Northern NY Agricultural Development Program
2016 Project Report

Re-Evaluating Yield Potentials of Corn Grain and Silage In Northern New York

Project Leader:

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Collaborator(s):

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- Clinton County: Mike Contessa, Champlain Valley Agronomics; CCE Soil and Field Crops Specialist Kitty O'Neil
- Cornell campus: Sheryl Swink, Greg Godwin, and Aristotelis Tagarakis, NMSP

Cooperating Producers:

- Clinton County: Adirondack Farms
- Jefferson County: Dodge Farms
- St. Lawrence County: Mapleview Dairy, Greenwood Dairy Farm

Background:

In 2013-2015, with funding from the farmer-driven Northern New York Agricultural Development Program (NNYADP), we evaluated corn yields for Northern New York farms to further evaluate the Cornell yield potential database for corn and associated nitrogen (N) recommendations and potential for phosphorus (P) removal through yields.

The average yield across the three years was 116 bu/acre versus an average listed yield potential of 118 bu/acre for the soil types in the study (Table 1). However, 15 fields (33%) yielded less than 90% of what was listed as the yield potential for the soil type (Cornell database), nineteen fields (41%) were within 10%, while twelve fields (26%) yielded more than 110% of the Cornell yield potential (Figure 1). The highest yielding fields had the lowest ratio of N applied to N removed (Figure 2) showing that the soil N supply for high yielding fields is substantially higher than for low yielding fields. It was clear from this assessment that field-to-field variability needed to be taken into account and that we needed to add a whole-farm yield potential assessment.

Table 1: Average yield data for 2013, 2014, and 2015 by year, combined years, and by BMR and non-BMR corn fields in Northern New York as compared to the Cornell yield potential database. Average nitrogen (N) applications across fields is given as the ratio of manure plus fertilizer N applied to the Cornell N recommendation for the fields.

	Fields	Average yield potential all fields	Average yield		Yield/yield potential	Average N applied/Cornell recommendation
	number	bu/acre	ton/acre	bu/acre	ratio (bu/bu)	ratio (lb/lb)
2013 All corn	22	119	20.9	124	1.04	2.0
2014 All corn	14	113	16.4	97	0.86	1.2
2015 All corn	10	123	21.5	127	1.04	1.1
2013 thru 2015	46	118	19.7	116	0.98	1.6
2013 Non BMR corn	18	122	22.3	131	1.08	1.7
2014 Non BMR corn	5	119	19.5	115	0.97	1.3
2015 Non BMR corn	5	128	23.3	138	1.09	1.1
2013 thru 2015	28	123	22.0	130	1.06	1.5
2013 BMR corn	4	105	14.9	88	0.83	3.4
2014 BMR corn	9	109	14.6	86	0.81	1.2
2015 BMR corn	5	117	19.6	116	0.99	1.1
2013 thru 2015	18	110	16.1	95	0.86	1.6

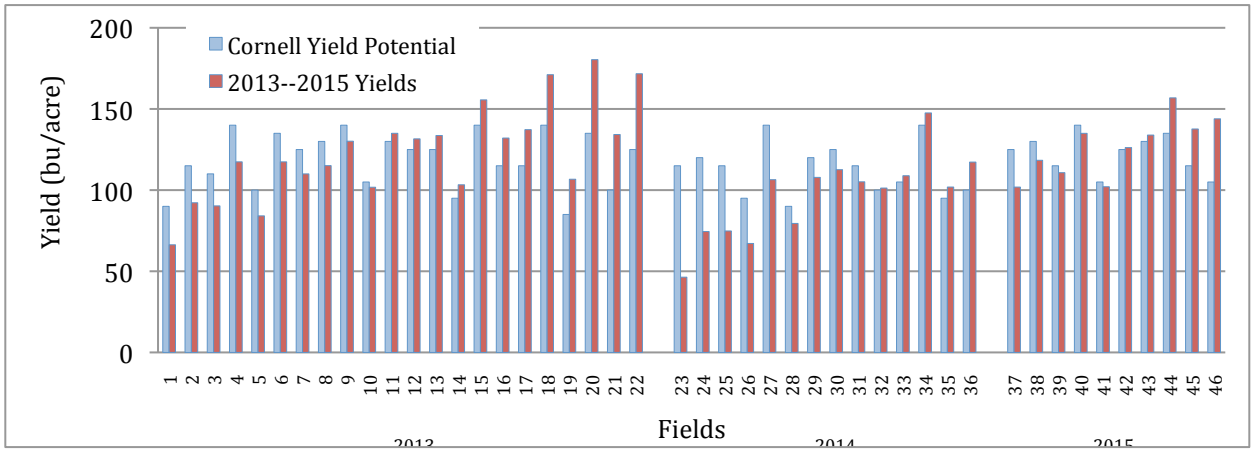

Figure 1: Actual 2013, 2014, and 2015 yields (measured in on-farm trials in NNY) for corn grain (sites 18, 22, 40, 41, 44, 46) and corn silage (yields converted to bushels per acre) and the yield potentials for those at sites that participated in the yield potential study. This database uses a conversion from silage to grain where 1 ton of silage at 35% dry matter equates to 5.9 bushels of grain at 15% moisture.

