Error sources:
  • Change in machine speed → Distance travelled → Area harvested
  • Delay (time)
    • Mass flow in wrong place
    • % moisture in wrong place
  • Width → Overlap → Area
  • Start and end pass (ramping effect)
Yield monitor data need to be cleaned – all maps from yield monitors contain errors!

Mean raw wet yield: 22.1 ton/acre vs 16.8 tons/acre with data points > 40 ton/acre removed. Raw data contained points with up to 3393 tons/acre!
Grain data more reliable but also need cleaning.
Process Cleaning Corn Silage and Grain Yield Monitor Data for Standardized Yield Maps across Farms, Fields, and Years

Protocol
2-8-2018

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Manual for whole farm yield monitor data cleaning

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Crop Sensors

Initial work: GreenSeeker (active sensor)
Timing of Sensing for Corn Silage

Yield predictions from V4 through V11
Knowing the Crop’s Growth Stage is Important

Scanning time: V6 (silage), V7 (grain) or later
For Further Details (Corn and Forage Sorghum)


Nitrogen Algorithm Development for NY

• V6 is the ideal time to start scanning
• Later scans are good for yield prediction, but:
  • Less crop “differentiation”
  • Yield could be impacted by delay in N application
• N-rich strips are essential
• Field testing needed
Limitations with Just Use of Crop Sensors

Yield enhancing or limiting factors that occur after sensing data are collected can lead to underestimation or over-estimation of \( R_{\text{harvest}} \) using \( R_{\text{NDVI}} \) as the independent variable”.

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Biological Buffer Capacity; Within-Field

• The same quadrant method can be applied within fields.
• Allows for development of management zones based on BBC (as determined by yield stability).
• Allows for quickly checking on crop response to nutrients, pest control, cover cropping, etc.
• Simple, easy to implement, treatment strips.
Next Steps

• Evaluate soil and field characteristics that separate Q1 versus Q2, Q3, and Q4 areas within a field (drivers for yield and yield stability).

• Collaboration with University of Buffalo (Dr. Erasmus Oware and colleagues) and Rochester Institute of Technology (Jan van Aardt and colleagues)
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On-Farm Research Network

• Apply N rich strips across quadrants within farmer fields to evaluate N response per zone:
  • Project in collaboration with Dupont/Pioneer/Corteva, Growmark FS, Champlain Valley Ag, University of Buffalo, Rochester Institute of Technology, counterparts in Missouri and Iowa and others.
  • Allows for evaluation of crop sensor algorithms, use of other technologies (UAS mounted NDVI and multi-spectral cameras, satellite imagery, EC mapping etc.)
Partners in Research

N-rich strip
2018 Projects

N rich strips
• 26 farmer fields
• Use of technology

Manure treatment
• 4 farmer fields
• Use of targeted soil sampling
• UAS flights
• Satellite imagery
• Modeling software
The Concepts: To be Tested

Average yield gain: 0.3 tons/acre

Average yield gain: 2.3 tons/acre
Ongoing Work

• Alternative methods for predicting yield:
  • Crop sensors (UAS mounted NDVI and multispectral cameras)
  • Satellite imagery
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In Summary

• Technology is great but calibration and data cleaning are very important.
• Multi-year yield data can be used to develop yield stability based management zones.
• Management zones allow for:
  • increased yields
  • better resource allocation over time
  • better sensor algorithms
Farmer, Industry, University Partnerships

Working together for real solutions in agriculture and environmental management
THANKS!

• Grants
  • Northern New York Agricultural Development Program (NNYADP)
  • Federal Formula Funds
  • USDA Conservation Innovation Grants
  • New York Farm Viability Institute
  • Northeast Sustainable Agriculture Research and Education

• Farm Advisors (CCE, NRCS, and Consultants)
• Farms, Research Facilities, and NMSP Staff