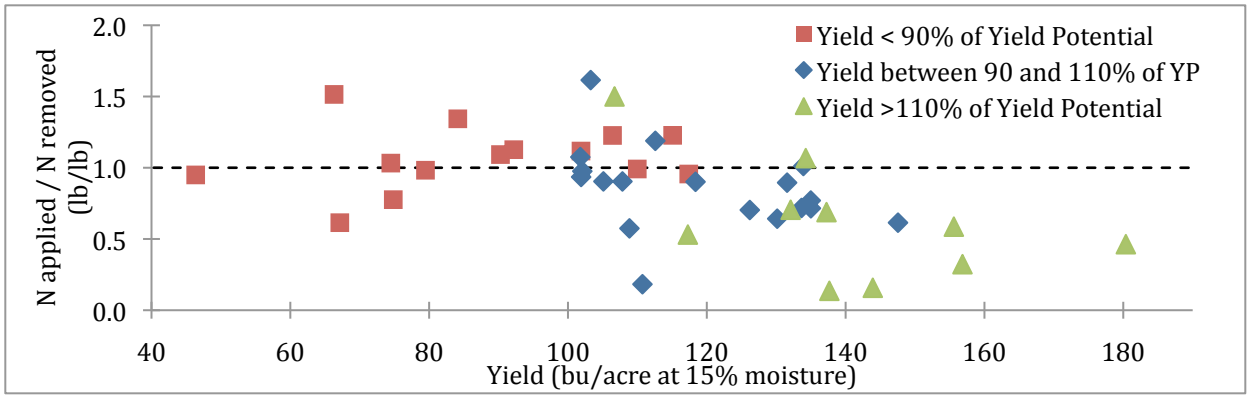

Figure 2: Ratio of nitrogen (N) applied (manure and fertilizer combined) to N removed with the actual harvest and the yield for each site in NNY, 2013-2015. Two grain sites and two silage sites are not included due to missing data for crop N content. This database assumes 1 ton of silage at 35% dry matter equates to 5.9 bushels of grain at 15% moisture.

Methods:

Part 1: Evaluate State Recorded Yield Data

We summarized state annual corn silage and grain yields from 1919 through 2015 using New York State annual agricultural statistics service data to determine trends in yields over time.

Part 2: Whole Farm Yield Monitoring

Yield monitor datasets were obtained for all fields harvested for corn silage or corn grain in 2015 for four farms in Northern New York for a total of 139 fields with complete field map data. The 2015 and 2016 field and datasets are currently (May 2017) being evaluated, cleaned and added to a growing database for NNY.

Two of the farms used John Deere equipment, one farm used a CLAAS Jaguar chopper, and another used a New Holland combine. While working on the first datasets, it became clear that raw yield map data contain a variety of errors due to machine and operating characteristics such as the time lag of grain and silage flow between harvest and sensor recording locations, overlapping of harvest passes that result in low yield errors, positional changes, start and stop delays, and changes in velocity. Thus it was critical to remove erroneous data points before analysis of the yield data as they may strongly impact accuracy of yield values at the field level as well as for specific locations or zones within fields.

To process the large number of whole farm/whole field yield maps collected in this project to ensure high quality data, we developed a protocol for removing errors in an efficient and consistent manner from both silage and grain corn yield monitor data. A literature search was conducted that identified a combination of processes and software (Yield Editor 2.0, free from ARS_USDA) developed for “cleaning” of grain yield datasets. These were adapted, in consultation with Yield Editor’s software developer, Scott Drummond, for use with silage monitor data. This process is now being used to analyze the whole farm datasets of all four farms at various field sizes; once completed, a manual will be uploaded on the project website.

Results:

Part 1: Evaluate state recorded yield data

Corn silage and grain yields have steadily increased over the past 60 years (Figure 3) with a slightly greater increase per year for corn grain than for corn silage, possibly reflecting the efforts in plant breeding for grain in the past decades.

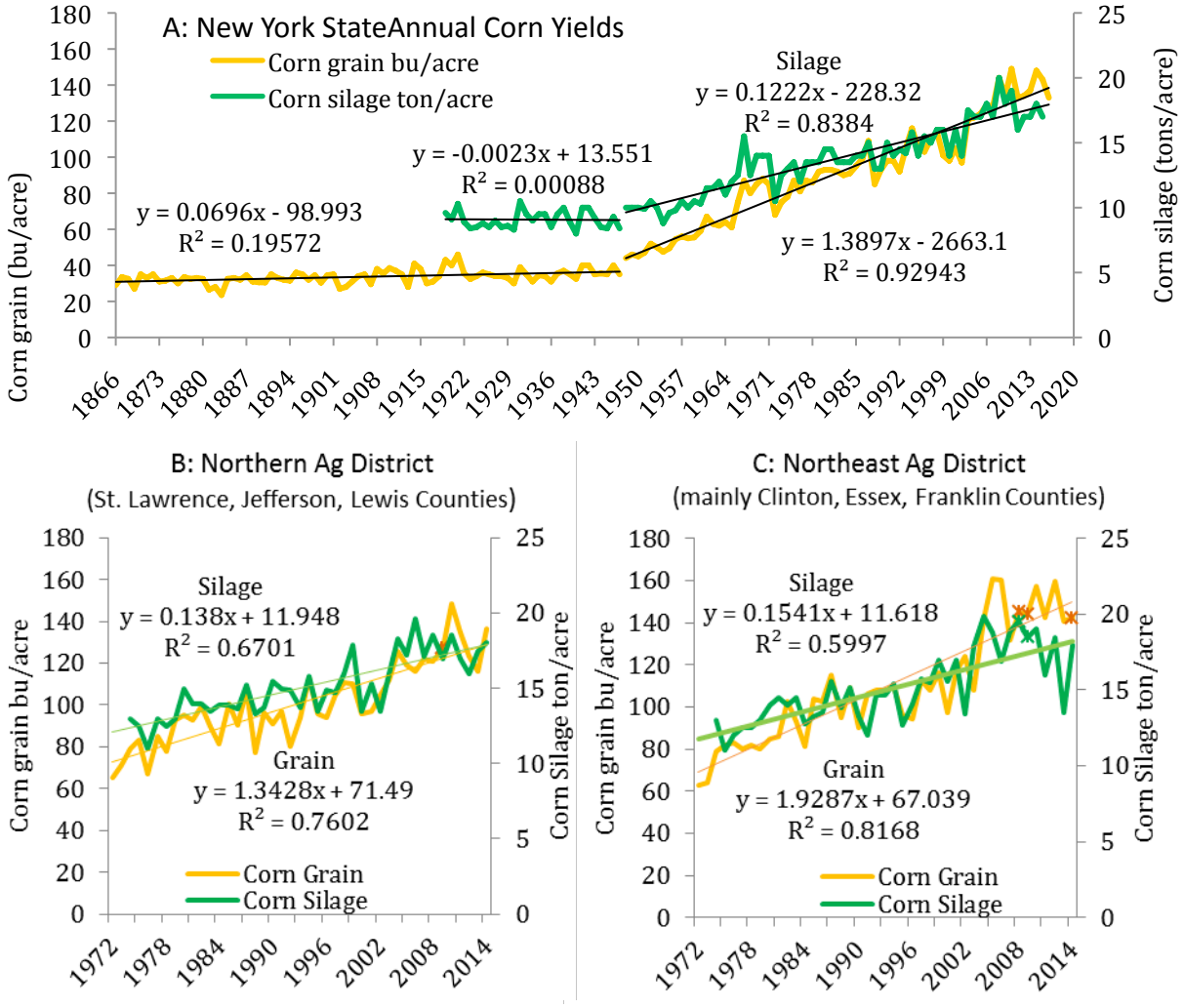

Figure 3: New York State (A) and Northern New York (B and C) average corn silage and grain yields over time show a steady increase 1948 – 2015 in both silage and grain yields but also large year-to-year variation. Yield data source: New York State Agricultural Statistics Service.

Part 2: Whole Farm Yield Monitoring

The protocol steps used for deriving final yields at field and subfield levels included:

(1) Export or read raw monitor harvest data into commercial software such as SMS that can read files from a large variety of monitor equipment (John Deere, CLAAS, Case I.H., New Holland, etc.) and export the data in AgLeader advanced file format.

(2) Import this file to Yield Editor 2.0.7 (YE), filter out erroneous data using YE's interactive filter settings in combination with guidance from the software's Automated

Yield Cleaning Expert (AYCE) tool, followed by manual removal of headlands data points and any remaining obvious erroneous yield points to obtain the average yield for the field without headlands.

(3) Export the cleaned data as .csv files ready to import to GIS software for analysis, and save the final Yield Editor session with average yield and statistics for the whole field. A soil map for an area of interest (aoi) containing the field can then be exported from NRCS's soil survey database and brought into GIS software (QGIS) as a layer along with the cleaned yield map layer and joined to determine the average yield for each soil type area (polygon) in the field.

Applying the cleaning protocol to datasets from the first 13 fields processed (2015 growing season) resulted in removal, on average, of 25% of the yield monitor raw data points (minimum removal was 15%, maximum was 38%) for each field. Table 2 shows the mean corn silage yield, soil type, and Cornell yield potentials for each of those fields in 2015. Field 115 was the only one to exceed the yield potential for it's predominant soil type (130% of YP). The rest of the fields were within 10% of the yield potential for their soil type or below. Across all fields the ratio of yield to yield potential was 0.95. However, the additional fields need to be added, and datasets are being evaluated, cleaned and analyzed so 2016 growing season data can be added (May 2017).

Table 2. Initial yield data results for the whole farm monitoring project: average yields based on "cleaned" yield monitor data for each NNY corn field compared to the Cornell corn yield potential for the predominant soil type and drainage. For conversion to bu/acre, 1 ton silage at 35% DM = 5.9 bu corn at 85% DM.

Year	Average yield for field (no headlands)		Predominant soil type	Drained or undrained	Cornell yield potential (YP)	Ratio of yield to Cornell YP
	ton/acre 35%DM	bu/acre 85%DM			bu/acre 85%DM	
2015	16.7	99	Northway* (Massena)	UD	105	0.94
2015	17.9	106	Northway* (Massena)	DR	125	0.85
2015	19.5	115	Northway* (Massena)	DR	125	0.92
2015	16.6	98	Deerfield	DR	110	0.89
2015	20.7	122	Appleton	DR	125	0.98
2015	21.2	125	Bombay	DR	135	0.93
2015	18.3	108	Bombay	DR	135	0.80
2015	23.9	141	Schroon	DR	130	1.08
2015	22.6	134	Bombay	DR	135	0.99
2015	19.0	112	Appleton	DR	125	0.90
2015	17.7	104	Appleton	UD	105	0.99
2015	14.9	88	Nellis	DR	140	0.63
2015	22.1	130	Junius	DR	100	1.30

Conclusions/Outcomes/Impacts:

State and regional yield records show that corn silage and grain yields have increased since 1945 and that weather-induced year-to-year differences are obvious. Most recently, there was excessive rainfall in June 2013 and 2015, and below average growing degree days in July and August 2014, followed by a severe drought in 2016. The Northeast Ag District was particularly

affected in 2013 and 2014. In 2015, corn yields benefited from greater than normal growing degree days in May and August with above normal rain only in June. These differences from year to year show the importance of documenting yields over time. With the data evaluation protocol that was developed as part of the study, such analyses can now be done much quicker. This assessment also allows for quicker documentation of whole farm yields, whole field yields, and within-field yield (for example, yields per field without inclusion of headlands; and yields per soil type within a field, or yield per soil management zone). With this protocol, we are now documenting the yields of each of the 139 fields in the 2015 dataset and in the 2016 datasets obtained to date.

Outreach:

The protocols for field selection and sampling were added to the project website (http://nmsp.cals.cornell.edu/NYOnFarmResearchPartnership/YieldDatabase.html). The data-processing protocol will be added once completed. WHEN? Two factsheets on adaptive management approaches to N management for corn (Agronomy Factsheets #77: Nitrogen for Corn; Management Options; and Agronomy Factsheets #78: Adaptive Management of Nitrogen for Corn) were shared at various extension meetings and made available through the factsheet website (http://nmsp.cals.cornell.edu/guidelines/factsheets.html). Talks on yield potentials and the importance of measuring yield for corn in New York as well as use of technology (yield monitors and crop sensors) were given.

Next Steps:

In 2017 we will continue to process 2015 and 2016 yield data collected for all corn fields of four NNY farms that use yield monitoring technology in a given year so we can update the Cornell yield database quicker. Once the data cleaning process is finalized, results from the analysis of the collected yield data will be compared to the current yield potential database.

Acknowledgments:

In addition to the Northern New York Agricultural Development Program funding, we received funding from NRCS in the form of a conservation innovation grant (CIG) that allowed us to evaluate the accuracy and precision of yield monitoring equipment for corn silage on one of the participating farms in this project.

Reports and/or articles in which the results of this project have been published:

1. http://nmsp.cals.cornell.edu/NYOnFarmResearchPartnership/YieldDatabase.html.

For More Information:

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